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Values, management and contributions of the high altitude wetlands to local livelihoods

Morapeli-Mphale, Matseliso

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VALUES, MANAGEMENT AND CONTRIBUTIONS OF THE HIGH ALTITUDE WETLANDS TO LOCAL LIVELIHOODS

A THESIS PRESENTED FOR THE DEGREE OF PHILOSOPHIAE DOCTOR

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MATŠELISO MORAPELI-MPHALE

BA, MSc

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SCHOOL OF ENVIRONMENT AND NATURAL RESOURCES

CENTRE FOR ARID ZONE STUDIES

UNIVERSITY OF WALES, BANGOR

DEDICATION

'This thesis is dedicated to my loving husband and sons who supported me throughout this study. It is also dedicated to my sister – the desire to be there when she needs me kept me going.

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A, B, C zones	(A-summer grazing zone locate at highest altitudes, B-Autumn grazing zone located midway between A and C areas, C-Winter grazing zones, located within villages at relatively low elevation areas)
AIDS	Acquired Immunodeficiency Virus
BASP	Biodiversity Strategy and Action Plan
CBNRM	Community Based Natural Resource Management
DFID	Department for International Development
DRC	Democratic Republic of Congo
EU	European Union
FAO	Food and Agriculture Organization
GA	Grazing Association
GDP	Gross Domestic Product
GIS	Geographic Information Systems
GNP	Gross National Product
GOL	Government of Lesotho
GPS	Global Positioning System
HIV	Human Immunodeficiency Virus
HPI	Human Poverty Index
ICBP	International Council for Bird Preservation
INCN	World Conservation Union
IWRB	International Waterfowl and Wetland Bureau
LHDA	Lesotho Highlands Development Authority
LHWP	Lesotho Highlands Water Project
LVAC	Lesotho Vulnerability Assessment Committee

MAPOSDA	Management and Policy Options for the Sustainable Development of Communal Rangelands and their Communities in Southern Africa
MCTDP	Maluti Drakensberg Transfrontier Development Programme
MDCP	Maluti Drakensberg Conservation Programme
NES	National Environment Secretariat
NTFP	Non Timber Forest Products
PRA	Participatory Rural Appraisal
RMA	Range Management Area
SADC	Southern African Development Community
TFCA	Transfrontier Conservation Area
UNDP	United Nations Development Programme
VDC	Village Development Council
WCED	World Commission on Environment and Development
WEDEM	Technical Cooperation Network for Wetland Development and Management
WFP	World Food Programme
WWF	World Wildlife Fund for Nature

ABSTRACT

The concerns regarding the high rates of species extinction in many ecosystems including wetlands seem to have prompted a hub of research aimed at re-designing and institutionalising approaches that would enable appropriate and sustainable management of the wetlands. Most of these approaches, however, have failed to integrate conservational and livelihood values of wild plants and have often resulted in disjointed solutions to resource management problems.

In Lesotho the importance of the wetlands goes beyond their role as sources of livelihood for rural households. They are also vital hydrological reservoirs for most Southern Africa and key determinants of economic growth due to generation of hydro-electricity and revenue emanating from the sale of water to South Africa. However, attempts to avert species loss and the need to maintain revenue and other benefits have culminated in conservation measures polarized towards the eco-hydrological values as opposed to the livelihood values of these resources.

Six villages in Pelaneng-Bokong area and twenty-nine wetland sites distributed across three management regimes and three grazing zones were studied in order to understand the complexity of the issues. This was attempted by determining floristic patterns of the key livelihood wetland plants, their harvesting and marketing patterns, the role of indigenous management systems as well as the contribution of wetland plant species to local livelihoods portfolios.

The findings have shown that key livelihood wetland species were common and widespread in both the communal and RMA areas but poorly represented in Bokong Nature Reserve. Although there were no obvious destructive effects on harvested and traded plants, there were indigenous management practices in place geared towards forestalling over-exploitation and free-riding. The study also uncovered numerous tangible and intangible livelihood benefits from wetland plants, demonstrating that these plants make a difference to livelihood security of the rural households and local assets. The critical role of wetlands as sources of water for Lesotho and Southern African region is acknowledged as well as the need to harmonize hydrological and livelihood values.

Chapter 1

Introduction & outline of the thesis

CHAPTER 1 – INTRODUCTION AND OUTLINE OF THE THESIS

1.1 Importance of natural resources to local livelihoods

Natural resources from various ecosystems including wetlands, offer goods and services that form a vital element of the everyday lives of rural people across the globe (Williams, 1998; Campbell and Luckert, 2002; Letsela *et a.l*, 2000; Shackleton, 2005; Hahn, *et al*, 2006). These include medicines, wild food, building materials, firewood and other goods, that have been gathered from the wild and used on a subsistence basis for millennia (Sheil and Wunder, 2000; Shackleton, 2001). Williams (1998) also observed that in dry zones where rainfall is low and erratic, wild species have been critical elements in the livelihood and survival of many rural communities in times of drought. Similarly, it has been indicated that, economically important wetland plants including sedges and reeds provide a buffer against unemployment (Cunningham, 2002), while wild vegetables fill a dietary gap during drought (LVAC, 2002). The use and sale of wild species can take place on a regular basis or during emergencies, comprising an important part of their 'natural insurance' or risk aversion strategy (Arnold and Ruiz-Perez, 2001; Dixon and Wood, 2003; Silvious, 2000; Streever *et al*., 1998; Woodward and Wui, 2001; IUCN, 2003) and in some cases, making a difference between having just enough and going hungry (Carney, 1998; LVAC, 2002; Ellis, 2000).

FAO (2001) estimated the number of rural dwellers who make use of natural resource products to meet a range of livelihood requirements to be tens of millions in sub-Saharan Africa (Arnold and Townson, 1998), while in Botswana, Kenya, Lesotho, Malawi, Swaziland and Zimbabwe, about 763,000 persons are employed in small scale production or trading in forest products (Arnold and Townson, 1998). Sustaining productivity of these resources in the face of increasing demand therefore remains an essential task (Williams, 1998). It is in this context that the contribution that natural resources make to local livelihoods has emerged as a crucial concept (Arnold, 1998; Ellis, 1999; Ashley, 2000; Arnold and Ruiz-Perez, 2001), in drawing attention to the importance of wild species, their influence on livelihoods and vice versa (Campbell and Luckert, 2002; Ashley, 2000).

Although the interest in the role of biodiversity in rural livelihoods was partly driven by the 'conservation agenda' and concerns regarding the high rates of species extinction (Shackleton, 2005), Peters *et al.*, (1989)'s study, where authors compared the market value of fruits and latex with the potential profits made from other land uses, further raised interest in the potential contribution that Non Timber Forest Products (NTFP) can make to livelihoods (Arnold and Ruiz Perez, 2001; Delang, 2006). It is this realization that spurred ideas central to the idea that natural resources contribution to the livelihoods may provide incentives to conserve resources (Arnold and Ruiz-Perez, 2001; Ambrose-Oji, 2003; Campbell and Luckert, 2002).

However, it also led to the growing scepticism over the long-term ecological integrity of NTFPs (Freese, 1996; Shankar *et al.*, 1996; Pandit and Thapa, 2003; Bjorndal *et al.*, 2004).

1.2 Existing gaps in research

Despite numerous studies on the role of NTFPs and livelihood linkages, there is a considerable gap in research on environments such as wetlands, which attract multiple uses. This is because current literature is related to forest products (NTFPs) while wetlands have received little attention, consequently conclusions drawn from the NTFPs may not necessarily be applicable to the wetlands, whose management policies tend to be largely dominated by a nature-conservation agenda (Turner *et al.*, 2000; Dixon, 2005). Admittedly, there has been a growing interest in the ecosystems as evidenced by growing wetland literature on wetland degradation due to climatic and socio-economic factors (Cunningham 2001; Winpenny, 1991; Robinson *et al.*, 1992; Mitsch and Gooselink, 2000; Keddy, 2000). With human beings considered to be part of the degradation equation, most of these studies tended to focus on eco-hydrological values (Finlayson & Ream, 1999; Price *et al.*, 2003; Detenbeck *et al.*, 2002). Complementary studies, aimed at valuing wetlands ecological services have also been noted (Turner, 1990; Barbier, 1994; Swallow, 1998; Mitsch and Gooselink, 2000; IUCN, 2003; Glaser, 2003; Carlson *et al.*, 2003; Jones, 1994; Winpenny, 1991), with most typically directed at ecological conservation as opposed to livelihood values (Bishop *et a*l., 1987; Costanza *et a*l., 1989; Dixon, 1989; Loomis *et al.*, 1991; WhiteHead and Blomquist, 1991; Thomas *et al.*, 1991; Faber, 1992; Turner *et al.*, 2000).

Recently however, there has been growing interest in the socio-economic values of these ecosystems, and a growing number of studies have documented cultural and socio-economic values of wetlands (Kairu, 2001; Manuel, 2003; Terer *et al.*, 2003; Dixon and Wood, 2003). For example, in these studies, economically valuable wetland resources such as fur harvests, marketable fish and useful plants were identified (Dixon and Wood, 2001 & 2003; Kotze, 1998; IUCN, 2003; Silvious, 2000). Little effort however has been made to link these services to the wider socio economic context. Terrer, *et al.*, (2003), in a study conducted in Tana River National Primate Reserve in Kenya, also identified various uses of wetland products such as source of thatching materials, medium of transportation, wild food and livestock grazing. Similar observations were made by Kairu's (2001) study conducted at Lake Victoria, Kenya. Information is however, inadequate on the role and livelihood values of wetland resources.

In this thesis, the aim is to contribute to the gaps outlined by improving current understanding of the livelihood values of high altitude wetland resources and determining their contribution to the local capital assets. Determining the value of the wetlands resources and their contribution to local livelihoods may provide valuable insights into local communities' livelihood options, values that people attribute to, and motivations for utilization of, resources. This information might in turn be incorporated into a valuation exercise that takes into account different values of the wetland ecosystems in Lesotho and within the Southern African region.

1.3 The High Altitude Wetlands in Lesotho

Apart from their crucial role in hydrological cycles, particularly their retention and slow release of water of water that help stabilize the stream flow, attenuate flooding, and reduce sedimentation loads (Mokhothu and Tsehlo, 1997), in Lesotho, the high altitude wetlands serve as an important hydrological reservoir and watershed for most Southern Africa . (See Chapter 2, Section 2.1.8). The hydrological significance of the wetlands has been further enhanced by the development of the Lesotho Highlands Water Project (LHWP), a major multi-laterally funded scheme for the capture and transfer of water to the industrial areas of South Africa and the generation of hydro-electricity in Lesotho. The scheme is planned for implementation in phases over a thirty-year period, and should provide royalties to Lesotho well into the next century. The strategy of

maintaining a constant supply of water thus involves maintaining well-vegetated watersheds and wetlands. Wetland plant species however, form critical sources of livelihood for local communities who reside near them. Attempts to balance the eco-hydrological values and livelihood needs make the management of wetlands an on-going challenge.

The concern for conservation has in turn spurred suggestions by several studies that the local communities' uses of wetlands resources should be curtailed (Mokuku, 1991; Guillarmord, 1963; Nkalai, 2000). Similar sentiments have been echoed the national Biodiversity Strategy and Action Plans (BSAP) indicating that wetland plants are *being harvested to extinction by unscrupulous Basotho acting on own account and in some instances acting as agents for foreign biodiversity merchants* (NES, 1995).The urgency for protection against over-exploitation of these resources has culminated in a proposal to establish ecosystem based protected area system.

The growing recognition of the importance of wetlands in Lesotho is also evidenced by a number of studies describing their hydrological functions (Guillarmord, 1962, 1963 and 1969; Van Zinderen Bakker, 1995; Van Zinderen and Bakker *et al.*, 1974; Backeús, 1988), while earlier studies carried out in the 1930s and 1940s (Stapels and Hudson, 1938; Killick 1963) commented on the role of wetlands as habitat for special vegetation communities.

Ecological research, especially on plant communities within the wetlands was enhanced further by comparative studies conducted on areas with similar conditions in neighbouring South Africa (Schwabe, 1995; Loxton, Venn Associates, 1993; Guillamord, 1971; Killick 1979 & 1997; Meakins *et al.*, 1993; Mokuku, 1991). Other studies focused on the altitudinal classification of the wetlands (Backeús, 1988; Marneweck and Grundling,, 1999). Exceptions to this trend, however, are studies conducted by Maluti Drakensberg Conservation Programme and Maluti Drakensberg Transfrontier Development Project (Majoro *et al.*, 1999; Hartley, 2001), which attempted to determine communities' perceptions on resource management. According to these studies, about 93 percent of the local communities, to varying degrees, utilized resources found in the summer grazing areas and wetlands for their subsistence.

The botanical literature, with some reference to local use of flora for firewood, roofing and thatching has been documented in Green, (1996, 1997, and 2000). Other studies examined local use of plants within riparian zones (Boehm *et al.*, 1999). Guillarmord (1971),Guillarmord (1996), Ambrose *et al.*, (2000), Maliehe (1997), Mathekga *et al.*, (1998) and Meyer (1995 & 1996) have synthesized more fully the uses of plant species in Lesotho. For instance, Taludkar (1988) reported use of wild plants in terms of erosion control, landscaping, basket making and cosmetics ingredients. While these studies form an important database upon which many plant-related studies can be founded, few of them are wetland-specific thus making it difficult to extrapolate them to a conceptual level (Shackleton, 2005). Also none of them have attempted to interpret the contribution of wetland plants within a holistic livelihood perspective. Thus, to date, there is little consolidated information on wetland plants preferred by local communities for livelihoods. Knowledge is lacking on their distribution and abundance, plant harvest quantities, extend of trading and how they are being regulated.

This study is therefore aimed at assessing the livelihood values of the high altitude wetland resources and their contribution to local livelihood systems across six villages within the three management regimes and three grazing zones (A, B and C), in Pelaneng - Bokong area, of Lesotho.

1.3 Objectives

The overall objective of the study was to assess the role, importance and contribution of wetland resources to local livelihood portfolios using a combination of quantitative and qualitative methods as well as ethno-botanical inventories.

Specific Objectives were to:

- Investigate the presence, distribution and relative abundance of wetland resources using ethno-botanical inventories, household surveys and Participatory Rural Appraisal (PRA) techniques.

- Assess local harvesting patterns using livelihood and panel surveys.

- Determine the extent of trade and evaluate the importance of commercialisation of wetland plant species to the local communities using panel surveys, market surveys and seasonal calendars.

- Estimate the contribution of wetland resources to the local livelihood portfolios, particularly the five capital assets (human, social, financial, natural and physical) using the sustainable livelihood framework and the five capital assets.

- To gain insight into the indigenous resource management practices and determine their role/significance in sustaining key livelihood wetland resources in Pelaneng-Bokong using a combination of PRA techniques, livelihood survey, key informants and feedback workshops.

1.4 Research Questions:

These objectives provided the means to answer the following key questions relating to some fundamental issues identified within the natural resource livelihood discourse:

- How important are the high altitude wetland plant species to local livelihoods and what contributions do they make to the local capital assets in Pelaneng-Bokong study area in Lesotho?
- How abundant are these plants and how are they distributed spatially; what are the harvesting, trading and marketing patterns?
- What is the role of indigenous management practices in sustaining wetland resources? And on this basis,
- How important are the wetland plants to livelihoods?

1.5 Thesis Outline

This thesis is organized into nine chapters, which apart from the general introduction and general conclusions were organised independently, with each constisting of an abstract, introduction, objectives and results. With this kind of framework, overlaps between the general methodology section and the methods section in individual chapters are inevitable. *Chapter 1*, gives a brief context for the study from both the global and Lesotho's perspectives and identifies existing gaps in livelihood-conservation linkages,

while the short literature review provided focuses on research trends discussed in detail in each of the subsequent chapters.

In *Chapter 2*, challenges and opportunities posed by the socio-economic and physical setting in Pelaneng-Bokong are explored as a way of contextualizing livelihood trajectories within the study area. This chapter also provides a context for subsequent chapters, particularly *Chapter 7* on 'Livelihood values', which elaborates on the current status of livelihood assets.

Chapter 3, the literature review, in a sense tells the story of conservation, providing the evolution of the debates on livelihood conservation. It begins by tracing the origin of conservation concern and describes the roots of ideas about conservation. It ends by showing that while the protectionist approach seems to be giving way to approaches that regard human beings as the focus of conservation, the idea that resources should be protected from human beings runs deep and has been a potent source of inspiration for other approaches. The chapter also contextualizes some of the key questions raised within the conservation-livelihood discourse.

To fully comprehend the value of wetland plant resources, information about the supply of species is also needed. *Chapter 4* addresses several of the key supply issues by presenting information on the composition, distribution and abundance of key livelihood wetland species on the landscapes.

Sampling procedures with three layers of stratification, namely elevation, management regime and grazing zone was adopted, while transects and quadrats were used to investigate species composition of key livelihood wetland species distribution, abundance disturbance level of wetland species, across the three management regimes and the A, B and C grazing zones studied.

In order to understand seasonal and spatial variability in harvesting patterns of the key livelihood wetland plants, in C*hapter 5*, the variability in harvesting intensity and seasonal harvesting patterns were determined between villages and across the management regimes and A, B and C grazing zones. This chapter also examined harvesting techniques used and their implications for generation of species.

In *Chapter 6*, the market attributes, seasonal fluctuations and trade patterns of wetland plants are determined and the implications of over-exploitation discussed.

Chapter 7 set out to appraise uses, values and contribution of wetland plant species to the local capital assets. To achieve this, the then current status of capital assets was determined and pentagons representing each of the assets drawn. This allowed for a comparative analysis with a second set of pentagons drawn at a later stage, showing the contributions of wetland plant species to the local livelihood portfolios.

The heightened interest in wild species has been linked to the issue of empowering local people and securing their rights to manage resources. It has also been argued that this potential could be enhanced by drawing on indigenous knowledge and building on the sustainable systems of use that local people have created (Posey, 1982, Prance, 1990; Stiles, 1994; Dove, 1993). Following a similar arguement Dixon and Wood (2003) have noted that local communities are the best guardians of the wetlands because they materially depend on them for livelihoods. It is on the basis of such arguments that *Chapter 8* was constructed in order to examine practices used by Pelaneng-Bokong inhabitants to regulate the use of wetland plants and determine plant species targeted, examine the role of indigenous practices in enhancing local communities' resilience against over-exploitation of key livelihood wetland plants and examine limitations and opportunities offered by indigenous resource management practices.

Chapter 9, the final concluding chapter, synthesizes all the findings by summarising key issues emerging and considering broader development issues.

Chapter 2

Study sites & methods

CHAPTER 2 - STUDY SITES AND METHODS

2.0 Abstract

The study adopted multiple research methods and data sources including ethno-botanical inventories, livelihood mapping, panel surveys and feedback workshops to study livelihood values and contribution of wetland plants to the local livelihood portfolios in Pelaneng-Bokong.

In this chapter, reviewed literatures were used to explore the challenges and opportunities offered by the socio-environmental setting, in Pelaneng-Bokong, as a way of contextualizing livelihood trajectories. Agriculture, within the study area, is the dominant activity of the domestic economy and is critical to rural livelihoods. It contributes to food security, employment and successful asset accumulation. Challenges posed by Lesotho's geographical realities, however, render agriculture prone to shocks and stresses, thus making it an unreliable source of livelihood. Reliance on natural resources in the face of declining agricultural production is probable. This is because, households with limited livelihood opportunities, due to agricultural failures, are likely to adapt livelihood strategies which include, but not, necessarily depend on, free goods provided by nature. On the other hand, opportunities offered by the socio-economic and environmental setting, such as abundant water and the disease-free environment, present considerable irrigation potential that could go a long way towards diversifying livelihoods as well as addressing food security concerns.

2.1 Context of wetlands and livelihoods in Lesotho

2.1.1 Introduction

The relationship between socio-economic and environmental circumstances is long-standing, yet constantly being re-discovered and re-invented. The evolution of poverty-environment relationships are well summarized by Gray & Moseley (2005). The prevailing wisdom related to these relationships are traced from Thomas Malthus' predictions of doom; the colonial powers in Africa and Asia who identified poor local peasants as key causes of soil degradation; and to the renewed vigour afforded to the topic since the era of 'Sustainable Development'. In Lesotho, the socio-environment interactions, have been interpreted to conform to both the 'Tragedy of the Commons' scenario (Rhode *et al.*,2001) as well as a downward spiral whereby '....poor people are forced to overuse the environmental resources to survive, and the impoverishment of the environment further making their survival even more difficult' (WECD, 1987). The subject becomes even more pertinent for marginalized, vulnerable communities such as those located in the mountain area.

While linking the environment with poverty is a laudable move that emphasize the interaction between resource conservation and poverty alleviation, it is important to note that, in focussing on the big argument, this debate tends to ignore a number of very important issues that relate to opportunities afforded by the environment to construct diversified livelihoods, and in turn, promote responsible use of natural resources. Several studies have been conducted on the socio-economic-environmental debate (e.g.World Bank 1992 &1996; UNEP 2002; Majoro, 1997; Letšela *et al.*, 2003; UNDP, 1999). This chapter examines these issues, in order to raise questions and provide some preliminary answers related to the linkages between the socio-environmental setting and resource utilization. It also seeks to show how these considerations are central to the development of responsible wetland management.

2.1.2 Purpose

While it is beyond the scope of this chapter to unravel complex causative links, or duplicate existing, excellent descriptions of both Lesotho as a whole and Pelaneng Bokong study site, it explores the key biophysical and socio-economic setting within which livelihood strategies are adopted and adapted in the study area. The aim is to enhance the understanding of the combination of resources and activities that the environment has afforded for livelihood construction as well as the challenges and opportunies that these combinations actually offer. The descriptions of the setting might help set a context for natural resources as well as wetland resources utilization.

2.1.3 Methods

Pelaneng-Bokong study area has benefited from studies carried out by the Lesotho Highlands Water Project (LHWP) and Lesotho Highlands Development Authority (LHDA). Biophysical and socio-economic descriptions of the area were also generated from two EU INCO-DC projects – Global Change and Sustainable Community Rangelands Project, which ended in December 2000 and its extension, Management and Policy Options for Sustainable Development of Communal Rangelands and their Communities in Southern Africa (MAPOSDA). Both projects consisted of multi-disciplinary teams in Lesotho, South Africa and Botswana in cooperation with the Centre for Arid Zone Studies, University of Wales, Bangor, Pyrenean Institute of Ecology, Spain and Norwegian Institute for Nature Research, Sweden. Documents

prepared by this project were reviewed, especially, for Pelaneng-Bokong area (eg. Makoae, 2000, Martinez-Rica, 2000, MAPOSDA, 2003, Mokhothu, 2004)

Other reviewed documents include reports on land resources in Lesotho, bulletins of the Bureau of Statistics, Lesotho Highlands Development Authority (LHDA) reports, reports on surveys conducted by the Lesotho Vulnerability Assessment Committee, policy and strategy papers of the Ministry of Agriculture and Food Security (eg. Marneweck and Grundling, 1999; Schwabe, 1995; LVAC, 2002). In addition the LHWP and MAPOSDA projects provided an excellent entrée into the area and highlighted areas requiring further research as well as communities in which such research could be conducted. It is from work and an identification of research needs emanating from these projects that this independent study has developed.

2.1.4 Location, topography and Climate

The Kingdom of Lesotho is one of the Southern African states located towards the southern tip of the continent, at around 30 degrees south and 30 degrees east. It occupies an area of 30, 3555 square kilometres. The country is mountainous, with the highest peak, Thabana-Ntlenyana rising to well above three and half thousand meters above sea level. An independent kingdom since the early 19th century, Lesotho was under British rule from 1868 until 1966 when independence was restored. The country is an enclave within the Republic of South Africa and is bordered by three of its nine provinces: Kwazulu-Natal to the east, the Eastern Cape to the south, and Free State to the north and west (See Figure 2.1).

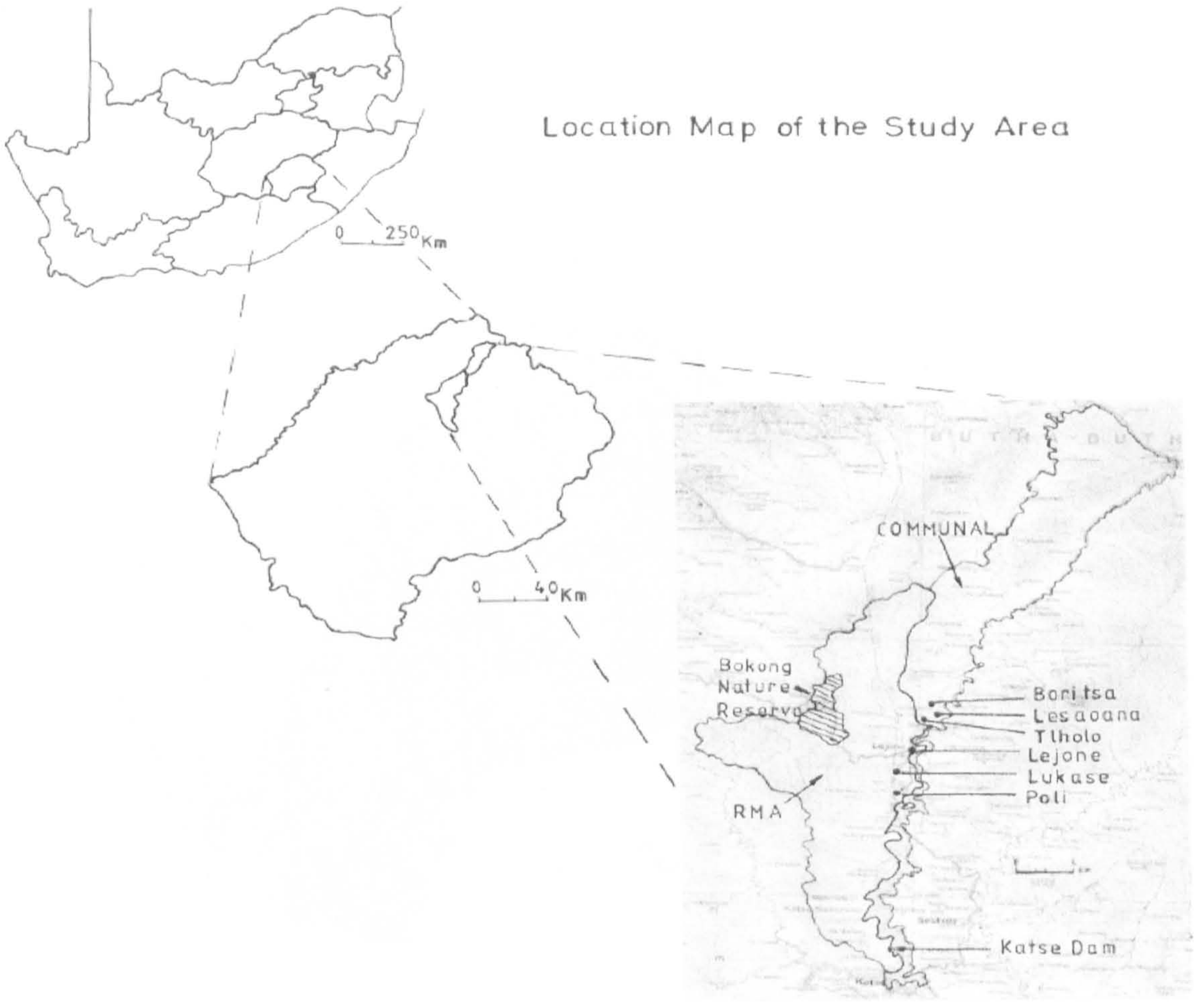


Figure 2.1 Location of Lesotho within Southern Africa; Location of the Pelaneng-Bokong Study area within Lesotho and Location of Bokong Nature Reserve, RMA, Communal Areas and sampled villages

Being totally surrounded by South Africa exposes Lesotho to a major bond of external economic dependence, placing Lesotho in a situation of having its development largely determined by exogenous factors and policies. However, Lesotho's close proximity to South Africa could also bring an advantage through access to markets particularly regarding preferential trade agreements with South Africa and Europe. Nevertheless, the principal detriment could be the severe constraint imposed by providing a free market for South African goods. This is likely to result in an unfair competition that undermines not only the possibilities of industrialisation, but subject Lesotho's agriculture to unfair competition against more efficient production (Morapeli, 1990). Similarly, FAO (2001) observes that Lesotho's position within South Africa has rendered her a market for the latter's products and generally acted as a disincentive to produce sufficient food, even for subsistence.

Lesotho is divided into four ecological zones, which are used as reference points for the ecology of Lesotho (see Figure 2.2).

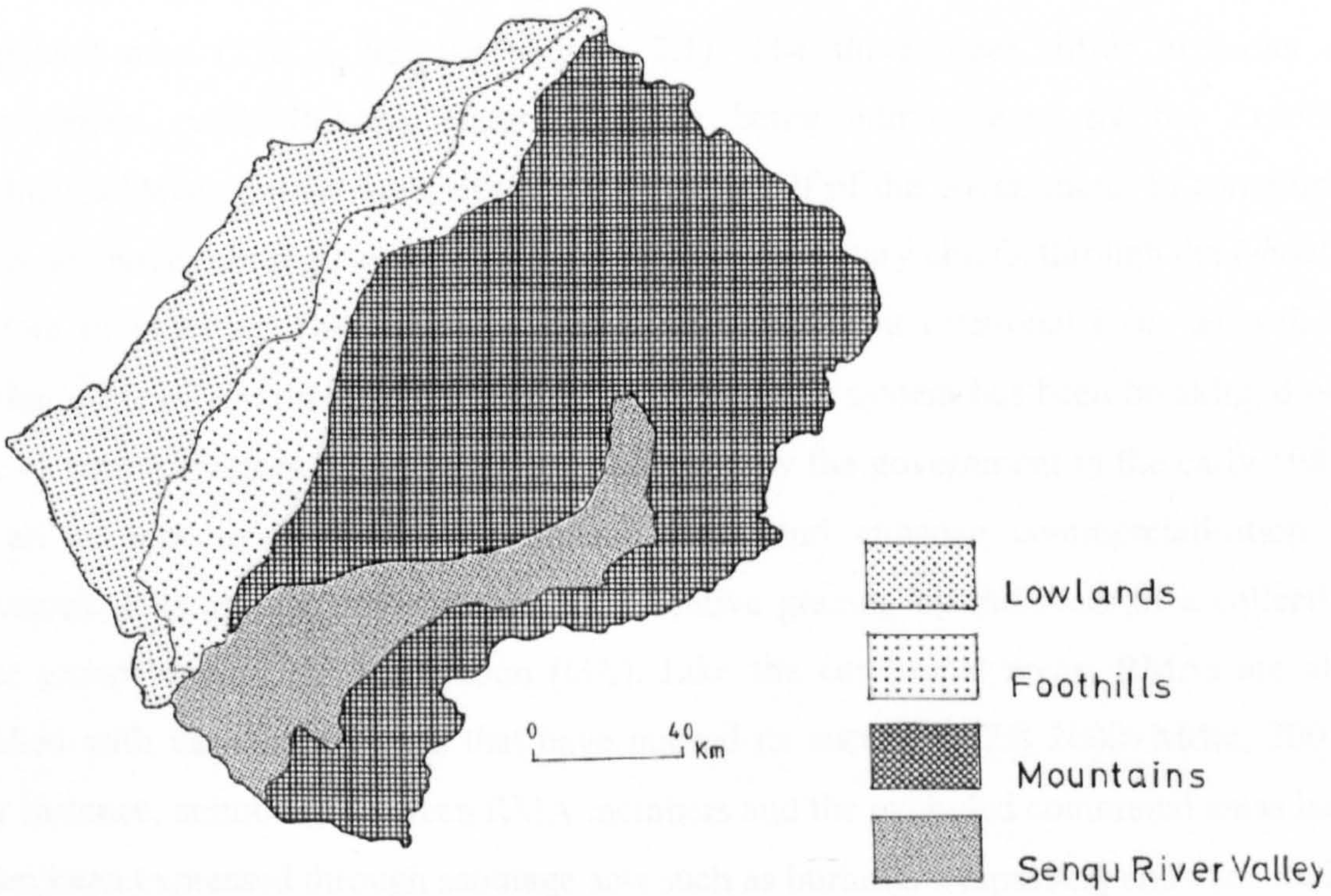


Figure 2.2 Lesotho Agro-Ecological Zones

These zones, interchangeably described as 'geographical zones', 'physiographic zones', 'ecological zones' and 'agro-ecological zones' consist of the Lowland, Foothills, Senqu Valley and Mountain (Highlands) Zones. The Lowland zone at an altitude ranging from 1400-1800 metres covers approximately 21.25 percent of the total area and forms a narrow strip along the western border with South Africa. Over 80 percent of productive arable land and highest population densities are found in this region. The Foothills, range from 1800-2000metres above sea level and cover approximately 11.5 percent of the country, and also supporting higher population densities. The Senqu Valley Zone (21.83 percent) is a major grassland area marked by shallow soils. The Mountain (Highland) zone, at an altitude ranging from 2000 -3400 metres, is primarily used for summer grazing and hosts unique alpine and sub-alpine habitats of the Drakensberg range including the wetlands.

The study area, Pelaneng-Bokong, is located within the mountain (highland) zone at the central highlands of the Leribe and Botha Bothe districts. Its eastern border is made of

the Katse reservoir between the localities of Katse and Lejone. Northwards from Lejone the border runs along the divide line between Pelaneng and Malibamatso watersheds, to reach the Holomo Pass. The area covers the Bokong Nature Reserve (1972 ha), Pelaneng Range Management Area (RMA) (364.69 ha) and the communally managed rangeland area (250.16 ha) (see Figure 2.1). The three areas differ in terms of management, with Bokong Nature Reserve being administered by the Lesotho Highlands Development Authority (LHDA) on behalf of the government. In communal areas, resources are regulated through a system of hereditary chiefs, through the *leboella* custom or practice. This system allows for grazing on a rotational basis as well as setting aside of certain areas for resting. However, this system has been breaking down due to various factors. The RMA was introduced by the government in the early 1980s in an attempt to improve range management and enhance commercialisation of livestock. It is an area set aside for collaborative grazing by members of a collective user group or Grazing Association (GA). Like the communal areas, RMAs are also riddled with various problems that have marred its success (NES 2000; Mdee, 2001). For instance, animosity between RMA members and the excluded communal areas have often been expressed through sabotage acts such as burning, trespassing and vandalizing of fences (Swallow, 1991; Lawry, 1988). Rangelands are further classified into three categories A – summer grazing land or cattle posts, B –winter grazing areas closer to the villages and C – grazing lands within the village (see Table 2.1 and Figure 2.3).

Table 2.1 Grazing Patterns within A,B & C

Grazing Area	Time spent
A	January – April
B	April – January
C	June - October

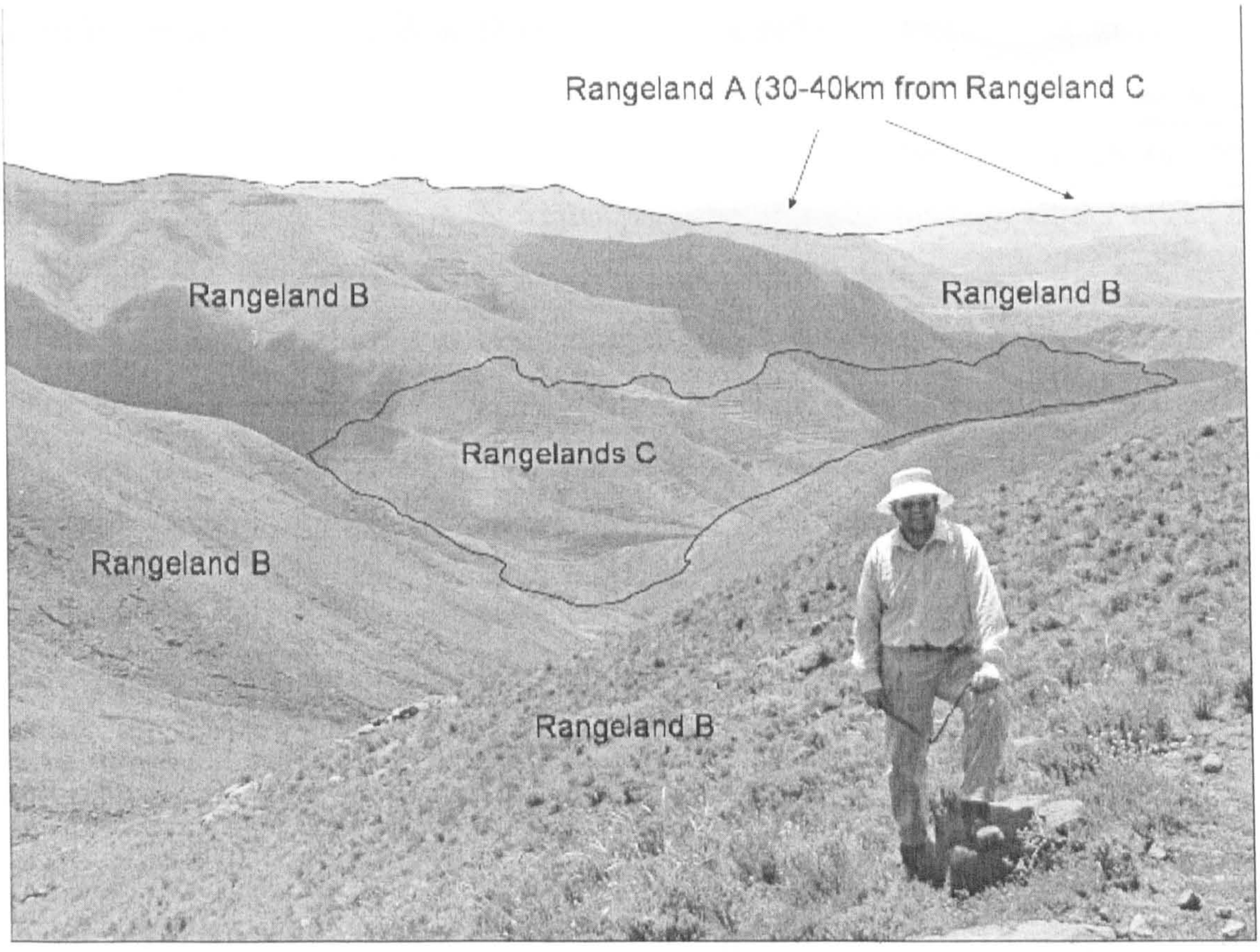


Figure 2.3 A, B, C Grazing Zone in Pelaneng-Bokong

2.1.5 Climate

Being mountainous, and outside the tropics, the climate in Lesotho is temperate and characterised by warm moist summers and cold dry winters (Carrol and Bascomb, 1967). The local climate, which is altitude dependent, is marked by four notable seasons (spring, summer, autumn and winter), and subject to wide seasonal and geographic variation. Temperatures average about 20°C with a minimum of -7°C. For much of the year, the Lesotho climate is characterised by clear skies, and there is a mean of 8.8 hours of sunshine per day throughout the year (NES, 2000).

In Pelaneng-Bokong annual temperatures are slightly lower with the range for the RMA being 5-14°C and for the communal areas 4-14°C. Means of maximum temperatures, on the other hand, vary between 7-27°C for Lesotho and 10-22°C for RMA and 9-21° for the communal areas. Means of minimum temperatures for whole study area range between1-6°C, varying with those of the whole country (3-9°C) (Martinez-Rica, 2000). Though largely unfavourable to crop production due to early frost and a relatively short

growing season, climatic conditions in this area reduce its proneness to pests and diseases that affect crop and livestock in the lowlands and foothills. This factor, according to NES (2000), bears many advantages for the production of many horticultural crops and fruit trees, which have the potential for high labour intake and better returns. This potential has however, not gone unnoticed, and the Ministry of Agriculture has rhetorically at least, placed diversification from grain crops to high value fruits and vegetables at the centre of their policy agenda (FAO, 2002). Nevertheless, there has been little progress in implementation of its efforts, with the biggest problem being lack of markets.

2.1.6 Rainfall

Rainfall is also related to altitude with mean annual rainfall increasing with altitude. For instance, in the lowlands rainfall averages from 600 mm to 900 mm per year while in the mountains, annual rainfall ranges between 1000mm and 1300 mm. The lowest rainfall, 500 mm to 600 mm per year, occurs in the central Senqu valley. 85% of Lesotho's annual rainfall is concentrated in the summer months of October to April with maximums in December and January. In the winter months of May to September, precipitation is rare, but when it occurs it is in the form of snow in the mountain zone. At high altitudes of this zone, snowfall can also occur in any month of the year. While average rainfall and temperature levels would be considered acceptable for crop production, the irony is that the mountains, which are otherwise unsuitable for crop production, receive the highest rainfall while the lowlands receive insufficient rain during the growing season.

Droughts and floods are common occurrences. Sekoli (1997) describes numerous periods of drought from 1902 to 1906; 1912 to 1920; 1926 to 1933; 1944 to 1953; 1964 to 1973; and 1996 to 1997. The periodic droughts, resulting from erratic precipitation, are often associated with severe soil erosion The Lesotho Meteorological services (2004) have also expressed fear that Lesotho's climate might be gradually becoming warmer and drier due to the Climate Change phenomenon. In particular, desert conditions are becoming manifest in the southern districts of the country, indicative of encroachment of the Namib Desert in Namibia (National Environment Secretariat 2003). The periodic droughts undoubtedly make farming risky and may have contributed to the drying up of some wetlands (Mokhothu and Tsehlo, 1997).

2.1.7 Soils

Lesotho's soils tend to reflect the nature of the underlying geologic material from which they are derived. The bedrock geology is characterized by a sequence of near horizontal sedimentary strata, which are topped by layers of basalt in the mountain and foothills and sandstone on the plateaus overlooking the lowlands (Nordstrom, 1988).

Soil Conservation Division (1979a) recognizes and describes five duplex soils in Lesotho. The most extensive soil groups are Mollisols and Alfisols. Mollisols are derived from basaltic parent material and are mainly found on mountain slopes and mountain valleys. Most Alfisols occur in the lowlands and foothills and are characterised by extensive gully erosion. About 64% of soils of Lesotho are acid soils and occur mostly in the lowlands and lower foothills where most of staple crops are grown. The result is that, whereas gully erosion is a spectacular feature in the lowlands, sheet erosion is more characteristic of the mountain zone. Lesotho is thus faced with a problem of limited and deteriorating land base and infertile soils. In fact, it is estimated that 15 million tons of topsoil from arable lands is lost annually. The task of trying to eke a living out of agriculture is thus a serious challenge

In Pelaneng-bokong, the rock substrate is entirely basalt belonging to Lesotho Formation, of Jurassic age, crossed by a few dolerite dikes and small dolerite intrusions (Martinez-Rica, 2000). Despite the severely limited ecological potential for productive and reliable agriculture, there are a few pockets of good quality cropping soils on mountain spurs and river valleys. With relevant agricultural extension, farmers could be assisted to produce sufficient field crops, fruits and vegetables to cover most of the food deficits currently being experienced. However, steep slopes, frequent overgrazing and inadequate management has resulted in soil losses in many places. For example, a study conducted in the area to compare impacts of heavy grazing and burning on soil nutrient content showed some deficiencies in nitrogen, phosphorous and water-soluble potassium on heavily grazed and burnt areas when compared with less impacted areas (MAPOSDA, 2004).

2.1.8 Water Resources and Water Use

Lesotho consists predominantly of high mountain plateaus dissected by deeply incised fluvial networks. Three prominent mountain systems occur across this kingdom, the highest elevation along eastern Drakensberg region bordering the Kwazulu-Natal Province of South Africa. The mountains, commonly known in the region as the Drakensberg Maloti Mountains of Southern Africa, serve as an important hydrological reservoir and watershed for most Southern Africa. A vital component of the Drakensberg Mountains' hydrology is the high altitude wetlands that occur there (Grundling and Marneweek, 1999; Schwabe, 1995). These wetlands, combined with relatively abundant rainfall in the Highlands render Lesotho a relatively water-abundant country in the middle of water-stressed area of Southern Africa.

Surface water resources are estimated at 4.73 km^3/year. Studies have shown that available surface and ground water resources currently exceed the needs of the people and livestock (Mokhothu & Tšehlo 1997; Ranthamane, 2001; Mdee, 2004). However, without proper management, this excess of water, particularly in the mountain region, where most wetlands are found, could act as an ecologically destabilizing factor as it encourages the growth of herds and human population beyond the limits of the environment to support them. Catchments within the bioregion originating from the wetlands form the source or contribute to a number of major rivers, including Mzimvubu, Mzimkulu, Mkomazi and Thukela on the South African side, and the Vaal and Orange rivers on the Lesotho side. The rivers rising on the South African side contribute over 8000 million m^3 in mean annual runoff to systems within the region (Mokhothu and Tsehlo, 1997).

Due to Lesotho's high altitude wetlands, the country has become an upstream riparian partner for South Africa and Namibia. Also, royalties from the sale of surplus water to South Africa, through the Lesotho Highlands Water Project (LHWP), are currently being channelled to a community development fund and expected to improve the livelihoods of the rural people. Additionally, abundant water within the highlands zone, presents a potential for irrigation, hence reducing impacts of persistent drought. FAO (2000) has demonstrated high employment and income possibilities as likely to emanate from irrigation. In Lesotho as a whole, as well as the study site, it could be one of the

main strategies through which commercialisation of agriculture could be realised. Crop diversification is also feasible through irrigation since most of the high value crops are limited by periodic droughts. Currently, however, marketing problems remain a stumbling block. For instance, the domestic market for agricultural products is currently dominated by imports while local produce hardly ever finds its way to the local wholesale and retail market. A market survey carried out in Pelaneng-Bokong, (MAPOSDA, 2000), attributed this situation to lack of a well developed market policy as well as the farmers' scale of production – which fails to meet the market needs.

2.1.9 Demographic Characteristics

Official population estimates are projections based on the 1996 population census which indicated a population of 1.96 million. Applying an annual growth rate of 2.1 percent, the current population can be estimated to be about 2.3 million, comparable to other African countries (e.g. 2.4 in Kenya; 3.0 in Uganda; 2.8 in Tanzania and 2.6 in Malawi). Population estimates do not take into account the impact of HIV/AIDS, with an estimated prevalence rate of 29 percent among adults of 15-49 years. Due to the pandemic, average life expectancy was estimated to have declined from 59.4 years in 1996 to 52.5 years in 2001. The high mortality in the most economically active population (15-49 years) is having a substantial impact on the economic situation. For example, Mphale *et al*, (2002) suggests that at Pelaneng-Bokong, HIV/AIDS is having a substantial impact on livelihood strategies, due to loss of labour resulting in postponement or abandonment of some farming activities, especially crop farming, livestock rearing and vegetable production. Additionally livestock are among household assets affected by HIV/AIDS, since they are often sold to meet medical expenses. Prevalence of HIV/AIDS is likely to increase the use of wild plants, particularly those that are claimed to have properties that treat some of the symptoms of the disease and/or boost the immune system.

Overall, Lesotho has a population density of 66 people per square kilometre. However, this is misleading since in reality the population is concentrated in the lowlands, foothills and Senqu River Valley, one quarter of the total area. These areas accommodate more than three quarters of the total population, while the mountain zone contains just over one fifth of the total population. Landlessness has increased dramatically from 13% in the 1970s to 55% in the 1990s as a result of increasing

population and loss of arable land through soil erosion (see Table 2.2). It is estimated that 15 million tons to topsoil from arable land is lost annually (Mdee, 2004).

Table 2.2 Comparison between Lesotho National Rural Households Owning land and the Landless (source: FAO, 2000)

Year	With land	Without land	% Landless
1970	212,866	26,919	13
1980	239,216	52,443	22
1990	229,292	123,947	55

Lesotho has a youthful population. About 36 percent of the population is younger than 15 years old; 58 percent is aged 15 – 64 years, with 6 percent being 65 years old or older. This situation may have serious implications for economic dependency.

The population growth rate in the study area, however, seems to be below the national average. For instance in 1976 the growth rate of 1.04% was lower than the national growth of 2.29%. In 1986 annual growth rate was 1.24% and rose to 1.40% in 1996. The highest population densities, observed in Ha Lejone, (140-159 people per square metre) are still significantly lower than the national average (588 people per square metre) in 1996. Low population density within the study area could partly be due to the study area's location in high elevation zone, characterized by harsh climate and low crop production potential. On the other hand, low population density could also serve as an explanation for the relatively good ecological conditions of the area compared to the rest of Lesotho.

2.2 Economic Profile

2.2.1 Poverty and Human Development

The Human Poverty Index (HPI) provides a useful measure of poverty. It is the proportion of poor people in society, computed using five basic indicators of poverty – percentage of (1) underweight infants, (2) without access to health services and (3) safe domestic water, (4) illiterate adults and (5) with life expectancy below 60 years. A society that has the highest HPI compared to others is the poorest. For instance, in 1998,

the HPI for SADC region revealed Mozambique as having the highest level of human poverty (48.5%), followed by Malawi (47.7%), DRC (41.1%) and Tanzania (39.8%). On the other hand, the country with the lowest level of human poverty was Mauritius (12.1%). Lesotho, on the other hand falls with a fairly narrow band with respect to HPI and, as a whole rated 23%. Mdee (2001) however points out that Lesotho has experienced a decline in the HPI particularly in the areas of health and life expectancy due to severe HIV/AIDS pandemic. This culminated in its placement at number 127 out of 174 countries in 2000, 137 in 2003 and further demotion to 145 in 2004. As a result, the Government of Lesotho has given attention to the challenge of chronic poverty since the beginning of this millennium. The task is nevertheless daunting with 40 percent of the population below poverty line. This staggering reality demands a strategic focus on strategies that could enable the poor to accumulate assets and improve their livelihoods.

The HPI in Pelaneng-Bokong was, however, found to be relatively low (19%) (MAPOSDA, 2003). This is attributed to relatively better health services compared to other mountain communities, renowned for their inaccessibility and abject poverty (Sechaba Consultants, 2000). These communities are often marginalized from mainstream national programmes, and consequently most disadvantaged in terms of access to basic services. The number and diversity of services within the study site, though concentrated in RMA areas (See Table 2.3), have increased due to an elaborate programme for rural development and compensation by the Lesotho Highlands Water Project (LHWP). The project among others enabled the construction of roads between the study area and the foothills and lowlands as well as access roads that connect neighbouring villages within Pelaneng-Bokong, thus improving overall accessibility. This is a good example of how an injection of physical assets in the form of infrastructure has helped rural communities to improve their status. However, construction of the Katse reservoir and supporting infrastructure has, in a way increased the communities' vulnerability through the expropriation of fields, dwellings and subsequent relocation of households and villages. Loss of rangelands, trees and other communally managed resources has subsequently resulted in increased pressure on the remaining natural resources (Mphale *et al.*, 2002).

Table 2.3 Comparison of Infrastructure and Services between RMA and Communal Areas in Pelaneng-Bokong – Note distribution of services skewed towards RMA areas (Source, MAPOSDA Repeat Socio-Economic Survey 2003 ,Pelaneng-Bokong)

Infrastructure/Service	Number in RMA	Number in Communal Areas
Hospital	1	0
Clinic/Health centre	1	0
Primary school	7	3
Secondary/High school	2	0
Agricultural Station	1	0
Water taps	All villages covered	About 40% coverage
Post office/telephone	1	0
Community Hall	1	0
LHWP Camp	1	0
Chiefs' office	1	0
Market	1	0
Government offices	3	0
Electricity sub-station	1	0
Mortuary	1	0

2.2.2 Macro-economic situation

Lesotho's economy is based on subsistence agriculture, livestock and remittances from miners employed in South Africa. However, the number of mine workers has declined steadily over the past several years. Lesotho's economic performance showed signs of improvements. However, the annual growth rate of GDP has been relatively low at an average of about 3 percent over the past five years (see Table 2.4). Although at this level, GDP seemed to compare favourably with a growth rate of 2.8 percent for Africa as a whole, it continued to grow below 5.0 percent, essential to reverse the trend in the rising number of poor people (Central Bank of Lesotho, 2002). Thus, it has not permitted growth in per capita income (FAO/WFP, 2005). For 2005/06 the growth rate

is estimated at 2 - 2.5 percent, reflecting adverse development in the textile industry. In particular, the imminent removal of textile quotas under the Multifibre Agreement on Textiles and Clothing has affected US orders for Lesotho produced clothes.

Table 2.4 Lesotho economic performance in recent years (FAO/WFP, 2005)

Indicator	2000	2001	2002	2003	2004
GDP (US$bn)	0.9	0.8	0.7	1.1	1.6
Real GDP growth (%)	1.3	3.2	3.8	3.3	3.4
Consumer price inflation (%)	6.0	6.9	10.5	6.1	5.1
Forex Reserves (US$m)	417.9	386.5	406.4	460.3	501.5
Exchange rate (M: US$1)	6.9	8.6	10.5	7.6	6.5

Consumer price inflation fell from 10.5 percent in 2002 to 5.1 percent in 2004 while the country's foreign exchange reserves have steadily increased since 2001 and was around US$500 million in 2005 (FAO/WFP, 2005). The national currency, the Loti, which is at par with the South African Rand, has also been appreciating against major hard currencies since 2003. Key factors responsible for improved growth have been construction and export-oriented manufacturing, led by the clothing and foot-wear sub-sector (Central Bank of Lesotho, 2002).

