

https://dspace.org/

Natural resource use and environmental perceptions in different types of rural villages in Bushbuckridge, South Africa

Mbedzi, Mary Emma

2024-09

University of the Witwatersrand, Johannesburg

https://hdl.handle.net/10539/45435

Mbedzi, Mary Emma. (2024). Natural resource use and environmental perceptions in different types of rural villages in Bushbuckridge, South Africa. [Master's dissertation, University of the Witwatersrand, Johannesburg]. WIReDSpace. https://hdl.handle.net/10539/45435

Downloaded from a DSpace repository. https://dspace.org/

Natural resource use and environmental perceptions in different types of rural villages in Bushbuckridge, South Africa



Mary Emma Mbedzi

A dissertation submitted to the Faculty of Science, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Master of Science

Supervisor: Professor Wayne Twine

2 September 2024

DECLARATION

I declare that this Master of Science (dissertation) is my own (1922169), unaided work. It is being submitted for the Degree of Master of Science at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



(Signature of candidate)

2 September 2024 at the University of the Witwatersrand, Johannesburg.

ABSTRACT

Households in rural communities in developing countries rely on natural resources that contribute to income generation, food, medicine, cooking energy, and act as livelihood safety nets. Levels of dependency vary between households within communities due to factors such as wealth status and household size. However, less is known about differences in household resource use between communities within an area. Environmental awareness, values, and preferences are shaped by various factors including, local context. Thus, perceptions of the environment and natural resources, and changes in these are likely to vary between communities. This study aimed to compare the levels of natural resource use and environmental perceptions across village types and determine if there is any relationship between the level of natural resource use and environmental perceptions across village types in the Bushbuckridge Local Municipality in the Mpumalanga province, South Africa. Village types were defined and categorised based on their size, socio-economic factors, access to basic services, connectedness, and remoteness.

The level of natural resource use was analysed using existing data from a survey of 491 households across 12 villages located in the Agincourt Health and Demographic Surveillance System (AHDSS) site. This included data on the use, collection, buying, and selling of a range of natural resources used locally (e.g., wild foods, firewood, and medicinal plants), annual consumptions, ownership of resources made from natural resources, and livestock (cattle) ownership. The survey included questions on respondents' perception of the change in the supply of natural resources over the past 5 years (2016-2021) before the survey. Focus group discussions were conducted in 10 of the study villages asking participants their perception of the changes in the environment and the causes thereof, the importance of the natural environment, natural resources used for their daily needs, income generation, their culture, as well as the changes in availability of natural resources

and impacts on their livelihoods. The study villages were classified according to a village typology that had been developed for the AHDSS study site, based on factors such as connectedness, access to amenities and services, and the proportion of Mozambican refugee households. ANOVA and Kruskal Wallis tests were used for continual data, while the Chi-squared test was used for categorical data to test for significant differences across village types in the quantitative part of the study. For qualitative, responses of participants from each village were recorded and grouped into village types, and an overall picture of the perception of natural resources that participants used was developed using the focus group schedule. Similarities and differences in natural resources between villages were assessed by grouping widely and less used resources by villages and village types.

There was no significant difference ($p>0.05$) in the mean prevalence of use, collection, buying, and selling of natural resources, or annual consumption of natural resources across villages and village types. Households in better-serviced villages owned more products from natural resources and were to greater extent, likely to own livestock than poorly-serviced villages. As to environmental perceptions, more respondents in the poorly serviced village types (refugee settlements (RS) and underdeveloped communities (UC)) perceived a decrease in the supply of natural resources than better-serviced village types (established communities (EC) and central communities (CC)). Participants in focus group discussions also noted a decrease in the supply of natural resources across all villages and village types. There was a relationship between village types, natural resource use, and perceptions of change in natural resource availability. Established communities correlated with a higher number of resources perceived as decreasing and central communities were associated with higher cattle ownership. Underdeveloped communities and refugee settlements were associated with a higher number of resources used/owned, a higher

number of resources used often (more than 4 times a month), and a higher number of resources sold, and buying firewood.

Natural resources were more highly used in, better-serviced village types (central communities, and established communities), than in poorly-serviced village types (underdeveloped communities, and refugee settlements), which was unexpected. However, there were quite a few proxies such as the collection and selling of resources, which were used that did not help back up these findings which could explain the unexpected results. Most respondents in remote and poorly-serviced village types perceived a change in the supply of natural resources, the greatest decrease being in the supply of natural resources. This is associated with awareness of the value of the environment and high reliance on natural resources for these poorly-serviced village types. This study suggests that differences exist in resource use patterns between villages, even in the same area. However, village characteristics were not a good predictor of all aspects of resource use. Changes in proxies of resource utilization and re-evaluating the existing village typology would be useful for further studies.

Keywords: Natural resources, Natural resource use, Environmental perception, focus group discussion, village types

DEDICATION

I am dedicating this work to the LORD God who saw me through my Master of Science journey and my family.

ACKNOWLEDGEMENTS

Firstly, I thank the LORD God who has kept me throughout this Master of Science journey.

I greatly thank my supervisor Professor Wayne Twine for his patience, guidance, his critiques, helping me with my not-so-good scientific writing skills.

I thank the project manager professor Samimi Cyrus of Bayreuth University for this project, and I am grateful for that which came with this project, funding from the German Research Foundation within the framework of the Cluster of Excellence “Africa Multiple”.

A big thank you to Dr Farirai Rusere for being a great help throughout my MSc work.

I acknowledge Dr Li Qirui of Bayreuth University who was of great help in the focus group discussions. Not forgetting Wits Rural Public Health and Health Transitions Research Unit (Agincourt Unit) for providing the well-experienced field workers, Themby Mashele and Violet Ndlovu, who made all the focus group meetings possible.

To my family and friends, thank you for your support and encouragement.

TABLE OF CONTENTS

DECLARATION ..... **II**
ABSTRACT ..... **III**
DEDICATION ..... **VI**
ACKNOWLEDGEMENTS ..... **VII**
LIST OF FIGURES ..... **X**
LIST OF TABLES ..... **XII**
LIST OF ABBREVIATIONS ..... **XV**
1. INTRODUCTION **1**
1.1 BACKGROUND 1
1.2 RATIONALE 3
1.3 AIM AND OBJECTIVES 4
2. LITERATURE REVIEW **5**
2.1 NATURAL RESOURCE USE 5
2.2 ENVIRONMENTAL PERCEPTIONS 9
3. METHODS **12**
3.1 STUDY AREA 12
3.2 DESCRIPTION OF STUDY VILLAGE TYPES 14
3.3 DATA COLLECTION 16
3.3.1 Household survey *16*
3.3.2 Focus group discussions *17*
3.4 DATA ANALYSIS 18
4. RESULTS **20**
4.1 NATURAL RESOURCE USE 20
4.1.1 Prevalence, frequency, and quantity of natural resource use *20*
4.1.2 Prevalence and frequency of collection of natural resources *28*
4.1.3 Prevalence, and frequency of buying natural resources *32*
4.1.4 Selling and average pricing of natural resources *36*
4.1.5 Ownership of items made from natural resources and livestock (cattle) *38*
4.2 ENVIRONMENTAL CHANGE PERCEPTIONS 42

4.3 Relationship between village types, natural resources, and perception of change in resource availability 50

5. DISCUSSION **52**

5.1 Natural resource use 52

5.1.1 Domestic use and ownership of natural resources and products *52*
5.1.2 Natural resource acquisition *58*
5.1.2.1 Prevalence and frequency of natural resource collection *58*
5.1.2.2 Prevalence and frequency of buying natural resources *59*
5.1.3 Selling and average pricing of natural resources *61*
5.1.4 Livestock (cattle) ownership *63*

5.2 Environmental change perceptions 64

5.3 The relationship between village type, natural resource use, and perceptions of change in resource availability 69

6. CONCLUSION **71**

7. REFERENCES **75**

8. APPENDICES **86**

8.1 Appendix 1: SUSCES household questionnaire 86

8.2 Appendix 2: Focus group discussion question guide 88

LIST OF FIGURES

Figure 3.1 Villages within the Agincourt study site (Hunter et al., 2021) ……...…13

Figure 3.2. Map of study villages showing different village types. Squares: central villages (CC); Circles: established communities (EC); Stars: underdeveloped communities (UC); Triangles: refugee settlements (RS)……16

Figure 4.1 The pooled percentage use of natural resources in sampled households……..…..…23

Figure 4.2 The pooled prevalence of use frequency of natural resources…….26

Figure 4.3 Pooled user household collection percentage of natural resources……..30

Figure 4.4 The pooled prevalence of collection frequency of natural resources…….……..……31

Figure 4.5 Pooled user households (%) which bought natural resource……..…..…….34

Figure 4.6 The pooled prevalence of buying frequency of natural resources…….…...35

Figure 4.7 Household ownership/ possession percentage of materials or resources that were made from natural resources……41

Figure 4.8 The pooled percentage of the change in the supply of natural resources change in sampled households……...……44

Figure 4.9 Ordination biplot of Principal Component Analysis (PCA) with components (dimensions) 1 and 2 with village types as vector variables. Factors were total number of resources used/owned (Num_res), total of resources used more than 4 times a month (Num_often), total of resources sold (Num_sold), and total number of resources perceived to be

decreasing (Num_decrease), cattle ownership (cattle_own), and purchased firewood (firewood_buy)…….……..52

LIST OF TABLES

Table 4.1. Perception of natural resource use across village types……..……...23

Table 4.2. The prevalence of use (%) of natural resources across villages, with results of chi-squared test…….……24

Table 4.3. The prevalence of use of natural resources across village types, with results of chi-squared test…….....24

Table 4.4 Natural resource use frequency of each resource across villages, with chi-squared and p-value……26

Table 4.5. Natural resource use frequency percentage of each resource across village types, with chi-squared and p-value……...……..27

Table 4.6. Average ±SE quantity per household per year…….28

Table 4.7. Average volume unit of natural resources used per year (±SE) across villages, with results of Kruskal Wallis test…….28

Table 4.8. Average volume unit of natural resources used per year (±SE) across village types, with results of Kruskal Wallis test…….....28

Table 4.9. The average number of resources used across villages, with the results of one-way ANOVA…….……29

Table 4.10. The average number of resources used across village types, with the results of one-way ANOVA…….…...29

Table 4.11. Prevalence (%) of user households that collected natural resources across villages, with results of chi-squared test……..30

Table 4.12. Prevalence (%) of user households that collected natural resources across village types, with results of chi-squared test……....31

Table 4.13. Prevalence of collection frequency of natural resource across villages, with results of chi-squared test……..……32

Table 4.14. Prevalence of collection frequency of natural resource across village types, with results of chi-squared test……..……33

Table 4.15 Prevalence (%) of user households that bought natural resources across villages, with chi-square and p-value……..34

Table 4.16 Prevalence (%) of user households that bought natural resources across village types, with chi-square and p-value……...35

Table 4.17. Frequency of natural resources bought (%) across villages, with results of chi-squared test…….36

Table 4.18. Frequency of natural resources bought (%) across village types, with results of chi-squared test……37

Table 4.19. User household percentage which sold natural resources……..38

Table 4.20. Average ±SE annual price in Rands per unit……..…38

Table 4.21. Average price (±SE) of natural resources in Rands across villages, with results of ANOVA (firewood) and Kruskal Wallis test…….38

Table 4.22. Average price (±SE) of natural resources in Rands across village types, with results of ANOVA (firewood) and Kruskal Wallis test……39

Table 4.23. Ownership of materials/ resources made from natural resources across villages with, results of chi-squared test…….....41

Table 4.24. Cattle-owning households (%) across villages……...…42

Table 4.25. Ownership of materials/ resources made from natural resources across village types, with results of chi-squared test…….…….....42

Table 4.26. Household cattle ownership across village types……...……43

Table 4.27. Change in the supply of natural resources (%) across the villages, with results of chi-squared test……..…….…….47

Table 4.28. Change in the supply of natural resources (%) across village types, with results of chi-squared test……...……...50

Table 4.29. The perception of the availability of natural resources across village……...….51

LIST OF ABBREVIATIONS

AHDSS - Agincourt Health and Demographic Surveillance System

CC - Central communities

EC - Established communities

KZN - KwaZulu-Natal

PCA – Principal Component Analysis

RS - Refugee settlements

SUCSES - Sustainability in Communal Socio-Ecological Systems

UC - Underdeveloped communities

1. INTRODUCTION

1.1 Background

Natural resources play an essential role in the livelihoods of many rural communities around the world which are dependent on these resources to meet their daily needs (Ishaya and Abaje, 2008). Billions of people use natural resources globally (Shackleton and De Vos, 2022), with over 80% of African households harvesting these resources (Meinhold et al., 2022). Environmental resources also serve as livelihood security for many households as they assist during economic crises, and social and biophysical challenges (Shackleton and Shackleton, 2004). For this study, the environment as defined by Hunter et al. (2010, p.526) is, "a community's natural surroundings that contain natural resources for which availability, accessibility, and quality shape rural livelihoods and the overall health and well-being of study area residents". In South Africa, more than 85% of rural households make use of natural resources from their environment, with poor households being more dependent on these than their rich counterparts. However, resource use patterns and levels of use vary across geographic locations (Shackleton and Shackleton, 2004). The understanding of the relationship between the environment and society is vital, because their misinterpretations and lack of understanding might have an impact on the health of the environment and people now and in the future (Matsika et al., 2013).

A high dependence on natural resources can lead to overexploitation if the resource base cannot meet the demand (Hunter et al., 2007). Land-use changes and overexploitation of natural resources harm households that are dependent on these resources (Shackleton and Shackleton, 2004). There are various factors involved that are root causes of degradation in South Africa and these include climatic variations, unemployment, poverty, and the apartheid system in which the indigenous

people were resettled in high densities in communal homelands (Meadows and Hoffman, 2002). The persistent high densities in these former-homelands have resulted in heavy utilization pressure placed on common pool resources which has led to environmental degradation. The increasing settlements have led to a gradual decrease in woodland and vegetation cover in rural communal lands of South Africa (Giannecchini et al., 2007). Population increases and unsustainable uses and harvesting of natural resources in communal lands are two of many factors which have led to woodland degradation, which in turn affects the livelihoods of rural communities (Makhado et al., 2009; Wessels et al., 2013). The need for land for settlements and agriculture to meet the needs of a growing population has exacerbated the decline in the availability of natural resources (Mahonya et al., 2019).

Rural households have diverse livelihood strategies, which include the use, collection, buying, and selling of natural resources, crop and livestock farming, as well as remittances from migrant members (Shackleton et al., 2001; Andrew et al., 2003). Environmental products from communal lands surrounding rural communities include wild foods, energy (firewood), medicine, and shelter (Dovie et al., 2002). People from developing countries are more active in the use of natural resources and are environmentally concerned because they rely more on environmental products for their livelihoods (Hunter et al., 2007). However, the accessibility of some natural resources and wild products does not always favour impoverished communities. Geographic location, level of education and how well-informed households are, conditions in households, and gender, influence how environmental products are perceived (Hunter et al., 2007). Environmental concerns are components of environmental perception that may affect areas, households, and age groups, and differ across communities, thus the difference in the perception of the environment (Hunter et al., 2007). Therefore, the understanding of these concerns specific to a group, area, or village of

study will assist in providing appropriate policies about the concerns/issues of that area of study. The level of concern that people show towards the environment indicates how they perceive the environment or how they deem the importance of ecosystem services in their lives. How people value natural resources leads to changes in human behaviours and practices, such as the overuse of or pollution of certain resources (Wisely et al., 2018). The availability of resources, for example, wild foods, serves as security and is important for communities and conservation plans and strategies (Wisely et al., 2018). The changes caused by land degradation impact rural livelihoods negatively, which can in some instances lead to behavioural changes, along with perceptions of the importance and value of certain resources by people who depend on them (Hunter et al., 2007).

1.2 Rationale

It is well known that natural resource use varies across households within communities due to socio-economic variables such as household size, and income (Shackleton et al., 2002; Paumgarten and Shackleton., 2009; Ragie et al., 2020). Most studies of natural resource use in rural South Africa have tended to focus on a small number of villages (e.g., Dovie et al., 2002; Shackleton et al., 2002; Twine et al., 2003a; Giannecchini et al., 2007; Matsika et al., 2012) without an assessment of the variation across types of villages within a particular area or region. However, finer-resolution studies across more villages will bring to light constraints and aspects at the community level that would have been overlooked by broad studies (Giannecchini et al., 2007). Environmental constraints and challenges also differ across geographical areas, and perceptions of natural resources are expected to differ across villages (Hunter et al., 2010). Environmental perceptions, and how these vary across types of villages, have also not been well studied in rural South Africa (Hunter et al., 2010).

Given the above, this study sheds new light on natural resource use and environmental perceptions across distinct types of villages (page 15-16). This improves understanding of the influence of village typology in the way rural people use natural resources, which involves harvesting these resources and how they perceive the environment. This study is part of a larger investigation on migration into and out of woodlands in southern Africa. Results from this study on how resource use and perceptions vary across village types provide useful insight into the role of the environment in explaining why levels of migration vary between different types of villages.

1.3 Aim and Objectives

The study aimed to compare natural resource use and environmental perceptions across distinct types of villages (characterised in terms of size, socio-economic characteristics, access to services, connectedness, and remoteness) in Bushbuckridge, Mpumalanga Province.

Objective 1

Compare levels of natural resource use between villages and between different village types.

It is hypothesized that levels of natural resource use will be higher in poorer, more remote villages.

Objective 2

Compare environmental perceptions between villages and between different village types.

It is hypothesized that, with increasing remoteness or village poverty level, there will be more respondents perceiving change in the availability of natural resources.

Objective 3

Determine the combined relationship between village types, natural resource use and perceptions of change in resource availability.

It is hypothesized that poor and remote village types will be associated with more frequent use of natural resources and will value the environment the most.

2. LITERATURE REVIEW

2.1 Natural resource use

Natural resources play a vital role in rural livelihoods in rural South Africa (Shackleton and Shackleton, 2004). Natural capital provides coping strategies for households during periods of shock because it is cheap and easily accessible (Tibesigwa et al., 2016). Natural resource use is not the only livelihood strategy and is complimented by other strategies, including labour income, livestock farming, and crop production (Dovie et al., 2002). Diversification of livelihood strategies reduces households' vulnerability and increases their resilience (Twine, 2013). Many rural households still use natural resources (e.g., fuelwood), even when alternatives (e.g., electricity) are available because of the costs that come with using the alternatives (Matsika et al., 2013). Commonly used natural resources include fuelwood, wild vegetables, edible fruits, and wooden utensils, which were used by more than 85% of rural households, of which some (e.g., wild spinach and edible fruits) amount to 58 kg and 104 kg annually per household on average respectively (Shackleton and Shackleton, 2004). There is a wide variety of uses for the same natural resource, for example, the marula tree which produces fruits, that can be used as a medicine, as well as used as relish across villages due to differences in preferences and values across population and households (Kugedera, 2020).

The collection of natural resources resides in village communal lands or agricultural fields of the village. About 97% of rural Bushbuckridge households forage for their natural resources (Ragie et al., 2020). Some wild foods (e.g., marula fruits) and materials (e.g., thatch grass) are harvested seasonally, with households taking opportunities to maximize harvest and trade these to generate income (Shackleton et al., 2002). The time spent harvesting and the distance to the natural resource influence the harvest frequency, with increasing distance to the resource decreasing the frequency of resources collected (Mensah et al., 2017).

Natural resource trading in South Africa is due to several reasons, including, retrenchments, and lack of alternative cash incomes (Shackleton and Shackleton, 2003). The economic value of natural resources is influenced by the type of resource and its management, available markets for the resource, and knowledge about the resource (Delgado et al., 2023). The decline in the knowledge about natural indigenous resources often leads to their neglect and mismanagement (Shai et al., 2020). Natural resources can be used for consumption and for generating income through selling these harvested natural products (Dovie et al., 2002). The household income generation varies across communities and households, the type of natural resource, and the number of resources sold (Shackleton et al., 2024). The slow advancements of the economy have required multiple income streams (Ragie et al., 2020), which enhanced the social capital (Mbiba et al., 2019) for many rural residents to aid during times of crisis. There is an increase in reliance on off-labour income for many rural communities, however, during an environmental crisis, poor households rely on natural resources more than their wealthy counterparts (Ragie et al., 2020). In a study by Ragie et al. (2020), 8.5% of households traded natural resources while 49% bought natural resources. Income generated from trading natural resources (e.g., carving) can reach an annual amount of R9000 (Shackleton and Shackleton, 2004). In a study done by Dovie et al. (2002), there was about 80%

of the gross use value on three natural resources (fuelwood, thatch grass, and edible herbs), which shows the contributions of natural resources in monetary terms.

Communal lands are a great support for most rural South Africans who are under the poverty line (Shackleton et al., 2000a). Villages in the former homelands each have demarcated communal land use for village residents, and with increasing population density, increasing pressure is placed on the natural resource pool (Coetzer et al., 2010). Traditional authorities enforce laws on the sustainable harvesting of natural resources and resource management systems that protect and control natural resources (Twine, 2005). However, this resource management system has weakened post-1994 (Giannecchini et al., 2007; Kirkland et al., 2007). Due to the increasing scarcity of natural resources and the weakening of traditional resource management systems, some village residents go beyond their allocated resource pool and harvest in other villages to make ends meet (Kirkland et al., 2007). Historical management of common pool resources had a significant impact on the functioning of the natural environment and the resources it provides (Clements et al., 2021; Mani et al., 2021). Twine et al. (2003b), noted that an increase in the harvesting of resources by outsiders (outside their demarcated fence, from other communities) was so due to the weakening of policies in place, with poverty playing a major role. Resource scarcity can lead to conflicts between villages or communities and impact the livelihood patterns in rural communities (Ishaya and Abaje, 2008).

