People and protected areas:

Natural resource harvesting as an approach to support rural communities surrounding Majete Wildlife Reserve, Southern Malawi

A Case Study

By

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Declaration

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Abstract

Protected areas across the developing world are increasingly incorporating the needs of local rural communities into their management decisions. The African Parks managed Majete Wildlife Reserve (MWR) in the lower Shire valley of southern Malawi is no exception. Through African Parks' extension department they aim to incorporate the needs of local communities into their management framework in order to maintain support for their conservation activities. A resource use program (RUP) which facilitates sustainable harvesting was implemented to allow community members access to thatching grass inside the reserve, via 8 RUP gates on the perimeter fence. Each RUP gate is opened once annually for 7 days and game scouts are made available to escort community members into the reserve to harvest grass.

As a case study, we assessed the 2015 RUP activities at 5 of the 8 RUP gates to determine the number of community members utilising the program, the biomass of grass removed, the variation in grass bundle masses and the distances walked by community members to access the RUP gates. We determined that a total of 2211 community members accessed the reserve via the 5 monitored RUP gates and removed 134 073kg of thatching grass in 2015. Additionally, we found a significant variation in the bundle masses between individual harvesters, as well as the harvesting characteristics at each RUP gate. We also confirmed anecdotal suggestions from the African Parks extension assistants (EAs) that community members' walk significant distances from their homes to the RUP gates to harvest grass.

To assess the possibility of extending the current RUP to include medicinal plant harvesting we conducted interviews with 12 traditional healers in communities adjacent to the reserve. In conjunction with interviews, we conducted rapid ethnobotanical surveys, where we accompanied the traditional healers into the field to collect and formally identify plants used for medicinal purposes. We identified a total of 96 different plant species used by these healers, the majority of which were trees and shrubs. The most commonly used plant parts were roots, leaves and bark, and traditional healers currently treat 27 different ailments and illnesses. Additionally, we found a substantial variation in the local names for medicinal plants, with some plants having 5-6 local names. Almost all the traditional healers we interviewed listed their healing practise as their main source of formal income (n = 11), while all of the healers stated that prior to the reserve fence being erected they harvested medicinal plants in the reserve (n = 12), and that they would like to be able to harvest medicinal plants in the reserve again (n = 12).

We conducted a household survey to determine general perceptions of the current RUP. Our findings suggest that overall; community members are satisfied with the RUP (92%) however there is some room for improvement. The majority of respondents requested that the annual RUP grass harvesting window is increased (96%), as currently it is not long enough for community members to harvest

enough grass for their household needs. A significant number of community members also requested the addition of medicinal plant (70%) and firewood (70%) harvesting to the RUP. This feedback adds support to the traditional healers request for medicinal plant harvesting inside MWR.

The findings of this study provide useful baseline data from which African Parks can continue to ensure that the RUP stays relevant to communities surrounding the reserve in the future. The long-term success of the reserve will ultimately depend on the continued support from local communities and the RUP is one way in which MWR can continue to engage with community members. The research acts as a useful case study to support the theory that communities are more likely to support continued conservation efforts when they can benefit and extract value from a protected area.

Opsomming

Beskermde gebiede dwarsoor die ontwikkelende wêreld inkorporeer toenemend die behoeftes van die plaaslike landelike gemeenskappe in hulle bestuursbesluite. Die Majete Wildreservaat (MWR) in die laer Shire-vallei van suidelike Malawi, wat deur African Parks bestuur word, is geen uitsondering nie. Deur African Parks se voorligtingsdepartement word ’n poging gemaak om die behoeftes van die plaaslike gemeenskappe in hulle bestuursraamwerk in te sluit om sodoende ondersteuning vir hul bewaringsaktiwiteite te onderhou. ’n Hulpbrongebruiksprogram (*resource use program (RUP)*) wat volhoubare oes fasiliteer, is geïmplementeer om lede van die gemeenskap toegang te gee tot die dekgras binne die reservaat via agt RUP hekke in die grensheining. Elke RUP hek word een keer per jaar vir sewe dae oopgesluit en wildwagters word beskikbaar gestel om gemeenskapslede in die reservaat te vergesel sodat hulle die gras kan oes.

Ons het in 2015 die RUP aktiwiteite by vyf van die agt RUP hekke waargeneem om te bepaal hoeveel lede van die gemeenskap die program gebruik, die grootte van die biomassa van die gras wat verwyder is, die afwisseling in die massa van die grasbondels, en die afstande wat deur elke lid van die gemeenskap gestap word om toegang te kry tot die hekke. Ons het bevind dat ’n totaal van 2 211 gemeenskapslede die reservaat via die vyf RUP hekke binnegekom het en 134 073 kg dekgras verwyder het. Daarbenewens het ons ook noemenswaardige afwisseling in die bondelgroottes van individuele plukkers gevind, sowel as in oeskenmerke by elke RUP hek. Ons kon ook anekdotiese voorstelle van die voorligtingsassistente van African Parks bevestig dat gemeenskapslede baie lang afstande vanaf hulle huise tot by die RUP hekke stap om die gras te kan oes.

Om die moontlikheid te ondersoek dat die huidige RUP uitgebrei word om die oes van medisinale plante in te sluit, is onderhoude gevoer met 12 tradisionele genesers in gemeenskappe langsaan die reservaat. Tesame met die onderhoude het ons vinnige etnobotaniese opnames onderneem waarvoor ons saam met die tradisionele genesers die veld ingestap het om plante wat vir medisinale doeleindes gebruik word, te versamel en formeel te identifiseer. Ons het ’n totaal van 96 verskillende plantspesies geïdentifiseer wat deur die genesers gebruik word, die meerderheid waarvan bome en struike was. Die plantdele wat die algemeenste gebruik word, was wortels, blare en bas, en tradisionele genesers behandel tans 27 verskillende kwale en siektes. Ons het ook aansienlike verskille in die plaaslike name vir die medisinale plante gevind, met sommige plante wat tot vyf of ses plaaslike name het. Feitlik al die tradisionele genesers met wie ons onderhoude gevoer het, het hulle helende praktyk as hulle vernaamste bron van formele inkomste beskryf, terwyl al die genesers genoem het dat hulle medisinale plante in die reservaat geoes het voor die heining opgesit is en dat hulle graag weer dié plante in die reservaat sou wou oes.

Ons het ’n opname van huishoudings onderneem om die algemene persepsies van die huidige RUP te bepaal. Ons bevindings dui aan dat, oor die algemeen, gemeenskapslede tevrede is met die RUP, hoewel

daar ruimte vir verbetering is. Die meerderheid respondente het vereis dat die jaarlikse tydperk vir die oes van gras in die RUP uitgebrei moet word, aangesien dit tans nie lank genoeg is vir gemeenskapslede om genoeg gras vir die behoeftes van hulle huishoudings te oes nie. ’n Noemenswaardige getal gemeenskapslede het ook die byvoeging van medisinale plante en vuurmaakhout tot die RUP aangevra. Hierdie terugvoer ondersteun die tradisionele genesers se versoek vir die oes van medisinale plante in die MWR.

Die bevindings van hierdie studie verskaf nuttige data waarmee African Parks kan voortgaan om te verseker dat die RUP in die toekoms relevant bly vir die gemeenskappe om die reservaat. Die langtermyn sukses van die reservaat sal uiteindelik afhanklik wees van die volgehoue steun van plaaslike gemeenskappe en die RUP is een manier waarop die MWR kan aanhou om met gemeenskapslede betrokke te bly. Solank die plaaslike mense voordeel trek en waarde in die reservaat kan sien, sal hulle meer geneig wees om die voortgesette bewaringspogings van African Parks in die Majete Wildreservaat te ondersteun.

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Abbreviations

CBNRM	Community Based Natural Resource Management
CBO	Community Based Organisation
DPNW	Malawian Department of National Parks and Wildlife
EA	Extension Assistant
GDP	Gross Domestic Product
GNI	Gross National Income
GVH	Group Village Headman
MDG	Millennium Development Goals
MK	Malawi Kwacha
MWR	Majete Wildlife Reserve
NGO	Non-Governmental Organisation
PA	Protected Area
PPP	Public-Private Partnership
RUP	Resource Use Programme
TA	Traditional Authority
TEK	Traditional Ecological Knowledge
UN	United Nations
UNEP	United Nations Environmental Programme
WHO	World Health Organisation

Chapter 1: Introduction

***"I see no future for parks, unless they address the needs of communities as equal partners in their development"* – Nelson Mandela**

World Parks Congress, Durban, 2003

Across the globe protected areas (PAs) and conservation initiatives have recognised the importance of gaining the support of local communities in biodiversity conservation (Amin et al. 2015; Naughton-Treves et al. 2005). This realisation has been of particular importance to developing country's where biodiversity is greatest (Naughton-Treves et al. 2005). Subsequently conservation projects have attempted to align the conservation of natural resources with the development needs of local communities (Abbot et al. 2001). Where these projects have allowed local communities the ability to harvest resources sustainably from within PAs there has been an increase in the support for conservation activities (Hausser et al. 2009; Mohebalian and Aguilar 2015; Wells and McShane 2004). The benefits of participatory programs are particularly evident across Africa, where restricting local access to natural resources found in PAs has led to conflict and illegal resource extraction (Faasen and Watts 2007; Weladji and Tchamba 2003; Meer and Schnurr 2013; Vedeld et al. 2012). Communities living adjacent to PAs and forests across Africa are most often low income subsistence farmers who are dependent on access to natural resources for survival and income generation (Amin et al. 2015; Kamanga et al. 2009; Pienaar et al. 2013; Pouliot and Treue 2013; Vedeld et al. 2012). As human populations' adjacent to PAs and forests continue to increase in size and density, harvesting of natural resources can reach unsustainable levels (Bruschi et al. 2014). To ensure the continued support of rural livelihoods and the ecological integrity of PAs and forests, it is vital that harvesting of natural resources is maintained at sustainable levels (Andrade et al. 2015; Bruschi et al. 2014).

Sub-Saharan Africa is one of the most impoverished regions in the world with 41% of the total population living on less than US$ 1.90 a day (The World Bank Group 2016). Over 60% of the regions' population rely on agriculture as their main livelihood source with 80% of staple crops produced by women (IAASTD 2009). The regions reliance on agriculture and subsistence livelihoods means that the rates of deforestation and soil fertility degradation are increasing across the region (IAASTD 2009). Climate change predictions indicate that sub-Saharan Africa will experience more erratic rainfall and increased temperatures which will negatively affect both water and food security (IAASTD 2009). The regions greatest threat to biodiversity is land-use change with an increasing amount of land being converted from forests and grasslands, to agricultural land and urban areas (IAASTD 2009). These factors present a major challenge to protected areas across the region as the pressure on natural resources by subsistence communities continues to grow.

1.1 The study country: Malawi in context

Malawi is a small African country situated within south and central Africa. With a largely rural population of 17.2 million people, Malawi is ranked as one of the poorest countries in the world (Population Reference Bureau 2015). Malawi's largely subsistence based economy and lack of valuable mineral resources have resulted in a Gross National Income (GNI) per capita of US$ 780, which is well below the US$ 2 270 average GNI per capita of the worlds' least developed countries (Population Reference Bureau 2015). High population density, 458 people per square kilometre of arable land, in a country which relies predominantly on subsistence agriculture and a high population growth rate spurred by a fertility rate of 5 children per woman, means that pressure on natural resources is extremely high (Population Reference Bureau 2015). The country's lack of economic development has left it trailing behind many of its' Southern African neighbours and as of 2014 Malawi was ranked just 136 out of 148 countries on the Global Competitiveness scale (The World Economic Forum 2014). Key findings from a Millennium Development Goal (MDG) survey conducted in 2014 highlight the poor quality of life experienced by most Malawians. Basic housing characteristics indicate that 9.5% of homes have electricity, 25.4% of homes have finished floors, 66.6% of homes have completed walls, and 41.5% of homes have a completed roof (National Statistical Office 2014). An average life expectancy calculated in 2012 was determined as 58 years of age for men and 60 years of age for women (World Health Organization 2014).

Subsistence agriculture is the predominant form of livelihood generation in southern Malawi, but, soil fertility is poor and yields per hectare are low (Orr and Mwale 2001). Poor farming practises, such as continuous cultivation without crop rotation or leaving land to lie fallow between harvests, as well as low application rates of inorganic fertilizers compound the problem and result in many households being self-sufficient in maize for less than half the year (Orr and Mwale 2001). In remote villages, far from rural trade centres, few, if any individuals have access to formal employment. The struggle for survival from day to day, and year to year, is a threat to people in these communities who are increasingly vulnerable to economic and environmental change (Devereux et al. 2006). Communities in these areas are highly dependent on natural resources for survival.

The lower Shire Valley lies in the southern-most part of Malawi and ranges from 30−150 m above sea level in altitude (Mwale et al. 2014). The valley is drained by the Shire River, which is also the only outlet of Lake Malawi. Poverty rates in the valley are the highest in the country with 80% of the people living on less than US$ 0.40 a day (Mwale et al. 2014). Livelihood strategies largely rely on subsistence farming, artisanal fishing, livestock rearing and some formal employment through small micro-enterprise businesses in the villages, a large commercial sugar estate and Majete Wildlife Reserve (Mwale et al. 2014).

Observations in the field indicate that poor rural communities specifically found in the southern Shire Valley depend on locally found natural resources for livestock grazing, medicinal plants, building material, wild fruits and vegetables and various protein sources. Poor, isolated rural communities, who are dependent on freely available natural resources, are most at risk from environmental degradation (Banana et al. 2007). With a population density of 458 people per square kilometre of arable land (Population Reference Bureau 2015) and only 15.3% of the population residing in urban areas the pressure on natural resources in Malawi is comparatively high compared to neighbouring Zambia and Tanzania, with 408 and 360 people per square kilometre of arable land respectively (Population Reference Bureau 2015). Poverty and high population density leaves rural communities at heightened risk to the effects of environmental degradation (National Statistical Office and ICF Macro 2011). Already, the first few months of the year, lead to large scale food shortages, caused largely by the fact that 60% of small-scale farmers produce less than their annual consumption needs in staple foods (National Statistical Office and ICF Macro 2011). This period of shortage starts towards the end of the dry season, when grain stores start to run out, and continues until the harvest starts towards the end of the rainy season- roughly December until April. During this time people rely heavily on subsidised or free maize – distributed by local government and aid agencies - and wild fruits and vegetables (Ellis & Manda 2012). Driven by both socio-economic and environmental factors the lower Shire Valley is highly vulnerable to extreme weather events, such as episodes of severe flooding and drought (Mwale et al. 2015) which are driven by large-scale atmospheric circulation and rainfall events in the surrounding highland areas (Jury 2014).

Remnant patches of natural vegetation in Malawi are largely restricted to formally protected areas and graveyards. In Malawian culture, the vegetation in places of burial, for both Muslim and Christian communities, is strictly protected. No person may enter the cemetery without the explicit permission of the area chief and absolutely no activities other than burying the dead may be practised (Steve Wemba pers. comms. March 2015). Although cemeteries provide small patches of protected habitat, normally less than 2 hectares in size, the truly valuable vestiges of natural ecosystems lie within the countries network of formally protected and gazetted National Parks and Wildlife Reserves. Malawi currently has 88 forest reserves, 4 wildlife reserves and 5 national parks, officially protecting over 20,000 km^2 of land. Since Malawi's total land area is 94,080 km^2 (Worldatlas 2016), 21.2% of the country is formally protected, however, due largely to human encroachment and illegal charcoal production (Smith et al. 2015) many of these areas, particularly the forest reserves, are degraded and over-exploited. It is estimated that Malawi loses 1-2.8% of its natural forest cover each year to encroachment for agriculture, fuel wood and charcoal production (Ministry of Natural Resources, Energy and Environment 2010). Charcoal production alone is estimated to lead to 15,000 hectares of deforestation in Malawi annually, much of which is harvested in indigenous Miombo woodlands (Smith et al. 2015). Despite the habitat degradation that has already occurred, there are some areas in Malawi where wildlife is making a welcomed return.

1.2 Malawian conservation on the rise – A case study of Majete Wildlife Reserve

Majete Wildlife Reserve (MWR) is 700 km^2 in size and situated in the lower Shire Valley, at the southern end of the Great Rift Valley (African Parks 2012). It was a classic case of habitat degradation and over-exploitation due to encroachment by local people (African Parks 2012). MWR was first proclaimed a protected area in 1955 and was managed by the Malawian Department of National Parks and Wildlife (DNPW). Due to a lack of resources, funds and adequately equipped staff, poaching was rampant throughout the reserve by the 1980's (African Parks 2012). The elephant population that numbered an estimated 200 in 1988, was all but exterminated by 1992 along with many other species of game whose numbers were also drastically reduced (Staub et al. 2013). During the period preceding 2003 the reserve had no positive economic impact on surrounding communities and was not able to provide many jobs. Due to the dire poverty around MWR, locals pushed the reserves natural resources to the limit. Illegal logging, over fishing and uncontrolled agriculture all became problematic (African Parks 2012).

The South African based management organisation, African Parks, was founded in 2000 in response to the dramatic decline of protected areas across the continent due to poor management and lack of adequate funding (African Parks 2016). African Parks has based its activities on a clear business orientated approach, where economic development and poverty alleviation are aligned with wildlife protection to ensure long term sustainability of parks and reserves (African Parks 2016). The organisation currently operates and manages ten parks and reserves in seven countries across the continent, using donor funding from various sources to support their activities. They currently protect 6 million hectares of African protected areas and aim to manage 20 parks and reserves by 2020 (African Parks 2016).

In March 2003, the Malawian Government and African Parks entered into a 25 year Public-Private Partnership (PPP) for the management, rehabilitation and development of MWR (African Parks 2012, Leslie 2014). This was the first project taken on by African Parks and serves as a positive example to other similar projects, with animal and tourism numbers exhibiting significant increases. From 2003 to 2015 animal numbers have increased from an estimated 250 to 8800, while tourism figures have increased from a handful of visitors in 2003 to a total of 7318 visitors in 2015 (African Parks 2015). Since taking over the management of MWR, African Parks, with the help of donor funding and the Malawian Government and people, have erected a perimeter fence to protect local people and wildlife, restocked the reserve with game and kick-started a valuable tourism industry in the area (African Parks 2012, Leslie 2014).

Key to African Parks vision for MWR is community involvement, development and education. There are a total of 140,000 people living around MWR, and African Parks sees it as a key imperative that these communities derive real and tangible benefits from the reserve to secure long term sustainability of the project. Micro-enterprise projects have been started around the reserve such as bee-keeping and a craft project, producing woven palm baskets. African Parks also runs environmental education, as well as social infrastructure projects. African Parks have built community infrastructure including: three schools, teachers' houses', libraries, boreholes and 5 health clinics, to try and improve living conditions and access to basic infrastructure in communities surrounding the reserve. A malaria project has also been started to help curb the effect malaria has on surrounding communities. Employment has risen ten-fold since African Parks took over management of the reserve. With the introduction of tourism facilities and the implementation of management frameworks within the reserve, the staff complement has grown from 12 to 125 permanent employees, with other staff being employed on a temporary basis when needed (African Parks 2012).

Importantly African Parks has tried to maintain active community engagement and involvement in the reserve through a natural resource harvesting project within the reserve. Through this programme community members are given supervised access to the reserve via "community resource use" gates, to harvest grass, reeds and indigenous bamboo. Grass is the most frequently harvested resource. Harvesting is conducted as resources available to communities outside the reserve start to diminish, and is generally conducted as close to the reserve boundaries as possible (African Parks 2012, Samuel Kamoto pers. comms. July 2014).

1.3 Aims and approach

As of 2015 MWR has been operated and run by African Parks for more than a decade. Wildlife numbers have increased dramatically from an initial 2000 introduced in the mid-2000's (African Parks 2012) to over 7000 estimated in the 2015 game count (Craig Hay pers. comms. February 2016). Community engagement projects initiated by the reserve, have made progress in addressing the lack of employment and over exploitation of natural resources in communities surrounding the reserve, however, very little quantitative data has been collected on the success and current outcome of, in particular, the Resource Use Programme (RUP). The aim of this study was to specifically look at the success and current outcomes of the RUP activities and investigate how activities could be expanded to further contribute towards the livelihoods of surrounding communities.

The aims were therefore to:

1. Quantify the amount of thatching grass being removed from MWR;
2. Determine an accurate estimate of the number of people accessing the reserve to harvest grass;

3. Assess the need for medicinal plant harvesting inside the reserve;
4. Create a scientific catalogue of plants that traditional healers wish to harvest inside MWR;
5. Estimate the perceived impact that the RUP activities are having on local communities;
6. Identify challenges for the RUP programme;
7. Provide recommendations for addressing identified challenges to MWR management.

1.4 Brief Chapter overview

Chapter 1: Introduction

Introduces the concept of participatory practice in protected area management and why it is important in the developing world and particularly in Africa. Introduces the idea of using engagement efforts as a method of encouraging community support for conservation activities. Outlines why protected areas that have engaged with communities in Africa have been more successful than those that have not. Gives a brief description of the study site and the country in which the study was conducted. Outlines the main hypothesis of using sustainable harvesting practice as a way in which to engage rural communities in protected area management and gives a description of the project aims.

Chapter 2: Literature Review

Introduces the concepts of community based natural resource management (CBNRM) and sustainable harvesting practice used in protected area management by examining past research. The chapter focuses on the use of participatory practice in protected area management. Examines the influence community inclusion in protected area management has on ensuring support for alternative livelihood strategies and conservation activities. The chapter aims to show why community inclusion in protected area management is more than just 'business as usual' conservation.

Chapter 3: Thatch grass harvesting in Majete Wildlife Reserve

Examines the data collected during the 2015 RUP grass harvesting season at 5 of MWR's 8 RUP gates. Provides an analysis of harvester numbers, biomass of grass removed from MWR, variations in harvesting characteristics at each RUP gate as well as comparisons to harvesting data collected in 2014. The chapter also provides details on the distances travelled by community members to each RUP gate. The information collected provides novel quantitative baseline data for a RUP in one of Malawi's protected areas.

Chapter 4: Medicinal Plants used by Traditional Healers

Assesses the use of medicinal plants by traditional healers in communities surrounding MWR. Provides scientific identifications for plants collected in the field through ethnobotanical surveys with traditional healers and provides descriptions of scientific and local names, plant parts utilised and the uses for the plant. Additionally, information from interviews provides an insight into the importance of traditional healing practice as forms of income, and the demand for medicinal plant harvesting in MWR from traditional healers.

Chapter 5: Perceptions of the Majete Wildlife Reserve Resource Use Programme – a household survey

Assesses community perceptions of the current MWR RUP through a questionnaire survey. Provides insights into the general perception of current harvesting activities. Questions addressed in this chapter include; whether the RUP is long enough, whether grass is harvested for subsistence use only, and what grass harvested is used for. The data collected provides important suggestions to MWR management - from the communities surrounding MWR - on how the RUP could be improved moving forward.

Chapter 6: Project conclusion and management recommendations

Consolidates the data collected in Chapters 3–5 and proposes amendments to the current RUP to make sure that the programme remains relevant and beneficial to community members. The findings presented in chapter 6 aim to provide an overview of the most important findings of this project to benefit not only the reserve but also the communities surrounding MWR. The data presented aims to ensure that MWR continues to grow their contribution to community members by increasing their support for alternative livelihood strategies and continuing to allow natural resource harvesting inside the reserve.

References

Abbot, J.O., Thomas, D.H.L., Gardner, A.A., Neba, S.E., & Khen, M.W., 2001, Understanding the links between conservation and development in the Bamenda Highlands, Cameroon. *World Development*, 29, pp. 1115-1136.

African Parks. 2012, *Majete Wildlife Reserve, Malawi*. Available from: http://www.african-parks.org/Park_1_13_About+the+Park.html.

African Parks, 2015, *African Parks Annual Report 2015*. Available from: https://api.african-parks.org/ckeditor_assets/attachments/11/14897_african_parks.pdf.

African Parks, 2016, *Our Story*, Available from: https://www.african-parks.org/african-parks/our-story.

Amin, A., Zaehringer, J.G., Schwilch, G., & Kone, I., 2015, People, protected areas and ecosystem services: a qualitative and quantitative analysis of local people's perception and preferences in Cote d'Ivoire. *Natural Resources Forum*, 39, pp. 97-109. DOI: 10.1111/1477-8947.12069.

Andrade, W.M.d., Ramos, M.A., Souto, W.M.S., Bento-Silvo, J.S., Albuquerque, U.P.d., & Araujo, E.d.L., 2015, Knowledge, uses and practices of the licuri palm (*Syagrus coronate* (Mart.) Becc.) around protected areas in northeastern Brazil holding the endangered species Lear's Macaw (*Anodorhynchus leari*). *Tropical Conservation Science,* 8, pp. 893-911.

Banana, Y.A., Vogt, N.D., Bahati, J., and Gombya-Ssembajjwe, W., 2007, Decentralized governance and ecological health: why local institutions fail to moderate deforestation in Mpigi district of Uganda. *Scientific research and essays*, 2, pp. 434–445.

Devereux, S., Baulch, B., Macauslan, I., Phiri, A., and Sabates-Wheeler, R., 2006, Vunerability and Social Protection in Malawi. *Institute for Development Studies*. University of Sussex. Available at: https://www.ids.ac.uk/files/Dp387.pdf.

Ellis, F., & Manda, E., 2012, Seasonal food crises and policy responses: a narrative account of three food security crises in Malawi. *World Development,* 40:7, pp. 1407-1417.

Faasen, H., & Watts, S., 2007, Local community reaction to the 'no-take' policy on fishing in the Tsitsikamma National Park, South Africa. *Ecological Economics*, 64, pp. 36-46. DOI: 10.1016/j.ecolecon.2007.06.026.

Hausser, Y., Weber, H., & Meyer, B., 2009, Bees, farmers, tourists and hunters: conflict dynamics around Western Tanzania protected areas. *Biodiversity Conservation,* 18, pp. 2679-2703. DOI: 10.1007/s10531-009-9667-6.

IAASTD, 2009, *Agriculture at a Crossroads: International Assessment of Agricultural Knowledge, Science and Technology for Development – Volume V: Sub-Saharan Africa.* Washington.

Jury, M.R., 2014, Malawi's Shire River fluctuations and climate. *American Meteorological Society,* pp. 2039-2049. DOI: 10.1175/JHM-D-13-0195.1.

Kamanga, P., Vedeld, P., & Sjaastad, E., 2009, Forest incomes and rural livelihoods in Chiradzulu district, Malawi. *Ecological economics,* 68, pp. 613-624. DOI: 10.1016/j.ecolecon.2008.08.018.

Leslie, A. 2014, Animals of Malawi in the Majete Wildlife Reserve. Earthwatch Institute. Available from: http://earthwatch.org/expeditions/animals-of-malawi-in-the-majete-wildlife-reserve.

Meer, T., & Schnurr, M.A., 2013, The community versus community-based natural resource management: the case of Ndumo game reserve, South Africa. *Canadian Journal of Development Studies,* 34, pp. 482-497. DOI: 10.1080/02255189.2013.849580.

Mohebalian, P., & Aguilar, F.X., 2015, Additionality and design of forest conservation programs: Insights from Equador's Socio Bosque Program. *Forest Policy and Economics.* DOI: 10.1016/j.forpol.2015.08.002.

Mwale, F.D., Adeloye, A.J., & Beevers, L., 2015, Quantifying vulnerability of rural communities to flooding in SSA: A contemporary disaster management perspective applied to the Lower Shire Valley, Malawi. *International Journal of Disaster Risk Reduction,* 12, pp. 172-187.

Ministry of Natural Resources, Energy and Environment, 2010, *Malawi fourth country report to the Convention on Biological Diversity (CBD).* Available at: https://www.cbd.int/doc/world/mw/mw-nr-04-en.pdf.

National Statistical Office, 2014. *Malawi MDG Endline Survey 2014, key findings.* Zomba, Malawi.

National Statistical Office and ICF Macro, 2011, *Malawi Demographic and Health Survey 2010.* Zomba, Malawi and Calverton, Maryland, USA.

Naughton-Treves, L., Holland, M.B., & Brandon, K., 2005, The role of protected areas in conserving biodiversity and sustaining local livelihoods. *Annual Review of Environmental Resources,* 30, pp. 219-252.

Orr, A., & Mwale, B., 2001, Adapting to Adjustment: Smallholder livelihood strategies in southern Malawi. *World Development*, 29, pp. 1325-1343. Available at: www.elsevier.com/locate/worlddev.

Pienaar, E.F., Jarvis, L.S., & Larson, D.M., 2013, Creating direct incentives for wildlife conservation in community-based natural resource management programmes in Botswana. *Journal of Development Studies*, 49, pp. 315-333. DOI: 10.1080/00220388.2012.720366.

Population Reference Bureau 2015, *2015 World Population Data Sheet*. Available from: http://www.prb.org/pdf15/2015-world-population-data-sheet_eng.pdf.

Pouliot, M., & Treue, T., 2013, Rural people's reliance on forests and the non-forest environment in West Africa: evidence from Ghana and Burkino Faso. *World Development*, 43, pp. 180-193. DOI: 10.1016/j.worlddev.2012.09.010.

Staub, C.G., Binford, M.W., & Stevens, F.R., 2013, Elephant herbivory in Majete Wildlife Reserve, Malawi. *African Journal of Ecology*, 51, pp. 536-543.

Smith, H.E., Eigenbrod, F., Kafumbata, D., Hudson, M.D., & Schreckenberg, K., 2015, Criminals by necessity: the risky life of charcoal transporters in Malawi. *Forests, Trees and Livelihoods*, 24:4, pp. 259-274.

The World Bank Group, 2016, *Poverty: Sub-Saharan Africa*. Available at: http://data.worldbank.org/topic/poverty.

The World Economic Forum, 2014, *The Global Competitiveness Report 2013-2014, full data edition*. Geneva.

Vedeld, P., Jumane, A., Wapalila, G., & Songorwa, A., 2012, Protected areas, poverty and conflicts – A livelihood case study of Mikumi National Park, Tanzania. *Forest Policy and Economics*, 21, pp. 20-31. DOI: 10.1016/j.forpol.2012.01.008.

Weladji, R.B., & Tchamba, M.N., 2003, Conflict between people and protected areas within the Benoue wildlife conservation area, North Cameroon. *Oryx*, 37, pp. 72-79. DOI: 10.1017/S0030605303000140.

Wells, M.P., & McShane, T.O., 2004, Integrating protected area management with local needs and aspirations. *Ambio*, 33, pp. 513-519.

Worldatlas, 2016, *Geography Statistics of Malawi*. Available at: http://www.worldatlas.com/webimage/countrys/africa/malawi/mwlandst.htm.

World Health Organization, 2014, *World Health Statistics 2014.* Geneva. Available at: www.who.int/gho/publications/world-health-statistics/2014/en/.

Chapter 2: Literature review

2.1 Introduction to community based natural resource management (CBNRM)

Community based natural resource management was at one point in time hailed as being the developing worlds' answer to both poverty alleviation and conservation in the most rural settings (Measham & Lumbasi 2013). However, more recent times have shown a change in attitude towards CBNRM projects to one of more mixed reviews (Measham & Lumbasi 2013). The last few decades have seen a number of CBNRM projects fail for a multitude of reasons (Measham & Lumbasi 2013). One of the most common reasons for failure of CBNRM projects has been financial benefits which failed to meet local expectations (Shackleton et al. 2002). However, where projects are driven from within local communities and supported by established governmental and non-governmental institutions, CBNRM projects can and will succeed (Blaikie 2006). CBNRM projects aim to move management rights and responsibilities for protected areas to local communities (Child and Barnes 2010; Pienaar et al. 2013). The hypothesis is if communities organise themselves collectively and reclaim their rights to resources, the hope is that the resources will not only be well managed but benefit the communities ecologically and economically in ways that would not be possible if centralized management was in place (Child and Barnes 2010; Pienaar et al. 2013).

Many CBNRM projects aim to extend environmental protection to areas outside or adjacent to national parks or formally protected areas (Child 1996). Projects from east Africa have shown that success is largely determined by whether the project goals and community interests are appropriately aligned (Mustalahti et al. 2012). Projects are more likely to succeed when the targeted community can see the value in the activities. Externally initiated projects often lead to feelings of alienation within communities and a lack of motivation to achieve project goals (Measham & Lumbasi 2013). It has been found that one of the biggest challenges to past projects has been top down project initiation (Measham & Lumbasi 2013). Communities are far more likely to engage in projects that they initiated themselves and these projects have been found to be the most successful (Measham & Lumbasi 2013).

Many protected areas around the world have opted not to relinquish full management control to local communities but rather maintain controlled access to existing cultural and harvesting practice (Van Wilgen et al. 2015). The idea is that by maintaining certain existing practice but not handing over complete management responsibilities, large reserves with complicated management and ecological systems can continue to be run by organisations with adequate financial and personnel resources to take additional strain off sometimes already stressed communities. This is often referred to as "co-management" (Warner 1997). The aim of this strategy is to maintain ecological and economic sustainability of large tracts of land or ocean, while ensuring communities remain engaged and have access to traditional practice and resources without bearing full operational management responsibility.

Co-management agreements generally include a government or NGO partnered with a community (Barany et al. 2005).

2.2 Co-management and harvesting agreements

Many co-management harvesting projects have been initiated around the world, particularly across Africa (Lilieholm & Weatherly 2009; Van Wilgen et al. 2015). In Uganda's Kibale National Park, harvesting of wild grown coffee in the park was legalised to create a source of income and employment for local communities (Lilieholm & Weatherly 2009). These programmes provide local communities with legal access to harvestable resources within protected areas. Resources vary from plants, collected for fuelwood, medicinal purposes, craft or construction use, to animals – either as a subsistence level protein source or for commercial hunting (Barany et al. 2005; Child 1996; McKean 2003; Pienaar et al. 2013; Warner 1997). An ideal sustainable harvesting project, will both promote positive outcomes for the resource and ecological system and address economic concerns. In reality achieving both of these targets is a challenge that is not always easily overcome. Often the success of one target is favoured over the other. Either ecological sustainability is compromised to make way for a more profitable enterprise, or economic gains are set aside to conserve ecological integrity (Patenaude & Lewis 2014).