2.2.3 Employment

Unemployment ranks high amongst the causes of poverty in Lesotho. Estimates of unemployment in Lesotho range from 30 – 45 percent (Sechaba Consultants, 2000; Bureau of Statistics, 1999). Indications are that the unemployment rate is increasing in Lesotho mainly due to reduced job opportunities in South Africa's gold mines, the slow down of construction activities of the Lesotho Highlands Water Project (LHWP) and population growth (FAO, 2000). In the study area 49 percent reported unemployed, with age group 35-65 dominating the unemployment category (MAPOSDA Repeat Socio-Economic Survey, 2003).

Migrant employment has historically been important in Lesotho's economy. Through remittances to Lesotho, workers have been able to support up to 600,000 individuals in Lesotho (FAO, 2000). A significant proportion of miners' remittances were also spent in agricultural investments and purchase of inputs. However, there has been a significant decline in migrant labour and retrenchments on the South African mines estimated at 11 per cent between 1993 and 1999 (Sechaba Consultants, 2000). In Pelaneng-Bokong, only two percent of households were reported as mine workers. This low percentage confirms the long-standing notion that the mountain region's participation in the migrant labour has always been significantly less.

The manufacturing sub-sector seems to have taken a lead in generating employment opportunities in Lesotho. Employment in this sub-sector is estimated by the Central Bank of Lesotho (2002, 2003) to have been about 44,000 in 2002. The government is the second largest employer, estimated at 36,509 populations employed and representing an increase from 36,055 registered in March 2003. This increase is due to an increase in the number of teachers in keeping with the government's objective of expanding access to free primary education. Nevertheless, there has generally been a slow growth in total government employment in recent years due to public service reforms that provide for, among others, lowering of the government wage bill through the right sizing of the civil service. The percentage of Pelaneng-Bokong residents working as teachers locally and textile workers in Maseru and Maputsoe together constituted 7%.

Unemployment has not only had far reaching implications for the agricultural sector and poverty reduction. Majoro (1997) and Letsela *et al.*, (2003), have alluded to an inverse relationship between unemployment and pressure on natural resources such as vegetables and medicinal plants, with households with no source of income relying more on primary resources provided by nature than those with purchasing power.

2.2.4 Livelihood Strategies

Livestock, crops and natural resources dominate the features of livelihoods in Lesotho while off farm activities supplement crops and livestock (Green, 2000). While there are variations between households and as well as between villages, livestock generally ranks high in the mountains while crops and off-farm activities rank high in the lowlands and peri-urban areas.

2.2.4.1 Crop Farming

As a whole, crop farming as a major livelihood system faces a number of problems. Frequent droughts, declining size of arable land, declining employment opportunities combined with lack of inputs, particularly in the mountain areas, have been responsible for declining trends in production levels and significantly reduced rural households access to food in recent years (FAO, 2000 & 2003; Green, 2000; Central Bank of Lesotho, 2002). For example, due to poor harvest, the Lesotho Vulnerability Assessment Committee estimated that 548 800 people would incurr a significant food deficit, requiring food or cash assistance between June 2005 and March, 2006 (FAO, 2005).

The majority of households in Pelaneng-Bokong practise subsistence crop farming. Cultivation of maize, pulses, wheat and potatoes occurs on the rich black soils along valleys and spurs. The number of fields a household has access to, determines the extent of diversification, prioritization of crops planted and yields. For example, in cases where only one field is available, it is commonly planted maize all the time, while farmers with several fields could plant more crops. Horticultural production is also popular in Pelaneng-Bokong, as evidenced by an increase in the number of households (from 3% in 1999 to 10% in 2003) for whom sale of vegetables constitutes the primary source of cash income (MAPOSDA Repeat Socio-Economic Survey, 2003).

2.2.4.2 Livestock

Livestock occupies a central role in livelihood strategies of the rural households. For instance, livestock acts as a buffer or an insurance against unemployment, failure to obtain income from other sources and a vital source of cash to purchase food when crops fail (LVAC, 2002; Green, 2000; Makoae, 2000). Ellis and Freeman (2004) suggest that livestock ownership plays a reinforcing role in asset accumulation. Equally, its absence can contribute to the inability of poorer households escape poverty.

In Pelaneng-Bokong, livestock fulfils a myriad of livelihood needs. For instance, financial asset contributions from livestock are estimated at 17% (Makoae, 2000). Livestock farming in particular entails rearing of small stock and sale of wool and mohair. Large stock such as cattle and equines are kept as draught animals as rugged terrain inhibits the use of farm machinery such as tractors. These are also used as social assets for traditional rites and ceremonies; for example feasts, sacrifices, burial

ceremonies and offerings Livestock is also, still widely used in the transference of *lobola* (bride wealth) although this practice has progressively been affected by cash economy.

Horses and donkeys are an important means of transporting both goods and humans in these areas where difficult terrain and inadequate communication systems mean that the more conventional ways cannot be used. Rearing of local breeds of poultry and pigs is another important way through which local communities, especially women, access cash and food for their households, though they are reared at small scale. Cow's milk is one of the important sources of protein consumed within households mainly by children and herd-boys, and is eaten fresh and fermented. Cattle are also important in that they are also hired out to households that do not own draught animals. Additionally, endowed households provide employment by hiring herd-boys from poor families who are paid twelve sheep annually. The value of livestock in enabling asset accumulation in the study area is, thus critical.

Despite its pivotal role, the livestock sector is not without problems. For example, common problems within the livestock sector include declining quality of rangeland, inadequate range management strategies, lack of markets for livestock and livestock products and stock theft. FAO (2000) suggest that the communal land tenure system is contributing to rangeland deterioration through overstocking, which in turn affects livestock productivity in the form of poor nutrition. In Pelaneng-Bokong, the most commonly cited problems in livestock husbandry are diseases (66%), stock theft (30%) and inadequate fodder and poor pasture (3%) (MAPOSDA Repeat Socio-Economic Survey, 2003).

2.2.4.3 Non-farm Activities

There are very few off-farm employment opportunities in Lesotho, particularly jobs where people are paid a regular wage. Common off-farm activities include: road construction jobs, gully reclamation activities, digging pit latrines, collecting stones, digging foundations of houses. However, some of these are erratic and short term in nature. Other informal activities include street vending and beer brewing, sewing and knitting, shoe repairs, handicrafts, bread making, selling wood and involvement in fund raising activities such as concerts and *stokvels* (Green, 2000; Sechaba Consultants,

2000; Turner, 2000). LVAC (2002) describes the returns from these activities as extremely low and resulting in livelihood insecurities.

In Pelaneng- Bokong, sale of locally brewed beer has been identified as an important source of cash income (Global Rangelands 1999 & MAPOSDA 2003). For example, the proportion of households deriving cash income from sale of locally brewed beer increased from 13 to 17 percent in 2003 (MAPOSDA, 2003). However, Makoae (2000) describes this activity as backbreaking and characterized by low returns. She attributes this to meagre incomes emanating from this trade, largely because of its dependency on local consumers who are, most of the time, faced by problems of low income. Beer brewing is also demanding in terms of energy - serious shortage of fuel wood in this area pose a serious problem for this trade.

Fishing has also become another important source of livelihood in the area since the inception of LHWP. Fish was also found to be an important nutritional supplement and source of instant cash for households in the area. Basic preservation technologies such as salt and sun drying are most used, however, in most cases people sell it while still fresh. Other off-farm activities include casual, infrequent occupations such as building and thatching, domestic work, collecting water, mud plastering, sale of natural vegetation and handicrafts.

2.3 General Methodology

This section provides an overview of the methodological framework used for the entire research study. Additional details of the research methods are given in the relevant results chapters of the thesis. The choice of methods was, to some extent influenced by the inter-disciplinary nature of the study, requiring approaches and tools to help integrate information that is derived in different ways from a variety of sources (Sithole *et al.*, 2002). It was also influenced by the advantages afforded by the use of questionnaire surveys to complement qualitative aspects of the study (Argyris *et al.*, 1985).

2.3.1 Justification for Study Area Selection

The study was conceived during and partly funded by an EU project – Management and Policy Options for the Sustainable Development of Communal Rangelands and Their Communities in Southern Africa (MAPOSDA) by the author, who was the Lesotho team leader then. The overall objective of the MAPOSDA project was to identify appropriate natural resource management systems, alternative strategies and income sources, and viable policy options to improve the welfare of communities and the sustainable use of their rangelands in selected areas of three southern African countries, Lesotho, Botswana and South Africa. In Lesotho, the project focused on Pelaneng-Bokong Range Management Area (RMA) and the adjacent communal areas, located within the highland zone of Lesotho. The study was carried out in six MAPOSDA study villages, namely Ha Lesaoana, Ha Poli, Ha Tlholo, Boritsa, Ha Lejone and Ha Lukase (see Figure2.1). Although part funded by MAPOSA, the work reported here was entirely the work of its author and contributes to the output of that project.

Pelaneng-Bokong study area is representative of most of highland areas of Lesotho due to its natural features, settlements and exploitative patterns. However, a special feature which is unique for this area is the presence of wetlands, sources of water for most rivers in Lesotho and contributing to a number of major rivers in the Southern African region and the Lesotho Highlands Water Project (LHWP). The study area's proximity to the LHWP allowed insights into issues related to protected areas and resource utilization.

In this area three systems of resource management are being implemented – (1) the protected area management system through the establishment of Bokong Nature reserve, (2) controlled grazing system, instituted by the Range Management Area (RMA) and (3) communal management system, governed by the chiefs. Each of these areas is further subdivided into three distinct grazing zones, related to altitude (See Figure 2.3). While a variety in management regimes provided a suitable ground for a comparison of abundance and distribution, harvesting patterns and marketing characteristics of wetland plants under different management regimes, categorization into grazing zones enabled temporal and spatial comparisons, since grazing zones are not only demarcated on different elevations but they are also used in different seasons.

2.3.2 Data Collection

Fieldwork was carried out in eighteen months (June 2004 to September, 2005). The study employed a multiple research process, combining both the ecological and socio-economic aspects of wetland plants, while surveys with the following specific steps were conducted: (1) Livelihood surveys; (2) ethno-botanical inventories; (3) livelihood mapping; (4) panel surveys; (5) market surveys; and (6) feedback workshops. A detailed description of the activities follows in Section 2.4 and 2.5. All the work was carried out through the medium of Sesotho, the local language.

2.4 Socio-economic surveys

The methodology used for the socio-economic surveys was designed as an iterative process using a combination of quantitative and qualitative methods. For instance, quantitative surveys, including household livelihood, panel and market surveys, complemented by Sustainable Livelihood Analysis (DFID, 2000), Participatory Rural Appraisal (PRA) techniques and Feedback Workshops were also employed.

The rationale for selecting the themes for the surveys was influenced by the need to determine the contribution of wetland plants to the local livelihood assets. This required information on the livelihood sources, local assets, communities, preferred wetland plants, their uses, location of harvesting sites, as well the management systems in place to protect and conserve the key livelihood plants.

2.4.1 Why Combine Quantitative and Qualitative Methods?

The need for combined methodological approaches was deemed paramount in this study due to the complexity embedded within livelihood strategies as well as livelihood–resource relationships. Such studies require more than just one methodological approach for clear understanding and explanation (Whyte, 1997). However, the point being made is not that issues such as livelihoods and human-resource relationships cannot be studied using either qualitative or quantitative methodological approaches, but that it is more advantageous if the two are combined. Advantages of using combined

methodological approaches are well documented (Abeyasekera, 2000; Marsland *et al.*, 2001; Davis, 1997; Leach and Kamangira 1997). For example, they allow for more profound insights and learning (Russel and Harshchbarger, 2003) and draw on the strengths and advantages of each other (Marsland *et al.*, 2001). This is particularly so because qualitative research has been criticised for being context-specific and not conducive for generalization (Abbot and Guijt, 1997), while quantitative approaches have been described as being able to produce statistically representative data which can be extrapolated, but lacking in depth (Gammuge, 1997; Tyynela, 2002).

2.4.2 Preparation for field work

A series of community gatherings – Pitso' were held prior to the main phase of data collection across the entire study area. They were meant to clarify the objectives of the research and explain how livelihood surveys and other research activities fitted within the overall framework of the study. Pitso's were also a means of facilitating the scheduling of appointments with individual households to commence the survey.

As part of the preparation process, a research assistant and two enumerators were trained to work with the researcher to pose questions to the respondents and record responses. This exercise was then followed by the pre-testing of the livelihood questionnaire in two of the six sampled villages, following procedures suggested by Mitchell (1996). Following this phase, a briefing session was held with the enumerators to adjust the questionnaire on the basis of the pilot survey. Some words and phrases which were familiar to the research team in English had to be rephrased to ensure both the respondents and researchers had the same understanding of information required. Great care was taken over this aspect. The data generated from this phase were used to create the initial SPSS for window data file used for the main phase of analysis.

During the interviews, the researcher and research assistant were paired with an enumerator each, to interview and record respectively. Pairing speeded up the process, since questioning and note-taking could be carried out simultaneously without interrupting the flow of the discussions. The team, who were based at the study site, met to compare notes at the end of each interview to ensure all data was clearly captured.

2.4.3 Livelihood Surveys

The data collection phase commenced with livelihood surveys in June-July 2004. The questionnaires, administered using face-to-face interviews were designed to assay local communities' sources of livelihood and differential wetland resource uses among different socio-economic groups. The livelihood surveys also provided vital baseline information upon which the other five steps of the study were based. For instance, pertinent information on preferred wetland plants as well as the location of commonly utilized wetland sites provided a basis for designing the sampling procedures for the ethno-botanical inventories, by ensuring that the sites selected on the digital map (See section 2.5.2.1) were important to the local communities. Similarly, information on the categorisation of households according to their livelihood sources was used as a sampling frame for panel member selection, ensuring that sampled panel members were representative of the major livelihood sources in the study area.

2.4.3.1 Sampling Procedures

Although the initial plan for the livelihood survey was to interview a maximum of 10% of randomly selected households per village, prevailing circumstances at the time led to larger samples being taken. For instance, this study was conducted at the same time as other village surveys meant to identify households that were experiencing chronic food shortages and to prepare for the eventual distribution of emergency food relief. Despite repeated clarifications on the objectives of the present study, community members thought that selecting a 10% sample was a criterion for identifying food insecure households, and thus, most expected to be interviewed. Consequently, participants in the study were recruited via self-selection sampling (Saunder *et al*, 2000).The sample size was 188 households, constituting 17-57% of total household per village (See Table 2.5).

Table 2.5 Total number of household and proportion (number, percentages) interviewed for livelihood survey across the six sampled villages in Pelaneng-Bokong study area- May –June 2004

Village	Number of Households per Village	Number interviewed	% interviewed
Ha Poli	129	32	25
Ha Lukase	70	16	23
Ha lejone	285	48	17
Ha Tlholo	76	29	38
Ha Lesaoana	90	51	57
Boritsa	62	19	12
Total	702	188	

Although the self-selection technique is widely used, it may be prone to bias and influence beyond the control of the researcher as the cases only appear in the sample because of their willingness to participate. It is also difficult to evaluate the effects of using a method such as self-selection that does not give a strict probability sample and has an intrinsically high error rate in selecting respondents (Rizzo, *et al.*, 2004; Kish, 1949). These issues are crucial where the sample is intended to be representative of the whole population (Patton, 1990). However, in this respect, apart from the burden of having to interview all self-volunteered households this method not only increased the sample size, thus making it more representative, but it also provided a more comprehensive baseline information to be used as a sampling frame for subsequent steps of the study. Given these considerations, self-selection was considered acceptable.

2.4.4 Livelihood Mapping

The Sustainable Livelihoods Framework emerged from the debates on sustainable rural development (Chambers and Conway, 1992; Farrington *et al.*, 1999) in the early 1990s. However, the most frequently applied conceptualization of the livelihoods framework was designed by Farrington *et al.*, 1999 for DFID. The approach was first used in an

attempt to draw on insights from previous research on food security and agro-ecological sustainability understand poverty and as a means of working out interventions that will reach the poor and reach their lives. The approach also borrows ideas from an ecological literature concerned with the sustainability of ecosystems (Conway, 1987). It is especially useful for analysing rural development practices as actively constructed household strategies (Douwe van der Ploeg *et al.*, 2000) and provides useful overview of the evolving inter-relationships between capabilities and capital that exist at farm to household level, the institutions that interact with them and the wider political, economic and social context (Bebbington, 2000). In this approach rural development practices are seen as a set of newly emerging livelihood strategies developed by rural households in an attempt to increase the 'pool' of livelihood assets at their disposal (Douwe van der Ploeg *et al*, 2000).

The Sustainable Livelihoods Framework takes into account measured changes in the different factors that contribute to livelihoods (Carney, 1998; Miranda *et al.*, 2003). These include various capital assets (human, social, financial, physical and natural) that households and communities have access to and how they are differentiated. The framework also examines institutions that operate within a given area, livelihood strategies people use to make a living and the outcomes or success of households in their livelihood strategies. According to this framework, such measures and outcome measures need to be differentiated and disaggregated across groups, households and individuals (Carney, 1998; Ashley and Carney, 1999, Frankenberger, 2000). This framework has been used by numerous researchers to evaluate various livelihood activities in different settings (eg. Thennakoon, 2002; Koziell, 1998; Townsley, 1998; Arnold, 1998; Havnevik *et al.*, 2006; Anderson and Clark, 2001; Mansfield and Pain, 2005).

Nonetheless the framework has been subject to criticisms. For instance it has been challenged for its simplistic perception of the community as a homogeneous unit both socially and economically (Mehta *et al.*, 2001; Ruttan, 2000; Cleaver, 2002). The critics of the approach have also focused on its failures to account for the dynamism and complexity imbedded in rural livelihoods (Rigg, 2005; Rocheleau, 2001). From the social point of view the critique has been that the approach tended to emphasize material aspects such as the production and income (Cleaver, 2002).

Despite these criticisms, the method is reasonably well tested and accepted (Allison, 1999; Ellis, 1998; Bebbington, 1999). Also, its avoidance of undue preoccupation with a particular component of individual or family livelihood strategy was found to be appropriate in the context of this study since it allowed for examination of the links between ecological and livelihood values from the management and environmental viewpoint. The recognition of seasonal and cyclical complexity of livelihood strategies (Allison, 1999) imbedded within the framework also matched the objectives of the study to achieving a better understanding of the contribution of wetland plants to local livelihoods. Additionally, the use of capital assets permitted an examination of wetland values beyond the cultural and social values and allowed for linkages of these services to the wider socio-economic context. Perhaps the most useful feature of this approach lies in its flexibility and ability to be used on different scales (individual, household, group, village, region or nation) and employs a variety of participatory techniques (Scoones, 1998). For instance, in this study, it allowed for the use of both quantitative and qualitative techniques, deemed crucial for inter-disciplinary studies. This further enhances the acceptability of the framework as a methodology for use in this study, since unlike other methodologies; it is not standard but rather adaptable to purpose (Ellis, 1998).

2.4.4.1 Determination of asset status

In an attempt to enhance the understanding of local livelihoods and allow for a more meaningful evaluation of the influence of wetland plants, indicators describing each of the capital assets were developed (Section 7.3.2). These were then confirmed with key informants and organizations working in the area. Participatory techniques, namely focus group discussions and ranking and scoring were used to determine the perception of households in each of the six villages on the importance of each capital asset and to verify information obtained from the key informants. The next step entailed allocating values to indicators and drawing pentagon segments to show schematically, the variation in access to assets.

2.4.4.2 Determining contribution of wetland plants to local livelihoods

A four-step approach was employed to estimate the contribution of wetland plants to local livelihoods as follows:

- A checklist was prepared prior to fieldwork in order to assist in determining the benefits of harvesting wetland plants in terms of their functions within the overall asset holdings and livelihood strategies (Appendix 7.2).
- Specific Questions soliciting information on type of plants and number of times each panel member indicated that they used for certain purposes were presented mainly through panel surveys.
- Responses to these were then computed and used to estimate quantifiable values of wetland plants. (See Chapter 7).
- Lastly, the values were presented dramatically in the form of pentagons.

2.4.5 Panel Surveys

Panel studies are standardised surveys whereby the activities and actions of a representative sample of persons (the 'panel') is followed over time and data collected from a sequence of interviews ('waves') periodically (Bigsten *et al.*, 2003). Panels are often aimed at providing up-to-date and comparable information on diverse social indicators over time for individuals and households (Verma *et al.*, 1996). They can also facilitate causal relationships between variables (Harpham *et al.*, 2003). Compared to some other social surveys, panel studies have broader and more integrative features, aimed at providing comparable and inter-related information (Artrostic *et al.*, 1999; Verma *et al.*, 1996). Despite their added advantages, panel studies can be costly and often have high levels of non-response (Harpham *et al.*, 2003; Atrostic *et al.*, 1999).

In this study, panel surveys used structured questionnaire administered on a face to face basis, monthly, for a year (August 2004 –July 2005). This provided a representative picture over time, in relation to the following broad topics: the extent of plant use in different seasons, motivations for using wetland resources, harvesting techniques used as well as the contribution of wetland resources to the households. More details are provided in Chapters 5, 6 and 7.

2.4.5.1 Sampling procedures

The list of households per village stratified according to livelihood sources was used as a sampling frame. During the second stage of the process, *Pitsos,* public gatherings were held in each of the ten villages to clarify the objectives and procedures to be used for panel surveys. People were then requested to volunteer their names as panel members. The names were cross-checked against the sampling frame to ensure a representative sample of local livelihood activities. As a result of this exercise, sixty-two panel members were selected from the six villages as shown in Table 2.6.

Table 2.6 The spread of panel interviews across the six sampled villages in Pelaneng-Bokong study area- August 2004 –July 2000

Village	Total Number of households	Number of panel members
Ha Poli	129	13
Ha Lukase	70	10
Ha Lejone	285	10
Ha Tlholo	76	10
Ha Lesaoana	90	10
Boritsa	62	9

2.4.5.2 Procedures for conducting panel studies

The procedure for conducting these surveys entailed use of calendars, designed for recording daily events related to harvest and use of wetland plants and to guide interviews. Interviews were held on specified dates, once a month either on one-to-one basis or as a group. The main advantage of group interviews was that the interviewee could consult other panel members and cross check with other members on issues

related to dates and volume harvested. One-to-one interviews, on the other hand were conducted within the homesteads. They were considered convenient by some members since they allowed them to do interviews simultaneously with other household chores, allowed for privacy during the discussion of sensitive issues (e.g. money related matters) and also allowed the researcher a chance to observe pertinent issues related to wetland plant uses. Where interviews coincided with other village activities, on-the-spot interviews were conducted. These events were found to be particularly useful in that they provided an opportunity for the researcher to observe and obtain first hand information on issues such as harvesting tools, techniques, quantities harvested as well as other anthropogenic disturbances.

2.4.6 Market Survey

The value of markets as rich sources of data related to human-plant species relationship has been extensively studied (Martin, 1995; Alexides and Sheldon 1996; Emmerton, 1998; Ambrose-Oji, 1997; Cunningham 2000; Veeman, 2000). In particular, surveys of both merchants and buyers have a broad range of data related to economic aspects of plant products, use and commoditification (Alesiades and Sheldon, 1996; Russel and Harshbarger, 2003).

In this study, surveys of local curio outlets, local markets and informal traders commercializing wetland resources were conducted using structured questionnaires and focus group discussions. These studies focussed at the local level and evaluated the demand and supply of wetland products, extent of commercialisation, income emanating from wetland resources. The transition from subsistence to commercialisation (Russel & Harshbarger, 2003) was also studied by identifying products that were not sold or rarely sold in the past. Additionally, data on quantity of products traded, availability, wetland origin, trading link and processing were also solicited (Martin, 1995; Cunningham 2000; Ambrose–Oji, 1997). Information obtained through the market surveys was used to complement data from the Panel Surveys.

2.4.7 Focus Group Discussions

Focus group discussions are an exploratory research tool conducted for the purpose of tapping on people's thoughts and feelings and obtaining detailed information about a particular topic of issue (Sherraden, 1995). If well managed, they allow deep-rooted feeling on a subject to emerge (*ibid*). Groups are usually composed of 6 to 12 people, selected purposively, and based on a set criterion. This size yields a variety of viewpoints and good participation. In this study, focus group discussions were conducted with different groups for different purposes. For instance, in order to gain a rapid understanding of indigenous management practices used to protect key livelihood wetland plants, several focus group discussion with specific resource users, elders and some local authorities were carried out to make follow-ups on information obtained from livelihood surveys. During the feedback workshops, people from the same village were grouped together to discuss and comment on the researchers' interpretation of the findings. Focus groups were also used during the participatory ground-truthing exercise (see Section 2.5.2.2) to interpret printed GIS Maps, topographic maps and verify the location of mapped wetlands as well as the extent to which they represent key features of the study area.

2.4.8 Seasonal Calendars

Seasonal calendars attempt to establish regular cycles or patterns of occurrences within a community over a period of 12 to 18 months (Thennakoon, 2002). They are also important in determining the seasonality of labour demand, plants availability and use, market availability and price variations. They are often used for gathering time related field data. In this case, seasonal calendars were used to complement panel surveys and fill in the gaps on seasonal variation in plants availability, harvesting and marketing.

2.4.9 Ranking Exercise

Ranks represent an ordering of a list of items according to their importance, as viewed by the respondent, for the particular issue under consideration. Preference ranking has been a popular tool in PRA activities for over a decade (Chambers, 1988). The general argument for using ranks is that local people are able to judge, from a given list of labelled items, whether one item is better or worse, more or less important, than other items (Abeyasekera *et al.*, 1997). The study utilized ranking and scoring to determine the status of capital assets.

2.4.10 Feedback workshops

Babu *et al.*, (1997) argues that information has a great impact on decision making, and hence its value is closely tied to the decisions that result from its use. Swanson (1997) on the other hand observed that information generated through research rarely reaches the end users. It ends up being knowledge generated for the sake of knowledge and ultimately being of little use. It is out of such similar observations that Chambers (1993; 1997) suggested the necessity of not just collecting information from people but also sharing findings with them for the purposes of improving their lives.

Though publications are one of the widely used methods to disseminate research results, their readership is limited and often, not accessible to rural communities, who in this case are vital recipients of research results. Under ordinary circumstances, one of the easiest and probably the quickest way of disseminating information has been the use of mass media such as newspapers, magazines, radios and televisions. However, in some parts of the developing countries of which Lesotho is part, information through mass media is also not always accessible (Van Den Ban *et al.*, 1990; Mokone, 1999). Some of the problems or limitations associated with mass media include the fact that newspapers and magazines are confined to few individuals in urban areas. Televisions are expensive and owned by few rural people who rarely tune to local broadcasters (Mokone 1999). Thus, workshops and conferences can be effectively used to disseminate and communicate research results to stakeholders.

Three Feedback workshops were held in July 2005 to disseminate research findings, gather opinions on the preliminary findings of the study and explore local's view on the effectiveness of resource management institutions. These are described in Chapter 8 Section 8.4.3.

2.5 Ecological studies

Ethno-botanical inventories are studies of useful plant species often accompanied by detailed field notes on collection, locality, characteristics of the plants, local names and their meanings and local uses (Martin, 1995; Cunningham, 2001). Collecting plant specimens is an important part of these inventories that allows voucher specimens to be

identified by scientific as well as local names (Martin, 1995). In this study, Ethno-botanical Field Inventories were conducted to investigate the distribution and abundance of key livelihood wetland plants.

2.5.1 Sampling design

Austin and Heylingers (1989) observed that regional surveys of biological diversity tend to differ from the usual statistical sampling techniques in that their purpose usually requires information about distributional patterns rather than unbiased estimates of mean abundance of individual species. In order to ensure adequate dispersion of samples through all the main vegetation types and at the same time avoid the imposition of a regime requiring very large number of samples, stratified sampling procedures, based on factors likely to influence floristic patterns, are often adopted (Tomlison, 1981; McNaughton, 1983). For instance, Austin (1978) and Jordaan *et al,* (undated) have demonstrated the influence of rainfall on distribution of plant species. Similar relationships between elevation, rainfall and vegetation have been noted in Lesotho (Martinez 2000; Mdee 2004). The influence of management on vegetation composition has also been widely demonstrated (eg. Jordaan *et al.*, undated; Stoddart *et al.*, 1952; McNaughton, 1983; Morris and Grab, 1997; Steinman, *et al.*, 2003; Nusser and Grab, 2002).

Given these considerations a stratified sampling procedure with two layers of stratification, namely, elevation and management regime was adopted in this study to ensure a representative sample. Superimposed on the management regimes are three, conveniently demarcated grazing zones (A, B and C). The A zone is the summit zone; B the mid slope and C the settlement or valley bottom zone (see Figure 2.3, Chapter 2). These three zones occurred to varying extents in the three management zones. For instance, all three zones occurred in the communal area and the RMA, while for the Bokong Nature Reserve all sampling sites were essentially on the A zone since the whole Nature Reserve is located within this zone.

It has been noted that many ecosystems today are subject to various forms of anthropogenic disturbances especially habitat modification and invasion by non-native species (Kremen, 1992; Harmer *et al.*, 2000, Carignan and Villard, 2004). Species whose presence are indicative of disturbance as well as those that are in danger of extinction, are therefore often used to assess environmental condition of different wetland sites (Ross, *et al.*, 2002). In this study, to determine levels of disturbance, two sets of species indicating disturbance as well as endangered species (NES, 2004), were identified and recorded in each sampled wetland site (See Appendix 2.3) A similar method was used by Sheil (1996) and later Ssegawa *et al.*, (2004) during a study of the distribution of sedges in Uganda.

McNaughton (1983) asserts that the timing of botanical surveys is critical and where necessary should take precedence over the sample size. This is attributed to taxonomic confusion likely to result if an attempt is made to conduct such inventories beyond specified seasons. In this study, the dry season inventory was undertaken in August 2004 and wet season (period of peak biomass) between January and February 2005. Three more wetlands were added to the sample at a late stage of the study as a result of observing their importance during ground truthing (Section 2.5.2.2). These were surveyed in August and December 2005 for the dry and wet season respectively. More specific details on stratification are provided in Chapter 4 Section 4.3.

2.5.2 Preparation for fieldwork

2.5.2.1 Determining the location and extent of wetlands

In order to obtain a comprehensive list of wetland sites that could be used as a sampling frame, this study used wetland data in the form of digital elevation model (DEM) with a 25m resolution and contour lines provided by Martinez-Rica (2000) in a study of the natural environment of Pelaneng-Bokong. Through the same study polygons of RMAs, communal areas and river data were also provided in Universal Transerve Mercator (UTM). From the provided data an aspect grid was created from the DEM using Spatial Analysis in ArcView in order to convert DEM to a vector file and specific altitude zone. Data deemed unnecessary was then removed using Boolean masks leaving vital information on rivers (see Figue 4.1) and altitude zone (See Figure 4.2). The 167

deliniated wetlands constituted a sampling frame and were later transferred to the relevant 1:50,000 topographic maps, and from which the sample wetlands were chosen. This exercise allowed for selection of wetlands on the basis of management regime, altitude and proximity to rivers (to aid navigation to wetlands).

Figure 4.1 Location of Wetland sites and the drainage system in Pelaneng- Bokong study area

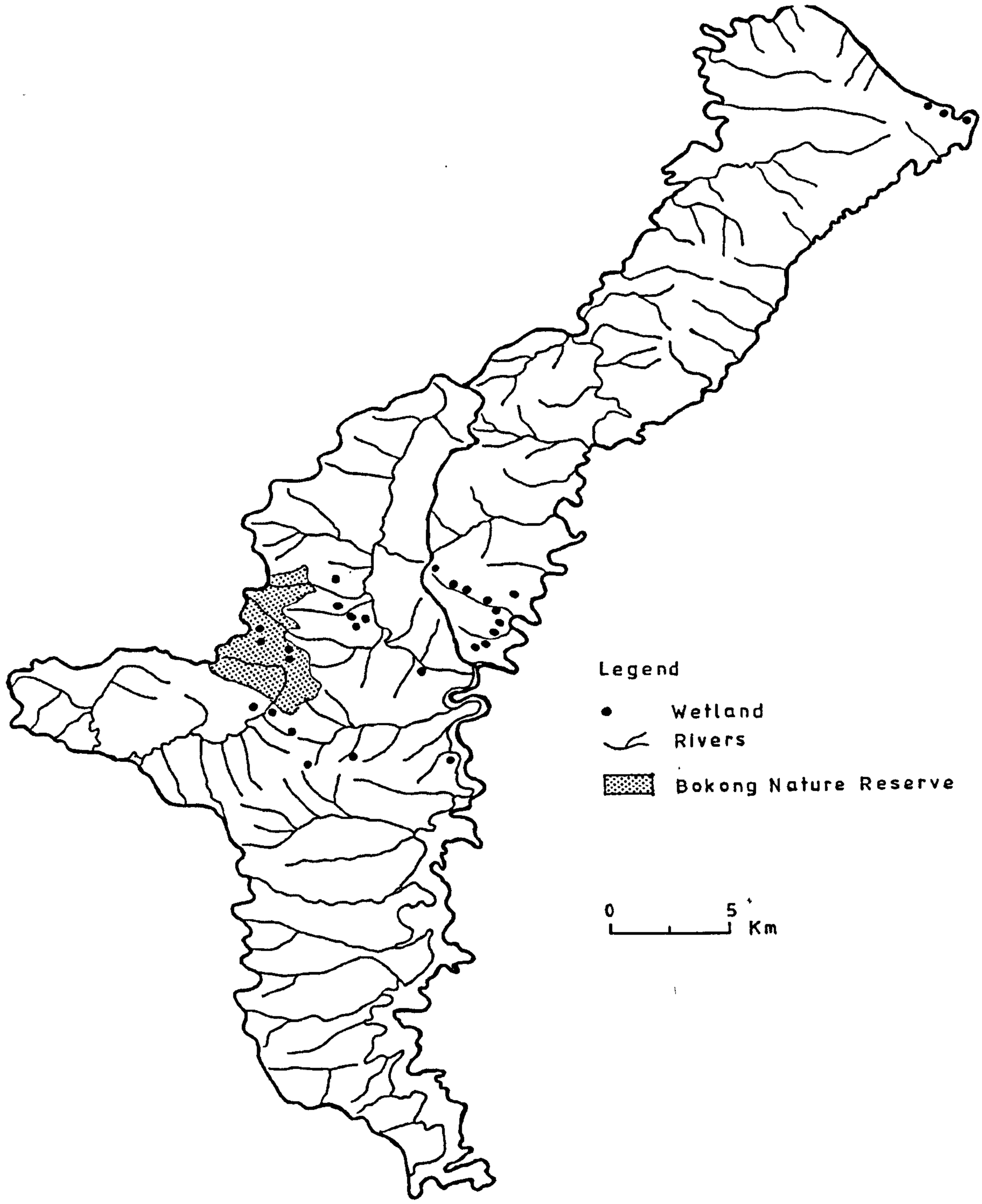


Figure 2.4 Sampled wetland sites within the communal areas, RMA and Nature Reserve

2.5.2.2 Participatory Ground-Truthing

Prior to compiling the inventories, printed GIS Maps, topographic maps and open-ended questions with key informants were used to verify the location of mapped wetlands as well as the extent to which they represent key features of the study area. Through this exercise, additional wetlands, located within the communal areas were added to the

sampling frame. These were then recorded using a hand-held Global Positioning System (Garmin GPS12CX).

During this stage a list of key livelihood species, previously obtained from the livelihood surveys was discussed, and using participatory methods, in particular the ranking and rating technique, were then prioritized with key informants. As a result a list of ten species which were particularly important in local peoples' livelihoods was produced. This was later confirmed through Panel Surveys (Chapter 5, Table 5.1).

2.5.3 Sampling Procedure

Quadrats, traditionally square, (though rectangular or even circular quadrats have been used) are standard areas for sampling and examining vegetation for floristic description (Paddy and Coker, 1992; Martin, 1995; Wadsworth *et al.*, 1999). Quadrat size is important and varies with type of vegetation. Transects, on the other hand are lines along which samples of vegetation are taken (*ibid*). They are usually set up deliberately across areas where there are rapid changes in vegetation and marked environmental gradients. Most transects are biased in their location, although it is possible to locate the start and end of a transect at random while taking samples along the lines connecting the two points.

Transect use has a long history. For example, Austin and Heyligers (1989) laid them across gradients to overcome problems of inadequate representative sampling and accessibility while minimising costs. They are also deliberately selected to contain the strongest environmental gradients such as climate, topography, soils and altitude in an area to optimise the amount of information gained in proportion to the time and effort spent (Pei-Fen, *et al.*, 2004). Details of characterization of plant composition using quadrats are given in Chapter 4 Section 4.3.

The current study used transects at pre-determined cross sectional profile of wetlands located purposively based on coarse visual differences in vegetation composition (Dickinson and Mark, 1999; Kent and Coker, 1992). A conventional $1m^2$ quadrat made of a collapsible steel frame was used to increase the accuracy when recording measures of abundance since each subunit of quadrat can be examined separately (Kent and

Coker, 1992). Quadrat size was held constant in order to allow for analysis of relative influence of different environmental variables on species diversity (Pei-Fen *et al.*, 2004), while several quadrats were located along the entire length of a transect.

Chapter 3

Linking conservation with livelihood values for effective management of wild plants

CHAPTER 3 – LINKING CONSERVATION WITH LIVELIHOOD VALUES FOR EFFECTIVE MANAGEMENT OF WILD PLANTS

3.0 Summary

Nature conservation is about people and the balance which might be struck between humans and nature. However, environmental changes, induced by human actions have led to the questioning and re-evaluation of linkages between conservation, society and livelihood roles of natural resources. This has in turn led to the notion that conservation and development are competing and contradictory. This chapter examines the evolution of some of the key conservation doctrines and linkages between conservation and livelihoods. It concludes that early doctrines were driven by concerns to avert species loss by human nature, thus attempted to separate humans from nature. Recent approaches however seem to follow global trends in recognizing that nature conservation should contribute to the basic human needs and that local peoples' knowledge and experiences should be incorporated onto resource management decision making processes. However, the preoccupation with the belief that nature could be protected from the people seem to have steered these initiatives towards the direction of trying to extend control on people as opposed to linking society, livelihoods and conservation.

3.1 Introduction

Conservation is about people and the balance that must be struck between humans and nature (UNESCO, 2004). In this light, it appears imperative that the link between conservation and livelihoods is recognized by all stakeholders. However, changes in nature induced by human action have led to questioning and re-evaluating linkages between conservation and livelihood values and, in most cases have led to an assumption that local management systems are incapable of achieving the desired conservation goals (Cooper, 1991; Adams, 2004; McNeely, 1988; Pasek, 1992, Amin, 1992). This has in turn, led to the notion that conservation and development were competing and contradictory (Weddel, 2002; Given, 1994; Hamilton and Hamilton, 2006; Shiva *et al.*, 1991), and supported conservation approaches aimed at separating

human beings and the same resources that sustained their livelihoods (Shiva *et al.*, 1991; Agrawal and Gibson, 1999; Salafsky and Wollenberg, 2000; Scherr, 2000). Denis Goulet clearly summarizes this issue in his examination of development and ecological ethics:

> 'The task of eliminating degrading underdevelopment imposes itself with the same urgency as that of safeguarding nature. These twin concerns have spawned two ethical streams of protest. Yet almost always the two streams flow in opposite directions: one is concerned with protecting nature, the other with promoting economic justice'. (Goulet, 1990 pp. 36).

However, without a framework that links the two, the ability of local people to conserve natural resources and secure livelihood might be lessened (Shiva, 1990). In this chapter, some of the major themes which emerge from data presented in the subsequent chapters are reviewed. To achieve this, linkages between conservation and livelihoods are traced through the examination of conservation approaches over time, while emphasizing milestones and uncertainties associated with attempts to secure livelihood benefits without compromising the conservation objectives. The historical context plays a vital role in understanding current management issues and practices. It is therefore hoped that an understanding of these issues might highlight the influence of and provide an insight into factors that might have influenced current thinking in environment-society relationships.

The chapter commences by a modest digression on the historical doctrines, in recognition of the key role they played in setting the stage for subsequent approaches in the resource management field. This is followed by a brief examination of the rise of environmental movement, thematic approaches used to counter resource exploitation and how they evolved to incorporate and/or exclude livelihood concerns in conservation.

3.2 The Historical Context – The Anthropocentric and Ecocentric Approaches

Negative environmental impacts have led to increased pressure for all the interrelated actors to evaluate their positions towards nature and environmental ethics, which focuses on redefining the boundaries of obligation to the environment and evaluating the human position towards it (Holden, 2003). The understanding of the natural

environment that emerged from research of the eighteenth and nineteenth century, influenced by early doctrines, profoundly affected human beings' view of their place in nature. Yet, to comprehend the existing behaviour towards protection of the environment and biodiversity, it is necessary to understand more fully the ethical approaches towards it.

Environmental ethics, as the discipline that studies the moral relationships of human beings to, and also the value and moral status of the environment and its non-human contents, attains a key role in defining the human nature-relationship (Robinson and Garrat, 1999). In this literature, the distinction between *anthropocentric* and *ecocentric* ideologies has been of considerable importance. The former refers to the relationship between humans and nature, whereby animals and plants are valuable only to the extent that they can be used and exploited by humans for humans, whereas the latter emphasizes that all living things, including human beings and non-living things, are equally vital to sustain the earth. In this context, Iguchi (2003) observes that, *anthropocentric* ideology assigns a greater amount of intrinsic value to human beings than to any nonhuman things and that human nature relationship under this doctrine tends to reflect domination and mastery over nature. Marcuse (1996) concurs that this school of thought valued nature in as far as it promotes human welfare and interest to the near exclusion of competing non-human values. Within this ethic the value of non-human objects is limited to the pleasure and the profit they bring to human beings.

O'Riordan and Kleeman (2002) on the other hand, recognize the *econcentric* ethic as an alternative approach that has its roots in utilitarian, exploitative worldview which assumes that biodiversity habitats are being eroded by human processes. It attributes resource degradation to poor management of resource ecosystems as well as interference and greed of human beings (Ludwig, Hiborn and Walters, 1993; McConnel, 1965 cited in O'Riordan, 1976). The dominance of this approach in the early writings related to man-nature relationships, are evidenced by criticisms levelled against deformations brought about by agriculture on the countryside (McCormich, 1989). This doctrine includes a belief that species, organisms and ecosystems have an intrinsic value of their own, and thus demands a code of behaviour such as humility, responsibility, low technology that would allow for stability of nature (O'Riordan, 1976).

Many traditional conservation approaches seem to take value orientation of the *ecocentric* ethic due to their imbedded assumption that '...human beings as destroyer of nature' (Jones, 1990, Colin, 1992). This has in turn resulted in a widening the gap between man and nature. These works gave rise to subsequent schools of thought, namely *Biocentric* idealism, whose emergence supported a recovery of the sense of kinship between man and nature and accepted moral responsibility to protect earth from abuse.

According to O'Riordan (1976) the proponents of the *bioethic* line of thinking seek to protect the integrity of natural ecosystems, not only for the pleasure of human beings but as a biotic right. For instance nature within this school of thought is not to be regarded merely as a convenient place for human beings but an integral companion to man. This notion is echoed by McCormick (1989), who suggests that, the emergence of *biocentric* idea not only emphasize the moral responsibility to protect earth from abuse but also supported the recovery of a sense of kinship between man and nature. However, like the *ecocentric* philosophy, *biocentric* idealism seemed to convey the notion of a highly sensitive, fragile equilibrium, which could easily be disrupted by human interferences (McComick, 1989; O'Riordan, 1976). For instance, Rolson (1992), argued for a greater respect for plants and animals, which he suggested should be treated as cousins to human beings. He also argued for conservation of '...stability, integrity and beauty of the biotic community'. Similar sentiments had been posed by Leopold (1949) arguing that, 'a thing is right when it tends to preserve stability and integrity of the biotic community' and that 'it is wrong when it tends to be otherwise'.

On the positive side, it can be argued that the two historical paradigms – *ecocentric* and *bioethic* schools of thought acknowledge a relationship between man and nature. For instance, Weddel (2002) observed that they made a considerable advance in the direction of trying to sustain the utilization of species and instil a moral responsibility towards nature. However, a point of contention has been on their attempt to thwart development and deny human beings the right to exist (Turner and Pearce, 1990).

While the differences related to the conceptualization of environmental ethics, given the complexity of environment-human interactions is unavoidable, they provide a context

within which historical philosophies approached the question of interaction between man and nature, and how these moral implications might have trickled down to modern environmental policy making. They also give a motive to explore the concept of environment-livelihood linkages in the context of a historical review of conservation approaches.

3.3 The Rise of Environmental Concerns

It terms of establishing a framework for examining the links between conservation and livelihoods, a description of the evolution of conservation concern seems essential because of its influence in shaping conservation approaches.

In 1962, Rachel Carson's *Silent Spring's* argument that humans, through reckless misuse of chemical pesticides, were fatally tampering with nature, introduced the idea that development and technological progress could be destructive to the environment, giving rise to the environmental movement. Carson's warnings coupled with strong influence of bioethical paradigm, sparked interest on the consequences of man's exploitative relationship with nature and the need to protect the environment (McCormick, 1989). The controversy sparked by *Silent Spring* also led to the enactment of environmental legislation meant to regulate the use of chemicals, establishment of several environmental interest groups and drew attention to environmental issues that had never been addressed before.

An extension of 'unspoiled nature' philosophy is evidenced by writings such as *The Coming Spaceship Earth* by Kenneth Boulding, where it is suggested that, humans' perception of limitless resources has resulted with tendencies to meet growing demands by simply pushing the frontier further forward (Boulding, 1966). The environmental movement, and the quest for the 'unspoiled' natural world, seems to hold an *ecocentric* point of view due to its scepticism about actions of humanity and consequent restrictions to traditional resource use practices (Sullivan, 2004).

3.4 The Protected Area Approach

Massive growth in support of conservation culminated in a series of strategies used meant to protect nature. The IUCN Protected Areas for example, constitutes the foundation of conservation approaches for most of the century (Adams, 2004). This

approach proposes the drawing of boundaries around special areas to protect them from direct use and, is based on the premise of an inherent separation between human society and nature to curb ecosystem disturbances and species extinction (Given, 1994; Tuxil and Nabhan, 2001; Slater, 2000).

Protected Area approach was implemented in many forms including parks, nature reserves and wilderness areas and justified in different places on different grounds. For instance, in the United States, Park Planning concepts were introduced as early as the 19th century to serve as models for the development of protected area networks worldwide (Brandon and Wells, 1992). In South Africa, the proclamation of Qwaqwa National Park in 1992 and Tembe Elephant Park in Kwazulu Natal in 1983 were justified based on argument about overstocking, soil erosion and associated environmental problems (Slater, 2000). The Transfrontier Conservation Areas (TFCAs) in southern Africa, on the other hand, were seen as a useful mechanism for the protection of global biodiversity and their establishment was based on the argument that biomes tend to straddle national boundaries, also that most of TFCAs are remote and likely to be neglected (Ramutsindela and Tsheola, 2000). Contrastingly, Letsela *et al*, (2000) have observed that, in Lesotho, it was the good conservation value of Bokong and Tsehlanyane areas resulting from the management practices of the local communities that prompted their designation as nature reserve and national park respectively.

Protected areas seem to have increased in number and extent in recent years. For example, six African countries (Botswana, Burkina Faso, Namibia, Rwanda, Senegal and Tanzania) have more than the international target of ten percent of their land under protection (UNEP, 2002). In this effort they are supported by industrialized countries through various bilateral-aid agencies and through other major partners important to conservation of wetlands including the World Conservation Union (IUCN), World Wildlife Fund for Nature (WWF), International Waterfowl and Wetlands Bureau (IWRB) and the International Council for Bird Preservation (ICBP).

Wetlands in particular, with their long history of degradation and loss as a result of being drained for alternative land uses (Field, 1994), and their unpopularity, especially

in Africa, due to water-borne diseases, flooding and water-logged soils (Kairu, 2001), have received attention through the signing of the Convention on Wetlands of International Importance, especially the Ramsar Convention. Consequently, 103 Ramsar sites were designated in Africa with a combined area of more than 20 million hectares (UNEP, 2002).

Despite its efficiency in restoring ecosystem functions, the protected area approach has been questioned on many grounds. In particular, its emphasis on the separateness of humans from nature has been at the core of its criticism (Zammit, 2002; Sullivan, 2004). The failure to incorporate 'the human dimension' of ecological issues, particularly in developing countries, where communities depend on primary resources to sustain livelihoods, has undermined conservation by leading to encroachment and illegal hunting activities (Keddy, 2000; Myers, 2002; O'Riodarn and Stoll-Kleeman 2002; Barbier, 1989; DFID 1999; Joosten and Clarke, 2002). The viability of the approach to sustain species indefinitely was further questioned on the basis that they can only contain limited populations (Mcneedy and Scherr, 2001; Pretty 2000).

The creation of parks and nature reserves profoundly change local life, as protection for the ecosystem requires control of anthropogenic activity (Pascual, 2004). This idea, based on the assumption that it is humanly possible to control economical and social life for the benefit of people and nature brings forth an *anthropocentric* and *ecocentric* idealism (Selwyn and Boissevian, 2004).

3.5 Sustainable Development Paradigm

The sustainable development paradigm presents a major departure from the conventional approaches that alienated man from natural systems. Instead, it addresses the tensions inherited from historical paradigms concerning ecological issues and human beings' utilization of resources. Its strongest point lies in not only the emphasis on the importance of environmental quality and conservation of assets, but also its recognition that people depend on products of ecosystems or several services including food, shelter, medicine and fuel, hence attempting to link conservation with livelihoods (World Commission on Environment, 1987; Pearce *et al.*, 1989; Turner, 1988). More significantly, the approach seeks to protect the environments of the poorest

communities in the world who depend directly on natural areas for fuel, water and food while at the same time protecting the environments of non-humans (Chambers, 2001).

The Sustainable Development concept was projected onto the world by the Stockholm Conference in 1972 and has been carried ever since by the United Nations Environment Programme (UNEP), IUCN and the WWF in the World Conservation Strategy in 1980. The commonly used definition of sustainable development is the one provided by the *World Commission on Environment and Development* (Brutland Commission, 1987) '...the development that meets the needs of the present without compromising the ability of future generations to meet their own needs'.

Other studies have also expressed some reservations about sustainable development concept, particularly, questions related to the economic implications of conservation, how much each generation should or should not enjoy, as well who should bear the costs of conservation have been challenged as ambiguous (WCED, 1987; Pearce *et al.*, 1989; Turner, 1988). Perhaps the greatest challenge facing 'sustainable development' paradigm, as observed by (Auty and Brown, 1997) lies in the fact that decisions related to current and future resource management have to be made now, implying predictive abilities based on historical knowledge, which in most cases is non-existent.

The notion of what Shiva (2001) recognized as cures for ecological crisis seem to have exacerbated the misunderstandings about the concept, consequently rendering it a target for criticism from different angles. These criticisms, fuelled by the free market, allegedly devoid of ethical implications of restraint and moderation, have spurred research aimed at assessing the sustainability of harvesting wild species for livelihoods (eg. Cunningham, 1987; Siebert, 1995; Clay 1997b; Hanson, 1992; Soehartono and Newton, 2002; May and Barata, 2004; Pouta *et al.*, 2006). Turner and Pearce (1990) contend that this paradigm's thesis entailing compensating the future for the current and past damage allows for non-utilitarian values but remains *anthropocentric*.

3.6 Integrated Conservation Initiatives

The growing awareness of the needs of local people, particularly those who live adjacent to the protected areas and depend on wild resources for their livelihoods, culminated in strategies meant to link conservation and development (McNeely, 1998). These approaches, encompass a wide variety of initiatives, including biosphere reserves, world heritage sites and multiple-use areas (Weddell, 2002). These present a shift from protecting nature from economic change to a concern to achieve conservation through economic intervention (Adams, 2004). With a major objective of reducing pressure on a protected area, these initiatives largely attempted to conserve natural areas in the core zones while allowing suitable human activities to continue in outer zones (Weddell, 2002; Brandon and Wells, 1992). This approach allowed for re-modelling and in some cases extension of existing nature reserves to fit the idea (*ibid*). In 2002, 50 such reserves, covering 52 million hectares and 35 World Heritage sites totalling 37 million hectares, were established in Africa (UNEP, 2002).

Nonetheless, some communities have found it difficult to come to terms with a management system which stops at a buffer zone (Sullivan, 2004). Also, high demand for natural resources, combined limited implementation and monitoring capacity for these conservation frontiers, have rendered some of these initiatives ineffective. For example, Semesi (1992) in UNEP (2000) observed that, despite the created buffer zones, the relatively higher value and greater demand of mangroves of the Rufiji Delta in Tanzania rendered conservation of mangroves in accessible places difficult. In Namibia however, even remoteness of wetlands failed to afford them natural protection (Simmons, 1992 in UNEP, 2000). Similarly in Okavango Delta, in Botswana, attempts to link conservation and uses, through adoption of a communal 'felt needs' approach, yielded minimal results in reducing grazing pressure on the wetlands (Van der Heiden, 1992).