The more abundant and available certain species are, the more likely they are to be frequently harvested and used (Matsika et al., 2013). When experiencing shocks, the use, and frequency of harvesting natural resources increases (Mbiba et al., 2019), and with more frequent effects of climate change, one would predict that there will be more natural resource demand, unsustainable use, and overexploitation of these resources as a means of coping. Socio-economic aspects, such

as income or employment status influence the use, and the number of natural resources that can be harvested (Twine et al., 2003b). There is a negligible difference in the prevalence of the use of natural resources across poor and wealthy households (Shackleton et al., 2024). Poor rural households (poorly serviced) and communities are said to benefit more from natural resources than wealthier rural households (Shackleton and Shackleton, 2004). However, in a study by Twine et al. (2003a), poor and wealthy households used natural resources extensively. The poor households were more reliant on indigenous resources, such as wild herbs and fruits than wealthy households. Livestock which are reared include cattle, goats, sheep, etc. for consumption and income (Kimera et al., 2020). In South Africa, a minority of rural households own cattle, with households that have alternative income sources having larger cattle herds (Shackleton et al, 2005). There are products that food animals provide. Communities can access products from cattle such as milk, dung, meat, and are used for ploughing (Shackleton et al., 2005). Both poor and wealthy households benefit from these products. Drought events have a severe negative impact on livestock farming in communal lands (Vetter et al., 2020).

Studies of resource use involving more than one village (e.g., Matsika et al., 2012; Shackleton et al., 2002; Twine et al., 2003a; Mbiba et al., 2019; Ragie et al., 2020) show that levels of resource use differ between villages, even in the same region. However, the relationship between resource use and village characteristics has not been well-studied. The challenges (e.g., delivery of services, income) may vary across villages and village types, and so will the degree to which natural resources will be used (Shackleton et al., 2002). Remote villages are less exposed to employment opportunities besides nature's goods and services, and this increases their reliance on proximate natural resources (Dovie et al., 2002). Harvesting pressure on species composition and structure is different across village types because of different constraints, challenges, geography, population,

etc., in each village (Matsika et al., 2013). Immigration has an impact on the sustainable use of natural resources as immigrants may not follow or be familiar with environmental laws and regulations on the sustainable use of natural products (Fisher et al., 2012).

2.2 Environmental perceptions

The ever-growing need for natural resources and unsustainable use of these resources deteriorate the functioning structure of proximate environments and their ecosystems (Kgaphola et al., 2023). The progressive unsustainable uses of natural resources deplete the natural capital and consequently, the human and social capital (Shackleton et al., 2024). Degradation of the environment and scarcity of natural resources as stated by Hunter et al., (2010), lead to local communities expressing a high concern and value for their local proximate environment. Most rural communal l~~and~~ areas in South Africa are susceptible to land degradation and are characterized by high population densities, higher rainfall, steeper slopes, and are more prone to degradation than commercial lands (Meadows and Hoffman, 2002). Land use practices influence the structure and the functioning of ecosystems (Higgins et al., 1999). Drivers of land degradation include biophysical (i.e., climatic changes, water availability), institutional (i.e., land demand and management), and socio-economic (i.e., poverty, population size) factors (Mani et al., 2021). Poverty and land use patterns have had impacts on land degradation, but dependency on agriculture in these communal lands is the main cause of land degradation (Meadows and Hoffman, 2002). Land degradation affects soil and vegetation. In terms of vegetation degradation, loss of vegetation cover, species composition change, bush encroachment, and deforestation are noted (Meadows and Hoffman, 2002). The loss in vegetation cover is due to factors such as drought, overgrazing, fires, and cutting of wood from the proximate environment (Meadows and Hoffman, 2002). High grazing pressures and crop rotation in the communal areas has an impact on soil degradation due

to high soil erosion (Meadows and Hoffman, 2002). How the land and resources from the environment are used has an influence on the composition of landscapes (Hoffman, 2014). The degree of the harvesting pressure, the method(s) used to harvest a particular natural resource, and the selected/preferred natural resources to be harvested differ from one place to another (Dovie, 2003).

The natural resource base and its degradation in these communal lands is not only affected by land-use activities but also climate change (Scheiter et al., 2019). Climatic change including changes in temperatures, rainfall seasons, and amount of annual rainfall has an impact on the natural environment and the resources it provides (Clements et al., 2021). Frequent extreme climatic events like drought have a prolonged effect on the vegetation cover and soil, reducing vegetation cover, and increasing bare soil which leads to soil erosion (Kgaphola et al., 2023). How the land and resources from the environment are used has an influence on the composition of landscapes (Hoffman, 2014).

Ou (2017, p.18) defines perception in psychology, philosophy, and cognitive science as "the process of attaining awareness or understanding of sensory information". A value is viewed based on importance, preference, and a measure of something to someone (Pascual et al., 2017). What someone values about the environment may not be equally valued by others, meaning that people within the same region might value the environment and services it provides differently. The knowledge of, and awareness of, ecosystem goods and services influence the value and pressure people put on natural resources (Dixon, 2008). Socio-ecological factors influence how the goods and services provided by nature are perceived/valued (Mensah et al., 2017). Satisfaction with certain services provided, for example, water, contributes to people's behaviours towards the services and how they perceive/value the environment (Dlamini et al., 2021). The setting of the

village, the constraints, and the challenges faced in each village type influence how the environment is perceived by the locals (Hunter et al., 2010). There are complexities involved in the understanding and acknowledgement of values that influence decisions made and the outcomes of those decisions (Pascual et al., 2017).

Rural residents, in a study conducted by Kirkland et al. (2007) in Bushbuckridge Local Municipality in the Mpumalanga province, perceived poverty and the increase in population as factors leading to unsustainable use and harvesting of natural resources. People from marginalized communities are directly affected by the effects of climate change and their reactions to and perceptions of the natural environment will be different from those who are not directly or highly dependent on natural resources for their livelihood (Ishaya and Abaje, 2008). Gender and age play a role in the perception and valuing of natural resources, with women and older members of society showing a high awareness and valuing of the environment (Mensah et al., 2017). Women are more involved in everyday chores which involve them interacting with the environment, while older residents have possibly seen the impacts of not having a specific natural resource in the span of their lives. A lack of information and experience influences how rural households perceive environmental resources (Mensah et al., 2017). In achieving sustainability goals for society now and in the future, there is a need to acknowledge and respect the diverse values there are across communities, households, and individuals (Pascual et al., 2017).

How people perceive or value the environment will have an impact on how they use resources provided by the environment. Some people's perceptions are rooted in or shaped by their traditional norms and values, which influence how they perceive the environment (Musavengane and Simatele, 2016). The degree of the use of resources and how reliant people are on these natural products shows the importance of these resources to people (Shackleton and Shackleton, 2006).

The scarcity of natural resources has an impact on well-being and livelihood. This causes households to highly perceive(aware) the importance of the environment as being greater(Hunter et al., 2010). The fragmentation of the environment consequently leads to the decline in supply and availability of natural resources affecting households that are dependent on the resources for their livelihoods (Mahonya et al., 2019). When there is strong social capital that includes transparency and effective communications within a community, it enhances effective collaborations within communities to allow people to see the importance of natural resources which allows for their sustainable use (Musavengane and Simatele, 2016). In a study done by Mahonya et al. (2019), respondents perceived a decline in the supply of most natural resources. The relationships between rural environmental perceptions across village types have not been given much attention in the literature, thus the importance and necessity of this study.

3. METHODS

3.1 Study area

This study was conducted in Bushbuckridge Local Municipality of the Ehlanzeni district in Mpumalanga Province, South Africa. The study site villages are in the Agincourt Health and Demographic Surveillance System (AHDSS) site, which covers an area of 420 km² with 27 villages (Kahn et al., 2012) (Figure 3.1). The region is semi-arid, with an annual rainfall of 550-700 mm (Kirkland et al., 2007), and a summer range from >900 mm in the west and >500 mm in the east, with 22 °C as the mean annual temperature (Fisher et al., 2012). The Bushbuckridge Local Municipality is in the savanna biome and is dominated by Lowveld Granite Bushveld Vegetation (Fisher et al., 2012). This is important because the savanna biome covers a little over one-third of South Africa and is home to over 9.2 million rural residents (Mbiba et al., 2019).

Bushbuckridge is one of the many rural areas in South Africa that was part of Gazankulu, a historic black homeland that was under the apartheid government (Meadows and Hoffman, 2002). Some villages have many former Mozambican immigrants who fled from Mozambique during the 1980s civil war and settled in the study area (Kahn et al., 2012).

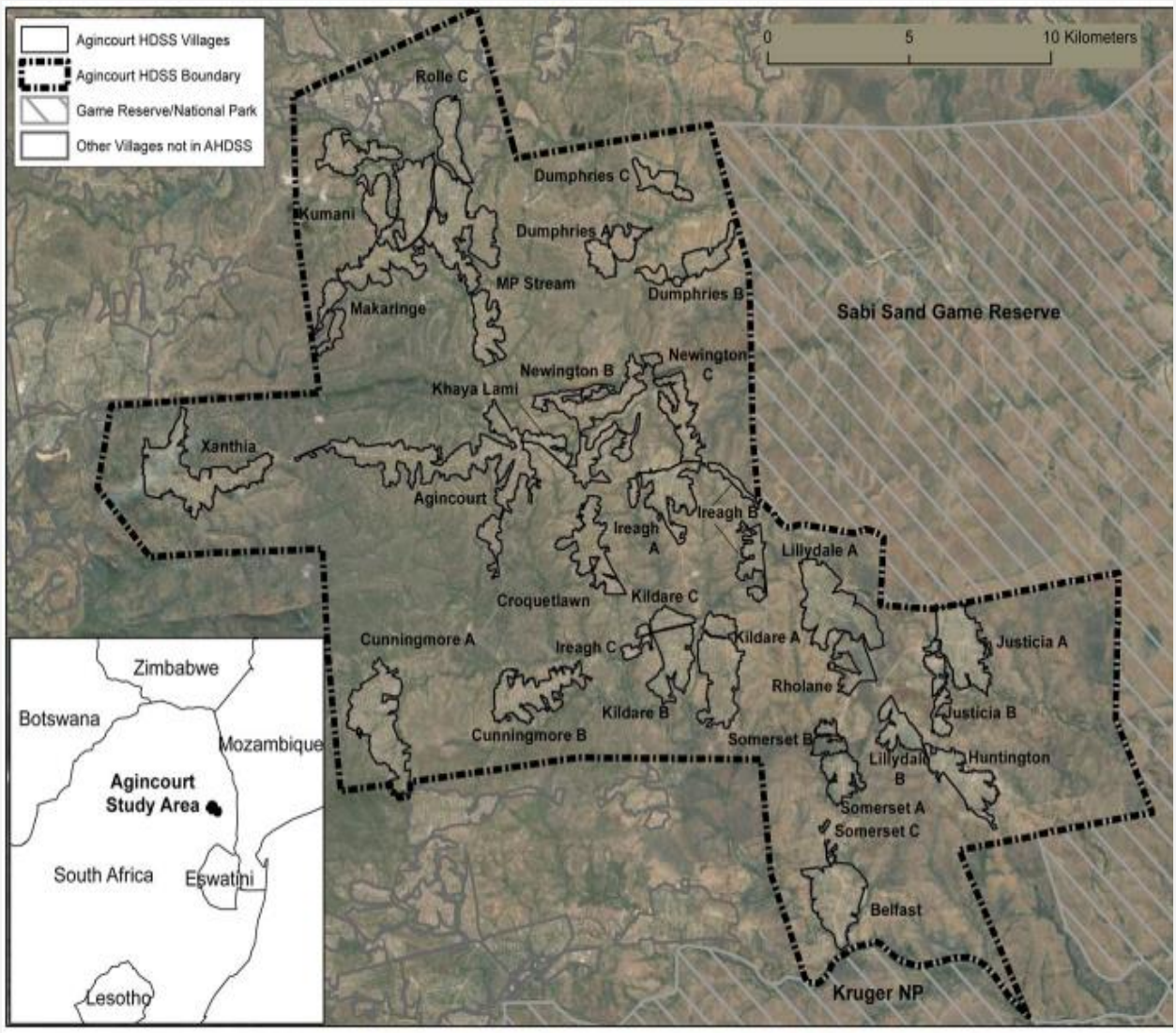


Figure 3.1. Villages within the Agincourt study site (Hunter et al., 2021).

The study site villages are under communal land tenure and are prone to degradation due to intensive resource harvesting as well as high grazing pressure due to high stocking rates resulting in a reduction in vegetation cover (Meadows and Hoffman, 2002). Subsistence farming, livestock grazing, and natural resources are the main uses of the land, with each village divided into residential, farming, grazing, and resource harvest areas (Mbiba et al., 2019). The communal lands provide a wide variety of natural products, from medicinal products to wild fruits, firewood, etc., which contribute to the livelihoods of rural dwellers (Shackleton et al., 2000a). The traditional authority controls the land use in the communal woodlands for each village within their stipulated village boundary (Mbiba et al., 2019). There is a high reliance on off-farm income for many households in Bushbuckridge (Ragie et al., 2020). There is a limited number of employment opportunities created in agriculture or crop production in most rural South Africa (Shackleton et al., 2000a). Social and pension grants are sources of income for many rural households. The population density of Bushbuckridge is 150-300 people per km² (Ayodeji, 2020).

3.2 Description of study village types

A village typology was developed for AHDSS villages classified by Hargreaves (2000) in which four village types were identified and classified using a participatory method.

Central communities (CC).

- These communities are large and well-established.
- Relatively large population.
- They are centrally situated on main roads, with relatively easy access to local urban centres, and they have had electricity the longest.
- Villages: Agincourt, Xanthia, Kildare A.

Established communities (EC).

- These communities are fairly developed, with good electricity supply, and access to a main road.
- Moderate population size.
- Villages: Cunningmore B, Ireagh A, Justicia A, Kildare B.

Underdeveloped communities (UC).

- These communities are more remote villages, which are isolated and not easily accessible by taxi/transport.
- These villages had no electricity supply in 2000 and received it much later than other villages, most northern villages are occupied by South Africans, and southern villages are mostly occupied by Mozambican refugees.
- Villages: Huntington, Ireagh B.

Refugee settlements (RS).

- These communities are smaller in size and mainly occupied by former Mozambican refugees.
- These refugee settlements were without basic services in 2000 and received these services more recently.
- Villages: Lilydale B, Kildare C, Justicia B.

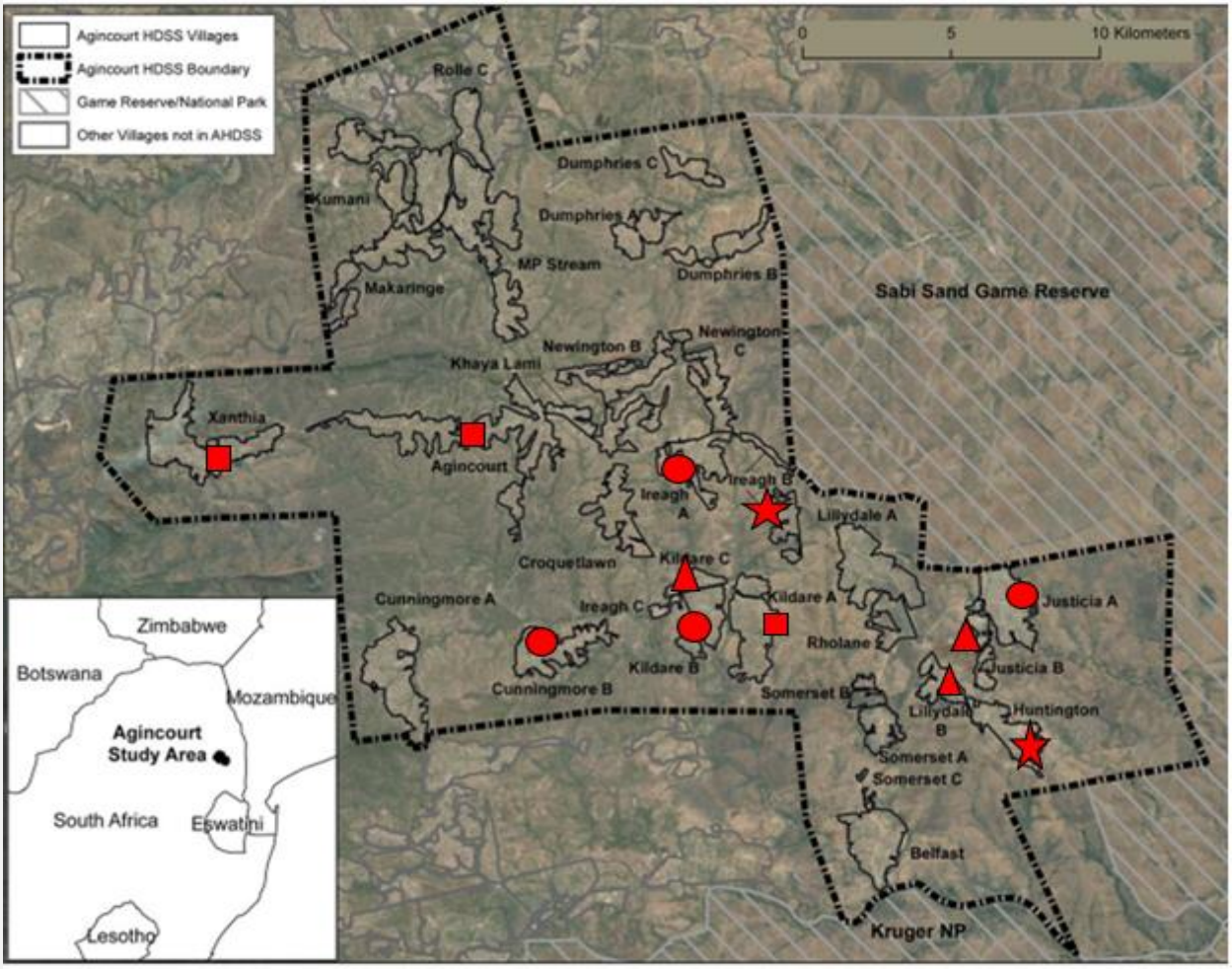


Figure 3.2. Map of study villages showing different village types. Squares: central villages (CC); Circles: established communities (EC); Stars: underdeveloped communities (UC); Triangles: refugee settlements (RS).

3.3 Data collection

3.3.1 Household survey

This study made use of existing household resource use data from the Sustainability in Communal Socio-Ecological Systems (SUCSES) study which is nested in the AHDSS. The pre-existing data was made available by my supervisor, Professor Wayne Twine. The SUCSES survey was first

conducted in 2010 in 590 households sampled from 12 villages, representing an 8% sampling intensity of households per village. The survey was repeated in the same households, six times between 2011 and 2021. The data from 2021 with 484 sampled households was used in this study. The data from the SUCSES household survey is covered by ethics clearance certificates M10301 and M190108.

Data from the SUCSES household questionnaire that was compared between SUCSES villages and village types included a) the use, frequency of use, collection, frequency of collection, buying, and frequency of buying of natural resources (i.e., firewood, wild fruits, wild vegetables, edible insects, bushmeat, medicinal plants), b) average quantity and income earned for natural resources per year, c) ownership of materials made from natural resources (i.e., reed mats, thatch roofs, animal kraals, and building from poles, utensils, and brooms, d) livestock ownership (cattle which forage in the communal lands), and e) perceived change in the availability of natural resources. For the survey, respondents were asked if they used, collected, and bought specific natural resources over the past 12 months, and the response was either yes=1 or no=0. For the frequency of use, collection, and buying when in season, respondents had to answer if they used, collected, or bought the natural resource where 1= less often than 1x per month (once every 6 weeks), 2= between 1x per month and 1x per week (1-4 x per month) and 3 = more than 1 x per week (more than 4x per month).

3.3.2 Focus group discussions

For environmental perception/value comparison across village types, the study made use of two villages from each of the village types: Agincourt and Xanthia for central communities, Cunningmore B and Justicia A for established communities, Ireagh B and Huntington for underdeveloped communities, and Justicia B and Lilydale B for refugee settlements. The data

collection was done in one focus group discussion per village with 10-12 and a maximum of 14 participants as suggested by Gill et al., (2008). Participants were randomly selected across the selected villages and were invited to a place of meeting 2-3 days before the day of the discussions. Both male and female participants were included, and the age group ranged from 20-75 years. A question guide or focus group schedule was used in each of the focus groups in the selected villages (Appendix 1). The focus group schedule was used to guide conversations about participants' perceptions of the importance of the local natural environment and its resources for people's well-being; how the environment has changed and what has caused the changes; together with how changes in the environment have impacted on residents of the village. A consent form was given to each of the participants to read and those not able to read and write were aided by the translator before the discussions could begin. Focus group discussions were conducted in the local language Tsonga (Shangaan) through an interpreter. A recorder was used to record all that was said by participants in the focus group discussions. The focus group discussions took 1-2 hours. Ethics clearance was obtained from the Wits Human (Non-Medical) Human Ethics Committee (certificate number H221018) before focus group discussions were done. Permission to conduct focus groups was also obtained from each of the village headmen or chief before commencement.