Where the needs of communities are not taken into full account or where co-management agreements are not honoured by the agency implementing the conservation activity communities are likely to push back. Christie (2004) found that in a series of marine protected areas in the Philippines, biological goals were favoured over social goals. While this had the positive outcome for biological ecosystems, it had the unintentional side effect of making indigenous communities feel excluded from natural resources they once used. As a result, local communities began to lose interest in the conservation of these areas and illegal fishing continued. In the initial stages of the projects, illegal fishing did decrease, but sadly as the projects continued and local communities began to feel that ecological benefits were not being shared equitably, their support for the various projects and the organisations running them began to wane. This particular project is a good reminder that community engagement, regardless of the organisation of a protected area, is vital for the long-term sustainability of the ecological system in question. Protected area co-management projects without community support are unsustainable. Without adequate conflict-resolution mechanisms in place, equitable sharing of resource benefits and the perception of this by all parties is bound to encounter challenges that could jeopardise the long-term success of any project.

Measham and Lumbasi (2013) found that where the goals of a conservation project align with the priorities and values of a community, projects will be successful. Where projects are initiated by communities themselves, and receive little other than technical support from external organisations and bodies, they are most likely to succeed. In this situation stakeholder engagement is constant as the main stakeholders are the ones controlling the operations on the ground. Project success is also bound by contextual factors (Mohammed & Inoue 2012). Contextual factors can play a vital role in project success or failure and include the social make-up of a community, existing cultural practises, social-economic challenges, political and institutional stability, frameworks and environments (Mohammed & Inoue 2012). Cultural norms and existing practice can play a large role in how resources are perceived. In northern Kenya, Measham and Lumbasi (2013) found that a contributing factor to the successful establishment and growth of the Ishaqbini Hirola Community Conservancy was linked to the cultural belief of the local Ijara people. The Ijara believe that if the Hirola were to disappear it would anger the gods bringing drought, death of their livestock and the destruction of their community. This ingrained cultural link proved to be a vital aspect of the projects success. The Ijara's sense of identity with the Hirola spurred local action and to date, other than receiving technical assistance from the Kenyan Government, the project has successfully been run by members of the Ijara community. Just as cultural beliefs governed the Ijara's sense of responsibility over the Hirola population of Northern Kenya, the Traditional Authority of Northern Ghana played an important role in the successful establishment of the Wechiau Hippo Sanctuary on the Black Volta River (Adjewodah and Beier 2004). The initiative built upon existing traditional taboos against killing hippos to create a sanctuary that is community run and all benefits flow to the local people. By creating an opportunity for eco-tourism as well as a shea nut butter cooperative the project facilitated the growth of the local economy and the creation of self-sustaining revenue streams. This in turn led to the installation of basic social infrastructure, including; clean water and sanitation facilities and schools (Olayide et al. 2013; Sheppard et al. 2010). Both these projects demonstrate that where traditional authority still commands respect and traditional contextual factors support the project goals, they are both vital components of the long-term success of conservation initiatives that are often not fully appreciated by scientific and government agencies.

In the semi-arid northern part of Rajasthan, India, Everard (2015) reports on a project that was initiated within the country by a local activist group, Tarun Bharat Sangh (TBS), on advice from a community elder. In a semi-arid region of India, highly dependent on ground water extraction, over exploitation of ground water resources had led to water shortages, decreased crop yields and livestock deaths. Historically communities in this region had used Water Harvesting Structures (WHS) which can be any structure, adapted to local topography, that trap monsoon rainwater and increases groundwater percolation. The project outline was simple, replicate age old practice and build WHS's in water stressed communities. From the out-set the project was successful, restoring soil moisture and ecology, improving food production as well as rejuvenating local grazing and vegetation. The initial success led to the construction of hundreds of WHS's. This expansion of the project led to decreasing soil erosion, allowing farmers to diversify cash crops and livestock composition. This project is a perfect example of how co-creation and community adoption of guiding principles supporting self-sustainable, community based engagement and co-management projects are more effective then rules and projects imposed by outside organisations.

Traditional land use in rural areas is often practised in close proximity to larger scale commercial operations and this can add an additional level of complexity to harvesting agreements. Where commercial development of natural-resource based industries is very rapid it can jeopardise the sustainability of traditional land-use practice (Gu & Subramanian 2014). Harvesting agreements need to take into consideration the needs and consumption rates of different stakeholders. For example: one commercial fishing operation on a lake ecosystem could extract more fish than all the subsistence fishers combined. In terms of a harvesting agreement, the rules for subsistence vs commercial operations would need to be carefully outlined and enforced to ensure fair resource distribution.

2.3 Assessing the sustainability of harvesting projects

Harvesting of resources in protected areas can provide impoverished communities with important sources of traditional craft and construction materials, as well as food, medicine and fuel (Barany et al. 2005; Child 1996; McKean 2003; Pienaar et al. 2013; Warner 1997). Harvesting programmes can provide products that communities may not be able to access outside of the protected area. Ecologically, harvesting projects need to be monitored and harvesting programme off-takes need to be quantified to maintain sustainable harvesting levels and minimise the chance of over-harvesting which can be detrimental to long-term sustainability of the ecological system. Without any reliable estimates of harvesting levels it is difficult to determine thresholds of sustainable use. Additionally, to balance the objectives of both, conservation and benefits to local people, the link between the economic benefits of the harvested resource and the resource base, including available biomass and life history traits, itself need to be fully understood (Baiyegunhi & Oppong 2016).

In a survey of South African national parks, most harvested resources were used as a source of traditional medicine and food, though few of the species surveyed had adequate empirical data attached to them. A lack of empirical data precludes scientific or management services being able to make any kind of reliable estimate of sustainable harvesting quantities. This knowledge gap leaves many resources at risk of unintentional over-exploitation (Van Wilgen and McGeoch 2015). In many cases animals or plants are collected illegally within protected areas. In these situations' it is often difficult to quantify the biomass being removed and this can severely jeopardise the sustainability of harvesting as regulating off take becomes very challenging. In rural areas' illegal harvesting is generally used as a source of meat or medicine because more sustainable and conventional options are not available. In urban centres, the illegal trade in plants and food products is generally driven by a smaller consumer base who pay high prices for "exotic" or "rare" products that are often consumed to show prosperity (MacDonald 2012). Resources harvested from protected areas, whether legal or illegal, often provide a source of food, medicine, fuelwood and income where very few alternatives are available, making them a vital component of household livelihood and survival strategies (Baiyegunhi & Oppong 2016; Sassen et al. 2015). Ideally all harvesting within protected areas should be accompanied by a regulatory framework, which is adequately enforced. Unfortunately, many protected areas lack the resources to enforce the rules of such agreements which then lead to an increase in illegal harvesting (Blokker et al. 2015; Sassen et al. 2015). Even in places where regulatory framework is present, it is not always effective. In the Kabarole area of Uganda, adjacent to Kibale National Park, an official licensing system was created to regulate the harvesting of wood to make charcoal. However, an active, illicit trade in sharing and duplicating these licenses was developed (Naughton-Treves et al. 2007). Together with the illegal licensing trade, survey data indicated that there was no clear understanding of the legal or cultural regulations around charcoal harvesting (Naughton-Treves et al. 2007). In the case of operational failures that lead to overexploitation some community harvesting projects have been used successfully to address environmental degradation. In Nepal, a membership system was created which provided local forest users with a cash subsidy to incentivise planting, development and protection of a community forest. Users were expected to participate in maintenance and protection activities while surplus income generated through the project was used for infrastructure development (Anup et al. 2015). Although a cash subsidy can increase participation it often involves an external partner to provide financial support, such as an NGO or Government, and although successful in this case, it is not a system that can be sustained independently and is in many cases difficult to replicate.

Resource dependent communities need development policies that encourage and facilitate the diversification of livelihood strategies. Through collaboratively developing activities that generate income from both sustainable natural resource use and other micro-enterprise industries poverty levels and vulnerability to climate change in these communities, could be reduced (Acharya et al. 2007; Bhandari & Grant 2007). Rural communities close to protected areas are often more vulnerable to crop raiding, livestock predation and decreased access to natural resources, making them the ideal populations to engage in harvesting and co-management agreements with protected areas (Adams & Hutton 2007). Harvesting projects that help provide alternative income generating activities in conjunction with community capacity building programmes, such as functional literacy programmes and micro-loan schemes, will help the most vulnerable of rural populations diversify their livelihood strategies while co-operating and helping to manage and police harvesting practice (Parker et al. 2015).

When dealing with the sustainability of plant resources it is important to consider the prevalence of invasive species and their abundance in the harvesting area. Extensive invasion by alien species can drastically reduce the quantity of biomass that can sustainably be removed from an area. Additionally, the propensity for an area to naturally burn and the frequencies with which burning takes place must be fully considered by management and included in regulatory frameworks (Blokker et al. 2015).

2.4 Determining perceived benefits of co-management and harvesting programme s

Rural communities and western society often have very different perceptions of the importance of conserving biodiversity. Often the full cost to rural communities of sharing their living space with various animal and plant species is not accounted for. What may appear to be a particularly sensitive forest area of high biodiversity to science, could be an important source of hardwood for charcoal production to a local community. Locally keystone species, valuable in maintaining ecosystem balance, might be seen as a dangerous animal that damages property, devastates crops or kills community members. Preservationist approaches have long been abandoned in modern conservation practises, hence the move to sustainable utilisation of protected areas. However, sustainable utilisation can have problems if the perceptions towards an area or resource, by the local people utilising it, is not fully understood by the government or scientific institutions in charge of protecting and managing it.

Charismatic species, like the Cetaceans, particularly whales and dolphins, are often the focus of very emotive environmental protection campaigns in western countries. However, in a survey conducted in the Brazilian Amazon it was found that fishermen were regularly killing the "Boto" (*Inia geoffrensis*) – an indigenous species of river dolphin – that is formally protected in the region, for use as bait to catch a number of economically important catfish species. During the survey, it was found that communities located close to conservation and research efforts saw the value of the "boto's" and were the least likely to kill them, especially since they did not seem to be a threat. Communities found to be regularly harvesting the "boto" were furthest from or un-accessible to researchers and conservation groups (Mintzer et al. 2015). If scientific and government agencies are able to identify the perceptions of local people towards areas that are to be protected, focused environmental education and outreach work can help to mitigate negative behaviours. Evidence from a Kilum-Ijim Forest Project, Cameroon, also suggests that active conservation projects and outreach can change people's attitudes towards more positive harvesting practice that focus on protection and respect of protected area boundaries (Abbot & Thomas 2001). A survey conducted in communities living around Katavi National Park, in Tanzania, also suggested that conservation activities and environmental education can be effective in changing people's attitudes to have a more positive outlook on conservation activities and practice (Holmes 2003). However, the study found that in many cases attitudinal changes are influenced by a complicated array of social, economic and cultural factors that can often be challenging to identify (Holmes 2003).

2.5 Climate change and importance of livelihood diversification in rural settings

Across the world, weather patterns are predicted to become more erratic and severe (Huq. et al 2004). The most vulnerable communities are largely found in resource dependent, least developed nations – such as Malawi (Huq. et al 2004). Rural communities in these countries, who rely on subsistence living, will be at greatest risk to climate change and associated fluctuations in rainfall and temperature cycles (Jacobi et al. 2013). In Bolivia, cocoa farmers stated that the greatest threat to their livelihood were changes in temperatures, predominantly heat, droughts and floods. The farmers in the region studied were found to accurately track climatic changes even though they had no access to scientific weather information (Jacobi et al. 2013). Most small scale rural farmers across the world, rely on rain as a means of irrigating their crops. Climatic changes that cause shifts in rainfall cycles will have a disproportionately large impact on the crop yields and therefore self-sustainability of rural subsistence communities.

Although natural hazards and disasters are viewed as having a generally negative impact on rural communities, Rampengan et al. (2014) found that isolated island communities in Sulawesi, Indonesia, responded to a catastrophic natural disaster by diversifying their livelihood strategies which enabled them to rebuild their community. By building on local knowledge with the addition of social cohesion and government assistance at critical points in time, the small island community was able to identify alternative livelihood strategies and develop them in such a way so as to make the community viable. This evidence supports the notion that it is often easier to build on and enhance creative livelihood strategies making use of local traditions, identity and history, than it is to reduce vulnerability of communities.

In areas where there is insufficient access to formal income generating streams, reliable markets for key natural resources are critically important, especially during periods of low agricultural yields or other income shortages. Diversification of livelihood strategies to include the use of traditional resources and skills can provide an important safety net when other income streams fail (Cotta 2015). The harvesting of wild food and medicinal resources provide poor rural communities with an invaluable source of food during times of scarcity and alternative healthcare options when western medicine is locally unavailable, hard to access or traditional healthcare options are simply preferred. Natural food and medicinal resources are harvested the most by families who lack access to “off-farm” income collection and those who live in close proximity to areas of natural vegetation (Andriamparany et al. 2014). Although livelihood diversification can help to provide households with safety nets, the type of activities used to do this must be fully considered. In a study conducted by Fisher (2004) it was found that although forest products helped to provide a safety net, the most lucrative products and activities- fuelwood, charcoal production and timber extraction – were also the most destructive and least sustainable. However, Fisher (2004) also found that lower earning activities that were less destructive can provide almost equal income streams to higher earning forest related activities when done in combination with one another. The impact of activities related to protected areas, regardless of biome, vegetation type or ecological system, need to be fully considered in terms of the level of destruction and degradation they cause. Overharvesting or destructive harvesting techniques can undermine the capacity for natural areas to withstand variations in annual weather patterns and climate change. As the incidences of climate change are becoming more intense, frequent and unpredictable, rural farmers will become increasingly vulnerable to periods of low agricultural yield. If protected areas are to provide communities with a safety net during periods of food shortages, it is vital their ability to cope with climate change is maintained (Finkbeiner 2015).

Natural resources can be a useful source of nutrients during times of food scarcity. In Benin, Boedecker et al. (2014) reported on wild edible plants making a contribution to the diets of rural people, particularly women during times of food shortage over the long dry season. Although the plants were not found to offer a significant contribution to nutrient uptake in the women's diet they did add diversity to what would otherwise be a very unvaried diet. Although not significant the contribution provided by these plants was nonetheless important. Along with providing an important source of food, indigenous plants offer an invaluable source of traditional medicine to rural communities. In Sub-Saharan Africa, where 22 million of the world's 34 million people infected with HIV reside, and where rural communities often have little alternatives, traditional medicinal plants can offer significant medicinal support to immune compromised individuals. Individuals over the age of 40 were found to harbour the most traditional knowledge, while younger generations were found to show less interest in traditional knowledge of natural resources and the continuation of this changing level of interest could lead to the erosion of traditional knowledge (Asiimwe et al. 2013). Distance from urban centres also appears to have an impact on levels of traditional resource knowledge. Those people, who live furthest away from large urban centres, generally have a more comprehensive knowledge of local resources borne out of necessity. When there is a food shortage or lack of western medicine, indigenous plants can offer an important alternative and so the knowledge of these resources is preserved (Bortolotto et al. 2015).

2.6 Utilising existing knowledge in developing harvesting strategies

Morsello et al. (2014) found that the more isolated a community is the more likely households are to rely on non-timber forest products (NTFPs) for subsistence survival. They found that regardless of whether they were purely harvesting for their own utilisation or selling the products in markets, their knowledge and diverse use of resources helped to buffer them against climate and market changes. It was also found that the more diverse the range of products harvested the less pressure was placed on any one individual resource, and so biological integrity of the ecological system was more likely to be maintained into the future. This evidence suggests that traditional ecological knowledge (TEK) is valuable when developing harvesting projects. This study emphasises the need for adequate social engagement in the development of harvesting projects to try and maximise existing knowledge of the diversity of use of a given ecological system. TEK can play a valuable role in helping conservation scientists and management organisations to develop sustainable frameworks around harvesting practises, from both the ecological and sociological contexts of the region and the resources in question.

O'Connell-Milne and Hepburn (2015) further support the argument that traditional harvesting knowledge can be invaluable. Their study found that traditional methods of harvesting, culturally and economically important, sea algae species on New Zealand's South Island, were not only the most efficient in terms of yield, but also lead to the fastest levels of regeneration. Traditional Maori techniques of harvesting were proven to be the most sustainable in the long term.

Many traditional taboos and laws were developed to conserve resources and ensure sustainable harvesting levels. Lunga and Musarurwa (2016) found that in certain parts of Zimbabwe, traditional leaders stipulated strict harvesting regulations within their communities to conserve both food and medicinal resources for times of climatic extremes or natural disasters. Taboos enforced by local authority structures, act as ways in which to protect livestock during breeding and lambing seasons, as well as conserve natural food sources for times of scarcity. Traditional ceremonies were limited to times of the year that did not coincide with the breeding and lambing seasons of livestock, to ensure that livestock would not be slaughtered during times that could threaten the sustainability of herds within the communities. Cutting down of indigenous fruit trees was prohibited as they provide valuable food sources outside of the formal crop harvesting season when food stocks are often in short supply (Lunga and Musarurwa 2016). Traditional harvesting practice can act as growth stimulants for certain natural resources, particularly certain species of plants and algae whose growth is naturally stimulated by defoliation in response to natural herbivory. Defoliation by humans, through harvesting, can have the same effect as natural herbivory (Cullis-Suzuki et al. 2015). Cullis-Suzuki et al. (2015) found that traditional harvesting methods for eelgrass collection off the Canadian coast-line increased the resource biomass, as it acted in concert with natural processes for shoot stimulation. Traditional harvesting methods like this are developed over generations of trial and error where sustainable utilisation was essential due to alternative survival options being unavailable.

The erosion of traditional natural resource management strategies often leads to resource over-exploitation and over-harvesting. In the Nicobar Islands off the coast of India, a natural disaster acted as a catalyst for the erosion of traditional reef management strategies. Patankar et al. (2015) found that the demographic most likely to ignore traditional rules were young fishers (19–35) and those who had received aid in the form of fishing gear (Patankar et al. 2015). The changing aspirations of young people can evidently have a significant impact on the effectiveness of traditional authority. This should be given ample consideration in developing countries where young people often make up the largest demographic and will therefore have the largest impact on natural resources.

Climate change adaptation strategies have been found to be the most effective when local and traditional knowledge is integrated with scientific approaches. This is particularly evident where local measurements and appropriate scientific data are lacking and TEK can play a very valuable role in helping to fill in the gaps (Leon et al. 2015).

However, in many cases the need to alleviate poverty has led to over-exploitation of natural resources through extractive resource use. In Mozambique, Bruschi et al. (2014) found that although the local people had an extensive knowledge of the natural resources available to them throughout the year, lack of formal employment and high population density led to extensive deforestation due to slash and burn agriculture and charcoal production. The immediate need to produce food crops and any source of formal income outweighed the desire to harvest natural resources sustainably. Traditional knowledge of natural resources is often held by older members of a given community and as the aspirations of younger generations start to change, so this traditional knowledge is at risk of getting lost with time. Mathibela et al. (2015) found that in the Blouberg area of Limpopo, South Africa, traditional knowledge of medicinal plants was held predominantly by women over the age of 60. Changing dynamics in the younger generations' level of education and religious beliefs meant that very few apprentice healers were in training, and so the number of emerging healers was minimal. Although people in the area still relied to a large degree on traditional healers when they fell ill, the future of medicinal plant knowledge in the area was found to be in question. In situations' such as this, recording this knowledge while it is still available and integrating these custodians into formal conservation management is important in terms of regional biodiversity and sustainable harvesting planning.

2.7 Conclusion

As populations in developing countries, such as Malawi, continue to grow unabated the pressure on natural resources for fuelwood, food, medicine and livelihood generation increases. Governments in countries with low GDP's do not have the tax revenue to expand their infrastructure network to buffer the pressure of a growing population on its natural resources. Without any alternative, rural communities have no option but to carry on utilising natural resources to survive. It is therefore of the utmost importance that innovative strategic solutions are sought that aim to find country specific alternatives to unsustainable natural resource overexploitation. Sustainable harvesting projects within protected areas, where resource use can feasibly be tracked and monitored, may help provide communities with valuable natural resources which are no longer available elsewhere. Co-harvesting agreements between protected areas and local communities could offer a sustainable solution to resource utilisation in rural Africa. For instance, where parks are fenced to protect dangerous and economically valuable animal resources which are threatened by poaching, co-harvesting strategies where local communities are given controlled access to parks and escorted by armed scouts could alleviate the threat of people being injured and people poaching game illegally. It also gives management the opportunity to control resource utilisation to sustainable levels. Crucially however, this strategy needs to be used with as co-operative and open a relationship with local communities as possible, so as not to cause animosity. Community engagement in co-harvesting strategies is of the utmost importance and the use of community extension officers and local champions who support the strategies, as well as park management who listen to the needs of the community are vital.

References

Acharya, S., Yoshino, E., Masamine, J., & Waikai, S., 2007, Empowering rural women through a community development approach in Nepal. *Community Development Journal,* 42, pp. 34-46.

Abbot, J.I.O., & Thomas, D.H.L., 2001, Understanding the links between conservation and development in the Bamenda Highlands, Cameroon. *World Development,* 29, pp. 1115-1136.

Adams, W.M., & Hutton, J., 2007, People, parks and poverty: political ecology and biodiversity conservation. *Conservation Society,* 5, pp. 147-183.

Adjewodah, P., & Beier, P., 2004, Working with traditional authorities to conserve nature in West Africa. African Conservation Telegraph; Newsletter of the Africa Section of the Society for Conservation Biology, October – November 2004, Volume 1, Issue 2.

Andriamparany, J.N., Brinkmann, K., Jeannoda, V., & Buerkert, A., 2014, Effects of socio-economic household characteristics on traditional knowledge and usage of wild yams and medicinal plants in the Mahafaly region of south-western Madagascar. *Journal of Ethnobiology and Ethnomedicine,* 10: 82.

Anup, K.C., Koirala, I., & Adhikari, N., 2015, Cost-benefit analysis of a community forest in Nepal. *Journal of Sustainable Forestry,* 34, pp. 199-213.

Asiimwe, S., Kamatenesi-Mugisha, M., Namutebi, A., Borg-Karlsson, A.K., & Musiimenta, P., 2013, Ethnobotanical study of nutri-medicinal plants used for the management of HIV/AIDS opportunistic ailments among the local communities of western Uganda. *Journal of Ethnopharmacology,* 150, pp. 639-648.

Baiyegunhi, L.J.S., & Oppong, B.B., 2016, Commercialisation of mopane worm (*Imbrasia belina)* in rural households in Limpopo Province, South Africa. *Forest Policy and Economics,* 62, pp. 141-148.

Barany, M., Holding-Anyonge, C., Kayambazinthu, D., & Sitoe, A., 2005, Firewood, Food and Medicine: Interactions between forests, vulnerability and rural responses to HIV/AIDS. Proceedings from the IFPRI Conference: HIV/AIDS and Food Security, April 14-16, Durban, South Africa.

Blokker, T., Bek, D., & Binns, T., 2015, Wildflower harvesting on the Agulhas Plain, South Africa: Challenges in a fragmented industry. *South African Journal of Science,* 111, DOI: 10.17159/sajs.2015/20140160.

Bhandari, E.S., & Grant, M., 2007, Analysis of livelihood security: a case study in the Kali-Khola watershed of Nepal. *Journal of Environmental Management*, 85, pp. 17-26.

Blaikie, P., 2006, Is small really beautiful? Community-based natural resource management in Malawi and Botswana. *World Development,* 34, pp. 1942-1957.

Boedecker, J., Termote, C., Assogbadjo, A.E., Van Damme, P., & Lachat, C., 2014, Dietary contribution of wild edible plants to women's diets in the buffer zone around the Lama forest, Benin – an underutilized potential. *Food Security,* 6, pp. 833-849.

Bortolloto, I.M., de Mello Amorozo, M.C., Neto, G.G., Oldeland, J., & Damasceno-Junior, G.A., 2015, Knowledge and use of wild edible plants in rural communities along Paraguay River, Pantanal, Brazil. *Journal of Ethnobiology and Ethnomedicine,* 11, 46, DOI: 10.1186/s13002-015-0026-2.

Bruschi, P., Mancini, M., Mattioli, E., Morganti, M., & Signorinin, M.A., 2014, Traditional uses of plants in a rural community of Mozambique and possible links with *Miombo* degradation and harvesting sustainability. *Journal of Ethnobiology and Ethnomedicine,* 10: 59.

Child, B., 1996, The practise and principles of community-based wildlife management in Zimbabwe: the CAMPFIRE programme me. *Biodiversity and Conservation,* 5, pp.369-398.

Child, B., & Barnes, G., 2010, The conceptual evolution and practise of community-based natural resource management in southern Africa: past, present and future. *Environmental Conservation,* 37, pp. 283-294. DOI: 10.1017/S0376892910000512.

Christie, P., 2004, Marine protected areas as biological successes and social failures in Southeast Asia. *American Fisheries Society*, 42, pp. 155-164.

Cotta, J.N., 2015, Contributions of local floodplain resources to livelihoods and household income in the Peruvian Amazon. *Forest Policy and Economics,* 59, pp. 35-46.

Cullis-Suzuki, S., Wyllie-Echeverria, S., Dick, K.A., Sewid-Smith, M.D., Reecalma-Clutesi, O.K., & Turner, N.J., 2015, Tending the meadows of the sea: A disturbance experiment based on traditional indigenous harvesting of *Zostera marina* L. (Zosteraceae) the southern region of Canada's west coast. *Aquatic Botany,* 127, pp. 26-34.

Everard, M., 2015, Community-based groundwater and ecosystem restoration in semi-arid north Rajasthan (1): Socio-economic progress and lessons for groundwater-dependent areas. *Ecosystem Services,* 16, pp. 125-135.

Fisher, M., 2004, Household welfare and forest dependence in Southern Malawi. *Environment and Development Economics*, 2, pp. 135-154. DOI: 10.1017/S1355770X03001219.

Finkbeiner, E.M., 2015, The role of diversification in dynamic small-scale fisheries: Lessons from Baja California Sur, Mexico. *Global Environmental Change,* 32, pp. 139-152.

Gu, H., & Subramanian, S.M., 2014, Drivers of change in socio-ecological production landscapes: Implications for better management. *Ecology and Society,* 19, pp. 41. DOI: 10.5751/ES-06283-190141.

Holmes, C.M., 2003, The influence of protected area outreach on conservation attitudes and resource use patterns: a case study from western Tanzania. *Oryx,* 37, pp. 305-315.

Huq, S., Reid, H., Konate, M., Rahman, A., Sokona, Y., & Crick, F., 2004, Mainstreaming adaptation to climate change in Least Developed Countries (LDCs). *Climate Policy,* 4, pp. 25-43.

Jacobi, J., Schneider, M., Bottazzi, P., Pillco, M., Calizaya, & Rist, S., 2013, Agroecosystem resilience and farmers perceptions of climate change impacts on cocoa farms in Alto Beni, Bolivia. *Renewable Agriculture and Food Systems,* 30, pp. 170-183.

Leon, J.X., Hardcastle, J., James, R., Albert, S., Kereseka, J., & Woodroffe, C.D., 2015, Supporting local and traditional knowledge with science for adaptation to climate change: lessons learned from participatory three-dimensional modelling in BoeBoe, Solomon Islands. *Coastal Management,* 43, pp. 424-438.

Lilieholm, R.J., & Weatherly, W.P., 2009, Kibale forest wild coffee: challenges to market-based conservation in Africa. *Conservation Biology,* 24, pp.924-930.

Lunga, W., & Musarurwa, C., 2016, Exploiting indigenous knowledge commonwealth to mitigate disasters: from the archives of vulnerable communities in Zimbabwe. *Indian Journal of Traditional Knowledge,* 15, pp. 22-29.

MacDonald, D.W., Johnson, P.J., Albrechtsen, L.., Seymour, S., Duprain, J., Hall, A., & Fa, J.E., 2012, Bushmeat trade in the Cross-Sanaga rivers region: Evidence for the importance of protected areas. *Biological Conservation,* 147, pp. 107-114.

Mathibela, M.K., Egan, B.A., Du Plessis, H.J., & Potgieter, M.J., 2015, Socio-cultural profile of Bapedi traditional healers as indigenous knowledge custodians and conservation partners in the Blouberg area, Limpopo Province, South Africa. *Journal of Ethnobiology and Ethnomedicine,* 11:49.

McKean, S.G., 2003, Towards the sustainable use of palm leaves by a rural community in Kwazulu-Natal, South Africa. *Economic Botany,* 57, pp.65-72.

Measham, T.G., & Lumbasi, J.A., 2013, Success factors for Community-Based Natural Resource Management (CBNRM): Lessons from Kenya and Australia. *Environmental Management,* 52, pp. 649-659.

Mintzer, V.J., Schmink, M., Lorenzen, K., Frazer, T.K., Martin, A.R., & da Silva, V.M.F., 2015, Attitudes and behaviours toward Amazon River dolphins (*Inia geoffrensis*) in a sustainable use protected area. *Biodiversity Conservation,* 24, pp. 247-269.

Mohammed, A.J., & Inoue, M., 2012, Explaining disparity in outcome from community-based natural resource management (CBNRM): a case study in Chilomo Forest, Ethiopia. *Journal of Environmental Planning and Management,* 9, pp. 1248-1267.

Morsello, C., Delgado, J.A.d.S., Fonseca-Morello, T., & Brites, A.D., 2014, Does trading non-timber forest products drive specialisation in products gathered for consumption? Evidence from the Brazilian Amazon. *Ecological Economics,* 100, pp. 140-149.

Mustalahti, I., Bolin, A., Boyd, E., and Paavola, J., 2012, Can REDD+ reconcile local priorities and needs with benefits? Lessons from Angai Forest, Tanzania. *Ecology and Society,* 17. DOI: 10.5751/ES-04498-170116.

Naughton-Treves, L., Kammen, D.M., & Chapman, C., 2007, Burning biodiversity: Woody biomass use by commercial and subsistence groups in western Uganda's forests. *Biological Conservation,* 134, pp. 232-241.

O'Connell-Milne, S.A., & Hepburn, C.D., 2015, A harvest method informed by traditional knowledge maximises yield and regeneration post harvest for karengo (Bangiaceae), *Journal of Applied Phycology,* pp. 447-454.

Olayide, O.E., Popoola, L., Olaniyan, O., Dapilah, F., & Issahaku, R.Y., 2013, Assessing the transition from survival to sustainability: case of the Wechiau Community Hippo Sanctuary in upper west region of Ghana, West Africa. *Journal of Sustainable Development,* 6, pp. 47-56.

Parker, P., Thapa, B., & Jacob, A., 2015, Decentralizing conservation and diversifying livelihoods within Kanchenjunga Conservation Area, Nepal. *Journal of Environmental Management,* 164, pp. 96-103.

Patankar, V., D'Souza, E., Alcoverro, T., & Arthur, R., 2015, Erosion of traditional marine management systems in the face of disturbances in the Nicobar Archipelago. *Human Ecology,* DOI: 10.1007/s10745-015-9781-x.

Patenaude, G., & Lewis, K., 2014, The impacts of Tanzania's natural resource management programme mes for ecosystem services and poverty alleviation. *International Forestry Review,* 16, pp. 459-473.

Pienaar, E.F., Jarvis, S.L., & Larson, D.M., 2013, Creating direct incentives for wildlife conservation in community-based natural resource management programme mes in Botswana. *Journal of Development Studies,* 49, pp. 315-333.

Rampengan, M.M.F., Boedhihartono, A.K., Law, L., Gaillard, J.C., & Sayer, J., 2014, Capacities in facing natural hazards: a small island perspective. *International Journal of Disaster Risk Science,* 5, pp. 247-264.

Sassen, M., Sheil, D., & Giller, K.E., 2015, Fuelwood collection and its impacts on a protected tropical mountain forest in Uganda. *Forest Ecology and Management,* 354, pp. 56-67.

Shackleton, S., Campbell, B., Wollenberg, E., & Edmunds, D., 2002, Devolution and community-based natural resource management: creating space for local people to participate and benefit? *ODI: Natural Resource Perspective,* 7.

Sheppard, D.J., Moehrenschlager, A., McPherson, J.M., & Mason, J., 2010, Ten years of adaptive community-governed conservation: evaluating biodiversity protection and poverty alleviation in a West African hippopotamus reserve. *Environmental Conservation,* 37, pp. 270-282.

Warner, G., 1997, Participatory management, popular knowledge, and community empowerment: The case of sea urchin harvesting in the Vieux-Fort Area of St. Lucia. *Human Ecology,* 25, pp. 29-46.

Van Wilgen, N.J., & McGeoch, M.A., 2015, Balancing effective conservation with sustainable resource use in protected areas: precluded by knowledge gaps. *Environmental Conservation,* 42, pp. 246-255.

Chapter 3: Thatch grass harvesting in Majete Wildlife Reserve

3.1 Introduction

Protected area (PA) management strategies have changed in the past few decades, the focus has shifted from relying solely on centralised control to a more inclusive focus, where PAs actively collaborate with communities on conservation activities (Parker et al. 2015; Shackleton et al. 2002). After initial practises excluding local communities in decision making processes generated hostile attitudes towards PA conservation objectives, conservation authorities around the world have started to realise the value of local participation and inclusion in decision making processes (Andrade & Rhodes 2012). The fortress conservation approach was the dominant type of conservation practise in the 1960's and 70's (Watts & Faasen 2009). Fortress conservation used fines and legislation to keep local people out of PAs and punished communities for using resources within protected areas. This often aggressive approach to conservation failed in many cases to garner support from communities neighbouring PAs (Mohebalian & Aguilar 2015; Watts & Faasen 2009).