Other approaches, notably the *Community Based Natural Resource Management* (CBNRM) approach, have attempted to give local communities direct control over utilization and benefits of natural resources in order to value them in a sustainable manner (Primack, 2002; Hando, 2004). CBNRM has been defined as '....a process by which local groups or communities organize themselves with varying degrees of outside support so as to apply their skills and knowledge to the care of natural resources and environment while satisfying livelihood needs' (Pretty and Guijt, 1992, pp. 22). This

approach was pioneered in southern Africa in the early 1980s, and initially focussed largely on community based wildlife management, in programmes such as 'CAMPFIRE' in Zimbabwe, 'ADMADE' in Zambia and the 'Purros Project' in Namibia. At the centre of this approach was the argument that the twin goals of economic development and biodiversity conservation need to complement each other in direct and immediate ways – and that this need is particularly stark in the contexts of deep rural poverty (*ibid*). This approach has the advantage of being highly adaptable to local socio-economic, biological and physical conditions. In some cases, CBNRM has been used to promote tourism to existing protected areas and channel a proportion of profits back to the communities, have been employed by different countries.

Critiques of this approach however, have observed that although CBNRM are often centred on the assumptions that the newly formed organizations within the CBNRM would replicate indigenous ones, the opposite is true (Leach, *et al.*, 1999). For instance, in Zimbabwe, once the Trust Management Board took over the planning and management decisions, CAMPFIRE communities felt alienated from the Trust and the wildlife on which they depended (Metcalfe, 1994). Similarly, Kellert, *et al.*, (2000) observed that, in Kenya and Nepal, CBNRM were found to be largely unsuccessful due to institutional problems, while Pomeroy and Carlos (1997) attributed the low success rate in the Philippines to lack of clear responsibilities on the side of community members.

Katerere (2000) contends that few CBNRM initiatives are truly community based, especially in regard to devolving decisions and power over resources to the community'. It is further argued that, these failures to recognize the real rights of the community are often masked by the concept of 'partnerships' (*ibid*). Similar notions are expressed by Mohamed (2000), in two studies aimed at: (1) persuading the fishing communities to allow fish stock recovery at Lake Malombe and Upper Shire River in Mangochi District, Malawi; and (2) transferring of communal lands to the Richtersvelders in South Africa. In Malawi, the government failed to relinquish power to local-level institutions to manage their resources, while in Richtersveld, lack of active participation in decision making has reportedly resulted in community's lack of interest in the park and conservation agency being the lead partner. Wily (2000) suggests that curtailment in devolution of powers to the local communities is seen in the view of

locals as being concerned with immediate livelihood returns and benefits from nature than the status of resources and their long-term future. Given findings such as these, it has been argued that the approach is being used to extend their control than to link livelihood needs to conservation (Adams, 2004).

Research suggests that similar trends are occurring elsewhere. In Botswana, there is fear that shifting hunting from individual into communal sphere will not only radically change the Basarwa people's access to wildlife meat and products and reduce the flexibility of hunting at times and for quantities needed by different individuals and households, but will increase the government's control over the Basarwa (Twyman, 2000).

Other problems of CBNRM are often related to the use of revenue earned from projects. For instance, Katerere (2000) noted that, since many of the local level government structures are underfinanced, CBNRM initiatives become a source of revenue for community development projects. For instance, projects funded by the community conservation services outreach programme of Serengeti National Park in Tanzania, included construction of classrooms, road works, bridge construction and dispensaries (Hando, 2004), while in Zimbabwe, a large percentage of revenue is retained by the Nyaminyami Trust for salaried management (Metcalfe, 1994). Unlike the sustainable livelihood approach, CBNRM, stated as direct control over human utilisation can be labelled as integrated due to its concern over protecting the natural resources by applying both the carrot and stick approaches.

Traditional resource conservation practices

In due recognition that neither formal scientific nor indigenous conservation practices have dealt sufficiently with challenges of sustainable use of resources, attention has been drawn to traditional conservation practices in many indigenous systems, since some researchers have suggested that they might offer a productive starting point for collaboration between conservationists and local residents and provide substantial insights into locally-initiated strategies to safeguard populations of useful species (Berkes, Colding and Folke, 2000; Colding and Folke, 2001; Brandon, and Wellis, 1992; Tuxil and Nabhan, 2001).

These practices often consist of designated areas including sacred groves, initiation and spiritual sites where villagers are prohibited from disturbing natural resources, with the most wide-spread practice being sacred groves (Hamilton and Hamilton, 2006; Mgumia and Oba, 2003). For instance, in Kodagu district in the central Western Ghats of South India, there are over 1200 sacred groves, used for conserving and supplying life-saving medicinal plant species (Boraiah, 2003). Among the Wanyamwezi in Tanzania, conservation of the miombo woodlands is associated with ancestral and spirit worship (Mgumia and Oba, 2003). Similarly, Dhar, *et al.* (2002) noted that villagers in India considered alpine meadow to be God's medicinal plants and harvested them during the festival of *Nanda Ashtami* only.

However, it has been counter-argued that, indigenous management systems are vulnerable to increasing economic and commercial pressures as they tend to make the transition away from subsistence economies (Richards, 2002). Specific examples of non-conserving behaviour of indigenous societies including habitat degradation and other patterns of subsistence behaviour that conform to economic optimization as opposed to resource conservation have been cited to discredit indigenous management regimes (eg. Smith and Wishnie, 2000; Becker and Leon, 2000; Omari, 1990; Goulet, 1995). Lohmann (1991) attributed the decline of Thailand's forest to both population pressure and the country's invasion by the market economy, whereas Schuking and Anderson (1991) blamed the disappearance of the rainforest on the tropical timber industry in Southeast Asia.

Additionally, indigenous conservation areas, particularly sacred groves are, in most cases plagued by the same degradation problems that are affecting other natural areas. For instance, they face widespread degradation due to mining, tourist development and other activities (Tuxil and Nabhan, 2001). In some cases, the weakening of institutions for managing groves combined with the fact that villagers no longer attach the same significance to sacred groves as elders did, have also threatened their viability (Mgumia and Oba, 2001). Indigenous practices combine both *anthropocentric* and *ecocentric* viewpoints in that, imbedded within them, is the understanding that resources should be managed wisely for the benefit of mankind.

3.8 Conservation by Commercialisation

Commerce in natural resources or wild products gathered from forests, wetlands and grasslands play a significant and often critical role in providing subsistence and cash income to a large part of the world's population (Neumann and Hirsch, 2000). Though historically little attention was paid to the significance of these for rural welfare, the commercial, consumptive use of wild species has recently become the focal point for much of the debate regarding the link between sustainable development and biodiversity conservation (Freese, 1997) (see Chapter 6 for details). It has been demonstrated that linkages between wild plants trade and the improvement of livelihoods could provide an incentive for local people to conserve resources (Kiernan and Freese, 1997; Clay, 1997; Bodmer, *et al.*, 1997). While this approach is largely acceptable (eg. Freese, 1998, Joshi and Joshi, 2005; Mcneely, 1998; IUCN/UNEP/WWF, 1991; Marshal, 2004; Marshal and Newton, 2003), it however, raised similar questions as those raised on the sustainable livelihood paradigm and indigenous management, related to imminent increases in demand and consequent destructive harvesting techniques and over-exploitation of species (May and Barata, 2004; Soehartono and Newton, 2002; Neumann and Hirsch, 2000).

Conclusion

Generally few would doubt the need for protecting biodiversity and livelihoods, but how it is done lends it to different interpretations and approaches. Many of the earlier doctrines that alienated livelihoods from nature have theoretically given way to the emerging idea that conservation should contribute to basic human needs rather than conflict with them. However, this radical revision of a paradigm built on what Child (2001) describes as 'fortress conservation' remains new and experimental. For instance, in Southern Africa, such initiatives have limited the role of communities to that of benefit-sharing while inequalities in resource distribution and decision making powers persist (Katerere, 2000; Mohamed, 2000; Scherr, 2000), a clear indication of the profound influence of early doctrines on scientific inquiry, as neatly summarised by Marcuse (1966) ' ..modern science has essentially become the handmaiden for the mastery of nature....'.

However as Katerere (2000) argues, linking conservation with livelihoods goes beyond sharing environmental benefits with local communities. Instead, it has been observed that, to enhance conservation and sustainable use of natural resources, management approaches need to acknowledge livelihood values of natural resources, not only as buffers against poverty, but as symbols that can inspire them to use them responsibly (Agrawal and Gibson, 1999; Wily, 2000; Letsela et al, 2000; Dovie, Shackleton and Witkowski, 2000). This issue, fuelled by questions on whether environmental benefits can be secured without compromising conservation objectives and whether local management practices can stand up to increasing economic, demographic and commercial pressures, has become a central element in debates about future conservation activities. Some of these pertinent questions are subjects of subsequent chapters.

Chapter 4

Vegetative patterns

CHAPTER FOUR - VEGETATIVE PATTERNS

4.0 Abstract

Multiple and often competing uses of wetland services dictate an understanding of their functions. Since vegetation patterns often express the influence of many ecological and human factors, an accurate accounting of the flora is indispensable in management programs. Sampling procedures with three layers of stratification, namely elevation, management regime and grazing zone was adopted, while transects and quadrats were used to investigated key livelihood wetland species' composition, distribution, abundance disturbance level of wetland species in 29 sampled wetland, across the three management regimes (communal, RMA and Bokong Nature reserve) and the A, B and C grazing zones.

Overall species composition was comparable between RMA and Bokong nature reserve and between the 'C' grazing areas. Key livelihood species however, were poorly distributed within the nature reserve while the 'B' and 'C' zones had the highest proportion of these species. Communal regimes and 'C' areas, on the other demonstrated highest disturbance levels. The study largely attributes differences in floristic composition to disparities in rainfall and elevation. Differences between the RMA and communal area, as well as the differences between the 'B' and 'C' zones, are harder to explain and might be a result of many factors including prolonged drought, anthropogenic disturbances, management as well as the establishment of the RMA and Bokong nature reserve.

4.1 Introduction

Multiple functions of wetlands often present challenges to management that tries to balance livelihood needs and maintenance of natural ecosystem processes (Keddy, 2000; Joonsten and Clarke, 2001). Christen *et al.*, (1996) categorise these multiple functions as processes, goods and services. In this context processes include hydrological storage, biological productivity, biogeochemical cycling and biological diversity. Goods, on the other hand include food, construction materials, medicinal plants and tourism, while services entail carbon storage and sequestration as well as detoxifying pollutants (Mitsch and Gooselink, 2000; Moss, 1993; Silvious *et al.*, 2000; Kotze *et al.*, 2002). However, loss of wetlands due to climate and human activities, has been dramatic worldwide with consequent changes to many wetland functions, services and resources (Lienert, 2002; Watson and Ormerod, 2004).

In Lesotho, for example, wetlands are important for regular flow of rivers and also act as filters producing crystal-clear water (Mokhothu and Tsehlo, 1997; Mokuku, 1997). At the same time it has been estimated that about 93 per cent of rural households

residing in mountain areas utilize wetland plant species for various purposes including food, fodder, medicine, construction and handicrafts (Majoro *et al.*, 1999). Intense usage has, however, rendered some of these wetlands prone to erosion (Guillarmord, 1962; Van Zinderen Bakker and Weger, 1974; Nusser, 2002). Concerns relating to losses in water storage capabilities of the wetlands have been raised, while their ability to supply good quality water to the rivers has been questioned (Marneweck and Grundling, 1999). Issues related to the long term sustainability of utilization and the maintenance of wetland benefits have become a focus of research in the last two decades, in various parts of the world. For example, in West Africa, Dixon and Wood (2003) observed that, wetland drainage and cultivation though critical for food and livelihood security, seemed to be placing many wetlands under extreme pressure. Similar notions were noted in Ghana (Dovie, 2003), West Africa, (Adams, 1993), Caète Estuary in North Brazil (Glaser, 2003) and Lake Victoria in Kenya (Kairu, 2001; Terer *et al.*, 2004). Decision-making processes related to biodiversity conservation and sustainable livelihoods, are thus complex and require an understanding of the wetlands functions and uses (Keddy, 2000; Joonsten and Clarke, 2002). According to Ssegawa *et al.*, (2004), Keddy (1988) and Watson and Ormerod (2004), vegetation patterns, particularly species composition, distribution and abundance are important and are often used to evaluate different attributes of ecosystems and their management implications.

Plant communities within the wetlands ecosystems in Lesotho are well known for their variability and diversity (Guillarmord, 1962 & 1963; Mokuku, 1991). They are described as being not only as highly variable across and within groups, but Schwabe (1995) also characterizes them as being of high species diversity and unusually rich in lower plants, with many endemic species. Wetlands vegetation pattern and associated variability with the water table, have also been documented (Van Zinderman Bakker, 1974; Marneweck and Grundling ,1999).

Most of these wetland floristic studies, however, have narrowly focused on the highest altitude areas, specifically those areas that have been targeted for conservation. These studies tended to lump the entire wetlands located in high altitude area as a single, albeit variable entity. Such broad studies also tend to aggregate vegetation and obscure differences between different localities as well as differently valued wetland species.

More significantly, the spatial pattern of wetland species preferred for livelihoods remain unstudied. The lack of such information presents a gap in knowledge.

In this study, an assessment of a diversity of wetlands was undertaken in order to get a better understanding of their vegetative patterns. Though the study focussed on key livelihood wetland species, wetland sites located within the Bokong nature reserve, from which the public has been excluded, were also examined and compared with wetlands in both communal and Range Mananagement Areas (RMA) areas that are accessible to the local communities. It is hoped that the inclusion of sites where collection is absent or at least low, could provide information about impacts of human activity on species abundances and distribution. The derived spatial patterns could be used to assess the current status of the wetlands and provide information on their use, which in turn will inform future management.

4.2 Objectives of the Study

This study was undertaken to document vegetative patterns, to quantify differences and evaluate variability in distribution and abundance in relation to local preferences and environmental factors.

The study had the following specific objectives:

1) To evaluate variability in species composition and distribution in relation to elevation, management regime and grazing zones during both the dry and wet seasons.

2) To determine overall and key livelihood species richness and assess their variability across the three management regimes during both the dry and wet season.

3) To determine and seasonal variation in levels of vegetation disturbance (modification) as well as the occurrence and/or absence of endangered species across the three management regimes.

These considerations lead to following series of questions:-

4.2.1 Research Questions

- Are there consistent patterns of species composition and distribution that give insights into local communities' preferences and resource use patterns?
- What environmental factors influence species occurrence, spatial distribution and thus, livelihood value?
- If consistent patterns and environmental relationships exist, why have they developed and what can be inferred from them about human beings –resource relationships?

4.2 Material and methods

The broad approach follows that outlined in Chapter 2 Section 2.5. Species compositon, distribution, abundance as well as the disturbance level of wetland were studied within each of the 29 sampled wetlands. These were stratified in terms of elevation, management regime and grazing zone A, B, C.

4.3.1 Sampling Procedure

4.3.1 Using elevation at the first level of stratification

Two clusters of wetland sites occurring at altitudes 1900-2750 (lowest elevation) and 2751– 50 (highest elevation) metres above sea level were selected. Within the 1900–2750 clusters, nineteen wetland sites were selected and ten percent sites sampled on 2750– 250 m.a.s.l. (Chapter 2 See Figure 2.5)

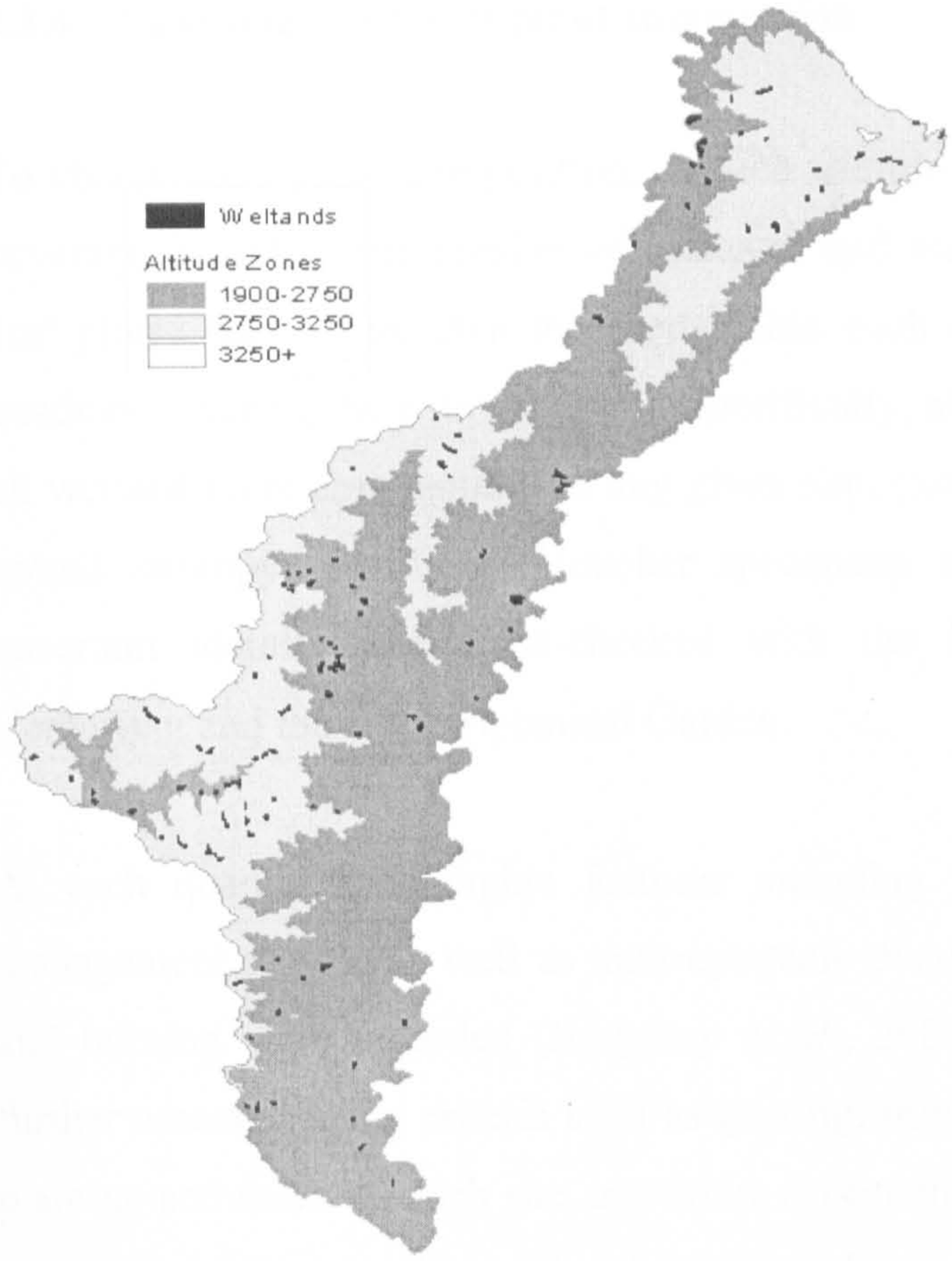


Figure 4.2. Location of wetland sites within different altitude zones in Pelaneng-Bokong study area.

4.3.2 Using Management Regime at the second level of stratification

In order to capture as many habitats and environmental gradients as possible, within the sample, wetlands were selected on the basis of representation of each of the three management regimes - communally managed, managed by RMA and Bokong Nature Reserve. To this end 12, 13 and 4 wetland sites were selected within the communal, RMA and Nature Reserve respectively (see Figure 2.5)

4.3.3 Using Grazing Zone at the third level of stratification

Within each management regime, wetland sites were further stratified according to grazing (A, B and C zones), with 20 wetland sites selected within the A zone while samples sizes for B and C constituted 3 and 9 sites respectively.

4.3.4 Characterization of plant composition

To characterize plant composition, at each sampled wetland site, visual estimates of coverage including the number of indicator and endangered species were made from 1m² plots. These were then recorded within each of the contiguous, collapsible 1m² quadrats covering the entire transect. Specifically, attempts were made to walk through all wetland plant communities at any given site, except where prevented by deep water or/and swampy conditions. Voucher specimens were collected for any species of uncertain identity and cross-checked with the National University of Lesotho's Herbarium and the Katse Botanical Garden.

At each quadrat topographic features including aspect, grazing area, altitude and management regime as well as anthropogenic disturbances such as grazing, trampling and burning were recorded (Brayshay *et al.*, 2000). The condition of each site was further assessed using criteria such as grazing, trampling, burning, cultivation and tree planting activities. At each site, elevation, aspect and slope were noted (Brayshay *et al.*, 2000). In addition to the quadrat based sampling, a cursory search for rare plants was conducted when walking through of each wetland.

4.4 Data Analysis

Data pertaining to this study were analysed and presented through descriptive methods using SPSS version 10 (Pallant, 2001). A Kruskal-Wallis test was used to determine differences in abundance level of species. An emphasis in the analysis was, however, placed on the descriptive analysis of patterns in vegetation structure, elevation and management across sites. To measure the extent to which the three management regimes as well as the three grazing zones had species in common, the Jaccard's Index of similarity, was used, $Cj=j/(a + b - j)$, where j is the number of species in common (joint) to the two samples and a and b are respectively the total number of species in each sample (Southwood, 1996). In this study, the similarity index was used on dry and wet season species composition data to determine common overall species, species that are of livelihood value, indicators of disturbance as well as endangered species.

4.5 Results

4.5.1 Overall species' composition and distribution

Botanical inventories of 29 wetlands yielded 108 species classified into 36 families (Table 4.1). Sixty-two (56%) and eighty-two (76%) of the 108 species described in this study were encountered during the dry and wet season respectively. Species recorded for the same wetland sites during both the dry and wet season did not differ considerably. For example, similarity in species composition between the seasons measured using Jaccard's Index for the whole study area, communal areas, RMA and the Nature Reserve were 33%, 30%, 20% and 40% respectively.

Table 4.1. List of plant species (described in local, scientific and family name) encountered during both the dry (n = 61) and wet (n = 79) seasons, across the 29 sampled wetland sites in Pelaneng-Bokong study site. Of these, four, *Letloepe la Khoho*, *Koae ea Makho*aba, Selingoana and Dry cotton wool flower could not be identified beyond common names.

Local Name	Species	Family	Seasons	
			Dry	Wet
Moseha	*Merxmuellera drakensbergensis*	Poaceae	x	x
Moseha	*Merxmuellera disticha*	Poaceae	x	x
Sechaba	*Eleocharis dregeana*	Cyperaceae	x	x
Rororo	*Juncus glaucus*	Juncaceae	x	x
Lechuchutha	*Tagetes minuta*	Compositae	x	x
Moriri oa matlapa	*Bryum sp.*	Bartramiaceae	x	
C. palodosum	*Cotula palodosum*	Compositae	x	x
Phefo	*Helichrysum flanaganii*	Compositae	x	x
Lesuoane	*Carex cognata*	Cyperaceae	x	x
Moluoane	*Salix mucronata*	Salicaceae	x	x
Leshala/Moarubetso	*Haplocarpha nervosa*	Compositae	x	x
Letsiri	*Festuca caprina*	Poaceae	x	x
Lengana	*Artemisia afra*	Compositae	x	
Khotolia	*Senecio harveyanus*	Compositae	x	x
Hlabahlabane	*Cirsium vulgare*	Compositae	x	x
Seboku	*Themeda triadra*	Poaceae	x	x
Selae/Semetsing	*Kniphofia triagularis*	Cruciferae	x	
Lelothoane	*Buddleja salviifolia*	Loganiaceae	x	
Moopetsane	*Wahlenbergia undulata*	Campanulaceae	x	
Maseema	*Gymnopentzia bifurcata*	Compositae	x	x
Loli	*Scirpus ficinoides*	Cyperaceae	x	x
Marama-a-baroetsana	*Sebaea marlothii*	Gentianaceae	x	x

Letloepe la khoho	*Unknown 1*	.	x	
Qobo	*Gunnera perpensa*	Gunneraceae	x	x
Koena-ea-liliba	*Mentha aquatica*	Labiatae	x	x
Khamakhamane	*Rumex lanceolatus*	Polygonaceae	x	x
Moferefere	*Senecio asperulus*	Compositae	x	
Thita-poho	*Fingerhuthia sesleriformis*	Poaceae	x	x
Tsaane	*Eragrostis curvula*	Poaceae	x	x
Joang ba matsa	*Potamogeton pusillus*	Potamogetonaceae	x	
Qoqobala	*Cerastium capense*	Caryophyllaceae	x	
Moqhoboqhobo	*Veronica anagallis*	Scrophulariaceae	x	
Dry cotton wool flower	*Unknown 2*	.	x	
Mohlatsisa	*Euphorbia striata*	Euphobiaceae	x	
Selingoana	*Unknown 3*	.	x	x
Qalooe	*Kniphofia triagularis*	Asphodelaceae	x	
Letjotjo	*Ficinia filifomis*	Cyperaceae	x	x
Tlhapi-ea-Loti	*Geum capense*	Rosaceae	x	x
Putsoa-pululu	*Arctotis arctotoides*	Compositae	x	
Mosikanokana	*Gomphostigma virgatum*	Loganiaceae	x	x
Lesookoana	*Alepidea thodei*	Apiaceae	x	x
Serelilenyana	*Crassula setulosa*	Crassulaceae	x	
Ponye/Koenana	*Diclis rotundifolia*	Scrophulariaceae	x	
Seoete	*Conium fontana*	Apiaceae	x	
Lijo-tsa-lihohoana	*Aponogeton junceus*	Aponogetonaceae	x	
Tsikitlana	*Gazania krebsiana*	Compositae	x	x
Leloele-la-loti	*Kniphofia caulescens*	Asphodelaceae	x	
Sebea-mollo	*Senecio macrocephalus*	Aponogetonaceae	x	
H. praecurrens	*Helichrysum praecurrens*	Compositae	x	
Mahlo-a-konyana-a-loti	*Lobelia galpinii*	Campanulaceae	x	x
Sedge	*Cyperus sp.*	Cyperaceae	x	x
Letsiri-le-lenyenyane	*Pentaschistis galpinii*	Poaceae	x	
Ngope sets'oha/Tlhapi-e-kholo	*Geranium multisectum*	Geraniaceae	x	x
Lecha-feela	*Eumorphia prostrata*	Compositae	x	
Gause grass	*Catalepis gracillis*	Poaceae	x	
Pheshoana ea loti	*Helichrysum trilineatum*	Compositae	x	
Pulumo-ts'oeu	*Helichrysum psilolepis*	Compositae	x	
Khamakhamane	*Rumex lanceolatus*	Polygonaceae		x
'Morobei	*Rosa rubiginosa*	Rosaceae		x
Lesuoane	*Carex cognata*	Cyperaceae		x
Pheho-la-khoho	*Conyza pinnata*	Compositae		x
Bolila	*Oxalis obliguifolia*	Oxalidaceae		x
Ngoakane-ea-mekhoabo	*Senecio polypodon*	Compositae		x
Molula	*Eragrostis plana*	Poaceae		x

Lehlomane	*Senecio erubescens*	Compositae	x
Qoqothoane	*Mariscus congestus*	Cyperaceae	x
Khotolia	*Senecio harveyanus*	Compositae	x
Mocheha-Thaha	*Pennisetum sphacelata*	Compositae	x
Moelela	*Tulbaghia acutiloba*	Alliaceae	x
Letjotjo	*Ficinia filiformis*	Cyperaceae	x
Leanya-poli	*Diclis rotundifolia*	Scrophulariaceae	x
Manku-a-maholo	*Conyza podocephala*	Compositae	x
Lebato	*Senecio isatideus*	Compositae	x
Moroko	*Trifolium burchellianum*	Fabaceae	x
Koae ea makhoaba	*Unknown 4*	Lycoperdaceae	x
Lekhala	Aloe sp.	Asphodelaceae	x
Lekolulo	*Solanum sp.*	Solanaceae	x
Mohalalitoe	*Zantedeschia albomaculata*	Araceae	x
Maseema	*Gymnopentzia bifurcata*	Compositae	x
Mohlatsisa	*Euphorbia striata*	Euphorbiaceae	x
Lethepu	*Dierama latifolium*	Iridaceae	x
Sebea-mollo	*Senecio macrocephalus*	Compositae	x
Papasane	*Rorippa nudiascula*	Cruciferae	x
Bohome	*Cynoglossum hispida*	Boraginaceae	x
Khapumpu	*Eucomis autumnalis*	Hyacinthaceae	x
Mosikanokana	*Gomphostigma virgatum*	Loganiaceae	x
Putsoa-pululu	*Arctotis arctotoides*	Compositae	x
Tsika-metsi/Bolibana	*Limosella major*	Scrophulariaceae	x
Qoqothoane	*Mariscus congestus*	Cyperaceae	x
Kholane	*Brachiaria eruciformis*	Poaceae	x
Mo-ara-metsi	*Crassula galpinii*	Crassulaceae	x
Tlhapi-ea-metsi-e-nyenyane	*Ranunculus meyeri*	Ranunculaceae	x
C. hispida	*Cotula hispida*	Compositae	x
Molepelle/Ntlo-ea-mokhoabane	*Helichrysum confertum*	Compositae	x
Star flower	*Rhodohypoxis deflexa*	Hypoxidaceae	x
Sekolana/Nyokoana-ea-likhoho	*Eriocaulon dregei*	Eriocaulaceae	x
Lijo tsa noko	*Ornithogalum juncifolium*	Hyacinthaceae	x
Lirulello	*Eumorphia prostrata*	Compositae	x
Molalahlolo	*Merxmuellera stereophylla*	Poaceae	x
Star flower	*Rhodohypoxis deflexa*	Hypoxidaceae	x
Letsiri-la-mekhoabo	*Festuca scabra*	Poaceae	x

Families with highest recorded species frequency included *Compositae, Poaceae* and *Cyperacea.* These accounted for 20%, 9% and 12% of total recorded species during the wet season and 18%, 14% and 14% during the dry season (see Figure 4.3).

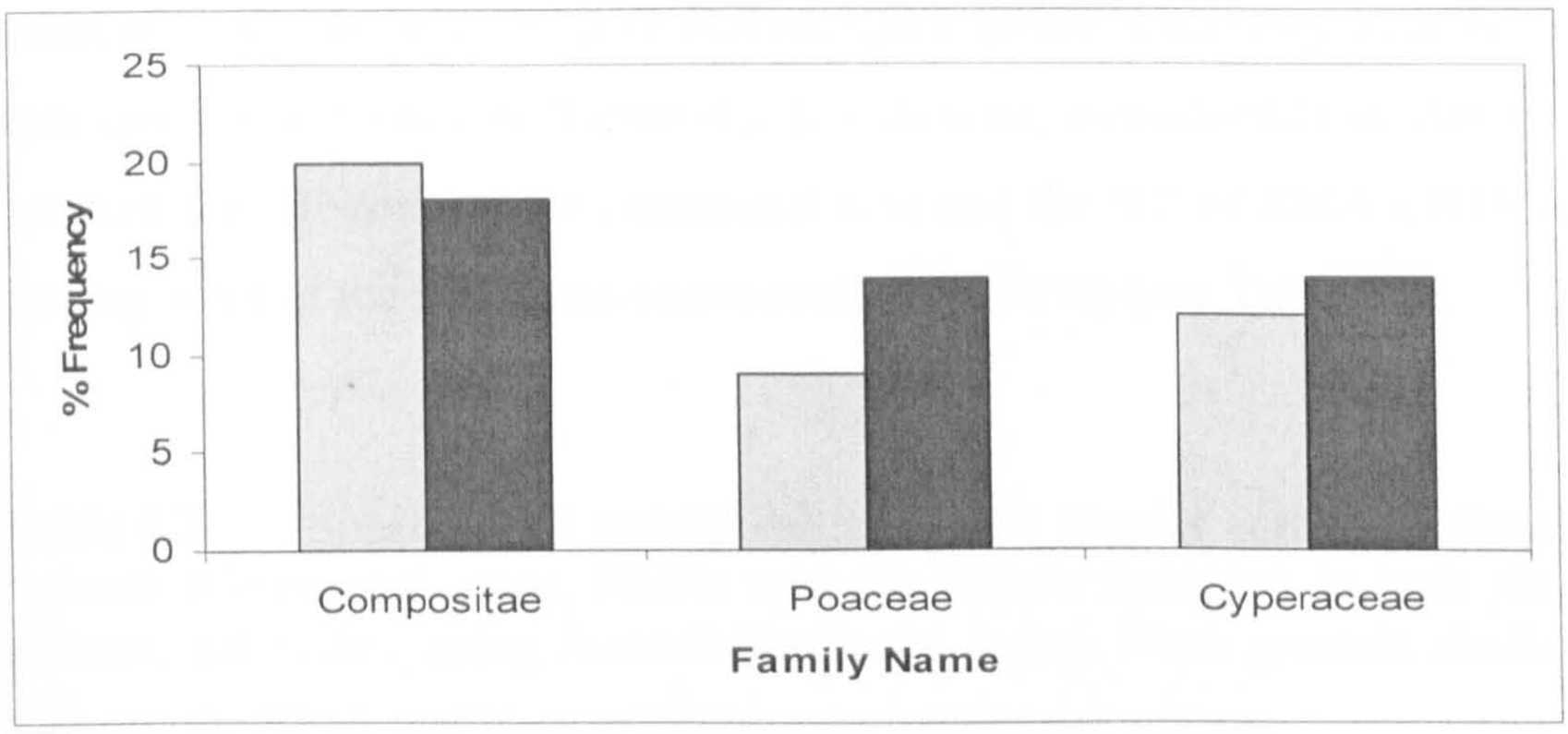


Figure 4.3. Species distribution (%) within the three dominant families across the 29 sampled wetlands during both the wet (shaded grey) and dry (black shading) season. n = 109

The distribution and composition of plant species across the three management regimes are presented in Appendix 4.1. Generally, vegetation of wetlands located at the Bokong Nature Reserve was found to be short, cushion forming species, dominated in some areas by the moss (*Bryum* sp.), Tika-Metsi (*Limosella major*) and/or Joang ba matsa (*Potamegoten pusillus*). These mainly occurred at saturated points. The rest of the periphery of the wetland comprise a zone dominated by tussocks of either Lesuoane (*Carex cognata*), Rororo (*Juncus glaucus*), both and other higher plants. Wetlands in these region were relatively flat, some with standing water and typical aquatic vegetation such as Lijo-tsa-lihohoana (*Aponogeton junceus*) The most frequently recorded species in this regime, during the dry season comprises of Rororo (*Juncus glaucus*), Joang-ba-matša (*Potamogeton pusilis)* and Phefo (*Helichrysum flanagai*). Highly recorded species during the wet season included Mosikanokana (*Gomphostigma virgatum),* Motabatabane (*Pycreus nitidus*) and Marama-a-baroetsana (*Sebaea marlothii).*

Within the communal regime and lower levels of RMA, wetlands were more grass/sedge dominated, mainly Moseha (*Merxmuellera spp.)* Rororo (*Juncus glaucus)* and Koena-ea-liliba *(Mentha aquatica).* However, the RMA regime portrayed some

similarities with both the Nature Reserve and communal areas in terms of species composition. For example, species such as Joang-ba-matša (*Potamogeton pusilis)* found within the nature reserve was also common in RMA. Rororo (*Juncus glaucus)* and Lesouoane (*Carex cognata)* were the only species common to all regimes. Jaccard's index showed the nature reserve species had a greater similarity with those of the RMA than communal areas (see Tables 4.2). Likewise, considerable similarity was depicted between the 'B' zone of the communal area and the 'C' of RMA (38%) as well as 'C' grazing areas of the RMA and communal areas (41%) (see Table 4.3).

Table 4.2 Similarity of overall wetland plant species across the three management regimes (Communal areas, RMAs and the Nature Reserve) in both the wet and dry seasons, calculated using Jaccard Similarity Index. Note greatest similarity observed between the RMA and Nature Reserve during the wet season.

		Communal		RMA		Nature Reserve	
		wet	dry	wet	dry	wet	dry
Communal	wet		0.37	0.36	0.19	0.16	0.16
	dry			0.239	0.32	0.15	0.16
RMA	wet				0.4	0.37	0.16
	dry					0.15	0.36
Nature Reserve	wet						0.23
	dry						

Table 4.3 Overall wetland plant species similarity across grazing zones A, B and C between communal and RMA regimes, using Jaccard Similarity Index

RMA

Communal		A		B		C	
		wet	dry	wet	dry	wet	dry
A	wet	0.2	0.19	0.1	0.19	0.15	0.18
	dry	0.10	0.16	0.14	0.15	0.20	0.24
B	wet	0.28	0.08	0.12	0.08	0.17	0.21
	dry	0.05	0.21	0.14	0.21	0.21	0.38
C	wet	0.20	0.15	0.18	0.19	0.41	0.34
	dry	0.14	0.27	0.16	0.21	0.33	0.37

4.5.2 Distribution of key livelihood species across management regimes

Of the 109 species identified during the study, the following ten were identified as important for local livelihoods (see Table 4.5).

Table 4.4. List of wetland plants prioritised by community members as key livelihood species in Pelaneng-Bokong study area

Local name	Species	Family	Use
Moseha	*Merxmuellera drakensbergensis/distichita*	Poaceae	Handicrafts, fodder, construction, fuelwood
Loli	*Scripus ficinoides*	Cyperaceae	Handicrafts
Rororo	*Juncus glaucus*	Juncaceae	Handicrafts, fodder
Lesuoane	*Carex cognata*	Cyperaceae	Fodder, handicrafts
Thita-poho	*Fingerhuthia sesleformis*	Poaceae	Handicrafts
Koena-ea-liliba	*Mentha aquatica*	Labiatae	Medicinal
Tlhapi	*Ranunculus multifidus*	Ranunculaceae	Medicinal
Khamakhamane	*Rumex lanceolatus*	Polygonaceae	Medicinal
Selae/Semetsing	*Rorippa narstutium aquaticum*	Cruciferaae	Food
Qobo	*Gunnera perpensa*	Gunneraceae	Medicinal

As shown in Figure 4.4 a) and b), key livelihood species were poorly represented in the nature reserve during both seasons. For example, of the ten key livelihood species, only two, namely Rororo (*Juncus glaucus*) and Lesuoane *(Carex cognata*) were encountered in this regime. On the other hand, even though these species were dominant in both the RMA and communal areas, they were more pronounced within the RMA. Exceptions to this pattern however were two medicinal plants, Khamakhamane (*Rumex lanceolatus*) and Kuena (*Mentha Aquatica)* which were more prevalent in communal wetlands than RMA in both seasons. Similarly, Thitapoho (*Fingerhuthis sesleformis),* was present in communal but absent in RMA. In contrast, Lesuoane (*Carex cognata)*, was virtually identical in both regimes during the wet season

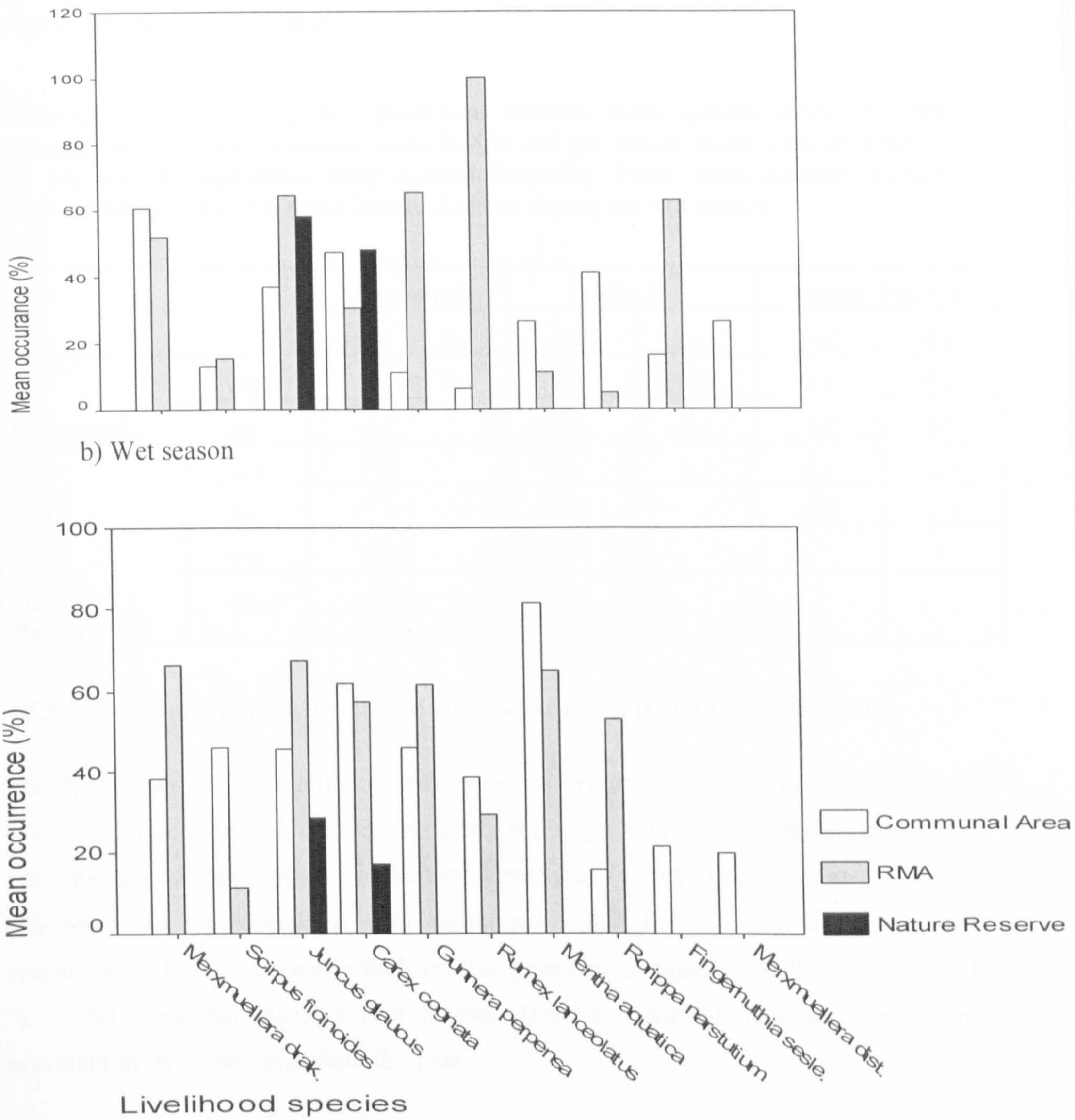


Figure 4.4 Occurrence (measured as % presence in quadrat) of key livelihood species across the communal areas, RMA and Bokong Nature Reserve in a) dry season and b) wet season. Number of quadrats examined, minimum and maximum species encountered and species richness per quadrat are shown on Table 4.8

As seen in Table 4.5, composition of key livelihood species in Bokong Nature Reserve during both the dry and wet season was virtually the same. Equally high, were the degree of similarity in species composition between the communal area wet and dry season (90%) as well as communal and RMAs (90%). Conversely, key livelihood

species composition was markedly different in Bokong Nature Reserve (20%) than the other two management regimes.

Table 4.5 Similarity of key livelihood wetland plant species across the three management regimes (Communal areas, RMAs and the Nature Reserve) in both the wet and dry seasons, calculated using Jaccard Similarity Index. Note greatest similarity observed between the RMA and Nature Reserve during the wet season.

		Communal		**RMA**		**Nature Reserve**	
		wet	dry	wet	dry	wet	dry
Communal	wet		0.9	0.9	0.2	0.2	0.2
	dry			0.9	0.9	0.2	0.2
RMA	wet				0.2	0.2	0.2
	dry					0.2	0.2
Nature Reserve	wet						1
	dry						

4.5.3 Distribution of key livelihood species across A, B and C grazing zones

The distribution of key livelihood species across grazing zones is presented in Figure 4.5. Floristic composition differed markedly across grazing zones in different seasons. For instance fodder plants including Lesuoane (*Carex cognata)* and Moseha (*Merxmuellera spp.)* occurred more frequently within the 'C' zone during the dry season, while in the wet season both species were almost equally distributed in 'B' and 'C'. All medicinal plants except Koena (*Mentha aquatica),* however were more prevalent in 'B' zone throughout the year.

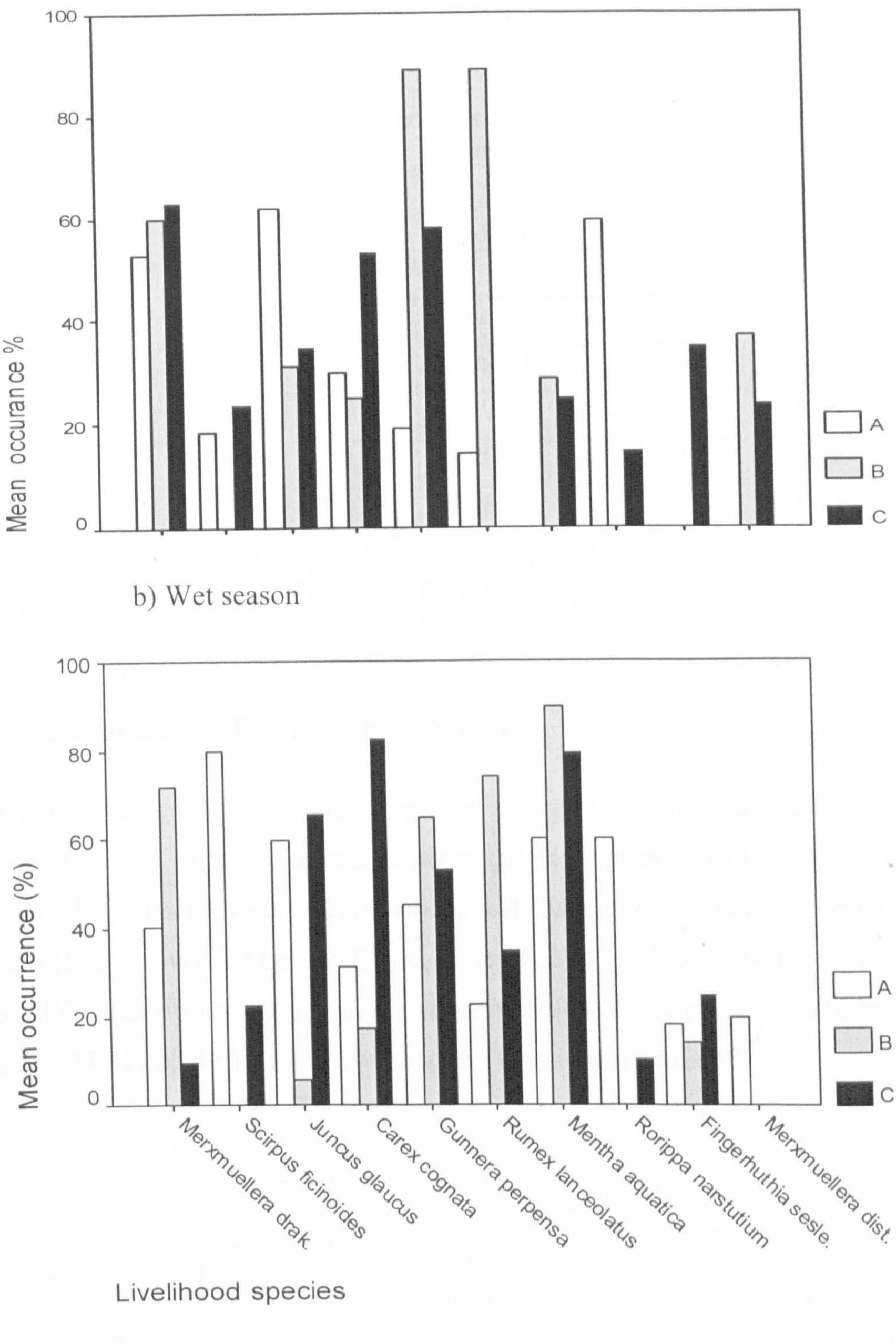


Figure 4.5 Distribution of Key Livelihood Species (occurrence per quadrat) across the A, B and C Grazing Zones in a) dry season and b) wet season. Number of quadrats examined, minimum and maximum species encountered and species richness per quadrat are show on Table 4.7.

The degree of similarity in key livelihood between three grazing zones in wetlands located between the RMA and communal areas, measured using Jaccard's index of

similarity are presented on Table 4.6. The greatest similarity was between 'C' regions in both seasons.

Table 4.6 Similarity of key livelihood species composition across grazing zones A, B and C between communal and RMA regimes, measured using The Jaccard Similarity Index

		RMA					
Communal		**A**		**B**		**C**	
		wet	dry	wet	dry	wet	dry
A	wet	0.4	0.6	0.4	0.6	0.6	0.6
	dry	0.4	0.57	0.43	0.6	0.55	0.55
B	wet	0.28	0.28	0.33	0.13	0.09	0.33
	dry	0.28	0.28	0.33	0.28	0.33	0.33
C	wet	0.44	0.44	0.33	0.3	0.77	0.77
	dry	0.5	0.5	0.4	0.33	0.66	0.67

4.5.4 Abundance of Key Livelihood Species

The abundance of key livelihood species across the communal, RMA and Bokong Nature Reserves in both seasons is presented in Figures 4.6 (a) and (b). Of the ten livelihood species Moseha (Merxmuellera drakensbergensis), was the most abundant in the dry [Kruskal Wallist test, n=73,Chi Square=22.596, df=6, p=.001] as well as the wet season[Kruskal wallis test, n=76, chi square=16.484, df=5, p=.006], with highest mean ranks of 37.75 and 47.19 for the wet and dry season respectively.

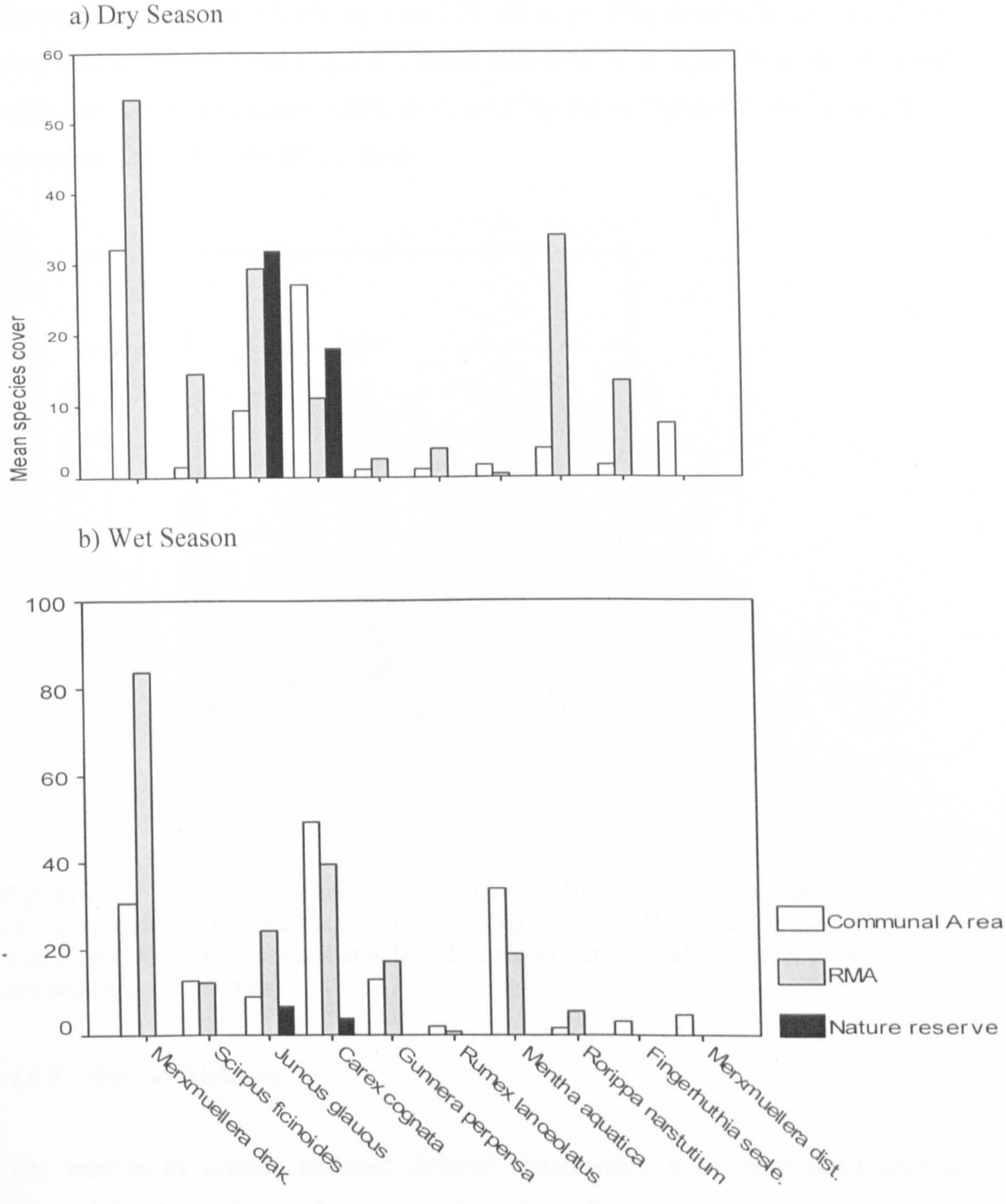


Figure 4.6 Variations in abundance of key livelihood species across the three management regimes in a) dry and b) wet seasons

Abundance level of key livelihood species was also compared across the grazing zones A, B and C in both the dry and wet season (see Figure 4.7). Results of Kruskal-Wallis tests revealed no significant difference in livelihood species abundance across regimes during both wet [Kruskal-Wallis test, n=76, chi square=1.969, df=2, p=.373] and dry

[Kruskal-Walis test, n=73, chi square=.277, df=1, p=.599] season. Similarly, species cover within the A, B and C grazing zones tended to be comparable in dry [Kruskal-wallis test, n=73, chi square=.2.891, df=2, p=.236] and wet [Kruskal-Wallis test, n=76, chi square=.276, df=2, p=.871] season.