3.4 Data analysis

Natural resource use metrics were expressed both per village and per village type. Binary and ordinal categorical variables were expressed as percent per village and village type, while descriptive statistics (mean, median, mode, standard deviation) were calculated per village and village type for numeric variables. For binary variables, that is, the use, collection, buying, selling, and ownership of materials made from natural resources, ownership of livestock, and changes in the availability of resources, where 1 = yes and 0 = no, a chi-squared test was used to test whether

the relative frequency of “yes” responses differed significantly across villages and village types. For categorical variables, category 1 = Less often than 1 x per month (once every 6 weeks), 2 = Between 1 x per month & 1 x per week (1 - 4 x per month), and 3 = More than 1 x per week (more than 4 x per month) for frequency of use, collection, and buying, and category 1 = decrease, 2 = increase, 0 = no change for changes in the availability of natural resources, a chi-squared was used to test if the frequencies differed significantly across villages and village types.

For numeric variables, that is, number of resources, quantities of natural resources, and annual prices of natural resources, the ANOVA test was used for comparing means (normal distribution of data), and Kruskal Wallis was used for comparing medians for non-normal data distribution. For the average number of resources used across village types, a one-way ANOVA test was used. All the statistical procedures were conducted using BlueSky Statistics software, version 10.3.1. The significance level was set at $p<0.05$.

For focus group discussions, the recorded information from the participants was translated and transcribed by the translator and facilitator responsible for conducting the focus group meetings. Transcribed information for each of the villages, in which focus groups were conducted was obtained. In this study, there was a comparison of responses (comparing the importance or availability of natural resources, similarities, and differences across village types), between villages and village types. The responses of participants from each village were grouped into village types, and an overall question of perception of natural resources that participants used was developed from the series of questions from the focus group schedule. The resources which were perceived to be widely and least used across village types were noted and categorised according to village types. Another summed up question was if participants perceived a reduction in the availability of any natural resource. The natural resources which were perceived to have reduced

in availability were listed and compared across village types. Natural resources that were mentioned by the greatest number of respondents across villages to have reduced were categorized as widely reduced. In contrast, those mentioned by the least number of respondents across villages were categorized as less common and more unique. To analyse the relationship between village type, natural resource use, and perceptions of change in natural resource availability, Principal Component Analysis (PCA) was used. The following variables were derived per household and used in the PCA, a) total number of resources used/owned(Num_res), b) total number of resources used more than 4 times a week (Num_often), c) total number of resources sold (Num_sold), d) total number of resources perceived to be decreasing (Num_decrease), e) cattle ownership (cattle_own), and f) buying firewood (firewood_buy) because this is a widely used and purchased resource. Dummy variables were used for each village type (value of 1 if the household is in the relevant village type and 0 if in another village type).

4. RESULTS

4.1 Natural resource use

4.1.1 Prevalence, frequency, and quantity of natural resource use

Firewood and wild vegetables were used by 86-95% of households. Wild fruits, edible insects, while medicinal plants were used by 20-40% of the households, and local fish and bushmeat were used by less than 10% of households (Figure 4.1). In focus group discussions, firewood, wild fruits, bushmeat, and medicinal plants were perceived as the most used natural resources with fish and wild vegetables perceived to be the least used natural resources by participants (Table 4.1).

There was no significant difference in the prevalence of use across villages (Table 4.2) or across village types (Table 4.3) for any of the natural resources. In focus group discussions, participants in all village types noted the use of firewood, mainly as fuel for energy used for cooking with a participant in Lillydale (RS) making mention of it, "*because we do not have money to buy electricity due to unemployment, we use firewood to cook*" (Table 4.1). Wild fruits were perceived by participants to be widely used across all the village types, except in UC. Most households in RS used medicinal plants. Medicinal plants were widely used across RS and EC villages. Bushmeat was perceived by participants to be used by villages in central and established communities (Table 4.1). Fish was only mentioned as being used by participants in underdeveloped communities in focus group discussions, with a respondent in Ireagh B saying, "*When it comes to fishing if they can find you there, they will arrest you because we are not allowed to do that*".

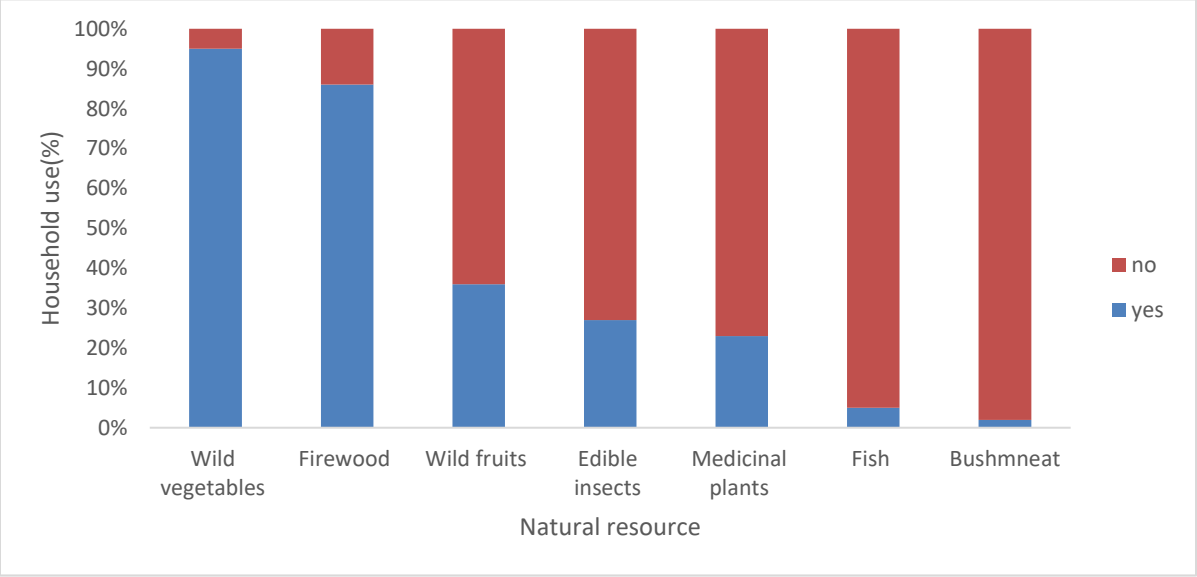


Figure 4.1 The pooled percentage use of natural resources in sampled households.

Table 4.1. Perception of natural resource use across village types.

Commonly used natural resources across village types			
CC	EC	RS	UC
Wild fruits	Firewood	Firewood	Firewood
Bushmeat	Wild fruits	Wild fruits	Sand
	Medicinal plants	Medicinal plants	
	Bushmeat	Reeds	
		Utensils/implements*	
		Sand	
Natural resources less commonly used.			
Firewood	Reed/grass	Wild vegetables	Wild fruits
Medicinal plants	Utensils/implements		Medicinal plants
Reeds/grass	Sand/stones		Utensils/implements
Utensils/implements			Fish
Sand			

Note: *utensils/implements made from wood from the bush.

Table 4.2. The prevalence of use (%) of natural resources across villages, with results of chi-squared test.

	Firewood	Wild fruits	Wild vegetables	Edible insects	Fish	Bushmeat	Medicinal plants
Agincourt	93.33	36.00	94.67	28.00	5.33	2.67	22.67
Cunningmore B	78.72	38.30	95.74	25.53	2.13	0	23.40
Huntington	84.85	48.48	90.91	33.33	6.06	0	12.12
Ireagh A	87.23	42.55	95.74	27.66	4.26	4.26	23.40
Ireagh B	85.71	28.57	100	23.81	4.76	0	23.81
Justicia A	85.92	30.03	95.77	26.76	4.23	1.41	25.35
Justicia B	91.67	33.33	100	25.00	0	0	16.67
Kildare A	77.55	32.65	89.80	22.45	2.04	0	26.53
Kildare B	83.33	20.83	95.83	18.75	4.17	2.08	20.83
Kildare C	92.86	35.71	92.86	21.43	7.14	7.14	42.86
Lillydale B	83.33	37.50	95.83	33.33	12.50	0	25.00
Xanthia	94.00	38.00	96.00	36.00	10.00	6.00	22.00
Degrees of freedom (d.f)	11	11	11	11	11	11	11
Chi-squared	12.59	9.02	6.14	5.83	8.12	11.08	6.34
p-value	0.321	0.620	0.864	0.885	0.702	0.436	0.850

Table 4.3. The prevalence of use (%) of natural resources across village types, with results of chi-squared test.

Resource	Firewood	Wild fruits	Wild vegetables	Edible insects	Fish	Bushmeat	Medicinal plants
CC	89.08	35.63	93.68	28.74	5.75	2.87	23.56
EC	84.04	35.21	95.77	24.88	3.76	1.88	23.47
UC	85.19	40.74	94.44	29.63	5.56	0	16.67
RS	88.00	36.00	96.00	28.00	8.00	2.00	28.00
d.f	3	3	3	3	3	3	3
Chi-squared	2.25	0.59	1.02	0.96	1.84	1.76	1.76
p-value	0.523	0.898	0.795	0.811	0.606	0.624	0.581

Firewood was used more than 4 times a month by over 70% of the households. There were 20-35% of the households which used wild fruits and wild vegetables more than 4 times a month, with less than 10% of the households used edible insects more than 4 times a month (Figure 4.2). There was no significant difference in the level of frequency of use of natural resources between villages (Table 4.4) (except wild fruits) and village types (Table 4.5). An average of 1679 (±150) kg of firewood, 90.55±29.61 individual fish, 33.09±4.20 buckets of wild fruits, 32.44±4.90 buckets of wild vegetables, and 11.57±2.02 mugs (4.4 Litres) of edible insects was used per year (Table 4.6). There was only a significant difference in the average quantity of firewood used per year across villages (F-value = 21.50, p-value = 0.0025, d.f= 11) and wild fruits (F-value = 25.44, p-value = 0.008, d.f = 11) (Table 4.7). Households in Kildare B (EC) used a larger quantity of firewood, while households in Ireagh B (UC) used a large quantity of wild fruits per year. There was no significant difference in the average quantity of natural resources used per year across village types (Table 4.8). Households used a mean of 2.77 resources in the pooled data, and there was no significant difference in the mean number of resources between villages (Table 4.9) or village types (Table 4.10).

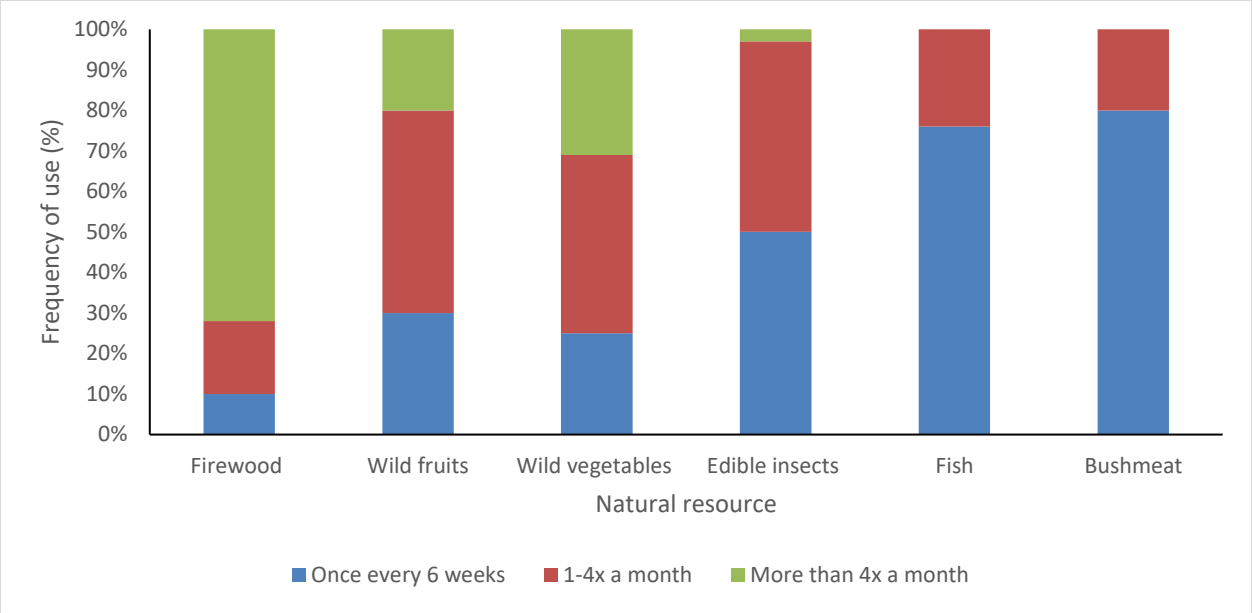


Figure 4.2 The pooled prevalence of use frequency of natural resources.

Table 4.4 Natural resource use frequency (%) of each resource across villages, with chi-squared and p-value.

Village	Frequency of use	Firewood	Wild fruits	Wild vegetables	Edible insects	Fish	Bushmeat
Agincourt	Less often (less than 1x per month)	11.43	29.63	39.44	61.90	75.00	0
	Often (between 1−4 x per month)	10.00	55.56	40.85	33.33	25.00	100
	More often (more than 4x per month)	78.57	14.81	19.72	4.76	NA	NA
Cunningmore B	Less often	8.11	66.67	26.67	41.67	0	NA
	Often	29.73	11.11	42.22	58.33	100	NA
	More often	62.16	22.22	31.11	0	NA	NA
Huntington	Less often	10.71	37.50	20.00	36.00	50.00	NA
	Often	17.86	37.50	43.33	63.63	50.00	NA
	More often	71.43	25.00	36.67	0	NA	NA
Ireagh A	Less often	17.07	25.00	15.56	38.46	100	100
	Often	17.07	60.00	53.33	53.85	0	0
	More often	65.85	15.00	31.11	7.69	NA	NA
Ireagh B	Less often	0	0	9.52	60.00	100	NA
	Often	22.22	66.67	52.38	40.00	0	NA
	More often	77.78	33.33	38.10	0	NA	NA
Justicia A	Less often	11.48	18.52	17.65	36.84	100	100
	Often	19.67	62.96	42.65	63.16	0	0

Village	Frequency of use	Firewood	Wild fruits	Wild vegetables	Edible insects	Fish	Bushmeat
	More often	68.85	18.52	39.71	0	NA	NA
Justicia B	Less often	18.18	0	41.67	33.33	NA	NA
	Often	18.18	75.00	41.67	66.67	NA	NA
	More often	63.64	25.00	16.67	0	NA	NA
Kildare A	Less often	7.89	43.75	31.82	54.55	100	NA
	Often	28.95	50.00	45.45	45.45	0	NA
	More often	63.16	6.25	22.73	0	NA	NA
Kildare B	Less often	20.00	40.00	32.61	77.78	100	100
	Often	15.00	20.00	45.65	22.22	0	0
	More often	65.00	40.00	21.74	0	NA	NA
Kildare C	Less often	0.00	60.00	15.38	33.33	0	100
	Often	0	0	23.08	33.33	100	0
	More often	100	40.00	61.54	33.33	NA	NA
Lillydale B	Less often	0	0	13.04	50.00	66.67	NA
	Often	15.00	77.78	47.83	50.00	33.33	NA
	More often	85.00	22.22	39.13	0	NA	NA
Xanthia	Less often	4.26	15.79	22.92	55.56	80.00	100
	Often	17.02	68.42	39.58	38.89	20.00	0
	More often	78.72	15.79	37.5	5.56	NA	NA
d.f		22	22	22	22	10	5
Chi-squared		28.95	40.96	32.76	22.07	10.11	10
p-value		0.146	**0.008***	0.065	0.456	0.431	0.075

Note: NA=Not enough data

Table 4.5. Natural resource use frequency (%) of each resource across village types, with chi-squared and p-value.

Village	Frequency of use	Firewood	Wild fruits	Wild vegetables	Edible insects	Fish	Bushmeat
CC	Less often (less than 1x per month)	8.39	29.03	32.52	58.00	80.00	60.00
	Often (between 1−4 x per month)	16.67	58.06	41.72	38.00	20.00	40.00
	More often (more than 4x per month)	74.84	12.90	25.77	4.00	NA	NA
EC	Less often	13.97	34.67	22.55	45.00	88.00	100
	Often	20.11	44.00	45.59	53.00	12.00	0
	More often	65.92	21.33	31.86	1.89	NA	NA
RS	Less often	4.55	16.67	20.00	42.86	50.00	100
	Often	11.00	56.00	40.00	50.00	50.00	0
	More often	84.09	27.78	40.00	7.14	NA	NA
UC	Less often	6.52	27.27	16.00	44.00	66.67	80.00
	Often	19.57	45.45	47.00	56.00	33.33	20.00
	More often	73.91	27.27	37.25	0	NA	NA
d.f		6	6	6	6	3	2
Chi-squared		8.73	6.01	10.13	4.36	2.29	2.5

p-value		0.189	0.423	0.119	0.628	0.514	0.287

Table 4.6. Average ±SE quantity per household per year.

Resource	Unit	Average annual quantity
Firewood	kg	1679 ±150
Fish	Number of individuals	90.55±29.61
Wild fruits	Buckets	33.09±4.20
Wild vegetables	Buckets	32.44±4.90
Edible insects	Mug (L)	11.57±2.02 (4.40 Litres)

Table 4.7. Average volume unit of natural resources used per year (±SE) across villages, with results of Kruskal Wallis test.

	Firewood (kg)	Wild fruits (bucket)	Wild vegetables(bucket)	Edible insects(mug)	Fish(individuals)
Agincourt	1593±197	49.87±10.97	22.60±2.87	7.34±3.26	12.50±21.86
Cunningmore B	1374±502	49.31±27.65	30.28±16.08	3.59±1.70	300±30.92
Huntington	1305±518	17.97±5.12	23.15±8.28	13.86±5.70	100±30.92
Ireagh A	1124±261	25.17±4.98	25.59±7.58	4.25±2.11	NA
Ireagh B	2157±549	73.00±30.40	48.24±16.19	9.52±5.25	NA
Justicia A	896±188	19.26±3.69	26.21±5.39	21.72±9.00	120±30.92
Justicia B	1244±567	15.05±6.37	9.83±4.82	0.28±0.26	NA
Kildare A	1493±343	32.80±10.91	24.66±5.84	15.07±8.37	50±30.92
Kildare B	2969±1075	68.18±27.85	80.81±43.31	3.03±1.17	NA
Kildare C	2432±1066	1.85±11.85	35.33±18.17	31.68±24.55	NA
Lillydale B	2501±590	29.80±16.91	31.31±10.78	11.26±4.62	40±30.92
Xanthia	2253±532	19.34±4.32	30.89±8.25	16.36±6.95	90±21.87
d.f	11	11	11	11	6
F-value	21.50	25.44	17.75	9.14	10.67
p-value	**0.029***	**0.008***	0.088	0.609	0.088

Table 4.8. Average volume unit of natural resources used per year (±SE) across village types, with results of Kruskal Wallis test.

	Firewood(kg)	Wild fruits	Wild vegetables	Edible insects	Fish
CC	1771±203	36.16±5.88	25.60±3.14	12.29±3.37	51.0±19.90
EC	1494±272	34.57±7.90	39.14±10.61	10.16±3.45	210±90.00
RS	2159±436	18.76±8.80	27.03±7.24	13.28±5.91	NA
UC	1638±382	31.07±9.30	32.88±8.16	12.50±4.18	NA
d.f	3	3	3	3	3
F-value	5.42	5.58	3.21	2.63	4.33
p-value	0.140	0.134	0.360	0.453	0.228

Table 4.9. The average number of resources used across villages, with the results of one-way ANOVA.

Village	The average number of natural resources ±SE
Agincourt	2.83±0.14
Cunningmore B	2.64±0.18
Huntington	2.76±0.21
Ireagh A	2.85±0.18
Ireagh B	2.67±0.27
Justicia A	2.77±0.14
Justicia B	2.67±0.35
Kildare A	2.51±0.17
Kildare B	2.46±0.18
Kildare C	3.00±0.32
Lillydale B	2.88±0.25
Xanthia	3.02±0.17
d.f	11
F-value	0.84
p-value	0.604

Table 4.10. The average number of resources used across village types, with the results of one-way ANOVA.

Village type	The average number of natural resources ± SE
Central communities	2.79±0.09
Established communities	2.69±0.08
Refugee settlements	2.86±0.17
Underdeveloped communities	2.72±0.17
d.f	3
F-value	0.39
p-value	0.760

4.1.2 Prevalence and frequency of collection of natural resources

For all the natural resources except edible insects, most user households (70-100%) collected natural resources, and only 5% of the user households collected edible insects (Figure 4.3). There was no significant difference between villages (Table 4.11) and village types (Table 4.12) for each of the natural resources collected by user households. In the pooled data, all the resources except fish were collected more than 4 times a month by 10-20% of the households (Figure 4.4). There was a significant difference across villages for wild fruits ($X^2 = 35.66$, p-value = 0.033, d.f = 22) and wild vegetables ($X^2 = 35.69$, p-value = 0.033, d.f= 22) (4.13), but no significant difference across village types (Table 4.14).