Protected area management is complicated due to highly variable site conditions and local community dynamics (Wells & McShane 2004). There will almost always be differences in the ways in which communities are impacted by wildlife and protected areas, and so site specific strategies to managing conflicts and challenges should be prioritised (Weladji & Tchamba 2003). More recent findings suggest that PA management strategies should promote simple, adaptive conservation and development initiatives that engage communities and compliment overall PA management goals (Hausser et al. 2009; Watts & Faasen 2009; Wells & McShane 2004). Often the implementation of community managed and open participatory PA projects are influenced by factors beyond the control of project implementers and managers (Hausser et al. 2009). Power relations between state, private stakeholders and local communities, as well as the historical context of the area and community in question can play a role in project success. These factors can all influence community by-in, and if unsuccessful can negatively impact how or even if, a project is implemented (Hausser et al. 2009). Participatory approaches can both benefit local communities and lead agencies in developing sustainable strategies for natural resource management (Beierle & Konisky 2000). In instances where a participatory approach has not been taken by the leading conservation authority, preservationist actions have led to negative socioeconomic and cultural impacts on communities (Faasen & Watts 2007).

Rural subsistence communities living adjacent to, or within protected areas have an often intimate relationship with their environment (Nustad 2015). Living a life dependent on natural resources means these communities have extensive knowledge of their environment. Africa has a long history of human habitation around wild areas and this has contributed to shaping the face of PAs across the continent (Nustad 2015). In South Africa it was found that communities living adjacent to PAs, expressed a widespread demand for a diversity of resources found within national parks (Van Wilgen & McGeoch 2015). In South African parks' natural resources were predominantly harvested for food and medicine (Van Wilgen & McGeoch 2015) while in Uganda and Zambia the most frequently harvested resources in PAs were indigenous trees for charcoal production and agricultural land expansion (Naughton-Treves et al. 2007; Watson et al. 2015). In areas where sufficient wage earning opportunities are rare, and particularly during seasonal periods of employment such as farming, reliable markets and sources of wild plants, trees and animals become vital sources of supplementary income, food, building materials and medicine (Cotta 2015). In impoverished communities, sources of wild caught food are often only sold on, if the quantity of harvested products exceeds the family's own requirements (Golden et al. 2013). In many cases' natural resources harvested in PAs contribute directly to the survival of families living in poor rural settings, rather than the harvested resource providing a source of informal income (Golden et al. 2013).

Resource harvesting is closely linked to human habitation, especially in rural subsistence communities where resources, such as; wild fruits and medicinal herbs, protein sources, timber and fuelwood, are often vital for survival. Controlled harvesting can offer a way in which to generate economic returns for communities living in rural areas (McKean 2003). Sustainable harvesting should aim to provide alternatives to more destructive land uses (McKean 2003). By allowing rural communities to harvest resources within PAs, there is an opportunity for the harvester to get a direct benefit from an area that they might otherwise be excluded from (Shackleton 1996). Allowing local communities to harvest certain resources within PAs provides an opportunity for local people to not only benefit from the PA, but engage with and play a role in reserve management. Engagement of this kind can help to foster a vested interest in conservation of the area by providing people with a sense of ownership (Van Wilgen & McGeoch 2015).

Harvesting natural resources within PAs presents a good opportunity for community engagement in conservation, however without data on harvesting levels and quantities, estimates of sustainability can not be made (Van Wilgen & McGeoch 2015). Constant monitoring of harvesting activities should take place to ensure that harvesting is kept at sustainable levels and that harvesting practices do not strain the resource's ability to regenerate (Geoghegan & Smith 2002).

Due largely to the diversity and abundance of large charismatic species and high densities of wildlife, Africa is seen as a continent of valuable wilderness areas. Recent decades have seen rapid increases in development, illegal wildlife exploitation and expanding human populations across the continent, leading many conservation agencies to express concern around conservation of the continents wildlife (Adams & Hulme 2001).

Majete Wildlife Reserve (MWR) is a 700 km^2 reserve in the southern Shire Valley of Malawi. MWR was first proclaimed a protected area in 1955 and up until 2003 was managed and operated by the

Malawian Department of National Parks and Wildlife (DPNW). Unfortunately, due to limited resources, funds and adequately equipped field staff, poaching was rampant in MWR, tourism was extremely limited and MWR contributed little to economic development and employment in surrounding areas (African Parks 2012; Staub et al. 2013). South African based management organisation, African Parks, was founded in 2000 in response to the dramatic decline of protected areas across the continent due to poor management and lack of adequate funding (African Parks 2016). In 2003, African Parks and the Malawian Government entered into a 25-year Public Private Partnership (PPP) for the management, rehabilitation and development of MWR. Since taking over the management of MWR, African Parks, with the help of donor funding and the Malawian Government and people, have erected a perimeter fence to protect local people and wildlife, restocked the reserve with game, and kick-started a valuable tourism industry in the area (African Parks 2012, Leslie 2014).

Key to African Parks' vision for MWR is community involvement, development and education. There are a total of 140,000 people living around the reserve, and African Parks sees it as a key imperative that these communities derive real and tangible benefits from the reserve to secure long term sustainability of the project (African Parks 2012). African Parks has tried to maintain active community engagement and involvement in the reserve through a sustainable resource harvesting project within the reserve. Through this programme, community members are given supervised access to MWR via "community resource use" gates, to harvest thatching grass, reeds and indigenous bamboo. Thatching grass is the most frequently harvested resource and includes; *Heteropogon contortus, Hyparrhenia hirta, Hyparrhenia filipendula* and Melinis spp. Thatching grass is harvested annually as resources available to communities outside the reserve start to diminish. All harvesting activities are conducted within 2km of the reserve boundaries (African Parks 2012, Samuel Kamoto pers. comms. July 2014).

The resource use programme (RUP) has been a part of MWR's community extension work for a number of years however, no reliable data had been collected on the number of people participating in the programme or the quantity of grass harvested annually. A lack of data had begun to concern MWR management as it has direct implications for the sustainability of harvesting activities.

The aims of this study were to develop a baseline dataset in order to: i) establish an estimate of the number of people accessing the RUP each year, ii) measure the biomass of grass being removed from MWR in kg, iii). describe demographics of the harvesters, and iv) document the distances travelled by the harvesters' population to each RUP gate.

3.2 Study area

3.2.1 Malawi in context

Malawi is a small African country situated within south and central Africa. With a largely rural population of 17.2 million people, Malawi is ranked as one of the poorest countries in the world (Population Reference Bureau 2015). Malawi's largely subsistence based economy has resulted in a gross national income (GNI) per capita of US$ 780, which is well below the US$ 2 270 average GNI per capita of the worlds' least developed countries. High population density, 458 people per square kilometre of arable land, in a country which relies predominantly on subsistence agriculture and a high population growth rate spurred by a fertility rate of 5 children per woman, means that pressure on natural resources is extremely high (Population Reference Bureau 2015). Key findings from a 2015 Millennium Development Goal (MDG) endline survey conducted in 2014 by the National Statistical Office of Malawi highlight the poor quality of life experienced by most Malawians. The survey results showed 9.5% of homes with electricity, 25.4% of homes with finished floors, 66.6% of homes with completed walls, and 41.5% of homes with a completed roof (National Statistical Office 2014). Lack of economic development has meant that Malawi's economy relies on substantial contributions from donor agencies. As of 2010, approximately 40% of Malawi's GDP was made up of aid contributions (Ministry of Finance 2011).

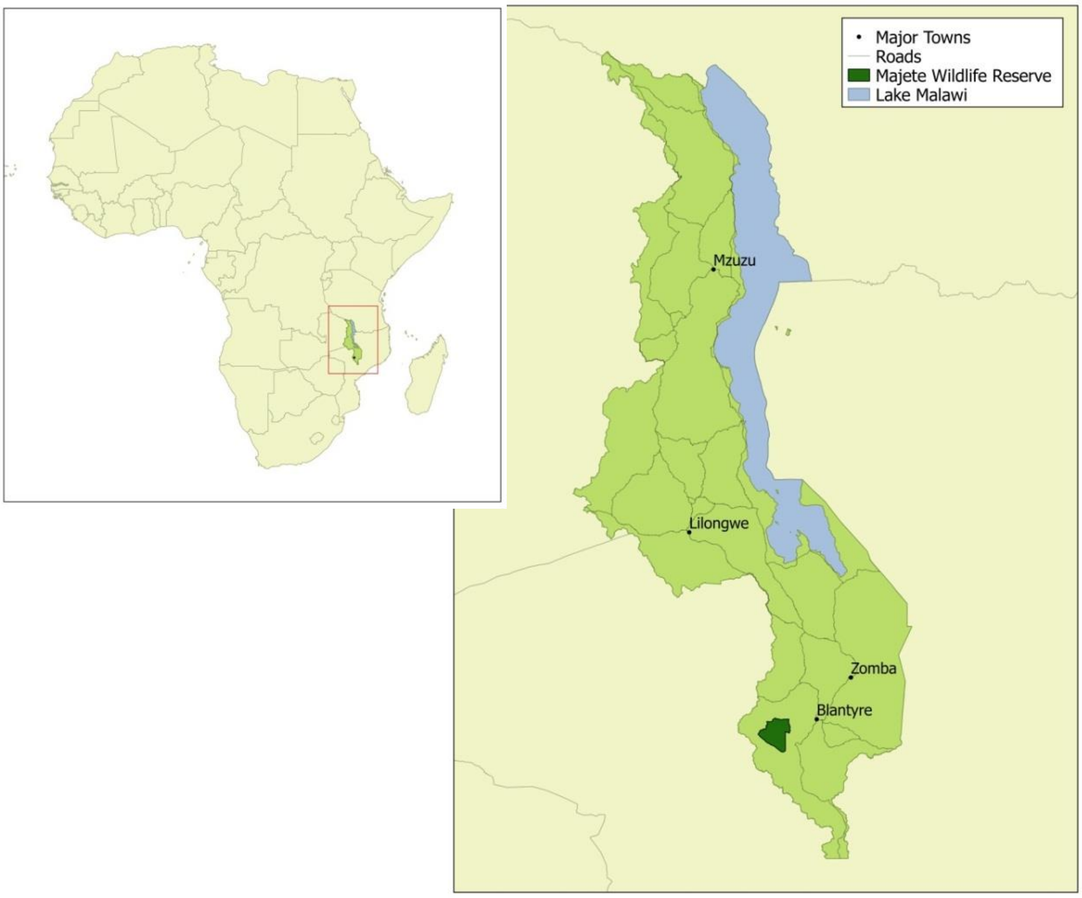

Figure 3.1: Location and extent of Malawi within Africa, and Majete Wildlife Reserve (MWR) within Malawi.

MWR is situated in the Shire Valley of Southern Malawi, in the administrative district of Chikwawa. The Shire River runs through the valley, providing a perennial water source and causing seasonal flooding. The entire valley lies below 150 m in sea level (Mwale et al. 2014) on the Great East African Rift Valley floor. Due largely to climate change the last two decades have seen recurrent incidences of drought and flooding in the Shire Valley (Chidanti-Malunga 2011). These climatic factors are believed to play a major role in the poverty levels experienced by residents of the valley, making it one of the poorest areas in Malawi (Chidanti-Malunga 2011).

3.2.2 Focus area: Majete Wildlife Reserve

We collected harvesting and demographic data for this project at five sites on the MWR boundary. A total of 8 gates are currently used in the Resource Use Programme (RUP). These gates are a combination of pedestrian and sliding vehicle access gates which have been built into the MWR boundary fence. Access is controlled by the law enforcement department on MWR and no community member can access the reserve without an armed game scout present to minimise the chance of dangerous wild animal encounters and to prevent poaching. We collected data at; Ka Koma, Kashon, Pende, Kabwatika and Mathanki RUP gates. We did not collect data at the remaining gates due to a lack of vehicular transport to the remaining gates during the harvesting period.

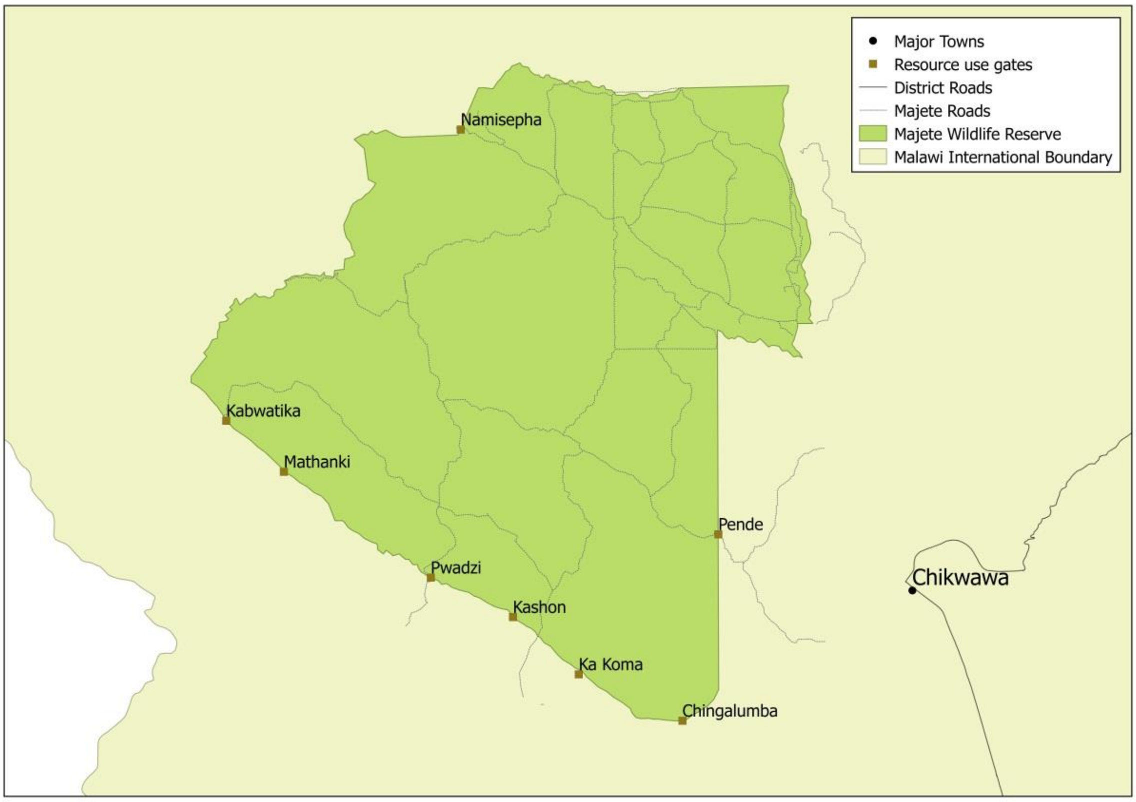

Figure 3.2: Majete Wildlife Reserve (MWR) with locations of Resource Use (RUP) Gates. RUP gates Pende, Ka Koma, Kashon, Mathanki and Kabwatika were monitored during the 2015 grass harvesting season.

3.3 Methodology

We designed data collection methods to be as simple as possible so that people not trained in scientific data collection could collect repeat measures easily. We worked with the African Parks community extension assistants throughout the study so that they could collect data when the researchers were unable to attend harvesting events and to develop data collection capacity within the African Parks extension team. The data collection methods were simple enough to be replicated by untrained workers. We used two different data techniques, one to collect harvesting data and one to map the villages involved in the RUP.

Reliable data on the harvesting activities conducted inside MWR had not been collected prior to this project. Therefore, we created this project as a baseline study to determine how much thatching grass was being removed annually from the reserve, as well as to determine how many harvesters utilise the RUP and the demographic breakdown of the harvesters. Data collected by the MWR extension department in 2014 was able to give us an indication of how many bundles of grass had been removed from the reserve previously. We used this as a rudimentary comparison indicator for the 2015 harvesting season.

3.3.1 Data collection – Harvesting

Thatch grass in MWR is harvested manually, with harvesters using a hand sickle to cut grass. Bundles of grass were made up of the following species; *Heteropogon contortus, Hyparrhenia hirta, Hyparrhenia filipendula* and Melinis spp. Bundles varied in size and weight according to what the harvester is able to carry on their head. Manual transportation of bundles on harvesters' heads was most common, but some harvesters made use of ox carts or bicycles to carry their bundles of grass home.

We created an identification card system to document the number of people entering MWR each day and to understand the number of repeat harvesters. As each community member entered MWR, we provided the person with a laminated card with a unique number on it. On the harvesters first day entering the reserve, we recorded; name, village of residence and gender. As each harvester exited the reserve, we recorded their unique number, weighed each bundle of grass in kilograms and counted the number of bundles per harvester. For the entire period that each gate was open for harvesting, we recorded information on every harvester that entered the reserve. We weighed bundles using 150 kg capacity hanging scales which were hung from a tree close to the RUP gate. A team of upwards of two people, lifted the bundles onto the scale using a rope sling while a scribe recorded the harvesters unique number and measurement data.

We collected data at 5 of the 8 gates opened for harvesting in 2015. We were unable to collect data at the other 3 sites due to a lack of vehicular transport. The 5 gates sampled acted as a sub-sample to generate an estimate of total thatch grass harvesting in the reserve for the 2015 harvesting season.

3.2.2 Data collection – Village mapping

We estimated the distance in kilometers (km) harvesters had to walk to access RUP gates to determine the general distances community members had to cover to participate in the MWR harvesting programme. We conducted this research in direct consultation with the MWR extension assistants (EAs) who drove us to each village known to participate in the RUP to collect data. We collected GPS coordinates at each village and RUP gate with a small handheld GPS device (Garmin Etrex 30). We then created a database with this data and used QGIS software (QGIS Development Team 2016) to map the straight-line distances between each village and the RUP gate through which residents of the village reported to gain access to MWR to harvest grass. We chose to represent distances as straight line values rather than actual walking values due to logistical and time constraints.

3.2.3 Statistical analysis

The initial analysis involved compiling all data into Excel (Microsoft Excel 2010) to determine basic harvesting characteristics based on the RUP gates, quantities of grass harvested (kg) and harvester demographics. From there the data was analysed using One-way ANOVA's to compare differences in the number of bundles, masses of bundles (kg) and return visits by both male and female harvesters to each gate. In cases where there were significant differences in the treatment means Bonferroni, Games-Howell and bootstrap post-hoc tests were used. All data analysis was done using Statistica 13 (StatSoft Inc. 2015).

3.3.1 Results

3.3.2 Thatch grass harvesting

Data collected during the 2015 harvesting season was able to give us a baseline dataset through which to estimate both the number of community members utilising the RUP annually as well as the biomass they removed. The harvesting season runs each year from approximately May to September, depending on the timing of the last rains. During the 2015 harvesting season a total of 2211 community members accessed MWR to harvest thatching grass through the 5 RUP gates surveyed. Kabwatika and Mathanki RUP gates were recorded to have the highest numbers of harvesters (Figure 3.3.1).

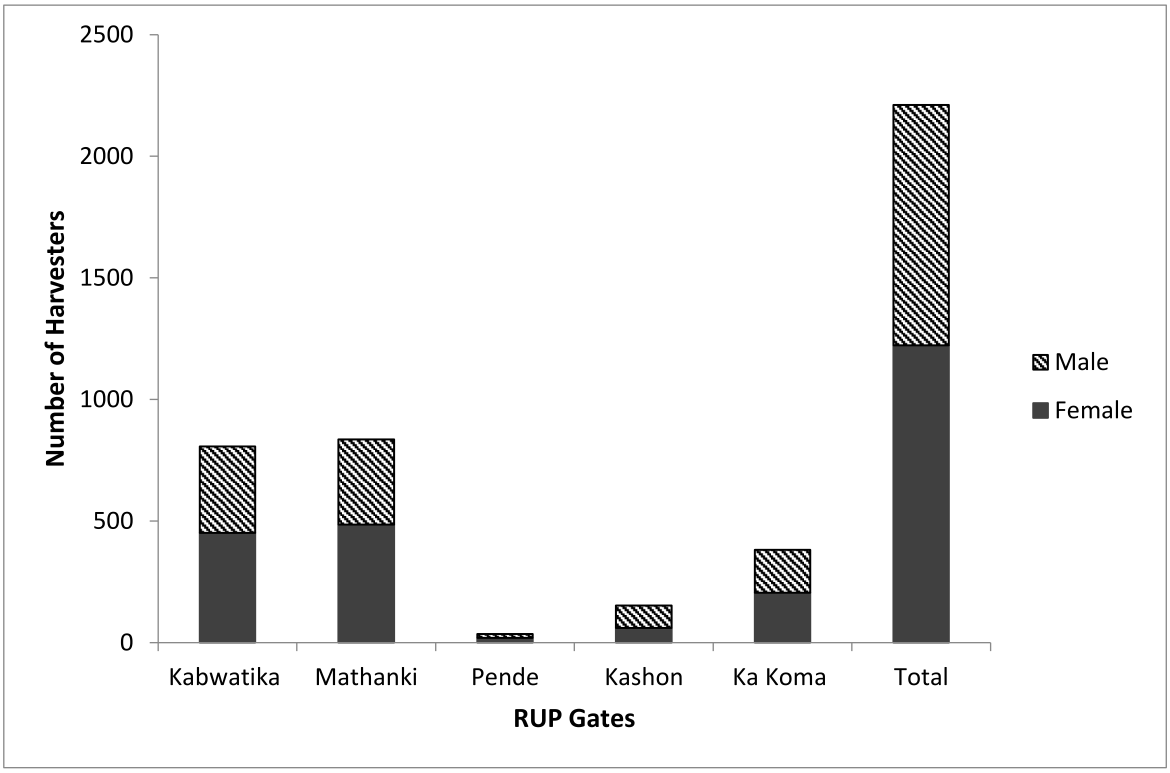

Figure 3.3.1: Graph to show the number of community members accessing MWR to harvest thatching grass during the 2015 resource use programme harvesting season.

The total quantity of thatching grass harvested between the 5 gates surveyed in 2015 was 134 073kg. Mathanki and Kabwatika RUP gates recorded the highest harvesting levels with community members harvesting 43 398kg of grass at Mathanki and 37 009kg of grass at Kabwatika (Figure 3.3.2). Kabwatika and Mathanki gates recorded the highest numbers of harvesters. There was no significant difference in the gender breakdown of harvesters, with the number of female harvesters recorded as only slightly higher than that of male harvesters.

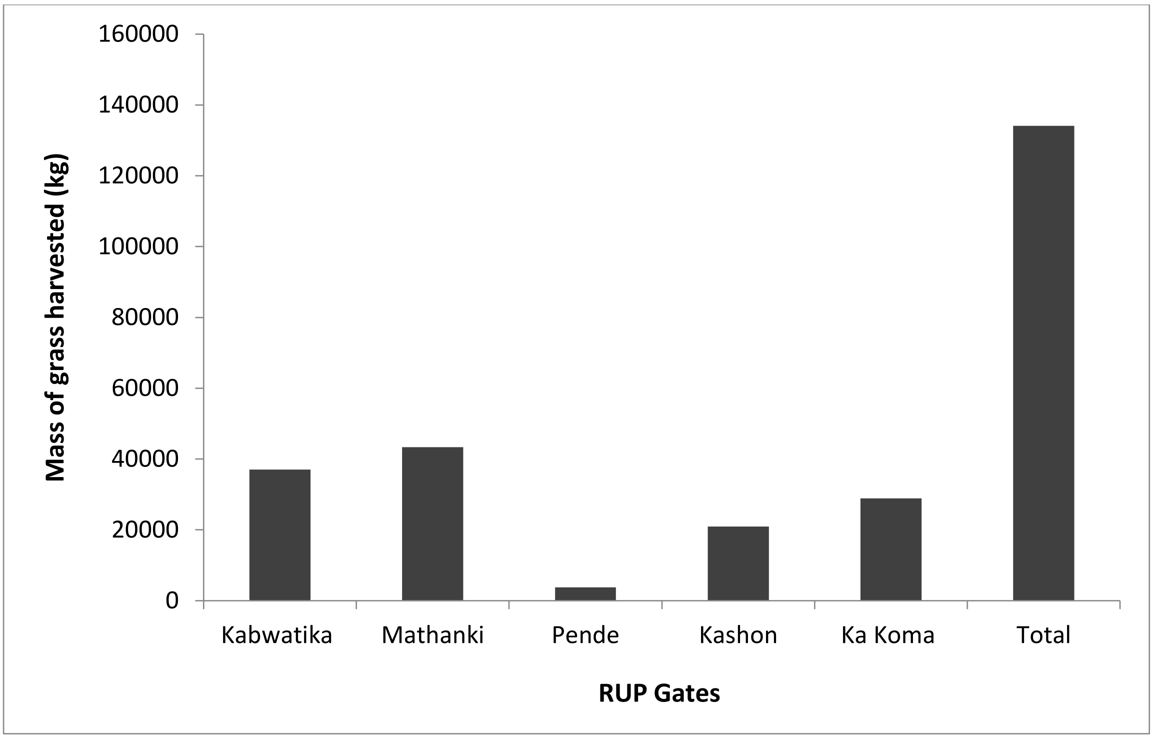

Figure 3.3.2: Graph to show the total mass of thatching grass (kg) harvested at each RUP gate during the 2015 harvesting season.

The RUP gates assessed during the 2015 harvesting season are distributed widely on the MWR boundary, which allowed us to collect data on community harvesters from villages on MWR's western, southern and eastern boundaries. Mathanki and Kabwatika gates where the highest harvesting levels were recorded (Figure 3.3.2) are both on MWR's south western boundary, in areas where formal employment opportunities are rare and the villages are furthest from the largest district town of Chikwawa. These areas were also where public transport access to Chikwawa was the most expensive [Joseph Mbalu pers. comms. August 2015]. Mathanki and Kabwatika recorded the highest quantities of grass removed from MWR, while Pende recorded the lowest quantities of grass removed from MWR.

Figure 3.3.3 gives a visual representation of where the RUP gates are in relation to Chikwawa and the relative quantities of grass harvested at each RUP gate. The largest % of the total harvest is clearly situated on MWR's south western boundary, with Kabwatika and Mathanki RUP gates clearly visible as situated the furthest from the largest district town of Chikwawa.

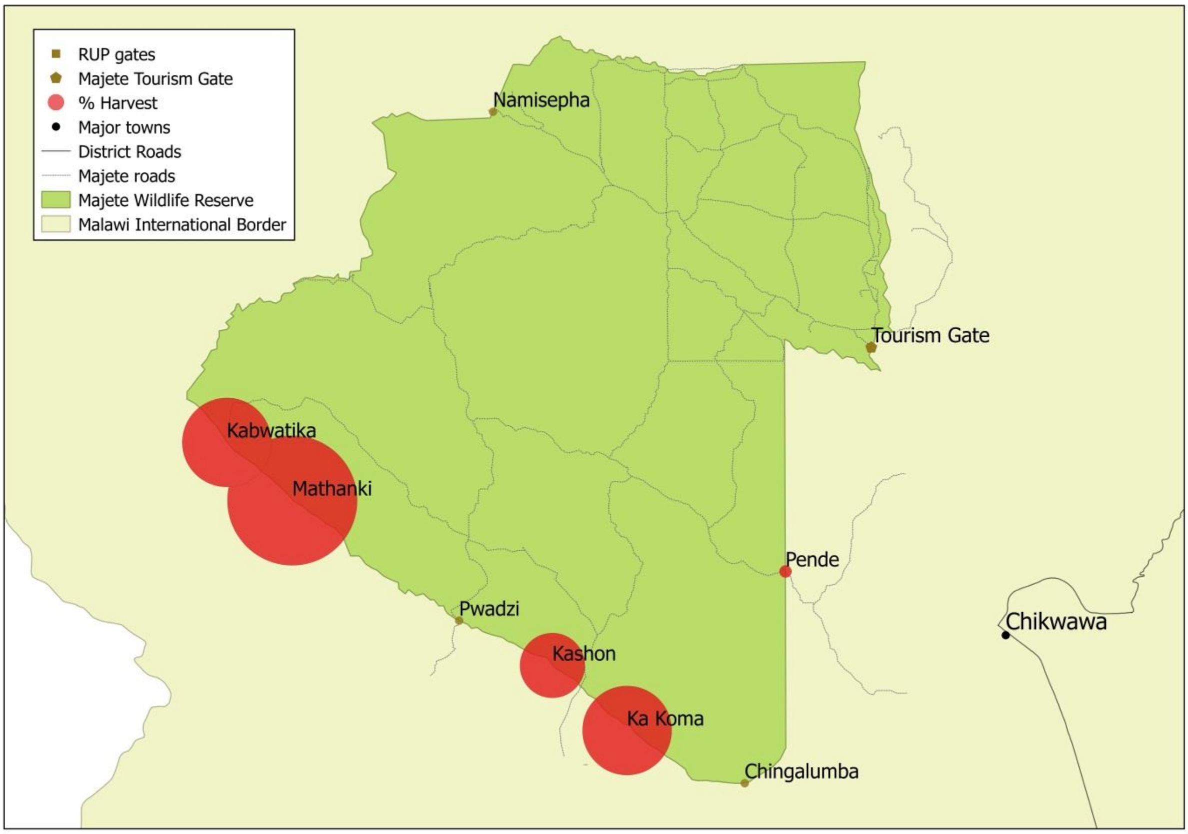

Figure 3.3.3: The distribution and intensity of harvesting activities recorded during the 2015 grass harvesting season. Red circles represent the % of the total harvest across the 5 surveyed RUP gates.

During the 2015 harvesting season, it became apparent that individuals harvesting in MWR generally harvested for more than one day during the period that the gate was opened for. We were able to track how many days' harvesters came back to harvest at each RUP gate through their unique numbers. To determine which RUP gates experienced the highest and lowest average number of repeat visits we conducted a one-way ANOVA in conjunction with a Games-Howell post hoc test to determine which RUP gates differed significantly in the number of average days' individuals accessed them during the harvesting period (Figure 3.3.4). The lowest number of average days spent harvesting at an RUP gate was recorded at Pende, this differed significantly from Kabwatika (MS = 2.63; df = 2238; p = 0.001), Kashon (MS = 2.63; df = 2238; p = 0.002) and Mathanki (MS = 2.63; df = 2238; p = 0.005). The average number of days spent harvesting at Ka Koma and Kabwatika also differed significantly (MS = 2.63; df = 2238; p = 0.004) with the average number of days spent harvesting being lower at Ka Koma RUP gate. The average number of days spent harvesting at Pende is therefore significantly lower than at Kabwatika, Kashon and Mathanki gates. The largest average number of days spent harvesting, per individual, was recorded at Kashon gate.

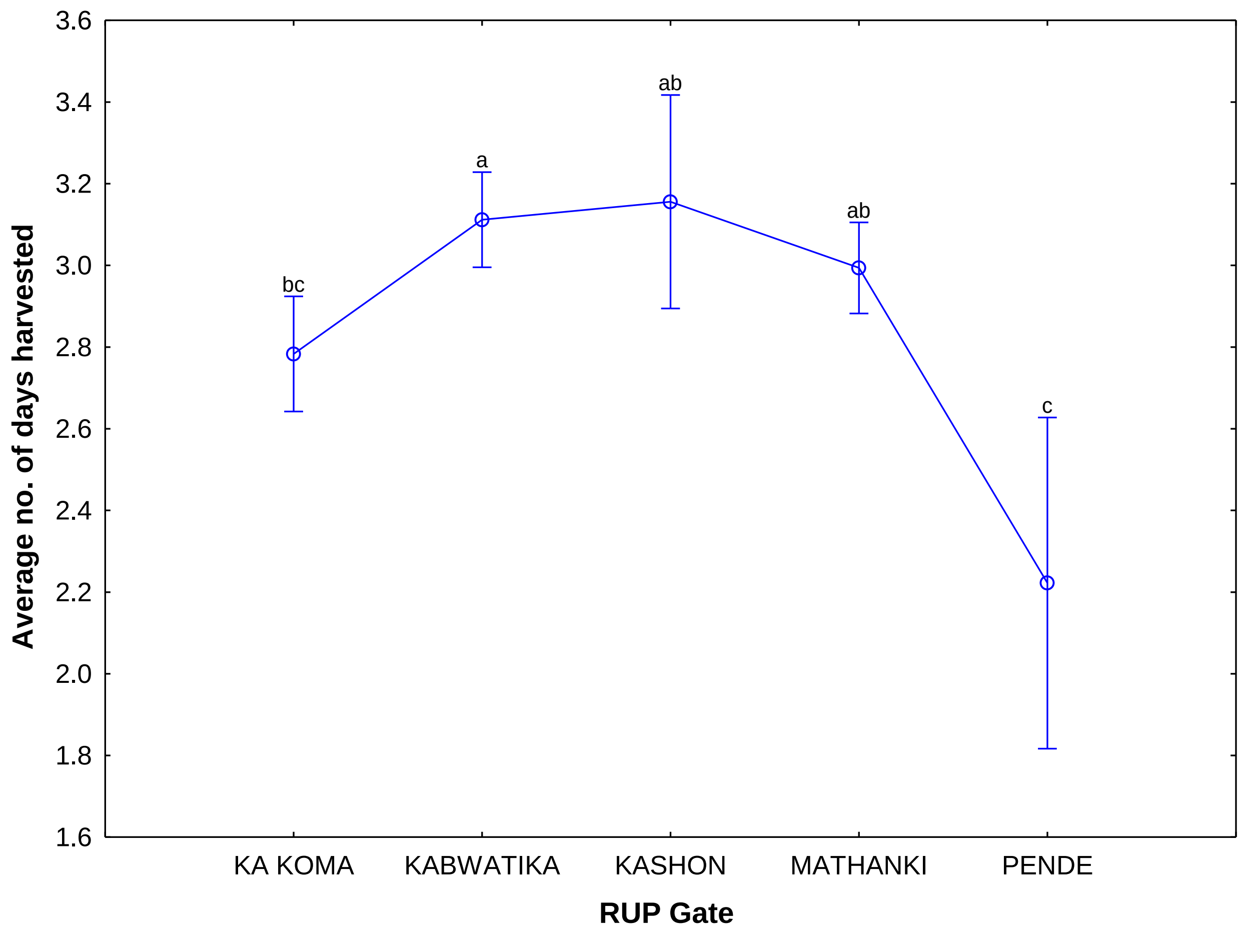

Figure 3.3.4: A weighted means test to describe the differences in the average number of days individuals spent harvesting at each RUP gate during the 2015 grass harvesting season. Differences between the average number of days spent harvesting at each gate are represented by the letters accompanying each variance bar. A significant difference is displayed where there is no matching letter.