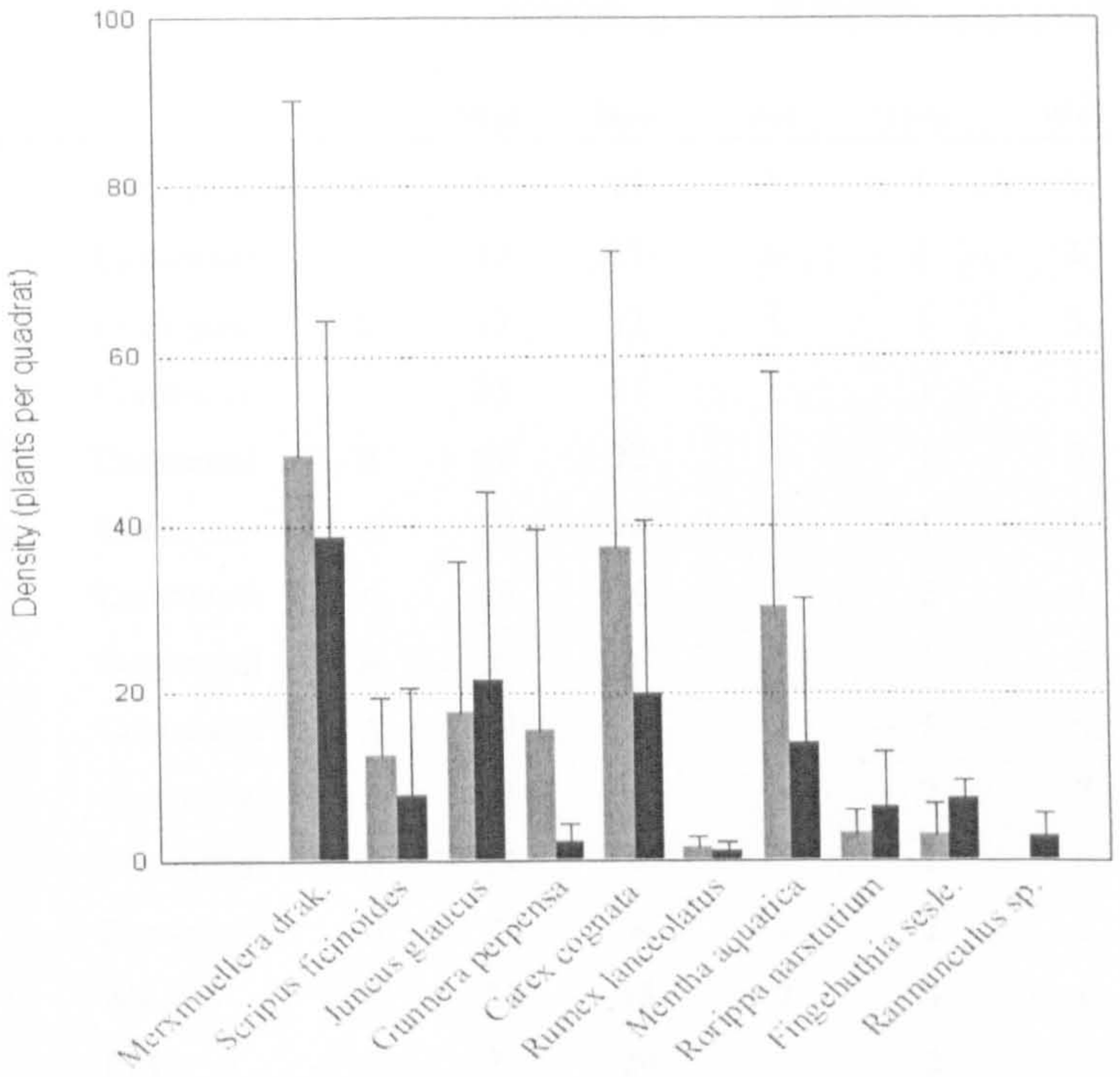


Figure 4.7 Variation in abundance of key livelihood species (measured as number of individuals per quadrat) across the Grazing zones A, B and C during both dry and wet season. Error bars show 2 standard deviation (wet season is represented by grey and dry season by black bars)

4.5.5 Species Richness

The number of species recorded differed considerably between wetland sites and between seasons, with the highest overall species richness being the in 'C' grazing zone during the wet season and 'A' in the dry season (see Table 4.7). For example, during the wet season, the highest number of species (23) was recorded in Setibi, located in 'C' zone of the RMA while during the dry season, the wetland sites that recorded the highest number of species was RMA Nature Reserve Border in 'A' region.

Table 4.7 Overall species richness and similarities between the wet and dry season calculated using The Jaccard's Index of Similarity in 29 wetlands, including number of quadrats examined, minimum and maximum number of species encountered per quadrat across the three management regimes in Pelaneng-Bokong.

Wetland Site	Regime	Zone	No. of quadrats		Minumum no. of species		Maximum no. of species		Species Richness		
			Wet	Dry	wet	Dry	Wet	Dry	Wet	Dry	Similarity Index
Perekising	Communal	C	13	13	1	1	8	8	21	14	0.3
Boritsana	Communal	C	13	17	1	1	3	4	12	12	0.09
Tlholo1	Communal	C	17	17	1	1	5	5	11	14	0.31
Tlholo 2	Communal	C	25	25	1	1	7	8	14	12	0.3
Boritsa 3	Communal	B	22	22	1	1	5	5	12	8	0.3
Lesaoana1	Communal	A	10	10	1	1	5	5	16	5	0.16
Lesaoana2	Communal	A	10	10	1	2	4	7	15	9	0.26
Boritsa 1	Communal	A	6	5	1	1	3	3	4	3	0.4
Boritsa 2	Communal	A	19	19	1	1	6	7	13	9	0.37
Mahlasela	Communal	A	15	17	3	2	7	5	16	19	0.09
Fanana1	Communal	A	11	4	1	5	6	5	22	12	0.2
Fanana2	Communal	A	2	4	1	2	5	7	6	14	0.05
Sebotha	RMA	C	20	18	2	3	6	3	5	6	0.57
Setibi	RMA	C	20	20	2	2	5	6	23	11	0.3
Mokhoulane1	RMA	B	27	27	4	4	6	6	8	9	0.41
Mokhoulane2	RMA	B	15	15	#	14	14	14	16	13	0.18
Thabang 1	RMA	A	17	17	1	2	2	2	9	4	0.18
Thabang 2	RMA	A	10	10	2	2	5	5	11	8	0.11
Thabang 3	RMA	A	15	16	1	1	4	4	8	17	0.4
Selingoana 1	RMA	A	16	16	3	3	5	5	6	8	0.4
Selingoana 2	RMA	A	18	18	2	2	4	4	6	6	0.3
Selingoana 3	RMA	A	12	12	4	4	5	5	8	11	0.12
Bokong 3	RMA	A	39	39	2	2	3	3	6	5	0.37
RMA Border	RMA	A	34	34	3	3	6	5	10	20	0.25
Bokong RMA	RMA	A	18	20	3	3	6	7	13	9	0.38
Mafikalisiu 1	Reserve	A	13	13	3	3	10	10	16	12	0.22
Mafikalisiu 2	Reserve	A	17	17	2	2	5	5	10	8	0.2
Bokong 1	Reserve	A	24	24	1	1	6	6	10	9	0.46
Bokong 2	Reserve	A	33	33	1	1	6	6	12	8	0.18

Similar intersite differences in species richness were noted for livelihood species. In this case highest species richness was recorded in 'C', lowest in 'A' and absent within the nature reserve (Table 4.8). For instance, the wetland site with the lowest number of

species within the 'A' regions and accounted for 24% while wetlands with no livelihood species constituted 7% and 10% during the wet and dry season respectively.

Table 4.8 Key livelihood species richness and similarities between the wet and dry season calculated using The Jaccard's Index of Similarity in 29 wetlands, including number of quadrats examined, minimum and maximum number of species encountered per quadrat across the three management regimes in Pelaneng-Bokong

Wetland Site	Regime	Zone	No. of quadrats		Minimum no. of species		Maximum no. of species		Species Richness		Similarity Index
			Wet	Dry	wet	Dry	Wet	Dry	Wet	Dry	
Perekising	Communal	C	13	13	1	1	8	8	9	3	0.33
Boritsana	Communal	C	13	17	1	1	3	4	6	4	0.42
Tlholo1	Communal	C	17	17	1	1	5	5	3	4	0.4
Tlholo 2	Communal	C	25	25	1	1	7	8	6	7	0.6
Boritsa 3	Communal	B	22	22	1	1	5	5	5	5	0.6
Lesaoana1	Communal	A	10	10	1	1	5	5	6	2	0.14
Lesaoana2	Communal	A	10	10	1	2	4	7	4	2	0.5
Boritsa 1	Communal	A	6	5	1	1	3	3	1	1	1
Boritsa 2	Communal	A	19	19	1	1	6	7	3	3	1
Mahlasela	Communal	A	15	17	3	2	7	5	1	4	0.25
Fanana1	Communal	A	11	4	1	5	6	5	2	2	0.3
Fanana2	Communal	A	2	4	1	2	5	7	2	2	1
Sebotha	RMA	C	20	18	2	3	6	3	3	6	0.5
Setibi	RMA	C	20	20	2	2	5	6	5	7	0.7
Mokhoulane1	RMA	B	27	27	4	4	6	6	3	4	0.75
Mokhoulane2	RMA	B	15	15	14	14	14	14	3	3	0.5
Thabang 1	RMA	A	17	17	1	2	2	2	2	1	0.5
Thabang 2	RMA	A	10	10	2	2	5	5	2	2	0.5
Thabang 3	RMA	A	15	16	1	1	4	4	1	1	0
Selingoana1	RMA	A	16	16	3	3	5	5	2	1	0
Selingoana2	RMA	A	18	18	2	2	4	4	1	1	1
Selingoana3	RMA	A	12	12	4	4	5	5	3	4	0.4
Bokong 3 RMA	RMA	A	39	39	2	2	3	3	1	2	0.5
RMA Border	RMA	A	34	34	3	3	6	5	1	1	1
Bokong RMA	RMA	A	18	20	3	3	6	7	2	1	0.5
Mafikalisiu 1	Reserve	A	13	13	3	3	10	10	0	0	0
Mafikalisiu 2	Reserve	A	17	17	2	2	5	5	0	0	0
Bokong 1	Reserve	A	24	24	1	1	6	6	1	0	0
Bokong 2	Reserve	A	33	33	1	1	6	6	2	2	1

The degree of similarity in species composition and richness between the wet and dry season computed through the Jaccard's Index of similarity is presented in Tables 4.7 and 4.8 for overall and livelihood species respectively. For the former, similarity was generally low, ranging from 5% to 57%. However, wetland sites located within the 'A' region portrayed relatively higher similarity of ≥40%. In contrast, livelihood species recorded higher similarity with 45% ≥40% and 20% virtually similar. Similarly, wetland sites in 'A' showed the greatest similarity.

On the other hand plant species encountered within the B and C grazing zone wetlands displayed relatively higher similarity than those found in A. For instance, 66% of species within both C and B zones displayed a similarity ranging between 30 and 50%. Conversely in A zone, only 40% of plant species displayed the same similarity.

4.5.6 Proportion of key livelihood species across the three regimes

As portrayed in Tables 4.9 and 4.10, the 'B' and 'C' zone had the highest proportion of livelihood species, particularly during the dry season. Conversely, the 'A' zone had the lowest.

Table 4.9 Proportion of key livelihood to overall species richness across grazing zones A, B and C in communal, RMA and Bokong Nature Reserve management regimes during the dry season

Zone	Communal			RMA			Nature reserve		
	Overall species richness (o)	Livelihood Species (p)	p/o	Overall species richness (o)	Livelihood Species (p)	p/o	Overall species	Livelihood Species (p)	p/o
A	32	7	0.2	26	4	0.2	19	2	0.1
B	8	5	0.6	15	4	0.3	-	-	-
C	26	8	0.3	11	7	0.6	-	-	

Table 4.10 Proportion of key livelihood to overall species richness across grazing zones A, B and C in communal, RMA and Bokong Nature Reserve management regimes during the dry season

Zone	Communal			RMA			Nature reserve		
	Overall species richness (o)	Livelihood Species (p)	p/o	Overall species richness (o)	Livelihood Species (p)	p/o	Overall species	Livelihood Species (p)	p/o
A	48	7	0.1	30	5	0.2	13	2	0.2
B	12	5	0.4	17	3	0.2			
C	28	9	0.3	27	7	0.3			

4.5.7 Species Disturbance Levels

Five species indicating disturbance or degradation were identified across 27/29 (93%) wetlands surveyed, with more prevalence of disturbance during the dry (79%) than wet season (69%) (see Table 4.11). However, the difference between season was found to be non significant [Mann-Whitney U test, n=29, Z=-.267, p=.79].

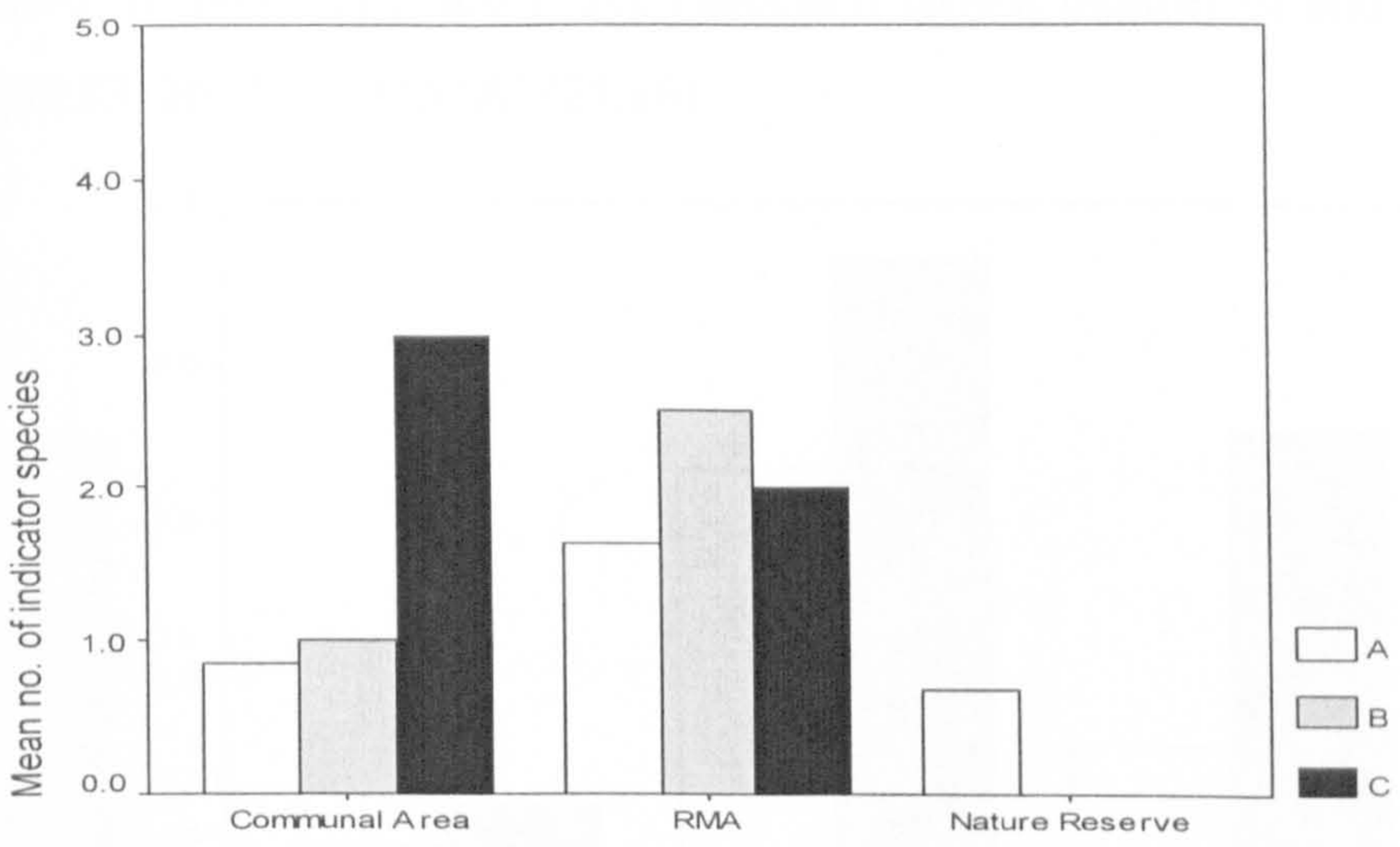
Table 4.11 The number of indicator species encountered and similarities between the wet and dry season calculated using The Jaccard's Index of Similarity in 29 wetlands, including number of quadrats examined, minimum and maximum number of species encountered per quadrat across the three management regimes in Pelaneng-Bokong

Wetland Site	Regime	Zone	No. of quadrats		Minimum no. of species		Maximum no. of species		Disturbance Level		
			Wet	Dry	wet	Dry	Wet	Dry	Wet	Dry	Similarity Index
Perekising	Communal	C	13	13	1	1	8	8	4	5	0.8
Boritsana	Communal	C	13	17	1	1	3	4	1	3	0.3
Tlholo1	Communal	C	17	17	1	1	5	5	3	3	0.5
Tlholo 2	Communal	C	25	25	1	1	7	8	0	1	0
Boritsa 3	Communal	B	22	22	1	1	5	5	0	1	0
Lesaoana1	Communal	A	10	10	1	1	5	5	1	0	0
Lesaoana2	Communal	A	10	10	1	2	4	7	2	1	0.5
Boritsa 1	Communal	A	6	5	1	1	3	3	1	1	1
Boritsa 2	Communal	A	19	19	1	1	6	7	4	4	0.6
Mahlasela	Communal	A	15	17	3	2	7	5	0	0	0
Fanana1	Communal	A	11	4	1	5	6	5	0	0	0
Fanana2	Communal	A	2	4	1	2	5	7	0	1	0
Sebotha	RMA	C	20	18	2	3	6	3	1	0	0
Setibi	RMA	C	20	20	2	2	5	6	3	2	0.6
Mokhoulane1	RMA	B	27	27	4	4	6	6	1	2	0.5
Mokhoulane 2	RMA	B	15	15	14	14	14	14	2	3	0.6
Thabang 1	RMA	A	17	17	1	2	2	2	1	1	0
Thabang 2	RMA	A	10	10	2	2	5	5	0	2	0
Thabang 3	RMA	A	15	16	1	1	4	4	1	2	0.5
Selingoana 1	RMA	A	16	16	3	3	5	5	2	2	1
Selingoana 2	RMA	A	18	18	2	2	4	4	2	2	0.3
Selingoana 3	RMA	A	12	12	4	4	5	5	0	1	0
Bokong 3 RMA	RMA	A	39	39	2	2	3	3	0	0	0
RMA Border	RMA	A	34	34	3	3	6	5	1	1	1
Bokong RMA	RMA	A	18	20	3	3	6	7	1	1	1
Mafikalisiu 1	Nature res.	A	13	13	3	3	10	10	3	2	0.6
Mafikalisiu 2	Nature res.	A	17	17	2	2	5	5	0	1	0
Bokong 1	Nature res.	A	24	24	1	1	6	6	1	0	0
Bokong 2	Nature res.	A	33	33	1	1	6	6	0	1	0

As seen on Figure 4.8, the 'C' zone displayed the highest disturbance levels, 'B' moderate and 'C' the lowest disturbance levels, [Kruskal-Wallis test, n=29, chi square=10.899, df=2, p=.004] with 'C' having the highest mean rank (21.80) and 'A'

the lowest (10.28). Exceptions to this trend were Mahlasela and Mafikalisiu wetlands, both within the 'A' zone with relatively high disturbance levels. Compared to the other management regimes, the communal area had the highest number of species indicating disturbance [Kruskal-Wallis test, n=29, chi square=8.024, df=2, p=.018]. An inspection of mean ranks for the management regimes also portrayed the communal area (17.94) as most highly disturbed and Bokong nature reserve as the lowest (6.67).

a) Dry Season



b) Wet season

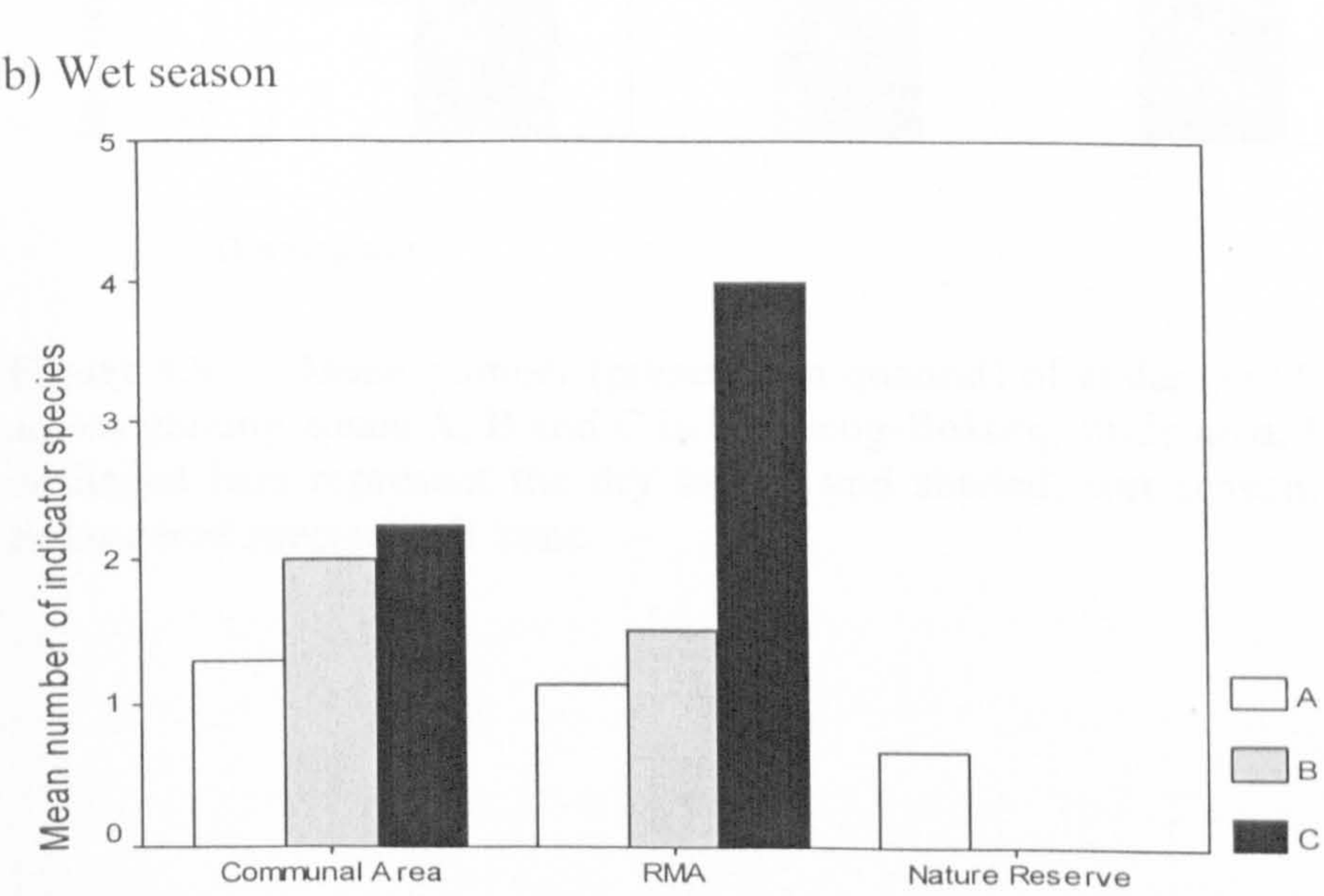


Figure 4.8 Mean number of disturbance indicator species across the grazing zones A, B and C in Communal, RMA and Bokong Nature Reserve management regimes in a) dry season and b) wet season

4.5.8 Endangered Species

Variations in the mean number of endangered species across the grazing zones, A, B, and C and communal areas, RMAs and the Nature Reserve are presented in Figure 4.9 and 4.10 respectively. Overall, endangered species were found in 18 (62%) of the 29 sampled wetlands. These species were more prevalent in wetlands located within the 'B' grazing zone [Kruskal-Wallis, n=29, Chi squared=17.382, df=2, p<.001] and also in wetlands located within communal areas [Kruskal-Wallis, n=29, Chi squared=11.951, df=2, p=.003]. The mean rank suggested largest number of endangered species in 'B' (48.83) and lowest in 'A' (24.46).

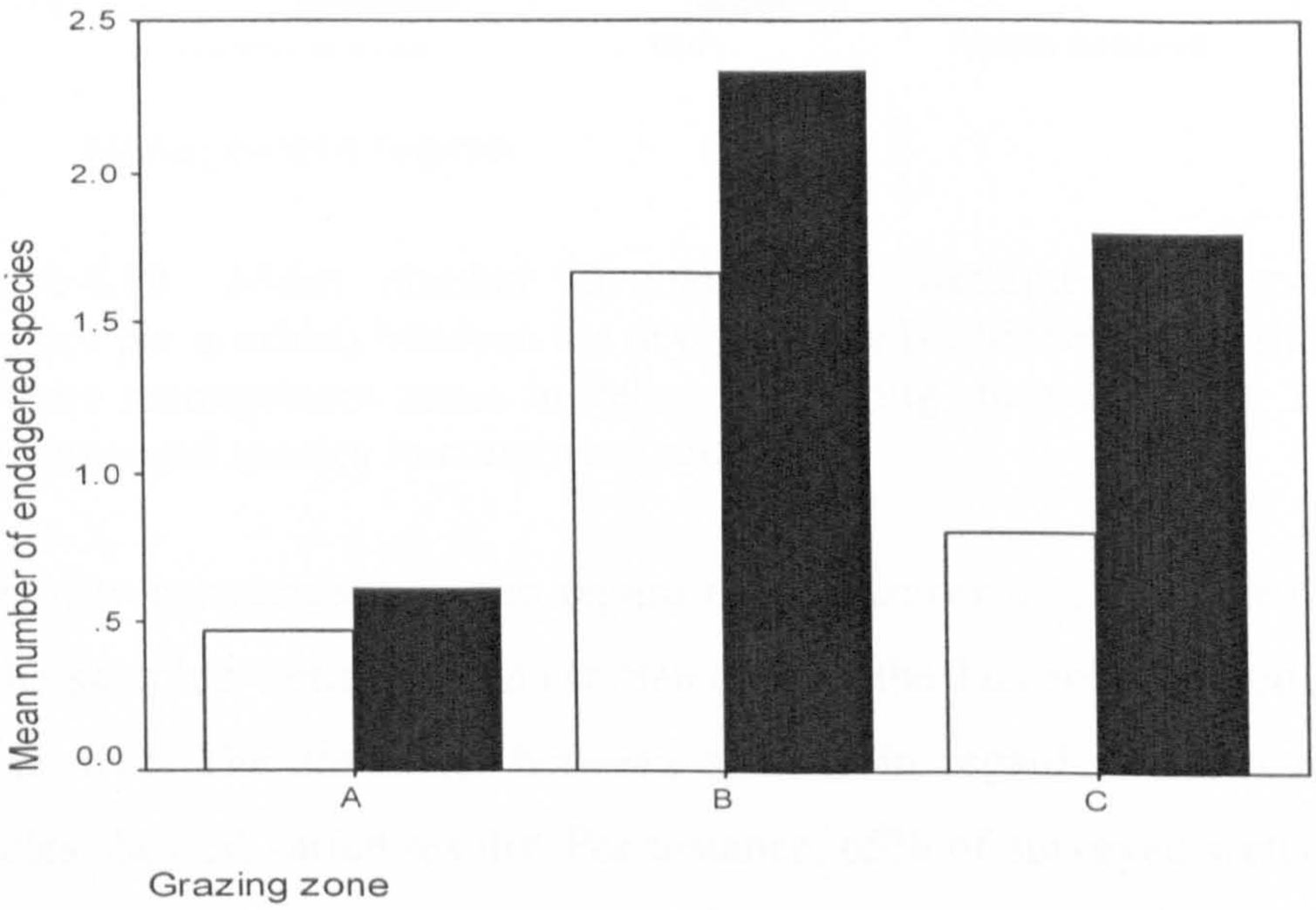


Figure 4.9 Mean number (presence in quadrat) of endangered wetland plant species across grazing zones A, B and C in Pelaneng-Bokong study area, Lesotho, (n = 29). The unshaded bars represent the dry season and shaded, wet season. Note prevalence of endangered species in B zone.

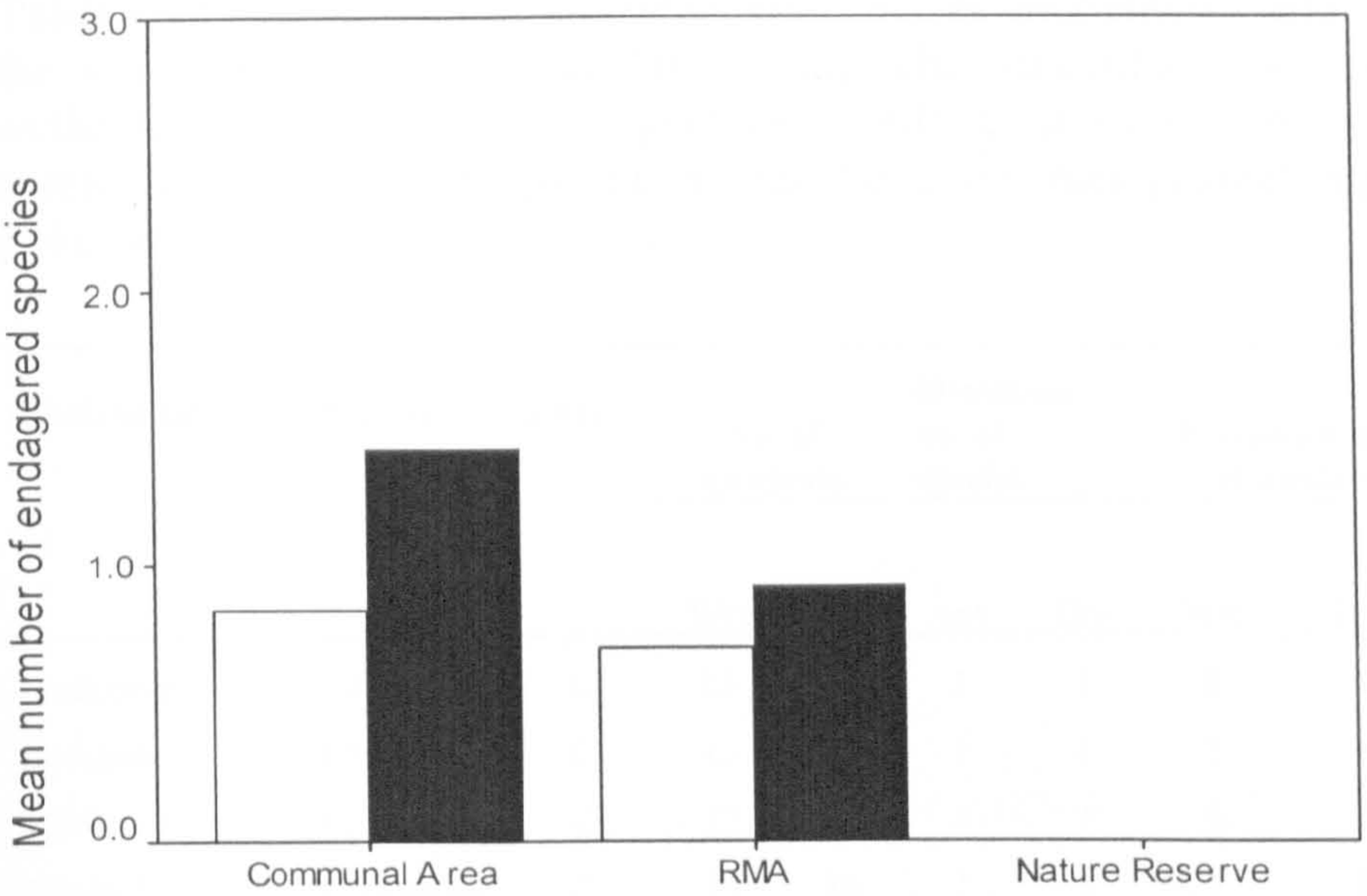


Figure 4.10 Mean number of endangered wetland plant species (measured in presence per quadrat) between the dry (unshaded) and wet (black shading) season across the three management zones in Pelaneng-Bokong study area (n = 29). Note prevalence of endangered species in communal areas.

Similarity between seasons in regard to the number of endangered species within each of the sampled wetlands was estimated using the Jaccard Similarity Index as shown in Table 4.12. The similarity between seasons in regard to the number of endangered species showed varied results. For instance, 65% of surveyed wetland sites revealed no (0%) similarity between the wet and dry seasons. However, this was due to either total absence of these species or their occurrence in either season. On one hand, in areas where endangered species occurred, the majority (78%) displayed high similarity, ranging between 0-1. On the other hand, and also note worthy was the poor representation of endangered species within the Bokong Nature reserve and the A grazing zone. For instance most (55%) wetlands within the A zone and RMA (54%) did not have any endangered species, while none of the sampled wetlands in Bokong Nature Reserve contained endangered species. In contrast, the communal areas and C grazing zone showed prevalence.

Table 4.12 The number of endangered species encountered and similarities between the wet and dry season calculated using The Jaccard's Index of Similarity in 29 wetlands, including number of quadrats examined, minimum and maximum number of species encountered per quadrat across the three management regimes in Pelaneng-Bokong

Wetland site	Regime	Zone	No. of quadrats		Minimum no. of species		Maximum no. of species		Endangered Spp.		
			Wet	Dry	wet	Dry	Wet	Dry	Wet	Dry	Similarity index
Perekising	Communal	C	13	13	1	1	8	8	3	1	0.3
Boritsana	Communal	C	13	17	1	1	3	4	3	1	0.3
Tlholo1	Communal	C	17	17	1	1	5	5	1	0	0
Tlholo 2	Communal	C	25	25	1	1	7	8	0	1	0
Boritsa 3	Communal	B	22	22	1	1	5	5	2	1	0.5
Lesaoana1	Communal	A	10	10	1	1	5	5	2	1	0.5
Lesaoana2	Communal	A	10	10	1	2	4	7	1	0	0
Boritsa 1	Communal	A	6	5	1	1	3	3	1	1	0
Boritsa 2	Communal	A	19	19	1	1	6	7	3	3	1
Mahlasela	Communal	A	15	17	3	2	7	5	0	1	0
Fanana1	Communal	A	11	4	1	5	6	5	0	1	0
Fanana2	Communal	A	2	4	1	2	5	7	1	1	1
Sebotha	RMA	C	20	18	2	3	6	3	1	1	1
Setibi	RMA	C	20	20	2	2	5	6	1	2	0.5
Mokhoulane1	RMA	B	27	27	4	4	6	6	3	2	0.6
Mokhoulane2	RMA	B	15	15	14	14	14	14	0	0	0
Thabang 1	RMA	A	17	17	1	2	2	2	1	0	0
Thabang 2	RMA	A	10	10	2	2	5	5	0	0	0
Thabang 3	RMA	A	15	16	1	1	4	4	0	0	0
Selingoana 1	RMA	A	16	16	3	3	5	5	0	0	0
Selingoana 2	RMA	A	18	18	2	2	4	4	0	0	0
Selingoana 3	RMA	A	12	12	4	4	5	5	3	2	0.6
Bokong 3 RMA	RMA	A	39	39	2	2	3	3	0	1	0
RMA Border	RMA	A	34	34	3	3	6	5	0	0	0
Bokong RMA	RMA	A	18	20	3	3	6	7	0	0	0
Mafikalisiu 1	Reserve	A	13	13	3	3	10	10	0	0	0
Mafikalisiu 2	Reserve	A	17	17	2	2	5	5	0	0	0
Bokong 1	Reserve	A	24	24	1	1	6	6	0	0	0
Bokong 2	Reserve	A	33	33	1	1	6	6	0	0	0

4.6 Discussion

This study attempted to evaluate variability in wetland plant species composition, distribution, richness and abundance in relation to the three management regime and grazing zones during both the dry and wet seasons. The work also estimated the prevalence of indicator and endangered species in an effort to assess wetland's level of disturbance. The summary of some of the key variables examined is presented on Table 4.13.

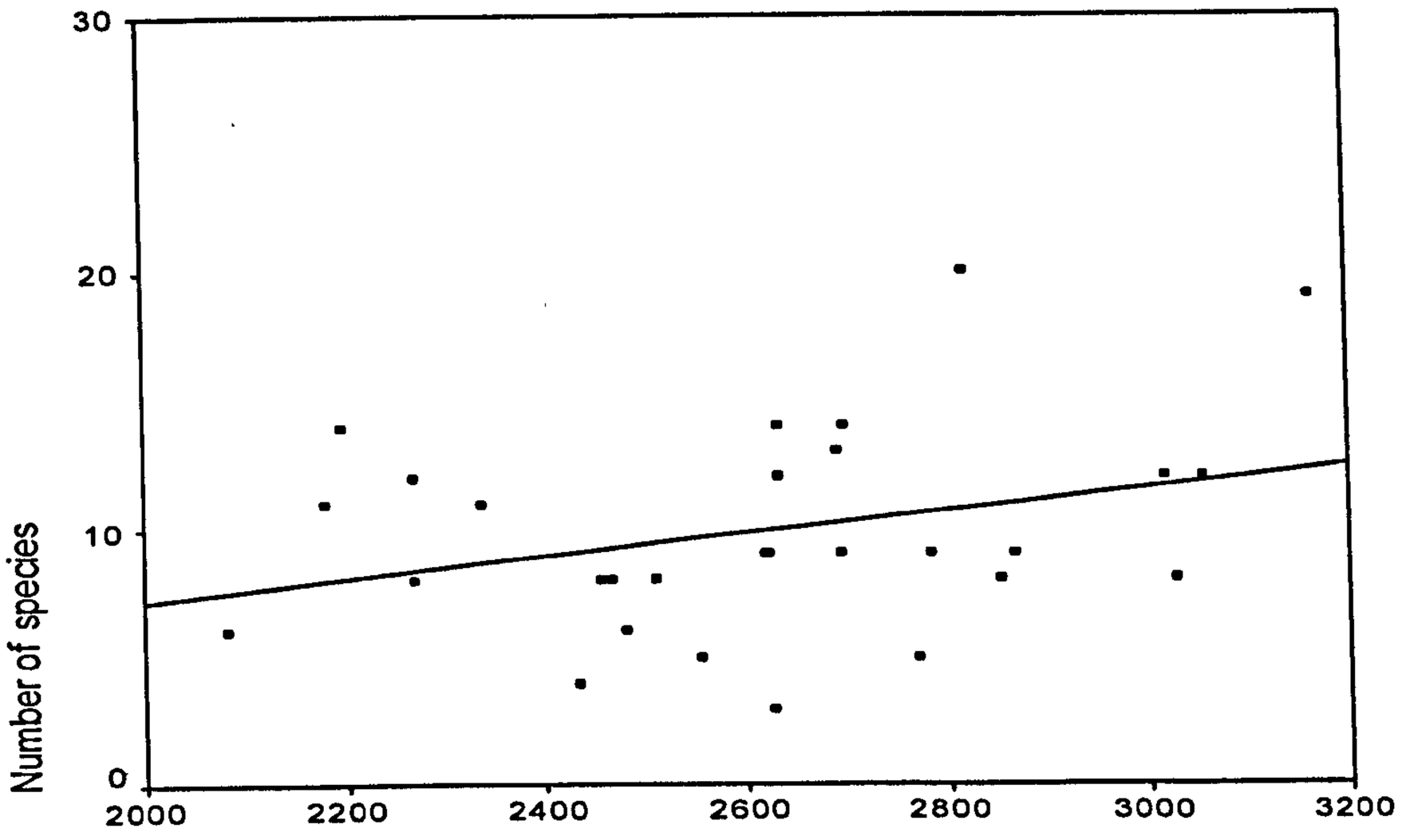
A high similarity in overall species composition and distribution was noted between RMA and Bokong nature reserve as well as between all the 'C' grazing zones. A plausible explanation to this could be that the Bokong nature reserve and 'A' zone of the RMA like the 'C' zones, are located within the same geographical and rainfall zone, thus indicating that there might be a relationship between species' occurrence rainfall. The finding regarding rainfall-correlated species occurrence somewhat corresponds with observations made by several authors on the linkages between wetland species distribution and variation in water table eg. (Van Zinderen Bakker, 1974; Marneweck andGrundling,1999; Nüsser,2002).

Table 4.13 Means of overall, key livelihood, indicator and endangered species across the 29 sampled wetlands for both seasons, within the grazing zones A, B and C and across the three management regimes in Pelaneng-Bokong study site

Zone	Communal								RMA								Nature Reserve							
	Overall species		livelihood species		Disturvance indicator species		Endangered species		Overall species		livelihood species		Disturbance indicator species		Endangered species		Overall species		livelihood species		Disturbance indicator species		endangered species	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
A	13.14	10.14	2.7	2.3	1.14	1	1.14	1.14	8.5	8.8	8.5	1.5	0.8	1.3	0.4	0.3	12	9.25	0.75	0.5	0	1		0
B	12	8	5	5	0	1	2	1	12	11	3	3.5	1.5	2.5	1.5	1								
C	14.5	13	6	4.5	2	3	1.75	0.75	14	8.5	4	6.5	2	1	1	1.5								

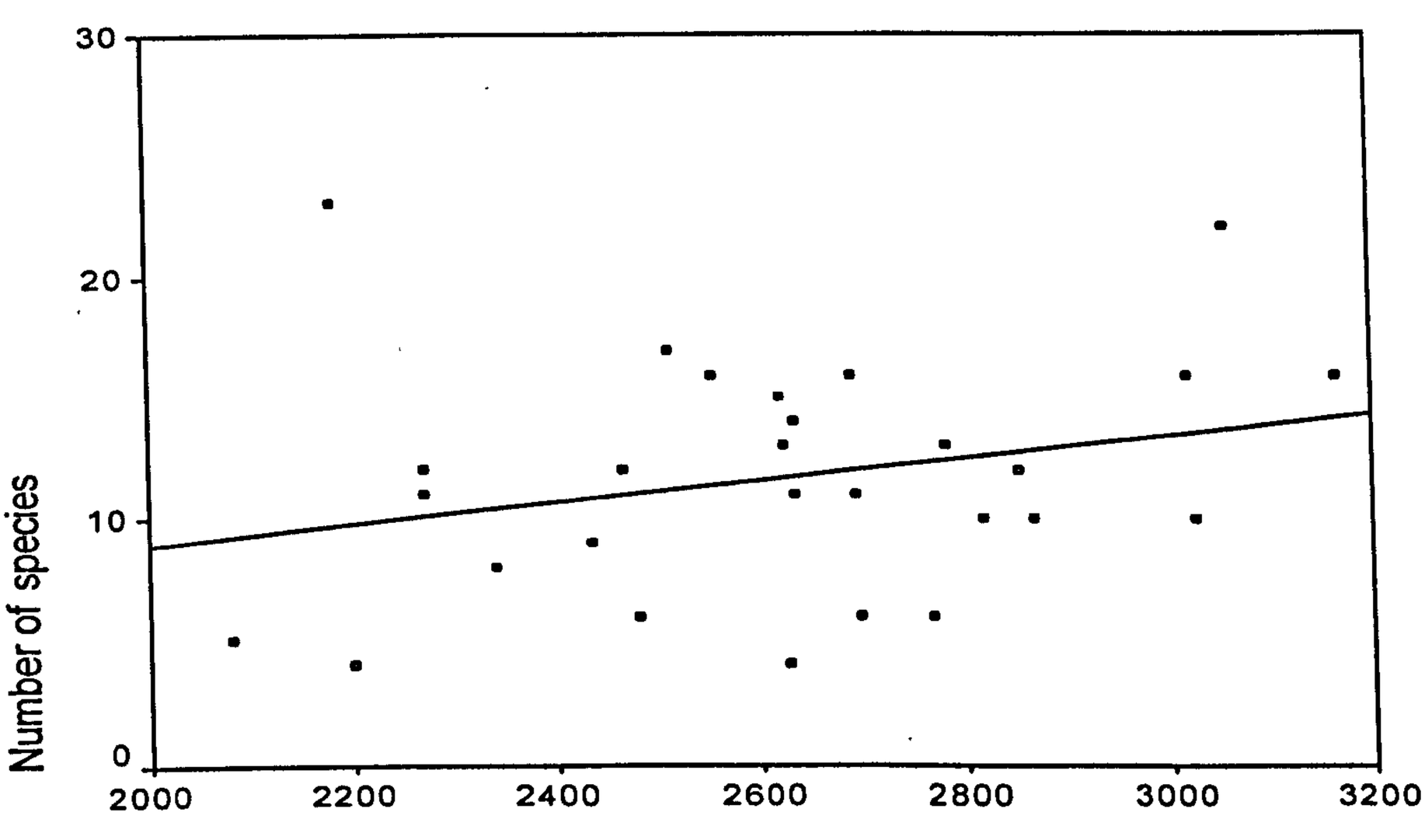
In contrast, species richness could not be explained by rainfall (See Figures 4.11 (a) and (b) and 4.12 (a) and (b).

a) Dry season



(Y=-1.385 + 4.30x, p = 0.12, r^2 = 0.087, n= 29)

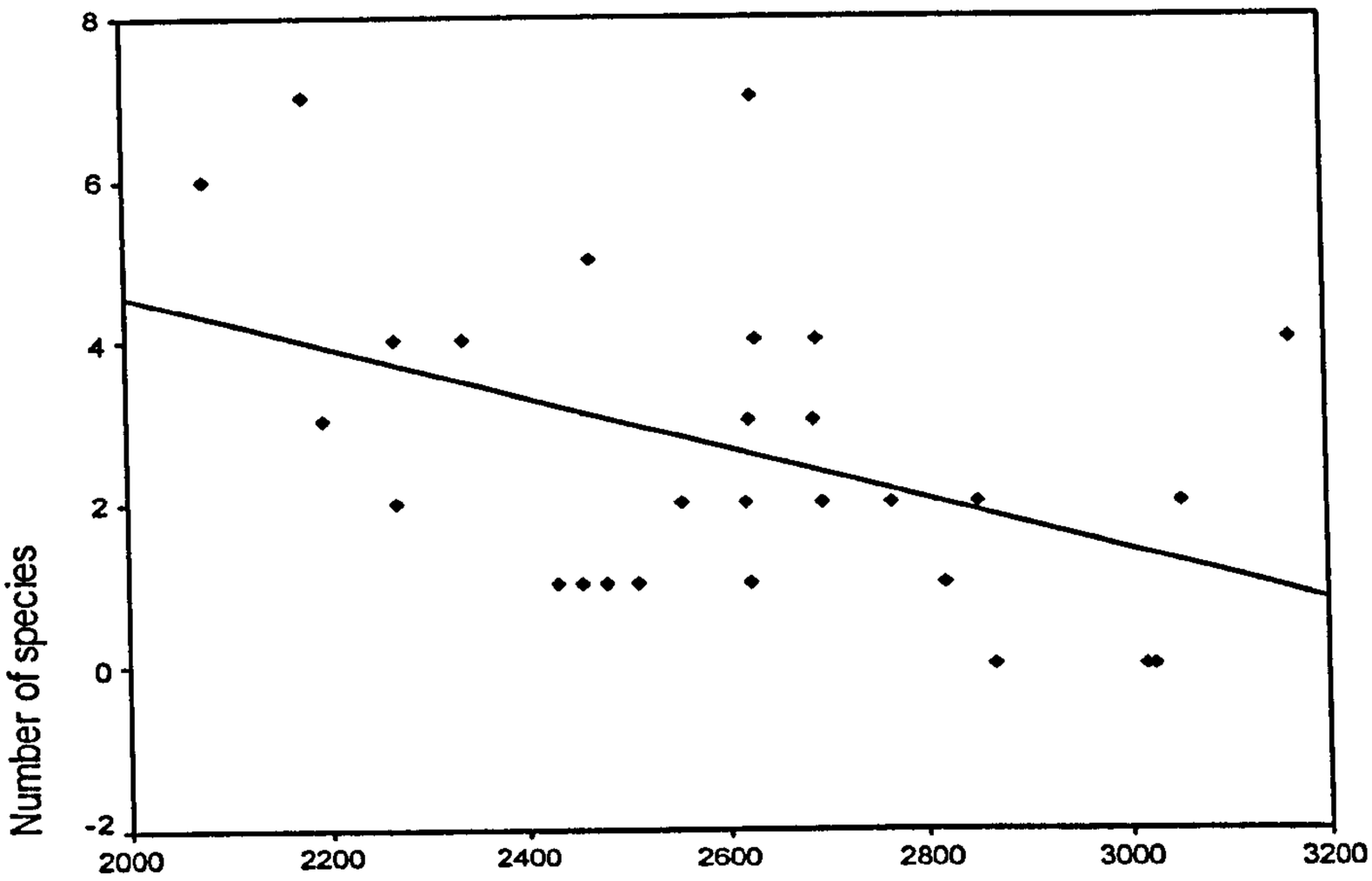
b) Wet season



(Y=-4.75 + 4.652x, p =0 .17, r^2 = 0.0703, n=29)

Figure 4.11 Relationships between overall species richness and altitude during a) dry season and b) wet season in Pelaneng-Bokong Study Area.

a) Dry season ($Y = 10.809 + -3.13x$, $p = 0.018$, $r^2 = 0.197$, $n = 29$)



b) Wet Season ($Y = 14.246 + -4.393x$, $p = 0.01$, $r^2 = 0.334$, $n = 29$)

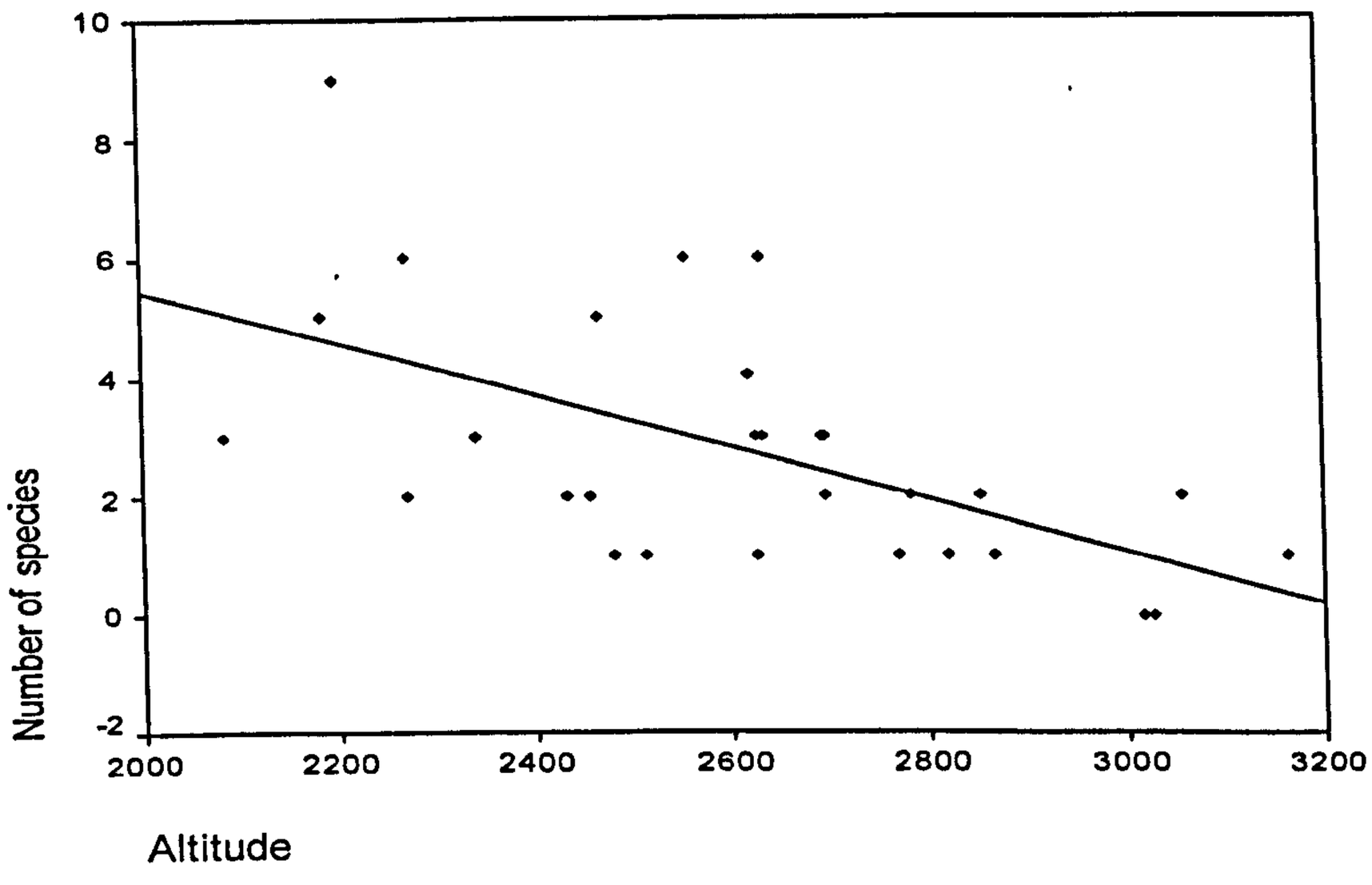


Figure 4.12 Relationships between key livelihood species richness and altitude during a) dry season and b) wet season in Pelaneng-Bokong Study Area

Given the alleged strong relationship between rainfall and altitude in the study area (see chapter 2, section 2.16), species richness during both the dry and wet seasons, were correlated with altitude to determine the influence of rainfall. The results of Pearson Correlation Coefficient model showed negligible linear relationship between altitude and species richness. However, for the key livelihood species, this relationship was

found to be significant during the dry ($R^2 = 0.196$, n = 29, p = 0.018) and wet season ($R^2 = 0.0334$, n = 29, p = 0.001). These findings agree with those of Fortney *et al.* (2004), who stated that, higher species richness and diversity occurred where dry season and low water levels coincided.