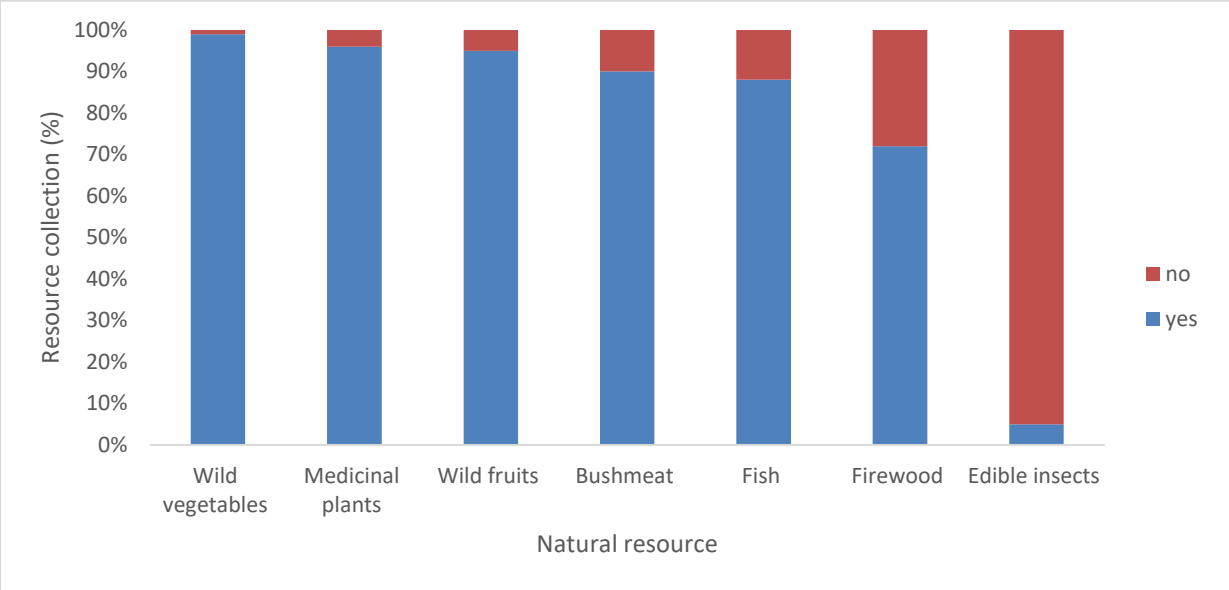


Figure 4.3. Pooled user household collection percentage of natural resources.

Table 4.11. Prevalence (%) of user households that collected natural resources across villages, with results of chi-squared test.

	Firewood	Wild fruits	Wild vegetables	Edible insects	Fish	Bushmeat	Medicinal
Agincourt	67.14	100	100	0	75.00	100	94.12
Cunningmore B	72.97	88.89	100	8.33	100	NA	100
Huntington	85.71	100	100	0	100	NA	100
Ireagh A	70.73	95.00	100	0	100	100	90.91
Ireagh B	77.78	100	95.24	0	100	NA	100
Justicia A	80.33	96.30	100	0	100	0	94.44
Justicia B	72.73	100	91.67	0	NA	NA	100
Kildare A	50.00	87.50	100	9.09	100	NA	92.31
Kildare B	65.00	100	97.83	11.11	50.00	100	100
Kildare C	76.92	80.00	100	33.33	100	100	100
Lillydale B	75.00	100	95.65	0	100	NA	83.33
Xanthia	76.60	89.47	100	11.11	80.00	100	100
d.f	11	11	11	11	10	5	11
Chi-squared	16.59	10.61	14.75	13.24	5.59	10	5.47
p-value	0.121	0.194	0.194	0.278	0.849	0.075	0.906

Table 4.12. Prevalence (%) of user households that collected natural resources across village types, with results of chi-squared test.

	Firewood	Wild fruits	Wild vegetables	Edible insects	Fish	Bushmeat	Medicinal plants
CC	65.81	93.55	99.39	6.00	80.00	100	95.12
EC	73.18	95.67	99.51	3.77	87.50	75.00	96.00
RS	75.00	94.44	95.83	7.14	100	100	92.86
UC	82.61	100	98.04	0	100	NA	100
d.f	3	3	3	3	3	2	3
Chi-squared	5.78	1.44	5.68	1.31	1.56	1.67	0.71
p-value	0.120	0.697	0.128	0.728	0.668	0.435	0.871

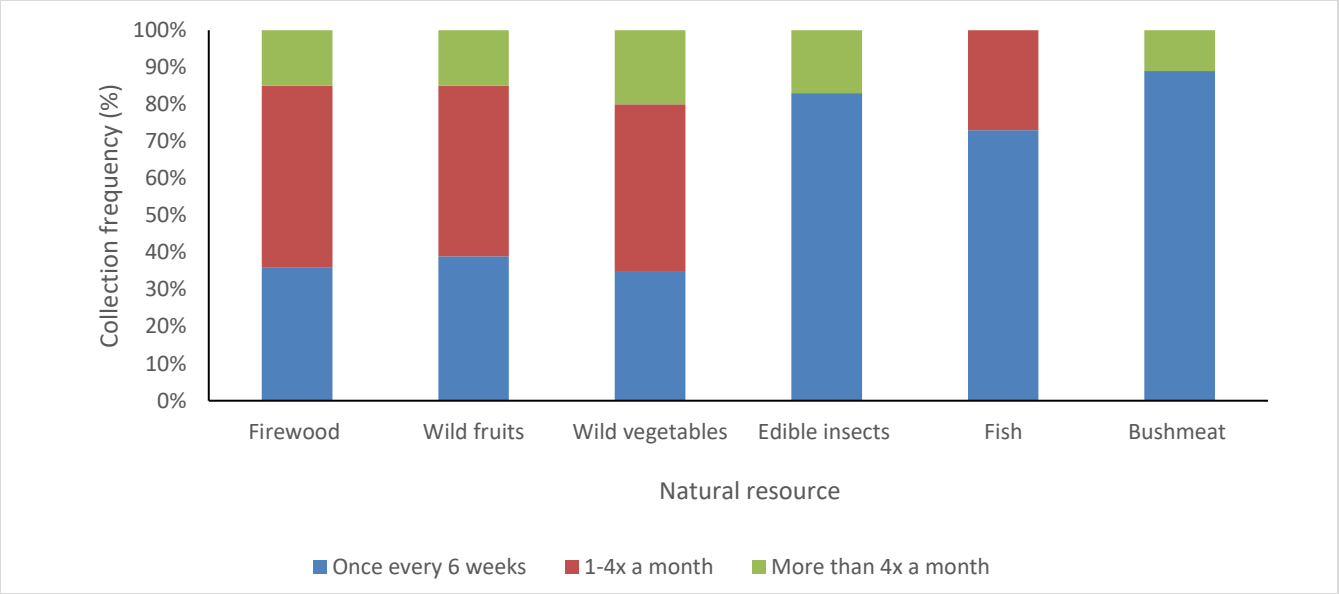


Figure 4.4 The pooled prevalence of collection frequency of natural resources.

Table 4.13. Prevalence (%) of collection frequency of natural resources across villages, with results of chi-squared test.

Village	Frequency of use	Natural resource				
		Firewood	Wild fruits	Wild vegetables	Fish	Bushmeat
Agincourt	Less often (less than 1x per month)	29.79	44.44	48.57	66.67	50.00
	Often (between 1−4 x per month)	57.45	48.15	40.00	33.33	50.00
	More often (more than 4x per month)	12.77	7.41	11.43	NA	NA
Cunningmore B	Less often	40.74	62.50	37.78	0	NA
	Often	37.64	12.50	35.56	100	NA
	More often	22.22	25.00	26.67	50.0	NA
Huntington	Less often	37.50	43.75	30	50.00	NA
	Often	37.50	37.50	53.33	NA	NA
	More often	25.00	18.75	16.67	NA	NA
Ireagh A	Less often	41.38	57.89	33.33	100	100
	Often	51.72	42.11	46.67	0	0
	More often	6.90	0	20.00	NA	NA
Ireagh B	Less often	14.29	0	15.00	100	NA
	Often	71.43	83.33	60.00	0	NA
	More often	14.29	16.67	25.00	NA	NA
Justicia A	Less often	32.65	26.92	23.53	100	NA

Village	Frequency of use	Natural resource				
		Firewood	Wild fruits	Wild vegetables	Fish	Bushmeat
	Often	53.06	57.69	50.00	0	NA
	More often	14.29	15.38	26.47	NA	NA
Justicia B	Less often	50.00	50.00	63.64	NA	NA
	Often	37.50	25.00	18.18	NA	NA
	More often	12.50	25.00	18.18	NA	NA
Kildare A	Less often	42.11	42.86	38.64	100	NA
	Often	52.63	50.00	45.45	0	NA
	More often	5.26	7.14	15.91	NA	NA
Kildare B	Less often	34.62	50.00	46.67	100	100
	Often	53.85	30.00	40.00	0	0
	More often	11.54	20.00	13.33	NA	NA
Kildare C	Less often	40.00	50.00	23.08	0	NA
	Often	20.00	0	30.77	100	NA
	More often	40.00	50.00	46.15	NA	NA
Lillydale B	Less often	33.33	11.11	13.64	66.67	NA
	Often	53.33	55.56	54.55	33.33	NA
	More often	13.33	33.33	31.82	NA	NA
Xanthia	Less often	38.89	17.65	33.33	75.00	100
	Often	44.44	70.59	47.92	25.00	0
	More often	16.67	11.76	18.79	NA	NA
d.f		22	22	22	10	4
Chi-squared		19.38	35.66	35.69	8.89	3.94
p-value		0.622	**0.033***	**0.033***	0.534	0.415

Table 4.14. Prevalence of collection frequency (%) of natural resource across village types, with results of chi-squared test.

Village	Frequency of use	Firewood	Wild fruits	Wild vegetables	Fish
CC	Less often (less than 1x per month)	35.29	36.21	41.36	75.00
	Often (between 1−4 x per month)	51.96	55.17	43.83	25.00
	More often (more than 4x per month)	12.75	8.62	14.81	NA
EC	Less often	36.64	46.48	33.99	85.71
	Often	49.62	39.44	43.84	14.29
	More often	13.74	14.08	22.17	NA
RS	Less often	39.34	29.41	28.26	50.00
	Often	39.34	35.29	39.13	50.00
	More often	21.21	35.29	32.61	NA
UC	Less often	28.90	31.82	24.00	66.67
	Often	50.00	50.00	56.00	33.33

Village	Frequency of use	Firewood	Wild fruits	Wild vegetables	Fish
	More often	21.05	18.18	20.00	NA
d.f		6	6	6	3
Chi-squared		3.7	10.52	12.23	1.71
p-value		0.718	0.104	0.057	0.634

4.1.3 Prevalence, and frequency of buying natural resources

Of the households that used resources, most households (60-100%) bought edible insects, firewood, and wild vegetables. However, 3-6% of the user households bought wild fruits and medicinal plants (Figure 4.5). There was no significant difference in the prevalence of user households buying all the natural resources except edible insects (X^2=23.77, p-value= 0.014, d.f=11) across villages (Table 4.15). All the user households across all villages except in Kildare A (80%) bought edible insects. There was no significant difference in the prevalence of buying natural resources across village types (Table 4.16). There was 20% of households which bought wild fruits more often (more than 4 times a month), while between 2-6% of the households buying wild fruits and edible insects more than 4 times a month (Figure 4.6). Fish and bushmeat were bought once every 6 weeks for all the households. The frequency of buying natural resources did not differ significantly across villages (Table 4.17) and village types (Table 4.18).

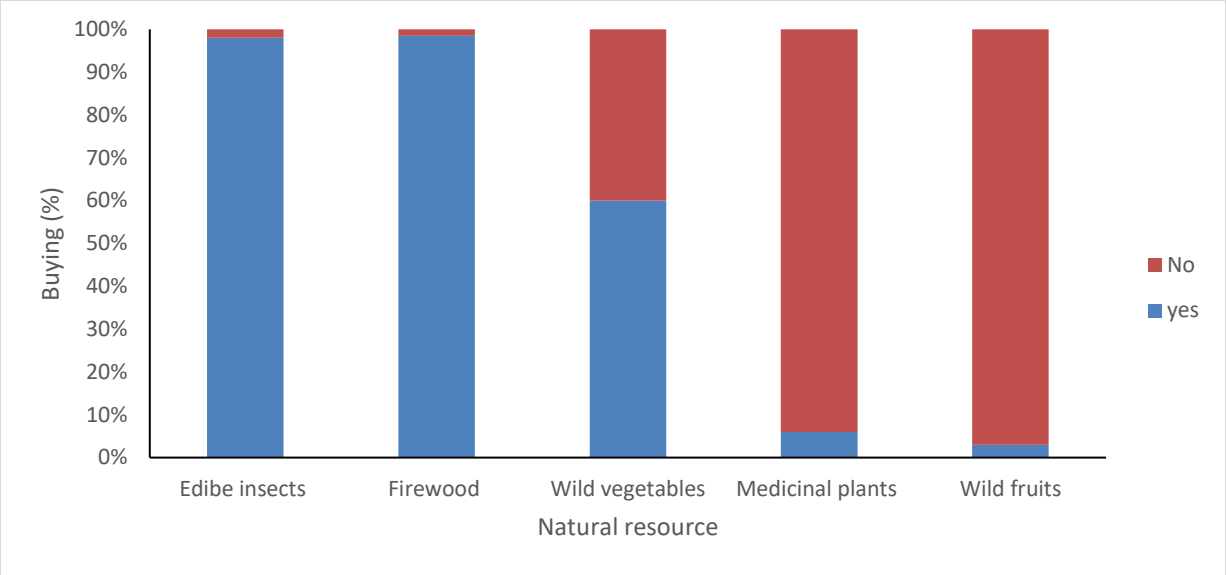


Figure 4.5 Pooled user households (%) which bought natural resources.

Table 4.15. Prevalence (%) of user households that bought natural resources across villages, with chi-square and p-value.

	Firewood	Wild fruits	Wild vegetables	Edible insects	Medicinal plants
Agincourt	95.65	0	100	100	11.76
Cunningmore B	100	12.50	NA	100	0
Huntington	100	0	NA	100	0
Ireagh A	100	5.26	NA	100	18.18
Ireagh B	100	0	0	100	0
Justicia A	91.67	7.69	NA	100	5.56
Justicia B	100	0	0	100	0
Kildare A	94.74	0	NA	80	7.69
Kildare B	100	0	100	100	0
Kildare C	100	0	NA	100	0
Lillydale	100	0	100	100	16.67
Xanthia	100	0	NA	100	0
d.f	11	11	4	11	11
Chi-squared	4.28	10.65	5	23.**77**	8.12
p-value	0.961	0.473	0.287	**0.014***	0.702

Table 4.16. Prevalence (%) of user households that bought natural resources across village types, with chi-square and p-value.

	Firewood	Wild fruits	Wild vegetables	Edible insects	Medicinal plants
CC	96.23	0	100	95.74	7.32
EC	97.92	7.04	100	100	6.00
RS	100	0	0	100	7.00
UC	100	0	50.00	100	7.14
d.f	3	3	3	3	3
Chi-squared	0.87	7.04	2.92	3.46	0.71
p-value	0.832	0.071	0.415	0.326	0.870

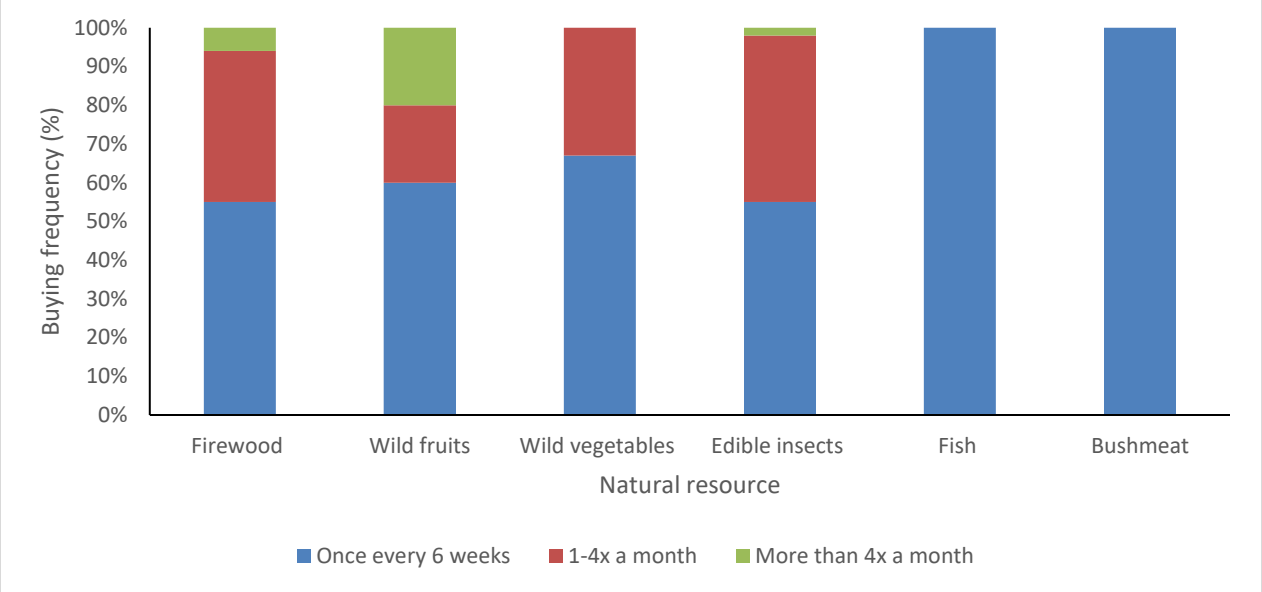


Figure 4.6. The pooled prevalence of buying frequency of natural resources.

Table 4.17. Frequency of natural resources bought (%) across villages, with results of chi-squared test.

Village	Frequency of use	Natural resource	
		Firewood	Edible insects
Agincourt	Less often (less than 1x per month)	40.91	61.90
	Often (between 1−4 x per month)	50.00	28.57
	More often (more than 4x per month)	9.09	9.52

Village	Frequency of use	Natural resource	
		Firewood	Edible insects
Cunningmore B	Less often	50.00	27.27
	Often	40.00	72.72
	More often	10.00	0
Huntington	Less often	75.00	45.45
	Often	25.00	54.54
	More often	0	0
Ireagh A	Less often	50.00	61.54
	Often	33.33	38.46
	More often	16.67	0
Ireagh B	Less often	100	100
	Often	0	0
	More often	0	0
Justicia A	Less often	36.36	42.11
	Often	54.55	57.89
	More often	9.09	0
Justicia B	Less often	100	33.33
	Often	0	67.67
	More often	0	0
Kildare A	Less often	61.11	62.50
	Often	38.89	37.50
	More often	0	0
Kildare B	Less often	64.29	75.00
	Often	28.57	25.00
	More often	7.14	0
Kildare C	Less often	0	50.00
	Often	100	50.00
	More often	0	0
Lillydale B	Less often	60.00	50.00
	Often	40.00	50.00
	More often	0	0
Xanthia	Less often	63.64	62.50
	Often	36.36	37.50
	More often	0	0
d.f		22	22
Chi-squared		20.26	23.48
p-value		0.567	0.375

Table 4.18. Frequency of natural resources bought (%) across village types, with results of chi-squared test.

Village	Frequency of use	Firewood	Edible insects
CC	Less often (less than 1x per month)	52.94	62.22
	Often (between 1−4 x per month)	43.14	33.33
	More often (more than 4x per month)	3.92	4.44
EC	Less often	51.06	49.02
	Often	38.3	50.98
	More often	10.64	0
RS	Less often	54.55	46.15
	Often	45.45	53.84
	More often	0	0
UC	Less often	87.50	62.50
	Often	12.50	37.50
	More often	0	0
d.f		6	6
Chi-squared		6.69	6.85
p-value		0.351	0.335

4.1.4 Selling and average pricing of natural resources

The user households that sold medicinal plants, reeds for mats and firewood were 1.02% and 0.89% respectively with no households that indicated to have sold wild fruits, wild vegetables and edible insects (Table 4.19). The average price per local unit of sale for the natural resources is reported (Table 4.20). There was no significant difference in the average prices of each natural resource across villages (Table 4.21). There was no significant difference in the average prices across village types for each of the resources (Table 4.22). In refugee settlements and underdeveloped communities, there were no prices recorded for fish and wild fruits for these village types.

Table 4.19. User household percentage which sold natural resources.

	Household selling (%)	
	Yes	No
Firewood	0.89	99.19
Wild fruits	0	100
Wild vegetables	0	100
Edible insects	0	100
Medicinal plants	1.02	98.98
Reed mats	1.02	98.98

Table 4.20. Average ±SE annual price in Rands per unit.

Resource	Units	Annual price
Firewood	Bakkie load (pick-up)	R422.56 ±11.97
Wild vegetables	Cup	R232.67±141.28
Fish	Individual fish	R5.33±23.33
Wild fruits	Cup	R51.0±14.35
Edible insects	Cup	R9.19±0.36

Table 4.21. Average price (±SE) of natural resources in Rand across villages, with results of ANOVA (firewood) and Kruskal Wallis test.

	Firewood	Wild fruits	Edible insects
Agincourt	440±27.80	NA	7.81±0.81
Cunningmore B	435±41.23	80.00±20.00	7.36±1.54
Huntington	425±65.19	NA	10.18±0.96
Ireagh A	458±37.64	NA	10.31±1.43
Ireagh B	475±65.19	NA	8.20±1.80
Justicia A	406±39.31	37.5±12.50	9.89±0.89
Justicia B	500±75.27	NA	8.00±3.61
Kildare A	364±30.73	NA	9.88±1.04
Kildare B	426±34.84	NA	10.63±1.69
Kildare C	510±75.27	NA	9.00±2.0
Lillydale B	420±58.30	NA	8.75±1.41
Xanthia	381±39.31	NA	9.56±0.89
d.f	11	1	11
F-value	0.85	3.60	10.11
p-value	0.59	0.165	0.520

Table 4.22. Average price (±SE) of natural resources in Rands across village types, with results of ANOVA (firewood) and Kruskal Wallis test.