To further understand how community members harvest grass in MWR we decided to look at how much grass (kg) is harvested per person, per day during the harvesting season at each RUP gate. Since we recorded harvesters returning at least twice to each RUP gate during the harvesting season it was important to understand how much grass (kg) was removed in a day, per harvester. In addition, we tested to see whether male and female harvesters, harvested more or less than one another at each RUP gate. The results of the ANOVA and bootstrap (Figure 3.3.5) suggest that the communities around each RUP were unique in their harvesting tendencies, with each RUP gate exhibiting significantly different average per day harvesting quantities (kg). The only gate where there was a significant difference in the amount of grass (kg) harvested between male and female harvesters was at Kashon gate, where female harvesters were recorded to harvest significantly more than their male counterparts (MS = 56.38; df = 2216; $p < 0.001$)(Figure 3.3.5)(ANOVA and bootstrap result). The largest quantities of grass harvested per person per day (kg) were recorded at Kashon and Pende gates, while the lowest quantities of grass harvested per person per day (kg) were recorded at Mathanki and Kabwatika gates. There are significant differences in the quantities of grass harvested between all gates except for Kashon and Pende.

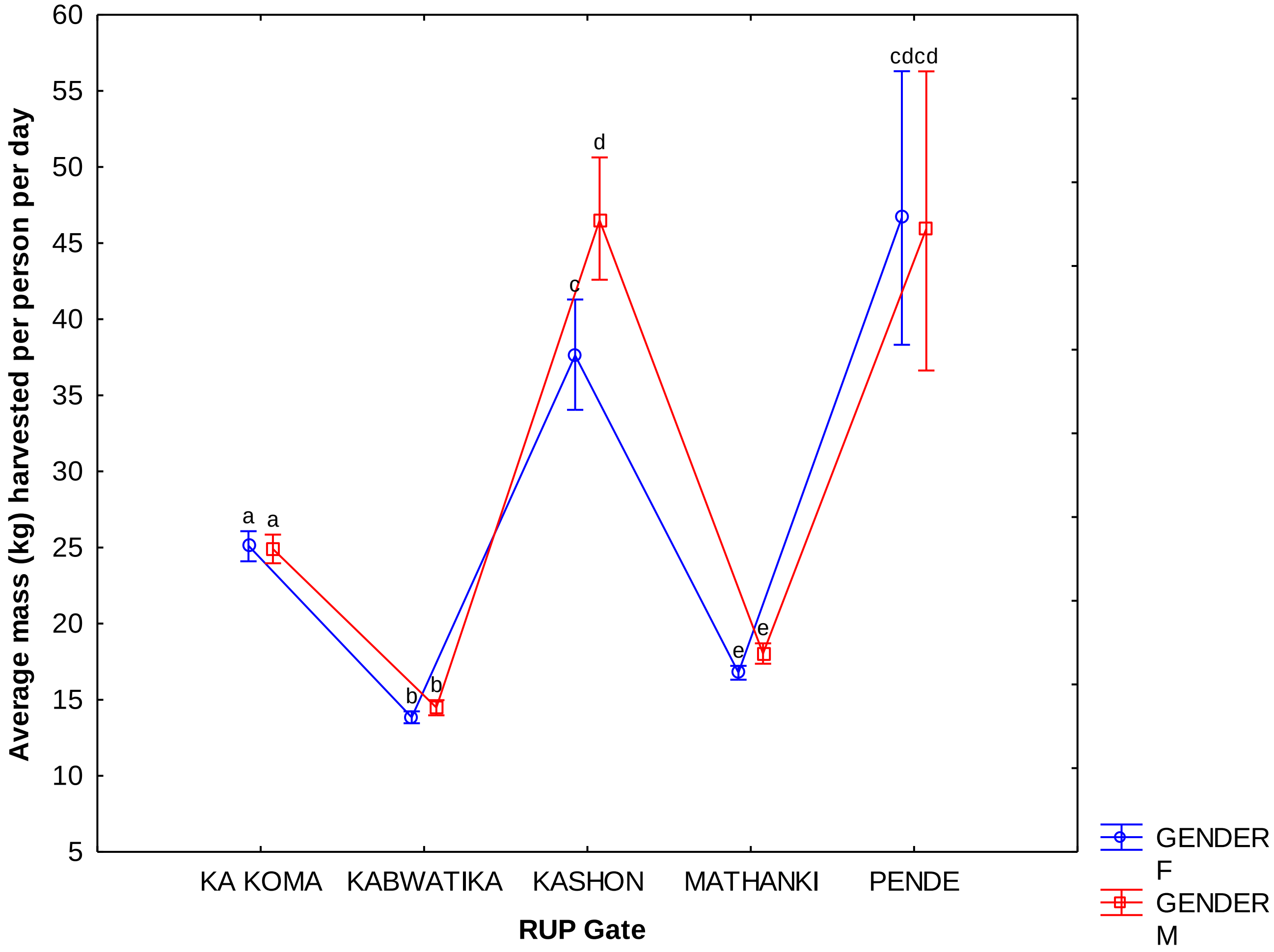

Figure 3.3.5: Results of the bootstrap test to show the differences in the average mass (kg) of grass harvested per day, per person at each RUP gate. Where letters differ there is a significant difference.

In 2014 the MWR extension team collected data on the grass harvesting activities by simply recording the number of bundles harvested at each RUP gate. Since our data revealed that individual harvesters returned to each gate at least twice during the harvesting period, we needed to determine on average how many bundles, individual harvesters collected at each RUP gate during the harvesting season. To obtain an estimate, we recorded how many bundles were harvested per individual at each RUP gate and then ran a one-way ANOVA with a Bonferroni post-hoc test on the data (Figure 3.3.6). Our results revealed that there was variation in the numbers of bundles harvested per individual at each RUP gate. The numbers of bundles harvested at Kashon RUP gate by female harvesters were significantly higher than the numbers of bundles harvested by female harvesters at Ka Koma (MS = 3.7; df = 2213; female:

p < 0.001; male: *p* = 0.09), Kabwatika (*MS* = 3.7; *df* = 2213; female: *p* < 0.001; male: *p* = 1.00) and Mathanki (*MS* = 3.7; *df* = 2213; female: *p* < 0.001; male: *p* = 0.25) RUP gates, however there was not a significant difference between the number of bundles harvested by male harvesters at each of those RUP gates. Similarly, there was a significant difference reported for the number of bundles harvested by female harvesters between Pende RUP gate and Ka Koma (*MS* = 3.7; *df* = 2213; female: *p* < 0.001; male: *p* = 0.03), Kabwatika (*MS* = 3.7; *df* = 2213; female: *p* < 0.001; male: *p* = 0.52) and Mathanki (*MS* = 3.7; *df* = 2213; female: *p* < 0.001; male: *p* = 0.06). Ka Koma and Pende were the only gates where a significant difference in the number of bundles harvested by male harvesters was recorded. Within each RUP gate there was no significant difference recorded between the number of bundles harvested by male and female harvesters. The highest number of bundles harvested in MWR by community members during the RUP harvesting season, were recorded at Pende RUP gate, with male and female harvesters collecting between 4.5 - 5.5 bundles each. The lowest number of bundles’, were collected at Ka Koma RUP gate with male and female harvesters collecting between 2.5 - 3 bundles each.

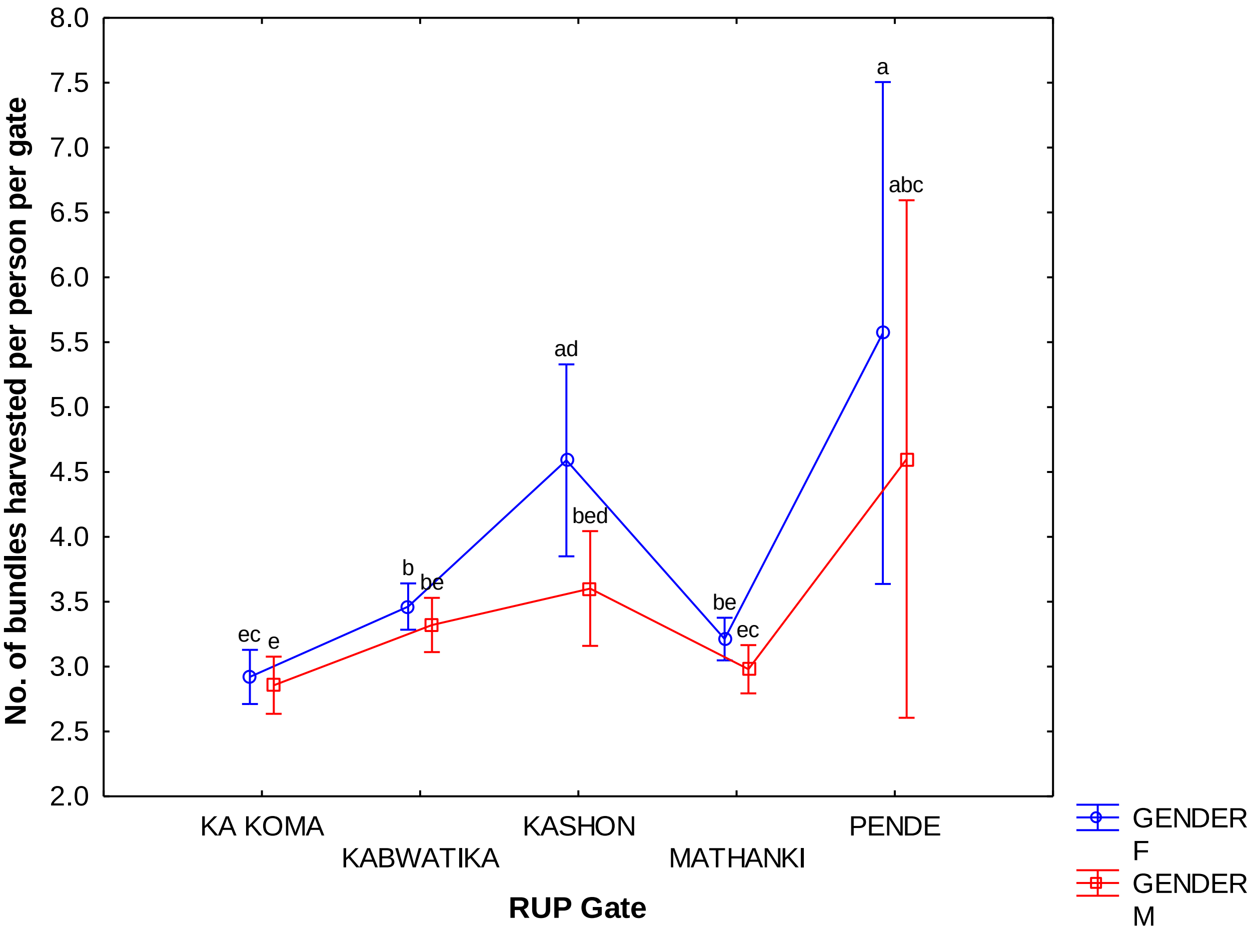

Figure 3.3.6: A weighted means test to show variation in the number of bundles harvested per individual at each RUP gate during the 2015 harvesting season. Where letters differ there was a significant difference.

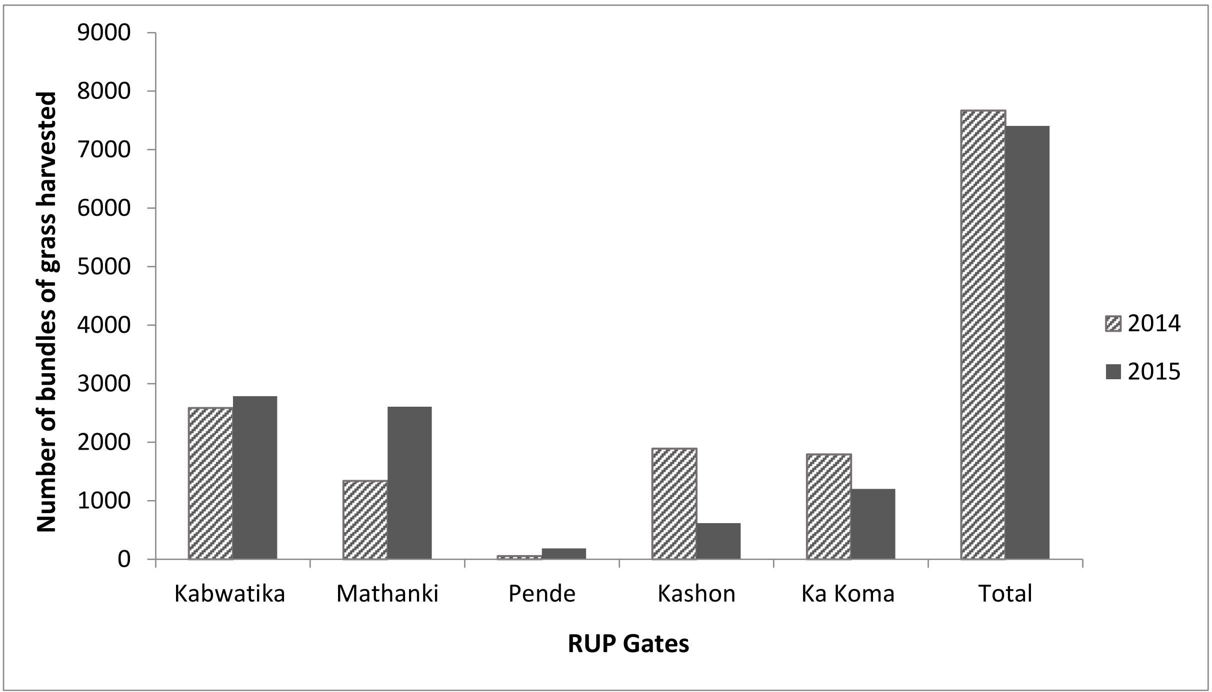

Figure 3.3.7: Comparison of the number of bundles harvested in MWR between 2014 and 2015. Mathanki showed the greatest increase in demand, while Kabwatika and Pende also showed increases in the demand for grass in MWR. Kashon and Ka Koma showed a decrease in demand for grass, while the total bundle count showed a slight decrease in overall demand for grass inside MWR.

Data collected in the 2014 grass harvesting season by the MWR extension team allowed us to compare the number of grass bundles harvested in 2015 to that of 2014 (Figure 3.3.7). Although basic, this data gives us an idea of the demand for grass harvesting in MWR and how it may have changed over the course of a year. The only RUP gate where demand has increased significantly is Mathanki, with Kabwatika and Pende showing only marginal increases in demand while Kashon and Ka Koma showed decreases in demand for grass inside MWR.

3.3.3 Distances travelled to reach each RUP Gate

Using the collected GPS co-ordinates we used the measuring tool on QGIS (QGIS Development Team 2016) in order to get straight line distance values (km) from each village to the gate that community members reported to harvest grass at. Figure 3.3.8 shows the location of villages involved in the RUP in relation to the RUP gates at which community members harvest grass. In total, GPS co-ordinates were collected at 85 villages that utilise 6 of the RUP gates. On top of the 5 RUP gates surveyed during the 2015 harvesting season we also collected GPS co-ordinates for villages known to utilise the Chingalumba RUP gate. Villages were colour co-ordinated with the relevant RUP gate at which community members reported to harvest grass. All villages reported to use a single RUP gate except one, Galonga village, in Chapananga district. Residents of Galonga were recorded to harvest grass at both Mathanki and Kabwatika RUP gates during the 2015 harvesting season.

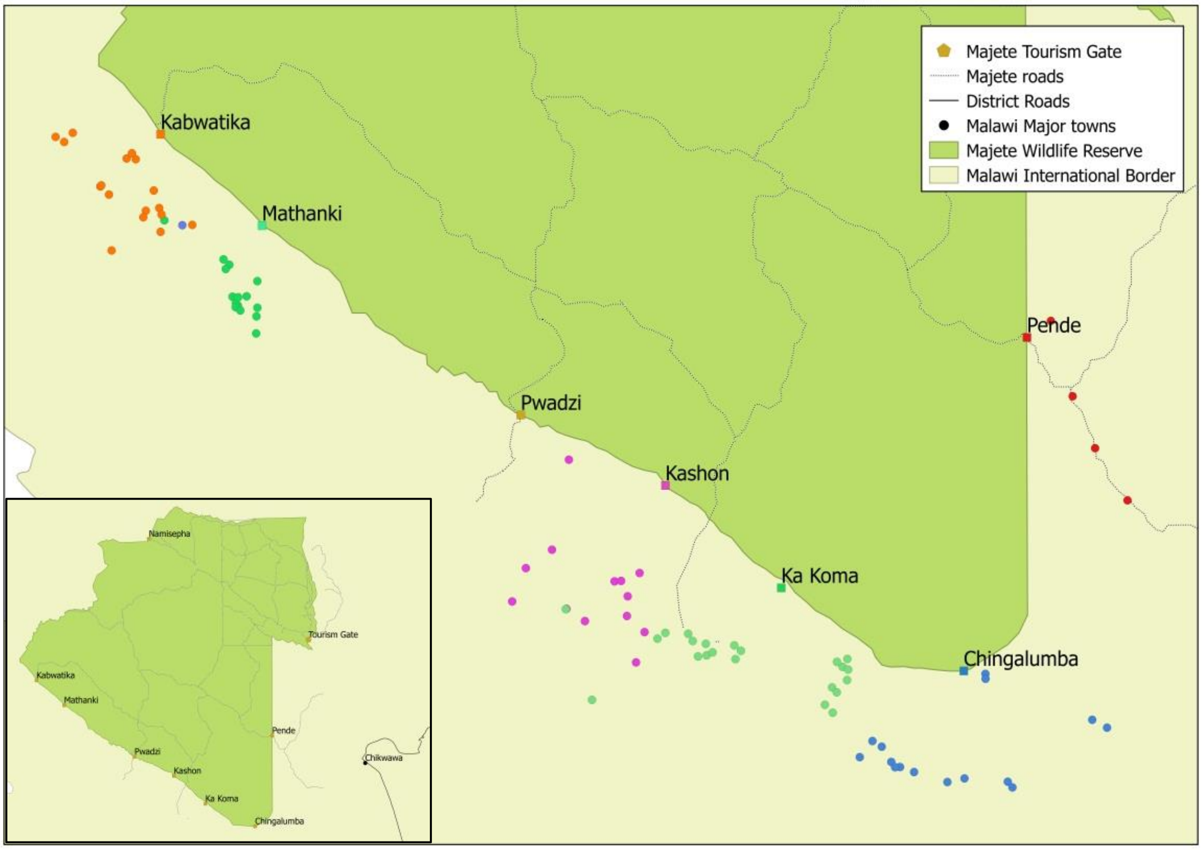

Figure 3.3.8: The distribution of the 85 villages which participate in the annual RUP harvesting season. Villages are colour co-ordinated with the RUP gate at which residents are known to harvest grass.

By measuring the straight-line distances (km) from each village to the RUP gate at which people reported to harvest we were able to create a baseline dataset through which to estimate the amount of effort required by community members to access each gate. Table 3.3.9 shows the shortest, longest and average journeys (km) required to access each RUP gate. The shortest and longest return distance was recorded for the Kashon and Ka Koma RUP gates, respectively. Kashon RUP gate recorded the largest variations between return distances, as well as the longest average distance travelled by community members to access the gate. Our observations during the 2015 harvesting season revealed that all grass harvested inside MWR was manually carried out of the reserve on the heads of the harvesters. Those who had access to a bicycle or ox wagon would transfer their load on exiting MWR and transport it home that way. Our observations also indicated that due to the poor condition of paths to certain RUP gates, such as Kabwatika, Mathanki and Ka Koma, the only option for harvesters was to carry their bundles home on their heads.

Table 3.3.1: A summary of the straight-line distances (km) between villages and the RUP gates residents reported to harvest grass at. The longest, shortest and average return distances to villages are represented for each RUP gate. On the ground distances are likely to be longer due to undulating terrain in the areas surrounding each RUP gate.

	Return distance (km)		
Gate	**Closest village**	**Furthest village**	**Average distance to villages**
Kabwatika	2.1	5.0	3.9
Mathanki	5.0	7.8	5.8
Kashon	0.4	11.7	7.7
Ka Koma	4.5	13.3	6.8
Pende	1.8	11.7	6.7
Chingalumba	1.3	9.32	6.6

3.4 Discussion

Thatching grass is most commonly harvested on MWR's south western boundary, with the largest quantities (kg) of grass being harvested at Mathanki, Kabwatika and Ka Koma RUP gates during the 2015 harvesting season. Along with the largest quantity of grass being harvested at these gates, they were also the RUP gates where the highest number of individual harvesters were recorded. Fewer harvesters were recorded at Kashon and Pende gates, but the per person quantities (kg) of grass removed from the reserve at these two gates were the highest of all 5 RUP gates. This suggests that although fewer overall community members utilise these gates, the demand from those who do use them is high. High harvesting levels on MWR's south western boundary, particularly at Mathanki and Kabwatika RUP gates, could be explained by the fact that these two RUP gates and surrounding villages are furthest from Chikwawa and formal employment opportunities. These results were similar to those of Fisher (2004) who found that communities that live furthest from major district towns and major roads relied more heavily on locally available forest resources. Comparisons of the bundle quantity data collected by the African Parks extension team in 2014, to our data collected in 2015 showed consistency in the total number of bundles harvested in the two harvesting seasons. Some RUP gates showed an increase in the number of bundles harvested from 2014-2015, while some showed a decrease. This shows a potential shift in the demand for grass between communities adjacent to MWR. Mathanki RUP gate showed the largest increase in demand, while Kashon RUP gate showed the largest decrease in demand. These findings supported anecdotal evidence from the extension team that the overall harvesting trends in 2015 were consistent with what had taken place in the 2013 and 2014 harvesting seasons [Joseph Mbalu and Steve Wemba (pers. comms. February 2016)].

Previous studies in Malawi have reported that the harvesting of natural resources, particularly firewood is the responsibility of women (Blaikie 2006; Fisher 2004; Kanthungo 2007; Mandondo et al. 2014). From our data it is clear that at least in the areas surrounding MWR, this is not true of thatch grass harvesting. Our data suggests that the harvesting of thatch grass by communities surrounding MWR is a responsibility shared equally by male and female household members.

Our data shows that there is variation in the way in which community members from different villages surrounding MWR interact with the RUP gates. It is apparent that while Kashon and Pende hosted the least number of harvesters, those who did harvest at those two gates collected the largest quantity of grass (kg) and number of bundles per person. Results on the average number of days that individuals access MWR to harvest grass also differed between RUP gates. These results support findings in other studies on community-based harvesting of natural resources, which demonstrate that communities are in no way homogenous and that community needs and values can vary significantly within a limited geographic area (Agyare et al. 2015; Holmes 2003; Wells & McShane 2004).

The straight-line distances that community members were reported to travel to harvest grass in MWR indicate that the grass available in MWR is of significant value to community members. Most grass harvested in MWR is manually carried out of the reserve on the heads of harvesters and a considerable amount of effort is spent carrying the bundles of grass home. This data supports findings by Fisher (2004) which found that asset-poor households in Malawi are reliant on forests for natural resources – particularly in areas where there has been environmental degradation around crop lands and villages. The results from this study support their argument, with asset-poor households in communities adjacent to MWR expending a significant amount of effort to make use of the grass harvesting permitted by the reserve through the RUP.

Community attitudes towards protected areas are often shaped by the perceptions gained from the type and degree of interactions between community members and reserve staff (Holmes 2003). The grass harvesting programme run through the MWR RUP, aims to ensure that even though the reserve is now fenced, community members are still able to benefit from the sources of natural resources in the reserve that they have historically harvested. Since the harvesting characteristics of communities surrounding the reserve vary considerably it is important that MWR management continue to monitor and adapt the existing programme to ensure long-term success. We suggest that the MWR management and extension team continue to engage with communities around the RUP to ensure that local needs are adequately addressed and the RUP stays relevant. From an ecological perspective it is vital that a more quantitative approach is taken to monitoring biomass off take of grass. Although counting the number of bundles removed from the reserve is logistically easier and can act as a rudimentary proxy, it is not an adequate long-term monitoring tool. Our suggestion would be for the MWR management and extension team to develop a method of monitoring the grass off take in kg's that is logistically feasible for the extension staff to manage. The monitoring tools used in this study proved to be effective but cumbersome in the field and required the help of extra staff at each extension gate. We would suggest that the MWR management team streamline the methodology in this study and develop a simpler way of monitoring both biomass off take (kg) and harvester numbers. The creation of an official harvester database and more effective tracking tools – such as a QR code and scanning system using tablets – could be worth considering. Making the measuring of bundle masses (kg) easier could be achieved through spot checks and biomass projections rather than measuring each individual bundle.

References

Adams, W., & Hulme, D., 2001, Conservation and Community: Changing narratives, policies and practices in African conservation. In: Hulme, D., & Murphree, M., (Eds), *African Wildlife and Livelihoods*. James Currey Ltd, London, pp. 11.

African Parks. 2012. Majete Wildlife Reserve, Malawi. Available from: http://www.african-parks.org/Park_1_13_About+the+Park.html.

African Parks, 2016, Our Story, Available from: https://www.african-parks.org/african-parks/our-story.

Agyare, A.K., Murray, G., Dearden, P., & Rollins, R., 2015, Understanding inter-community performance assessments in community-based resource management at Avu Lagoon, Ghana. *Environment, Development and Sustainability*, 17, pp. 1493-1508.

Andrade, G.S.M., & Rhodes, J.R., 2012, Protected areas and local communities: an inevitable partnership toward successful conservation strategies? *Ecology and Society*, 17, DOI: 10.5751/ES-05216-170414.

Beierle, T.C., & Konisky, D.M., 2000, Values, conflict, and trust in participatory environmental planning. *Journal of Policy Analysis and Management*, 19, pp. 587-602.

Blaikie, P., 2006, Is small really beautiful? Community-based natural resource management in Malawi and Botswana. *World Development*, 34, pp. 1942-1957.

Chidanti-Malunga, J., 2011, Adaptive strategies to climate change in Southern Malawi. *Physics and Chemistry of the Earth*, 36, pp. 1043-1046.

Cotta, J.N., 2015, Contributions of local floodplain resources to livelihoods and household income in the Peruvian Amazon. *Forest Policy and Economics*, 59, pp. 35-46.

Faasen, H., & Watts, S., 2007, Local community reaction to the 'no-take' policy on fishing in the Tsitsikamma National Park, South Africa. *Ecological Economics*, 64, pp. 34-46.

FAO, 2014, Review of food and agricultural policies in Malawi: Country report 2014. Available at: http://www.fao.org/publications/card/en/c/d43ae320-1d7e-4728-b8c0-9efca4064c82/.

Fisher, M., 2004, Household welfare and forest dependence in Southern Malawi. *Environmental and Development Economics*, 9, pp. 135-154.

Geoghegan, T., & Smith, A., 2002, Conservation and sustainable livelihoods: collaborative mangrove management in St. Lucia. *International Forestry Review,* 4, pp. 292 – 297.

Golden, C.D., Bonds, M.H., Brashares, J.S., Rodolph Rasolofoniaina , B.J.,& Kremen, C., 2013, Economic valuation of subsistence harvest of wildlife in Madagascar. *Conservation Biology,* 28, pp. 234-243.

Hausser, Y., Weber, H., & Meyer, B., 2009, Bees, famers, tourists and hunters: conflict dynamics around Western Tanzania protected areas. *Biodiversity Conservation,* 18, pp. 2679-2703.

Holmes, C.M., 2003, The influence of protected area outreach on conservation and resource use patterns: a case study from western Tanzania. *Oryx,* 37(3), pp. 305-315. DOI: 10.1017/S0030605303000565.

Kanthungo, J.I., 2006, An assessment of biodiversity contribution to rural livelihood security and protected area governance in Malawi: A case study of communities along Nkhotakota Wildlife Reserve. Available at: https://www.slu.se/globalassets/ny_struktur/org/centrb/cbm/dokument/publikationer-cbm/masteruppsatser/john-ian-kanthungo-thesis.pdf.

Leslie, A. 2014. Animals of Malawi in the Majete Wildlife Reserve. Earthwatch Institute. Available from: http://earthwatch.org/expeditions/animals-of-malawi-in-the-majete-wildlife-reserve.

Mandondo, A., German, L., Utila, H., & Nthenda, U.M., 2014, Assessing societal benefits and trade-offs of Tobacco in the Miombo woodlands of Malawi. *Human Ecology,* 42, pp. 1-9.

Mwale, F.D., Adeloye, A.J., & Beevers, L., 2015, Quantifying vulnerability of rural communities to flooding in SSA: A contemporary disaster management perspective applied to the Lower Shire Valley, Malawi. *International Journal of Disaster Risk Reduction*, 12, pp. 172-187.

McKean, S.G., 2003, Toward sustainable use of palm leaves by a rural community in Kwazulu Natal, South Africa. *Economic Botany*, 57, pp. 65-72.

Ministry of Natural Resources, Energy and Environment, 2010. *Malawi fourth country report to the Convention on Biological Diversity (CBD).* Available at: https://www.cbd.int/doc/world/mw/mw-nr-04-en.pdf.

Ministry of Finance, 2011, *Malawi Aid Atlas 2010/2011 FY,* Lilongwe, Malawi. http://www.mw.undp.org/content/dam/malawi/docs/capdev/AID%20ATLAS%202010-11%20-%20Malawi.pdf.

Mohebalian, P.M., & Aguilar, F.X., 2015, Additionality and design of forest conservation programme s: Insights from Equador's Socio Bosque Programme. Forest Policy and Economics. DOI: 10.1016/j.forpol.2015.08.002.

National Statistical Office, 2008, 2008 Population and Housing main report. Available from: http://www.nsomalawi.mw/2008-population-and-housing-census.html.

National Statistical Office, 2014. *Malawi MDG Endline Survey 2014, key findings*. Zomba, Malawi. Available at: http://www.nsomalawi.mw/latest-publications/mdg-endline-survey-2014.html.

Naughton-Treves, L., Kammen, D.M., & Chapman, C., 2007, Burning biodiversity: Woody biomass use by commercial and subsistence groups in western Uganda's forests. *Biological Conservation*, 134, pp. 232-241.

Nustad, K.G., 2015, Creating Africa's: Struggles over nature, conservation and land. Hurst & Company, London, pp. 4, 7.

Population Reference Bureau 2015, 2015 World Population Data Sheet. Available from: http://www.prb.org/pdf15/2015-world-population-data-sheet_eng.pdf.

QGIS Development Team, 2016, QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org.

Shackleton, C.M., 1996, Potential stimulation of local rural economies by harvesting secondary products: a case study of the Central Transvaal Lowveld, South Africa. *Ambio*, 25, pp. 33-38.

Smith, H.E., Eigenbrod, F., Kafumbata, D., Hudson, M.D., & Schreckenberg, K., 2015, Criminals by necessity: the risky life of charcoal transporters in Malawi. *Forests, Trees and Livelihoods*, 24:4, pp. 259-274.

Staub, C.G., Binford, M.W., & Stevens, F.R., 2013, Elephant herbivory in Majete Wildlife Reserve, Malawi. *African Journal of Ecology*, 51, pp. 536-543.

Watson, F.G.R., Becker, M.S., Milanzi, J., & Nyirenda, M., 2015, Human encroachment into protected area networks in Zambia: implications for large carnivore conservation. *Regional Environmental Change*, 15, pp. 415-429.

Watts, S., & Faasen, H., 2009, Community-based conflict resolution strategies for sustainable management of the Tsitsikamma National Park, South Africa. *South African Geographical Journal*, 91, pp. 25-37.

Weladji, R.B., & Tchamba, M.N., 2003, Conflict between people and protected areas within the Benouse Wildlife Conservation Area, Northern Cameroon. *Oryx*, 1, pp. 71-79. DOI: 10.1017/S003053030000140.

Wells, M.P., & McShane, T.O., 2004, Integrating protected area management with local needs and aspirations. *Ambio,* 33, pp. 513-519.

Van Wilgen, N.J., & McGeoch, M.A., 2015, Balancing effective conservation with sustainable resource use in protected areas: precluded by knowledge gaps. *Environmental Conservation*, 42, pp. 246-255.