The results of this study also showed that, key livelihood species, dominated by Moseha *(Merxmuellera drakensbergensis)* in both the dry and wet season, were poorly represented in the nature reserve and occurred more frequently within RMA regime and in 'B' zones. The fact that Moseha (*Merxmuellera spp*) like the other key livelihood species occur on the outer edge of the wetland, where the water table is far below the surface (Guillarmord, 1963; Van zinderen Bakker, 1994), might be related to the relatively dry conditions within the 'B' and 'C' zones, which might have led these species to adapt to the relatively low soil moisture conditions.

The observed relationship between livelihood species distribution and the management regime, however, is more difficult to interpret. For instance, in this study, livelihood species occurred more frequently in RMA and 'B' zone. This need not imply that RMA regime receives more rainfall than the communal area; neither does the 'B' grazing zone experience more rainfall than the 'C' region, given marginal, if any, differences in altitude within these areas. These results give rise to several possible explanations: (1) Lesotho experiences a rather low and erratic rainfall and is subject to periodic droughts. It is often land in generally steep areas where effects of drought become more pronounced as water holding capacity of the soils is generally low. In this case, it is probable that soils in communal areas are physiologically drier than those in RMA, thus some of the livelihood species might have reached their current stress limit; (2) Harvesting levels of livelihood species might be relatively higher in communal than RMA; (3) The proximity of 'C' areas to the villages might render them more accessible and thus, more vulnerable to over-harvesting than 'B' zone. Similar findings were made by Lienert *et al.*, (2002), pointing to the likelihood of disturbances and extinctions at lower than higher altitude, where wetlands are surrounded by villages and agricultural lands; (4) other factors, including fire, cultivation and trampling, likely to modify vegetation, might have affected communal 'C' zone than RMA. These findings nonetheless suggest a possible influence of management on species distributions.

The findings of this study also showed high prevalence of indicator species within communal regime and 'C' zones. The local community's views were sought on the issue, and the majority attributed it to drought while a few blamed it on frequent incidences of fire. The association between prolonged dry seasons and disturbance in wetland dynamics was also made by (Mokhothu and Tsehlo, 1997) and by (Sseagawa *et al.*, 2004). Perhaps problems of the communal 'C' areas also have to be explained in the context of the establishment of the RMA and more recently Bokong Nature reserve on the 'A' and 'B' zones which used to be prime grazing areas of the communal area. In this case, the possibility that ecological improvements within Bokong and the Nature Reserve might have been at the cost of communal areas cannot be ruled out. Additionally, Mokitimi *et al.*, (2000), suggests that, exclusion of non-RMA members from the 'A' and 'B' grazing areas has put the 'C' zone under intense grazing pressures. The main feature emerging from this analysis is a classic example of a strategy that benefits one area ecologically by aggravating problems of another.

The dominance of endangered species within the communal area and 'B' zone portrayed in this study, on the other hand, though difficult to explain, has serious management implications. For instance, why would Moseha (*Merxmuellera drakensbergensis),* the most abundant livelihood species be listed as endangered? And also, if endangered, why is the protected area located within the afro-alpine 'A' areas as opposed to the communal 'C'?

In summary, this study highlights the extent to which the three management regimes and associated grazing zones which exist in relatively close proximity to each other can differ in species composition, distribution, abundance and disturbance. Although many studies attribute differences in floristic composition to rainfall, differences between the nature reserve and the other two regimes cannot be explained by rainfall alone since the relationship between species richness and altitude (Figures 4.11 and 4.12) is negligable. The differences might be a product of both social and ecological history (Leach, *et al.*, 1999). For instance, differences between the RMA and communal area, as well as the differences between the 'B' and 'C' zones, are harder to explain and might be a result of many factors including prolonged drought, anthropogenic disturbances and management.

The high prevalence of disturbance indicator species within the communal 'C' grazing zone, possibly constitutes a threat to the survival of species and habitats, thus ranking such an area high on the priority list for conservation initiatives. By the same token, the study questions the choice of Bokong Nature Reserve as a protected area given the absence of endangered species within the area. Nevertheless, the fact that this study only focussed on the current scenario portrays only a snapshot of the situation. Comparative studies of wetland vegetation patterns at additional sites would help determine the extent to which the patterns revealed by this study are also true for other wetlands (Fashing and Gathua, 2004).

4.7 Conclusions

- Compared to other wetland plants, livelihood species were found to be relatively abundant and widely distributed in lower elevations and in both the RMA and communal areas. The relatively high proportion of key livelihood species offers a choice of species to harvesters and traders, while distributed availability is more likely to reduce over-exploitation and provide sustained livelihoods. This might mean that wetland-related livelihoods are likely to remain stable into the immediate future at current level of use.

- Variations were noted in species occurrence and distribution in relation to elevation, particularly in regard to key livelihood species. However, the study revealed little predictability between wetland vegetation and altitude as well as between vegetation and management, thus implying that floral composition and distribution might be a product of both ecological and sociological histories.

- The differences between the communal and RMA areas in terms of species composition and distribution were few, thus raising questions about the criteria used to separate the two. However, livelihood species occurred more within the RMA than communal areas, a probable indicator of increased harvesting pressure in this area.

- There is little difference between seasons in relation to species composition, distribution as well as disturbance. This means that as far as livelihood species are concerned, rainfall might not be the main factor determining species richness.

- The occurrence of key livelihood species in disturbed areas might be an indicator that these species are generalists, thus likely to survive under unfavourable conditions. While this can be an advantage to for local communities in the short run, the occurrence of these species render such sites prime conservation areas.

Chapter 5

Resource harvesting patterns

CHAPTER 5 - RESOURCE HARVESTING PATTERNS

5.0 Summary

Although most rural communities harvest wetland plants to meet livelihood needs, harvesting patterns have received little attention. This chapter uses panel surveys and participatory approaches to investigate seasonal and spatial variability in harvesting patterns of the key livelihood wetland vegetation within the six study villages, across the two management regimes. The results show that wetland plants are harvested from the high altitude wetlands to meet a wide portfolio of livelihood needs. These include vegetables, medicinal products, thatching material and fuel wood. This renders harvesting of wetland plants not a matter of choice but rather survival. However, despite appreciable reliance on these species, many are harvested responsibly, thus enhancing the natural assets. This is due to relatively low harvested quantities, use of non-destructive harvesting equipment and techniques that allow for regeneration of plants. The high percentage of harvesting events and associated low harvested quantities of species within the 'C' zone and communal areas on the other hand could be an indication of decreasing abundance levels of species in areas close to the villages.. These findings highlight the need for further research on acceptable harvesting techniques and harvest limits for key livelihood species to ensure long term responsible use of the resource.

5.1 Introduction

The tradition of harvesting and utilizing wild plants, such as those found on wetlands persists in many rural communities. In such communities, these plants often figure prominently in livelihood maintenance (Ellanna and Wheeler, 1989; Nicholas, 1998).

Wetlands represent a transitional zone between dry land and open water and are an important habitat for a variety of flora and fauna that are of key livelihood value (Nicholas, 1998). For instance, wetland plants utilised for food, fodder, medicine, thatch and timber, are among the most commonly harvested species, particularly in rural Africa (Jones, 1994; Field, 1994). Wetlands also possess a number of ecological characteristics that merit special attention. They are, for example, among the most productive ecosystems, and important sources, sinks and transformers of many chemical and biological materials (Mitsch and Gooselink, 1993; Keddy, 2000; Joonsten and Clarke, 2002; Özesmi, 2003). Thus, responsible, non-destructive harvesting of these plant resources, could ensure the sustained yield of natural capital while promising continued benefits to the communities (Anderson, 1990; Siebert, 2004; Kinniard, 1992;

Constanza, (1992) However, concerns have been raised about unsustainable harvesting practices and over-exploitation of many plant products world-wide (Redford and Robinson, 1987; McShane and McShane-Caluzi, 1997; Clay, 1997; Kiernan and Freese, 1997). This has in turn, prompted much research to determine the viability of harvesting Non-Timber Forest Products (NTFP) (Kinniard, 1992; Thiollay, 1992; Child, 2002; Ticktin *et al.*, 2002; Glaser, 2003; Endress *et al.*, 2004; Kala, 2005). Advocates of this practice emphasize dual benefits of conserving biological diversity and providing economic benefits (Siebert, 2004; Anderson, 1990). Sceptics, however, contend that excessive harvesting and destructive methods used are often ecologically unsustainable (Robins, 2000; Dayton and Primack, 1996; Balick and Mendelshon, 1992).

In contrast to the well-documented harvest practices of non-timber forest products (NTFPs), wetland plants, have received little attention (Freese, 1997 & 1998; Özesmi, 2003). Instead, the bulk of research on aquatic plants seems to have been polarised towards examining relationships between human-induced disturbance (road construction, land use, density, and urbanisation) and the decrease of wetland biota (Gibbs, 1993; Johnson, 1994; Kaiser, 1998; Sculthorpe, 1967; Bauer *et al.*, 2004; Scot *et al.*, 2000). A few studies (e.g. Rowell *et al.*, 1985; Nicholas, 1998; Ellanna, 1989), have concentrated on the economic benefits accruing from harvested wild plants as well the ecological effects of harvesting (Kardell, 1986; Zurini *et al.*, 2004). Significant exceptions (e.g. Özesmi, 2003) have focused on harvesting patterns of herbaceous wetland biota.

In Lesotho, wetland resources and products are used locally. They are also sold nationally and to tourists in the form of products such as brooms, mats, traditional artefacts and hats. However, harvesting practices of plants has been overlooked in environmental planning and in execution and management of projects such as the Lesotho Highlands Water Project (LHWP).

5.2 Objectives

The chapter investigates seasonal and spatial variability in harvesting patterns of the key livelihood wetland vegetation within the six study villages, across the two management regimes. As part of the effort to understand these factors, this research sets out to:

- Determine variability in harvesting intensity across the six villages, grazing zones and management regimes.
- Determine variability in seasonal harvesting patterns between villages and across the A, B and C grazing zones.
- Investigate harvesting techniques used and their implications for the regeneration of species.

5.3 Materials and methods

As indicated earlier (Chapter 2, Sections 2.4.5 and 2.3.4.1) detailed data on harvesting patterns were collected using panel surveys from August 2004 to July 2005. Sixty-two panel members, consisting approximately 8% of the total population, were interviewed using structured and semi-structured interview schedules. The spread of panel members across the six villages is presented in Table 2.6. Although the sample was small, it was deemed sufficient for this study since the aim of the exercise was to assess the main trends in harvesting rather than collect baseline data. These surveys provided detailed information of individual components of harvesting at the household and individuals levels over the whole calendar year. Panel members were required to keep a record of all leaves, stems, roots and adult plants harvested, quantity harvested, harvesting techniques employed and frequency of harvesting. They also noted the date of harvest and spatial pattern of harvest by recording wetland sites visited. Additional information on other livelihood activities was also sought in order to determine their influence on harvesting intensity.

This task was achieved through the use of wetland activity calendars, designed for Panel members to fill in on a daily basis. These calendars proved to be very useful not only in capturing daily information pertaining to harvesting activities, but their greatest advantage lies in the fact that they minimise errors in records of harvesting activities since activities can be recorded daily and panel members do not have to memorise events. These calendars were referred to during the face to face interviews and thus complemented them. Furthermore, this tool proved to be particularly useful in soliciting information from panel members who, either felt intimidated by interviews, or, for some reason, could not be present during the dates set for the monthly interviews.

Throughout the survey, local units were used to record the quantities (e.g bundles, handfuls, donkey-load, and oxcart load) of each plant harvested as well as the number of harvesting trips. These weights were then converted into grams or kilograms using the average mass of plant material weighed using a standard laboratory scale. Following discussions, agreements were reached on what certain local units entailed. For example, a bundle was used to measure plants used for fodder, thatching and craftwork. However, different resources had different sizes of bundles; thus, this exercise helped the researcher to establish a general standard. Once this was determined, these would be measured and standardized against metric units. These conversions allowed for comparison between households and villages.

5.4 Analysis

All quantitative data were analysed using SPSS for windows. Harvesting intensity was estimated by compiling utilization frequency per species, computation of the proportion of harvesters and quantities utilized in reference to proportion plants referred to by their vernacular names with respect to the total number of interviews (Hansis, 1998). Spatial harvesting patterns were determined by compiling the proportion of harvesters utilizing wetland sites. The seasonal pattern of harvesting, on the other hand was determined by computing harvesting events per species, per month, across the three grazing zones.

Harvesting techniques were estimated by computing the proportion of harvesters reported to have utilized specific techniques and plant parts. These were then evaluated against plant characteristics and/or requirements in order to determine the extent to which techniques allow for regeneration.

Non-parametric statistical tests, mainly Mann-Whitney U and Kruskal-Wallis tests were used to compare harvesting events between villages, grazing zones and management regimes while parametric tests (one-way ANOVA) was used to determine differences in quantities of key livelihood species harvested across grazing zones and management regimes.

5.5 Results

5.5.1 Spatial comparisons and seasonal variations in harvesting intensity

5.5.1.1 Commonly harvested plants and uses

Harvested wetland plants provided an array of services to the local people (Table 5.1). In addition to providing fuel for cooking, they also provided fencing and construction materials, food and medicine. Also, species such as Moseha (*Merxmuellera drakensbergensis)*, played a multiple role providing for subsistence needs and generating income for households through sale of craft items.

Table 5.1 Commonly harvested wetland species and specific uses

Species	Common name	Specific Use
Merxmuellera drakensbergensis		
	Moseha	Crafts, 'soft' brooms used indoors, baskets, wood-fuel, cultural ceremonies, construction, fodder and ropes
Scripus ficinoides	Loli	Sleeping and sitting mats, beer strainers, traditional eating mat (*sethebe*)
Carex cognata	Lesuoane	Decorates handicrafts, fodder
Juncus glaucus	Rororo	Construction, fencing material, crafts, fodder and ropes
Gunnera perpensa	Qobo	Medicinal, its root is used as a detoxifier, concentrated mixture can speed up the labour process, stack used as a snack.
Rumex lanceolatus	Khama-khamane	Medicinal, treats livestock indigestion and constipation problems.
Rannunculus multifidus	Tlhapi	Medicinal, treats tooth-ache and septic wounds.
Mentha acquatica	Kuena	Medicinal, remedy for colds and flu.
Fingerhuthia sesleriformis	Thita-poho	Crafts, 'hard' brooms used for carpets and outside.

5.5.1.2 Variability in harvesting intensity across villages

The monthly proportion of harvesters, harvesting events and mean quantities per species harvested varied somewhat among villages (Tables 5.2 and 5.3). Overall percentage of harvesting events ranged from 0-67% and a relatively low proportion of harvesting events were noted at Ha Lesaoana. However, there were no appreciable differences in harvesting events across villages [Kruskal-Wallis test, n=457, df=5, X^2 = 5.676, p=.339], while a comparison of harvesting events between the RMA and communal areas displayed statistically significant difference [Mann-Whitney-U test, n=457, Z=-18.795, p < .001], with the communal more pronounced than the RMA areas.

Table 5.2 Monthly percentages of sample households engaged in harvesting each species in the six study villages

Month	Species	Village					
		Poli	Lukase	Lejone	Tlholo	Lesaoana	Boritsa
August	*Merxmuellera sp.*	15	30	20	20	30	33
	Juncus glaucus	8	-	-	10	20	-
	Carex cognata	38	20	20	-	30	11
	Gunnera perpensa	8	20	-	-	-	-
	Rannunculs sp.	-	10	20	-	10	-
	Rumex lanceolatus	-	10	10	-	-	11
	Mentha aquatica	15	-	10	-	-	11
	Fingerhuthia sp.	-	-	10	20	-	-
Sept.	*Merxmuellera sp.*	-	50	40	50	10	67
	Scripus ficinoides	-	-	-	-	-	22
	Juncus glaucus	-	20	20	40	-	12
	Carex cognata	-	-	30	20	-	12
	Gunnera perpensa	8	30	50	-	10	22
	Rannunculs sp.	-	-	10	-	-	12
	Rumex lanceolatus	-	-	10	10	-	11
	Mentha aquatica	-	10	10	30	-	11
	Rorippa sp.	-	10	40	10	-	11
	Fingerhuthia sp.	-	-	30	60	-	44

Month	Species	Poli	Lukase	Lejone	Tlholo	Lesaoana	Boritsa
October	*Merxmuellera sp.*	23	50	-	40	-	33
	Scripus ficinoides	8	10	-	-	-	11
	Juncus glaucus	23	20	-	40	-	22
	Carex cognata	-	10	-	50	-	11
	Gunnera perpensa	31	10	10	10	-	22
	Rannunculs sp.	8	10	10	20	-	33
	Rumex lanceolatus	-	10	-	20	-	11
	Mentha aquatica	15	10	10	30	-	22
	Rorippa sp.	8	40	-	10	-	11
	Fingerhuthia sp.	15	-	10	40	-	21
Nov.	*Merxmuellera sp.*	-	-	10	-	-	44
	Scripus ficinoides	-	20	-	10	-	-
	Juncus glaucus	8	10	-	-	-	33
	Carex cognata	-	-	10	10	-	11
	Gunnera perpensa	8	40	20	10	-	44
	Rumex lanceolatus	-	-	10	-	-	22
	Mentha aquatica	-	10	30	10	-	44
	Rorippa spp	8	30	-	10	-	11
Jan.	*Merxmuellera sp.*	8	10	-	10	-	-
	Gunnera perpensa	-	-	-	10	-	-
	Rannunculs sp.		10	-	-	-	-
March	*Merxmuellera sp.*	23	10	30	20	-	-
	Scripus ficinoids	8	-	10	-	-	-
	Juncus glaucus	15	-	10	-	-	-
	Carex cognata	-	-	10	-	-	-
	Gunnera perpensa	23	10	20	-	-	-
	Rannunculs sp.	8	-	-	-	-	-
	Mentha aquatica	8	-	-	-	-	-
April	*Merxmuellera sp.*	31	50	30	30	10	11

Month	Species	Poli	Lukase	Lejone	Tlholo	Lesaoana	Boritsa
	Scripus ficinoides	-	20	-	-	10	-
	Juncus glaucus	23	10	-	3	10	-
	Carex cognata	8	-	10	1	10	-
	Gunnera perpensa	31	10	10	1	10	-
	Rannunculs sp.	8	20	40	-	10	22
	Rumex lanceolatus	-	10	10	-	-	-
	Mentha aquatica	15	-	10	2	10	-
	Fingerhuthia sp.	23	-	-	-	-	-
May	*Merxmuellera sp.*	8	40	10	30	10	56
	Scripus ficinoides					10	11
	Juncus glaucus	15	10	-	20	20	-
	Carex cognata	-	-	10	20	20	-
	Gunnera perpensa	-	30	10	10	10	11
	Rumex lanceolatus	-	-	-	10	-	11
	Mentha aquatica	-	10	10	10	10	11
	Rorippa sp.	-	-	-	-	-	11
	Fingerhuthia sp.	8	10	-	1	-	-
June	*Merxmuellera sp.*	15	20	20	30	-	56
	Scripus ficinoides	-	-	-	-	10	-
	Juncus glaucus	23	30	-	30	-	11
	Carex cognata	-	-	-	10	10	11
	Gunnera perpensa	-	30	-	10	-	22
	Rannunculs sp.	-	20	-	-	-	33
	Rumex lanceolatus	8	10	-	10	20	11
	Mentha aquatica	-	10	-	10		11
	Rorippa sp.	8	10	-	-	-	22
	Fingerhuthia sp.	8	-	-	-	-	11

Despite having the highest proportion of harvesters, communal areas, interestingly, did not rank high in terms of mean quantities harvested. Instead, largest mean quantities

were recorded in RMA Ha Lejone (281Kg) and Lukase (276Kg) and both harvested within the 'B' grazing zone (Table 5.3).

Table 5.3 Mean quantities harvested (Kg) per person from each of the three grazing zones A, B and C per year

Village	Species	Quantities harvested (Kgs)		
		A	B	C
Ha Poli	*Merxmuellera sp.*	0.1776	42.82	3.6
	Scripus ficinoides			0.085
	Juncus glaucus		0.085	15.82
	Carex cognata			18.138
	Fingerhuthia sesleformis		0.166	20.59
	Gunnera perpernsa			0.17
	Rannunculus multifidus			0.0163
	Rumex lanceolatus		0.040	
	Mentha aquatica		0.0018	0.01096
	Rorippa narstutium aquatica			1.5073
Ha Lukase	*Merxmuellera sp.*	9.625	276.22	56.13
	Scripus ficinoides			33.3
	Juncus glaucus		7.06	6.822
	Fingerhuthia sesleformis		0.2163	
	Gunnera perpernsa		0.1213	0.1899
	Rannunculus multifidus		0.0425	0.02836
	Rumex lanceolatus			0.21
	Mentha aquatica			0.01187
	Rorippa narstutium aquatica			0.0174
Ha Lejone	*Merxmuellera sp.*		280.777	29.024
	Scripus ficinoides		0.0555	
	Juncus glaucus		0.0555	0.0555
	Carex cognata			24.168
	Fingerhuthia sesleformis			26.9466
	Gunnera perpernsa		0.04747	0.1424
	Rannunculus multifidus			0.0637
	Rumex lanceolatus			0.21
	Mentha aquatica		0.0182	0.00776
	Rorippa narstutium aquatica			0.0174
Ha Tlholo	*Merxmuellera sp.*		8.118	106.39
	Scripus ficinoides			0.0555
	Juncus glaucus			33.82
	Carex cognata			142.03
	Fingerhuthia sesleformis			80.336

	Gunnera perpensa			0.0949
	Rannunculus multifidus			0.0424
	Rumex lanceolatus			0.262
	Mentha aquatica			0.0261
	Rorippa narstutium aquatica			0.0738
Ha Lesaoana	*Merxmuellera sp.*			0.693
	Juncus glaucus		0.0555	0.4995
	Gunnera perpensa		0.0015825	0.02165
	Rannunculus multifidus			0.0141
Boritsa	*Merxmuellera sp.*		65.79	242.99
	Scripus ficinoides		0.164	0.185
	Juncus glaucus			0.3885
	Carex cognata			27.073
	Fingerhuthia sesleformis		8.803	1.616
	Gunnera perpensa			0.233
	Rannunculus multifidus			0.089
	Rumex lanceolatus		0.311	0.291
	Mentha aquatica			0.094
	Rorippa narstutium aquatica			0.1934

5.5.1.3 Variability in harvesting patterns across grazing zones

Figure 5.1 shows harvesting events across the grazing zones, which are distinct divisions of the area into summer (A), autumn (B) and winter (C) grazing zones for purposes of management (as displayed on Figure 2.3). The highest proportion of harvesters and harvesting events [Kruskal-Wallis test, n=399, chi square=32.6, df=2, p<.001] occurred in Zone C. In this zone, harvesters from Ha Tlholo and Boritsa were more pronounced, while in the 'B' zone, Ha Lukase and Boritsa showed dominance. The 'A' region on the other hand was almost exclusively harvested by Ha Lukase communities.

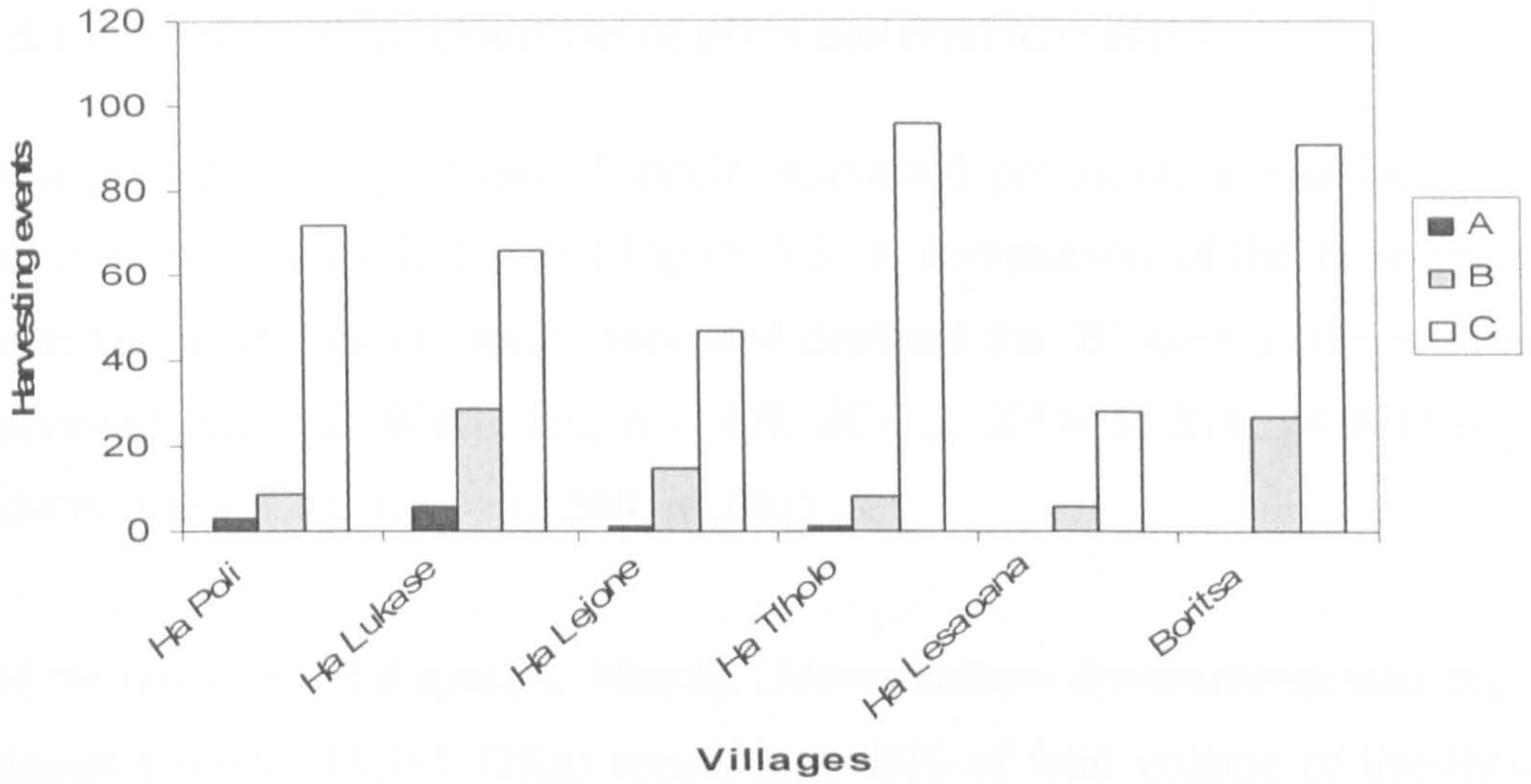


Figure 5.1 Annual harvesting events across the A, B and C zones summed across the six villages

Harvesting events also varied across species [Kruskal-Wallis test, n=429, chi square=402.3, df=9, p=.001}. For instance, as portrayed on Figure 5.2, most species were harvested in both the 'B' and 'C' zones. Exceptions to this trend, however, were *Merxmuellera drakensbergensis*, which was harvested across the three zones, as well as *Rorippa narstutium aquatica* and *Carex cognata*, harvested exclusively in 'C'. However, most medicinal plants were more frequently harvested from the 'C' than the 'B' grazing zone.

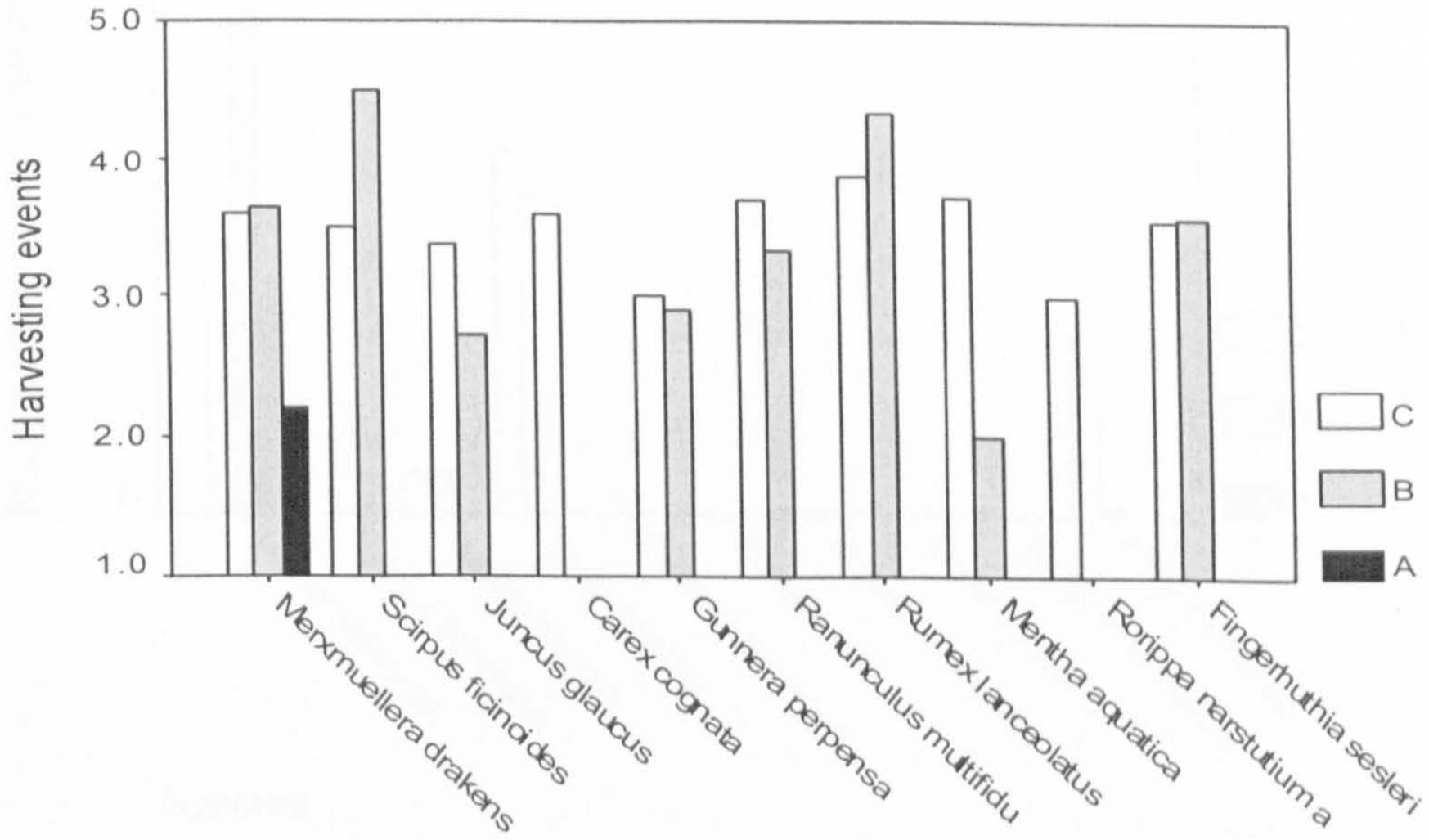


Figure 5.2 Harvesting events by species summarised annually across the three grazing zones

5.5.1.4 Variability in quantities of plant material harvested

Data pertaining to quantities of species harvested per month across the grazing zones are presented in Table 5.3 and Figure 5.3. A comparison of the three grazing zones regarding quantities of species harvested depicted the 'B' zone as the most intensively harvested [Kruskal Wallis test, n = 429, df = 2, X^2 = 51.214, p<.001] or [One way ANOVA test, F (2, 426) = 12.209, p<.001].

Of the ten livelihood species, Moseha (*Merxmuellera drakensbergensis)* registered the highest volume (13,195.32Kg) constituting 85% of total volume of livelihood species harvested during the study period. Additionally, in regard to *Merxmuellera drakensbergensis*, the 'B' zone, largely dominated by Ha Lukase and Ha Lejone, accounted for 63% of the total harvest, while Boritsa recorded the highest quantities of *Merxmuellera sp.* harvested in 'C'and Ha Lesaoana the lowest. All sedges and rushes except Loli (*Scripus ficinoides),* recorded the highest volume harvested at Ha Tlholo. Nonetheless, there was no significant difference between the six villages in relation to quantities of livelihood species harvested [One way ANOVA, F(2,423) = .947, p=.451].

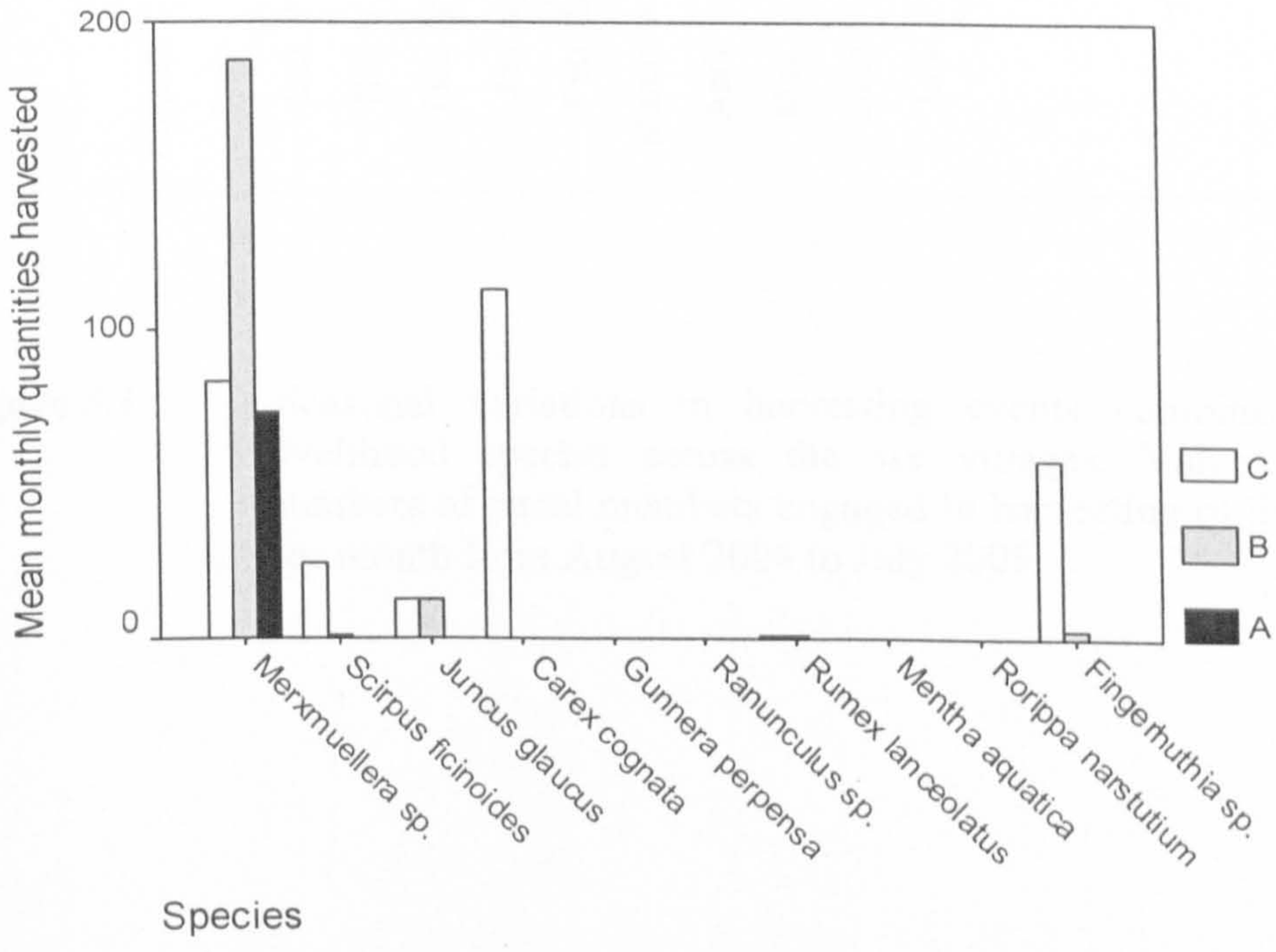


Figure 5.3 Monthly quantities of livelihood species (kg) harvested across the three grazing zones

5.5.1.5 Seasonal variation in harvesting

A discernable seasonal harvesting pattern across the six sampled villages was recognized (see Figure 5.4). The highest number of harvesting events occurred between August and October (spring), and between March and April (autumn). On the other hand, the lowest numbers of harvesting events were experienced between November and January (summer) and between May and July (winter). Similarly the lowest volumes of medicinal and food plants were recorded between December and February (Figure 5.5). Contrastingly however, quantities of sedges and rushes harvested were highest around the same period (Figure 5.6).

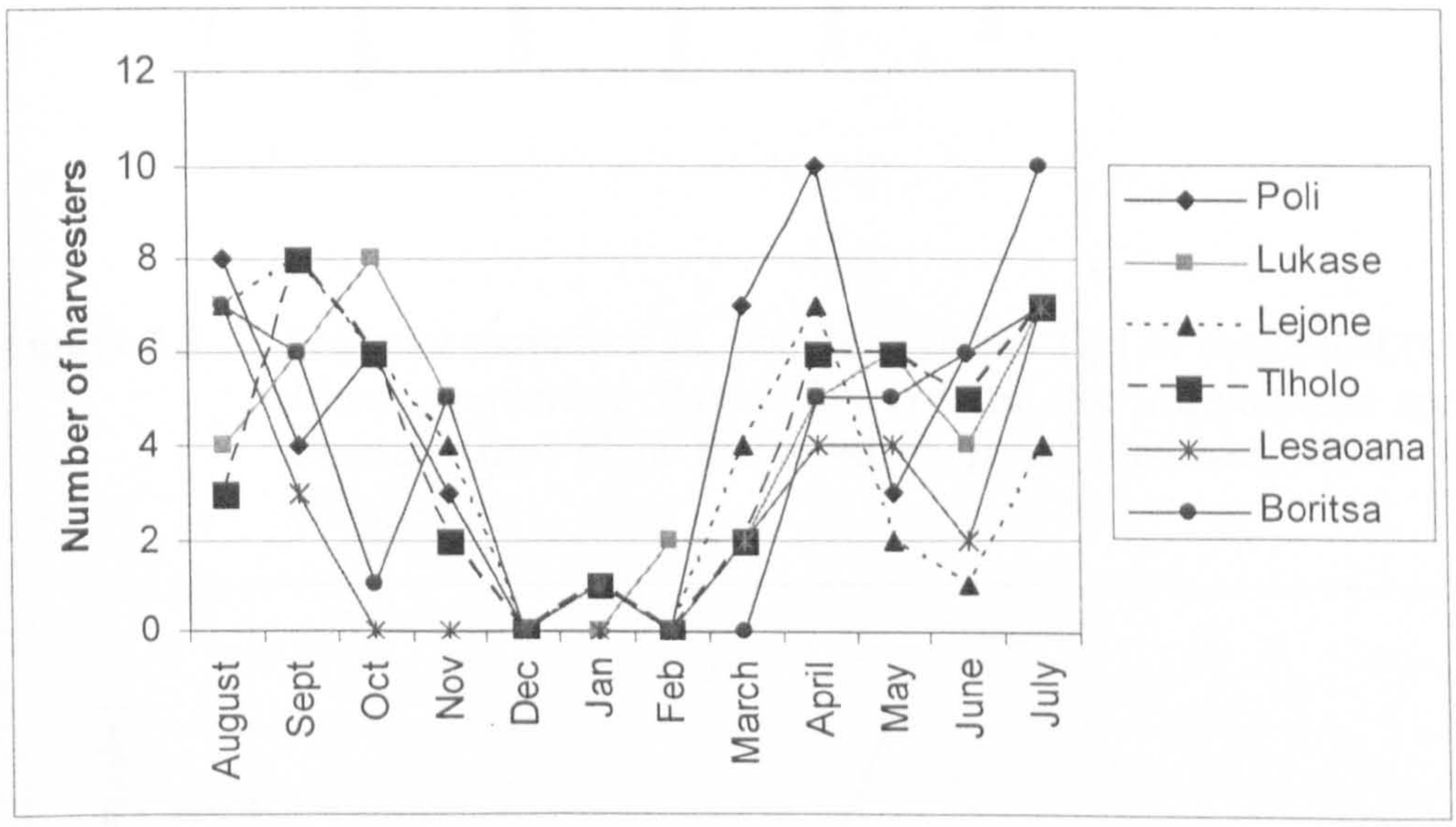


Figure 5.4 Seasonal variations in harvesting events combined for all key livelihood species across the six villages. Values represent the numbers of panel members engaged in harvesting of livelihood plants per month from August 2004 to July 2005

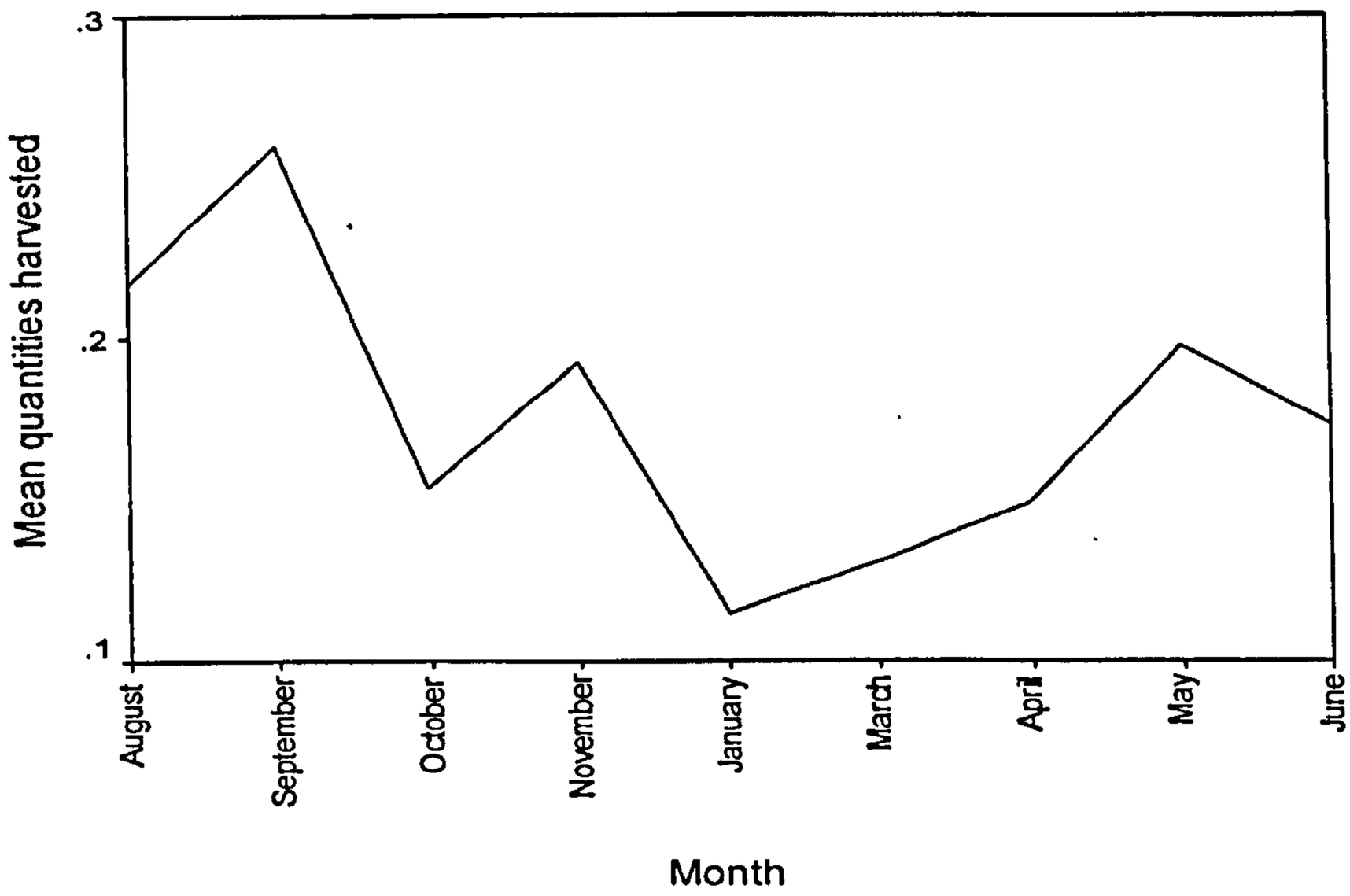


Figure 5.5 Seasonal variations in quantities (mean Kg) of medicinal (*Gunnera spp., Mentha aquatica, Rumex lanceolatus and Rannunculs spp.*) and food (*Rorripa spp*) plant harvested by panel members across the six study villages.

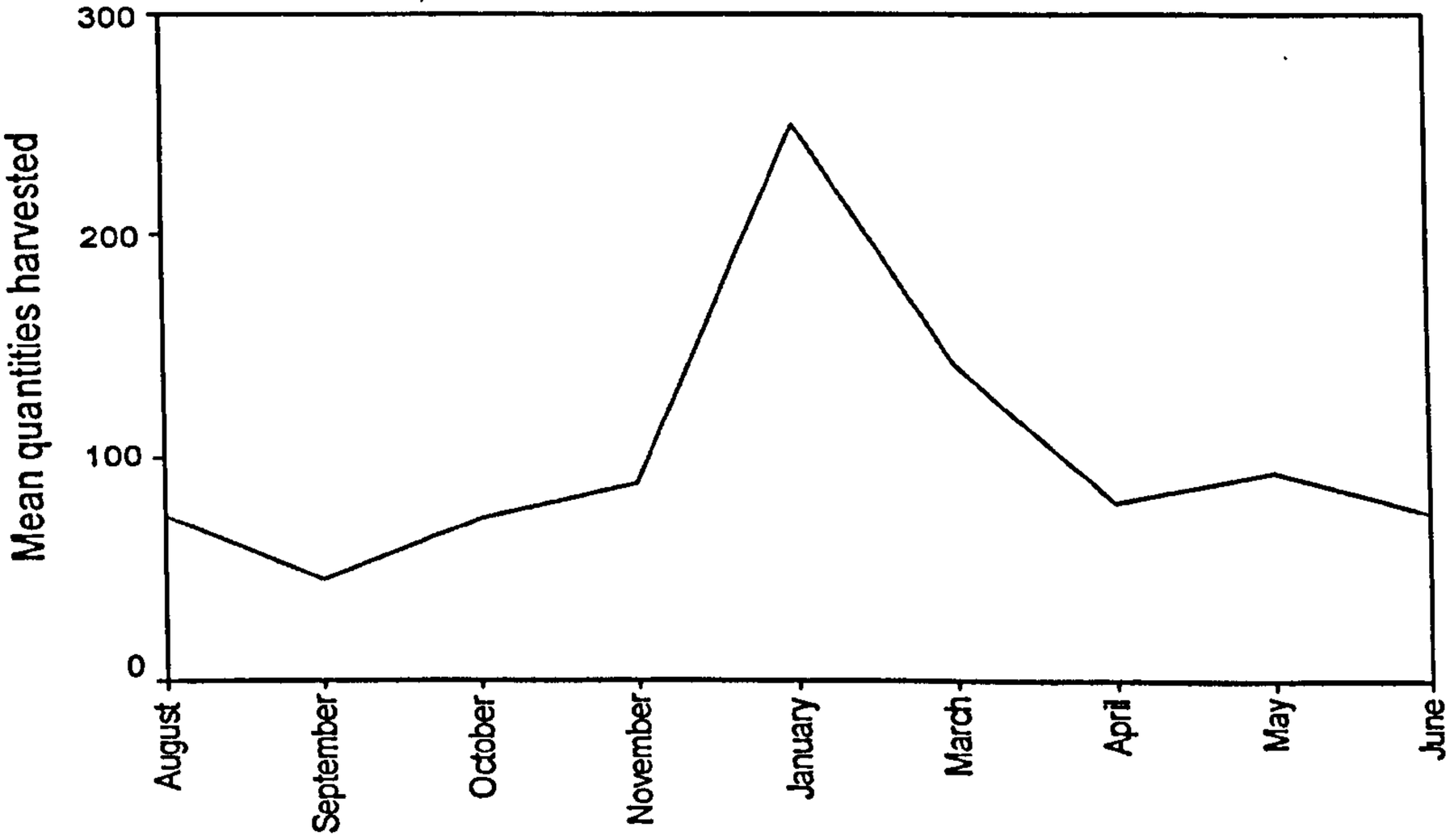


Figure 5.6 Seasonal variations in quantities (Mean Kg) of sedges and rushes (*Merxmuellera spp., Scripus spps, Juncus spp,, Carex spp. and Fingerhuthia spp.)* harvested across the six study villages

Table 5.4 Total quantities (Kgs) of species harvested across grazing zones, A, B and C

Month	Species	Grazing zone		
		A	B	C
August	*Merxmuellera sp.*	43.49	1264.45	19.25
	Juncus glaucus			1.11
	Carex cognata			1.965
	Fingerhuthia sesleformis			10.086
	Gunnera perpernsa			0.47475
	Rannunculus multifidus			0.2836
	Rumex lanceolatus			1.575
	Mentha aquatica		0.2375	0.681
September	*Merxmuellera sp.*	2.31	1417.85	297.9
	Scripus ficinoides			1.11
	Juncus glaucus			137.082
	Carex cognata			1.965
	Fingerhuthia sesleformis		7.923	27.39
	Gunnera perpernsa		0.4755	0.9503
	Rannunculus multifidus			0.26018
	Rumex lanceolatus		0.276	1.05
	Mentha aquatica			0.1425
	Rorippa narstutium aquatica			1.63597
October	*Merxmuellera sp.*	2.31	327.25	855.47
	Scripus ficinoides		1.48	67.155
	Juncus glaucus			270.84
	Carex cognata			1189.44
	Gunnera perpernsa			1.424
	Rannunculus multifidus			0.5672
	Rumex lanceolatus			2.1
	Mentha aquatica			0.19
	Rorippa narstutium aquatica			1.372
November	*Merxmuellera sp.*		2.31	1031.56
	Scripus ficinoides			133.75
	Juncus glaucus			3.885
	Carex cognata			3.73
	Gunnera perpernsa			1.5825
	Rumex lanceolatus			1.575
	Mentha aquatica			0.8235
	Rorippa narstutium aquatica			1.6359
January	*Merxmuellera sp.*		745.92	4.62
	Gunnera perpernsa			0.15825

Month	Species	A	B	C
	Rannunculus multifidus			0.0709
March	*Merxmuellera sp.*		1491.6	568.68
	Scripus ficinoides		0.555	0.555
	Juncus glaucus		0.555	67.14
	Carex cognata			1.965
	Gunnera perpernsa		0.3165	0.6336
	Rannunculus multifidus			0.07090
	Mentha aquatica			0.0255
April	*Merxmuellera sp.*	611.75	8.92	1324.9
	Scripus ficinoides			135.6
	Juncus glaucus		67.155	138.87
	Carex cognata			138.87
	Fingerhuthia sesleformis			0.15825
	Gunnera perpernsa			1.20
	Rannunculus multifidus			0.2592
	Rumex lanceolatus			1.11
	Mentha aquatica			0.1425
	Rorippa narstutium aquatica			0.1386
May	*Merxmuellera sp.*		1406.43	570.99
	Scripus ficinoides			1.11
	Juncus glaucus		1.11	8.85
	Carex cognata			943.2
	Fingerhuthia sesleformis		4.632	4.362
	Gunnera perpernsa		0.1165	5.79125
	Rumex lanceolatus			1.05
	Mentha aquatica			0.11875
June	*Merxmuellera sp.*		1691.34	13.1
	Scripus ficinoides			0.555
	Juncus glaucus		127.1875	2.22
	Carex cognata			2.22
	Fingerhuthia sesleformis		4.323	4.326
	Gunnera perpernsa		0.5275	0.633
	Rannunculus multifidus		1.269	0.1418
	Rumex lanceolatus		1.269	1.05
	Mentha aquatica			0.1175
	Rorippa narstutium aquatica			0.08672

5.5.2 Harvesting Techniques

Hand harvesting was the most common technique for all plants, while cutting equipment used were mainly manual and included metal rods, knives, hand sickle and hand saws (Table 5.5). Harvesting equipment however differed with plant material and quantities required. For instance, suitable leaves of sedges, rushes and grasses, were often cut in bundles of 2.31 Kg and involved use of hand sickles. However, where large quantities were required, cutting was done using a hand saw. Harvested materials were often tied together as bundles transported home on head or using either donkeys or ox-carts.