	Firewood	Wild fruits	Edible insects	Fish
CC	400.39±18.10	NA	8.80±0.61	65±35
EC	431.70±18.86	51±14.35	9.57±0.57	NA
RS	466.36±38.98	NA	8.62±1.14	NA
UC	450.0±45.70	NA	95±1.02	NA
d.f	3	0	3	0
F-value	1.12	-	0.41	0.5
p-value	0.344	-	0.746	0.480

4.1.5 Ownership of items made from natural resources and livestock (cattle)

In the survey, between 50-97% of the households owned implements/utensils, grass hand brooms, twig hand brooms, and reed mats, while 46% of households owned fences or kraals made from poles, 19% owning poles for building from locally harvested poles, and 12% of households owning thatch grass for roofing (Figure 4.7).

There was no significant difference in the ownership of materials made from natural resources between villages for all the resources/materials, except materials used for fences and animal kraals (X^2 = 48.87, p-value <0.001, d.f =11). Households in Cunningmore B and Kildare C owned materials used for fencing/animal kraals (Table 4.23). The prevalence of ownership of cattle differed significantly between villages (X^2= 25.89, p= 0.007, d.f = 11), with 24% and 22% of households in Xanthia and Agincourt owning cattle (Table 4.24). There was a significant difference in the ownership of implements/utensils made from wood from the bush (X^2=12.49, p=0.006, d.f = 3) and buildings made from locally harvested poles (X^2=8.18, p=0.042, d.f = 3) across village types with most households in CC owning these materials (Table 4.25). In focus groups, reeds and utensils/implements were perceived to be owned by most participants in refugee

settlements and perceived to be not as much owned by participants in central communities, established communities, and underdeveloped communities (for utensils/implements). A participant in Xanthia (CC) explained, "*We are making a traditional grinder, traditional spoon, and traditional tray and also selling all those things to generate money*". In focus group discussions, a participant in Cunningmore B noted, "*We are using reeds to make a traditional kitchen and also for roofing the house*". In focus group discussions, sand and stones used for building houses were perceived to be used across all village types by participants but widely used in RS and UC (see Table 4.3). Sand/stones are one of the easily accessible materials needed and used to build which can be fetched from rivers. A participant in Ireagh B (UC) explained, "*We are selling soil and river sand to build houses*". Locals make use of wood from the bush to make utensils, carve furniture, and traditional materials that locals use or trade for their livelihoods.

There were 12.45% of households in the survey which owned cattle. A participant in Agincourt (CC) commented on cattle ownership, "*Even the livestock is too little, back in the day, people were having more cows and there were woodlands where they were feeding the livestock in*". Prevalence of ownership of cattle was lowest (≤2%) in Lillydale B, Kildare C, and Justicia B which fall under refugee settlements (RS). One of the participants in Kildare C (RS) explained, "*So since we do not have the border fence, our livestock are being stolen easily because the border fence used to surround every village, and it was not easy for thieves to drive the livestock out of the village*". The prevalence of ownership of cattle across village types differed significantly (X^2= 9.35, p= 0.025, d.f= 3). Most households in CC owned cattle with the least households in RS owning cattle (Table 4.26).

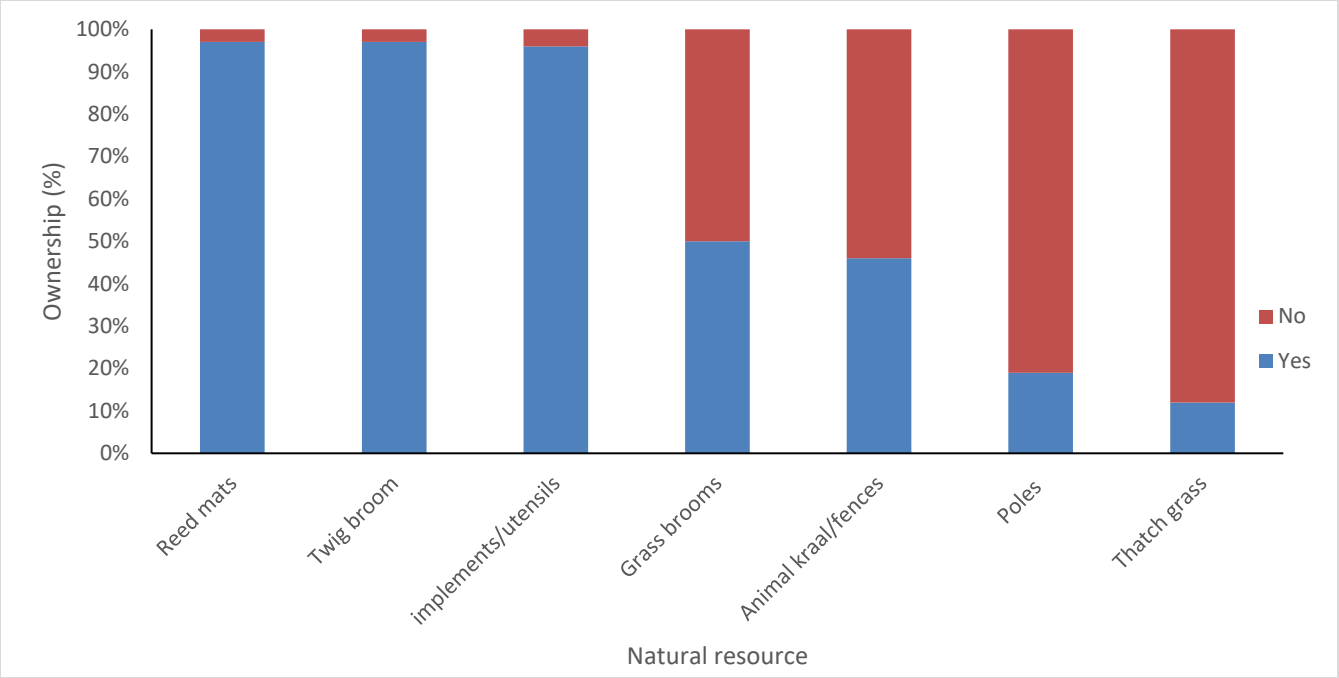


Figure 4.7 Household ownership/ possession percentage of materials or resources that were made from natural resources.

Table 4.23. Ownership of materials/ resources made from natural resources across villages, with results of chi-squared test.

	Thatch grass	Poles	Fences/Animal kraals	Reed mats	Twig brooms	Grass brooms	Implements /utensils
Agincourt	13.33	30.67	64	98.67	98.67	56	98.67
Cunningmore B	12.77	23.40	72.34	100	97.87	48.94	97.87
Huntington	21.21	12.12	36.36	87.88	93.94	48.48	87.88
Ireagh A	2.13	6.38	29.79	100	100	59.57	93.62
Ireagh B	9.52	9.52	33.33	95.24	95.24	57.14	85.71
Justicia A	18.31	12.68	40.85	97.18	95.77	43.66	97.18
Justicia B	25	25	50	91.67	100	50	91.67
Kildare A	10.20	14.29	22.45	95.92	97.96	34.69	95.92
Kildare B	6.25	18.75	41.67	93.75	93.75	47.92	97.92
Kildare C	21.43	21.43	71.43	100	100	64.29	92.86
Lillydale B	0	16.67	37.50	95.83	100	54.17	95.83
Xanthia	8	26	56	96	96	52	98
d.f	11	11	11	11	11	11	11
Chi-squared	19.19	19.19	48.87	14.59	7.90	10.49	15.06
p-value	0.058	0.058	**<0.001**	0.202	0.722	0.487	0.180

Table 4.24 Cattle-owning households (%) across villages.

Village	Cattle ownership (Yes)
Agincourt	24.00
Xanthia	22.45
Cunningmore B	17.02
Huntington	15.15
Ireagh A	10.64
Ireagh B	9.52
Justicia A	8.45
Kildare C	7.14
Kildare B	4.17
Lillydale B	4.17
Kildare A	4.08
Justicia B	0
d.f	11
Chi-squared	25.89
p-value	**0.007***

Table 4.25. Ownership of materials/ resources (%) made from natural resources across village types, with results of chi-squared test.

	Thatch grass	Poles	Animal kraal/fences	Reed mats	Twig hand broom	Grass hand broom	Implement/utensils
CC	10.92	24.71	50.0	97.13	97.70	48.85	97.71
EC	10.80	15.02	45.54	97.65	96.71	49.30	96.71
RS	12.0	20.0	50.0	96.0	100	56.0	94.0
UC	16.67	11.11	35.19	90.74	94.44	51.85	87.0
d.f	3	3	3	3	3	3	3
Chi-squared	1.57	8.18	3.96	6.44	3.23	0.926	12.49
p-value	0.666	**0.042***	0.266	0.092	0.358	0.819	**0.006***

*p-value<0.05

Table 4.26. Household cattle ownership (%) across village types.

Village type	Yes	No
CC	17.92	82.08
EC	9.86	90.14
RS	4.00	96
UC	12.96	87.04
d.f	3	

Chi-squared	9.35
p-value	**0.025***

*p-value<0.05

4.2 Environmental change perceptions

There was a high prevalence (%) of households which noted no change in the supply of all natural resources, except firewood (Figure 4.8). Some households noted a decrease in the supply of all natural resources, except for reeds for mats, medicinal plants, and bushmeat, with the greatest decrease in firewood perceived. There was a low prevalence (%) of households which noted an increase in the supply of natural resources. Most households said they did not know if there was any change in the supply of medicinal plants. In focus group discussions, trees, wild fruits, and medicinal plants were perceived and noted by respondents across village types to have decreased in availability.

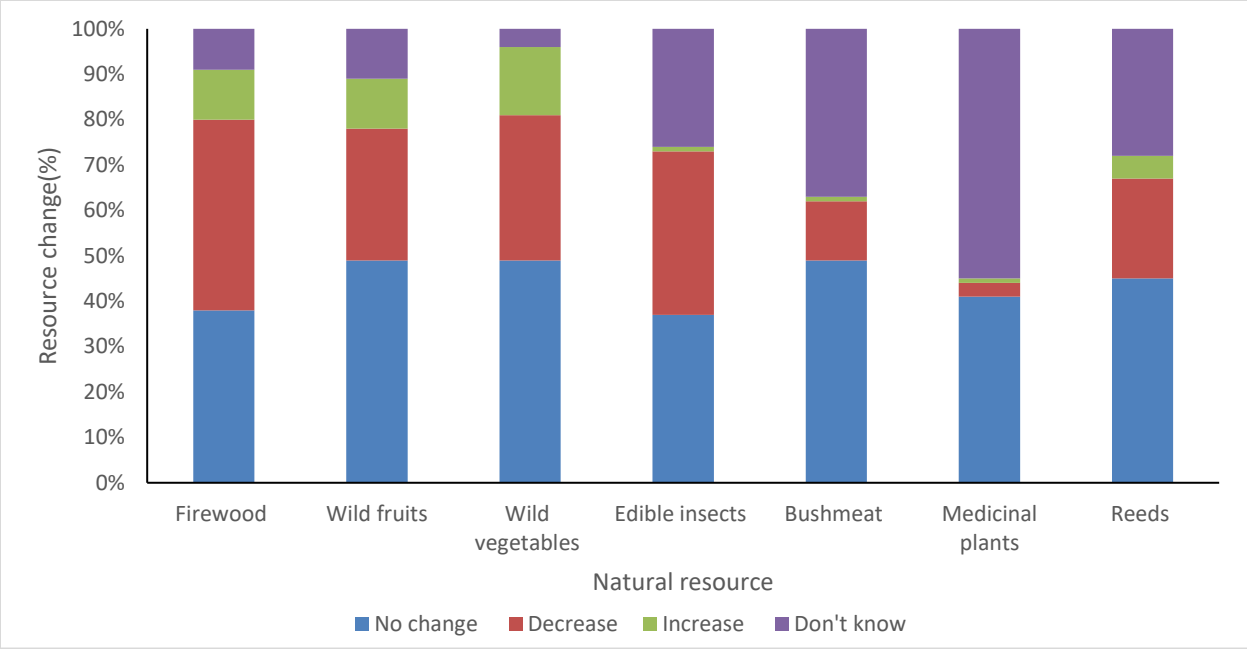


Figure 4.8 The pooled percentage of the change in the supply of natural resources change in sampled households.

There was a significant difference in the perceived change in the supply of edible insects, bushmeat, and medicinal plants across villages (Table 4.27). Despite the high prevalence of households stating no change in the supply of these resources, most households in Cunningmore B, Kildare C, and Ireagh B noted a decrease in the supply of edible insects, bushmeat, and medicinal plants, respectively. There was a significant difference in the change in the supply of resources for all the natural resources between village types, except firewood (Table 4.28).

For medicinal plants (X^2= 24.17, p=0.004, d.f = 9), a large proportion of respondents did not know if there was a change, and it was lowest in UC villages which also had the highest prevalence of households which indicated no change in the supply of the resource. Refugee settlements had the highest prevalence (8%) of respondents who indicated a decrease in the supply of medicinal plants. Some trees serve as medicinal plants have become scarce and decreased in availability due to

continual unsustainable ways of harvesting them. In focus groups, a respondent in Justicia B (RS) explained, "*We are struggling to find the roots that we suppose to make a traditional medicine on the bush because those trees that we used for traditional medicine, they are cutting it off and also remove it*". In focus groups, medicinal plants, reeds for mats, wild fruits, and edible insects were perceived by participants to have decreased in availability and supply across all the village types, except in underdeveloped communities (Table 4.29). For reed mats ($X^2 = 17.06$, $p=0.048$, d.f = 9), a large proportion of respondents indicated no change in the supply of reed mats, this was highest in underdeveloped communities. Refugee settlements (RS) had the highest prevalence (28%) of respondents who indicated a decrease, and established communities (EC) had the highest proportion of respondents (7%) who indicated an increase in the supply of reeds for mats. Grass and reeds are used for roofing and serve as cool houses during hot weather. Some people opt for or prefer other alternatives of roofing like corrugated iron and asbestos. Respondents in all village types perceived grass and reeds except in UC to have decreased in availability. A respondent in Xanthia (CC) explained, "*So since we no longer get grass, it means we no more roofing our house with grass, we do have houses that we roof with tiles, but we still need that hut houses, especially during summer it is very cool*". The decrease in the availability of some natural resources has led to households using alternatives, such as a participant who explained that they now use asbestos for roofing due to the decrease in availability of grass for roofing.

A large proportion of respondents indicated no change in the supply of wild fruits with the lowest proportion of RS (38%). Refugee settlements had high responses (36%) from respondents indicating a decrease, while established communities had a large proportion of respondents (14%) indicating an increase in the supply of wild fruits. A respondent in Kildare C (RS) explained, "*We do not have the monkey fruit, wild plums, jackal berries, monkey orange we were eating all of*

these when we grew up and you cannot find the wild barriers even if you can go to the bushes". There was a high proportion of respondents who indicated no change in the supply of edible insects in underdeveloped communities (57%), and a decrease in the supply of this resource in refugee settlements (46%). Edible insects were only mentioned in underdeveloped communities only in Ireagh B with a participant saying that "*mopane worms our children do not know it", which can be due to its scarcity*".

A large proportion of respondents indicated no change in the supply of wild vegetables with a low proportion of respondents (40%) in RS. There was a high percentage of respondents in RS who indicated a decrease (36%), while18% indicating an increase in the supply of wild vegetables. In focus group discussions, wild vegetables were perceived by participants in RS and UC to have decreased availability in their local environment. Some tree species' leaves are edible and are consumed as vegetables. In the survey, a large proportion of respondents indicated a decrease in the supply of bushmeat in RS (30%) and no change in the supply of wild vegetables in CC (56%). Wild animals were perceived by respondents to have decreased in availability in all village types, except RS with one of the participants in Xanthia (CC) saying, "*People were hunting wild animals but these days you can't find it in the bush*". The availability of wild animals was perceived by participants in the focus groups, to have been threatened due to the continual deforestation of the bush which serves as a habitat and refuge for wild animals from potential threats with one of the participants in Ireagh A (EC) saying, "*wild animals in the olden days we were able to see it in the woodlands but now is no longer available*".

Many factors cause the continual chopping of trees, including unemployment amongst others which has led many to use this natural resource to earn an income using trading the resource to support their families, with some using it as a main fuel source for cooking. In focus groups, trees

were noted across all the village types to have decreased in availability. A respondent in Ireagh A (EC) explained, "*We are losing the trees just because of the high price of electricity I do not think that people would cut the trees if the price of the electricity was low*". Another participant in Ireagh A (EC) also mentioned that "*the trees more especially when you need the traditional medication there is a shortage of trees meanwhile the trees were there but now you can only get the traditional medication at Bushbuckridge when you climb the mountain peak*". A respondent in Lillydale B (RS) explained, "*They are cutting trees that have fruits that we supposed to eat, they are cutting all the wild fruits trees. I do not think we are cutting the trees for the reason of not having money to buy electricity not just because we are not following our traditional law, and we do not know the importance of natural resources*".

Across all the villages and village types, participants noted and perceived a scarcity in water supply due to lack of rain and changing rainfall season with some days becoming hotter than usual. A participant in Cunningmore B said, "*There is a shortage of rain, and it is very hot these days*" with another participant in Ireagh B saying, "*The rainy season has changed, we normally expected rain around September, e.g., last year the rain was raining towards December, so I do not know why the rainy season changed*". Rain was perceived and noted by participants as one of the reasons why there has been a decrease in the availability and impact of trees. A participant in Justicia A said, "*There are trees which are unavailable due to lack and shortage of rain*".

Table 4.27. Change in the supply of natural resources (%) across the village, with results of chi-squared test.

Natural resource	Village	No change	Decrease	Increase	Don't know	d.f	Chi-squared	p-value
Firewood	Agincourt	38.67	45.33	6.67	9.33	33	26.81	0.768
	Cunningmore B	21.28	51.06	10.64	17.02			
	Huntington	42.42	39.39	15.15	3.03			

Natural resource	Village	No change	Decrease	Increase	Don't know	d.f	Chi-squared	p-value
	Ireagh A	42.55	34.04	12.77	10.64			
	Ireagh B	52.38	38.10	9.52	0			
	Justicia A	40.85	36.61	12.68	9.86			
	Justicia B	33.33	41.67	8.33	16.67			
	Kildare A	46.94	40.82	6.12	6.12			
	Kildare B	27.66	48.94	12.77	10.64			
	Kildare C	21.42	50	14.29	14.29			
	Lillydale B	41.67	45.83	4.17	8.33			
	Xanthia	44	36	14	6			
Wild fruits	Agincourt	54.67	26.67	9.33	9.33	33	28.47	0.692
	Cunningmore B	36.17	31.91	14.89	17.02			
	Huntington	57.58	27.27	15.15	0			
	Ireagh A	48.94	27.66	14.89	8.51			
	Ireagh B	52.38	33.33	9.52	4.76			
	Justicia A	45.07	25.35	16.90	12.67			
	Justicia B	41.67	25	16.67	16.67			
	Kildare A	57.14	28.57	4.08	10.20			
	Kildare B	44.68	34.04	8.51	12.77			
	Kildare C	21.43	42.86	14.29	21.43			
	Lillydale B	45.83	37.5	4.17	12.5			
	Xanthia	60	24	6	10			
Wild vegetables	Agincourt	48	34.67	16	1.33	33	42.19	0.131
	Cunningmore B	46.81	25.53	21.28	6.38			
	Huntington	48.48	42.42	9.09	0			
	Ireagh A	57.45	31.91	10.64	0			
	Ireagh B	61.90	23.81	14.29	0			
	Justicia A	39.44	35.21	16.90	8.45			
	Justicia B	50	33.33	16.67	0			
	Kildare A	59.18	28.57	12.24	0			
	Kildare B	42.55	31.91	12.77	12.77			
	Kildare C	28.57	35.71	21.43	14.29			
	Lillydale B	41.67	37.50	16.67	4.17			
	Xanthia	60	24	16	0			
Edible insects	Agincourt	42.67	29.33	1.33	26.67	33	53.38	**0.014***
	Cunningmore B	25.53	59.57	0	14.89			
	Huntington	54.55	33.33	3.03	9.09			
	Ireagh A	34.04	38.30	0	27.66			
	Ireagh B	61.90	28.57	0	9.52			

Natural resource	Village	No change	Decrease	Increase	Don't know	d.f	Chi-squared	p-value
	Justicia A	49.30	26.76	0	23.94			
	Justicia B	33.33	50	0	16.67			
	Kildare A	34.69	28.57	2.04	34.69			
	Kildare B	23.40	36.17	0	40.43			
	Kildare C	14.29	50	0	35.71			
	Lillydale B	20.83	41.67	0	37.50			
	Xanthia	38	38	0	24			
Bushmeat	Agincourt	52	5.33	0	42.67	33	55.30	**0.009***
	Cunningmore B	55.32	8.51	0	36.17			
	Huntington	48.48	15.15	3.03	33.33			
	Ireagh A	36.17	21.28	0	42.55			
	Ireagh B	57.14	14.29	0	28.57			
	Justicia A	57.75	9.86	4.23	28.17			
	Justicia B	41.67	25	0	33.33			
	Kildare A	61.22	8.16	0	30.61			
	Kildare B	36.17	10.64	0	53.19			
	Kildare C	14.29	35.71	0	50			
	Lillydale B	37.50	29.17	0	33.33			
	Xanthia	56	16	0	28			
Medicinal plants	Agincourt	48	0	0	52	33	47.85	**0.046***
	Cunningmore B	27.66	2.13	2.13	68.09			
	Huntington	48.48	0	3.03	48.48			
	Ireagh A	36.17	4.26	0	59.57			
	Ireagh B	71.42	19.52	0	19.05			
	Justicia A	39.43	2.81	1.41	56.34			
	Justicia B	41.67	8.33	0	50			
	Kildare A	38.76	2.04	0	59.18			
	Kildare B	29.17	4.17	0	66.67			
	Kildare C	14.29	14.29	0	71.43			
	Lillydale B	45.83	4.17	0	50			
	Xanthia	52	0	0	48			
Reed mats	Agincourt	46.67	22.67	2.67	28	33	42.86	0.117
	Cunningmore B	29.79	25.53	10.64	34.04			
	Huntington	51.52	21.21	9.09	18.18			
	Ireagh A	38.30	25.53	2.13	34.04			
	Ireagh B	71.43	19.05	0	9.52			
	Justicia A	45.07	19.72	8.45	26.76			
	Justicia B	58.33	25	0	16.67			
	Kildare A	42.86	20.41	0	36.73			

Natural resource	Village	No change	Decrease	Increase	Don't know	d.f	Chi-squared	p-value
	Kildare B	42.55	17.02	6.38	34.04			
	Kildare C	14.29	35.71	14.29	35.71			
	Lillydale B	62.5	25	0	12.5			
	Xanthia	54	16	2	28			

Table 4.28. Change in the supply of natural resources (%) across village types, with results of chi-squared test.