Chapter 4: Medicinal plants used by traditional healers

4.1 Introduction

The use of traditional medicine and practice is still prevalent in low-middle income countries across the world (Suswardany et al. 2015). In rural and remote areas of the developing world, access to formal healthcare services is often limited due to transport, financial and logistical constraints (Rakotoarivelo et al. 2015; Suswardany et al. 2015). In rural areas with high levels of poverty, environmental factors and living conditions can contribute to disease prevalence. Factors such as household crowding, food insecurity and poor sanitation can lead to higher infection rates of communicable disease, couple this with limited access to healthcare facilities and rural communities often suffer from high mortality rates (Ellis et al. 2013; Tribess et al. 2015; Williamson et al. 2015). Even where western medicine is available, many rural communities still commonly use traditional medicine. Additionally, it is well documented that community members will combine traditional and western medication and treatment regimens (De Wet et al. 2013; De Wet et al. 2016; Hill et al. 2014; Mukolo et al. 2015; Shai & Sodi 2015; Stanifer et al. 2015;). Local communities consider traditional healers to take a more holistic approach to health care, spending more time with each patient, and administering culturally appropriate psychological counsel, an attribute often perceived by rural communities to be absent in western medical practitioners (Campbell & Amin 2014; Loeliger et al. 2016). Traditional medicine is most often reported to be used to treat daily symptomatic ailments and chronic diseases, but in Africa it has also been reported to treat infectious and opportunistic diseases (Asiimwe et al. 2013; Ellis et al. 2013; Stanifer et al. 2015). In rural areas' most communities generally have a readily accessible traditional healer (Hill et al. 2014) or have access to medicinal plants that they might use to self-medicate, negating the need for any form of medical practitioner (Rakotoarivelo et al. 2015). Research suggests that traditional healthcare can offer valuable support to western medical services in rural areas, in countries where access to and funding for formal healthcare is limited (d'Avigdor et al. 2014; Maneenoon et al. 2015; Ryan et al. 2011)

Traditional healthcare administered in the home is the first line of treatment for many rural and urban dwellers across Africa (Ellis et al. 2013; Lungu et al. 2016), in many cases only when severe symptoms continue is healthcare sought out elsewhere – either with a traditional healer or formal healthcare providers (Ellis et al. 2013; Lungu et al. 2016). The use of traditional medicine across sub-Saharan Africa is strongly linked to cultural and spiritual belief systems (Naidu 2014; Wagner et al. 2016). Many people turn to traditional medicine because it addresses the patients need for a spiritual explanation of their symptoms, particularly in relation to cultural superstitions and fears of sorcery – which are very prevalent in many communities across the subcontinent (Naidu 2014). Traditional healers generally rely on spiritual guidance for their herbal treatments that rarely have dosing guidelines leaving patients at risk of adverse effects caused by unknown toxicity levels of medicinal plants (d'Avigdor et al. 2014;

Hill et al. 2014). In most places across sub-Saharan Africa further research on the use of traditional medicine by rural communities is needed to better understand practices and doses (De Wet et al. 2016; Naidu 2014). In Malawi, a rural African country, a combination of inadequate healthcare infrastructure, a lack of formally trained medical practitioners and limited funding for state run healthcare centres and hospitals, has meant that people continue to rely heavily on traditional medicine (Daire & Khalil 2010; Lungu et al. 2016). Strong beliefs surrounding traditional medicine also mean that a disproportionately low percentage of the general population make use of the healthcare facilities available. As a country, Malawi relies significantly on the healthcare provided by traditional healers (Daire & Khalil 2010).

In the southern region of Malawi, Majete Wildlife Reserve (MWR) – 700 km^2 protected area - is attempting to engage local communities in conservation. The park was officially gazetted in 1955 and run by the Malawian Department of National Parks and Wildlife (DPNW) for almost five decades. Due to a lack of funding and personal resources, the park suffered rampant poaching, resource exploitation and encroachment during this time (African Parks 2012; Staub et al. 2013). In 2003, the South African based management company, African Parks - founded in 2000 to address declining trends in protected areas across Africa – entered into a 25 year Public-Private Partnership (PPP) with the Malawian Government, to take over management responsibilities for MWR from the DPNW (African Parks 2016). Since 2003, African Parks have erected a perimeter fence, restocked the reserve with animals and kick-started a valuable tourism industry (African Parks 2012, Leslie 2014).

Long-term sustainability of any conservation project relies on the support of local communities. There are a total of 140,000 people living adjacent to MWR and African Parks have made a concerted effort to try and involve these communities in how the parks resources are utilised (African Parks 2012). A resource use programme (RUP) is currently run by MWR which allows community members controlled access into the park to harvest thatching grass, bamboo and reeds, most commonly used as building materials (African Parks 2012). During community meetings with the MWR extension manager in 2014-2015, community members requested that the park consider adding medicinal plant harvesting to the existing RUP programme (Samuel Kamoto pers. comms. July 2014).

The aim of this study was to: (1) assess the need for medicinal plant harvesting in MWR; (2) determine what plant species traditional healers surrounding the park currently harvest and (3) determine what ailments and illnesses the plants currently harvested are used to treat.

4.2 Study area

4.2.1. Malawi in context

Malawi is a small African country situated within south and central Africa. With a largely rural population of 17.2 million people, Malawi is ranked as one of the poorest countries in the world (Population Reference Bureau 2015). Malawi has a lack of formal healthcare practitioners and facilities. The number of skilled physicians is extremely low, with only 2 doctors per 100 000 people and 28 nurses per 100 000 people (World Health Organisation 2014). The country is extremely poor with 66.7% of people living below the poverty line (World Health Organisation 2014). Due to high poverty rates 42.4% of children under the age of 5 have been subject to growth stunting linked to poor nutrition (World Health Organisation 2016). A general lack of health care facilities and medical practitioners means that life threatening, medical conditions are often not adequately addressed. In Malawi, the incidence rate of malaria and TB are 22% and 23% respectively, both diseases are life threatening if left untreated (World Health Organisation 2016). On top of this evident need for medical care across the country, 65% of the population have required some kind of formal medical intervention for a neglected tropic disease (NTD) (World Health Organisation 2016). Of the 17.2 million (Population Reference Bureau 2015) people living in Malawi, 85% of people live in rural areas where access to formal healthcare facilities is limited (Campbell et al. 2014). Rural populations in Malawi make up the most impoverished and least educated sector of the population, it is also the sector most vulnerable to infant and under-five mortality (Ministry of Finance, Economic Planning and Development 2014).

The last few decades of Malawi's political landscape have been marred with allegations of government sector mismanagement and corruption, resulting in a loss of donor confidence and reduced funding to the health sector (Daire & Khalil 2010). This loss of invaluable funding to the healthcare sector has resulted in less access for rural communities to vital formal healthcare facilities and staff. Mental healthcare facilities are particularly basic, with only 1 occupational therapist and 2 psychiatric clinical officers in the country and only 0.37 psychiatric beds and 2.5 psychiatric nurses per 10 000 people (WHO 2005). The Chikwawa district of Malawi is one of the poorest districts in the country, which has seen little change in living conditions since 2000 (Ministry of Finance, Economic Planning and Development 2014). The levels of poverty have actually increased in the last ten years, with the percentage of the population living on less than US$ 1 a day in the Chikwawa district increasing from 65% in 2005, to 81% in 2012 (Ministry of Finance, Economic Planning and Development 2014). High poverty levels have led to higher levels of stunting in children and malnutrition in both adults and children, putting greater strain on local medical facilities and staff (Ministry of Finance, Economic Planning and Development 2014).

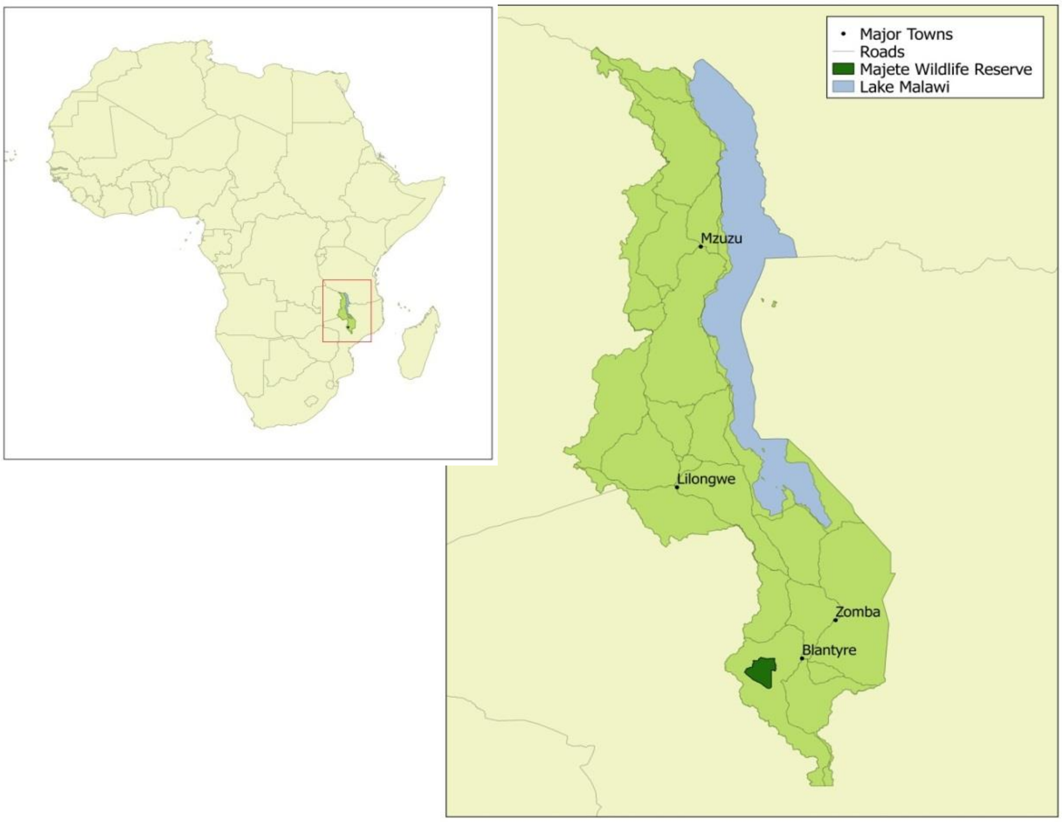

Figure 4.1: Location of Malawi within Africa, and Majete Wildlife Reserve within Malawi. MWR is situated in the south of the country, in the lower Shire valley, south of the biggest major city in the south, Blantyre.

4.2.2 Focus area: Majete Wildlife Reserve

We collected data for this study from communities adjacent to Majete Wildlife Reserve (MWR) in the Chikwawa district of Southern Malawi (Figure 4.1). Interviews were conducted across all 4 of the administrative districts surrounding the reserve (Figure 4.2.1) that are currently engaged in activities with the reserves extension department. The 4 administrative districts are as follows: on MWR's southern boundary – Kakoma and Chapananga, on the western boundary – Kasisi; and on the northern boundary – Mwanza. Each district encompasses a number of CBO's (community based organisations) and in some cases more than one traditional authority. All interviewed traditional healers were members of a community or village that currently take part in the existing MWR RUP. The topography and environment between interview sites differed, with sites on the northern boundary falling within the high-altitude miombo woodland, and sites on the southern and eastern boundary falling within the low-altitude mixed woodland vegetation type. Miombo woodland which makes up the vegetation type in some areas in MWR and surrounding villages has been prioritised for conservation due its high levels of endemism and for containing a number of threatened and endangered species (Jew et al. 2015).

Miombo woodland has been subject to a significant amount of deforestation due to agricultural expansion across southern and central Africa (Jew et al. 2015) and the areas adjacent to MWR are no exception. Much of the land outside of the reserve, in the areas in which we conducted interviews, have been extensively deforested due to agricultural expansion and charcoal production.

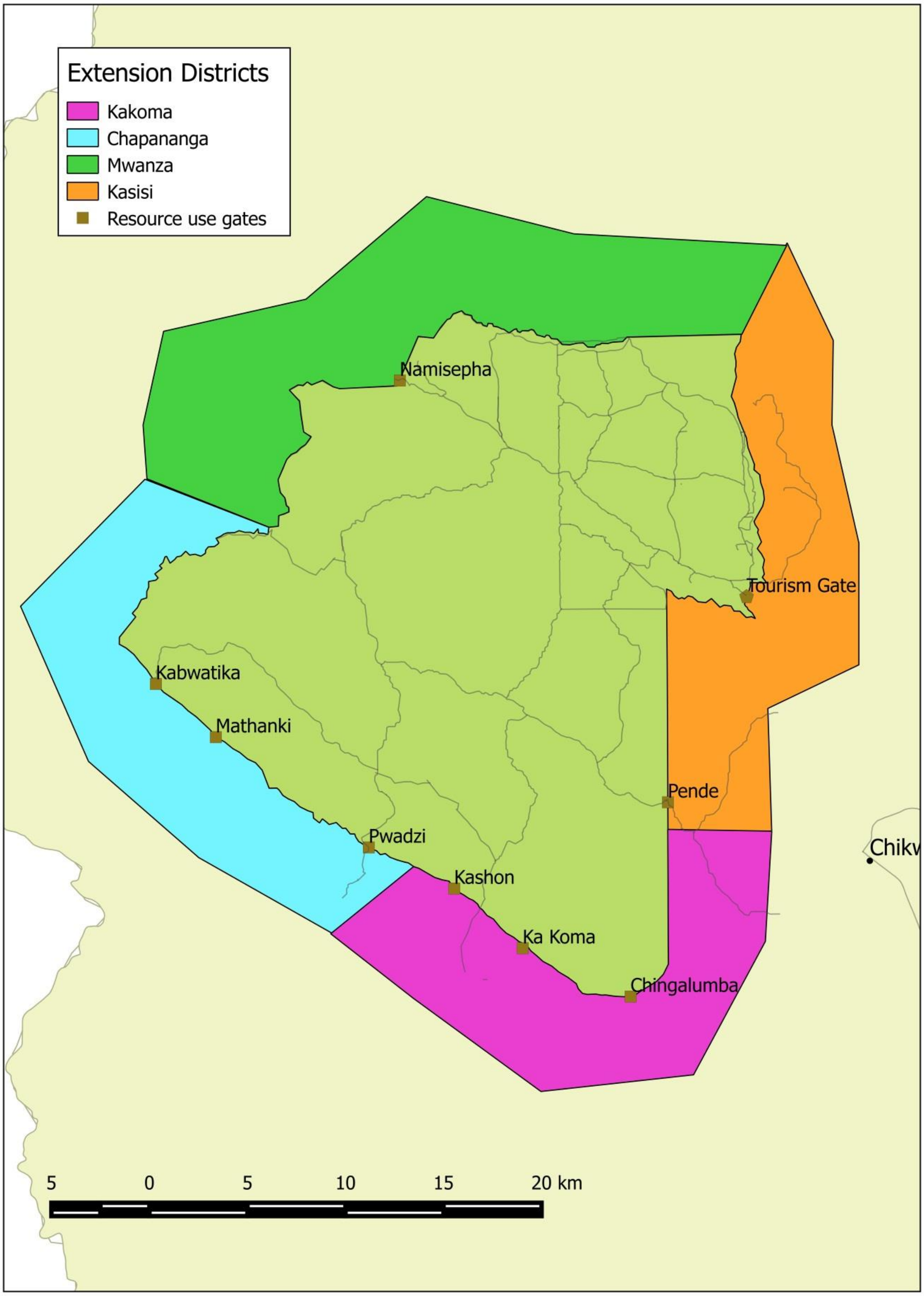

Figure 4.2.1: Locations of the four extension districts surrounding MWR. These areas were determined by the MWR management and extension teams.

4.3.1 Methodology

We conducted the study from March 2015 – April 2016, in the four extension districts surrounding the reserve designated by the MWR extension department and with whom the park already has a working relationship. The districts are referred to as follows: Chapananga, Kakoma, Mwanza and Kasisi. Each district is run by a Traditional Authority or TA figure, who is the overarching chief of the district. Under the TA's leadership, villages are divided into community based organisations or CBOs. Villages are grouped by geographic proximity into CBOs and each CBO consisted of several villages each headed by a village headman or headwoman. These village headmen and headwomen then run the CBOs and interact with the district TA. In some cases, a few villages will be grouped together and will be overseen by a group village headman or headwoman. The traditional leadership is graphically explained in Figure 4.2.2. The MWR extension team interact with communities at a CBO level.

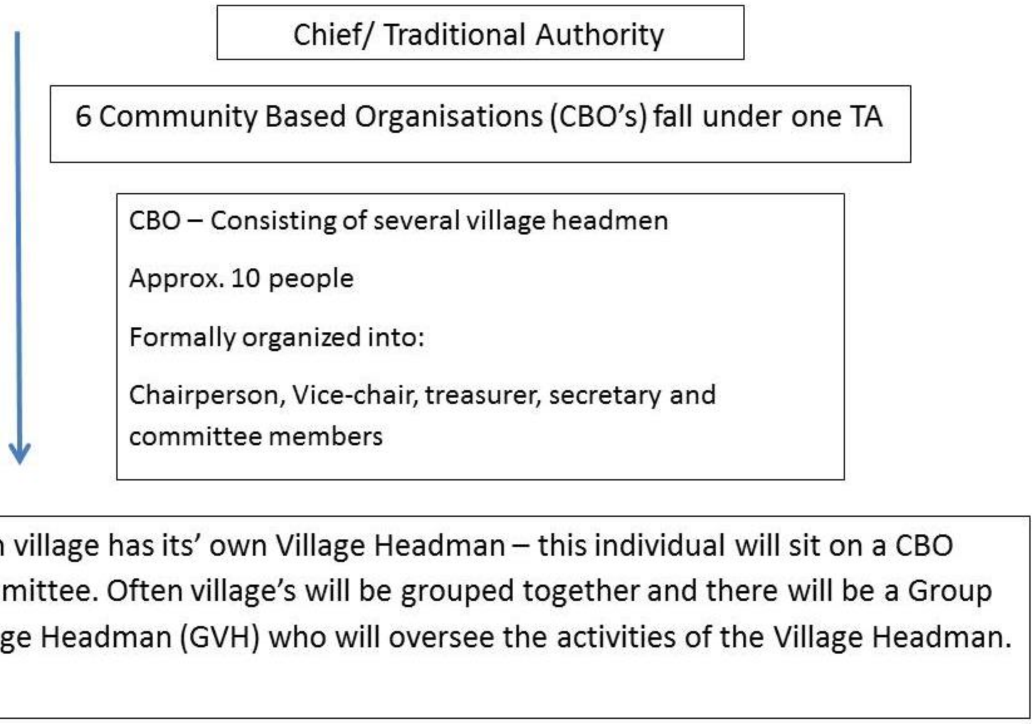

Figure 4.2.2: A breakdown of the Traditional Authority (TA) structure of the communities surrounding MWR. The park interacts with communities at a CBO level.

Each of the extension districts is broken down into a number of CBOs that fall under a TA. There are four community extension assistants (EA) who are full time employees of MWR and each live in a village that falls within one of the four extension districts. The EAs act as the liaison between communities and reserve management. There are a total of nineteen CBOs that interact with the MWR

Extension Department, and formally meet three times a year at the MWR Association meetings in order to discuss activities and concerns with reserve management.

We conducted all fieldwork for this project through the MWR Extension Department. Before we visited a field site, we notified the relevant EA for each community, who would then identify traditional healers willing to be interviewed. We conducted semi-structured interviews and rapid ethnobotanical appraisals with each willing participant. Three traditional healers were interviewed in each extension district, with an EA acting as the translator. In total we interviewed 12 traditional healers around MWR. We began interviews with formal introductions and then the researcher and EA accompanied the traditional healer into the bush and farmland around their home to collect specimens of the medicinal plants they used regularly. After collection the traditional healer went through the use of each plant with the researcher and translator. We then pressed and mounted specimens for later identification by a trained botanist from the National Herbarium in Zomba. We collected the majority of plant specimens in areas adjacent to the park fence and, a few samples from inside the park. All specimens collected inside the park were collected within 100m of the boundary fence. Figure 4.3 represents the distribution of interview locations in relation to gates used to access the reserve.

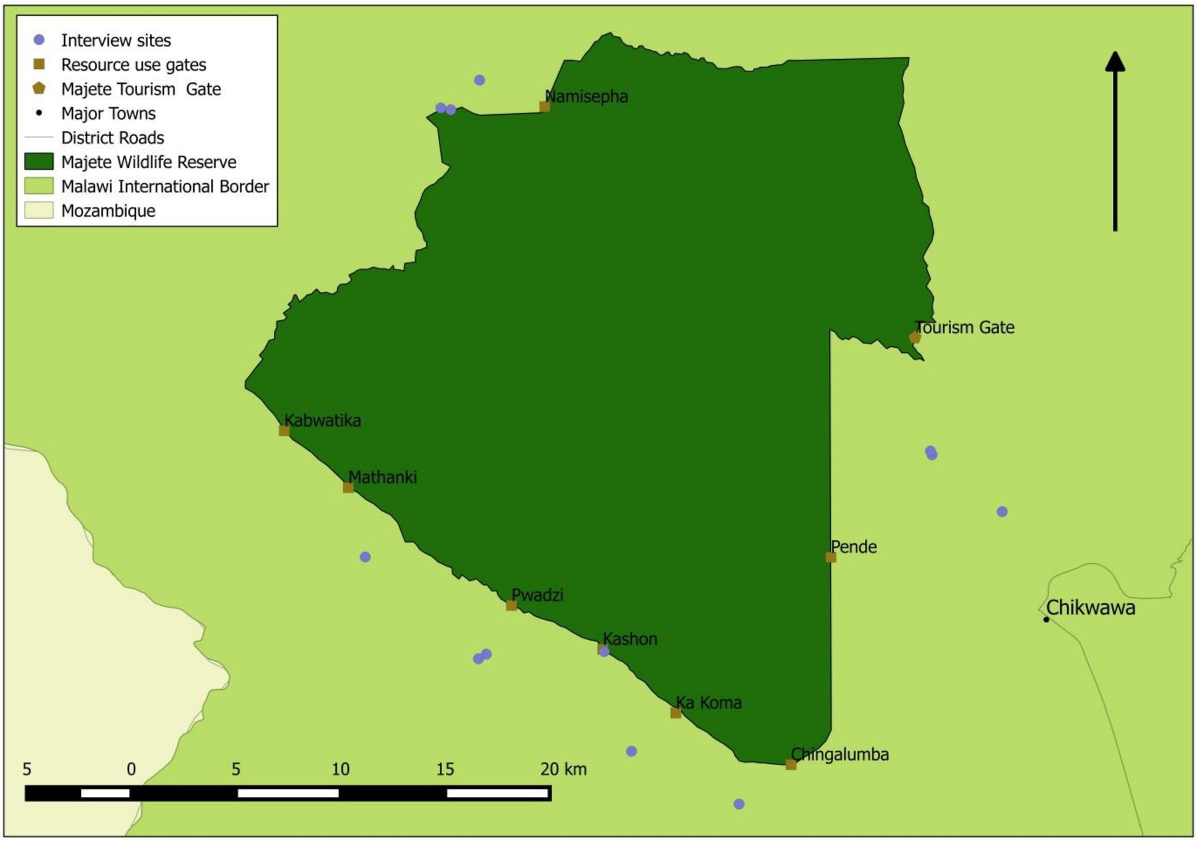

Figure 4.3: Map to show the distribution of interviews in the communities surrounding MWR. Blue symbols represent interview sites, while brown symbols represent resource use gates used to access MWR.

4.3.2 Ethics

We gained ethical clearance for this project through the Stellenbosch University ethics committee under the reference: SU-HSD-000332. We obtained verbal permission from participants prior to the start of each interview. Due to local customs and the dire poverty that face most villagers surrounding the reserve, and the fact that many of the healers gave the researcher hours of time they could have been using to treat clients, each participant in the study was presented with a gift of non-perishable staple food items as a token of appreciation at the end of each interview. This procedure was agreed upon by the researcher and the MWR extension programme manager.

4.4 Results

4.4.1 Medicinal plants reported

A total of 96 different plant species were identified that are used by traditional healers in the areas surrounding MWR (Table A.1) – see appendix 1. For each plant species' the scientific, Chichewa and English names were determined. The botanical family, growth form, part of the plant used and the use of the plant were also recorded. The 96 species' recorded were made up of 37 families. Rubiaceae (21.6%) and Vitaceae (18.9%) were the most commonly reported families. The remaining families made up 59.5% of the reported species with most families only reporting 1 or 2 species (Table A.1) – see appendix 1.

4.4.2 Dominant growth forms, parts used and ailments treated

Most of the medicinal plants identified by the traditional healers were trees (39%) followed by shrubs (18%) and plants that varied in size and growth form between trees and shrubs depending on the environment (17%). Creepers (14%), herbs (13%) and palms (1%) followed next. Palms (1%) were the least represented group of plants predominantly because there is only one commonly found species in the study area. The "Tree/Shrub" category represents plants whose growth form differs depending on environmental conditions. (Figure 4.4.1).

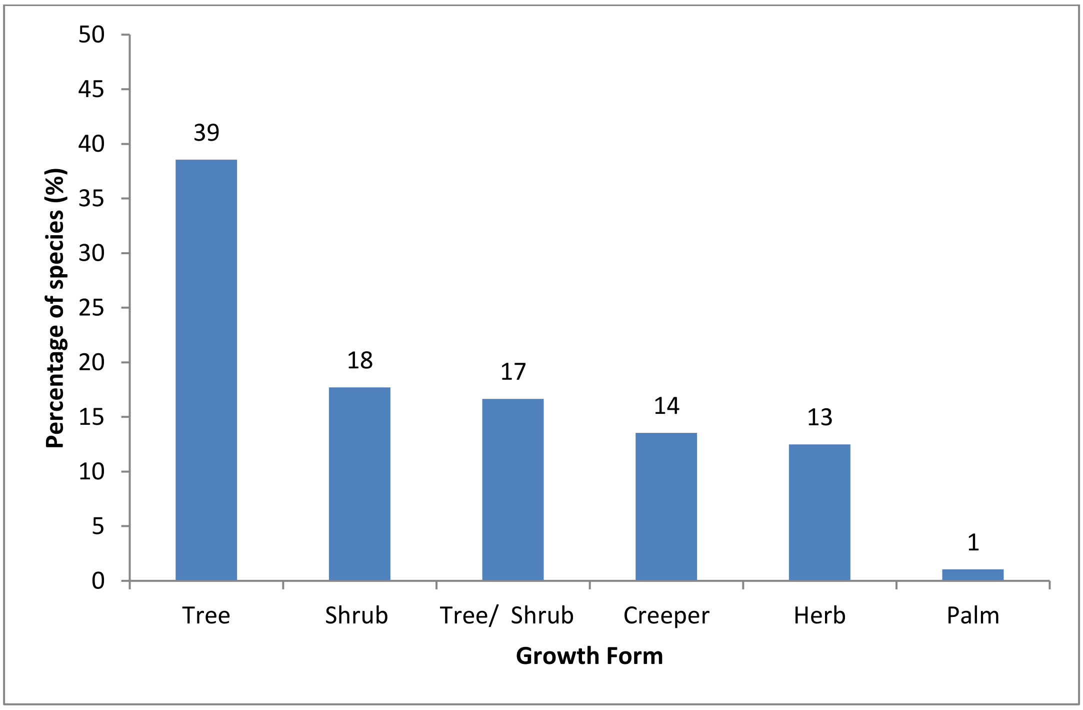

Figure 4.4.1: Breakdown of the medicinal plant growth forms as a percentage of the total number of plants identified.

Table 4.1: Medicinal Plants used by traditional healers in communities surrounding Majete Wildlife Reserve

No.	Scientific Name	Chichewa Name	English Name	Family	Vegetation Form	Parts used	Uses
1	*Abrus precatorius*	Mpinimini/ kantubwi/minimini	Lucky bean creeper/ coral bean	Fabaceae	Creeper	Roots and leaves	Roots used to treat Bilharzia, leaves used to increase energy levels (leaves are sweet when chewed)
2	*Acacia adenocalyx*	Nsolora	Small leaved acacia	Fabaceae	Tree	Leaves	Used to treat dysentery
3	*Acacia amythethophylla*	Mfungo	Large-leaved Acacia	Fabaceae	Tree	Bark	Used to help people find a job
4	*Acacia nilotica*	Matowo	Red Thorn	Fabaceae	Tree/ Shrub	Leaves	The leaves are mixed with *Azanza garckeana* and used to treat unexplained screaming, laughing or constant talking - normally attributed to possession by "bad spirits"
5	*Acacia sieberana*	Chidyangoma	Paperbark Thorn	Fabaceae	Tree/ Shrub	Roots	Used to protect a person from witchcraft, specifically spells which make you immobile
6	*Acalypha chirindica*	Kachitosi - name used to describe this family of plants	Understorey false-nettle	Euphorbiaceae	Herb	Leaves	Used to treat pain
7	*Ageratum houstonia (compsitae)*	Blangeti la amfumu (ntawetawe)	Mexican ageratum	Asteraceae	Tree	Roots	Used to treat stomach pains

8	*Albizia harveyi*	Njenjete	Bushveld false thorn/Sickle-leaved albizia/sickle leaved false thorn	Fabaceae	Tree	Roots	Used to make a partner fall back in love with you (used in particular when a spouse has a mistress) - the roots are soaked in water and fed to the unfaithful partner
9	*Albizia harveyi foum*	Njenjeti	Bushveld false thorn/Sickle-leaved albizia/sickle leaved false thorn	Fabaceae	Tree	Roots	Used to minimize mourning at funerals and stop people feeling sad
10	*Ampelocissus africana*	Mwanampepho	Simple-leaved wild grape	Vitaceae	Creeper	Roots	Used to treat stomach and backpain
11	*Annona senegalensis*	Mpoza	Wild custard-apple	Annonaceae	Tree/ Shrub	Roots	Mixed with engine oil and used to help someone find a job
12	*Aristolochia hockii*	Vaa Nichalamba/ dululu /matholisi/ matulisa	NA	Aristolochiaceae	Creeper	Roots	Roots are combined with those of *Holarrhena pubescens* and used to treat colic in babies

13	*Azanza garckeana*	Mfungo/ Ntowu	Snot-apple/ Azana/Slymappel	Malvaceae	Tree	Leaves and roots	The leaves are mixed with *Acacia nilotica* and used to treat unexplained screaming, laughing or constant talking - normally attributed to possession by "bad spirits"; Roots are used to protect new born babies from illness or disease
14	*Bersama abyssinca*	Chisite	Winged Bersama	Melianthaceae	Tree	Roots	Used to improve fertility in women
15	*Bersama abyssinica (sub spp. nyassae)*	Bwembakhole	NA	Melianthaceae	Tree	Roots	Used to improve fertility in women
16	*Borassus aethiopum*	Mulaza	Borassus Palm	Arecaceae	Palm	Leaves	Used for protection from witchcraft - leaves are tied around joints
17	*Calotropis procera*	Phoo	Kapok tree	Asclepiadaceae	Shrub	Roots	Used to treat mentally handicapped people, often referred to as "mad people" in Malawi
18	*Catunaregam spinosa*	Chipembere / Nyalugwe/ Msondoka/	Thicket-thorn / Leopard/ Coastal bone-apple	Rubiaceae	Tree	Roots	In the South of Malawi it is used to protect a person from witchcraft and treat constipation; in the North of Malawi it is used to treat headaches and to help an unmarried man find a wife

19	*Cissus faucicola*	Mwana Mphepo	NA	Vitaceae	Creeper	Tuber	Mixed with tubers harvested from *Cissus votundifolia* and used to treat indigestion.
20	*Cissus integrifolia*	Ntambe/ Mtambe	Depa-vine	Vitaceae	Tree	Leaves	The leaves are mixed with leaves from other herbs and used to prevent a child from dying because its parents had sex after the husband was unfaithful to his wife.
21	*Cissus quadrangularis*	Mdida	Veld grape	Vitaceae	Tree	Roots	A so called "general healer" - used to treat a variety of ailments
22	*Cissus votundifolia*	Pwepwele	Round-leaved vine	Vitaceae	Creeper	tubers	On its own used to treat Diarrhoea. When mixed with tubers from *Cissus faucicola* it is used to treat indigestion.
23	*Cocculus hirsuitus*	Nagoneka / Namgoneka	Broom creeper	Menispermaceae	Creeper	Leaves and roots	Leaves are used to treat dysentry, roots are used to treat hernia's. The roots are also used to make a tea which is used as men as a "date rape drug" - it allows a man to sleep with a woman without her knowledge of the event

24	*Coffea swynnertonii*	Nkanda wa Namwali	Inhambane coffee/ Mozambique coffee	Rubiaceae	Tree/ Shrub	Bark and Roots	Bark and roots are combined with *Xeroderris stuhlmannii* and used to treat continuous menstration in women
25	*Combretum microphyllum*	Nkotamo/ Nkotama/ Nkotamu/ Changaluma	Burningbush/ flamecreeper	Combretaceae	Tree	Roots	Used as a painkiller to treat: Headaches, stomach pains, abdominal pain; also used to treat hooping cough and pneumonia as well as indigestion. Additionally, it is used as a love potion - in order to make someone fall in love with you.
26	*Combretum mossambicense*	Nkotamo	Knobbly climbing Bushwillow	Combretaceae	Shrub	Roots	Protects the body from witchcraft
27	*Cordyla africana*	Ntondo	Wild mango	Fabaceae	Tree	Leaves	Used to call someone back who is very far away
28	*Crossopteryx febrifuga*	Gona ndi Gonemba	Common crown-berry/ Crystal bark	Rubiaceae	Tree	Roots	Used to protect a person against witches who come in the night
29	*Cryptolepis obtusa*	Kagondolosi	NA	Asclepiadeae	Creeper	Leaves	Used to treat eye infections and impotence in men
30	*Cyphostemma setosum*	Mwanamphepho	NA	Vitaceae	Creeper	Roots	Used to treat indigestion
31	*Cyphostemma zombense*	Mwanamphepho	NA	Vitaceae	Creeper	Roots	Helps aid digestion and treats indigestion

32	*Dalbergia melanoxylon*	Phingo	African blackwood/ zebrawood	Fabaceae	Tree	Roots	Used to protect one from witch craft
33	*Dalbergiella nyassae*	Mlembela	Mane-pod	Fabaceae	Shrub	Leaves, Roots and bark	Used to treat stomach aches
34	*Dicoma amoena*	Palibekanthu	NA	Astaraceae	Herb	Roots	Aids opportunity in business and improves job prospects. Used to help a person get a promotion.
35	*Diospyros zombensis*	M'dima / Nyandima/ Nandima/ Nyadima	NA	Ebenaceae	Tree/ Shrub	Roots and leaves	Leaves are used to increase fertility in women; roots are used to treat abdominal pain; roots and leaves are combined to treat toothaches caused by cavities
36	*Diplorhyncus condylocarpon*	Tombos	Horn-pod tree	Apocynaceae	Tree	Roots	Roots mixed with those from *Senna petersiana* and used to treat anxiety
37	*Dombeya acutangula*	Mphangula	NA	Sterculiaceae	Shrub	Roots	Used by men to protect themselves against sexually transmitted diseases transmitted by women who have had miscarriages