Table 5.4 Harvesting methods, utilized tools and timing of harvest for key livelihood species

Species	Harvested parts	Harvesting Technique	Harvesting equipment	Harvesting Season (PRA)
Moseha (*Merxmuellera drakensbergensis)*	Leaves	-Hand harvesting -grazed	-hand sickle -hand saw	Year round
Koena *(Mentha aquatica)*	Leaves	-pick leaves/twigs -pull roots	use hands	Year round
Qobo *(Gunnera perpensa)*	Bulbs	-Dig or pull out bulbs	-hands or metal rod	Year round – harvesting rate low in winter
Semetsing *(Rorippa narstatutium aquatica)*	Leaves	-Pick leaves	-hands or cut using knife	Year round
Tlhapi *(Rannunculs multifidus)*	Roots	-Dig/pull out roots	-hand, metal rod or stick	Year round – rate low in winter
Khamakhamane *(Rumex lanceolatus)*	Roots	-Dig/pull out roots	-hands, metal rod or stick	Year round
Rororo *(Juncus glaucus)*	Leaves	-Hand harvesting -grazed	-hand sickle	Year round
Thitapoho *(Fingerhuthia sesleformis)*	Leaves	-Hand harvesting	-hand sickle	Winter Summer
Loli *(Scripus ficinoides)*	Leaves	-Hand harvesting	-Hand sickle	
Lesuoane *(Carex cognata)*	Leaves	-Hand harvesting -grazed	-Hand sickle	Year round

On the other hand, plant materials used for medicinal or food purposes were either leaves or roots and were cut in quantities of 1-5 handfuls or 1-5 bulbs or roots (0.01 – 1kg). Whereas leaves were either picked by hand or cut using a knife, root harvesting involved grasping the plant material as close to the sediment layer as possible, or digging (using a stick or metal rod) into the sediment to grab the root down and pulling intact plant out of the bottom of the sediment. Though time-consuming, hand harvesting was found to be advantageous in that, it was selective and allowed harvesters to cut fewer required plants, thus minimizing disturbance and wastage. This method was also accessible to all community members.

Though most plants were harvested all year round (Table 5.5), it was indicated that, the quality of wetland plants was never consistent and varied from site to site. Therefore, plants considered unsuitable for certain purposes were often left uncut. However, in some cases, season and availability determined plant material to be harvested and techniques. For instance, while leaves of Kuena-ea-liliba (*Mentha aquatica),* were utilized during the growing season, in winter, when plants have shed leaves, community members resorted to dry stems or roots. Harvesting methods thus shifted from hand-picking of leaves in summer to root-digging in winter.

Additionally, fodder species occurring on 'C' wetlands, were grazed only in winter (June – July), before the planting and ploughing season and when other, more palatable grasses were scarce. In other months, fodder species in 'C' area were cut and livestock were pen-fed. This practice protected the wetlands from excessive trampling, particularly during summer (rainy reason), when wetlands were likely to be more saturated and thus, more vulnerable. Wetland sites located within the 'A' grazing area were grazed in summer and rested in winter

5.6 Discussions

This study summarizes research on practices employed for harvesting key livelihood wetland species in Pelaneng-Bokong study area with emphasis placed on spatial and seasonal variation in harvesting intensity and harvesting techniques utilized.

5.6.1 Harvesting Intensity

5.6.1.1 Species Harvesting Rate

Merxmuellera drakensbergensis (hereafter referred to its local name Moseha*)* was found to be the most intensively harvested plant and Loli (*Scripus ficinoides)* and Thitapoho (*Fingerhuthia seslesformis)* the least. Several factors could explain Moseha's prominence. First, its multi-purpose usage (e.g. for fuelwood, construction, weaving crafts) as well as lack of preferred substitutes could be responsible for the elevated status of Moseha in the study area. On the other hand, the limited source of energy available in cold, high altitude climate might increase the demand of moseha as a fuelwood (Makoae, 2000; MAPOSDA, 2003). Being a member of Poaceae family renders Moseha one of the most favoured plants for weaving crafts since it can withstand twisting and bending without breaking and can dry dry without destroying the woven structure. Additionally, the location of the Pelaneng-Bokong in low temperature, high elevation zone, seems to have narrowed choices of preferred thatching species. For instance, Mohlomo (*Hyparrhenia hirta),* otherwise widely used for thatching in other parts of Lesotho, does not grow in this area, thus increasing harvesting pressure on Moseha. Similarly, low purchasing power of local communities (Makoae, 2000) means that they cannot afford subsitute roofing materials such as iron sheets and tiles. Similar findings were made by Letsela *et al.*, (2003).

On the other hand, it is probable that the relatively low harvesting levels of Loli (*Scripus ficinoides)* is related to its low abundance as indicated in Chapter 4. According to local collectors, the demand for these plants is high, scarcity is thus likely to intensify competition. Scarcity and low harvesting levels of Loli were also reported on Mbongolwane wetland in Kwazulu-Natal in South Africa (Kotze *et al.*, 2002).

5.6.1.2 Variability in harvesting events and quantities harvested

Though evidence of harvesting is apparent on virtually every wetland (personal observation), communal areas and the 'C' zone were the most frequently harvested areas. Interestingly, these areas did not register corresponding high volume of species harvested. A plausible explanation to this might be that although used regularly due to its proximity to the villages, the 'C' areas might not have the required quantity and

quality of resources. Spatial variation in harvesting reflects both geographic and socio-economic factors. All things being equal, people usually harvest species that are near to their homes. Such proximity-based harvesting is documented by, eg. LeBlanc (1977) in her study of shellfish gleaning in Bais bay, and has since been reported for non timber forest products, mangroves and medicinal plants harvesting practises (e.g. Gibbs, 2000; Ladio and Lozada, 2000). However, resource harvesting within 'B' could also reflect easy availability of key livelihood resources in this area.

With regard to medicinal plants, there was a somewhat inverse relationship between harvesting events and quantities harvested with more harvesting incidences and relative low quantities harvested. The reason here might lie on the subsistence nature of harvesting, entailing collection of small units for immediate needs only. Harvested quantities reported were all lower than those reported in South Africa (Kotze *et al.*, 2002) and Alaska (Ellana and Wheeler, 1989). In particular medicinal plants, vegetables and snacks were often harvested in units of 1-5 plants, 1-5 roots and 1-5 handfuls. However, if people used the recommended dose for medicinal plants, harvesting intensity could be reduced even further. For instance Barnes *et al.*, (2002), suggest use of smaller quantities of herbs such as Tlhapi (*Ranunculus multifidus*) and Khamakhamane (*Rumex lanceolatus*) in treating related ailments.

Regarding sedges and rushes, particularly Moseha, though largely collected for subsistence, are often needed in large quantities. For instance, apart from the daily fire-wood requirements, cultural ceremonies and funerals are large consumers of fire-wood and tend to increase harvesting pressure on Moseha.

The results also portray varied harvesting intensities in different villages, with RMA villages showing prominence in the 'B' and 'A' grazing zones. These findings are quite logical given the fact that the RMA has been opportunistically located on what used to be the 'A' and 'B' grazing zone of the communal areas thus leaving the communal areas with much of the 'C' zone. Thus, those who are part of the RMAs have an additional advantage of being able to access wetlands within the three microhabitats (A, B and C).

5.6.2 Seasonal pattern of harvesting

The agricultural calendar probably influences the harvesting pattern of wetland resources. For instance, that low harvesting rates seemed to coincide with the crop weeding period. Highest harvesting rates, on the other hand were reported during the ploughing and planting seasons. This might be due to the fact that, ploughing and planting activities are comparatively less labour demanding compared to weeding, thus allowing more time for other activities such as harvesting of wetland plants. Low harvest rates of wetland plants in summer might also be due to the relative abundance of substitute plants. On the other hand, the increased harvesting rate during the post-harvest period might be due to the demand for ropes, used for tying bundles of crops in preparation for thrashing. These ropes are commonly made of wetland plants, which are more resilient to bending.

5.6.3 Harvesting techniques and implications on regeneration

5.6.3.1 Harvesting tools

The manner in which plants are harvested to obtain the desired product can result in differences in plant population growth rates. This study showed that there has not been a significant shift in the harvesting techniques of local people, in the sense that manual, non-destructive tools which allow for harvesting of few plants, as opposed to large-scale, mechanised techniques were largely employed. Freese (1997) observes that, overexploitation of wild species can be attributed to advancement in harvesting technologies.

5.5.3.2 Harvested plant parts

Although harvesting of leaves of most plants was popular, underground parts, stems and to a lesser extent, flower stalks were sometimes harvested. For instance, harvesting of Koena-ea-liliba (*Mentha aquatica)*'s stems and roots, was reportedly restricted to the winter season. The leaves of this plant are used to treat colds and flu, hence, hence its high demand in winter when local communities are more susceptible to influenza and cold. Logically, a perceived decrease in supply of leaves during this period, might lead to acts of desperation, including the harvest of stems and roots. However, removal of stems and roots in winter is likely to halt growth and inhibit leaf production due to

removal of growth points. The dynamics of leaf harvesting, has been widely studied (e.g. Endress *et al.*, 2004; Siebert, 2004; Stoddard *et al.*, 1975).

The harvesting of below-ground-parts for species including Qobo *(Gunnera perpensa),* Tlhapi-ea-Metsi-e-nyenyane *(Rannunculus meyeri)* and Khamakhamane (*Rumex lanceolatus)* seems to be widely practised. This technique, especially when applied to density-independent species, is likely to reduce competition and increase plant vigour. However, continuous, year-round harvesting, and particularly non-observance of flowering period in the long run, might, negatively impact on regeneration rates.

5.6.3.3 Timing of harvest

The timing of harvesting activities in relation to plant cycle is important in determining the rate of regeneration. The findings of this study showed that, most of the key livelihood wetland species, with the exception of grazed plant species, were harvested all year round. While this might be attributed to the fact that, wetlands tend to be a relatively stable resource base due to usual year-round availability of water even during the dry season (Nicholas, 1998). Year-round harvesting, in some cases; can minimise chances of flower production and hence seed dispersal.

Rotational grazing of wetland resources, particularly if matched to appropriate stocking rates, might ensure protection of the wetlands. Nonetheless, grazing and its effects on vegetation growth has been subject to a lot of debate (e.g. Hudak, 1999; Mier and Tsoar, 1996; Bollig and 1996; Winterhalder *et al.*, 1973; Mishra *et a*l., 2003). In Lesotho, adverse effects of grazing and trampling on high altitude wetlands in have been widely studied (e.g. Staples and Hudson, 1938; Guillarmord, 1962, 1963 and 1969; Van Zinderen Bakker and Werger, 1974; Mokuku and Letsie, 2001; Nusser and Grab, 2002).

5.6.4 Contribution of harvesting practices to the natural assets

The value of natural assets can be surmised to have increased due to harvesting practices employed. The results of this study provide several indicators of how harvesting patterns employed in the study area may to have enhanced the productive potential of wetland plants and to protect wetland ecosystems. These include:

- Rotational grazing and resting wetlands, which serve to protect both the plants and the habitat.

- Harvesting techniques that enhance propagation by selectively harvesting plants that are required, thus avoiding mass harvesting.

- Seasonal harvesting that protects vegetation against continuous over-exploitation.

However, this apparently positive picture could be marred by disparities between management regimes. For instance, while delineation of RMA and the Nature Reserve might arguable improve some wetlands sites by limiting access, the system might worsen conditions within the communal areas. The question that remains is whether these contributions are sufficient to enhance species regeneration. However, this question can partly be answered through more research on what would really constitute sustainable harvest of wetland plants.

5.7 Conclusions

- Harvesting intensity is highly variable and cannot always be explained within the confines of management regime or grazing zones.

- Livelihood species seem to be hardy and able to tolerate and even respond positively to defoliation. This suggests that, at current harvest levels that the portion of livelihoods dependent on wetland plants has a potential to be sustainable at current harvesting levels.

- Harvest rates seem to somewhat correlate with access to basic needs such as shelter and energy rather than abundance and scarcity. Reductions in harvesting, if necessary could be achieved by enhancing alternative livelihood options.

- Sustainable harvesting levels might be attributed to the relative abundance of livelihood plants (Chapter 4), lack of advancement in harvesting techniques and abundance levels of livelihood species. However, there is a concern about the future, particularly the use of plants for fuel-wood.

- Given that harvesting of medicinal plants is a relatively low impact activity, especially since the quantities needed are very low, the prospects for sustainable supply of these plants are high. However, interventions that would further increase the supply of these plants need to be explored.

Chapter 6

Influence of market orientation on wetland plants

CHAPTER 6 - INFLUENCE OF MARKET ORIENTATION ON WETLAND PLANTS

6.0 Summary

Wild plants trade has been growing in importance due to its role as an income generator for rural households and a tool for obviating complete conversion of ecosystems. However, its importance has been paralleled by scepticism on over-exploitation and greater risk of species extinction. In Lesotho, threats to wild plants have been associated with uncontrolled trade. This chapter investigates the market characteristics and extent of wetland plants trade in Pelaneng-Bokong study area of Lesotho. Approximately, 90% of key livelihood wetland plants were traded. However, the levels of trade, measured in terms of community members involved and volume traded per species were low. Moseha (Merxmuellera drakensbergensis) featured prominently in wetland plant trade while Boritsa and Ha Lukase villages dominated. Craft-making skills and access to markets were found to be the main determinants of trade.

Also notable were, seasonal fluctuations in the proportion of collectors, quantities and prices of traded products, possibly as a result of scarcity of resources in spring and winter. While such fluctuations could potentially induce over-harvesting and stock-piling, the current combination of low trade levels, limited village-based markets and common use of leaves as trade material served as a disincentive to over-exploit traded plants, hence insignificant ecological impacts. Further studies in more populous areas, with diverse income sources and efficient marketing system are suggested in order to analyse and compare effects of sustainable off-take in different settings.

6.1 Introduction

Wild plants from different ecosystems have attracted a considerable global interest in recent years due to an increasing recognition to their contribution to local economies and environmental protection (Joshi and Joshi, 2005). In some rural communities, several households depend on wild species for subsistence while some products feature prominently as raw materials for small to large scale industrial processing. This renders commerce in wild plants an important source of revenue to the local communities. In addition, the relatively low capital input, low opportunity cost for labour, traditional skills and use of locally available plants as raw material further enhances the economic viability of trade in wild species (Cunningham, 1987). However, the harvesting, commercialization of wild plants and related ecological and environmental impacts have been subject to controversies and debates raised in several studies (e.g. Cunningham *et*

*a*l, 1987; Cunningham, 1991; Padoch *et al.*, 1991; Hamilton and Hamilton, 2006; Bishop and Scoones, 1974; Freese, 1998).

A number of authors have advanced the view that commercial use of wild plants is an effective conservation tool and an incentive for people to protect and maintain wild species responsibly, since it can out-compete alternative unsustainable uses (IUCN/UNEP/WWF, 1991; Dasgupta *et al.*, 2000; Freese, 1997; Neumann and Hirsch, 2000). These arguments, though acknowledging possible changes in species abundance and composition due to commercial harvesting, nevertheless recognise the role of commercialization in obviating complete conversion of ecosystems to other land uses (Peters *et al.*, 1989; Kiernan and Freese, 1997). For instance, Boffa *et a*l., (1990) noted minimal ecological impacts from commercial exploitation of shea nut (*Butyrospermum parkii)* in Burkina Faso. Other studies have echoed similar sentiments, such as Siebert (1995) who suggested that rattan's (*Calamus spp*) ability to produce multiple canes, has reduced the risk of its over harvesting in two Indonesian National Parks, while palm heart extraction in populations of acai (*Euterpe oleracea)* could be carried out without reducing fruit harvest (Anderson,1988). In addition, the way in which non-timber forest products were harvested in Sierra de Manantlam Biosphere reserve, were argued to be sustainable (Marshal and Newton, 2003).

The sustainable commercialisation of wild species paradigm, popularly known as the "Use it or lose it" approach (Freese, 1997), has also been criticised as self-defeating on the basis that market demand for wild plants and the quest for increased economic gain are likely to increase pressure on wild species and consequently result in depletion of resources (e.g. Cunningham, 1987 & 1993; Hanson, 1997; Soehartono and Newton, 2002; Neumann and Hirsch, 2000). Bishop and Scoones (1994) and May and Barata (2004) also showed that, high demand market conditions could spur engagement in harmful harvesting techniques and hence bring on resource depletion. As a consequence of depletion, geographical shifts in extraction could occur (Clay, 1997; Soehartono and Newton, 2002).

Theories and lessons learnt about commercialisation of wild species are critical in sustainable management of natural systems. However, many wild species are commercialised as part of livelihood strategies, thus, the question of non-utilization

cannot always be accommodated (Freese, 1998). The challenge therefore is to have management strategies in place that would ensure adequate ecosystem and species conservation and the provision of a sustained income.

The importance of trade in wild plants, however, has been highlighted by several studies. For example, Clay (1997) found wage earnings from palm harvesting to be two/three times the Brazilian minimum wage. Gram *et al.*, (2001) also reported that income earned from gathering natural products from the Amazonian flood plain was higher than for agricultural activities. In a study conducted in India, Burma (1992) quoted in Neumann and Hirsch (2000) asserted that during drought, the economies of some impoverished tribal areas depended solely on products collected from the forests. In some cases, however, harvesting of wild species seldom account for a significant percentage of the annual calorific needs, but remain important sources of income for certain groups of people (Pouta *et al.*, 2005). Nevertheless, in some rural communities, these resources are marketed through informal channels and are not often included in cost-benefit analysis and policy and decision-making (Ozesmi, 2003), hence, little is known about their sustainable commercialisation (Freese, 1998; Ozesmi, 2003).

In Lesotho, concerns have only recently been raised about threats to biodiversity values due to illegal and uncontrolled trade in wild plants, some of which are harvested from the wetlands and/or appear under the list of rare and endangered flora (Mokuku, 1999; Mdee, 2004; NES, 2000). Despite the concern, systematic studies on the extent of commercialisation and associated ecological effects are rare. The exception to this is a study conducted by Letsie (1993), which estimated that as many as 100, 000 wild medicinal plants were harvested weekly and sold in urban areas or exported illegally to neighbouring South Africa.

6.2 Objectives

In view of the lack of information on the commercialisation of wild plants in Lesotho this study was undertaken to determine market characteristics/pattern, extent and, seasonal variability in wetland plant trade in Pelaneng-Bokong study area. Specific objectives included:

- To determine market attributes of wetland plants, by examining commonly traded species, the form in which they are traded and preferred market outlets.

- To determine the extent and seasonal fluctuations in trade events (or retailers involved), quantities and prices of commercialised wetlands plant species across six villages and two management regimes.

- To examine how the current trade pattern (form of trade, marketing outlets, price and seasonality of trade) contribute to over-exploitation of wetland plant species (contribution to the natural assets).

It was expected that the study might contribute in better understanding of the role that wetland resources play in local economy. Findings of the study might also assist in the decision and policy formulation process geared towards better utilization and conservation of wild plants of the wetlands.

6.3 Materials and methods

The approach used in this chapter follows that indicated in Chapter 2. Data pertaining to marketing patterns in the study area was obtained through panel and market surveys (Chapter 2 sections 2.4.5 and 2.4.6). In panel studies information was obtained at the individual level and members were asked to record, through the use of calendars, daily quantities of plants and/or craftwork items produced and sold and market outlets used. Where possible, dried samples plant materials and finished products targeted for trade were weighed using a laboratory scale.

In addition to the panel surveys, Setibi Handicraft Centre, one of the two handicraft markets within the area, was also visited monthly to make an inventory of incoming

products, prices and sales records of traded wetland products. Where possible these visits were scheduled to coincide with days when cooperative members gathered to produce handicrafts, thus allowing the researcher an opportunity to make observations and question producers on quantities of plant material used and value adding activities carried out.

Structured interviews covering the following themes were administered in the local language, with each interview taking about half to one hour to complete. These composed questions covering:

- Commonly traded wetland species;
- Form of trade;
- Extent of trade (traders, trading events and quantities traded);
- Seasonal fluctuations in trade;
- Income obtained from commercialised plants;
- Value adding activities, number of people involved, inputs used and associated prices;
- Issues related to storage facilities as well as the extent to which people traded individually or as cooperatives were pursued.

It was however, difficult to record data on quantities sold and incomes obtained accurately on a monthly basis, since finished products were not always sold during the same month that they were made. Also, the Setibi Handicraft Centre were not used to the idea of keeping books and records, while other panel members were not comfortable revealing sensitive information on income and its uses.

6.4 Analysis

Data were entered in the computer package SPSS version 10.0 (Pallant, 2001) and both parametric and non-parametric tests were used as appropriate. To address the objectives of the chapter, the following analyses of different variables were carried out:

- Characteristics and extent of trade values were determined by using panel survey data to compute, across all villages, the number of times respondents indicated that they had sold a species or used parts of a species to produce a saleable item. These were then totalled and used as a basis for a matrix used for recording and calculating the proportion of retailers involved in trade, volume harvested for trade, associated prices, cash generated as well as marketing outlets used.

- Gross income was estimated by computing cash reported by panel members from the sale of wetland plants and products across all villages throughout the eleven month study period. Net income was determined by subtracting production costs (mainly input and transportation costs) from gross income. Producers' own time input was not costed. From this exercise it was also possible to estimate income per species per village.

- Seasonal variations in variables such as proportion of retailers, quantities traded and prices charged, were computed by grouping months into the four seasons (spring, summer, autumn and winter) and subjecting each variable against them.

- The Sustainable Livelihoods Framework (DFID,1998) was used to determine the contribution of wetland plants' trade on the livelihood assets. In particular, the trade's potential to enhance household's ability to increase income and employment opportunities (Financial Assets).

- Contribution to the natural assets was appraised by analysing variables such as quantities marketed, marketing outlets and type of species marketed to determine the extent to which they encouraged over-exploitation of the resources.

6.5 Results

6.5.1 Commercialised Wetland Plants

Table 6.1: Wetland plant species and/or plant materials commonly traded or used to manufacture traded products in Pelaneng-Bokong - November 2004 to July, 2005

Name of Species	Local Name	Plant Part Used	Products
Merxmuellera drakensbergensis	Moseha	Leaves	Mats, brooms, ropes, baskets, hats, ornaments
Fingerhuthia sesleriiformis	Thitapoho	Leaves	Brooms
Juncus glaucus	Rororo	Leaves	Ropes
Scirpus ficinoides	Loli	Leaves	Trays, local beer strainers
Carex cognata	Lesuoane	Roots	Traditional loin skirts (*thithana*)
Gunnera perpensa	Qobo	Bulb	Bulb
Mentha aquatica	Koena-ea-liliba	Leaves	Leaves
Rumex lanceolatus	Khamakhamane	Roots	Roots
Rannunculus multifidus	Tlhapi	Roots	Roots

Of the ten species prioritised as being critical to the livelihoods in Pelaneng-Bokong study area (See Chapter 4, Table 4.4), nine (90%) were used to manufacture handicrafts which were either used for household purposes and/or traded. However, in the case of medicinal plants, these plants were often traded unprocessed (see Table, 6.1). The most popular species for manufacturing handicrafts were members of Cyperaceae and

Poaceae families (see Table 4.7, section 4.7.1). Plants in these families are not only characterised by high resilience to defoliation, rapid vegetation regeneration hence demonstrating high potential for sustainable utilisation (Cunningham 1985 cited in Shackleton, 2005), but are said to provide the highest quality and durable raw materials (Van Wyk and Gericke, 2000; Letsela *et al.*, 2003). Moseha (*Merxmuellera drakensbergensis)* was the most versatile, and utilized for various trade items including as hats, basketry, mats, ropes and brooms.

6.5.3 The extent and seasonal variation in wetland plants commercialisation

6.5.3.1 Traders and trading events

As depicted in Table 6.2, the number of panel members engaged in wetland plant trade varied widely from village to village [Kruskal-Wallis test, n = 718, df = 5, X^2 = 55.25, p <.001]. An inspection of the mean ranks indicated that there were more people engaged in wetland plant trade in Boritsa [mean rank = 411.38] and the least in Ha Tlholo (Mean rank = 324). However, the difference in number of traders was limited to villages and were found to be non significant between the RMA and communal areas [Mann-Whitney u test, n = 720, Z =.-380, p=.704].

Table 6.2 Numbers of panel members engaged in wetlands plants trade (n) and volumes (Kg) of plant material traded (in brackets) reported on nine wetland plant species and distributed across six study villages. A 12 month survey conducted from August 2004 to July 2005 in Pelaneng-Bokong study area, Lesotho.

Species	Month	Villages					
		Poli (n=13)	Lukase (n=10)	Lejone (n=10)	Tlholo (n=10)	Lesaoana (n=10)	Boritsa (n=9)
Merxmuellera	Aug		1(4.35)				2(12.43)
	Sept			2(4.26)			2(16.32)
	Oct	1(2.33)	1(24)				1(279.72)
	Nov	1(6.2)	2(4.66)				2(559)
	Dec	1(2.33)	3(292)			1(10)	2(8.55)
	Feb		1(2.3)				1(279.12)
	May		2(8.55)				
	June		2(8.55)				2(12.43)
Juncus glaucus	Sept						2(1)
	Oct						1(0.55)
	Nov						1(1)
	Dec						2(1)
	Feb						1(44.4)
	April						1(0.5)
	June						1(0.5)
Scripus ficinoides	Sept		1(4.44)				2(1.11)
	Oct						1(4.44)
	Nov	1(0.55)					1(33.3)
	Dec		1(0.55)				
	April					1(7.2)	
	May						1(4.44)
	June						1(0.55)
Fingerhuthia sesleformis	Aug		1(5.76)	1(5.76)			
	Sept			2(4.33)			2(7.93)
	Oct	1(2.16)		1(8.64)	2(4.32)		2(7.93)
	Nov	1(2.16)					
Carex cognata	Aug						1(1.97)
	Sept						1(1.97)
	Oct						1(1.97)
	Nov						1(39.30)
	Feb		1(0.16)				
	June		1(0.16)				
Rannunculus sp.	Nov	1(0.071)					

	March	1(0.071)			
Rumex lanceolatus	June		1(0.53)		
Mentha aquatica	May				1(0.0024)
	June		1(0.0024)		

Trading events and traders across the study area also varied significantly with the type of species (Figure 6.1) [Kruskal –Wallis test, n = 720, df = 8, X^2 = 67.697, p <.001]. For example, the overall highest number of traders across the study area were trading in *Merxmuellera drakensbergensis,* and this species accounted for 44% of the total harvest events. In contrast, medicinal plants were the least traded.

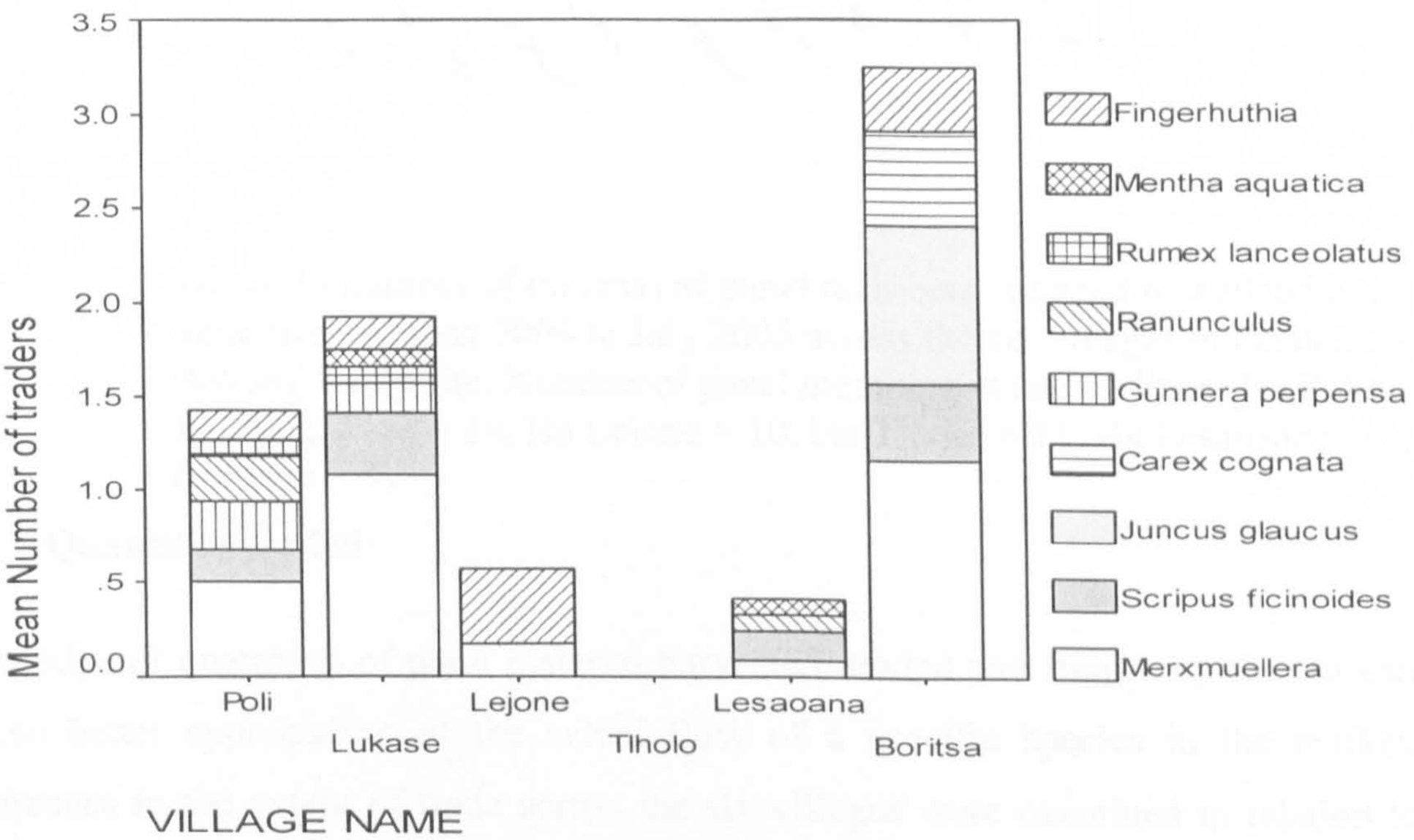


Figure 6.1 Mean numbers of of panel members engaged in wetland plant trade across the six study villages. Figures are expressed in terms of the number of times given species were traded per month for twelve months

6.5.3.2 Seasonal variation in number of traders

The number of panel members engaged in wetland plant trade and/or trading events varied significantly in different months [Kruskal-Wallis test, n = 721, df = 11, X^2 = 28.072, p = .003] For instance, as shown in Figure 6.2 the number of traders seemed to be characterized by several peaks and troughs with the number of traders increasing substantially in December and decreasing between January and February.

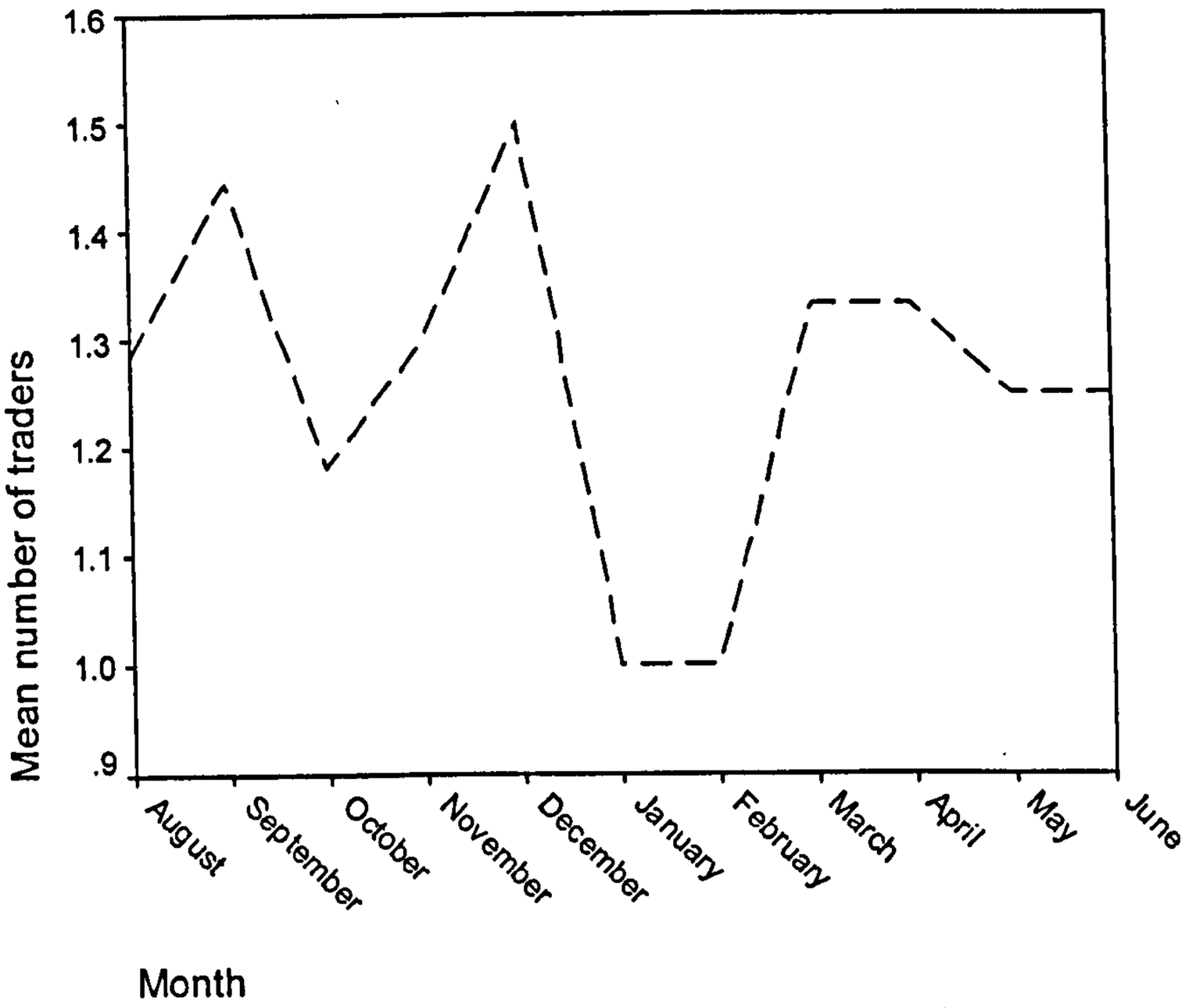


Figure 6.2 Trends in number of (means) of panel members engaged in wetland plant trade from August 2004 to July 2005 across the six villages in Pelaneng-Bokong Study site. Number of panel members in each village (Ha Poli= 13, Ha Lukase = 10, Ha Lejone = 10, Ha Tlholo = 11, Ha Lesaoana = 10, Boritsan = 9)

6.5.4 Quantities traded

Knowledge of quantities of plant material harvested, traded and frequency thereof can lead to better appreciation of the actual flow of a specific species in the market. Differences in the extent of trade across the six villages were examined in relation to quantities of different species harvested for trade. These are presented as mean quantities per species per panel member in Table 6.3 and estimated total quantities of traded species per village in Table 6.4.

Traders in Boritsa traded in all other species except medicinal plants. Panel members from this village accounted for 52% of total traded quantities of *Merxmuella drakensbegensis* and recorded the highest volume of traded plant material (62 Kg/panel member) in November and March (see Table 6.3). In contrast, there were no sales at Ha Tlholo, and quantities of plant material traded at Ha Poli, Lejone and Lesaoana were relatively low.

Table 6.3 Mean quantities (Kg) of wetland species traded per panel member per month across villages

Species	Month	Villages					
		Poli	Lukase	Lejone	Tlholo	Lesaoana	Boritsa
Merxmuellera sp.	Aug		0.435				1.3
	Sept			0.426			1.8
	Oct	0.17	0.24				31.08
	Nov	0.48	0.466				62.11
	Dec	0.17	29.2			0.1	0.95
	Feb		0.23				31.013
	March		55.9				62.1
	April		1.63				0.006
	May		0.855				
	June		0.855				1.3
Juncus glaucus	Sept						1.11
	Oct						1.11
	Nov						1.11
	Dec						1.11
	Feb						4.9
	April						0.05
	June						0.05
Fingerhuthia sesleformis	Aug		0.576	0.576			
	Sept			0.433			0.881
	Oct	0.166		0.864	0.432		0.881
	Nov	0.166					
Carex cognata	Aug						0.22
	Sept						0.22
	Oct						0.22
	Nov						4.37
	Jan						0.58
	June						0.22
Gunnera perpensa	Oct	0.012					
	Feb		0.016				
	June		0.016				
Rannunculus sp.	Nov	0.0054					
	June	0.0054				0.0709	
Rumex lanceolatus	June		0.053				
Mentha aquatica	May		0.00235			0.00235	
Scripus ficinoides	Sept		0.444				0.12
	Oct						0.49
	Nov	0.042					3.7
	Dec		.0555				
	April				0.72		0.49
	May						0.06

The amount of *Fingerhuthia sesleformis* (50%) and *Scripus ficinoides* (78%) traded were also higher in Boritsa than in the other villages (see Table 6.5). Though their level

of commercialisation was relatively low (less than 5Kg per person), it was only in Boritsa that species such as *Juncus glaucus* and *Carex cognata* were used as decorations for handicrafts, and hence entered the market stream. Conversely, medicinal plants were not only traded in low quantities (0.02 – 0.5Kg) but their marketers were mainly concentrated at Ha Lukase. However, despite the inter-village differences, the Kruskal-Wallis test revealed no significant difference in terms of quantities of plant material traded across villages [Kruskal –Wallis Test, n = 429, df = 5, X^2 = 6.904, p = .23].

Table 6.4 Estimated total quantities (Kgs) of plant species traded by panel members in Pelaneng-Bokong study area from August 2004 to July 2005 across the six study villages

Species	Village					
	Poli	**Lukase**	**Lejone**	**Tlholo**	**Lesaoana**	**Boritsa**
Merxmuellera drakensbergensis	10.86	2177.66	4.26		10.00	2336.25
Scripus ficinoides	0.55	5.00			7.20	44.95
Juncus glaucus						51.55
Carex cognata						52.42
Gunnera perpensa	0.16	0.32				
Rannunculus multifidus	0.14				0.07	
Mentha aquatica		0.01				
Fingerhuthia sesleformis	4.32	5.76	23.06	8.76		31.72
Rumex lanceolatus		0.53				

6.5.4.1. Seasonal variations in quantities of traded plant material

Fluctuations in amount of traded plant material were noted over months, across the studied villages [One-way ANOVA, F(10, 70) = 2.87, p = .005]. M*erxmuellera drakensbergensis* was by far the most traded wetland species (Figure 6.3) with traded quantities ranging from 40 Kg in August to peaks of 1133.52 Kg in November and

1678.43 Kg in March. In comparison, the sales of other species are small, though there are variations between sales of these species as shown on Figures 6.4 and 6.5.

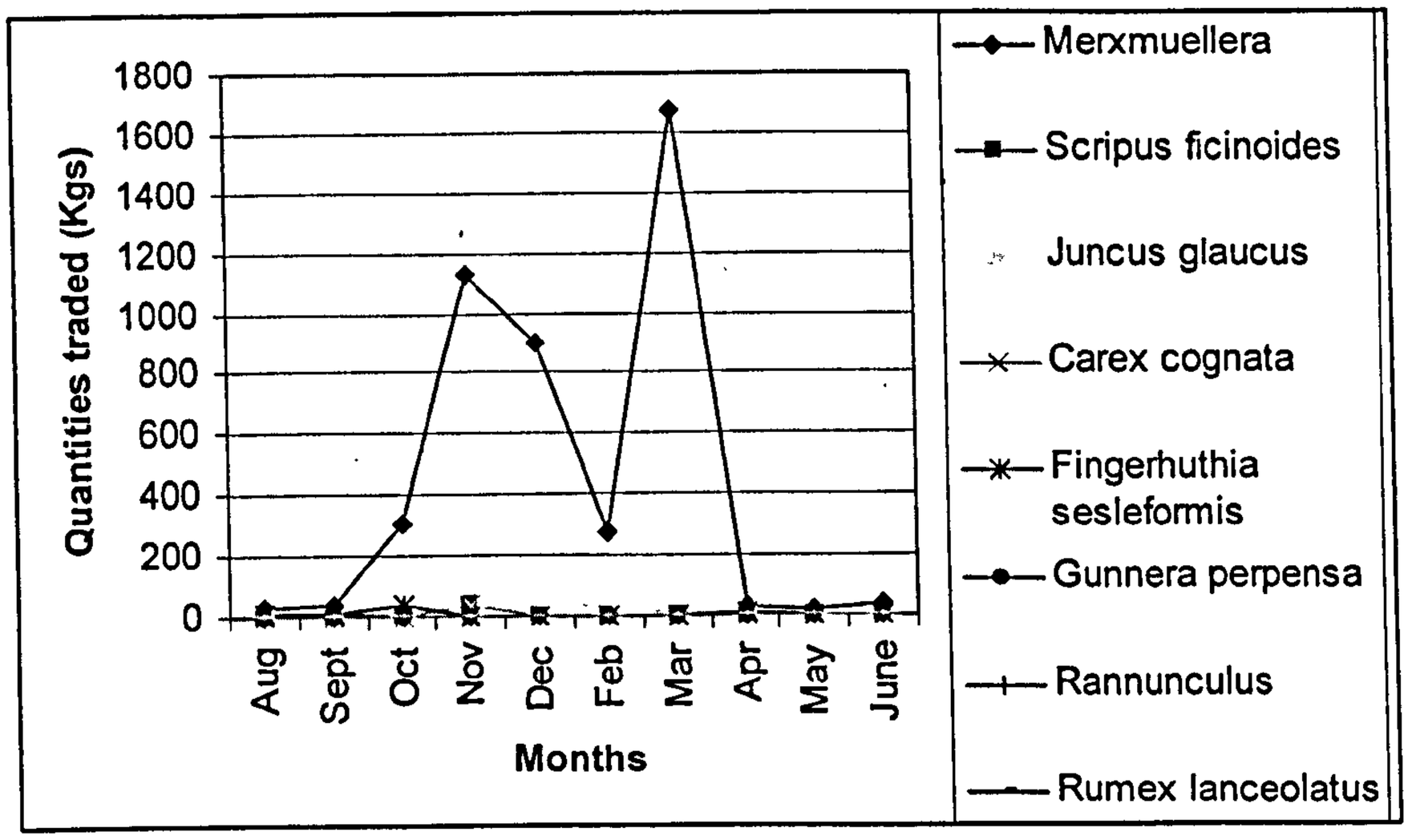


Figure 6.3 Monthly trends in estimated quantities (measured in kilograms) of all key livelihood plant species traded from August 2004 to July 2005 Number of panel members in each village (Ha Poli= 13, Ha Lukase = 10, Ha Lejone = 10, Ha Tlholo = 11, Ha Lesaoana = 10, Boritsan = 9)

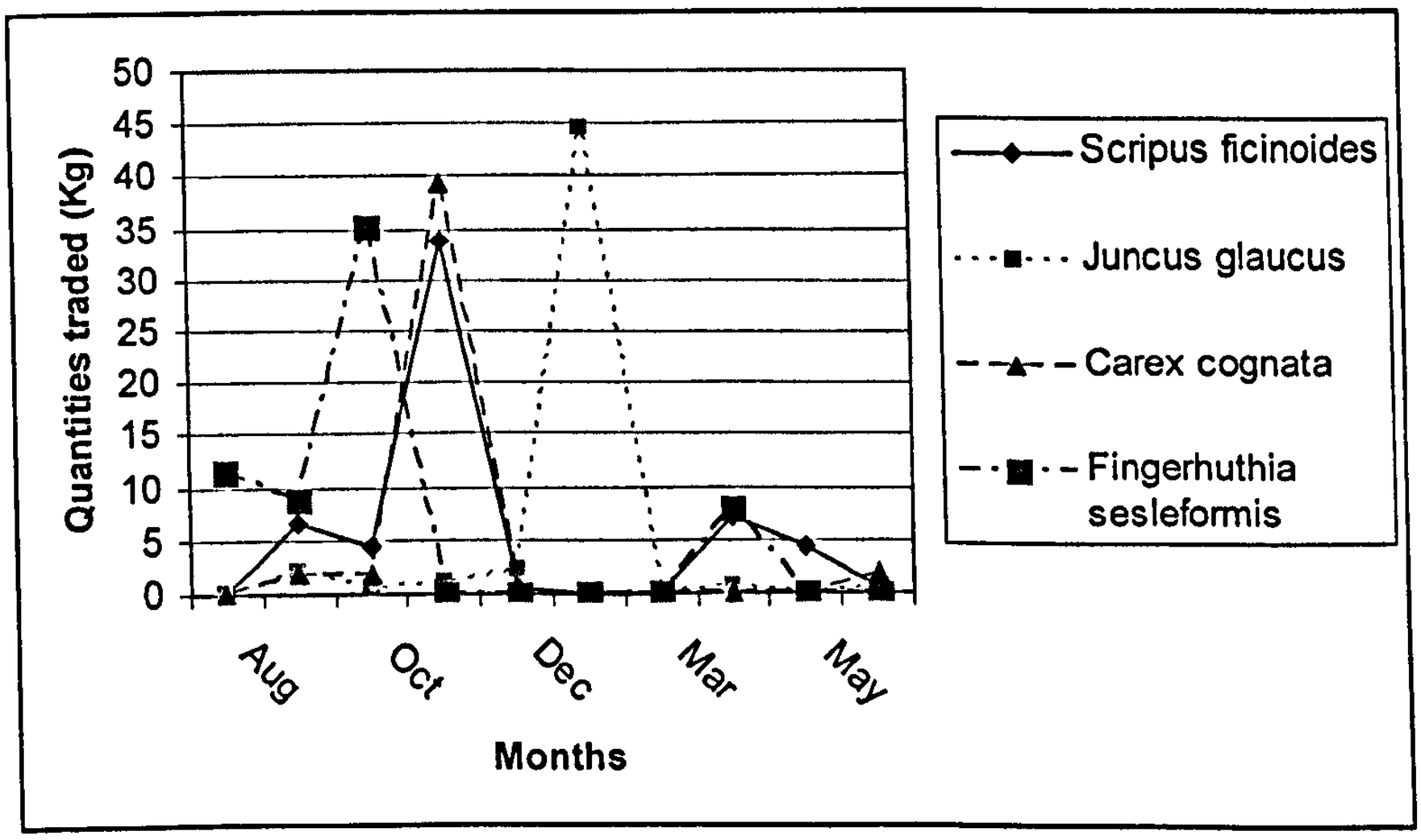


Figure 6.4. Trends in estimated quantities (Kgs) of four other wetland species *Scripusficinoides, Juncus glaucus, Carex cognata* and *Fingerhuthia sesleforis*, used in manufacturing handicrafts traded from August, 2004 to July 2005 across the six study villages in Pelaneng-Bokong. Number of panel members in each village (Ha Poli= 13, Ha Lukase = 10, Ha Lejone = 10, Ha Tlholo = 11, Ha Lesaoana = 10, Boritsan = 9)

The second highest traded species was *Fingerhuthia sesleformis* (Figure 6.4) with quantities traded (35.08) peaking in October. This was followed by *Scripus ficinoides, Juncus glaucus* and *Carex cognata* fluctuating widely between 0Kg to 45 Kg during the sampled months.

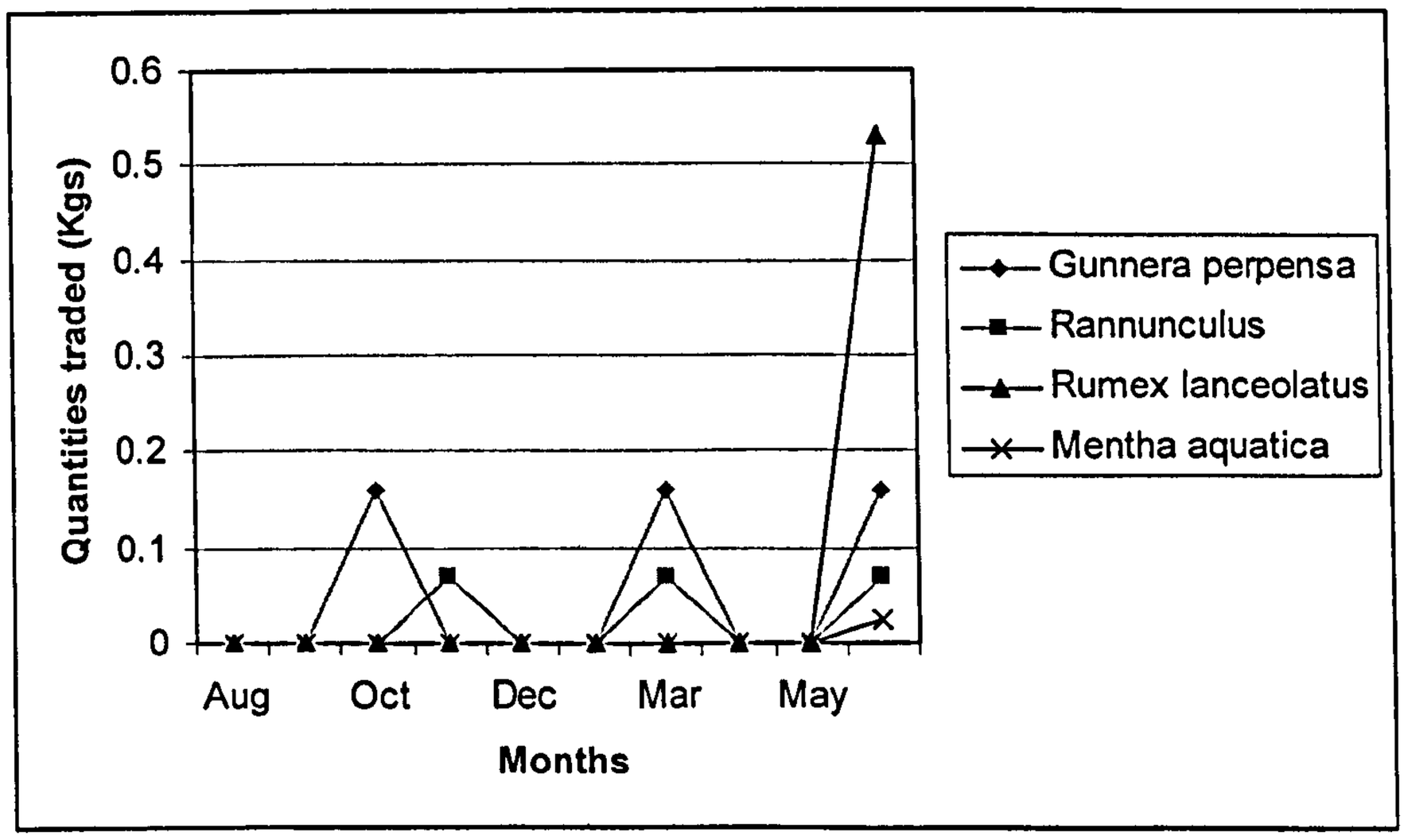


Figure 6.5 Trends in estimated quantities (Kgs) of medicinal plants - *Gunnera perpensa, Rannunculus spp., Rumex Lanceolatus* and *Mentha aquatica* traded from August, 2004 to July 2005 across the six study villages in Pelaneng-Bokong. Number of panel members in each village (Ha Poli= 13, Ha Lukase = 10, Ha Lejone = 10, Ha Tlholo = 11, Ha Lesaoana = 10, Boritsan = 9)

Traded quantities of medicinal plants were much lower than those of other species used as raw materials for handicrafts (Table 6.4 and Figure 6.3). There was no trade recorded for these species for most months and where trade occurred, marketed quantities remained constant, often below 1Kg (see Figure 6.5).

6.5.5 Economic value of wetland plants

The income generated from the sales of wetland plants and products, after deducting production costs, was R2,827.00 per annum, equivalent to about R257.00 per person per month for the production or selling period of approximately 11 months (see Table 6.5). Income earned generated from the sale of handicrafts constituted the highest single

source, constituting 98% of total wetlands-plant-generated incomeed, while the remaining 2% was from the sale of medicinal plants. The data was however, extremely variable with large differences among the surveyed villages. For instance, Boritsa earned the highest income (R1,428.50) accounting for 51% of total income generated from wetland plants. This was followed by Ha Lukase, with a net income of R899.00 accounting for 32% and Ha Tlholo the minimum (R17.50), constituting 0.6% of the total. The net income of approximately R2,827.00 per annum was found to be significantly lower than R2,000.00 per producer obtained by Shackleton (2005) for her broom study in Bushbuckridge municipality in South Africa.