Natural resource	Village type	No change	Decrease	Increase	Don't know	d.f	Chi-squared	p-value
Medicinal plants	CC	46.55	0.57	0	52.87	9	24.17	**0.004***
	EC	33.80	3.28	0.94	61.97			
	RS	36	8	0	56			
	UC	57.41	3.70	1.85	37.04			
Reeds mats	CC	47.70	20.11	1.72	30.46	9	17.06	**0.048***
	EC	39.62	21.70	7.08	31.60			
	RS	48	28	4	20			
	UC	59.26	20.37	5.56	14.81			
Firewood	CC	42.52	41.38	8.62	7.47	9	10.84	0.287
	EC	33.96	41.98	12.26	11.79			
	RS	34	46	8	12			
	UC	46.30	38.89	12.96	1.85			
Wild fruits	CC	56.90	26.43	6.90	9.77	9	17.25	**0.045***
	EC	43.87	29.25	14.15	12.74			
	RS	38	36	10	16			
	UC	55.56	29.63	12.96	1.85			
Wild vegetables	CC	54.60	29.89	14.94	0.57	9	17.34	**0.044***
	EC	45.75	31.60	15.56	7.08			
	RS	40	36	18	6			
	UC	53.70	35.19	11.11	0			
Edible insects	CC	39.08	31.61	1.15	28.16	9	23.11	**0.006***
	EC	34.91	38.68	0	26.42			
	RS	22	46	0	32			
	UC	57.41	31.48	1.85	9.26			
Bushmeat	CC	55.75	9.20	0	35.06	9	21.92	**0.009***
	EC	47.64	12.26	1.42	38.68			
	RS	32	30	0	38			
	UC	51.85	14.81	1.85	31.48			

*$p<0.05$

Table 4.29. The perception of the availability of natural resources across village types.

Natural resources that decreased widely in availability			
CC	EC	RS	UC
Trees	Trees	Trees	Trees
Wild fruits	Wild fruits	Wild fruits	
Wild vegetables	Medicinal plants	Medicinal plants	
Less common or unique natural resources that decreased in availability			
Medicinal plants	Wild animals	Reeds	Wild animals
Reeds	Reeds/grass	Wild vegetables	Wild vegetables
			Edible insects

4.3 Relationship between village types, natural resources, and perception of change in resource availability

Established communities correlated with a higher number of resources perceived as decreasing, with central communities associated with higher ownership of cattle (Figure 4.9). Underdeveloped communities were associated with a higher number of resources used/owned, higher number of resources used often (more than 4 times a month), a higher number of resources sold, and buying firewood. Refugee settlements correlated with a higher number of resources/owned, a higher number of resources used often, a higher number of resources sold, and buying firewood, with a particularly strong association with a number and frequent use of resources.

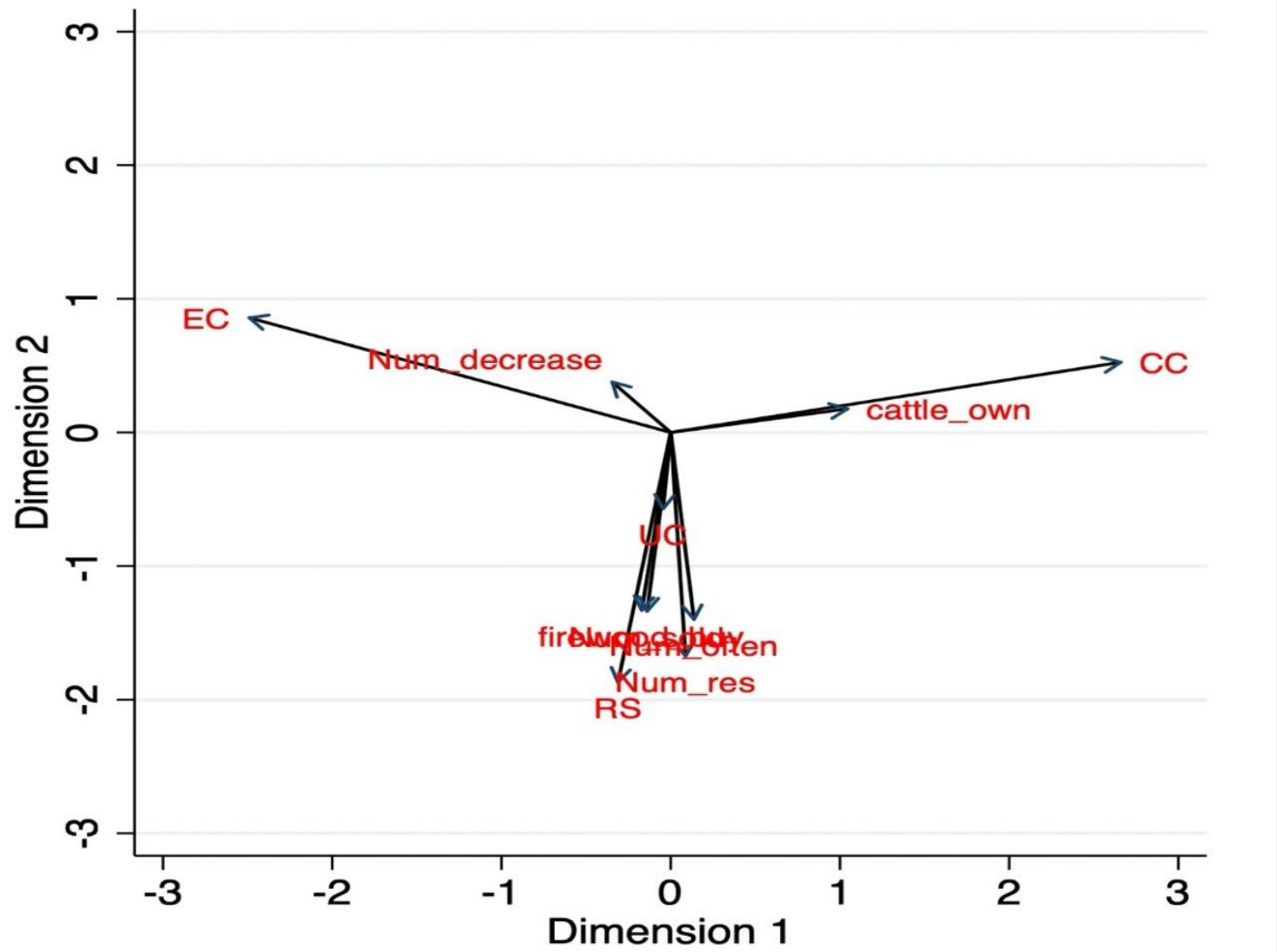


Figure 4.9 Ordination biplot of Principal Component Analysis (PCA) with components (dimensions) 1 and 2 with village types as vector variables. Factors were total number of resources used/owned (Num_res), total of resources used more than 4 times a month (Num_often), total of resources sold (Num_sold), and total number of resources perceived to be decreasing (Num_decrease), cattle ownership (cattle_own), and purchased firewood (firewood_buy).

5. DISCUSSION

5.1 Natural resource use

5.1.1 Domestic use and ownership of natural resources and products

The first aspect of resource use that was compared across villages and village types was the prevalence and frequency of use of consumable natural resources. Prevalence and frequency of use were expected to be higher in smaller, less developed, more remote villages. Wild vegetables and firewood were widely used by most households, followed by wild fruits, edible insects, and medicinal plants. Firewood, wild fruits, and wild vegetables were mostly used more than 4 times a month by user households, while fish and bushmeat were the least used natural resources, being used less than 1x per month.

The levels of use agree with other studies that were done in rural communities across South Africa (Dovie et al., 2002; Shackleton et al., 2002; Twine et al., 2003a; Shackleton and Shackleton, 2004; Falayi et al., 2019; Martins and Shackleton, 2019; Herd-Hoare and Shackleton, 2022). However, this study found no significant difference in the prevalence of use for any of the natural resources across villages, which would explain no significant difference in the prevalence of use found across village types for all the natural resources. No significant difference was found in the frequency of use for any of the natural resources across villages, except wild fruits, with households in Kildare A (central communities) using the resource more than 4 times a month. Kildare A falls within a rainfall zone (550-700mm per year) (Seabi, 2017) in which a high number of wild fruit species were used (Shackleton et al., 2000b). Shackleton et al.2000b reported households in Bushbuckridge using drying and storing wild fruits for consumption during seasons when they are scarce. With Kildare A being a central village and characterized by a large population, there will

be high use and trade of wild fruits which may explain the frequent use of wild fruits in this village. However, there was no significant difference in frequency of use across village types. In focus group discussions, participants in refugee settlements mentioned using firewood, wild fruits, medicinal plants, and sand, while participants in established settlements mentioned using firewood, wild fruits, bushmeat, and medicinal plants more often. Poverty and unemployment play a major role in the utilization, reliance, and frequency of use of natural resources. The unemployment rate in the Mpumalanga Province stands at 36.2% as of the first quarter of 2024 (Stats SA, 2024). The Bushbuckridge Local Municipality (2024) reported a 63% poverty rate and 53% unemployment rate as of 2022 in their Integrated Development Plan report which can be associated with fewer employment opportunities, hence, the use of natural resources for their livelihoods. For this reason, it can then be explained that no significant difference was found in the use and frequency of use of natural resources in villages and village types. Another reason could be due to the continual use of and reliance on natural resources across rural communities, regardless of village context, due to prevailing levels of poverty. This is particularly so for commonly used resources such as firewood. Ayodeji (2020) reported that 98% of the sampled households in the Bushbuckridge Local Municipality indicated to using fuelwood as a form of energy. Two-thirds of the households in Bushbuckridge were connected to electricity in the early 2000s (Madubansi and Shackleton, 2007). Despite the electrification of many households in rural Bushbuckridge, various studies documented a high prevalence of use of fuelwood in many of the villages in the region. In a study conducted by Madubansi and Shackleton (2007), household fuelwood use increased by 3% from 93% in 1991 to 2002 in one of the villages (Xanthia) which is part of this study. In a study done by Falayi et al., (2019), over 70% of the interviewed households said that they could not afford to pay for electricity-related costs, hence the widespread

use of firewood over the villages. This may explain the lack of difference in use of fuelwood between villages even though some of the study villages and village types received electricity much earlier than others. However, in a study conducted by Shackleton (2020) in two villages in Limpopo Province, there was a significant difference between the villages in the prevalence of use of wild vegetables, firewood, edible insects, and wild fruits. Paumgarten and Shackleton (2009) conducted a study in two villages, one in Bushbuckridge and the other in Nkonkobe Municipality in the Eastern Cape, and they reported a significant difference in both the villages for wild vegetables, wooden utensils, bushmeat, and fish. The difference between these studies and this study is that one of the villages studied by Shackleton (2020) lost its communal land to open-cast mining which had an impact on the availability of natural resources. The villages in the study conducted by Paumgarten and Shackleton (2009) are in two different provinces with different socio-economic factors and vegetation types, while this study was in the same location (same municipality) with the same vegetation types, and this could explain no significance found in the use for most of the natural resources.

In the ownership of products or materials made from natural resources, most households owned reeds for mats, hand twig brooms, utensils/implements, and hand grass brooms, while 19% and 12% of households owning poles for building and thatch grass respectively. These patterns of natural product ownership are comparable with those reported in other South African studies (Dovie et al., 2002; Shackleton et al., 2002; Twine et al., 2003b; Falayi et al., 2019; Shackleton, 2020; Herd-Hoare and Shackleton, 2022). This trend shows the continued use of and reliance on natural resources across South Africa.

There was no clear difference in the ownership of products/ materials made from natural resources across villages, except for poles used for animal kraal/fencing, with most households in

Cunningmore B (established community) owning poles for animal kraal/fencing and this was the third most village where the households owned cattle. Products made from natural resources are essential for everyday domestic uses which are used across all villages which could be a reason for no difference across villages. Comparing village types, poles used for building were used by most households in central communities (CC) and least used by underdeveloped communities (UC), with more households in refugee settlements (RS) owning more poles than households in established communities (EC), and vice versa for utensils/implements ownership. These resources (poles and implements/utensils) were more used by the CC village type, which is the better serviced, more advantaged, or wealthy of the four village types. Twine et al. (2003a) conducted a study in Limpopo across three villages, which were presented as; “small, remote and poorly serviced”, “large and better serviced”, and “intermediate” between the two villages, and most households in the “large and better serviced” village used wooden utensils and poles more than other villages.

The reason for most households owning materials/products from natural resources in CC is the better accessibility to economic opportunities and thus the advantage of acquiring these resources/materials, usually via trade. Another reason could be that accessibility to opportunities in the CC villages means that tools can be purchased to harvest resources, for example, poles. Central communities (CC) have a large population. A large population increases the demand for housing. Thus, more housing poles are needed to supply the needs of a growing population. The ownership of poles in UC was significantly lower than other village types, which can be associated with a small population which probably means significant demand for poles will be lower, and access to building materials other than poles can contribute to low ownership of poles in underdeveloped communities. The higher household ownership of poles for building in RS than

in EC villages was not expected since EC villages have a large population and are better better-serviced than RS. The village typology for this study was classified in the early 2000s (Hargreaves, 2000). There have been socio-economic changes over the years which could be the reason for the results found in the ownership of materials made from natural resources. From the early 2000s to date, there have been services provided in all the village types and as reported by Madubansi and Shackleton (2007), about two-thirds of households in Bushbuckridge were connected to electricity in the early 2000s which was after the classification. A recent study done by Ragie et al., (2020) reported a high (84%) prevalence of households that relied on off-farm income as their source of cash income. This shows that there has been a change in villages and village types and a change in various strategies besides natural resources that households in Bushbuckridge have adopted for their livelihoods.

Another aspect of resource use compared between village types was the quantities of resources consumed by households, which were expected to be high in villages that are better-serviced and have a large population. Several studies across rural South Africa have quantified the annual consumption of natural resources, with Twine et al., (2003a), Shackleton (2020), Shackleton and Shackleton (2006), and Falayi et al., (2019) for the Eastern Cape Province, Dovie et al., (2002) in Mpumalanga for the Bushbuckridge area, and a review study done by Shackleton and Shackleton (2004). In all these studies, the annual quantities of firewood used (3212-6599 kg) per household were higher than those of this study (1679 kg). Past and current management of communal lands has and continues to impact the availability of natural resources (Mani et al., 2021). The increase in population has meant clearing the natural environment to meet social needs but this has negative influence in these communal lands. Findlay and Twine (2018) noted the continual use and collection of live wood. In focus group discussions, some participants also noted the building of

more houses which has had an impact on vegetation cover and availability of some natural resources, and this may explain the quantity of fuelwood found in this study than earlier studies. The annual consumption quantities of fish used per household for this study (90.55 kg) were within the consumption range (10-100 kg) of the study conducted by Shackleton (2020). Annual consumption of wild fruits per household was higher than in this study (33 buckets) in all the studies, except a study conducted by Dovie et al., (2002) (31 Litres). Annual consumption of wild vegetables per household was higher (58.2 kg) and (42 kg) in a review study by Shackleton and Shackleton (2003) as well as in a study done by Shackleton (2020) respectively compared to this study (32.44 buckets). The impacts on the supply of natural resources due to mismanagement and unsustainable use of the common pool resources as Mani et al (2021) emphasized could be the reason for the decrease in wild vegetables and edible insects noted in this study compared to other studies. Dovie et al., (2002), Twine et al., (2003a), and Shackleton (2020) reported the annual consumption quantities of edible insects per household and Twine et al., (2003a) reported a higher (72.2 Litres) annual consumption quantity for the resource than this study (4.4 Litres).

In this study, there was no clear difference in the average annual quantities of the natural resources used across villages, except firewood, which was significantly higher in Kildare B (EC), and wild fruits which were significantly higher in Ireagh B (UC), and no significant difference was found across village types. Even though Shackleton and De Vos (2022) state that the amount of fuelwood that can be consumed in households depends on many factors, which include the size of the household, where the household is located, and if it is located where it has access to the resource, village context had little effect on the amount of fuelwood used in this study. However, Madubansi and Shackleton (2007) reported that two-thirds of households in the Bushbuckridge were connected to electricity which could impact the fuelwood used across villages. Ragie et al. (2020)

reported that 84% of households in the Bushbuckridge had an income which means that households are not solely relying on natural resources but have alternatives for their livelihoods which could impact natural resource annual consumption of across villages and village types. Another reason for no clear difference being found in the annual quantities of natural resources across village types can be that, although the availability of natural resources used and consumed can vary through seasons and locations, the local communities will tend to adopt the same patterns and behaviours of consumption to some extent to meet their basic needs, regardless of village context.

5.1.2 Natural resource acquisition

5.1.2.1 Prevalence and frequency of natural resource collection

Some households acquire their natural resources by collecting them from the local environment, while others buy them, and others doing both. The frequency of collecting was expected to be higher in poorly-serviced and remote village types. Most user households indicated collecting all the resources except for edible insects. Edible insects, fish, and bushmeat were collected less often than one time per month by most households. Nevertheless, households collected all other resources, except fish, more than 4 times a month. Some natural resources like wild fruits, thatching grass, and some medicinal plant parts are only available at certain times and seasons of the year, while others such as firewood are available throughout the year (Andrew et al., 2003). Wild vegetables, medicinal plants, wild fruits, bushmeat, fish, and firewood were collected by most households, with fewer households in the study area collecting edible insects due to seasonality. In a study conducted by Twine et al. (2003b), there was a similar trend of collection of natural resources with edible insects being the least collected of the natural resources. Hunter et

al. (2007) reported the same proportion of the surveyed households in the AHDSS study area collecting and harvesting edible insects.

There was no clear difference in the prevalence of user household collection of resources across villages and village types. Poverty and means of survival for their livelihoods in these rural communities could be a reason for no clear differences in the user collection of natural resources across the villages and the village types. A study conducted by Findlay and Twine (2018) noted village leaders who perceived that the continual use and collection of live wood, even though it is not allowed by the authorities to harvest, was due to poverty in the local community. In many instances, despite fines in place if found harvesting certain natural resources or harvesting without permission, it has not stopped collectors from harvesting natural resources (Kepe, 2007). Poverty is a major driver of natural resource dependance. Thus, the continual harvesting despite management and control in the common pool resources, which may explain no significant difference found across villages and village types.

5.1.2.2 Prevalence and frequency of buying natural resources

The prevalence and frequency of buying natural resources were expected to be higher in better-serviced village types. There was a high prevalence of user households that bought edible insects, firewood, and wild vegetables, with fewer user households having bought medicinal plants and wild fruits. The high prevalence of edible insects bought per household could be due to their affordability. Edible insects contain great amounts of nutrients like iron and proteins, and for some, their abundance is determined by the amount of rainfall and availability of vegetation they feed on (Cloutier, 2015). South Africa has experienced a decrease in annual rainfall over the years (MacKellar et al., 2014). The decrease in availability of these insects and when in season could

mean a high prevalence of people or households buying the resource. The same could be deduced about wild vegetables, that scarcity due to low rainfall which could explain the high prevalence of user households buying when in season. Even though there has been an increase in households connected to electricity, and for some using fuelwood as an alternative can help decrease the cost that comes with electricity. However, the impact on the natural environment has increased the distance in which fuelwood needs to be fetched, and some households who have no people to go far in collecting the resource or those who would invest in buying rather than labouring to harvest the resource (Wessels et al., 2013). This could explain the high prevalence of user households buying the resource.

Few user households buying medicinal plants could be because of clinics provided in the Municipality which people go to instead of medicinal plants. The reason for few user households buying wild fruits could be that households dry and store wild fruits as documented by Shackleton et al (2000b), and consumed by households instead of buying this resource. In studies done by Paumgarten and Shackleton (2009) and Ragie et al. (2020) in the Bushbuckridge areas, 94% and 49% of households bought natural resources, respectively. The prevalence of buying certain resources varies greatly between studies conducted in different parts of South Africa. For example, the prevalence of the purchasing of edible insects ranges from 0% of households in selected villages in Limpopo and KwaZulu-Natal provinces (Shackleton and Shackleton, 2004; Shackleton, 2020) to 76% of households in another Limpopo village (Shackleton and Shackleton, 2004). The prevalence of purchasing fuelwood reported in the literature ranges from 17% to 70% (Shackleton and Shackleton, 2004; Shackleton, 2020). This shows that households in the study area continue to rely on natural resources and the importance of the natural environment to the Bushbuckridge Local Municipality.