38	*Ehretia amoena*	Chisikisira Namwali/ Mulapilapi/ Chisikisa anamwali/ Chisikisilanamwali/ Chimwetsananmwari	Sandpaper bush	Boraginiaceae	Tree/ Shrub	Roots and leaves	Roots are used to: prevent funeral goers from contracting the illness of the deceased while paying their respects, to curb the sexual desires of young women undergoing initiation rituals, fed to newborn babies to prevent them from contracting an illness if they have been carried around by a sexually active married woman. Roots are also used to slow someone's heart rate. Leaves and small branches are used in virginity ceremonies as a "first penetration" tool to prepare young women for marriage.
39	*Ehretia amoena klotzschi*	Nchekalulume	Sandpaper stamperwood	Boraginaceae	Tree	Roots	Used to treat coughing - burn and grind the roots, mix with salt and eat
40	*Ehretia divaricata*	Chimwetsnamwali	Forest Stamperwood	Loraginaceae	Tree/ Shrub	Roots	Used to treat whooping cough and to stimulate tooth growth in teething babies
41	*Ehretia obtusifolia*	Dama	Stamperwood	Boraginaceae	Tree	Roots	Mixed with other herbs and used to increase the amount of blood in a patients body

42	*Elytaria lyrata*	Mbuto ya chuloe	Habit of the frog	Scrophulariaceae	Herb	Roots and leaves	Used to treat vaginal infections, boil roots and leaves together and steam the vagina
43	*Ficus sycomorus*	Mkuyu	Sycomore fig	Moraceae	Tree	Latex	Latex is used to prevent ringworm
44	*Flacourtia indica*	Mtudza	Governors-plum	Flacourtiaceae	Tree/ Shrub	Roots	Mixed with *Mlembela and* used to treat stomach ache. Fruit are edible.
45	*Flueggea virose*	Nchengula / Kathyothyo/ Mpomboma	Snowberry	Euphorbiaceae	Tree	Bark and Roots	Bark is used to treat pneumonia; Roots are used to increase fertility in women
46	*Grewia bicolor*	Katheze	White-leaved raisin	Tiliaceae	Tree/ Shrub	Roots	Used to treat miscarriages
47	*Grewia flavenscens*	Kathenza	donkeyberry	Tiliaceae	Tree	Bark used medicinally and fruit eaten as a food	The bark is tied together and soaked in water to make a tea which is fed to pregnant mothers at full term who have gone into labour as a way of speeding up labour.
48	*Grewia inaequilatera*	Maphira bubudu/ Theza	NA	Tiliaceae	Creeper	Leaves	Used to improve male virility - the leaves are soaked in water and the man drinks the water
49	*Hibiscus cannabinu L.*	Kaufiti	Witch weed	Malvaceae	Herb	Leaves	Used to treat burn wounds
50	*Holarrhena pubescens*	Kakope / Nkanachamba/ Mkalanchambe	Feverpod/ jasminetree	Apocynaceae	Shrub	Roots	Used to treat colic in newborn babies and menstrual pain in women

51	*Kigelia africana*	Mvunguti	Sausage Tree	Bigononiaceae	Tree	Fruit	Used to treat swelling on a small child's head
52	*Kirkia acuminata*	Mtumbu	Common kirkia / white seringa	Kirkiaceae	Tree	Leaves, Bark and Roots	Protection from thieves - when a thief touches your possession they get stuck. Leaves and roots from all 4 corners of the tree are collected and pound down, they are then boiled and the face of the patient is washed
53	*Lecaniodiscus fraxinifolius*	Mtalala	River-litchi	Sapindaceae	Tree	Bark	Used to protect a person from witchcraft - the bark is dried, burnt, crushed into a powder and mixed with engine oil. The oil mixture is then rubbed into incisions cut into the body
54	*Leonotis nepetifolia*	Tchumbe	Lion's ear/ Klip dagga	Lamiaceae	Herb	Roots and leaves	Used to treat Bilharzia, emerge the plant in water and drink the water
55	*Markhamia obtusifalia*	Mwanaburewe/ Mwanambewe/ msewa/ Katsangole	Golden Bellbean	Bigononiaceae	Tree	Roots and leaves	Roots are used to treat Candida infections; Roots and leaves are used in combination to protect young women who are menstruating from developing a cough when she eats food from another house

56	*Multidentia crassa*	Mbilima	NA	Rubiaceae	Tree/ Shrub	Roots	Used to treat headaches
57	*Neoratanenia mitis*	Mdyamfuko	NA	Fabaceae	Shrub	Roots	Mixed with *Vernonia colorata* and the head of a tortoise and used to reduce anal pain
58	*Nidorella auricalata*	Phembele - Old/Big	NA	Asteraceae	Herb	Leaves	Mixed with leaves from *Sphaeranthes angolensis* and used to treat fatigue
59	*Ocimum americanum*	Mpungabwe/Chantzi	NA	Lamiaceae	Tree	Roots	Used by men to increase their sexual power - chew the outer part of the root
60	*Ocimum americanum*	Mpungabwe/Chantzi	NA	Lamiaceae	Herb	Seeds	Used to treat eye infections
61	*Paederia bojerana*	Ntudzitudzi	NA	Rubiaceae	Creeper	Leaves	Used to treat bad dreams. The strong smelling leaves are pound in a mortar and then rubbed all over the head of the patient. The smell is said to chase bad dreams away.

62	*Parinari excelsa (malawi sub spp)*	Machende a Nguluure	Mobola-plum	Chrysobalanceae	Shrub	Roots	The roots are roasted and turned into a powder, salt is added and this is mixed into porridge. Served at funerals as a tradition as well as a way in which to prevent the funeral goers from contracting whatever disease the deceased may have passed away from.
63	*Passiflora edulis*	Mapiragwe ndi Mphepho	Passion fruit	Passifloraceae	Creeper	Roots	Improves fertility in women
64	*Philenoptera violacea*	Mpakasa	Apple-leaf	Fabaceae	Tree	Leaves	Used to prevent a newborn baby from suffering pain after it has breast fed from it's mother who has had nightmares that she is having sexual intercourse with her child. Leaves are pound and rubbed onto the breasts.
65	*Phyllanthus reticulatus*	Mtanathnyerere	Potato-bush	Euphorbiaceae	Tree/ Shrub	Roots	Used to treat blood in faeces
66	*Piliostigma thonningii*	Chitimbe	Camel's foot/Monkey Bread	Fabaceae	Tree	Roots	Used by traditional leaders to make themselves more powerful and more respected - roots are pound to a powder and mixed with old engine oil, then rubbed into incisions cut into the body
67	*Piliostigma thonningii*	Chitimbe	Camels-foot/ Monkeybread	Fabaceae	Tree/ Shrub	Leaves	Used to treat nosebleeds

68	*Protea petiolaris*	Chingambwani	NA	Proteaceae	Shrub	Tuber	Latex is used to treat impotence and increase sexual power in men
69	*Pseudarthria hookeri*	Bwandama	Bug catcher	Fabaceae	Shrub	Roots and leaves	Used to make a love potion - used to make a husband and wife love each other
70	*Pseudolachnostylis maprouneifolia*	Msollo	Kudu-berry	Euphorbiaceae	Shrub	Barks and roots	Used to treat Diarrhoea
71	*Pterocarpus brenanii*	Bwembakole	Eared bloodwood	Fabaceae	Tree	Roots	Used to protect a person from being convicted in a court case - a piece of the root is cut and put on the ground and covered by a leaf.
72	*Pupalia lappacea*	Damata	NA	Amaranthaceae	Herb	Seeds	Used as a Love Potion. The seeds are harvested, burnt and pound to a powder. The powder is then mixed with the pubic hair of the lover who does not want to be left and mixed into the food of their partner. Is used by both men and women to stop their lover from leaving them for another.
73	*Rothmannia fischeri*	Ndyakamba	Woodland rothmannia	Rubiaceae	Shrub	Roots	Used to protect newborn babies from diseases

74	*Searsia tenuinervis*	Mtamire/ Tamia / Mtatu	Curled-leaved crowberry	Anacardiaceae	Shrub	Roots and leaves	Used by pregnant women to relieve pain also to prevent miscarriages after she has slept with 3 or 4 men.
75	*Senna petersiana*	Ndyapumbusa/ Mtanthanyerere	Eared senna/ Monkey pod	Fabaceae	Tree	Roots	Used to treat menstrual pain; mixed with *Diplorhyncus condylocarpon* and used to treat anxiety
76	*Solanum anguivii*	Nthungwira	Bitter Apple/Poison apple	Solanaceae	Shrub	Roots	The roots from both plants are roasted on the fire and turned into a powder. The powder is then mixed with a combination of diesel and cooking oil and rubbed into small incisions (normally made on the foot and ankle) to prevent snakes from biting the patient.
77	*Solanum panduriforme*	Nthungutula	Potato plant	Solanaceae	Herb	Roots	Used to treat and protect people from snakebites
78	*Sphaeranthes angolensis*	Phembele - young/small	NA	Asteraceae	Herb	Leaves	Mixed with leaves from *Nidorella auricalata* and used to treat fatigue
79	*Steganotaenia araliacea*	Mpoloni/ Chipsukula	Carrot-tree	Apiaceae	Tree	Fruit/seed pod	Mixed with old engine oil and used to prevent newborn children from developing a swollen head

80	*Tabernaemontana elegans*	Kakope/ Mgaga	Toad-tree	Apocynaceae	Tree	Roots and leaves	Roots and leaves used to treat backache and rheumatism; Roots are used to improve male and female libido, and to help a couple have twins
81	*Tamarindus indica*	Mbwemba	Tamarind	Fabaceae	Tree	Roots and leaves	Roots used to increase fertility in men and women; leaves used to help people find work, also used by people accused of a crime to escape conviction and to make someone loose their job
82	*Terminalia mollis*	Chiletsamfiti	Large-leaved Terminalia	Combretaceae	Tree	Roots	Used to protect crops from magic stealing
83	*Tragia brevipes*	Kayaya ma	NA	Euphorbiaceae	Creeper	Roots and leaves	Used to treat vaginal infections in pregnant women
84	*Tricalysia coriacea*	Phundabwi	Forest bush-coffee	Rubiaceae	Shrub	Roots	Used to treat coughing
85	*Tricalysia spp.*	Dama	NA	Rubiaceae	Tree	Membrane below the bark	Used to treat a lack of blood (Kaudzu) in small children
86	*Trichodesma zeylanicum*	Dungumwamba / Chilungumwamba	Late weed	Boraginaceae	Herb	Roots and leaves	Used to treat indigestion

87	*Turraea floribunda*	Ntunda	Honeysuckle tree	Meliaceae	Tree/ Shrub	Roots	Used to treat heart disease (possibly heartburn) and high blood pressure
88	*Turraea nilotica*	Nkanakachamba/ Nkulabala/ Msindira	Lowveld honey-suckle tree	Meliaceae	Shrub	Roots	Used to treat swollen testicles
89	*Vernonia colorata*	Futsa	Lowveld Vernonia/ Star-flowered Vernonia	Astaraceae	Tree/ Shrub	Roots	Mixed with *Neoratanenia mitis* and the head of a tortoise and used to reduce anal pain
90	*Vigna radiata*	Solokoto	Mung bean	Papilionoidae	Herb	Roots	Used to treat yellow fever
91	*Vitex mombassae*	Mpsimpsa	Smelly-berry Fingerleaf	Verbenaceae	Shrub	Roots	Used to treat Rheumatism
92	*Xeroderris stuhlmannii*	Mlonde / Mulonde	Wingbean	Fabaceae	Tree/ shrub	Bark and Roots	Bark and roots are combined with *Coffea swynnertonii* and used to treat continuous menstruation in women; Bark is used to treat nappy rash and swollen heads in small children and babies
93	*Xeroderris stuhlmannii mendonca*	Mnonde / Mlonde	Wingpod	Fabaceae	Tree	Bark	Used to increase the blood in someone's body - determined by checking to see whether capillaries are close to the surface in the inner eyelid
94	*Ximenia americana*	Mphinji pinji	Tallow wood	Olacaeae	Shrub	Roots	Used to treat heart attacks.

95	*Ximenia americana L.*	Nthengeni	Blue sourplum	Olacaceae	Tree	Roots and leaves	Used to treat bloody dysentery
96	*Zanha africana*	Changaluche / Nkangaluche/ Mtutulemuko	Velvet-fruit Zanha	Sapindiceae	Tree/ Shrub	Roots and Bark	Roots are used to treat post-natal depression in women (Masungu); Bark is used as a painkiller - specifically to treat headaches

4.4.3 Dominant growth forms, parts used and ailments treated *(Continued)*

Interviews with traditional healers showed that roots (50%) were the most commonly used part of the plant, followed by leaves (35%) while bark (10%), tubers (3%), fruit (2%) and latex (1%) were also used, they were all used at much lower levels than bark and leaves (Figure 4.4.2). Observations in the field indicate that harvesters were conscious of preserving the integrity of the plants for long-term harvesting, by removing only small sections of roots, always replacing soil over excavated areas and not ring-barking trees (Authors observations March 2015-May 2016).

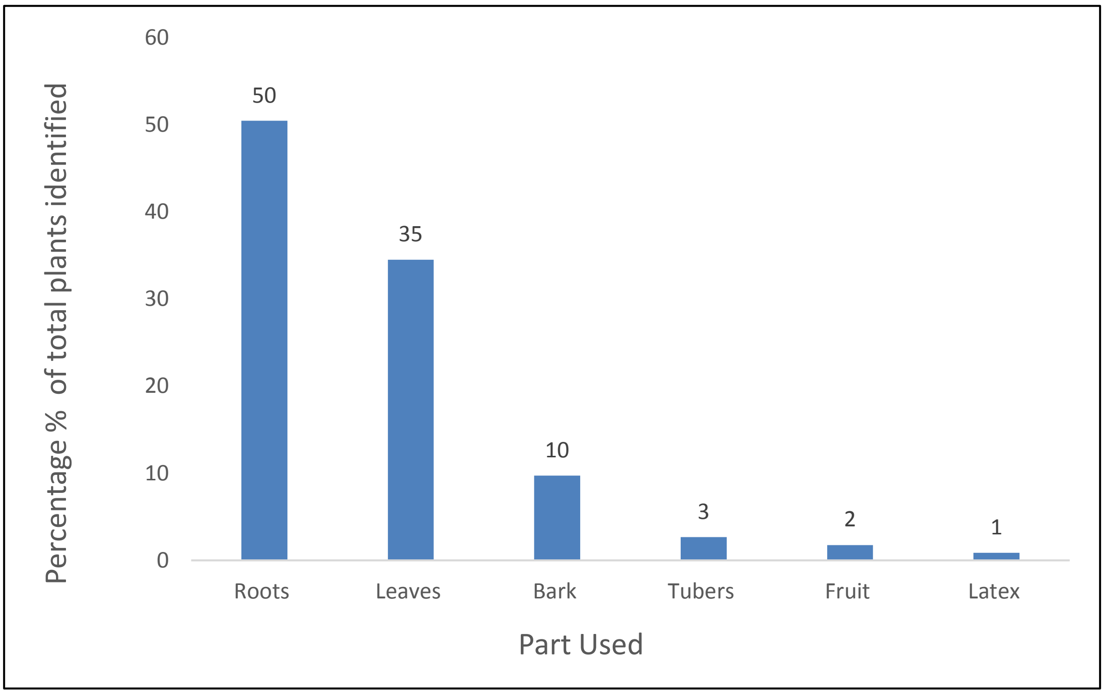

Figure 4.4.2: Graph showing the plant parts used by traditional healers, represented as a percentage of the total number of plants identified.

We identified the top three ailments treated by traditional healers as being symptomatic illnesses often considered to be basic healthcare needs (Table 4.2). Gastrointestinal ailments (13.4%), pain treatment (11%) and the treatment of childhood illnesses (9.4%) suggest that traditional healers fill a vital role in treating basic ailments for poor rural communities. Additionally, 6.3% of species were used to treat mental health issues.

Table 4.2: Medical ailments treated by traditional healers in the study areas

Category	No. of species	Total % of species
Gastrointestinal	17	13.4
Pain management	14	11.0
Childhood illness	12	9.4
Witchcraft	11	8.7
Mental health	8	6.3
Female fertility	7	5.5
Respiratory	6	4.7
Male virility	6	4.7
Job/fortune seeking	6	4.7
Gynaecological disorders	5	3.9
Love spells	5	3.9
Traditional ceremonies	4	3.1
Prenatal care	3	2.4
Infectious diseases - bilharzia, yellow fever and malaria	3	2.4
Fatigue	3	2.4
Cardiac care	3	2.4
General healthcare	2	1.6
Eye care	2	1.6
Treatment and prevention of snake bites	2	1.6
Date rape drug	1	0.8
STD treatment	1	0.8
Fungal infections	1	0.8
Food	1	0.8
Burn wounds	1	0.8
Sinus and allergies	1	0.8
Prostate healthcare	1	0.8
Increase the blood in someones body	1	0.8

All the traditional healers we interviewed (n = 12) stated that they had harvested medicinal plants in MWR, prior to African Parks building the management fence and that they would like to be given permission to once again harvest medicinal plants inside the reserve. A few respondents (n = 5) indicated that they were scared of the wild animals while harvesting but would feel safe with an armed escort inside the reserve. Most of the (n = 11) traditional healers we interviewed were registered with the International Traditional Healers Association of Malawi, a regulatory body for traditional healers in the country. Additionally, most (n = 11) of the healers we interviewed indicated that their healing practise was their main source of income and used to support themselves and their families (Table 4.3).

Table 4.3: Interview results of traditional healers on the subjects of harvesting medicinal plants in MWR and their livelihoods

Question	n = 12	
	N	**Y**
Did you ever harvest inside Majete?	0	12
Would you like to harvest in Majete?	0	12
Are you a certified healer?	1	11
Is your job your main source of income?	1	11

4.5 Discussion

The results from the ethnobotanical study suggest that traditional healers in the villages surrounding MWR use a diverse array of wild plants to treat numerous medical ailments, as well as support the spiritual wellbeing of village residents. The research also provides documentation of some the species used by traditional healers in the villages adjacent to MWR. In each extension district surrounding the reserve there are government run clinics that are designed to provide basic healthcare to remote areas. These clinics are staffed a few days a week by a nurse and a community healthcare extension worker. Our research indicates that community members still actively engage the services of traditional healers for the treatment of numerous ailments, both medical and spiritual, despite the presence of these formal healthcare centres. Discussions with MWR extension staff and community members indicate that because of poor wages and delayed salary payments employees of the clinics often sell state and donor sponsored medication to private clinics to make extra money. This then means that instead of receiving free medication, local people have to buy their medication back from the private clinics at a significant premium (Joseph Mbalu pers. comms. February 2016). Corruption at the remote health care centres means that in many cases people simply can not afford to buy medication (Joseph Mbalu pers. comms. February 2016). Additionally, for more serious ailments the closest district hospital is located in Chikwawa, a journey of up to 60km on poor quality roads for most rural villagers.

The roots, leaves and bark of trees and shrubs were the most common plant parts harvested by the traditional healers interviewed in this study. This is important information since the western side of MWR is predominantly covered by Miombo woodland (Staub et al. 2013) and is also where most of the resource use programme activities are conducted. Since roots, leaves and bark are the most commonly harvested plant parts for medicine, and the Miombo woodland vegetation type is dominated by trees and shrubs, many of which are endangered or threatened, overharvesting of these plants if left unchecked could have a detrimental impact on trees found within walking distance of the resource use gates. Since walking is the only mode of transport for most traditional healers and local people, the impact of medicinal plant harvesting within the reserve would only be within a fairly small radius of each resource use gate. These restrictions to mobility should help reserve management in monitoring the impact of medicinal plant harvesting by traditional healers.

The medicinal plants found inside MWR are and will continue to be a very important resource for the traditional healers in the areas surrounding the reserve. Not only did all the traditional healers interviewed express a desire to harvest medicinal plants inside the reserve, but the interviews revealed that all of the traditional healers harvested inside the reserve before the fence was erected and have essentially lost a valuable resource at the expense of the reserve fence. All but one traditional healer stated that their healing practise was their main source of income. Limiting the access to medicinal plants within MWR then has a direct negative impact on the ability of traditional healers to earn an income and support their dependents.

From the results in this study we would suggest that the MWR management incorporate medicinal plant harvesting into the existing RUP activities. Allowing traditional healers access to wild growing medicinal plants inside MWR will improve the ability of healers to not only find traditional medicine but will also add support to their existing livelihood strategy. Since the plant parts most commonly harvested include bark and roots, and predominantly fall within the Miombo woodland vegetation type which features many endangered and vulnerable plant species, it would be imperative for MWR management to design and actively implement a monitoring framework to ensure that overharvesting does not occur.

References

African Parks., 2012, Majete Wildlife Reserve, Malawi. Available from: http://www.african-parks.org/Park_1_13_About+the+Park.html.

African Parks., 2016, Our Story, Available from: https://www.african-parks.org/african-parks/our-story.

Asiimwe, S., Kamatenesi-Mugisha, M., Namutebi, A., Borg-Karlsson, A-K., & Musiimenta, P., 2013, Ethnobotanical study of nutri-medicinal plants used for the management of HIV/AIDS opportunistic ailments among the local communities of western Uganda. *Journal of Ethnopharmacology,* 150, pp. 639-648.

Campbell, N., Schiffer, E., Buxbaum, A., McLean, E., Perry, C., & Sullivan, T.M., 2014, Taking knowledge for health the extra mile: participatory evaluation of a mobile phone intervention for community health workers in Malawi. *Global Health: Science and Practise,* 2, pp. 23-34.

Campbell, L.M., & Amin, N.N., 2014, A qualitative study: potential benefits and challenges of traditional healers in providing aspects of palliative care in rural South Africa. *Rural and Remote Health,* 14: 2378.

Daire, J.M., & Khalil, D.D., 2010, Health system strengthening beyond the MDG's for maternal and child health in Malawi: Lessons from policy analysis. *World Medical & Health Policy,* 1 (11), pp. 127-194.

d'Avigdor, E., Wohlmuth, H., Asfaw, Z., & Awas, T., 2014, The current status of knowledge of herbal medicine and medicinal plants in Fiche, Ethiopia. *Journal of Ethnobiology and Ethnomedicine,* 10, 38.

De Wet, H., Nciki, S., & van Vuuren, S.F., 2013, Medicinal plants used for the treatment of various skin disorders by a rural community in northern Maputaland, South Africa. *Journal of Ethnobiology and Ethnomedicine,* 9, 51.

De Wet, H., Ramulondi, M., & Ngcobo, Z.N., 2016, The use of indigenous medicine for the treatment of hypertension by a rural community in northern Maputaland, South Africa. *South African Journal of Botany,* 103, pp. 78-88.

Ellis, A.E., Doumbia, S., Traores, S., Dalglish, S.L., & Winch, P.J., 2013, Household roles and care-seeking behaviours in response to sever childhood illness in Mali. *Journal of Biosocial Science,* 45, pp. 743-759.

Hill, E., Hess, R., Aborigo, R., Adongo, P., Hodgson, A., Engmann, C., & Moyer, C.A., 2014, "I don't know anything about their culture": The disconnect between allopathic and traditional maternity care providers in rural northern Ghana. *African Journal of Reproductive Health,* 18, pp. 36-4.

Jew, E.K.K., Dougill, A.J., Sallu, S.M., O'Connell, J., & Benton, T.G., 2015, Miombo woodland under threat: Consequences for tree diversity and carbon storage. *Forest Ecology and Management,* 361, pp. 144-153.

Leslie, A. 2014. Animals of Malawi in the Majete Wildlife Reserve. Earthwatch Institute. Available from: http://earthwatch.org/expeditions/animals-of-malawi-in-the-majete-wildlife-reserve.

Loeliger, K.B., Niccolai, L.M., Mtungwa, L.N., Moll, A., & Shenoi, S.V., 2016, Antiretroviral therapy initiation and adherence in rural South Africa: community health workers' perspectives on barriers and facilitators. *AIDS Care* 28 (8). DOI: 10.1080/09540121.2016.1164292.

Lungu, E.A., Biesma, R., Chirwa, M., & Darker, C., Healthcare seeking practices and barriers to accessing under-five child services in urban slums in Malawi: a qualitative study. *BMC Health Services Research* 16 (410). DOI: 10.1186/s12913-016-1678-x.

Maneenoon, K., Khuniad, C., Teanuan, Y., Saedan, N., Prom-in, S., Rukleng, N., Kongpool, W., Pinsook, P., & Wongwiwat, W., 2015, Ethnomedicinal plants used by traditional healers in Phatthalung Province, Peninsular Thailand. *Journal of Ethnobiology and Ethnomedicine,* 11, 43. DOI: 10.1186/s13002-015-0031-5.

Ministry of Finance, Economic Planning and Development (MFEPD), 2014, Millennium Development Goal Report for Malawi. Available at: http://www.undp.org/content/dam/malawi/docs/general/Malawi_MDG_Report_2014.pdf.

Mukolo, A., Cooil, B., & Victor, B., 2015, The effects of utility evaluations, biomedical knowledge and modernization on intention to exclusively use biomedical health facilities among rural households in Mozambique. *Social Science & Medicine,* 138, pp. 225-233.

Naidu, M., 2014, Understanding African indigenous approaches to reproductive health: beliefs around traditional medicine. *Ethno Med,* 8, pp. 147-156.

Population Reference Bureau, 2015, 2015 World Population Data Sheet: with a special focus on woman's empowerment. Available at: http://www.prb.org/pdf15/2015-world-population-data-sheet_eng.pdf.

Rakotoarivelo, N.H., Rakotoarivony, F., Ramarosandratana, A.V., Jeannoda, V.H., Kuhlman, A.R., Randrianasolo, A., & Bussman, R.W., 2015, Medicinal plants used to treat the most frequent diseases encountered in Ambalabe rural community, Eastern Madagascar. *Journal of Ethnobiology and Ethnomedicine,* 11(68), DOI: 10.1186/s13002-015-0050-2.

Ryan, T.J., Hirt, H-M., & Willcox, M., 2011, Collaboration with traditional health practitioners in the provision of skin care for all in Africa. *International Journal of Dermatology*, 50, pp. 564-570.

Shai, M., & Sodi, T., 2015, Pathways to mental health care by members of a rural community in South Africa. *Journal of Psychology in Africa*, 25, pp. 191-194.

Suswardany, D.L., Sibbritt, D.W., Supardi, S., Chang, S., & Adams, J., 2015, A critical review of traditional medicine and traditional healer use for malaria and among people in malaria-endemic areas: contemporary research in low to middle-income Asia-Pacific countries. *Malaria Journal*, 14: 98. DOI: 10.1186/s12936-015-0593-7.

Stanifer, J.W., Patel, U.D., Karia, F., Thielman, N., Maro, V., Shimbi, D., Kilaweh, M., Lazaro, M., Matemu, O., Omolo, J., & Boyd, D., 2015, The determinants of traditional medicine use in Northern Tanzania: a mixed-methods study. *PLoS One*, 10(4): e0122638. DOI:10.1371/journal.pone.0122638.

Staub, C.G., Binford, M.W., & Stevens, F.R., 2013, Elephant herbivory in Majete Wildlife Reserve, Malawi. *African Journal of Ecology*, 51, pp. 536-543.

Tribess, B., Pintarelli, G.M., Bini, L.A., Camargo, A., Funez, L.A., de Gasper, A.L., & Zeni, A.L.B., 2015, Ethnobotanical study of plants used for therapeutic purposes in the Atlantic Forest region, Southern Brazil. *Journal of Ethnopharmacology*, 164, pp. 136-146.

Wagner, R.G., Bertram, M.Y., Gomez-Olive, F.X., Tollman, S.M., Lindholm, L., Newton, C.R., & Hofman, K.J., Health care utilization and outpatient, out-of-pocket costs for active convulsive epilepsy in rural northeastern South Africa: a cross-sectional Survey. *BMC Health Services Research* 16 (208). DOI: 10.1186/s12913-016-1460-0.

Williamson, J., Ramirez, R., & Wingfield, T., 2015, Health, healthcare access, and use of traditional versus modern medicine in remote Peruvian Amazon communities: A descriptive study of knowledge, attitudes, and practices. *The American Journal of Tropical Medicine and Hygiene,* 94, pp. 857-864.

World Health Organisation, 2005, Mental Health Atlas 2005: Malawi. Available at: http://www.who.int/mental_health/evidence/mhatlas05/en/.

World Health Organisation, 2014, Country cooperation strategy at a glance: Malawi. Geneva. Available at: http://www.who.int/entity/countryfocus/cooperation_strategy/ccsbrief_mwi_en.pdf.

World Health Organisation, 2016, World Health Statistics 2016: Monitoring health for the Sustainable Development Goals. Available at: http://www.who.int.

Chapter 5: Perceptions of the Majete Wildlife Reserve Resource Use Programme – a household survey

5.1 Introduction

Rural communities across the developing world are often highly dependent on natural resources for survival (Fisher 2004; Kanthungo 2007). This dependency means that impoverished rural communities are often both the cause and victims of environmental degradation (Fisher 2004; Sassen et al. 2015). In Africa, dependency on natural resource across the continent is high, with the following resources most frequently cited as crucial for livelihood strategies: wood, bush meat, land for agriculture, and non-timber forest products (NTFPs) (Dovie et al. 2002; Fisher 2004; Hunter et al. 2011; Kamanga et al. 2009; Macdonald et al. 2012; Mandondo et al. 2014; Pouliot & Treue 2013; Sassen et al. 2015; Shackleton et al. 2007). Growing rural populations and impacts of climate change mean that rural communities across the world are at increasing risk of poverty, food shortages and the health risks associated with both (Ellis & Manda 2012; Jury 2014; Sassi 2012). Deforestation due to agricultural land expansion and charcoal production is a leading cause of environmental degradation across Africa (Kamanga et al. 2009; Mandondo et al. 2014). In many African country's deforestation and environmental degradation have led to the destruction of large tracts of natural vegetation and indigenous forests (Kamanga et al. 2009). In many cases the poorest households in rural communities rely significantly on indigenous vegetation and forests for additional resources, and sources of income as safety nets during times of hardship (Dovie et al. 2005; Pouliot & Treue 2012; Zulu & Richardson 2013). The loss of these valuable resources means that already vulnerable communities are at higher risk of poverty and food shortages during times of environmental fluctuations (Pouliot & Treue 2012).

In many places across Africa, land is governed by traditional authorities who grant people land use rights (Dovie et al. 2005). Unfortunately, this traditional system often leads to overuse and exploitation of natural resources, particularly as rural communities' populations grow (Amin et al. 2015; Dovie et al. 2005). Additionally, the communities found in areas directly adjacent to PAs are most commonly rural, undeveloped and impoverished with limited livelihood opportunities (Wunder 2001; Sunderlin et al. 2005). Rural communities across the continent rely on subsistence agriculture for survival (Bobo et al. 2014; Dovie et al. 2005), however Ellis (1998) found that 30-50% of households depend on non-farm income. In areas where formal employment is limited the deficit in income and food not covered by agriculture is often provided by locally found natural resources (Dovie et al. 2005). Often these natural resources are locally abundant or only harvested within PAs adjacent to these rural communities (Amin et al. 2015). In situations where communities are dependent on PAs for natural resources, the long-term integrity of the PA is dependent on support from local people (Amin et al. 2015). It has become imperative for PAs to integrate local communities and their needs into management frameworks (Wells & McShane 2004). Throughout history PAs were often gazetted in areas where people had always resided (Dowie 2009). Indigenous communities who had always relied on natural resources were frequently forcibly excluded from their homes and the resource harvesting they once relied on, was made illegal, leading community members to resort to illegal encroachment and resource exploitation (Dowie 2009; Faasen & Watts 2007; Patenaude & Lewis 2014).

Across sub-Saharan Africa rapid population growth and agricultural expansion continues to threaten biodiversity through habitat fragmentation and uncontrolled resource overexploitation (UNEP 2013). In countries, such as Malawi, where most of the population depends on subsistence agriculture and solid wood fuel, this habitat fragmentation is severe and exacerbated by a rapidly growing human population (Fisher 2004; UNEP 2013). In the southern region of Malawi, Majete Wildlife Reserve (MWR) – a 700 km^2 protected area - is attempting to engage local communities in conservation. The reserve was officially gazetted in 1955 and run by the Malawian Department of National Parks and Wildlife (DPNW) for almost five decades. Due to a lack of funding and personnel resources, the reserve suffered rampant poaching, resource exploitation and encroachment during this time (African Parks 2012; Staub et al. 2013). In 2003, the South African based management company, African Parks - founded in 2000 to address declining trends in protected areas across Africa – entered into a 25 year Public-Private Partnership (PPP) with the Malawian Government, to take over management responsibilities for MWR from the DPNW (African Parks 2016). Since 2003 African Parks have erected a perimeter fence, restocked the reserve with animals and kick-started a valuable tourism industry (African Parks 2012, Leslie 2014).

Long-term sustainability of any conservation project relies on the support of local communities. There are a total of 140,000 people living adjacent to MWR (National Statistical Office 2008) and African Parks have made a concerted effort to try and involve these communities in how the reserves resources are utilised (African Parks 2012). A resource use programme (RUP) is currently run by MWR which allows community members controlled access into the reserve to harvest thatching grass, bamboo and reeds, which are most commonly used as building materials (African Parks 2012). In meetings with community members during 2014-2015 (Samuel Kamoto pers. comms. July 2014), it appeared that community members did not think that the current RUP strategy was adequately meeting the harvesting demands of the people living adjacent to the reserve. Calls were made for medicinal plants in particular, to be included in the RUP strategy (Samuel Kamoto pers. comms. July 2014).