Table 6.5 Quantities of wetland or plant products traded and net income (averaged for 11 months) per product across the six study villages. Net income is revenue from sales minus any direct costs of production. Producers' own time input was not costed. (US$1 = 8.50 Rands)

Village	Products made	Quantities Traded	Income (Rands)	% Total income from wetland plants
Ha Poli (n=13)	Brooms	11	55.00	23
	Hats	1	10.00	0.043
	Ropes	4	80.00	13
	Tray (*Sethebe)*	3	35.00	15.2
	Beer Strainer	1	10.00	4
	Bowl	2	40.00	17
Total			**230.00**	**8**
Ha Lukase(n=10)	Mats	12	65.00	7
	Brooms	12	144.00	16
	Bowls	2	65.00	7
	Hats	3	150.00	17
	Clay Pots	7	190.00	21
	Ropes	4	90.00	10
	Tray (*Sethebe)*	4	95.00	11
	Beer Strainer	1	15.00	2
	Bowl	1	15.00	2
	Tray	3	70.00	8
Total			**899.00**	**32**
Ha Lejone(n=10)	Brooms	12	**75.00**	**3**
Ha Tlholo(n=10)	Brooms	3	**17.50**	**0.6**
Ha Lesaoana(n=10)	Brooms	12	55.00	31
	Ropes	1	20.00	11
	Tray (*Sethebe*	2	25.00	14
	Beer Strainer	11	77.00	44
			177.00	**6**
Boritsa(n=9)	Mats	7	215.00	15
	Brooms	63	380.00	27
	Ropes	15	725.00	51
	Tray (*Sethebe*	17	87.50	6
	Bowl	3	21.00	2

Total	**1428.50**	**51**

Income generated from the sales of *Merxmuellera drakensbergensis* products was the highest and accounted for 60% of the total income from wetland plant sales (Table 6.6). This was followed far behind by income accruing from *Scripus ficinoides* products, contributing almost half of the income earned from *Merxmuellera drakensbergensis* R805.00. Of all wetland plant species used to manufacture handicrafts, *Carex cognata* generated the lowest income accounting for 1% of total income earned. Similarly, all traded medicinal plants generated modest income (<1%).

Table 6.6 Estimated net income earned per wetland species (calculated for approximately 11 months) across the six study villages. Net income is revenue from sales minus any direct costs of production. Producers' own time input was not costed. (US$1 = 8.50 Rands)

Species	Income (Rands)	%
Merxmuellera drakensbergensis	1 693	60
Fingerhuthia sesleriiformis	144	5
Juncus glaucus	110	4
Scripus ficinoides	805	28
Carex cognata	30	1
Rannunculs	5	0.2
Gunnera perpensa	23	0.8
Mentha aquatica	12	0.42
Rumex lanceolatus	5	0.2
Total	2 827	

6.5.6 Seasonal Variations in Price of Traded Wetland Resources

Clay (1997) argues that the rise or fall in prices of species could result in over-exploitation and/or scarcity depending on the circumstrances. To determine seasonal price variability prices of one product, brooms, each made of Moseha (*Merxmuellera drakensbergensis)* and Thitapoho (*Fingerhuthia selseformis),* were studied over twelve months (see Figure 6.5). These products are short, hand-held, traditional hand crafted brooms commonly used in both the rural and urban areas of Lesotho and often in high demand. They consist of two types, the 'soft' one used for sweeping smooth surfaces indoors, and the 'hard'one used for carpets and for sweeping yards. Brooms are among the most widely traded wetland plant products, and are generally replaced at least three

times a year given that their lifespan is generally between 10 weeks and 6 months (Shackleton, 2005). In the study area, each primary school child was expected to donate one broom for sweeping the school compound once a year.

Apart from their economic value, brooms also play a critical role culturally, and are given as presents on different occasions. For instance a bundle (containing not less than 3 brooms) is often given as a going-away present to newly married couples. In some cases, they are exchanged for other purchased items. Also, unlike other handicrafts which tend to vary in size, make and price brooms tend to be relatively standard designs and are therefore comparable over time and between villages.

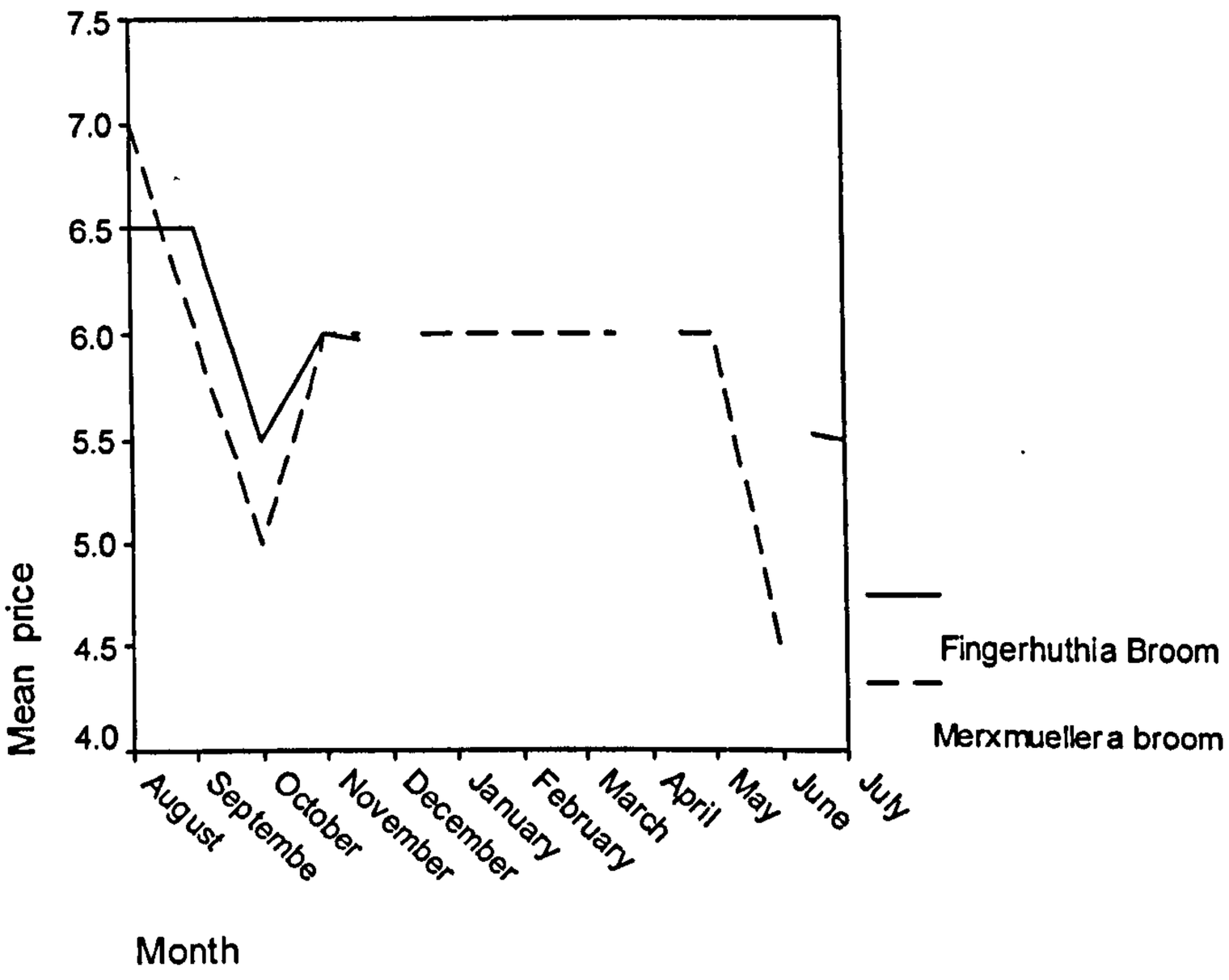


Figure 6.6 Trends in prices (in Rands – US$1 = 8.50) of *Merxmuellera sp.* and *Fingerhuthia sp.* brooms sold by panel members from the six study villages in Pelaneng-Bokong study area over a period of 12 months

The selling price of the two types of brooms differed slightly with the 'soft' *Merxmuellera drakensbergensis* broom costing more than the 'hard' *Fingerhuthia sesleformis* broom reflecting the difference in processing time and prices of inputs. For instance, the former takes about 5 to 6 hours to make and producers need twine string (costing about R25.00 and lasts up to a year) to sew the grass together. Conversely, it takes a relatively shorter time to make the 'hard' broom (2 – 3 hours) and could be tied together by any recycled items.

There seemed to be discernible pattern in price fluctuations of both products. For instance prices for both were notably high in August, when supplies of plant material were low, and experienced sharp drops in October (when the demand was low due to abundance. From November to May (summer and autumn) the price of *Merxmuellera drakensbergensis* broom stabilized, while *Fingerhuthia sesleformis* brooms were not traded within the same period.

6.5.5 Marketing Outlets

The marketing channels used for commercial products were largely informal and limited to homesteads and neighbouring villages, though at times, trading was combined with trips to Ha Lejone town or lowland districts (see Figure 6.6).

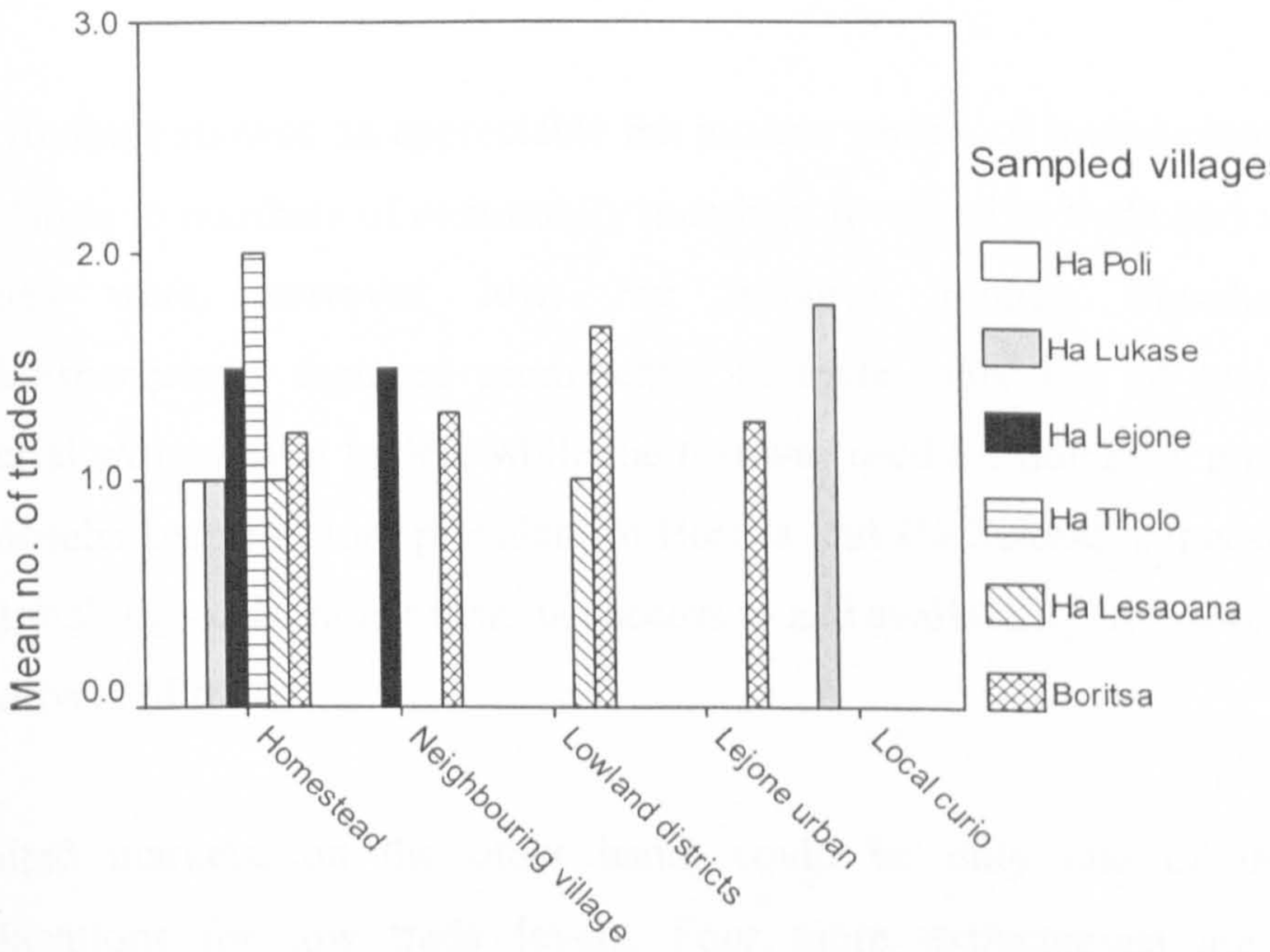


Figure 6.7 Distribution of panel members engaged in wetland plant trade across market outlets they utilized to sell wetland plants and products in Pelaneng-Bokong for a 12 – month period (August, 2004 to July 2005).

At Ha Lukase, however, there was a small-scale curio shop, established by the Lesotho Highlands Water Project. This largely worked as a cooperative for making and selling

handicrafts, and was mainly utilized by communities situated in the RMA. The six villages differed appreciably in relation to market channels used [Kruskal-Wallis test, n = 64, chi square = 19.2, df = 4, p= < .001]. For instance, traders from Boritsa were the most resourceful, using almost all the available marketing opportunities. In contrast, villagers from the other five villagers were limited to one or two marketing outlets.

6.6 Discussions

6.6.1 Extent of wetland plants trade

It has been suggested that collection of wild plants for trade constituted a serious threat to species in some plant groups (Kala, 2005; Glaser, 2003). This study, therefore, investigated market characteristics of wetland plants by determining traded plants, dynamics of wetland plants trade, quantities involved, seasonal variability and assessing the implications of trade to plant regeneration in Pelaneng-Bokong study area.

The findings showed an appreciable but modest variety of traded plants. Levels of trade in relation to numbers of community members involved in trade and volume traded per species were, however, low. For instance, though Moseha (*Merxmuellera drakensbergensis)* featured prominently in trade, only 6% of total harvested plant material was actually traded, while the rest was used for domestic purposes. Also, trade in Moseha seemed more prevalent in Boritsa and Ha Lukase, suggesting that possibly, craft-making skills, rather than just access to and availability of resources may be one of the drivers of trade.

Limited markets, on the other hand, could be only one of the many possible explanations for low trade levels. Four more explanations are possible: 1) the replacement of traditional artefacts with manufactured items; 2) Low purchasing power locally (see chapter 2); 3) remoteness of the study area and isolated nature of individual villages, particularly given that, urban demand has been cited as one of the generators of commercial trade in wild plants for rural source areas in Africa (Cunningham, 1991); and; 4) trading in plants and crafts is not the main source of income but is instead used as a supplementary source of income. This finding lends support to the observation made by Shackleton (2005) about the supplementary nature of mat trade in Bushbuckridge in South Africa. On the other hand, utilization of local markets by

Pelaneng-Bokong residents could be a way of reducing transport costs. Vormisto (2002), in a marketing study of Chambira hummocks and bags in North Eastern Peru, found that villagers often need fixed agreements before visiting other regions and often sell locally to try and reduce transportation costs.

Trade in herbal medicine was found to be even less developed and limited to very few villages. This could probably be due to a combination of factors, of which, the overriding factor could be the high abundance – low demand paradox. It is also possible that commercialisation of medicinal plants might be obscured by the traditional herbalists' consultation fees. Similar findings were made by LetŠela *et al.*, (2003). Also, the fact that two of the commercialised medicinal plants, Qobo (*Gunnera perpensa)* and Koena-ea-liliba (*Mentha aquatica)* were listed as endangered species (NES Legal Notice No. 93, 2004), could result in reluctance to acknowledge involvement in their trade.

6.6.2 Seasonal Variations in Trade

The findings portrayed an inverse relationship between monthly quantities of plants traded, prices and number of traders. For instance, in relation to *Merxmuellera drakensbergensis* and *Fingerhuthia sesleformis* in August, few villagers were engaged in trade, quantities traded were also relatively low while prices charged for products were high. Similarly, in October, increases in quantities traded invoked a drop in prices. These seasonal fluctuations could be explained through causal links between prices, quantities and demand (Majoro, 2000), and could suggest scarcity of wetland plants like Moseha in spring, resulting in a few traders and high prices. On the other hand, producers, in order to take advantage of high prices when supplies are low, might be tempted to over-harvest and store products to sell when prices are high. These findings are consistent with those of Padoch *et al.*, (1991) in a study of commercial exploitation of medicinal plants in Indonesia, where prices of *Gahuru* were subject to considerable fluctuation due to a combination of changes in abundance and uncertainty among traders.

6.6.3 Contributions of wetland plant trade to livelihoods

In general, income earned from wetlands plant trade though modest, reflects a potential for good returns. Also, a few individuals from Boritsa and Ha Lukase, though a minority, were able to earn reasonable incomes from trading in wetland plants. This is important information that is likely to be lost when data are reduced to averages. Income accruing from wetland plants is also notable when viewed in the Pelaneng-Bokong setting where the majority of households are either unemployed of earning far below the legal minimum wage of R565.00 per month (equivalent of U$S67).

6.6.4 Implications of trade on species' regeneration

The degree of species' vulnerability to exploitation depends not only on supply and demand, but also on life form, part used and frequency of use. Findings of this study portrayed several attributes of the wetland plant trade, which would be less likely to result in over-exploitation. For instance, a variety of traded plants, potentially presents craft-makers with alternative raw materials. This is important in any business and could decrease competition, demand and depletion of plant species. Conversely, the dominance of *Merxmuellera drakensbergensis* as the highly traded resource could have adverse ecological implications.

Though for most traded plant species leaves were commonly utilized, roots were the main ingredients of herbal medicine. The effect of their removal, however, has a more damaging effect on species population than harvesting leaves. In contrast, if harvested in a sustainable way, leaves could enable re-growth. Similar findings were made by Vormisto (2002) and Kotze *et al.*, (2002).

Low levels of trade and limited local-based market outlets, though not economically sustainable, might have positive ecological impacts by acting as a disincentive for over-exploitation. Reported tendencies of rural communities to collect wild plants to secure home consumption and only sell surplus quantities to meet other household cash needs (Prance and Boom, 1992), is consistent with the findings of this present study.

For some plants, seasonal fluctuations could spread harvest and trade over the year, thus reducing chances of over-exploitation. However, fluctuations in prices could have serious economic repercussions. For example, seasonality may create uneven income

streams that would not only increase livelihood insecurity but may induce people to over-harvest and stockpile products in order to make profit when prices of products are high. These findings are consistent with previous research (e.g. Freese, 1998; Neumann, 2000 and Clay, 1997).

Similar studies in more populous areas, with diverse income sources and efficient marketing system are needed in order to analyse and compare effects of trade on wild plants in different socio-economic settings.

6.7 Conclusions

- Trade in wetland plants provides readily accessible, though limited opportunity for income generation.

- Current trade level is neither a threat to harvested species nor wetland sites.

- Trade in wetland plants is subject to considerable fluctuations due to changes in abundance in different seasons. For people who become too dependent on traded plants, this seasonality is likely to increase livelihood insecurity and also induce people to over-harvest and stock-pile plants and products to make profits when prices of products are high.

- Current level of returns though sustainable, are low and might not be an incentive for people not to convert wetlands into other land uses such as croplands, considered to be more profitable.

- The local demand for wetland products is low, mainly due to high levels of unemployment and low purchasing power. However, this scenario is likely to change with envisaged increase in the number of tourists. However, tourist-dependant markets are often characterised by boom-and-bust, thus requiring efforts to explore new markets if the industry is to grow. Currently the potential to trade in the lowlands or other larger urban centres is currently limited by poor road infrastructure and high transportation costs. However, the impact on the

resource base should be a consideration before hopes are raised regarding profitability of selling crafts to tourists.

Chapter 7

Preferred wetland plants, use values & contributions to local livelihood portfolios

CHAPTER 7 - PREFERRED WETLAND PLANTS, USE VALUES AND CONTRIBUTIONS TO LOCAL LIVELIHOOD PORTFOLIOS

7.0 Abstract

The importance of wetland species as providers of numerous goods and services essential to local livelihoods has been widely acknowledged. This chapter adopts the sustainable rural livelihoods framework to appraise uses, values and contribution of wetland plant species to the local capital assets. The results indicated that 20% of all wetland plants contributed to livelihood sustenance in the study area and were being utilized across the livelihood spectrum. Medicinal plants and craft-making wetland plants constituted the highest uses. Though used more for household subsistence needs than trade, thus generating modest income, they remain vital for households with less diversified sources of livelihood and few sources of income. Wetland plants also contributed appreciably to all livelihood assets by providing support to other livelihood sources, shelter, energy, medicinal herbs and the means to cope with lean periods. These results underscore the need to ensure that natural reserves are prevented from diminishing to a level that they cannot support livelihoods.

7.1 Introduction

The interest in livelihood values of wild plants, particularly for the world's 1.3 billion extremely poor people, who often live in countries that are economically poor but rich in biodiversity, has been growing steadily over years (Wolfson, 2003). In these societies, few rural households are entirely removed from the natural resource economy and most remain directly dependent on the continued existence of biodiversity for their livelihood needs (Grundy, 2003). The recognition of the value of wild species has in turn promoted research on the value of plants from different ecosystems for different human societies. For example, Hecht *et al.*, (1988) describe the importance of *babassu* palm among the landless farmers in Brazil. Similarly Zorini *et al,*. (2004) suggested that mangroves represented an essential source of income in Kisakasaka village on the island of Zanzibar and Mida Creeek in Kenya, while patterns of edible plant selection and their relationship with the environment was investigated by Ladio and Lozada (2000) in a Mapuche community of Northwestern Patagonia. Some work has attempted more in-depth assessment of rural communities' dependence level on wild resources (eg. Ellanna and Wheeler, 2006) and these have developed indices to determine relative importance of different species to society (Reyes-García *et al.*, 2006).

The socio-cultural context of wild species has also been widely researched. For instance, the use of "free" plants from ecosystems including wetlands, forests and rangelands, have been described as an essential part of risk aversion strategies (Dixon and Wood, 2003; Silvious, 2000; Streever *et al.*, 1998; Woodward and Wui, 2001; IUCN, 2003). Economically important plant species have been cited not only to enhance income generation, but to provide employment during slack periods of the agricultural cycle (Grundy, 2003). Wild vegetables, on the other hand, fill a dietary gap during lean periods (LVAC, 2002). Some studies have argued that it is the poorer and more vulnerable households that tend to depend more on the natural resource base and more of each resource than households that are fairly well diversified (Luckert and Campbell, 2003).

Wetlands can provide goods and services important for the locals' livelihood security that merit attention. For example, direct harvest of many wetlands yields a number of products, ranging from fire wood, construction materials and medicinal plants. For instance, Motsamai (1988) and Letsela *et al.* (2003) indicated that high altitude wetlands in Lesotho provided valuable browse and grazing for livestock, particularly during drought or early growing season when grazing reserves are low. Likewise, the Brazilian Pantanal, contains grasses and sedges that supports over 5 million cattle (Dugan, 1993). Despite their extensive conversion to other land uses, in many parts of Africa, wetlands also continue to be cultivated in their natural form (Kotze *et al.*, 2003; Dixon and Wood, 2003).Terrer *et al.*, (2003) indicated that the fauna and flora of some wetlands are often culturally significant and form a critical part of religious heritage.

However, a gap in information on the influence of wetland plants on local livelihood portfolios still exists due to the fact that most of these studies relied on surveys and interviews to capture relative importance of different plant species in daily life (Reyes-Garcia *et al.*, (2006). Responses to interview questions would bear a stronger resemblance to daily uses of plants if surveys were combined with observational data (Ladio and Lozada, 2004; Reyes-Garcia *et al.*, 2006).

Few of these studies have attempted to link these services to the local livelihood portfolios. A holistic assessment of species' influence on local livelihoods on the other hand would enable the consideration of the extent to which various uses and associated

values of plants depend on the interplay between capital assets and the context in which they are situated.

7.2 Overall Objective

To understand local driving forces on wetland resource utilization, and to introduce an additional element of livelihood values in decision-making, this study adopts the sustainable rural livelihoods strategy (Carney, 1998), to investigate the contribution of wetland plant species on local livelihoods. This strategy is a component of the Sustainable Livelihoods Approach framework, based on the recognition that livelihood strategies include multiple components in the form of access and/or lack of financial, human, natural, social and physical assets. The approach was developed by the UK Department for International Development (DFID) in the late 1990s as a tool for analyzing projects oriented towards poverty alleviation (DFID, 2000).

The current study might provide valuable insights into local communities' livelihood options, values that people attribute to, and motivations for utilization of resources, and thus could be used to reconcile local livelihood needs and biodiversity conservation.

7.2.1 Specific Objectives

- To characterise current livelihood systems and determine the relative importance of wetland plants among households in the study area.

- To appraise use and livelihood values of preferred species.

- To determine contributions of wetland plant species to local capital assets

7.3 Materials and methods

The broad approach follows that outlined in Chapter 2, Section 2.4. A three-step approach was employed in assessing the contribution of harvested wetland plants to local livelihoods. These included (a) the analysis of local socio-economic profiles; (b) appraisal of capital asset status and (c) determination of wetland plant species influence on local assets.

1.

7.3.1 Analysis of socio-economic profile

Information on the livelihood activities and income sources of the local communities and on the use of wetland resources across the income groups was obtained through livelihood surveys. This was used to establish if there was a relationship between livelihood sources and use of wetland plants. Topics covered information on livelihood sources, preferred wetland plants as well as their major uses and values.

7.3.2 Determination of the status of capital assets

As indicated in Chapter 2 section 2.4.4, the Sustainable Livelihood Framework was adopted to assess the status of capital assets. This involved preparation of a matrix of key indicators describing each of the five capital assets, later discussed and agreed upon with key informants across the six villages (Table 7.2.). For example, social assets refer to social resources such as networks, membership of groups, relationships of trust upon which people draw in pursuit of livelihoods, while physical assets refer to basic infrastructure, including transport, shelter and energy (Carney, 1998).

The second stage of the exercise entailed allocating values to indicators. In each village a Focus group, made up with men and women were established in order to determine the perception of each village on the importance and rank of the indicators of each capital asset. Groups had to discuss and reach a consensus on the number of people who had access to a given indicator, or where appropriate, an actual count of indicators per village was made. For instance, financial assets were examined in terms of the financial resources, that people use to achieve their livelihood objectives and hence the numbers of people who had access to given financial resources were used as proxies. On the other hand, human assets, representing skills, knowledge and good health (DFID, 2000) were represented by the number of schools and hospital in each village, while social assets, defined by Carney, (1988) as social resources upon which people draw in pursuit of their livelihood objectives, were estimated through the number of social organizations and informal groups in each of the six study villages. Indicators for natural assets included of natural resources such as water and rangelands important for livelihoods in each village. Lastly, physical assets were represented by the number of basic infrastructural services such as roads, modes of transport and toilet facilities

needed by communities to support livelihoods. These were discussed at length with villagers and once agreements were reached, values given each indicator were summed up for each asset. Pentagon segments representing the capital assets (financial, human, social, natural and physical) were then drawn to show schematically, the variation in access to assets, with the centre point of the pentagon, representing zero access to assets while the outer perimeter represents maximum access to assets.

The problem with this exercise was that, despite explanations some people still viewed the exercise as some kind of shopping list and thus, tried to downplay some of the indicators, hoping they might be allocated more resources if the existing ones were deemed inadequate. For example, some people from Ha Tlholo did not want to admit that they had access to a mobile clinic. Similarly, social indicators were sometimes over-emphasized in order to portray an image of responsible citizens. In such incidences, information obtained from the key informants proved invaluable and were used to probe and cross-check information generated through the group discussions.

7.3.3 Appraisal of uses values of preferred species

Using the pilot study results, six main categories of wetland plant use were identified: handicraft production, construction, fodder, firewood, food and medicine. Under the construction category, uses include roofing material for houses and construction of cattle-posts, chicken pens and vegetable garden enclosures. The agricultural category consists of activities such as wool and mohair sales, crop farming, livestock production and vegetable production. The wage-earning category on one hand consisted of household members working for wages both locally and outside the region. In the study area, these were teachers, secretaries, mine workers, textile factory workers, shop assistants and livestock herders. This differed with the informal/casual category, which comprised of Food-for-Work schemes, digging pits for latrines, weeding and other casual activities. The business category, on the other hand, consisted mainly of people who brewed and sold local beer, tailors and shop and taxi owners.

To enable a comparative analysis of species' values, a scale of 0->10, based on the number of uses each plant had, was adopted where, no value (=0), very low value, low (less or equal to1), High (2-10) and very high (>10). For instance Moseha, due to its

multiple uses had the highest value, whereas medicinal plants scored low. A similar scale was used by Reyes-Garcia *et al.*, (2006) in their study of cultural, practical and economic value of wild plants in Bolivian Amazon.

7.3.4 Contribution of wetland plants to the local capital assets

Prior to fieldwork, a checklist, consisting of questions assessing the influence of various wetland plants on the five capital assets was prepared and updated throughout the 12 months (see Appendix 7.1). Questions were designed to establish whether plants generated income and/or employment locally, how income was utilized, how involvement in collection of wetland plants had enhanced villagers' capabilities to access physical assets including markets, shelter and energy. Responses to these questions were then used to develop a matrix of indicators of contributions to the five capital assets as indicated in Table 7.5.

Values for each indicator was determined by computing the number of times panel respondents indicated that they used a species for a certain purpose. For instance, contributions of wetland plants to financial assets consisted of the following: a) number trading events per village; b) number of times wetland plants were used to improve agricultural production; c) number of events when wetland plants were used to improve livestock health and; d) number of times plants generated employment, thus helping them to achieve their livelihood objectives. These were then totalled across villages and divided by the potential maximum total value, where the maximum potential value was the overall capital asset status (Table 7.5). Thus, if all of the financial capital was derived from wetland plants, the potential score would be 100%. Once values for indicators were determined, they were used to draw pentagon segments representing contributions of wetland plants to the capital assets (financial, human, social and physical) per village.

7.4 Results

7.4.1 Characterisation of livelihood systems

7.4.1.1 Socio-economic Profiles

The main sources of livelihood (grouped) in Pelaneng Bokong are presented in Table 7.1. Agriculture occupied a prominent position in most villages, with 75% to 88% of households deriving livelihoods out of agriculture. An exception to this trend was Ha Lejone with less than 50% households involved in agriculture. Contrastingly, the business category ranked lowest.

Table 7.1 Livelihood activities adopted by the Pelaneng-Bokong inhabitants; Data represents percentages (rounded) of sample households deriving main source of livelihood within a given category, (-) means no households within the category

Village	Agriculture	Wage Earning	Own Business	Informal/Casual
Ha Poli	75	16	-	10
Ha Lukase	88	6	6	-
Ha Lejone	44	17	2	37
Ha Tlholo	83	10	-	7
Ha Lesaoana	78	17	4	8
Boritsa	75	10	-	8

NB: percentages do not add up to 100 because households were engaged in more than one livelihood activity.

Agriculture was the prominent livelihood strategy across the six villages. Agricultural activities undertaken included crop, vegetable and livestock farming, although some of the poorer households engaged in sharecropping arrangements with others. Unlike the other five villages, Lejone had fewer households engaged in agriculture and more in the informal sector. Of the four livelihood categories, 'Own business' ranked lowest. The sampled villages, however, did not differ considerably in livelihood sources [Kruskal-Wallis test, N = 188, X^2 = 8.156, df = 5, p =.148], neither was there a statistically

significant difference in sources of income and welfare between the communal and Range Management Areas (RMA) [Mann-Whitney U test, N=188, Z=-1.902, p=.057].

7.4.1.1 Importance of wetland species

Uses of wetland plant species across livelihood sources are presented in Figure 7.1. Wetland plants were utilized across the livelihood spectrum. However, spatial variations were noted in terms of the extent to which they were used. For instance the use of wetland plants seemed more pronounced within the informal sector at Ha Poli, Ha Lesaoana and Ha Lejone, whereas, at Boritsa, people relying on agriculture for livelihood, utilized wetland plants more. Nonetheless, these disparities in plant utilization across the four sources of livelihoods were found to be statistically non-significant [Kruskal-Wallis test, n=188, $X^2 = 2.14$, df = 3, p=.543].

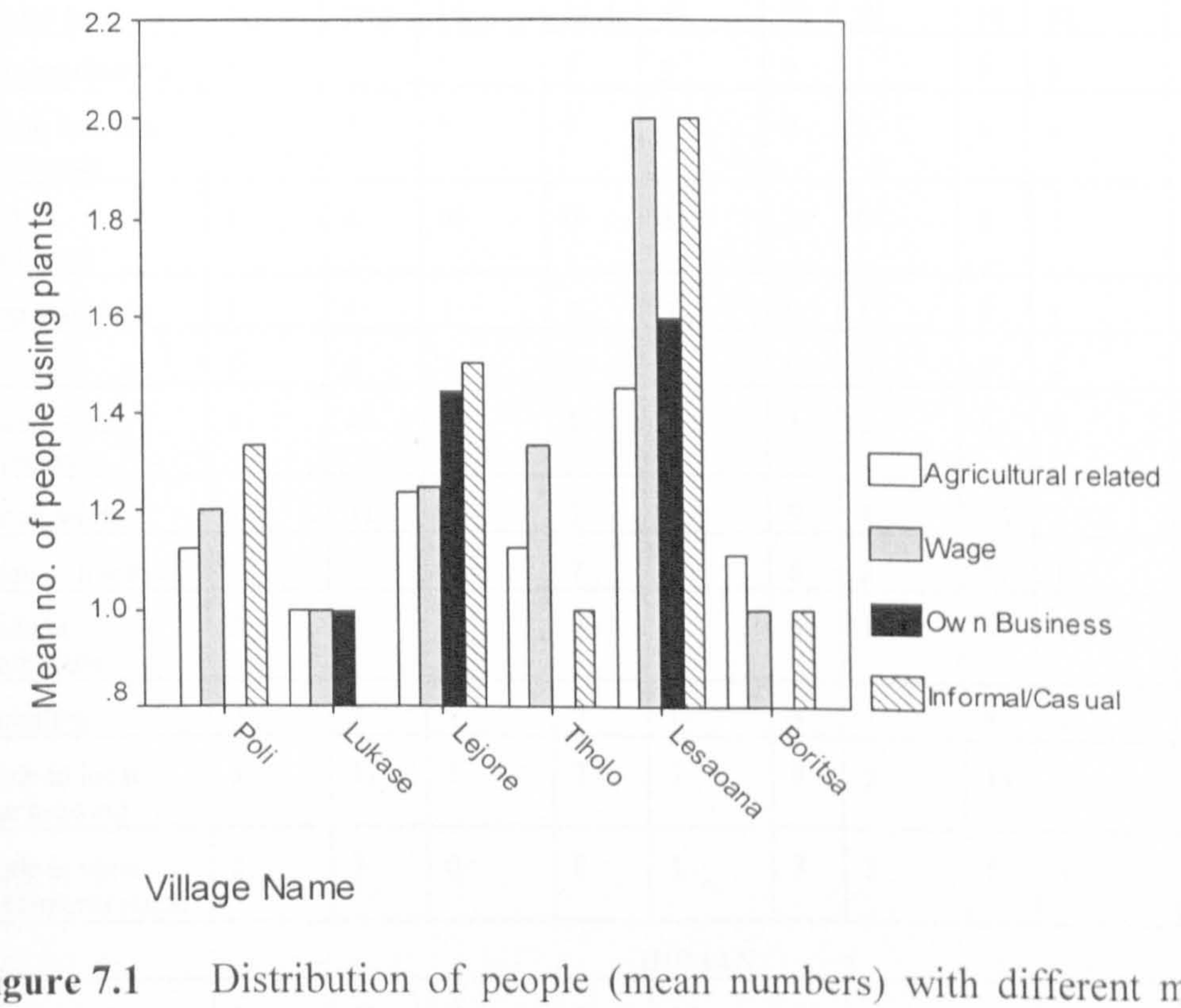


Figure 7.1 Distribution of people (mean numbers) with different main livelihood strategies who used wetland plant species for different purposes in six villages

7.4.1.2 Determination of the status of overall capital assets

Although estimated scores reflecting the value of each of the indicators of livelihood assets varied widely across management regimes and villages, access to infrastructural services had some influence on the status of local livelihood assets (Table 7.2). For

instance, RMA villages, especially Ha Lejone had the highest percentage of overall financial, human and physical assets and highest distribution of the infrastructure and services (Table 2.3). The differences between management regimes and villages in relation to overall natural and social assets were less pronounced.

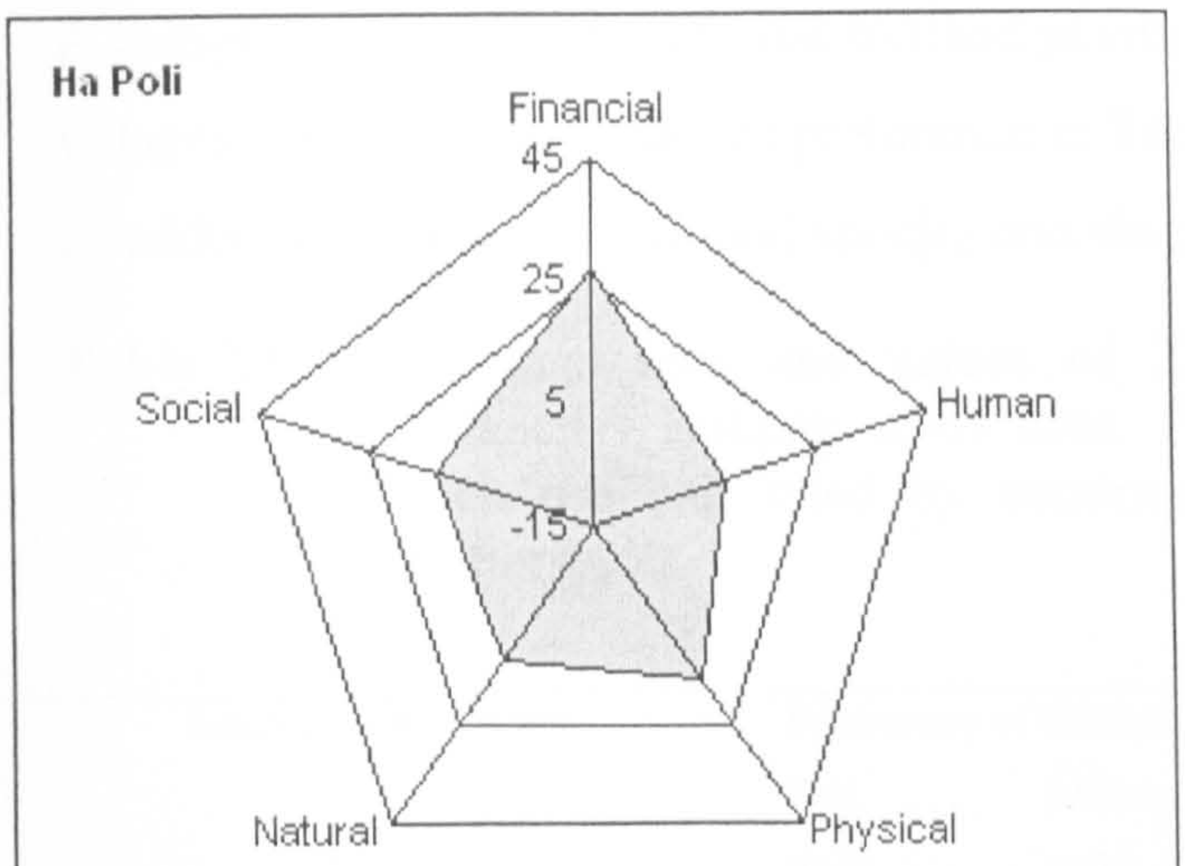
Table 7.2: Estimated values of key indicators of livelihood assets across the six study villages in Pelaneng-Bokong. Values represent number of people with access to given resources and/or actual numbers of selected services present in each of the six villages. % = Individual village score over total value for the whole study area.

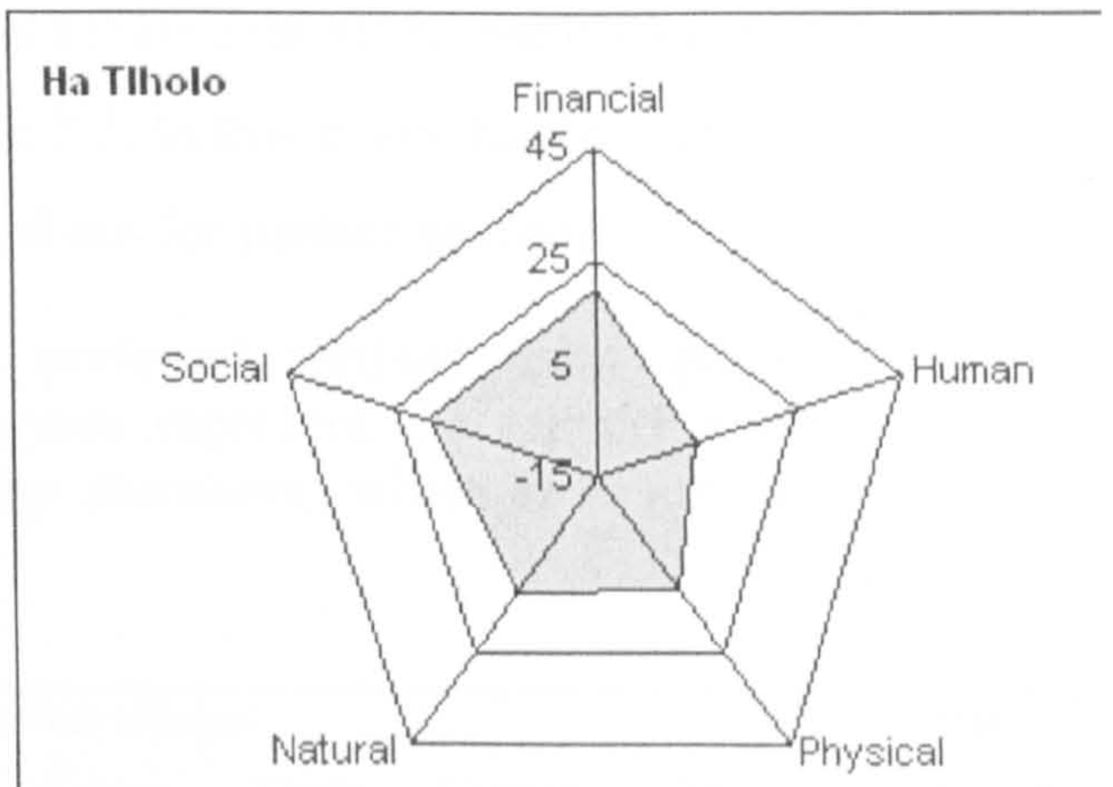
	RMA						COMMUNAL					
Key Indicators	**Poli**		**Lukase**		**Lejone**		**Tlholo**		**Lesaoana**		**Boritsa**	
	Score	%	Score	%	Score	%	Score	%	Score	%	Score	%
FINANCIAL												
Income Sources	**27**	**20.5**	**15**	**11.4**	**32**	**70**	**19**	**14**	**22**	**17**	**17**	**13**
Mine remittances	2	7	1	7	3	9	1	5	3	14	2	12
Textile factories remittances	2	7	1	7	3	9	1	5	1	5	1	6
LHWP employees	1	4	0	0	1	3	0	0	1	5	0	0
Shop assistants	1	4	1	7	3	9	1	5	1	5	1	6
Teachers	1	4	1	7	3	9	0	0	3	14	1	6
Government. employees	1	4	1	7	1	3	1	5	0	0	0	0
Casual work	3	11	1	7	3	9	3	16	3	14	2	12
Trade in livestock	2	7	1	7	2	6	2	11	1	5	1	6
Trade in handicrafts	2	7	3	20	3	9	1	5	1	5	2	12
Herbalists	2	7	1	7	1	3	1	5	1	5	1	6
Trade in local beer brewing	3	11	1	7	3	9	2	11	2	9	2	12
Trade in agric. implements rental	2	7	0	0	1	3	1	5	1	5	1	6
HUMAN												
Skills and health	9	24	3	8	14	37	4	11	4	11	4	11
Schools												
Nurseries	1	11	0	0	2	14	0	0	0	0	1	25
Primary	1	11	0	0	1	7	1	25	0	0	0	0
Secondary/High school	1	11	0	0	1	7	0	0	0	0	0	0
Driving school	0	0	0	0	2	14	0	0	1	25	0	0
Knitting and sewing school	0	0	0	0	3	21	0	0	0	0	0	0

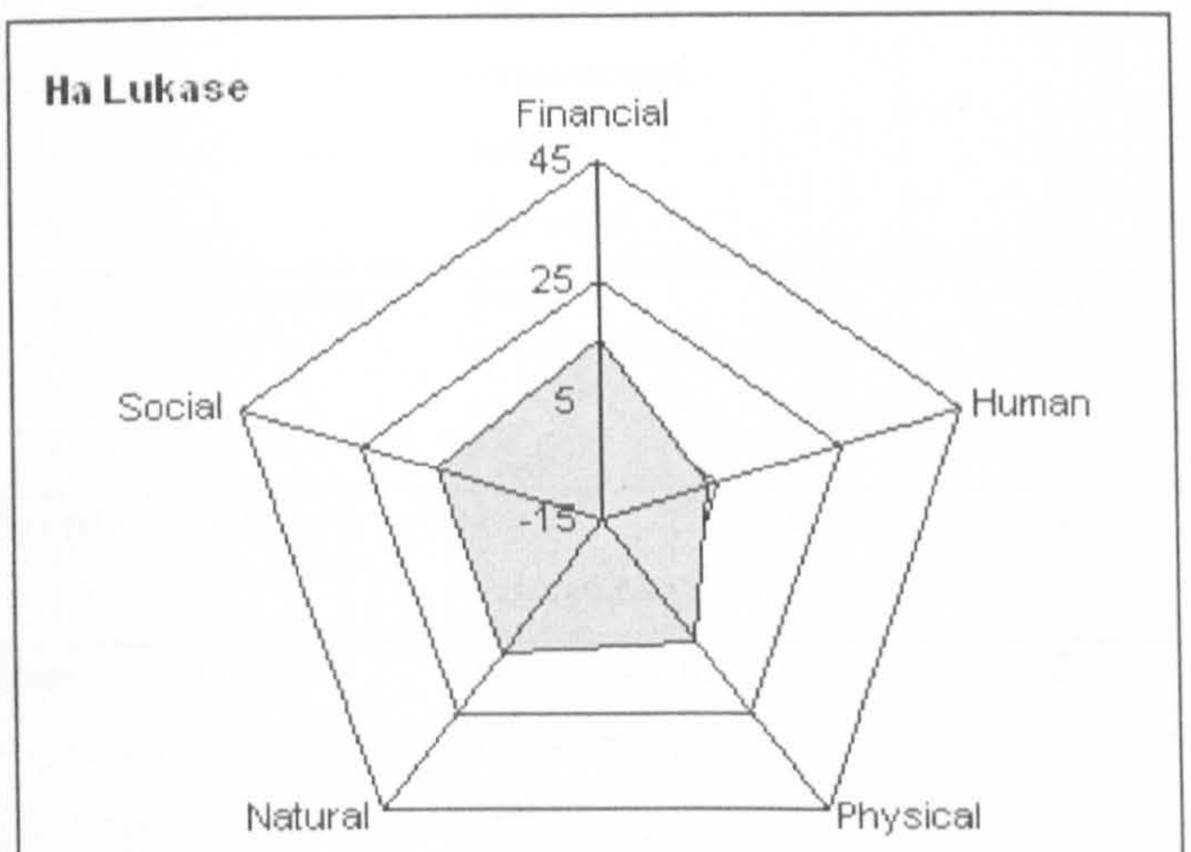
Health facilities												
Hospitals	1	11	0	0	0	0	0	0	0	0	0	0
Clinics	1	11	0	0	2	14	0	0	0	0	0	0
Indicator	Poli	%	Lukase	%	Lejone	%	Tlholo	%	Lesaona	%	Boritsa	%
Health-workers	3	33	3	33	3	33	3	33	3	33	3	33
Social Org.	**13**	**15**	**12**	**14**	**15**	**18**	**18**	**21**	**14**	**15**	**13**	**15**
Burial societies	2	15	2	17	3	20	3	17	2	14	2	15
Stokvels	2	15	1	8	3	20	3	17	2	14	1	8
Sharecropping	2	15	2	17	2	13	3	17	3	21	3	23
Mafisa	2	15	2	17	2	13	3	17	2	14	2	15
Bride price	2	15	2	17	2	13	3	17	2	14	2	15
NATURAL												
	12	**18**	**12**	**18**	**10**	**15**	**11**	**16**	**11**	**16**	**10**	**15**
Piped water	3	25	3	25	1	10	3	27	3	27	1	10
Natural spring	3	25	3	25	3	30	18	27	2	18	3	30
Rivers	3	25	3	25	3	30	3	27	3	27	3	30
Rangelands	3	25	3	25	3	30	3	27	3	27	3	30
PHYSICAL												
	16	**21**	**10**	**13**	**23**	**30**	**10**	**13**	**9**	**12**	**8**	**11**
Tarred road	3	19	0	0	3	13	0	0	0	0	0	0
Gravel road	2	13	1	10	3	13	1	10	1	11	1	13
Transport mode												
Bakkies	3	19	0	0	2	9	1	10	2	22	1	13
Sedans	1	6	0	0	2	9	1	10	0	0	0	0
Ox-carts	4	25	4	40	4	17	2	20	3	33	2	25
Markets	0	0	0	0	3	13	0	0	0	0	0	0
Toilet Facilities												
VIP latrine	1	6	1	10	3	13	2	20	1	11	1	13
Pit latrine	2	13	4	40	3	13	3	30	2	22	3	38

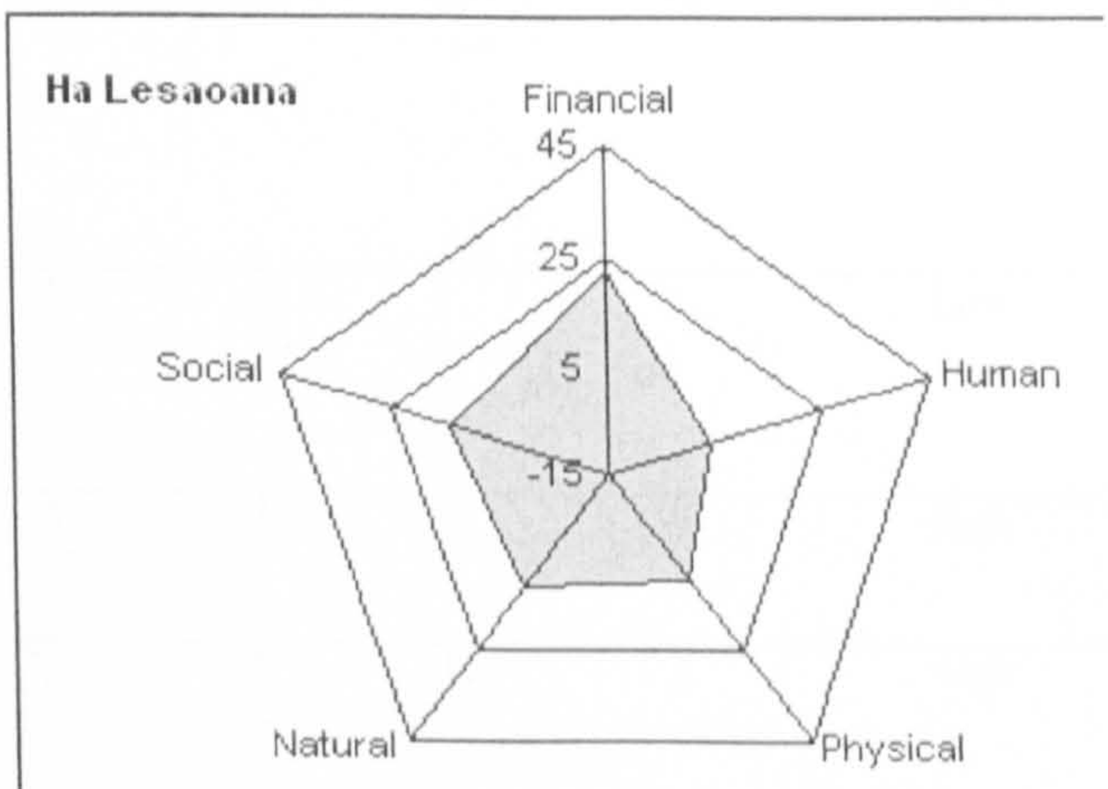
Pentagons, depicting asset status (natural, human social, physical and financial), across the six villages are presented in Figure 7.2). Of the five pentagons, in most villages, financial pentagons were bigger, reflecting relatively better access to financial than other livelihood assets, while pentagons representing human assets were smaller. With regard to the financial assets, Ha Lukase and Boritsa were exceptions and financial pentagons considerably smaller than the other four capital assets. This could be attributable to low access to alternative means of livelihood outside agriculture. Spatial variations in the size of physical pentagons, reflecting inequalities in distribution of infrastructure across the villages were also noteworthy. For instance, villages in the

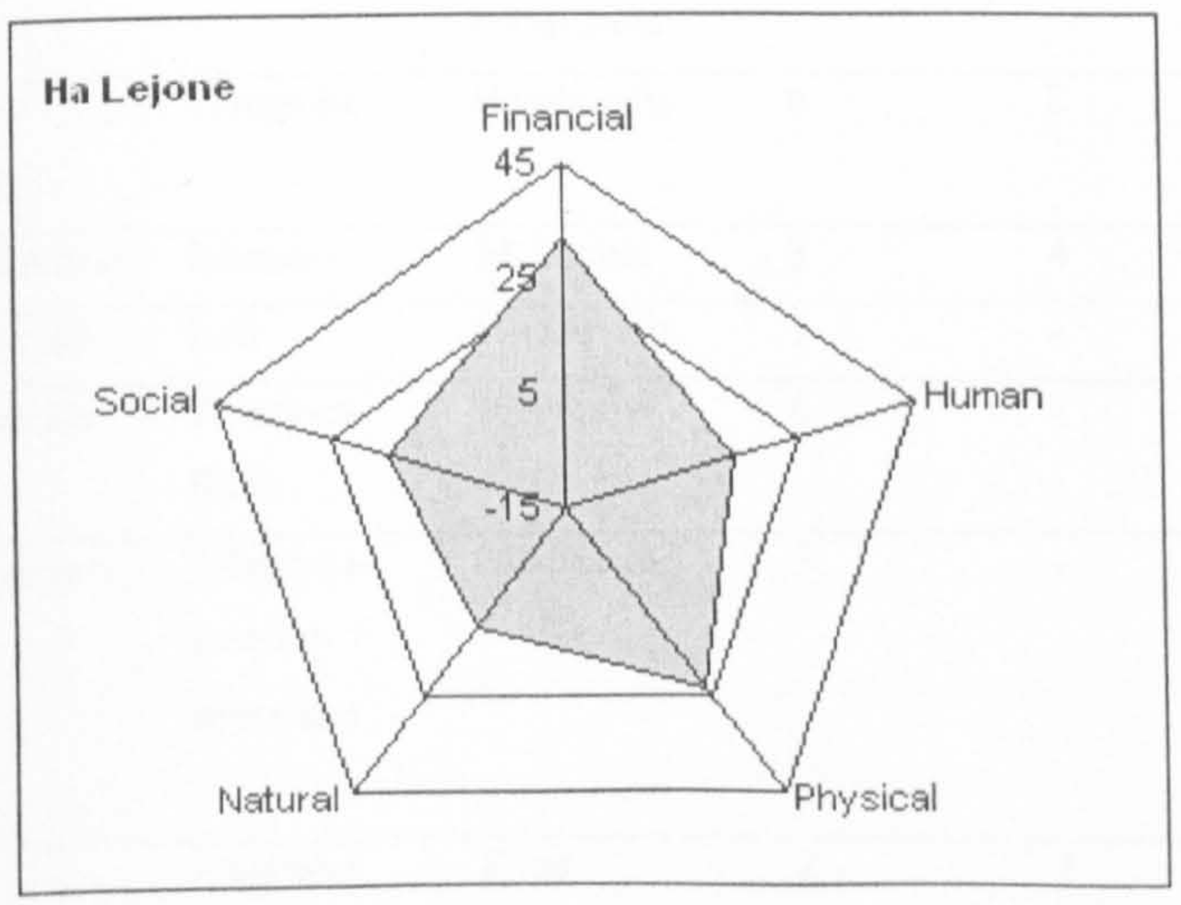
RMA had bigger physical pentagons than those in communal areas. The natural assets pentagons showed a lot of similarities across the study area. Ha Lejone had the greatest financial, human and physical asset categories while Ha Tlholo had the highest social assets. Boritsa had the smallest physical asset pentagon.