However, there was no clear difference in the prevalence of purchasing natural resources in user households across villages and village types in this study. There was also no clear difference in the frequency of buying natural resources by the user households. The development of shopping centres and road infrastructures probably increased access to certain products other than natural resources, since the classification of village types by Hargreaves (2000), reduced the difference across village types. In well-developed communities with better access to opportunities such as jobs, households can buy resources rather than collect resources for their consumption (Shackleton et al., 2001; Shackleton et al., 2002). Shackleton et al., (2002) conducted a study in rural Limpopo and KwaZulu-Natal (KZN) provinces, and the village in KZN which was considered poor had more households that collected resources, whilst other villages in the Limpopo province, which were considered wealthy, most households bought natural resources for consumption. Paumgarten and Shackleton (2009) also noted the same trend as Shackleton et al., (2002), where more wealthy households bought natural resources than poor households. Nevertheless, this expected difference in the purchasing of resources between villages was not observed in this study. The Bushbuckridge Local Municipality (2024) reported a 53% unemployment rate. This high unemployment rate means few have excess to employment opportunities, and even in villages and village types that are considered better-serviced in this study, there is significant unemployment that when compared to the less privileged villages and village types could be negligible.

5.1.3 Selling and average pricing of natural resources

The prevalence and frequency of selling natural resources were expected to be higher in poorly-serviced and remote village types. There were not as many households that were noted to be selling resources in the survey of this study. There were only three natural resources (firewood, medicinal

plants, and reeds for mats) that were sold by households. Households responded to selling these three natural resources, while no households indicated selling the other resources. In the study conducted by Ragie et al. (2020), 8.5% of the user households sold natural resources with those that sold natural resources generating a very insignificant income. There was a low prevalence of households that sold natural resources in Limpopo: 6% sold medicinal plants and less than 2% for other resources (Shakleton, (2020), Shackleton et al., (2002) reported less than 5% of households selling firewood, medicinal plants, and reeds. In a review study conducted by Shackleton and Shackleton, (2004), less than 5% of the households in two villages in Limpopo sold natural resources in an ad hoc response to need (Paumgarten and Shackleton, 2009). State grant income in South Africa allows for households across the nation to have a means of cash income every month, which can allow for adventuring in other trading, other than natural resource trade. Ragie et al. (2020), in their paper on the AHDSS study site, reported about 99% of households received cash incomes from off-farm activities, with 84% of the households receiving state grants and 73% of the households receiving cash incomes from employment. There is income generation from selling resources, though negligible, but the expected difference across village types was not observed in this study. There were only three natural resources (firewood, medicinal plants, and reeds for mats) that were sold by households in this study. Unwillingness to pay high prices for local natural resources by consumers due to various reasons, including the of alternatives for instance, brings about low cash returns because of low cash sales (Mahonya et al., 2019).

Commercialization of natural resources tends to benefit poor households more than their wealthy counterparts (Shackleton and Shackleton, 2006; Paumgarten and Shackleton 2009). Due to limited data on annual cash income made from selling each of the natural resources, this study made use of the annual prices for each of the resources, which gives a sense of how much income different

village types of communities earn from trading in these natural resources by looking at the prices for each resource. However, there was no difference in the annual prices in Rands per unit across villages and village types for all the natural resources. There is probably not much difference in poverty levels across villages that enable sellers to increase their prices in some villages. Willingness to pay for natural resources is relative to the abundance of local resources and the availability of alternatives, and prices are likely to be the same across villages. Some factors influence the pricing of natural resources, and these include, the type of natural resource sold, the amount of time taken to collect a resource, stock prices, and transportation of the resources (Mugido and Shackleton, 2018). Pricing of these resources may vary throughout the year due to the demand and the availability of these resources. Ragie (2016) in her thesis reported a mean of R12000 per annum was generated by the households that sold natural resources, which shows that there is a reasonable amount of cash generated from natural resources that goes a long way for poor communities that rely on the cash income generated from selling natural resources. The lack of alternative cash incomes for poor communities and households makes them benefit more from the commercialization of natural resources than their wealthier counterparts. Given the limited annual cash income data, a more intense study that looks at informal trade in these communities, keeping track of natural resources sold and how much is sold per year could yield additional insights.

5.1.4 Livestock (cattle) ownership

Livestock ownership is attributed to a wide range of usages and these usages account for incomes and savings generated (Shackleton et al., 2005). Livestock ownership not only helps in generating cash incomes, but it also helps in many cultural rituals (like bride price payment) in many rural areas (Andrews et al., 2003). Ownership of cattle was expected to be high in better-serviced village

types. There was a significant difference in the household ownership of cattle across villages and village types. Most households in Agincourt and Xanthia (central communities) owned cattle, with no households in Justicia B (refugee settlements) owning cattle. In the ownership of cattle across village types, most households in central communities owned cattle, followed by underdeveloped communities, followed by established settlements, and households in refugee settlements owned cattle the least. Shackleton et al., (2001) made note of wealthy households that received high off-farm income, advantaged communities, to be owning more herds of cattle than their poor counterparts who owned goods (i.e., milk, dung, etc.) provided by livestock. Communities with off-farm incomes and wages are less reliant on livestock (Shackleton et al., 2005). Paumgarten and Shackleton (2009) conducted a study across two villages in the Bushbuckridge and Nkonkobe Municipality in the Eastern Cape and found that the households in both communities which were considered wealthy owned more cattle than their poor counterparts. In a study conducted by Twine et al., (2003a), households that were wealthy in livestock consumed more natural resources than their poor counterparts. However, high ownership of cattle by wealthy or better-serviced villages or village types does not always mean a high consumption of natural resources, because Twine et al., (2003a) also reported a high consumption of natural resources from households with higher income. High consumption of natural resources does not equate to high reliance on these resources. This means that even though there was high ownership of cattle in better-serviced villages and village types, there is no evidence from this study showing significant high use of natural resources, thus, high ownership of cattle does not necessarily mean high use of natural resources.

5.2 Environmental change perceptions

The second objective of the study compared environmental perception between village types. The focus was on perceptions of change in the availability of natural resources in the surrounding

communal lands. Exposure to cash incomes in the economy or shift to commercial activities influences how people in the rural setting perceive the value of the resources provided by the environment and how they will harvest the resources (Thondhlana and Shackleton, 2015). Valuing natural resources by an individual, a group of people, and a community who have alternative cash income, and are not fully reliant on the direct provision from the environment will be different from those who have no alternatives for their livelihoods but products from the environment. I expected the greatest number of respondents to perceive a decrease in the supply of natural resources in underdeveloped communities (UC) and refugee settlements (RS) and the least number of respondents in central communities (CC) and established communities.

There was a difference in the change of supply of all the natural resources, except firewood. In the change in the availability and supply of natural resources responses where respondents noted a decrease in the supply of natural resources, there was greatest number of respondents noted a decrease in the supply of natural resources in refugee settlements (RS), followed by underdeveloped communities (UC), and there were least respondents who perceived a decrease in the supply of natural resources in established communities (EC) and central communities (CC). Unsustainable resource harvesting and land degradation are possible contributing factors that could have led to the decrease in natural resources which most respondents noted. The population increase has meant environmental degradation in communal lands and deforestation to accommodate the growing population. This affects the trees used for firewood, edible insects that feed on vegetation, wild vegetables, wild fruits, and every natural resource from the environment. Climate change with the effects of degradation in communal lands is likely to be felt and seen by residents. The Wits Agincourt Research Unit has contributed to survey studies in the villages in the Bushbuckridge Municipality, and together environmental awareness programs could

contribute to the awareness of the environment and thus, the perception of a decrease in the supply of natural resources.

Poor communities are more reliant on natural resources than their rich, more advantaged counterparts. The continual use due to higher reliance and fewer alternatives for their livelihood could explain the greatest decrease in the supply of natural resources in refugee settlements and underdeveloped communities. Respondents in central communities (CC) perceived the decrease in the supply of all natural resources except edible insects the least. Shackleton (2020) and Dovie et al., (2002) conducted studies in the Limpopo and the Bushbuckridge area respectively and they both reported that most respondents perceived a decrease in the supply and availability of natural resources rather than an increase in the supply of natural resources. Dovie et al., (2002) conducted a study in a village (Thorndale) in the Bushbuckridge area which is dominated by residents who are former Mozambican refugees, and they reported a high prevalence of households that perceived a decrease in the availability of natural resources and low prevalence of households which perceived an increase in the availability of natural resources. This agrees with the results found in this study. This could be that refugee settlements are less advantaged, which if less advantaged probably means a high prevalence of respondents noting the greatest decrease in the supply of natural resources as noted in this study, accepting the hypothesis proposed in this study that the poorer the village type is, the more respondents will perceive the change in the availability of natural resources.

The focus group discussion for this study looked at the perceptions of local community members of change in the natural environment, the supply and availability of natural resources, and the causes of changes across villages and village types in the Bushbuckridge Local municipality. Participants across all the village types said they noted a decrease in the supply of all the natural

resources. I expected respondents in underdeveloped communities (UC) and refugee settlements (RS) to perceive a decrease in the supply of natural resources due to a higher reliance on natural resources than central communities (CC) and established communities (EC). There was no clear pattern in the increase in the supply of natural resources across village types. No clear pattern of increase in the supply of natural resources noted by focus group participants could be emphasized in focus groups, where participants noted scarcity for most of the natural resources across villages. Most respondents in UC mentioned an increase in the supply of medicinal plants, edible insects, and bushmeat. Reed mats and wild fruits were owned by most respondents in EC and wild vegetables were owned by most respondents in RS. Most of the respondents in EC did not know if there was any change in the supply of medicinal plants, reed for mats, wild vegetables, and bushmeat and most respondents in RS did not know if there had been a change in the supply of wild fruits and edible insects in the survey. Underdeveloped communities (UC) had the lowest proportion of respondents who did not know if there had been a change in the supply of all the natural resources. The "do not know" category may mean that residents were not as concerned about the environment or simply means they were not aware or better informed about their environment, hence they do not know the state of their proximate environment. Responses from respondents from both poor and less poor village types who did not know if there was a change in the supply of natural resources can be seen as not valuing or being concerned much about the environment and the resources that it provides. Continual dependency on natural resources with a lack of any alternative income for poor communities usually means that the pattern of use of these natural resources is unlikely to change (Ayodeji, 2020). The continual use of, and higher reliance on natural resources by poor, less advantaged village types make them more prone to

environmental degradation and a decrease in the supply of the natural resources on which they are more dependent than their rich counterparts.

Vegetation continues to be one of the most used natural resources and has many purposes of use which include food, timber and construction, medicine, religion and culture, firewood, charcoal, and used for tools (Shopo et al., 2022). This wide variety of use of these natural resources shows the continual dependency on this resource for both poor and less poor areas which with harvesting leads to the decrease in supply of the resources if not given time to recover or if there are no measures in place to hinder its exploitation through unsustainable harvesting. Hunter et al., (2010) reported over 70% of the households across the villages perceived cutting trees as a serious issue in their village, and a high proportion of households in Cunningmore B (EC), Justicia A (EC), and Kildare A (CC) which perceived cutting of trees as a serious issue. Mbiba (2018) did a study that looked at the availability of natural resources through the span of 10 years measured by the Enhanced Vegetation Index (EVI), there was a decline in the availability of natural resources across all the villages (AHDSS villages). Contrary to this study, the greatest decline in the availability of natural resources in Mbiba's (2018) study was in CC followed by EC, then RS, and the least decline was in UC. The availability of natural resources was in the order CC>EC>RS>UC with villages and village types at the higher end of the local rainfall gradient experiencing the steepest decline in the availability of natural resources. The contradiction of results found by Mbiba (2018) and this study could be the measure of natural resource availability used. The household survey conducted in this study looked at the change in the supply of specific natural resources, whilst Mbiba's (2018) study used EVI as a measure of natural resource availability. In a study conducted by Falayi et al., (2019) in the Eastern Cape, there was an increase in the use of

natural resources which shows the dependency on natural resources for the livelihoods of people in rural areas.

Both respondents from the survey data and the participants from focus groups perceived and noted the decrease in the supply and availability of natural resources. Even though there was no significant difference in the level of natural resource use across village types, one would expect that respondents in village types that are highly reliant (poorly serviced) on natural resources would perceive the greatest decrease in supply and availability. Most households in central communities (CC) and established communities (EC) had ownership of cattle and resources made from natural resources which could mean high natural resource consumption by the herds and a large population in these village types which has a higher demand for environmental services than underdeveloped communities (UC) and refugee settlements (RS). In environmental perception, most respondents in refugee settlements and underdeveloped communities perceived the greatest decline in the supply and availability of natural resources than central communities and established communities. The continual use of natural resources means that there is a level of impact on the environment, consequently leading to a decrease in the supply and availability of some natural resources affecting all the village types but mostly those highly relying on natural resources or ecosystem services provided by the environment.

5.3 The relationship between village type, natural resource use, and perceptions of change in resource availability

The third objective of this study aimed to explore the combined relationship between village types, natural resource use, and perception of change in availability with an expectation of poor and remote village types to be associated with more frequent use of natural resources and value the environment the most. Poorly-serviced and remote village types, (refugee settlements and

underdeveloped communities) were associated with a higher number of resources used/owned, a higher number of resources used often, a higher number of resources sold, and buying firewood. Correlation with a higher number of resources used/owned and their use often could be associated with dependency on these resources by households in these village types for their livelihoods than better-serviced communities. A higher number of resources sold associated with these village types could be that households rely on these resources for income generation and cash savings for their livelihoods. Despite electrification, Madubansi and Shackleton (2007) noted the continual use of firewood for cooking in Bushbuckridge households. Electricity is associated with a high cost of money, and the cost of buying firewood could be less in these village types which could explain the association with buying of firewood in these village types. This study found a significant difference in the ownership of cattle, with higher ownership in central communities (CC). The association of central communities with higher cattle ownership is in alignment with this study. This is probably because communities have the means (enough cash income) to buy cattle, and even have enough capital for cattle farming. Established communities were associated with a higher number of natural resources perceived as decreasing in availability in contrast with survey results which showed most respondents in refugee settlements perceived the greatest decrease in availability of natural resources. Education levels can influence households on their perception of the environment. High education levels can bring about environmental awareness, making villages that are better serviced such as established communities show more concern and, hence more value for the environment. Hunter et al., (2010) emphasised that young people and those who are educated are more environmentally aware and thus show more concern for the environment which may explain the association of established communities with a higher number of natural resource perceptions, a decrease in availability.

6. CONCLUSION

This study aimed to compare natural resource use and perceptions of environmental change between different village types within a rural municipality in South Africa to determine if these vary in predictable way across villages with different characteristic within a local setting. This study looked at the level of use of natural resources and environmental perception across distinct village types in the Bushbuckridge Local Municipality in the Mpumalanga Province. Firstly, this study compared the level of use of natural resources between village types with an expectation of higher use in poorly serviced and remote villages and village types. There was no distinct difference in the use of natural resources across the distinct village types despite the high prevalence of the use of natural resources in the study area. Collection, buying, selling, and annual quantities of natural resources were used as proxies for the use of natural resources. There were no distinct differences found across the village types. Livestock (cattle) ownership and ownership of products made from natural resources were considered when looking at the use of natural resources across village types. Most households in better-serviced village types (central communities (CC) and established communities (EC)) owned cattle and natural resource products with few households in poorly serviced underdeveloped communities (UC) and refugee settlements (RS). Cattle ownership is associated with a higher use of natural resources because of the fodder needed for the herds.

Secondly, this study looked at the respondents' environmental perceptions across the villages and village types with the expectation that the more remote or the poorer villages or village types are, the more important natural resources will be. In the survey, most respondents in remote or poorly serviced villages and village types (refugee settlements and underdeveloped communities) perceived a decrease in the supply of natural resources than those in better-serviced village types

(established communities and central communities). In focus group discussions, participants across the village types noted a decrease in the supply and availability of natural resources but there was no significance. The participants mentioned an increase in home stands being built which has led to deforestation, degradation, and scarcity of some natural resources they used growing up.

A point was emphasized by Shackleton and Shackleton, (2004), that poor households depend on natural resources more than their rich counterparts, I believe this is in conjunction with the point made by Dovie et al., (2002) that less exposure to employment opportunities increases the reliance on natural resources by poorly serviced communities and village types. Low employment opportunities, incomes, and education levels in poorly serviced and remote villages and village types make them more highly reliant on natural resources than their counterparts. In conclusion, there is a higher level of use in better-serviced village types, central communities, and established communities than poorly-serviced village types, underdeveloped communities, and refugee settlements for some natural resources, but poorly-serviced villages are more depended on natural resources than their counterparts. However, in terms of population size, villages, and village types with a higher population (better serviced) have a high demand for natural resources, hence using more natural resources than poorer villages and village types. It can also be concluded that more remote and poorly serviced villages and village types consider and value natural resources more than their counterparts concerning the change in the supply and availability of natural resources reported.

The low sample size of users of some resources affected the comparison between villages and village types. An increase in surveyed households across villages and village types could resolve the low sample size. This study was also limited to households' natural resource use, respondents',

and participants' perception of change in the supply of natural resources association. However, some factors may influence and shape the use, and perceptions of change in the supply of natural resources viewed by individuals. This study gave a basis to natural resource use across village types which were characterized by, size, socio-economic factors, access to services, connectedness, and remoteness with a village typology put in place in the early 2000s. Future research can look at re-evaluating villages that fall under certain categories of the village typologies characterized in village typologies. In addition to just updating the village typology, i.e., the class in which villages fall, there may need to be a reassessment of the typology methodology using metrics that are appropriate to the current household conditions (for example, households now have electricity in all the villages). The tourism industry plays an important role in the country's revenue and natural resources play a crucial role in that industry. Thus, conservation strategies and natural resource management strategies are crucial to be implemented in environmental policies to help combat unsustainable harvesting and further deterioration of communal land pool resources. There was a high prevalence of respondents who responded to not knowing if there was a change in the supply of natural resources. Environmental awareness programs in local villages are encouraged to bring about awareness of impacts on the environment and the effect on society which depends on these environmental resources for their livelihoods. Commercialization of natural resources in rural areas can aid in poverty reduction, which is faced by most South African households, allowing for cash savings and safety nets during a crisis.

Future research can build on this study by:

1) Re-classifying village types to assess how villages have changed.

2) Examining the relationship between resource use and different village-level variables.

3) Examining the relationship between environmental change perceptions and different village-

level variables.

4) Examining the relationship between resource use and environmental perceptions in different types of villages.

7. REFERENCES

Andrew, M., Shackleton, C., Ainslie, A., 2003. Land use and rural livelihoods: Have they been enhanced through land reform? Plaas Policy Brief, 5.

Ayodeji, P.I., 2020. Woodland resource use, attitudes, and conservation practices: evidence from three communities in Bushbuckridge Mpumalanga province, South Africa. *African Journal of Science & Nature*, 10. https://doi.org/10.46881/ajsn.v10i0.179

Bushbuckridge Local Municipality. 2024. Integrated Development Plan Report.

Clements, H.S., De Vos, A., Bezzera, J. C., Coetzer, K., Maciejewski, K., Mogrbi, P. J., Shackleton, C., 2021. The relevance of ecosystem services to land reform policies: Insights from South Africa. *Land Use Policy*, 100, 104939.

Cloutier, J., 2015. Edible insects in Africa: An introduction to finding, using and eating insects. Agrodock.

Coetzer, K.L., Erasmus, B.F.N., Witkowski, E.T.F., Bachoo, A.K., 2010. Land-cover change in the Kruger to Canyons Biosphere Reserve (1993– 2006): A first step towards creating a conservation plan for the subregion. *South African Journal of Science*, 106(7), 1–10. https://doi.org/10.4102/sajs.v106i7/8.221

Delgado, T. S., McCall, M. K., López-Binnqüist, C., 2023. Non-Timber Forest Products: Small matters, big significance, and the complexity of reaching a workable definition for sustainability. *Small-Scale Forestry*,22, 37-68.

Dlamini, S., Tesfamichael, S.G., Mokhele, T., 2021. Socio-demographic determinants of environmental attitudes, perceptions, place attachment, and environmentally responsible

behaviour in Gauteng province, South Africa. *Scientific African*, 12, e00772. https://doi.org/10.1016/j.sciaf.2021.e00772

Dixon, J.A.,2008. Environmental valuation: Challenges and practices. *A Personal View*, Conservation Strategy Fund. United States of America.

Dovie, D. B. K., 2003. Rural economy and livelihoods from the non-timber forest products trade. Compromising sustainability in southern Africa? *The International Journal of Sustainable Development & World Ecology*, 10, 3, 247–262.