The aim of this study was to determine: (1) how important resource harvesting inside MWR is to community members; (2) whether community members would like to harvest additional resources in the reserve; (3) if so which resources those are; and (4) how the existing RUP strategy could be improved to better meet the needs of local communities.

5.2 Study Area

5.2.1 Malawi in context

Malawi is a small country situated within southern central Africa (SADC 2012), with a predominantly rural population of roughly 17.2 million people who are largely dependent on natural resources for survival (Figure 5.1) (Population Reference Bureau 2015). Basic housing characteristics indicate that only 25.4% of homes have finished floors, 66% of homes have completed walls, just 41.5% of homes have a completed roof and only 9.5% of homes are electrified (National Statistical Office 2014). Malawi's largely subsistence based economy has resulted in a gross national income (GNI) of just US$ 780 per capita, which is well below the US$ 2 270 average GNI per capita of the world's least developed countries. A high population density, of 458 people per km^2 of arable land, in a country which relies predominantly on subsistence agriculture, together with a high population growth rate spurred by a high fertility rate of 5 children per woman, means that pressure on natural resources is extremely high (Population Reference Bureau 2015). Across Malawi, subsistence agriculture is mainly rain fed, with very little formal irrigation (Kamanga et al. 2009). In the southern area of the country the dominant crops grown are maize, beans and sorghum, with the average household land holding being approximately 0.5 ha in size (Kamanga et al. 2009). Due to an over-reliance on maize, poor farming methods and increasingly unreliable rainfall (Sassi 2012), a six week seasonal poverty trap exists in Malawi, where between planting the new crop and harvesting, families run out of food and have to rely on alternative livelihood strategies to generate income in order to buy supplement food (Orr et al. 2009). On top of the poverty trap that exists across most of the country, the southern region of Malawi also ranks the highest in poverty indices, population density and scarcity of forest resources (Fisher 2004).

Across Malawi, charcoal production is a very common livelihood strategy, with Zulu (2010) suggesting that wood fuels contributed as much as 3.5% to the country's gross domestic product (GDP) despite the production of charcoal being illegal. Charcoal production is often used as a livelihood strategy by poorer households to generate an income (Zulu & Richardson 2012) and since over 95% of the population rely on solid fuels for energy generation, charcoal production is a leading cause of deforestation in Malawi (UNEP 2013). The loss of natural forests in Malawi has impacts on other livelihood strategies, such as the collection of supplementary food during seasonal shortages, timber and construction materials, as well as traditional medicine (Meke et al. 2016). The loss of forest cover in Malawi has the greatest impact on the poorest sectors of the population who are most reliant on natural resources (Zulu 2008). Across much of the country and particularly in the southern region, only pockets of natural vegetation remain, either in graveyards or protected areas (Kamanga et al. 2009). Across much of Africa indigenous grass species collected in areas of natural vegetation, are used to roof peoples' homes in rural communities (Gaugris et al. 2006; Kirby et al. 2008). Grass roofs are often associated with lower income homes (Doctor 2004; Gaugris et al. 2006), and higher disease burdens, particularly higher malaria burdens, which have been associated with higher child mortality rates (Doctor 2004; Kirby et al. 2008). For most rural Africans, being able to afford a roof made of corrugated iron roof sheeting is perceived to be a sign of prosperity and is highly desired (Manda 2007). This is especially true in the rural communities of southern Malawi, adjacent to MWR, where most rural inhabitants still live in homes with traditional grass roofs. Corrugated iron roof sheeting, commonly referred to as “Malata”, is available for purchase in the larger village markets surrounding MWR but is unaffordable for most community members who rely on small scale subsistence farming and have little access to sources of formal income (Steve Wemba pers. comms. February 2015). In addition to negating the need for grass harvesting, Gaugris et al. (2006) found that corrugated iron roofs require fewer timber support laths than thatched roofs. Increased prevalence of corrugated iron roofs in the areas surrounding MWR would therefore decrease the pressure on natural vegetation for both timber and grass for thatching.

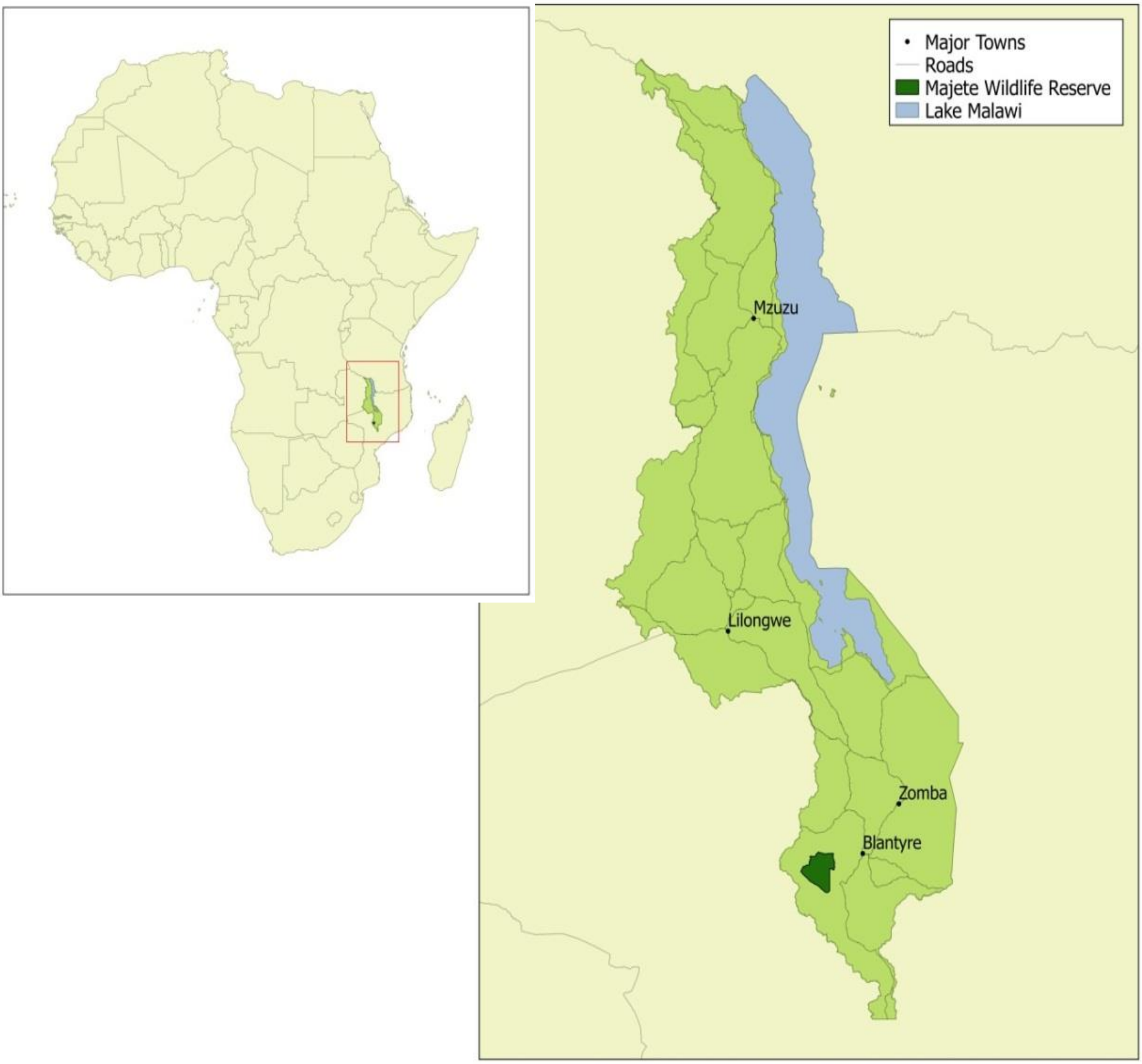

Figure 5.1: Location of Malawi within Africa, and MWR within Malawi. MWR is situated in the south of the country, in the lower Shire valley, south of the biggest major city in the south, Blantyre.

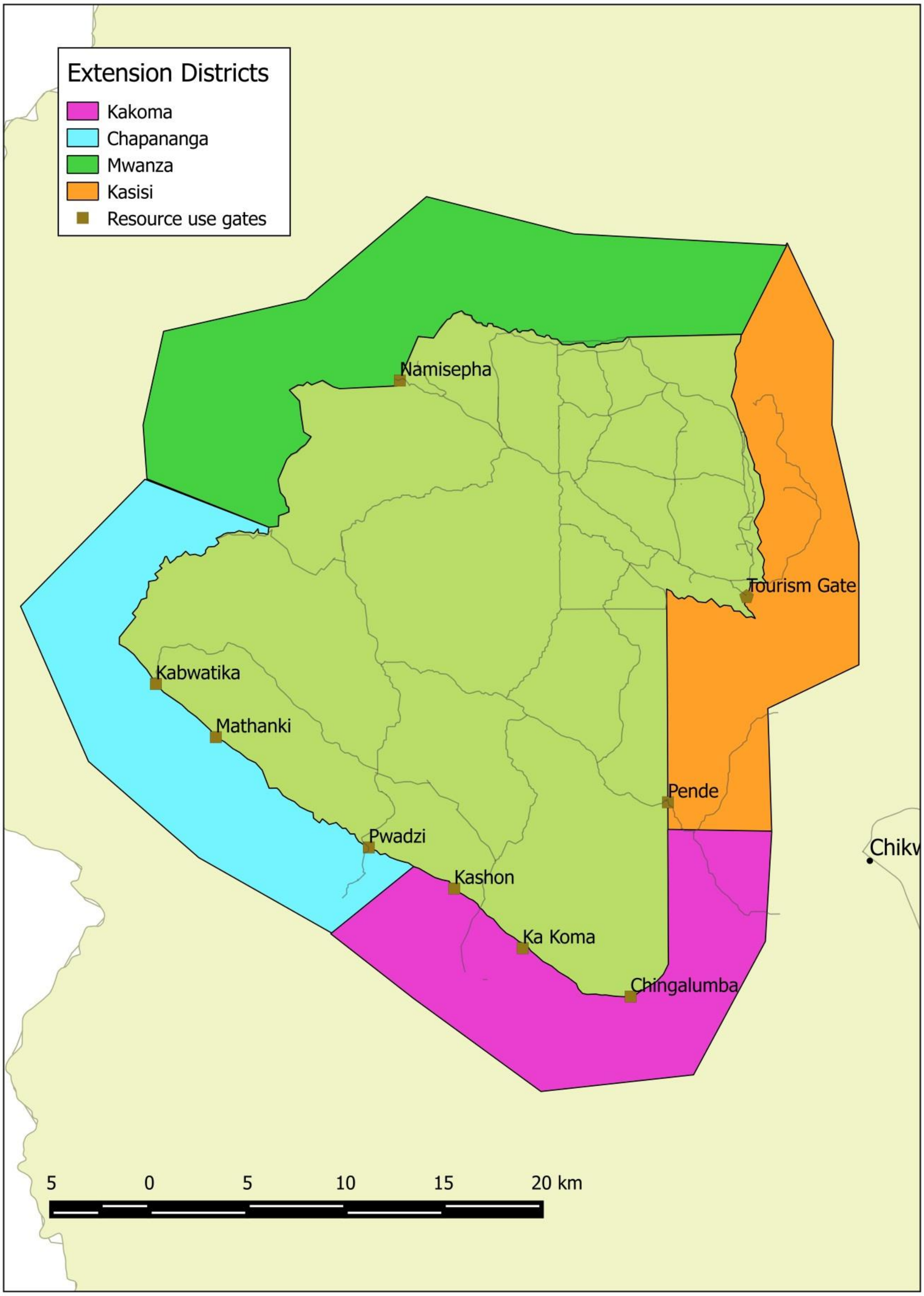

Figure 5.2: Locations of the four extension districts surrounding MWR.

5.2.2 Focus area: Majete Wildlife Reserve

We collected survey data from communities adjacent to MWR in the Chikwawa district of Southern Malawi (Figure 5.1). The communities surrounding the reserve have been divided into four extension districts (Figure 5.2) with which the reserve interacts on a regular basis. These areas were determined by the MWR management and extension teams. Each district encompasses a number of CBOs and in some cases more than one traditional authority. Each extension district is overseen by an extension assistant (EA) employed by MWR. The extension assistants report to the MWR extension coordinator and oversee all extension activities in their districts. We collected data in the following extension districts: Chapananga, Kakoma and Kasisi. Data collected by African Parks from 2013-2014 on the resource use programme indicated that the largest quantities of thatching grass were harvested in MWR at RUP gates that fall within these three extension districts. Each extension district encompasses all villages within a corridor of 5 km from the reserve fence. The RUP gates are a combination of pedestrian and vehicle access gates in the reserve fence that allow staff and community members access to the reserve. There are 8 gates currently used for RUP harvesting activities.

5.2 Methodology

5.2.2 Data collection and sampling

Data was collected between March and May 2016, using household questionnaires. Due to the fact that no members of the research team spoke Chichewa, the questionnaires were developed and then translated into Chichewa with help from the MWR community extension coordinator. The questionnaires were simplified as far as possible to accommodate high levels of illiteracy and limited education in the sample population. The questionnaires contained both multiple choice and open ended questions. We decided to use majority multiple choice questions to make translating the answers into English easier, and to make the questionnaires easier for the extension assistants to facilitate. Open ended questions were used to gain opinions and insights that we felt would not be fully expressed through multiple choice answers (Appendix 2). Questions topics were varied but with a focus on the RUP. Questions were designed to answer knowledge gaps regarding how much and how often community members needed to harvest grass, whether grass was harvested for sale or subsistence use, whether community members thought the RUP worked and how it could be improved. The answering of questionnaires was facilitated by the MWR extension assistants who first explained the purpose of the study to participants and then provided a detailed explanation of how to fill in the questionnaire. Those community members who were literate were given the choice to fill in the questionnaire form on their own, under guidance of the extension assistant. In the case of illiterate community members, the extension assistant would verbally explain each question to the participant in Chichewa and then record their response verbatim on the participants' questionnaire form. Participants were randomly selected from the sample areas at the discretion of the extension assistants who tried to ensure an equal gender balance in respondents.

A pilot study was conducted in the Chapananga district to establish where ambiguities lay and to fine tune the questionnaire form. Questions that caused confusion in the pilot sample were either removed or re-worded. The questionnaire was also fact checked by the MWR extension coordinator and education officer to make sure that no questions were culturally inappropriate.

In total 250 questionnaires were distributed across the following three extension districts; Ka Koma, Chapananga and Kasisi (Figure 5.2). Data collected during the 2015 harvesting season at 5 of the 8 RUP gates determined that there were 2211 community members harvesting thatch grass in MWR across those 5 sites (Chapter 3, Figure 3.3.1). We conservatively estimated that the total number of community members harvesting grass inside MWR including the 3 RUP gates not surveyed in 2015 was 2211-3000 individuals. A sample size of 250 would then give us a minimum of an 8 % sample of the harvesting population. Attention was focused on Kakoma and Chapananga districts with 100 questionnaires being distributed in each of the districts, while in Kasisi 50 questionnaires were distributed. Questionnaires were distributed in this manner as the highest numbers of harvesters utilising the existing RUP come from the Ka Koma and Chapananga districts, followed by the Kasisi district.

Through the questionnaire we aimed to generate a more thorough understanding of the sentiments surrounding the current RUP from a larger group of participants. By targeting community members that we knew were residents of villages currently involved in the RUP we hoped to garner insights on how the current RUP was perceived and how it could possibly be improved moving forward. This allowed us to generate insights without the results being dominated by the viewpoints of a few local authority figures. By conducting a household survey of randomly selected community members our aim was to identify general trends in the perceived positives and negatives of the current RUP. In a previous study it was found that discontent with conservation activities has often been driven by a perception of an unfair distribution of benefits within communities surrounding protected areas (Silva & Mosimane 2012). Since Melaku et al. (2014) and Fisher (2004) found that non-timber forest products can contribute significantly to household incomes in rural communities it is important to consider the perceived benefits that the current MWR RUP has on community members surrounding the reserve. By understanding both what respondents believed to be beneficial aspects of the RUP and identifying where aspects of the RUP could be improved or changed, it would give us an opportunity to improve the RUP moving forward in a way that best aligned with the needs of community members.

5.2.3 Statistical analysis

Since we collected baseline data and there were no previously conducted surveys in this area to compare our results to, only basic statistical analysis was performed. For questions with similar response rates we conducted chi-squared tests to determine whether differences between responses were significant.

5.3.1 Ethics

Ethical clearance for this project was obtained through the Stellenbosch University ethics committee under the reference: SU-HSD-000332. Verbal permission was requested from participants prior to the start of each interview. Participants in this study did not receive any monetary compensation for their voluntary participation.

5.5 Results

We completed a total of 227 questionnaires for this study; 99 from Kasisi, 85 from Kakoma and 43 from Kasisi for a final response rate of 91 %. The gender balance for respondents was almost equal with slightly more men (52%) taking part in the survey then women (48%). For many of the open ended questions, respondents provided multiple answers, this has resulted in some questions having a higher than 100% response rate.

5.5.1 RUP participation

Of the respondents 79% were part of the existing MWR RUP while only 21% were not. Of the respondents who were not currently part of the RUP programme, 56% said that they were a part of the RUP in the past, 39% said they had never been a part of the RUP and 6% said that they were not sure if they were ever part of the RUP. The most commonly listed reasons for not taking part in the RUP was that the gate was too far from where the respondents' respective village was in order to carry harvested resources home (63%), and that the current RUP doesn't allow people enough time to harvest the required quantity of grass (78%). Other reasons for not taking part were; a fear of wild animals (3%), being away over the RUP period (3%), the respondent being too old (8%) or too ill (3%) to participate, and reserve management burning the area directly next to the RUP gate just prior to the harvesting season (5%). Amongst all the respondents, 88% said that they lived in a village that was part of the current RUP, 12% did not come from a village currently part of the RUP and 1% were not sure whether their village participated in the programme me.

5.5.2 Resource preference and use

During fieldwork it became apparent that there was a lack of consistency between the local Chichewa names for different grass species. In particular, the two grasses locally referred to as Nyumbu and Chigonkhondo were both identified as Hyparrhenia species, however since *Hyparrhenia hirta* and *Hyparrhenia filipendula* are both found in the reserve and look similar, many people interchanged the local names for the two species. For this reason, both will be referred to as Hyparrhenia spp. in the results rather than referring to species names. Kambumbu is represented as Melinis spp. due to the fact that the grass harvested in the reserve could not be identified to species level.

The dominant thatch grass species found in MWR were selected for equally during harvesting. Responses indicated that there was no difference in harvesting selection with 99% of respondents saying that they harvested the following species; Nsine (*Heteropogon contortus)*, Nyumbu (Hyparrhenia spp.), and Chigonkhondo (Hyparrhenia spp.). Respondents suggested that they harvested Kambumbu

(Melinis spp.) slightly less frequently (73% of respondents). While 37% of respondents said that they harvested other as yet unidentified grass species.

Although respondents' answers suggest that there was little difference in selecting for different species while harvesting, their answers suggested that certain species of grass were more favoured than others. When asked which species they deemed to be most important, the answers differed from what species they harvested; 52% of respondents indicated that Nyumbu (Hyparrhenia spp.) was deemed the most important species, followed by 46% for Nsine (*Heteropogon contortus),* 16% for Chigonkhondo (Hyparrhenia spp.), 12% for Kambumbu (Melinis spp.) and 13% for other, as yet unidentified species.

Our findings show that *Hyparrhenia* spp. found in MWR, as well as *Heteropogon contortus* were the most important species of grass for the community members utilising the RUP. Respondents indicated that grass harvested in the reserve was predominantly used for thatching roofs (93%). Other uses for grass harvested in MWR were; Building (30%), furniture (14%), fodder for livestock (19%), woven baskets (2%), mats (1%) and other uses (2%).

5.5.3 Housing characteristics

Of the respondents, 87% reported to have a grass roof while only 15% reported that they had an iron roof on their home. There was an overlap in the percentage values because in Malawi the average homestead is made up of between 3-5 buildings. This is normally made up of a main building for sleeping, and then smaller outbuildings normally divided into: a kitchen, pit latrine, grain store, livestock pen, or a smaller sleeping room used by the children. While some people may have an iron roof on the main house, the smaller outbuildings in many cases were still thatched.

Iron roofs were revealed to be very important to respondents with 97% saying that having an iron roof was very important to them, 2% responded that they were not sure if an iron roof was more important and only 1% of respondents stated that an iron roof was not important. When asked why iron roofs were more important the largest percentage of respondents said it was because they did not leak (54%). Reducing harvesting effort (31%) and the fact that iron roofs require less maintenance (25%) were also cited as important reasons for owning an iron roof.

5.5.4 Harvesting characteristics

From the questionnaire responses' we were able to determine that most people want to harvest between 5-14 bundles of grass per annum (Figure 5.5.1). There was a significant difference between the preferences for different numbers of bundles (Chi square; $p < 0.001$) with 5-9, or 10-14 bundles being the most popular.

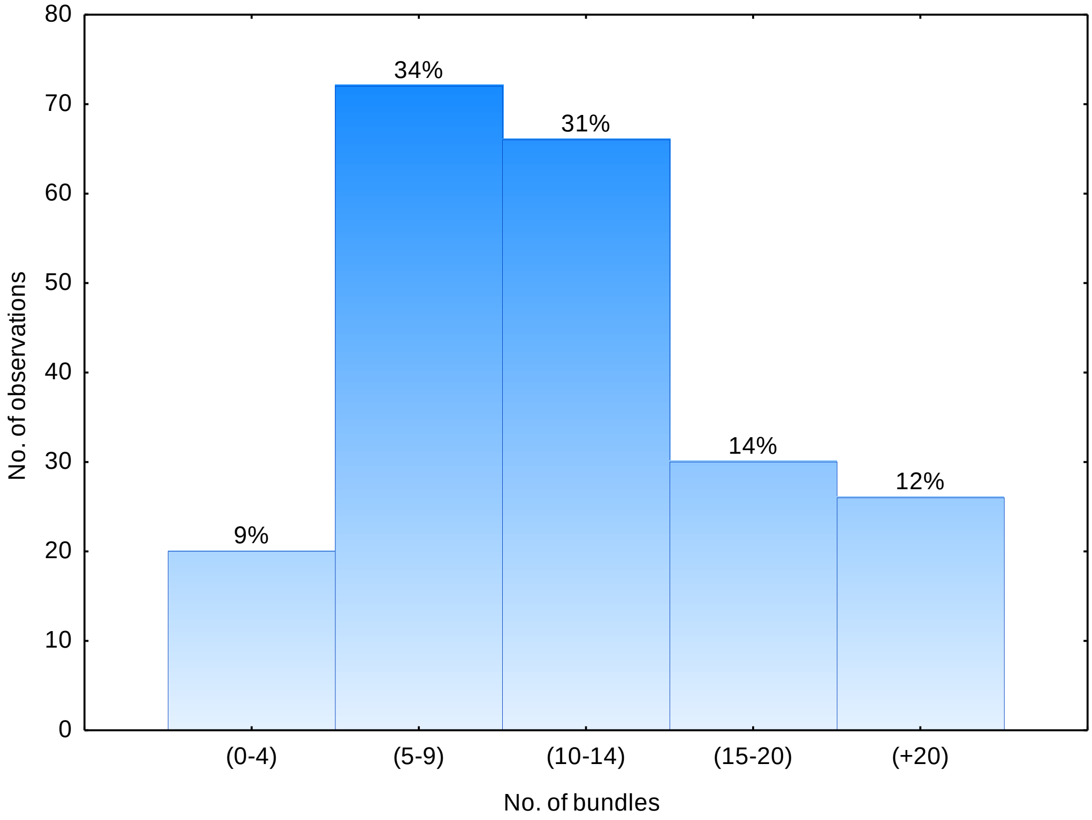

Figure 5.5.1 Number of bundles respondents estimated they needed to harvest per annum

Results as to whether or not respondents sold the grass they harvested, indicated that the majority of grass harvested in MWR was for home consumption. A significant number of respondents said that they did not sell the grass they harvested (70%), while a much smaller number said that they sometimes (12%) or did sell (17%) the grass they harvested.

Figure 5.5.2 Sale and Purchase prices, as reported by respondents, for a bundle of grass. Prices reflect market value across the year.

To estimate the financial value in Malawi Kwacha of thatch grass harvested in MWR we asked respondents to report the sale and purchase price of a bundle of grass. The sale price, is the price that community members sell a bundle of grass in the village for. The purchase price, is the price that a bundle of grass costs if they were to buy it in the village market. The results showed price peaks for both questions, one at MK 500-599 for a bundle and one at MK 1000+ for a bundle. We did not specifically ask respondents to report on prices at any particular time of year, but the price difference may stem from seasonal availability, as grass is not readily available at the start of the rainy season in late November. Although there seems to be a marked variation in the price of a bundle of grass, the prices for selling and buying are consistent with one another (Figure 5.5.2).

Responses from the questionnaires indicated that community members perceive grass resources to be scarce outside of MWR, with 59% of respondents saying that resources are not available and 20% of respondents reporting that resources are only sometimes available outside of MWR. Just 20% of respondents reported that grass resources were available to them outside of MWR. In line with these results, 97% of respondents said that harvesting inside MWR was very important to them, while only 2% said they were not sure and just 1% said that harvesting inside MWR was not important.

General consensus between respondents was that the dry season (68%) is the best time of year to harvest grass in MWR, this was followed by the end of the wet season (29%). The wet season (0%) and end of the dry season (2%) were the worst times of the year to harvest grass. Community members and MWR staff identified the seasons with the following calendar months: dry season is described as June – August, while the end of the dry season is September – November, the wet season starts in December and runs until March. The end of the wet season is April – May. The end of the dry season (September – November) is also the hottest time of the year, making any manual labour extremely strenuous during this time.

The general consensus between respondents was that one opportunity to harvest inside MWR per year was not enough. When asked how many times a year people needed to harvest grass an overwhelming majority of respondents said twice (66%), while only 14% said only once (Figure 5.5.3). Informal discussions with community members suggest that although roofs are only thatched once a year, the strenuous nature of collecting grass and transporting it home means that often individuals are not able to collect enough grass for their households' needs during one 7 day window.

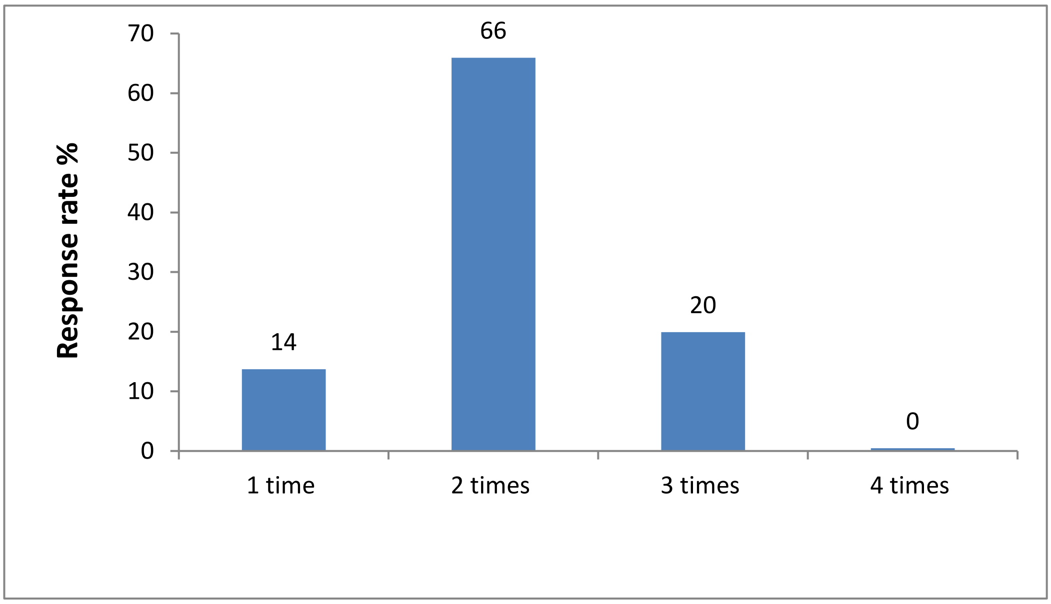

Figure 5.5.3 Graph to show how many times a year respondents need to harvest grass.

Desire for the RUP to allow people to harvest more frequently inside MWR was confirmed further when we asked respondents whether they would like to harvest resources more often. An overwhelming majority of people (96%) said that they would like to harvest resources more frequently, while only 4% said that they would not like to harvest more frequently and just 1% said that they were not sure.

Respondents indicated that the existing RUP benefits them. When asked this question, 95% of respondents said they did, while only 3% said that they did not and just 2% were not sure.

5.5.5 The future of the RUP

To investigate the possibility of expanding the existing RUP we asked respondents what additional resources were sought after by community members surrounding MWR. The answers indicated that there was a significant demand for both medicinal plants (70%) and firewood (70%), the demand for fruit (6%), timber (2%) and bamboo (6%) was minimal in comparison. While there was no demand for meat (0%) (Figure 5.5.4).

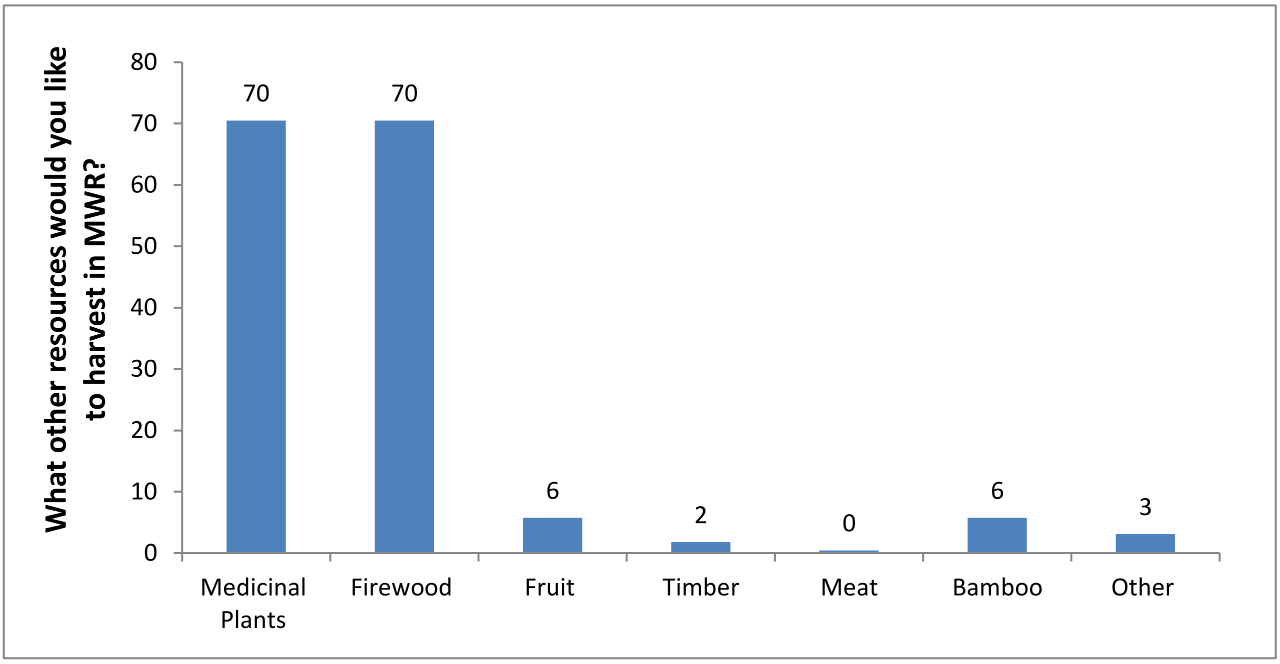

Figure 5.5.4 Resources community members would like to be added to the RUP.

The majority of respondents stated that the addition of these two resources to the existing RUP would be very important (93%), while only 5% were unsure and 2% said it was not important.

Respondents believe the RUP functions well, with 92% stating that it does. Reassuringly only 4% of respondents think that the existing RUP does not function well, while 1% said that it functioned well sometimes and 3% were unsure (Figure 5.5.14).

In our final question we asked respondents to explain why they thought that the current RUP functioned well in an open answer format. Answers were varied but the most common answer was that it allows people an opportunity to thatch their homes (40%), other reasons included; getting grass for free (23%), grass is abundant in MWR and easy to find (18%), it allows for income generation (16%), grass resources aren't available outside of MWR (16%), iron roofs are too expensive for most people (7%) and a number of other reasons were also listed (16%) (Figure 5.5.5).

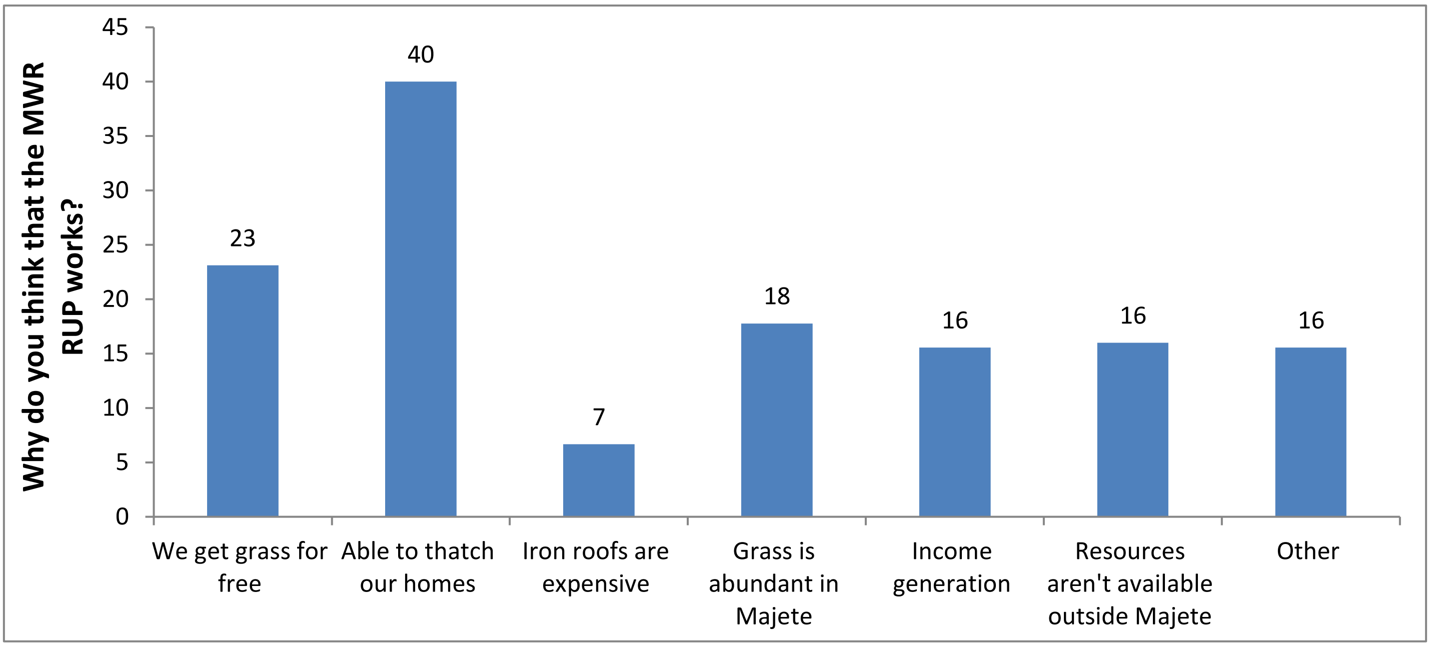

Figure 5.5.5 Respondent answers as to why they thought that the current RUP functions well.

5.6 Discussion

The intention of this study was to determine how the current RUP is viewed by community members living adjacent to MWR. Since prior to this study little formal research had been conducted on public perceptions, MWR management were basing most of their decision making on informal anecdotal feedback from the extension assistants and community leaders, which although helpful, provided a limited scope of reference.

The majority of respondents reported to be active participants in the existing RUP, while those who weren't, commonly lived in villages too far away from MWR to participate in the programme or stated that the reserve did not allow them enough time each year to harvest enough grass. The most commonly harvested and most preferred grass species were the *Hyparrhenia* spp. as well as *Heteropogon contortus*. These grasses were also of the same species we observed being sold in the local markets as thatching grass. Respondents indicated that the *Melinis* spp. of grass were less valuable to them, as they were predominantly used for feeding livestock rather than thatching roofs. Using grass to thatch homes was the most commonly reported reason for harvesting grass in MWR.

Housing characteristics in the sample area reinforced the reported demand for grass with a large percentage of respondents reporting that they have grass roofs on their homes. Despite the prevalence of grass roofs, there is substantial demand for iron roofs with most people aspiring towards having an iron roof that will not leak during the rainy season. This aspiration towards having a house with a corrugated iron roof is consistent with other areas of Malawi and Africa, where people perceive corrugated iron roofs as requiring less maintenance and being a sign of status and prosperity (Doctor 2004; Gaugris et al. 2006; Kirby et al. 2008; Manda 2007).

During our research for Chapter 3, we determined that most participants during the RUP harvested between 1 or 2 bundles of grass in MWR per day during the RUP. During the current 7 day RUP harvesting window this means that at most participants would be able to collect 7-14 bundles of grass in MWR. Although this is technically possible, most harvesters do not achieve this. Our survey suggests that most participants need to harvest 5-14 bundles per year to thatch their homes while a notable percentage cited needing to harvest 15 – 20 or more bundles. This difference could be attributed to some community members having more buildings with thatch roofs than others, community members possessing one or more building with an iron roof or the community member being the only able bodied adult able to harvest grass in their household. Additionally, from the results it is clear that grass harvested in MWR is for domestic purposes, with the majority of people using grass for their own use rather than as an income generating opportunity. For those who do sell or buy grass, the prices for a bundle of grass varied quite substantially but the two prices did track one another with neither bought, nor sold prices showing significant differences. Harvesting inside MWR was reported as being very important with a large percentage of respondents stating that grass resources were not available to them outside of the reserve. Since the end of the wet season and the dry season were cited as the best time to harvest grass, the results suggest that the reserve should conduct all harvesting activities between May and September. Also when asked, a majority of respondents said that they would like to harvest more frequently in MWR, with most respondents citing that they would like the RUP to run twice a year. Distance measurements in Chapter 3 (Table 3.3.9) indicate that community members often walk substantial distances (km) on undulating terrain to harvest grass in MWR and then carry it home. Informal discussions with community members indicated that due to the physical demands of harvesting grass many community members are not physically capable of harvesting grass for multiple days in a row. This means that during one 7 day window community members may only be capable of harvesting grass for a few days (Joseph Mbalu pers. comms. August 2015). To improve the RUP moving forward we suggest that each gate is opened twice a year for 7 days, rather than just once.

Most surveyed community members said that they believed the RUP benefited them and there was support for including other resources into the programme. Medicinal plants and firewood were cited as the most sought after, with bamboo showing a relatively low popularity among participants. A significant majority of respondents said that these resources were very important to them, suggesting that MWR management should reconsider the resources included in the existing RUP framework. This demand for firewood and medicinal plant harvesting inside MWR is consistent with demands on Protected Areas from rural communities across other parts of Malawi and Africa (Amin et al. 2015; Bruschi et al. 2014; Kamanga et al. 2008) and reflects both the need for access to fuel sources (Kamanga et al. 2008) and the importance of traditional medicine to rural Malawian communities (Simwaka et al. 2014). Reassuringly most participants do believe that the current RUP works, with the most common reason for this being that it gives people an opportunity to thatch their homes.

The survey results showed a predominantly positive perception of the existing RUP within the communities adjacent to MWR. In order to keep the programme relevant, moving forward, our suggestion for reserve management would be to increase the grass harvesting RUP from one 7 day window, to two 7 day windows at each gate annually. While also considering the inclusion of monitored medicinal plant and firewood harvesting in the reserve.

References

African Parks, 2012, Majete Wildlife Reserve, Malawi. Available from: http://www.african-parks.org/Park_1_13_About+the+Park.html.

African Parks., 2016, Our Story, Available from: https://www.african-parks.org/african-parks/our-story.

Amin, A., Zaehringer, J.G., Schwilch, G., & Kone, I., People, protected areas and ecosystem services: a qualitative and quantitative analysis of local people's perception and preference in Cote d'Ivoire. *Natural Resources Forum*, 39, pp. 97-109.

Bobo, K.S., Aghomo, F.F.M., & Ntumwel, B.C., 2014, Wildlife use and the role of taboos in the conservation of wildlife around the Nkwende Hills forest reserve, South-west Cameroon. *Journal of Ethnobiology and Ethnomedicine*, 11(2), pp. 1-23.

Bruschi, P., Mancini, M., Mattioli, E., Morganti, M., & Signorini, M.A., 2014, Traditional uses of plants in a rural community of Mozambique and possible links with Miombo degradation and harvesting sustainability. *Journal of Ethnobiology and Ethnomedicine*, 10, 59. DOI: http://www.ethnobiology.com/content/10/1/59.

Doctor, H.V., 2004, The effect of living standards on childhood mortality in Malawi. *African Population Studies*, 19, pp. 249 – 263.

Dovie, D.B.K., Shackleton, C.M., & Witkowski, E.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 (3), pp. 269-283, DOI: 10.1080/13504500209470122.

Dovie, B.K.D., Witkowski, E.T.F., & Shackleton, C.M., 2005, Monetary valuation of livelihoods for understanding the composition and complexity of rural households. *Agriculture and Human Values*, 22, pp. 87-103. DOI: 10.1007/s10460-004-7233-0.

Dowie, M., 2009, Introduction: "Enemies of Conservation". *Conservation Refugees: The hundred-year conflict between global conservation and native peoples*. Massachusetts Institute of Technology, pp. xvi-xxvii.

Ellis, F., 1998, Household strategies and rural livelihood diversification. *Journal of Development Studies*, 35, 1-38.

Ellis, F., & Manda, E., 2012, Seasonal food crises and policy responses: a narrative account of three food security crises in Malawi. *World Development*, 40 (7), pp. 1407-1417.

Faasen, H., & Watts, S., 2007, Local community reaction to the “no-take” policy on fishing in the Tsitsikamma National Park, South Africa. *Ecological Economics*, 64, pp. 36-46.

Fisher, M., 2004, Household welfare and forest dependence in Southern Malawi. *Environment and Development Economics*, 9, pp. 135-154.

Gaugris, J.Y., van Rooyen, M.W., Bothma, J. du P., & Van der Linde, M.J., 2006, Hard wood utilization in buildings of rural households of Manqakulane Community, Maputaland, South Africa. *Ethnobotany Research and Applications*, 5, DOI: 097-114.

Hunter, L.M., Twine, W., & Johnson, A., 2011, Adult mortality and natural resource use in rural South Africa: evidence from the Agincourt health and demographic surveillance site. *Society and Natural Resources*, 24, pp. 256-275.

Jury, M.R., 2014, Malawi’s Shire river fluctuations and climate. *American Meteorological Society*, 15, pp. 2039-2049.

Kamanga, P., Vedeld, P., & Sjaastad, E., 2009, Forest incomes and rural livelihoods in Chiradzulu district, Malawi. *Ecological Economics*, 68, pp. 613-624.

Kanthungo, J.I.,2007, *An assessment of biodiversity contribution to rural livelihood security and protected area governance in Malawi: a case of communities along Nkhotakota Wildlife Reserve.* Master’s Thesis, Uppsala University.

Kirby, M.J., Green, C., Milligan, P.M., Sismanidis, C., Jasseh, M., Conway, D.J., & Lindsay, S.W., 2008, Risk factors for house-entry by malaria vectors in a rural town and satellite villages in The Gambia. *Malaria Journal*, 7, DOI: 10.1186/1475-2875-7-2.

Leslie, A. 2014. Animals of Malawi in the Majete Wildlife Reserve. Earthwatch Institute. Available from: http://earthwatch.org/expeditions/animals-of-malawi-in-the-majete-wildlife-reserve.

Macdonald, D.W., Johnson, P.J., Albrechtsen, L., Seymour, S., Dupain, J., Hall, A., & Fa., J.E., 2012, Bushmeat trade in the Cross-Sanga rivers region: evidence for the importance of protected areas. *Biological conservation*, 147, pp. 107-114.

Manda, M.A.Z., 2007, Mchenga – urban poor housing fund in Malawi. *Environment and Urbanization*, 19, pp. 337 – 359. DOI: 10.1177/09562247807082818.

Mandondo, A., German, L., Utila, H., & Nthenda, U.M., 2014, Assessing societal benefits and trade-offs of tobacco in the Miombo woodlands of Malawi. *Human Ecology*, 42, pp. 1-19.

Meke, G.S., Mumba, R.F.E., Bwanali, R.J., & Williams, V.L., 2016, The trade and marketing of traditional medicines in southern and central Malawi. *International Journal of Sustainable Development & World Ecology,* DOI: 10.1080/13504509.2016.1171261.

Melaku, E., Ewnetu, Z., & Teketay, D., 2014, Non-timber forest products and household incomes in Bonga forest area, southwestern Ethiopia. *Journal of Forestry Research,* 25, pp. 215-223.

National Statistical Office, 2008, 2008 Population and Housing main report. Available from: http://www.nsomalawi.mw/2008-population-and-housing-census.html.

National Statistical Office, 2014. *Malawi MDG Endline Survey 2014, key findings.* Zomba, Malawi.

Orr, A., Mwale, B., & Saiti-Chitsonga, D., 2009, Exploring seasonal poverty traps: the "sixe week window" in Southern Malawi. *The Journal of Development Studies,* 45 (2), pp. 227-255.

Patenaude, G., & Lewis, K., 2014, The impacts of Tanzania's natural resource management programme mes for ecosystem services and poverty alleviation. *International Forestry Review,* 16(4), pp. 459-473.

Population Reference Bureau 2015, 2015 World Population Data Sheet. Available from: http://www.prb.org/pdf15/2015-world-population-data-sheet_eng.pdf.

Pouliot, M., & Treue, T., 2013, Rural people's reliance on forests and the non-forest environment in West Africa: evidence from Ghana and Burkina Faso. *World Development,* 43, pp. 180-193.

SADC, 2012, Southern African Development Community: Towards a Common Future – Malawi. Available at: http://www.sadc.int/member-states/malawi/.

Sassen, M., Sheil, D., & Giller, K.E., 2015, Fuelwood collection and its impacts on a protected triopical mountain forest in Uganda. *Forest Ecology and Management,* 354, pp. 56-67.

Sassi, M., 2012, Short-term determinants of malnutrition among children in Malawi. *Food Security,* 4, pp. 593-606.

Shackleton, C.M., Shackleton, S.E., Buiten, E., & Bird, N., 2007, The importance of dry woodlands and forests in rural livelihoods and poverty alleviation in South Africa. *Forest Policy and Economics,* 9, pp. 558-577.

Silva, J.A., & Mosimane, A.W., 2012, Conservation-based rural development in Namibia: A mixed-methods assessment of economic benefits. *Journal of Environment & Development,* 22, pp.25-50.

Simwaka, A., Peltzer, K., & Maluwa-Banda, D., 2014, Indigenous healing practice practicein Malawi. *Journal of Psychology in Africa*, 17, pp. 155 – 161. DOI:10.1080/14330237.2007.10820162.

Staub, C.G., Binford, M.W., & Stevens, F.R., 2013, Elephant herbivory in Majete Wildlife Reserve, Malawi. *African Journal of Ecology,* 51, pp. 536-543.

Sunderlin, W.D., Angelsen, A., Belcher, B., Burgers, P., Nasi, R., Santoso, L., & Wunder, S., 2005, Livelihoods, forests and conservation in developing countries: an overview. *World Development*, 33, pp. 1383-1402.

UNEP, 2013, Africa environment outlook 3: summary for policy makers. Available at: http://www.unep.org/pdf/aeo3.pdf.

Wells, M.P., & McShane, T.O., 2004, Integrating protected area management with local needs and aspirations. *Ambio,* 33, pp. 513-519.

Wunder, S., 2001, Poverty alleviation and tropical forest – what scope for synergies? *World Development*, 29, pp. 1817-1833.

Zulu, L.C., 2008, Community forest management in Southern Malawi: Solution or part of the problem? *Society & Natural Resources,* 21(8), pp. 687-703.

Zulu, L.C., 2010, The forbidden fuel: charcoal, urban wood fuel demand and supply dynamics, community forest management and woodfuel policy in Malawi. *Energy Policy,* 38, pp. 3717-3730.

Zulu, L.C., & Richardson, R.B., 2013, Charcoal, livelihoods, and poverty reduction: evidence from sub-Saharan Africa. *Energy for Sustainable Development*, 17, pp. 127-137.

Chapter 6: Project conclusion and management recommendations

6.1 Overview

The results of this project help to address a number of knowledge gaps pertaining to the Majete Wildlife Reserve (MWR) resource use programme (RUP). Previously only limited formal monitoring on the RUP activities was conducted, which meant that crucial data needed to make informed management decisions was outstanding. The data gathered in this project aim to assist management in making informed decisions moving forward with the RUP, with an emphasis on improving livelihood opportunities for local communities while maintaining ecological integrity.

6.2 Key Findings

Chapter 3: Thatch grass harvesting in MWR

- One of the most significant results to come out of the data collected during the 2015 RUP season was that the number of community members recorded to be harvesting grass inside MWR was much lower than initial estimates. Initial reports from the MWR extension department suggested that approximately 5700 community members (African Parks 2014) accessed the reserve in 2013 to collect grass. The number of harvesters recorded across the 5 monitored gates in 2015 suggested that even at a conservative estimate, when we add to the estimates for the 3 outstanding gates no more than 3000 community members utilise the RUP. We discovered the disparity when we realised that the MWR extension team was recording the numbers of grass bundles removed from the reserve, not people. When we compared bundle figures from previous years to the data collected in 2015, we saw consistency with our calculations suggesting that demand for grass has not changed significantly.
- The highest demand for grass was found to be consistent with data from previous years with Mathanki, Kabwatika, Kakoma and Kashon gates showing the highest levels of harvesting in 2015. The results support the notion that the highest demand for grass is on MWR's southern boundary.
- Demographic trends in the data suggest that grass harvesting is conducted equally by men and women.
- The distance from villages to the RUP gates is inversely proportionate to the amount harvested, in that the further people have to walk the less they harvest.
- However, in areas where grass is scarce outside of MWR, people are willing to undertake extensive return journeys on foot to harvest grass.

Chapter 4: Medicinal plants used by traditional healers

- A total of 96 different plant species were reported to be used by the traditional healers in the areas adjacent to MWR.
- The two most prominent plant families harvested were Rubiaceae (21.6%) and Vitaceae (18.9%).
- The most frequently harvested growth forms were trees (39%) and shrubs (18%).
- The most commonly harvested plant parts were roots (50%), and leaves (35%), while bark was harvested just 10% of the time.
- Harvesters were conscious of maintaining sustainable harvesting levels. All of the traditional healers we interviewed reported to harvesting only a small amount of each plant in order to maintain sustainable harvesting levels and ensure the survival of the plant.
- Traditional healers identified the most common ailments they use plants for treating as: gastrointestinal ailments (13.4%), pain treatment (11%) and childhood illnesses (9.4%).
- All the traditional healers reported that they harvested medicinal plants inside MWR before the perimeter fence was erected and that they would like to harvest medicinal plants in the reserve now. Additionally, almost all the traditional healers stated that their healing practise was their main source of income.
- The data collected also showed a high level of variation in the local names given to plants used by traditional healers, with some species having up to 5 different local names. These results support the fact that using local names as a way to identify medicinal plants is inaccurate and risky where biological monitoring is concerned.

Chapter 5: Determining perceptions of the Majete wildlife reserve RUP – a household survey

- The survey yielded 227 responses of which an almost equal percentage were men (52%) and women (48%) from villages in Kasisi, Kakoma and Chapananga districts.
- Of the respondents 79% reported to be current participants in the RUP.
- Of the 21% of respondents who reported to not be a part of the RUP the most commonly cited reasons were as follows:
  - The gate is not open for long enough each year (78%)
  - The respondent lived too far away from the closest RUP gate to participate (63%)
- The most commonly harvested grass species are the *Hyparrhenia* spp. (locally known as Nyumbu 99% and Chigonkhondo 99%) and *Heteropogon contortus* (Nsine 99%), the same species were also reported to be the most popular species for roof thatching (Chapter 5, Figure 5.3 and 5.4).
- Grass harvested in MWR was reported to be most commonly used for roof thatching (Chapter 5, Figure 5.5), with 87% of respondents reporting to have grass thatched roofs.
- Most respondents said that having an iron roof was very important to them (97%), because they do not leak (54%) (Chapter 5, Figure 5.6).
- Respondents indicated that they needed to harvest between 5-14 bundles of grass annually to meet their household needs (Chapter 5, Figure 5.7), when we consider that the average number of bundles harvested per individual was 3.2 in 2015 (Chapter 3), even if more than one household member harvests grass, the duration of the current RUP is not long enough for participants to be able to harvest enough grass.
- Most respondents stated that they did not sell the grass they harvested (70%), while 59% of respondents stated that grass was not available to them outside of MWR, and 20% stated that grass was only sometimes available to them outside of MWR.
- We attempted to estimate what a bundle of grass was sold for by harvesters, versus what it would cost to buy a bundle in the local market. There was a significant variation in price with respondents indicating that a bundle could be bought or sold for anything between 100-1000 Malawi Kwacha (0.14 - 1.4 USD). [At the time of writing 1 USD = 719 MWK (www.xe.com).
- The price variation could be linked to the seasonal availability of grass, as the start of the rainy season coincides with a seasonal grass shortage.
- Almost all participants in the survey (98%) said that it was very important for them to be able to harvest grass in MWR and the best time of year to harvest was reported to be the end of the wet season (29%) and the dry season (68%) (Chapter 5, Figure 5.9 and 5.10).

- The general consensus was that respondents wanted to harvest resources more often in MWR (96%) (Chapter 5, Figure 5.12), with 66% of surveyed participants stating that they would like to harvest twice a year in the reserve (Chapter 5, Figure 5.11).
- The two additional resources that participants would like to be added to the existing RUP were medicinal plants (70%) and firewood (70%) (Chapter 5, Figure 5.14) with 93% of respondents stating that the addition of these two resources would be very important to them (Chapter 5, Figure 5.15).
- Most participants (95%) responded that they do think the current RUP benefits them (Chapter 5, Figure 5.13).
- 92% of respondents said that they believed the RUP functions well (Chapter 5, Figure 5.16), the two most common reasons cited by respondents for thinking the RUP functions well were that;
    - They are able thatch their homes (40%) (Chapter 5, Figure 5.17)
    - They are able to harvest grass for free (23%) (Chapter 5, Figure 5.17)

6.3 Conclusion

The participants in this study indicated that on the whole those community members who participate in the MWR resource use programme me (RUP) think that it not only benefits them, but that it also functions well. Respondents did however suggest areas in which the RUP operations could be improved and expanded to further improve the impact that the existing programme has on community members who participate in the RUP. Chapter 5 helped us gain insights into the needs of community members and how the current RUP strategy could be realigned, to ensure that MWR continues to benefit communities adjacent to the reserve.

From the perspective of community members there were three improvements that could be made to the current RUP that would have a large impact. These improvements were to expand the existing grass harvesting window so that community members had a longer period of time in which to harvest grass, and to incorporate medicinal plant and firewood harvesting into the existing RUP strategy. Before the reserve fence was constructed, community members harvested all these resources inside MWR. Ensuring local, long-term support of African Parks' conservation efforts on MWR is essential, and will only be achieved if community members feel that their needs are being considered by reserve management. It is therefore vital that management consider the suggestions put forward by community members on how to keep the RUP relevant, moving forward.

We also suggest ways in which MWR could provide alternative solutions to medicinal plant and fire wood harvesting in the reserve, so as to minimise pressure placed on the reserve ecosystems and staff. By providing communities with alternative solutions that can be based outside of the reserve we hope to ensure the long-term economic and environmental sustainability of communities surrounding MWR.

6.4 Recommendations to management

Grass Harvesting

We recommend expanding the current harvesting period from one 7 day window per gate per year, to two 7 day harvesting windows per gate per year. Incorporating an extra week of harvesting would allow community members a second chance in which to harvest grass. By doing this, MWR would provide community members who were unable to attend or who were not able to harvest enough grass during the first 7 day window another opportunity to harvest grass in the reserve. For those community members who live far away from the RUP gate in their area, or are the only individual in their household able to collect grass, extending the current harvesting window would go a long way in improving these individuals ability to harvest enough grass to meet their households' needs.

Additionally, we recommend modifying the RUP grass monitoring method. Previously grass harvesting was monitored by recording the number of bundles of grass removed per day at each gate. Our results reveal high levels of variability in the mass per bundle of grass. Recording the number of bundles is therefore an inaccurate monitoring technique when estimating biomass extraction. We would recommend that MWR creates a formalised harvester database through which they can track which individuals are harvesting grass, at which gates, for how long and how much – in kg's – is removed from each gate. Although this method would involve time and capital input at the beginning, once established it would provide a more time and energy efficient way in which to track both biomass removal at different sites as well as harvester activities. Tracking grass biomass removal volumes will assist MWR management in planning for future RUP activities and will provide valuable data in terms of monitoring where and to what extent, defoliation through harvesting is occurring. Tracking this defoliation will be valuable when planning burning regimes and ensuring that carrying capacity of the areas around the RUP gates is maintained at ecologically sustainable levels. For example, by tracking biomass extraction through harvesting activities, MWR can plan burning activities to ensure that areas are not defoliated through harvesting and burnt in the same year. This will aid in stimulating regrowth of grass and avoid overuse of particular areas.

Medicinal Plants

Our recommendation is that MWR should include medicinal plant harvesting into the RUP framework. The results of the data collected in both Chapter 4 and 5 indicated that MWR was always a source of medicinal plants to traditional healers in communities surrounding the reserve and that there is currently a strong demand from community members and traditional healers for access to MWR to harvest medicinal plants in the reserve. As for grass harvesting, we would recommend that MWR creates a database for traditional healers and community members who plan on harvesting medicinal plants in the reserve. The same database as used for grass harvesting could be used, with community members indicating which resources they would like to harvest in the reserve – i.e. grass or medicinal plants or both. Having a database would allow MWR management to track through which RUP gates medicinal plants are being harvested so that follow up monitoring can be carried out. Since harvesters need to be accompanied by a game scout in the reserve we recommend that the extension and law enforcement departments discuss a predetermined harvesting window each month in which community members can access the reserve to harvest medicinal plants. For instance, two days a month, the gate is opened and a game scout is made available to escort community members into the reserve. An extension assistant (EA) would need to be present to record harvesting activities and to coordinate scouts and community members. The harvesting window would be determined by community demand and availability of scouts, the dates and number of days would be coordinated by the EAs. Prior to each medicinal plant harvesting window we would suggest that the EAs sensitise community members to sustainable harvesting practices to ensure that harmful activities such as ring-barking don't occur.

Given the limitations to the number of man hours that game scouts and EAs can spend monitoring harvesting activities and how frequently gates can be opened to facilitate harvesting, it would be in MWR's best interests to develop a way for local healers and community members to harvest medicinal plants outside of the reserve through the development of medicinal plant nurseries and woodlots. A Traditional healer, Fawema Dzongwe, from Kashon Village in Kakoma district on MWR's southern district expressed a great desire to start a medicinal plant nursery outside of the reserve for the use of her community. She asked that she would be given access to the reserve to collect seeds, and plant material from which to grow her own plants. Evidence suggests that where local champions are present, community initiatives are most likely to succeed (Adjewodah and Beier 2004; Everard 2015; Measham & Lumbasi 2013).

Firewood

Expanding the RUP to include firewood harvesting is possible however it will be more logistically challenging than medicinal plant and grass harvesting in MWR. The substantial scale and demand for fire wood harvesting means that the supply of deadwood close to the RUP gates will be depleted faster than the supply of medicinal plants and will not regenerate as quickly as that of grass. The felling of live trees should not be allowed, which would restrict community members to harvesting only deadwood or trees felled by elephants. Additionally, collecting deadwood opens community members up to the threats of increased encounters with dangerous snakes. This would be an additional liability to MWR, and unlike the threats posed by large game could not be mitigated by the presence of game scouts.

Feedback from community members during the household survey in Chapter 5 indicated that there is substantial demand and desire for MWR to allow fire wood harvesting in the reserve. Additionally, the community members who requested that the reserve allow fire wood harvesting said that it was a very important resource for them (Chapter 5; Figures 5.14 and 5.15). This feedback indicates that it is worth MWR investigating the possibility of incorporating alternative fuel micro-enterprise opportunities into future extension activities, as an alternative to allowing fire wood harvesting in the reserve. Establishing projects that create charcoal briquettes out of agricultural waste would be a way in which to create micro-enterprise industries that are supported by local demand and provide local employment in communities adjacent to the reserve. MIT's D-lab have collaborated with communities in other parts of Africa to develop effective ways in which to generate charcoal briquettes out of agricultural waste that are not only more ecologically sustainable then briquettes made from trees, but also burn more efficiently and cleaner, and offer a potentially cheaper fuel source than traditional charcoal (Banzaert & Winter 2013; MIT D-Lab 2015). Providing people with sustainable alternatives to destructive natural resource harvesting would be invaluable to both poverty alleviation and the maintenance of what remains of natural vegetation patches.

References

Adjewodah, P., & Beier, P., 2004, Working with traditional authorities to conserve nature in West Africa. African Conservation Telegraph; Newsletter of the Africa Section of the Society for Conservation Biology, October – November 2004, Volume 1, Issue 2.

African Parks, 2014, Annual Report 2014: Our conservation model unpacked. Available at: https://api.african-parks.org/ckeditor_assets/attachments/3/apn_annualreport_2014.pdf.

Banzaert, A., & Winter, A.V., 2013, Design of Agricultural waste charcoal cooking fuel for developing countries. Proceedings of the ASME 2013 International design engineering technical conferences & computers and information in engineering conference. August, 2013, Portland, USA. Available at: http://proceedings.asmedigitalcollection.asme.org/proceeding.aspx?articleid=1830437.

Everard, M., 2015, Community-based groundwater and ecosystem restoration in semi-arid north Rajasthan (1): Socio-economic progress and lessons for groundwater-dependent areas. *Ecosystem Services*, 16, pp. 125-135.

Measham, T.G., & Lumbasi, J.A., 2013, Success factors for Community-Based Natural Resource Management (CBNRM): Lessons from Kenya and Australia. *Environmental Management*, 52, pp. 649-659.

MIT D-Lab, 2014, Adoption of agricultural waste charcoal briquettes in Uganda: User evaluation. Available at: http://d-lab.mit.edu/research/biomass-fuels-cookstoves/areas.

Appendix 1 - Supporting information for Chapter 4

Table A.1: Taxonomic diversity of medicinal plants used by traditional healers in the communities adjacent to MWR.

	Family	No. of Species	Percentage of species (%)
1	Amaranthaceae	1	2,7
2	Anacardiaceae	1	2,7
3	Annonaceae	1	2,7
4	Apiaceae	1	2,7
5	Apocynaceae	3	8,1
6	Arecaceae	1	2,7
7	Aristolochiaceae	1	2,7
8	Asclepiadaceae	2	5,4
9	Asteraceae	3	8,1
10	Bigononiaceae	2	5,4
11	Boraginaceae	4	10,8
12	Chrysobalanceae	1	2,7
13	Combretaceae	3	8,1
14	Ebenaceae	1	2,7
15	Euphorbiaceae	4	10,8
16	Fabaceae	4	10,8
17	Flacourtiaceae	1	2,7
18	Kirkiaceae	1	2,7
19	Lamiaceae	3	8,1
20	Loraginaceae	1	2,7
21	Malvaceae	2	5,4
22	Meliaceae	2	5,4
23	Melianthaceae	2	5,4
24	Menispermaceae	1	2,7
25	Moraceae	1	2,7
26	Olacaeae	1	2,7
27	Papilionoidae	1	2,7
28	Passifloraceae	1	2,7
29	Proteaceae	1	2,7
30	Rubiaceae	8	21,6
31	Sapindiceae	1	2,7
32	Scrophulariaceae	1	2,7
33	Solanaceae	1	2,7
34	Sterculiaceae	1	2,7
35	Tiliaceae	3	8,1
36	Verbenaceae	1	2,7
37	Vitaceae	7	18,9
	Total	37	100

Appendix 2 – Questionnaire used in the household surveys in Chapter 5

Village	
Age	
Gender	M / F
Date	
Time	
Location of Interview	
Interviewee Number	
Verbal consent given	Y / N
Interviewer Name	

1. Are you part of the Majete harvesting project?

Yes	
No	
I'm not sure	

2. If you answered No to question 1, were you ever a member of the Majete harvesting project in the past?

Yes	
No	
I'm not sure	

3. If you answered yes to question 2, why are you no longer a member of the Majete harvesting project?

4. Is your village part of the Majete harvesting project?

Yes	
No	
I'm not sure	

5. What do you harvest in the park? (keep)

Nsine (Spear Grass – *Heteropogon contorus*)	
Nyumbu (Common thatching grass- *Hyparrhenia hirta*)	
Chigonkhondo	
Bamboo	
Other – please describe	

5b. Which one is most important to you? (add comment blocks for note taking – extension assistants: if they tell you why)

Nsine (Spear Grass – *Heteropogon contorus*)	
Nyumbu (Common thatching grass- *Hyparrhenia hirta*)	
Chigonkhondo	
Bamboo	
Other – please describe	

6. What do you use the plants you harvest in Majete for?

Roofs	
Mats	
Building - walls etc.	
Furniture	
Fodder	
Other – please describe	

7. What type of roof does your house have?

Thatch/Grass	
Corrugated Iron sheets	
Other – please describe	

8. How important is it to you to have a corrugated iron roof?

Very Important	
Not Important	
I'm not sure	

9. If it is important to have an iron roof, why?

10. How many bundles of grass or bamboo do you harvest each year?

0 – 4	
5 – 9	
10 – 14	
15 – 20	
More than 20	

11. Do you sell what you harvest?

Yes	
No	
Sometimes	
I don’t know	

12. How much do you sell a bundle of grass for?

13. How much does a bundle of grass cost in the market?

14. Can you or the people in your village harvest these things outside of Majete?

Yes	
No	
Sometimes	
I’m not sure	

15. How important is it that African Parks allows you or your village to harvest inside Majete?

Very Important	
Not Important	
I'm not sure	

16. What is the best time of year to harvest in Majete?

Wet season	
End of the wet season	
Dry Season	
End of the dry season	
I'm not sure	

17. How many times a year do you need to harvest inside Majete?

1 time	
2 times	
3 times	
Other – please describe	

18. Would it be helpful if Majete allowed you to harvest more inside the Park?

Yes	
No	
Sometimes	
I'm not sure	

19. Do you think the harvesting project helps people who live outside the park?

Yes	
No	
Sometimes	
I'm not sure	

20. What other resources would you like to harvest inside the Park?

Medicinal plants	
Firewood	
Other	

21. How important would it be for you to be able to harvest this extra resource in the park?

Very Important			
Not Important			
I'm not sure			

22. Do you think the Majete harvesting project works?

Yes	
No	
Sometimes	
I'm not sure	

22b. Why do you say this?