Dovie, D.B.K., Shackleton, C.M., Witkowski, T.F., 2002. Direct-use values of woodland resources consumed and traded in a South African village. *International Journal of Sustainable Development & World Ecology*, 9, 269–283. https://doi.org/10.1080/13504500209470122

Falayi, M., Shackleton, S.E., Cundill Kemp, G., Shackleton, C.M., 2019. Changes in household use and sale of locally collected environmental resources over a 15-year period in a rural village, South Africa. *Forests, Trees & Livelihoods*, 28, 90–107. https://doi.org/10.1080/14728028.2019.1568309

Fisher, J.T., Witkowski, E.T.F., Erasmus, B.F.N., Van Aardt, J., Asner, G.P., Wessels, K.J., Mathieu, R., 2012. Human-modified landscapes: Patterns of fine-scale woody vegetation structure in communal savannah rangelands. *Environmental Conservation*, 39, 1, 72–82. https://doi.org/10.1017/S0376892911000592

Findlay, S., Twine, W., 2018. Chiefs in a democracy: A case study of the 'new' systems of regulating firewood harvesting in post-apartheid South Africa. *Land*,7, 35. https://doi.org/10.3390/land7010035

Giannecchini, M., Twine, W., Vogel, C., 2007. Land-cover change and human? Environment interactions in a rural cultural landscape in South Africa. *Geographical Journal*, 173, 26–42. https://doi.org/10.1111/j.1475-4959.2007.00227.x

Gill, P., Stewart, K., Treasure, E., Chadwick, B., 2008. Methods of data collection in qualitative research: interviews and focus groups. *British Dental Journal*, 204, 291–295. https://doi.org/10.1038/bdj.2008.192

Hargreaves, J. 2000. Village Typology: The Agincourt Field Site, Descriptive Results and Preliminary Discussion. Agincourt Health and Population Unit, School for Public Health, University of the Witwatersrand, Johannesburg.

Herd-Hoare, S., Shackleton, C.M., 2022. The use and value of wild harvested provisioning ecosystem services along a landscape heterogeneity gradient in rural South Africa. *Ecosystems & People*,18, 616–629. https://doi.org/10.1080/26395916.2022.2140711

Higgins, S.I., Shackleton, C.M., Robinson, E.R., 1999. Changes in woody community structure and composition under contrasting landuse systems in a semi-arid savanna, South Africa. *Journal of Biogeography*, 26 (3), 619–627.

Hoffman, M. T., 2014. Changing patterns of rural land use and land cover in South Africa and their implications for land reform, *Journal of Southern African Studies*, 40(4), 707–725.

Hunter, L.M., Strife, S., Twine, W., 2007. Environmental perceptions of rural South African Residents: The complex nature of post-material concern. *Society & Natural Resources*, 23, 525–541.

Hunter, L.M., Strife, S., Twine, W., 2010. Environmental Perceptions of Rural South African Residents: The Complex Nature of Environmental Concern. *Society & Natural Resources*, 23, 6, 525–541. https://doi.org/10.1080/08941920903357782

Hunter, L.M., Talbot, C., Twine, W., McGlinchy, J., Kabudula, C.W., Ohene-Kwofie, D., 2021. Working toward effective anonymization for surveillance data: Innovation at South Africa's Agincourt Health and Socio-Demographic Surveillance Site. *Population & Environment*, 42, 445–476. https://doi.org/10.1007/s11111-020-00372-4

Ishaya, S., Abaje, I.B., 2008. Indigenous people's perception on climate change and adaptation strategies in Jema'a local government area of Kaduna State, Nigeria. *Journal of Geography & Regional Planning*, 1(8), 138–143.

Kahn, K., Collinson, M.A., Gomez-Olive, F.X., Mokoena, O., Twine, R., Mee, P., Afolabi, S.A., Clark, B.D., Kabudula, C.W., Khosa, A., Khoza, S., Shabangu, M.G., Silaule, B., Tibane, J.B., Wagner, R.G., Garenne, M.L., Clark, S.J., Tollman, S.M., 2012. Profile: Agincourt Health and Socio-demographic Surveillance System. *International Journal of Epidemiology*, 41, 988–1001. https://doi.org/10.1093/ije/dys115

Kepe, T., 2007. Medicinal plants and rural livelihoods in Pondoland, South Africa: Towards an understanding of resource value. *International Journal of Biodiversity Science & Management*, 3, 170–183.

Kgaphola, M.J., Ramoelo, A., Odindi, J., Mwenge Kahinda, J.-M., Seetal, A.R., Musvoto, C., 2023. Impact of land use and land cover change on land degradation in rural semi-arid South Africa: Case of the Greater Sekhukhune District Municipality. *Environmental Monitoring & Assessment*, 195 (6), 710. https://doi.org/10.1007/s10661-023-11104-0

Kimera, Z. I., Mshana, S. E., Rweyemamu, M. M., Mboera, L.E.G., Matee, M.I.N., 2020. Antimicrobial use and resistance in food-producing animals and the environment: An African perspective. *Antimicrobial Resistance and Infection Control*, 9 (37), 1-12.

Kirkland, T., Hunter, L.M., Twine, W., 2007. "The Bush is No More": Insights on institutional ihange and natural resource availability in Rural South Africa. *Society & Natural Resources*, 20, 337–350. https://doi.org/10.1080/08941920601161353

Kugedera, A.T., 2020. Assessing the utilisation of Marula (*Sclerocarya birrea*) by smallholder farmers in Vuravhi Communal Lands of Chivi District, Masvingo, Zimbabwe. *International Journal of Agricultural Sciences & Veterinary Medicine*, 8 (4), 11–15.

Mackellar, N., New, M., Jack, C., Observed and modelled trends in rainfall and temperature for South Africa: 1960–2010. *South African Journal of Science*, 110 (7–8), 1–13.

Madubansi, M., Shackleton, C. M., 2007. Changes in fuelwood use and selection following electrification in the Bushbuckridge lowveld, South Africa. *Journal of Environmental Management*, 83(4), 416–426.

Mahonya, S., Shackleton, C. M., Schreckenberg, K., 2019. Non-timber forest product use and market chains along a deforestation gradient in southwest Malawi. *Frontiers in Forest and Global Change*, 2(71), 1-12.

Makhado, R. A., von Maltitz, G. P., Potgieter, M. J., Wessels, D. C. J., 2009, contribution of woodland products to rural livelihoods in the northeast of Limpopo province, South Africa. *South African Geographical Journal*, 91(1), 46–53.

Mani, S., Osborne, C.P., Cleaver, F., 2021. Land degradation in South Africa: Justice and climate change in tension. *People and Nature*, 3, 978–989. https://doi.org/10.1002/pan3.10260

Martins, V., Shackleton, C.M., 2019. Bushmeat use is widespread but under-researched in rural communities of South Africa. *Global Ecology & Conservation*, 17, e00583.

Matsika, R., Erasmus, B.F.N., Twine, W.C., 2012. A tale of two villages: Assessing the dynamics of fuelwood supply in communal landscapes in South Africa. *Environmental Conservation*, 40, 71–83. https://doi.org/10.1017/S0376892912000264

Matsika, R., Erasmus, B.F.N., Twine, W.C., 2013. Double jeopardy: The dichotomy of fuelwood use in rural South Africa. *Energy Policy*, 52, 716–725. https://doi.org/10.1016/j.enpol.2012.10.030

Mbiba, M., 2018. Interactions between social capital, natural capital, and resources use in the central Lowveld of Mpumalanga Province, South Africa. University of the Witwatersrand, Johannesburg.

Mbiba, M., Collinson, M., Hunter, L., Twine, W., 2019. Social capital is subordinate to natural capital in buffering rural livelihoods from negative shocks: Insights from rural South Africa. *Journal of Rural Studies*, 65, 12–21. https://doi.org/10.1016/j.jrurstud.2018.12.012

Meadows, M.E., Hoffman, M.T., 2002. The nature, extent and causes of land degradation in South Africa: legacy of the past, lessons for the future? *Area*, 34, 428–437. https://doi.org/10.1111/1475-4762.00100

Meinhold, K., Dumenu, W. K., Darr, D., 2022. Connecting rural non-timber forest product collectors to global markets: The case of baobab (*Adansonia digitata* L.). *Forest Policy and Economics*, 134, 102628.

Mensah, S., Veldtman, R., Assogbadjo, A.E., Ham, C., Glèlè Kakaï, R., Seifert, T., 2017. Ecosystem service importance and use vary with socio-environmental factors: A study from household-surveys in local communities of South Africa. *Ecosystem Services*, 23, 1–8. https://doi.org/10.1016/j.ecoser.2016.10.018

Mugido, W., Shackleton, C. M., 2018. Price determination of non-timber forest products in different areas of South Africa. *Ecological Economics*, 146, 597–606.

Musavengane, R., Simatele, D.M., 2016. Community-based natural resource management: The role of social capital in collaborative environmental management of tribal resources in KwaZulu-Natal, South Africa. *Development Southern Africa*, 33, 806–821. https://doi.org/10.1080/0376835X.2016.1231054

Ou, Q., 2017. A brief introduction to perception. *Studies in Literature and Language*, 15(4), 18–28.

Paumgarten, F., Shackleton, C.M., 2009. Wealth differentiation in household use and trade in non-timber forest products in South Africa. *Ecological Economic*, 68, 2950–2959.

Pascual, U., Balvanera, P., Díaz, S., Pataki, G., Roth, E., Stenseke, M., Watson, R.T., Başak Dessane, E., Islar, M., Kelemen, E., Maris, V., Quaas, M., Subramanian, S.M., Wittmer, H., Adlan, A., Ahn, S., Al-Hafedh, Y.S., Amankwah, E., Asah, S.T., Berry, P., Bilgin, A., Breslow, S.J., Bullock, C., Cáceres, D., Daly-Hassen, H., Figueroa, E., Golden, C.D., Gómez-Baggethun, E., González-Jiménez, D., Houdet, J., Keune, H., Kumar, R., Ma, K., May, P.H., Mead, A., O'Farrell, P., Pandit, R., Pengue, W., Pichis-Madruga, R., Popa, F., Preston, S., Pacheco-Balanza, D., Saarikoski, H., Strassburg, B.B., van den Belt, M., Verma, M., Wickson, F., Yagi, N., 2017.

Valuing nature's contributions to people: The IPBES approach. *Current Opinion in Environmental Sustainability*, 26, 7–16. https://doi.org/10.1016/j.cosust.2016.12.006

Ragie, F. H., 2016. Relationships between household resource dependence, socio-economic factors, and livelihood strategies: A case study from Bushbuckridge, South Africa. MSc dissertation. University of the Witwatersrand, Johannesburg.

Ragie, F.H., Olivier, D.W., Hunter, L.M., Erasmus, B.F.N., Vogel, C., Collinson, J., Twine, W., 2020. A portfolio perspective of rural livelihoods in Bushbuckridge, South Africa. *South African Journal of Science*,116(9–10), 1–8.

Scheiter, S., Schulte, J., Pfeiffer, M., Martens, C., Erasmus, B.F.N., Twine, W.C., 2019. How does climate change influence the economic Value of ecosystem services in Savanna Rangelands? *Ecological Economics*, 157, 342–356.

Seabi, W. M., 2017. The relative influence of rainfall, topographical position and distance from village on composition and structure of herbaceous vegetation in a communal rangeland of Bushbuckridge, University of the Witwatersrand, Johannesburg.

Shackleton, C.M., De Vos, A., 2022. How many people globally actually use non-timber forest products? *Forest Policy & Economics*, 135, 102659. https://doi.org/10.1016/j.forpol.2021.102659

Shackleton, C.M., Dzerefos, C.M., Shackleton, S.E., Mathabela, F.R., 2000b. The use of and trade in indigenous edible fruits in the Bushbuckridge savanna region, South Africa. *Ecology of Food & Nutrition*, 39(3), 225–245. https://doi.org/10.1080/03670244.2000.9991616

Shackleton, C., Shackleton, S., 2003. Value of non-timber forest products and rural safety nets in South Africa. *International Conference on Rural Livelihoods, Forests, and Biodiversity*, 19–20.

Shackleton, C. M., Garekae, H., Sardeshpande, M., Sinasson Sanni, G., Twine, W. C., 2024. Non-timber forest products as poverty traps: Fact or fiction? *Forest Policy and Economics*, 158, 103114.

Shackleton, C.M., Shackleton, S. E., 2004.The importance of non-timber forest products in rural livelihood security and as safety nets: A review of evidence from South Africa. *South African Journal of Science*, 100(11),658–664.

Shackleton, C.M., Shackleton, S.E., 2006. Household wealth status and natural resource use in the Kat River Valley, *South Africa. Ecological Economics*, 57, 306–317. https://doi.org/10.1016/j.ecolecon.2005.04.011

Shackleton, C.M., Shackleton, S. E., Cousins, B., 2001. The role of land-based strategies in rural livelihoods: The contributions of arable production, animal husbandry and natural resource harvesting in communal areas in South Africa. *Development Southern Africa*, 18(5), 581–604.

Shackleton, C., Shackleton, S., Netshiluvhi, T., Mathabela, F., 2005. The contribution and direct-use value of livestock to rural livelihoods in the Sand River catchment, South Africa. African *Journal of Range & Forage Science*,22, 127–140. https://doi.org/10.2989/10220110509485870

Shackleton, S.E., Shackleton, C.M., Netshiluvhi, T.R., Geach, B.S., Ballance, A., Fairbanks, D.H.K., 2002. Use Patterns and Value of Savanna Resources in Three Rural Villages in South Africa. *Economic Botany*, 56, 130–146. https://doi.org/10.1663/0013-0001(2002)056[0130:UPAVOS]2.0.CO;2

Shackleton, S., Shackleton, C., Cousins, B., 2000a. Re-valuing the communal lands of southern Africa: New understandings of rural livelihoods. *Natural Resource perspectives*.

Shackleton, R. T., 2020, Loss of land and livelihoods from mining operations: A case in the Limpopo Province, South Africa. *Land Use Policy*, 99.

Shopo, B., Mapaya, R. V., Maroyi, A., 2022. The traditional uses of plant diversity in Gokwe South District, Zimbabwe: Timber & construction, ethnoveterinary medicine, firewood & charcoal, food, tools and handicraft, religious ceremonies & rituals & other uses. *Ethnobotany Research & Applications*, 24, 34.

Stats SA (Statistics South Africa). 2024.

Thondhlana, G., Shackleton, S., 2015. Cultural values of natural resources among the San people neighbouring Kgalagadi Transfrontier Park, South Africa. *Local Environment*, 20, 1, 18–33.

Tibesigwa, B., Visser, M., Collinson, M., Twine, W., 2016. Investigating the sensitivity of household food security to agriculture-related shocks and the implication of social and natural capital. *Sustainability Science*, 11, 193–214. https://doi.org/10.1007/s11625-015-0332-6

Twine, W., 2013. Multiple strategies for resilient livelihoods in communal areas of South Africa. *African Journal of Range & Forage Science*, 30, 39–43. https://doi.org/10.2989/10220119.2013.768703

Twine, W.C., 2005. Socio-economic transitions influence vegetation change in the communal rangelands of the South African Lowveld. *African Journal of Range & Forage Science*, 22, 93–99. https://doi.org/10.2989/10220110509485866

Twine, W., Moshe, D., Netshiluvhi, T., Siphugu, V., 2003. Consumption and direct-use values of savanna bio-resources used by rural households in Mametja, a semi-arid area of Limpopo Province, South Africa: Research letter. *South African Journal of Science*, 99(9), 467–473.

Twine, W., Siphugu, V., Moshe, D., 2003. Harvesting of communal resources by 'outsiders' in rural South Africa: A case of xenophobia or a real threat to sustainability? *International Journal of Sustainable Development and World Ecology*, 10(3), 264–274.

Vetter, S., Goodall, V.L., Alcock., R., 2020. Effect of drought on communal livestock farmers in KwaZulu-Natal, South Africa. *African Journal of Range & Forage Science*, 37(1), 93–106.

Wessels, K.J., Colgan, M.S., Erasmus, B.F.N., Asner, G.P., Twine, W.C., Mathieu, R., van Aardt, J.A.A., Fisher, J.T., Smit, I.P.J., 2013. Unsustainable fuelwood extraction from South African savannas. *Environmental Research Letters*, 8(1), 014007.

Wisely, S.M., Alexander, K., Mahlaba, T., Cassidy, L., 2018. Linking ecosystem services to livelihoods in southern Africa. *Ecosystem Services*, 30, 339–341. https://doi.org/10.1016/j.ecoser.2018.03.008

8. APPENDICES

8.1 Appendix 1: SUSCES household questionnaire

B. LIVELIHOOD ACTIVITIES

Use of Natural Resources

Q16. Did this household use any of the following resources during the past 12 months?

"In season" means the months of the year when it is available in the bush.

	Type of resource	a Used? (1 = Yes → b, 0 = No, X = Don't know → next row)	b Frequency of use when in season? (Key 12) Category!	c Total amount used in a month when in use (number of volume units)	d *Volume unit (Key 13)	e How many months in the last 12 months was this resource used? (X = Don't know)	f What is the local name for the species you used most? (only one) (X = Don't know)	g Did this household collect this resource? (1 = Yes → h, 0 = No, X = Don't know → i)	h Frequency of collection by the hh when in season? (Key 12)	i Did this household buy this resource? (1 = Yes → j, 0 = No, X = Don't know → next row)	j Frequency of buying when in season? (Key 12) Category!	k What is the local price per unit? (Rand) (X = Don't know)	l Volume unit (Key 13)
1	Fire wood (tihunyi)[1]												
2	Wild fruits (e.g. nkanyi, makwakwa)												
3	Wild vegetables (e.g. guxe, bangala)												
4	Edible insects (e.g. tinjiya, masonja)												
5	Fish from local dams and rivers												
6	Bushmeat (e.g. wild birds, buck, rabbits)												
7	Medicinal plants (unprocessed)												

Key 12: Frequency of use/collection/buying

1 = Less often than 1 x per month (e.g. once every 6 weeks)

2 = Between 1 x per month & 1 x per week (1 - 4 x per month)

3 = More than 1 x per week (more than 4 x per month)

Key 13: Volume unit

1 = Mug	6 = 50 kg maize meal bag
2 = 5 litre bucket	7 = 80 kg maize meal bag
3 = 10 litre bucket	8 = Wheelbarrow load[1]
4 = 20 litre bucket	9 = Bakkie load (vrag)[1]
5 = Bundle[1]	10 = Individuals (e.g. Fish)

*Example of number of volume units & volume (columns c & d)

One and a half bakkie loads is recorded as:

c Number of volume units	d Volume unit (Key 13)
1.5	9

Q17. Does your household have any of the following, that are still in use?

	Item	Have? (1 = Yes, 0 = No, X = Don't know)
1	Buildings with a thatch grass roof	
2	Buildings made with poles from the bush	
3	Fences or animal kraals made from poles from the bush	
4	Utensils or implements made from wood from the bush	
5	Reed mats (sangu)	
6	Twig hand brooms (nkukulu wa le handle)	
7	Grass hand brooms (nkukulu wa le indlwini)	

Q18. Did anybody in this household sell any of the following natural products in the last 12 months?

	Product/material	a Sold? (1 = Yes → b, 0 = No, X = Don't know → next row)	b Number of months in last 12 in which this was sold (X = Don't know)	c Average income per month when sold (X = Don't know)	d Total income over 12 months (X = Don't know)
1	Fire wood (tiyunyi)				
2	Furniture made from wood from the bush (e.g. made from morotso)				
3	Wooden carvings (e.g. statues, mortars, spoons etc)				
4	Poles				
5	Reed mats (nsango)				
6	Marula beer				
7	Marula nuts (timongo)				
8	Fresh wild fruit (e.g. nkhanyi, makwakwa, masala, tintoma)				
9	Dried monkey orange (nkwakwa)				
10	Wild vegetables (e.g. guxe, nkaka, bangala)				
11	Edible insects (e.g. tinjiya, masonja)				
12	Thatching grass				
13	Twig hand brooms (nkukulu wa le handle)				
14	Grass hand brooms (nkukulu wa le indlwini)				
15	Medicinal plants				

Q19. Please tell me if there has been a change in availability of the following resources around this village over the last 5 years.

	Resources	a Change in supply of resources (1 = Decrease, 2 = Increase → b 0 = No change, X = Don't know → next row)	b Local name of the species most affected if there has been a change *(only one)* (X = Don't know, "–" if not applicable)
1	Fire wood		
2	Wild fruits (e.g. nkanyi, mkwakwa, ntoma)		
3	Wild vegetables (e.g. guxe, bangala, cheke)		
4	Edible insects (e.g. grasshoppers)		
5	Bushmeat (e.g. buck, widl birds)		
6	Medicinal plants		
7	Reeds for mats		

Livestock farming

Q20. Let me ask you some questions about livestock. *(Only fill in d and e if there are secondary and tertiary uses, otherwise leave blank)*

	Livestock categories	a Does the household own any? (1 = Yes → b, 0 = No → next row)	b How many does this household own at present?	c Main use of these livestock *(Key 14)*	d Secondary use of this livestock *(Key 14)*	e Tertiary use of this livestock *(Key 14)*	f How many have you slaughtered in the last 12 months?
1	Cattle						
2	Donkeys						
3	Sheep						
4	Goats						
5	Pigs						
6	Chickens						

Key 14: Livestock use		
M = Meat	N = Manure	I = Investment/asset
L = Milk	P = Ploughing	C = Cultural/religious
E = Eggs	T = Transport	

8.2 Appendix 2: Focus group discussion question guide

GROUP DISCUSSION GUIDE

Socio-ecological drivers of movement into and out of African Woodlands

This is a guide for focus group discussions. There is an intentional degree of redundancy in questions for triangulation. Participatory methods will be used to capture and express the results.

1. **What are the challenges for maintaining and developing your livelihoods, compared to the past?**

2. **How has the natural environment** (e.g. climate change like drought, rain, heat and landscape change like woodland) **changed in the community in your lifetime? What is/are the cause(s)?**

3. **How is natural environment important to you and your family** (e.g. daily needs, incomes, and culture)**?**
   What are the natural resources do you use for your daily need?
   What natural resources do you use for your daily need to generate income?
   What are the natural resources do you use for your daily need for your culture?
   Which ones are most important to you?

4. **Which resources have changed in availability? How have the chamges in the availability of natural environment affected you and your family over the last 10 years?**