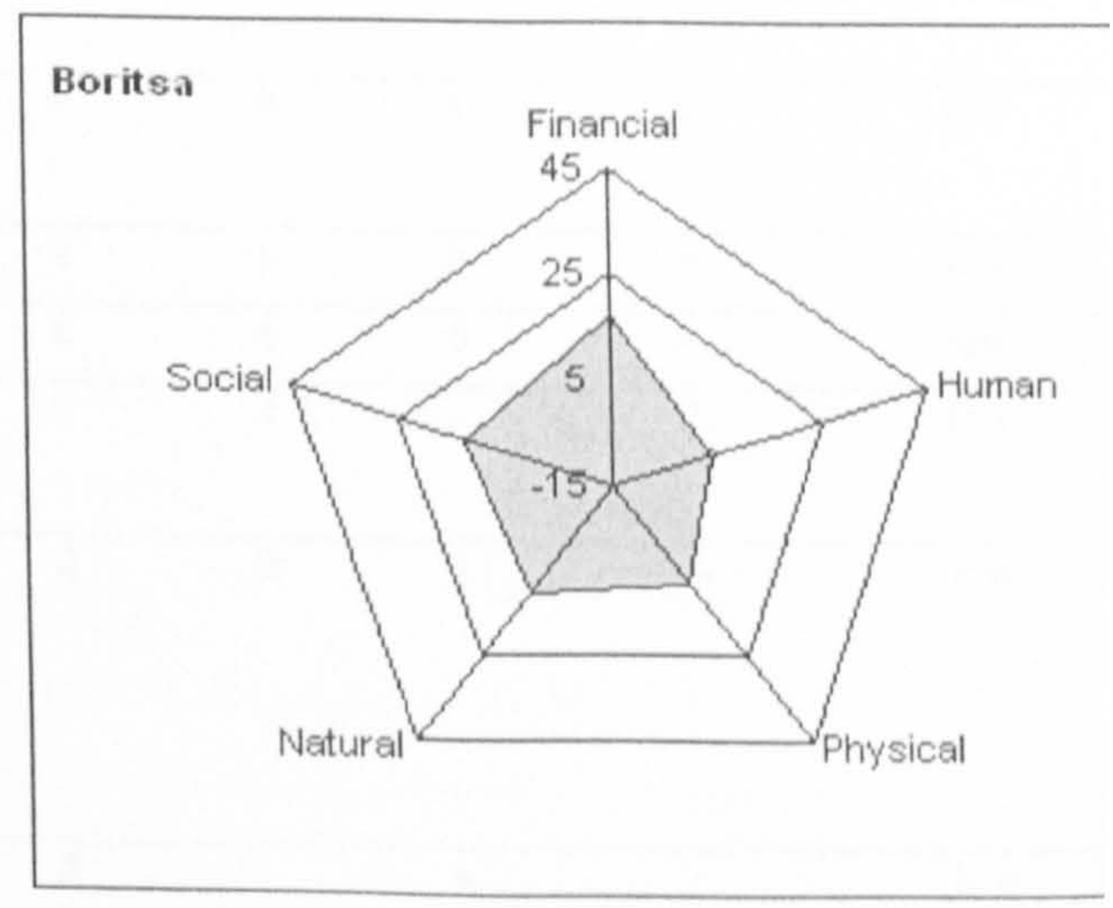


Figure 7.2 Overall livelihood assets across villages. Pentagons were determined by totalling values of key indicators for each village as described in section 7.3 .2 The centre point of each pentagon represents zero access to assets while the outer perimeter maximum access to assets

7.4.2 Preferred Plant Species and Use Values

A comprehensive list of preferred wetland plants and their uses across the six sampled villages is presented in order of preference in Table 7.3. In this study, the first ten were considered as the key livelihood species and singled out for further analysis.

Table 7.3 Practical uses and values of 22 preferred wetland plant species in Pelaneng- Bokong study area. Figures represent the number of times each use was cited by community members, where n = number of respondents

Species	Local Name	Uses	Frequency of citation across villages						Use Values
			Poli n=32	Lukase n=16	Lejone n=48	Tlholo n=29	Lesaoana n=51	Boritsa n=12	
Merxmuellera drakensbergensis	Moseha	Handicrafts, construction, fodder, firewood	15	15	24	20	19	10	High
Rorippa narstutium acquatica	Semetsing	Food	6	11	7	12	2	5	Low
Gunnera perpensa	Qobo	Food, medicinal	9	6	3	7	8	9	high
Juncus glaucus	Rororo	Construction, handicrafts, fodder	10	5	-	7	11	1	high
Carex cognata	Lesuoane	Fodder, handicrafts	9	6	3	7	2	-	high
Fingerhuthia sesleriformis	Thitapoho	Handicrafts	6	2	1	9	4	1	low
Rumex lanceolatus	Khamane	Medicinal	3	4	4	6	0	6	low
Scripus ficinoides	Loli	Handicrafts	5	-	6	6	6	-	low
Mentha aquatica	Kuena-ea-liliba	Medicinal	6	-	2	4	-	2	low
Ranuculus meyeri	Tlhapi-ea-metsi-e-nyenyane	Medicinal	3	-	2	2	1	5	low
Rorippa nudiascula	Papasane	Food	2	1	5	-	-	-	low

Alepidea amatymbica	Lesooko	Medicinal	1	-	1	2	1	1	low
Eleocharis dregeana	Sechaba	Fodder, Handicrafts		1		1	1	1	high
Pentaschistis	Molalahlolo	Handicrafts	1	1					low
Zantedeschia albobaculata	Mohalalitoe	Medicinal		1				1	low
Malva parvifloa	Tikamotse	Medicinal			1		1		low
Dierama latifolium	Lethepu	Handicrafts	1				1		low
Mariscus congestus	Qoqothoane	Handicrafts	1					2	low
Aloe striatula	Seholobe	Medicinal							low
Senecio asperulus	Mofefere	Medicinal			1		1		low
Eucomis autumnalis	Khapumpu	Medicinal	1						low
	Seliba	Medicinal					1		low

A total of 22 (20% of all the wetland species) species, distributed among 14 families, were identified as important contribution to for livelihood sustenance in Pelaneng-Bokong study area (see Table 7.3). Among these, 9 were used for handicrafts, 1 for firewood, 2 for construction, 3 for food, 4 for fodder and 10 were medicinal. The most frequently cited were medicinal herbs and handicrafts. Most of the species reported as medicinal however, fell in the low value category, having at least one use, while grasses and sedges had at least two uses. Moseha (*Merxmuellera drakensbergensis)* was most frequently cited across the six villages and had the highest number of uses. This species was recorded as making a contribution to all uses except food and medicine. Wetland plants made the least contribution to firewood.

7.4.3 Importance of Wetland Plants for Subsistence, Trade and Bartering

The consumptive, trade and barter importance of wetland plant species are compared in Figure 7.3. In the study area, wetland species were more frequently used for household consumption than for trade or bartering. For instance, use of species for household consumption was more prevalent and trade lowest at Ha Tlholo. Variations to this trend were however noted in Boritsa, where almost all harvested plant materials were traded [Kruskal-Wallis test, n = 73, df=1, X^2 = .000, p=1.000]. Bartering, though negligible, was only recorded at Ha Poli.

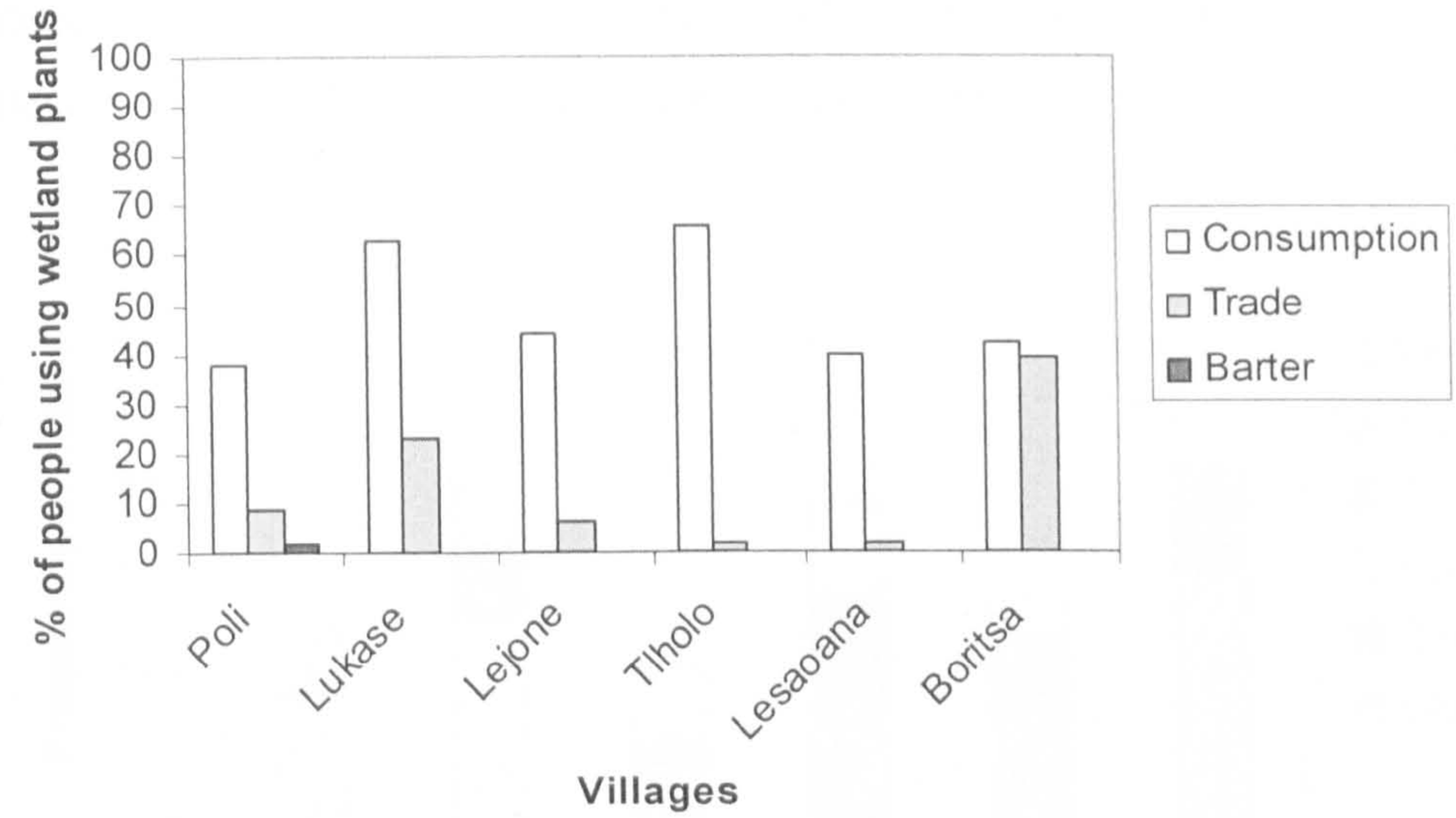


Figure 7.3 Value of wetland plants for consumption, trade and barter. Values represent frequency (%) at which wetland plants are utilized for consumption, sale or barter across the six selected villages

Annual income generated through the sale of wetland plants and products is shown in Table 6.6 and net income per village on Table 6.5. The most valuable species economically were *Merxmuellera drakensbergensis, Scripus ficinoides, Fingerhuthia sesliformis* and *Juncus glaucus,* all of which were used to make handicrafts. Conversely, medicinal plants such as *Mentha aquatica, Rumex lanceolatus* and *Zantedeschia albobaculata* were rarely traded, thus contributing least financially. Respondents in Ha Lukase and Boritsa recorded the highest income from wetland plants and products.

7.4.4 Livelihood Values of Preferred Wetland Plants

Figure 7.4 represents the distribution of uses of wetland plants for six categories of uses within the six sampled villages. For all categories, in all the villages, the number of uses reported for handicrafts was the highest, followed closely by medicine. In contrast, uses in the fodder category were recorded the least. For instance in Ha Lesaoana, the handicrafts category constituted 56% of total use categories. Similarly, in Ha Lukase and Boritsa 40% and 47% of all use categories respectively were handicrafts. An exception to this trend was Ha Lejone where the number of uses of medicinal plants was higher than those of handicrafts. Though ranking lowest across the study area, fodder

category was in fact more prominent in Ha Tlholo (42%). Similarly, the construction category registered the highest number of uses in Ha Tlholo.

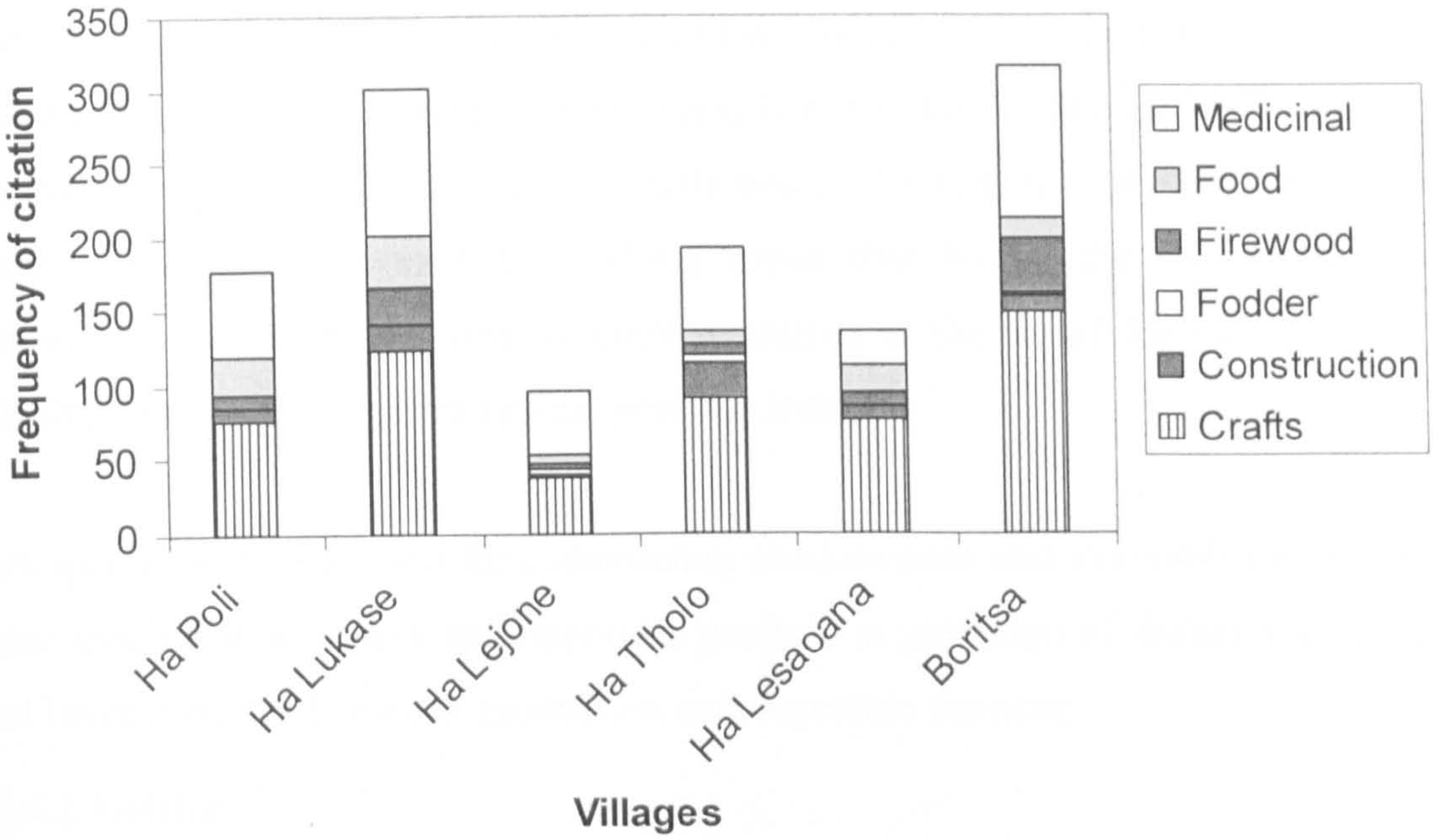


Figure 7.4 Variations in uses of wetland plants across the six categories in the six study villages. Data represents the number of times respondents indicated that they used given wetland plants for a certain purpose grouped under the six major use categories.

7.4.4.1 Handicrafts

The majority (45%) of respondents utilized wetland plants to make handicrafts. In Boritsa and Ha Lukase, 26% and 22% of respondents, reported utilizing wetland plants to produce handicrafts respectively. Handicrafts, though largely used by households for various livelihood activities, were often targeted for the market, thus broadening the income earning spectrum in the area. Products such as ropes, popularly utilized for tying bundles of different crop material in readiness for thrashing and/or transportation to the residential areas, during the harvesting season, augmented and reinforced crop farming.

Earnings from handicrafts were also used to purchase food items, school requirements, and foot medical bills and also financed subscription fees for local burial and credit societies. The latter forming a critical insurance against death-related shocks and stresses.

7.4.4.2 Construction

More species were used for construction at Ha Tlholo (32%) than in the other villages. Moseha (*Mermuellera drakensbergensis)* and Rororo *(Juncus glaucus)* were often used together to roof residential houses and cattle posts. The former formed the main roofing material and was also used for making ropes that bound the roof to the poles. Conversely, the latter was used in small quantities at the tip of the roof, to give it a finishing touch and safeguard against possible leakages.

Both species were also used for constructing chicken pens and vegetable garden fences. These species, thus occupy and important position in provision of shelter and providing vital investment for livestock production and vegetable farming.

7.4.4.2 Fodder

Four wetland species, Moseha (*Merxmuellera drakensbergensis),* Rororo *(Juncus glaucus),* Lesuoane (*Carex cognata*) and Sechaba *(Eleocharis dregeana),* provided forage. Participants reported that, with the exception of Sechaba *(Eleocharis dregeana),* these plants are largely unpalatable to livestock. However, during the lean periods such as winter, during drought or snow, when other forms of forage were not available, these plants were critical. For instance, during the winter seasons of both 2004 and 2005, when heavy snow occurred, the three species were used as coping strategies in four (Lukase, Lejone, Tlholo, Boritsa) out of the six sampled villages. Ha Tlholo recorded the highest number of respondents (41.6%) utilizing wetlands forage resources.

7.4.4.3 Food

Species such as Semetsing (*Rorippa nasturtium aquatica)*, commonly known as watercress, though less frequently cited (9%), was much appreciated in the study area. For instance, this species was considered to be not only more nutritious than the ones grown around the homesteads, but also, their year-round availability enhanced their role as coping mechanisms in periods such as winter, when planted vegetables are in short supply. Though mainly collected as a relish taken together with rice or maize meal (88%), some villagers (12%) indicated that, the species had other nutrient and

pharmacologic properties. The largest number of respondents (32%), who indicated that they used wild vegetables from the wetlands to supplement their diet was from Ha Lukase.

7.4.4.4 Fuelwood

Of all the livelihood species, Moseha (*Merxmuellera drakensbergensis)*, was the only one favoured for firewood. Though key informants indicated that, the use of this species as firewood is limited to cultural feasts and funerals, it was found that these limitations were only applied in Ha Lejone and Ha Lukase, a clear indicator that firewood shortage in the area might have elevated the status of this species as a source of energy. More importantly, its use as firewood supported two livelihood strategies- namely sale of local beer and pottery, both of which, required substantial amount of fuel. The highest (40%) number of households who used Moseha as firewood was reported in Boritsa.

7.4.4.5 Medicinal

Medicinal plants constituted the second largest use category in the study area. Of all human medicinal herbs, the most commonly cited (47%) was *Gunnera perpensa,* used as both a blood-purifier and anti-oxidant. In all the sampled villages, collection of medicinal plants was unrestricted although trade was limited to licensed traditional herbalists. This suggested an important contribution to the local health status as well as an enhancement to income sources of the traditional healers. Comparisons between villages portrayed Boritsa as prominent in medicinal plant harvesting, with highest number (26%) of households reported to be harvesting wetland medicinal plants.

7.4.5 Contributions of wetland plant species to Local Capital Assets

There was a somewhat inverse relationship between overall livelihood status and contributions of wetland plants to the local livelihoods in the sense that, plants contributed more where livelihood assets were appreciably lower and vice versa (Table 7.4). For instance, in Ha Lukase and Ha Poli, where overall financial assets were lowest (Table 7.2 and Figure 7.2), trade in wetland plants and products was more prevalent, hence contributions to financial assets highest. Similarly, the highest contributions to the human assets were noted in Boritsa, where education and health services were lowest.

Table 7.4 Numbers of respondents who cited use of wetland plants for different activities which contribute to the five livelihood assets across the six villages in Pelaneng-Bokong. The contribution is expressed as a percentage of uses of wetland species that contribute to the overall capital assets

Indicators	Poli	Lukase	Lejone	Tlholo	Lesaoana	Boritsa
FINANCIAL						
Livestock health	3	4	4	6	0	6
Employment generation	0	1	0	0	0	0
Total value of indicators with overall value of financial assets in parentheses	32(38)	47(13)	24(37)	49(24)	17(23)	61(15)
Estimated contribution of plants to financial assets	**0.8**	**4**	**0.6**	**2**	**0.7**	**4**
SOCIAL						
Reinforced cultural activities and their use in sustaining resources						
Use of handicrafts for cultural purposes	31	28	17	47	13	25
Use of firewood for funerals and cultural ceremonies	0	6	6	1	1	6
Use of income earned to pay for subscriptions for local societies	0	0	0	0	0	3
Estimated contribution of plants to social assets	**4**	**4**	**2**	**4**	**2**	**4**
HUMAN						
Improved access to food, education and health						
Use of earned income for school stationary	0	5	0	0	0	6
Use of income to pay for medical fees	0	0	0	0	0	8
Use of wetland species as medicine	27	25	31	21	10	42
Use of species as vegetables and snacks	5	12	15	2	1	6

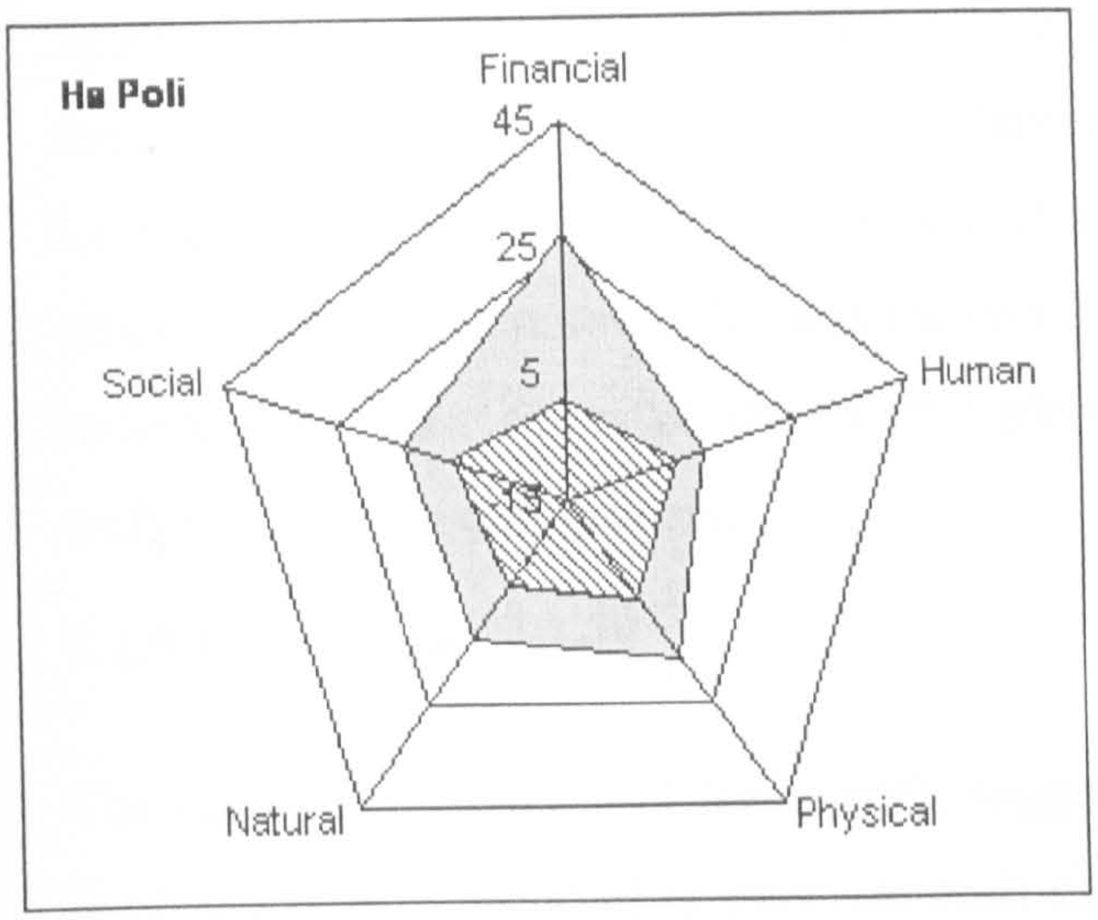
Bartering plants and products for food items	3	0	0	0	4	1
Indicators	**Poli**	**Lukase**	**Lejone**	**Tlholo**	**Lesaoana**	**Boritsa**
Total value of indicators with overall value of human assets in parentheses	35(9)	37(4)	46(14)	23(7)	15(6)	63(2)
Estimated contribution of plants to human assets	**4**	**9**	**3**	**3**	**3**	**32**
PHYSICAL						
Broadened the shelter and energy resource base						
Collection of plants for day to day firewood	8	25	5	8	9	36
NATURAL						
Enhanced capacity to harvest responsibly						
Harvesting events (for household consumption)	67	78	60	85	29	76
Marketing events	7	25	7	2	3	37
Total value of indicators with overall value of natural assets (in parentheses)	74(14)	103(16)	67(11)	87(11)	32(12)	113(16)
Contribution of plants to the natural assets	**5**	**6**	**6**	**8**	**3**	**7**

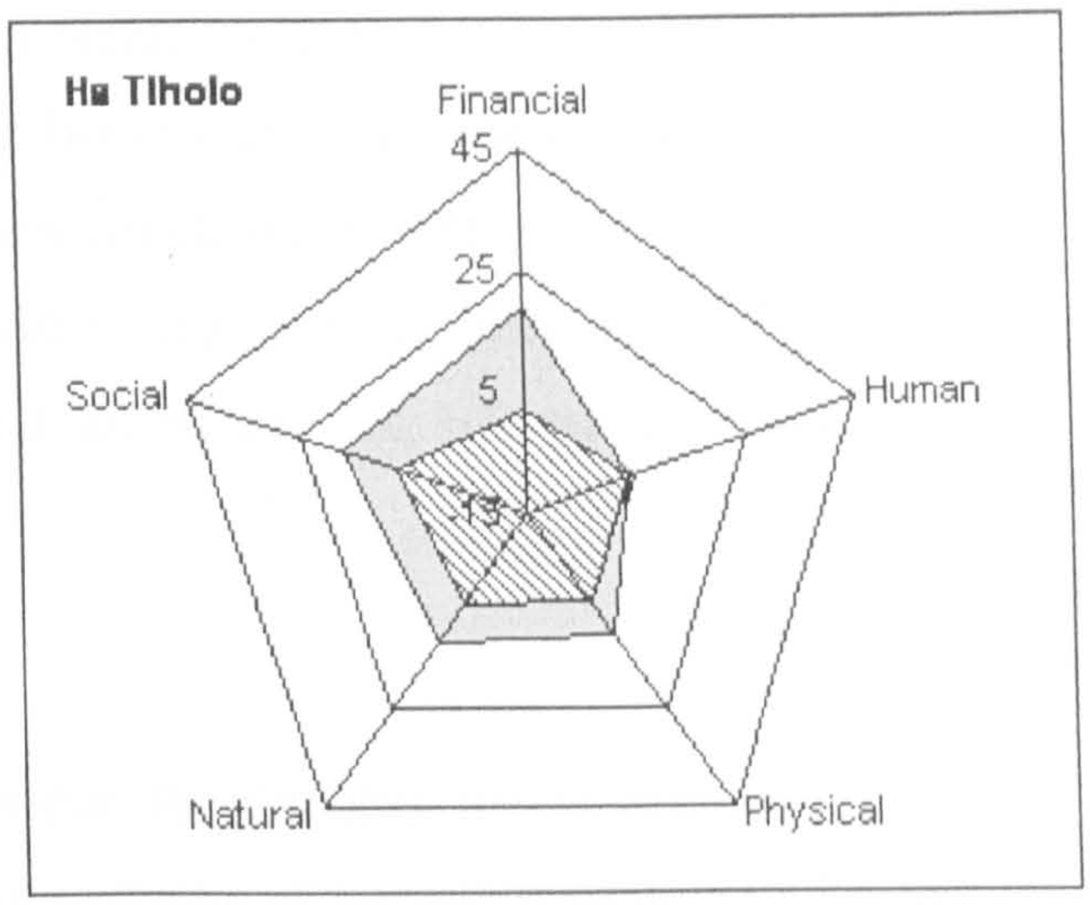
To help explain the differences between the overall livelihood assets and contributions of wetland plants to the assets, correlation coefficients were calculated to ascertain if there were significant relationships between overall livelihood assets and the extent of wetland plants contribution. As shown on Table 7.5, the financial assets displayed a weak linear but significant ($r = 0.3235$, $p = 0.028$) relationship, while the natural ($r = 0.9018$, $p = .298$) and social assets ($r = 0.8822$, $p = .633$) displayed strong, positive but non-significant relationships between overall livelihood assets and wetland plants' contribution to the livelihood assets,

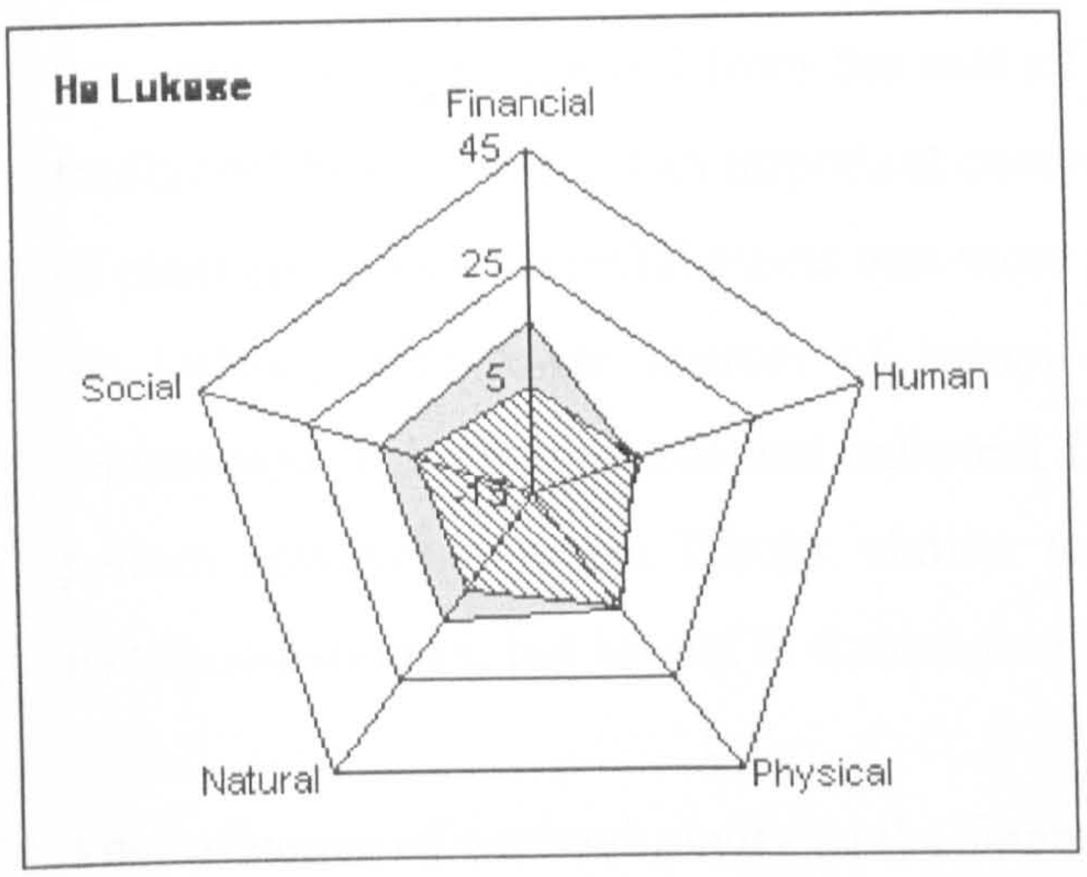
Table 7.5 Correlation coefficients for relationships between overall livelihood assets and contribution of wetland plants across the six study villages in Pelaneng-Bokong (n = 6)

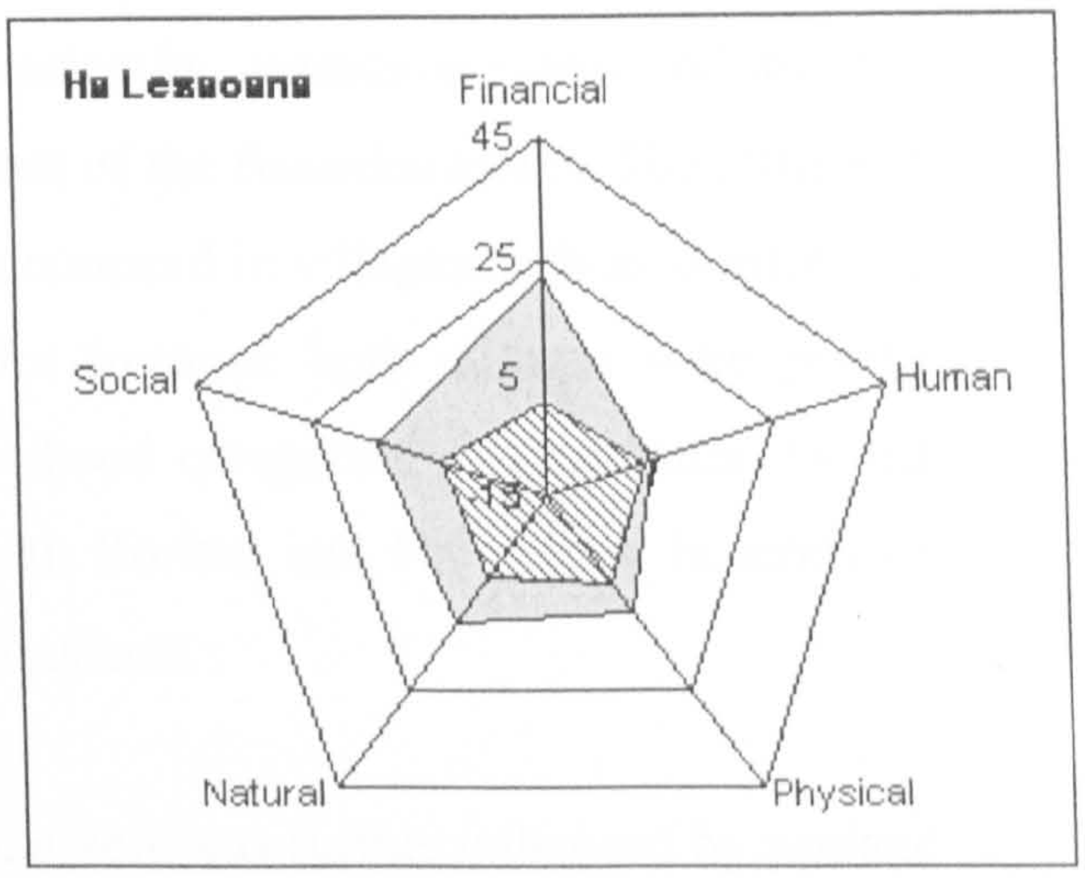
Livelihood asset	Pearson Correlation Coefficient (r)	Level of significance (p)
Financial	.3235	.028
Human	.1074	.148
Physical	.4760	.198
Natural	.9018	.298
Social	.8822	.633

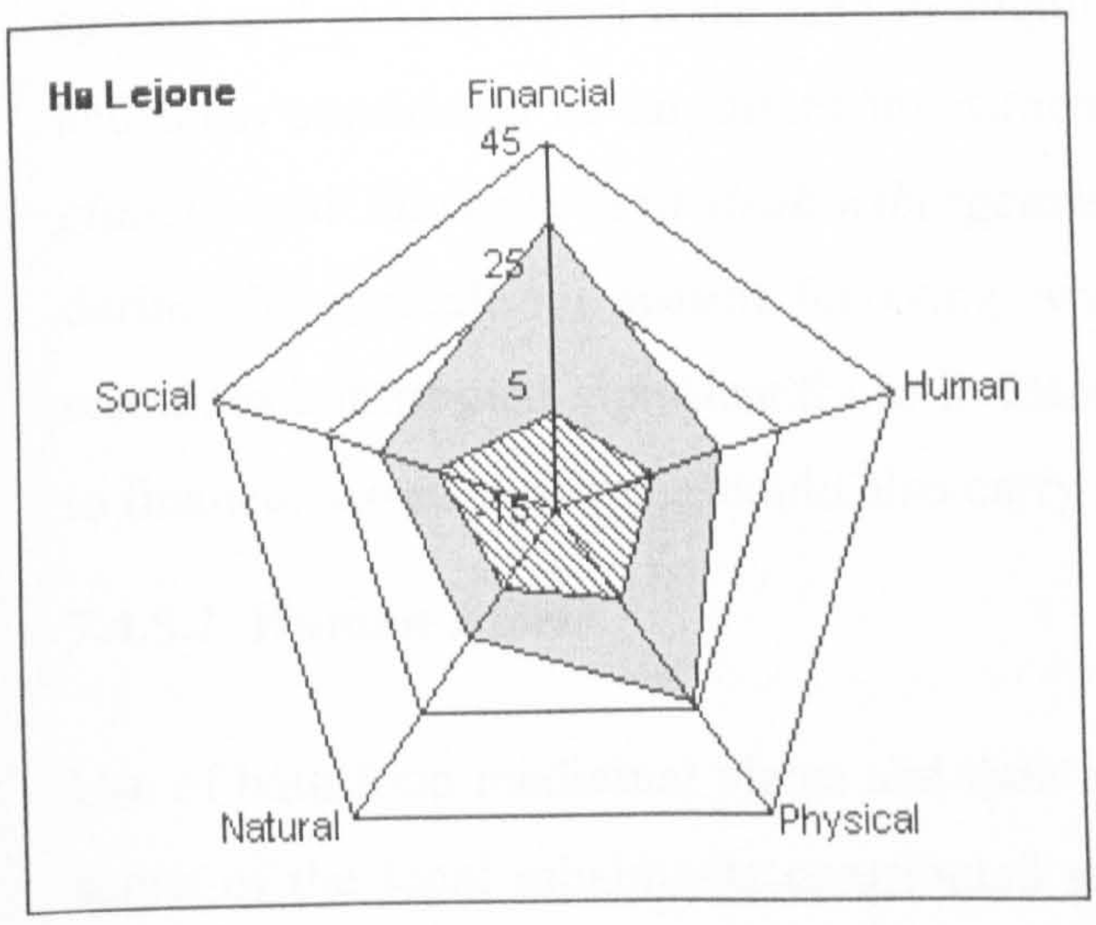
Pentagons representing both the overall livelihood assets and influence of wetland plants on them are presented in Figure 7.5. The comparison highlights some very instructive features normally disguised by broader community level analysis. In particular, it is noted that, while the pentagons shapes and sizes are different across the villages, reflecting how contributions of plants differed from village to village. Pentagons representing human assets were notably bigger than others suggesting substantial contributions of plants to human assets.











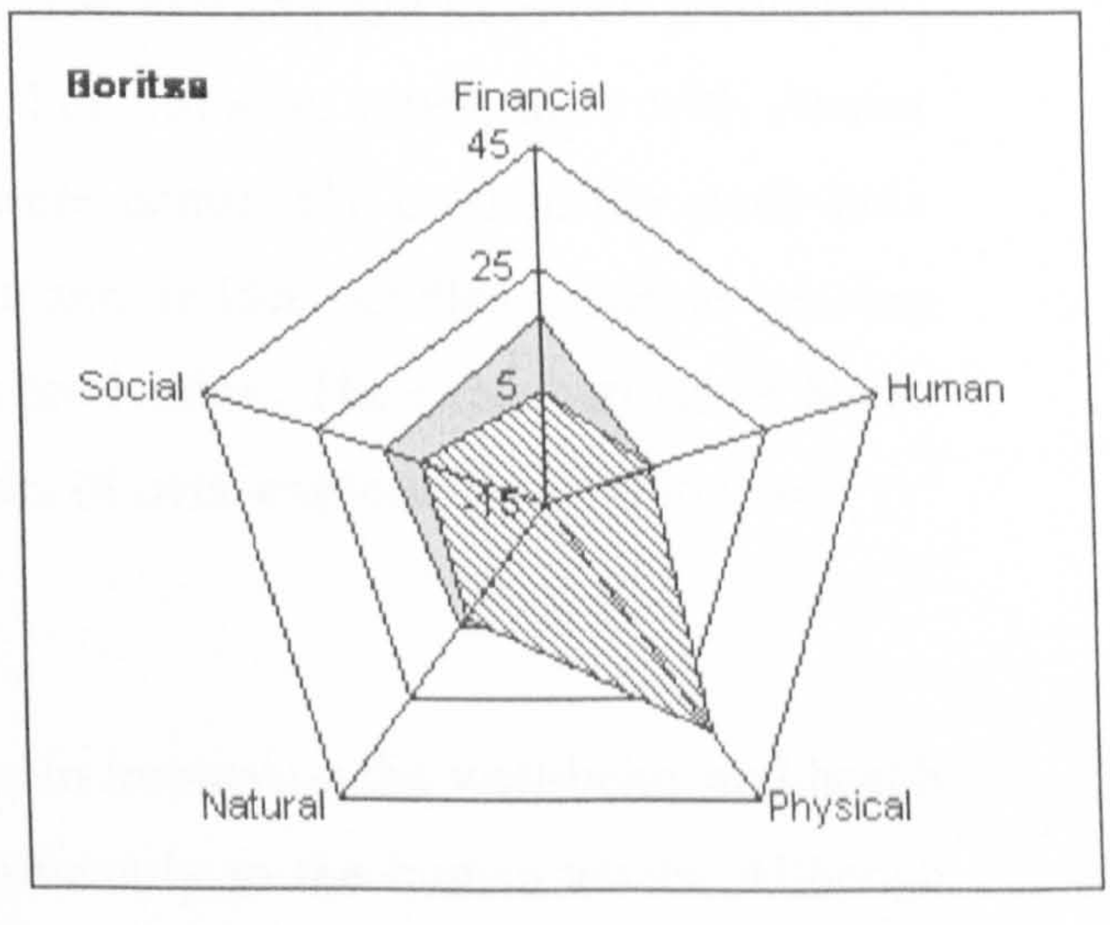


Figure 7.5 Contributions of wetland plants on livelihood assets, where contributions are expressed as percentage of uses that contribute in some way to the overall capital assets across the six sampled villages. The core pentagon represents wetland plants' contribution and the peripheral the overall local livelihood assets

Spatial variations in the contribution of wetland plants were also noted. For example, the contribution to financial capital was larger in Boritsa and Ha Lukase, whereas at Ha Lesaoana and Ha Lejone, it was the social assets which were relatively larger than in other villages. Also noteworthy was the considerably large physical pentagon in Boritsa, reflecting the low status of the overall physical assets and the substantial impact of wetland plants to these assets.

7.4.5.1 Financial Assets

The sustainable livelihood framework suggests that the financial assets can determine the households' potential to generate cash or other forms of income (Carney, 1998). In this study, income received from the sale of handicrafts, medicinal plants and fees for traditional healers formed an important component of the financial assets. The influence of plant species on financial assets was more pronounced in villages such as Boritsa and Ha Lukase, with fewer sources of income. For instance both villages were poorly represented in both business and informal livelihood categories. An exception to this pattern however, was Ha Tlholo, similar to both Boritsa and Ha Lukase in terms of livelihood sources, but lowest in financial contributions.

The influence of wetland plants on the financial assets was further enhanced by wetland species and products that were used to augment crop farming and livestock production, and thus, considered as important investments. For instance, ropes made with *Juncus glaucus* and *Merxmuellera drakensbergensis* were commonly used in the study area during the agricultural season for tying wheat and fodder bundles, whereas grazing resources contributed significantly to livestock production. The contributions of plants to financial assets, however, could also carry risks of over-exploitation of resources.

7.4.5.2 Human Assets

Use of both food medicinal plants and their role in improving the well-being and health status of the local inhabitants contributed significantly to the human assets. Although these were used across all the sampled villages, the contribution of plants to human assets was more profound in villages such as Boritsa, which lacked facilities such as hospitals, clinics and schools. It is thus logical for such communities to rely more on medicinal herbs and traditional herbalists. Human assets were also enhanced by the use

of cash accruing from sale of handicrafts and plants for school fees, stationery and medical fees.

7.4.5.3 Social Assets

Indicators of how social capital has been enhanced through harvesting and use of wetland resources, constituted the ability of local institutions to protect and ensure sustained yield from various wetland sites. In the study area, this was achieved through the role of local chiefs and traditional healers in regulating the use of wetland resources, particularly in 'B' and 'C' areas. For instance, the use of the customary rotational system regulation – *maboella,* protected wetland sites from continual use whereas, local communities' efforts to regulate harvesting, particularly by keeping out trespassers held a promise for sustained yield and thus, an important contribution to the development of social assets.

7.4.5.4 Physical assets

The influence of wetland plants on the physical assets was mainly in the form of shelter afforded for roofing, fencing and energy obtained mainly from the use of Moseha as firewood.

7.4.5.5 Natural assets

The increase in other capital assets was achieved through transformation of natural capital (wetland plants) into other forms of capital. However, the decreases in value of natural assets in this context can be surmised to have been somewhat compensated by practices that discourage over-exploitation and enhance species regeneration. These include selective harvesting and the indigenous management practices in place (social assets). For instance, low volumes of plant material harvested for trade might reduce over-exploitation, while selective harvesting techniques could enhance propagation through avoidance of mass harvesting. Seasonal harvesting on the other hand has the ability to protect vegetation against continuous over-exploitation.

However, this positive picture could be marred by over-reliance on one species, Moseha (*Merxmuellera drakensbergensis)* as the main contributor to the capital assets, hence rendering the species liable to over-exploitation in the long run.

7.5 Discussions

The objective of this chapter was to appraise the uses, livelihood values and contribution of preferred wetland plant species to the local capital assets.

7.5.1 Livelihoods and relative importance of wetland resources

The study demonstrated that households at Pelaneng-Bokong depended on a wide portfolio of activities and income sources, among which crop and livestock featured prominently. This could be attributed to the fact that though agriculture is considered the mainstay of livelihoods, even in good years, home-grown food does not last for the whole year (Kollavali, 2002), households are thus compelled to adopt other livelihood strategies to cope with the shortfalls. However, Ha Lejone seemed to be an exception to this trend in that, it had fewer households engaged in agriculture and more households depending on the LHWP compensation scheme and casual employment. This finding lent support to the theory that diversification stimulates the exit from agriculture and *vice versa* (Ellis, 1998).

Though wetland plants were utilized across the livelihood spectrum, they were more prevalent in villages with less diversified sources of livelihood. This finding contradicts those reported for the study on Plant Resources Used for Subsistence in Tsehlanyane-Bokong, Lesotho (Letsela *et. al.*, 2003), suggesting that the use of wild plants was more prominent among households without income. The results of study are, however, entirely consistent with previous research by Luckert and Campbell (2003).

7.5.2 Uses and Livelihood Values of Preferred Species

The results of this study revealed handicrafts and medicinal herbs as the most cited commodities in the study area. Interestingly, despite livestock's role as a significant source of livelihood, the use of wetland plants as fodder recorded the lowest number of users. This could be attributed to the relatively easy access to other forage grasses. Also, the fact that wetland species used as fodder including *Merxmuellera drakensbergensis*

and *Carex cognata,* were considered unpalatable rendered them largely unusable when other grasses are available (Guillarmord, 1962).

There was a high correspondence between the practical and economic values of plants with species such as Moseha (*Merxmuellera drakensbergensis),* with the highest value (due to many uses) also having the highest economic value. This could be partially explained by the fact that products made of these resources, though largely used for other socio-cultural activities, also entered the market.

7.5.3 Livelihood values of wetland plants

Wetland plants were used more for household subsistence needs than for trade. Plausible explanations to this could be lack of developed marketing systems in the area (Letsela *et al.*, 2003) and low purchasing power within the local communities (Maposda, 2003). However, the envisaged increases in tourism in the study area, aimed at, among others, promoting craft and traditional products, is likely to reverse the situation.

Nonetheless, despite low trade levels, these resources were found to be extremely important for local livelihood portfolios as many households were using them, among others to broaden their income-earning spectrum, augment agriculture and smooth consumption inequalities. Similar notions were voiced by Luckert and Campbell (2003), Shackleton (2005) and Grundy (2003).

7.5.4 Contributions to the Capital Assets

The major research question which motivated the study was to determine the contribution of wetland resources harvesting to rural populations' livelihood portfolios. This offered a good starting point to discuss the role of wetland resources in the rural livelihoods. Wetland plants contributed significantly to all livelihood assets in the whole study area, especially human assets probably due to extensive use of medicinal plants, as a result of inadequate health facilities in the study area, rendering modern medicine not only unaffordable, but also unavailable for most.

The trade of wetland plants cannot be recognised as a significant generator of local employment nor is the income generated from it the main source of livelihood,

particularly compared with the income from agriculture. However, in a situation where 60% of the population is estimated to be living on the equivalent purchasing power of US$1 per day (Mdee, 2004), an income of about R257 (equivalent of S$30.00) per month generated by wetland plants cannot be described as inconsequential. This is more so in Pelaneng-Bokong where the majority of the population is unemployed and wage work is available to about one seventh of the households, constituting about one-tenth of income (MAPOSDA, 2003). The importance of local-based trade is further illuminated by limited access to public services in the study area that would otherwise allow villagers to pursue and diversify livelihoods (See Table 7.2). For instance, most of the roads in the study area, except those developed as part of the Lesotho Highlands Water project are not all-weather roads, thus making it difficult to access lowlands markets and to facilitate growth of agriculture and non-agricultural activities.

Also, given the study area's reliance on agriculture as a source of livelihoods coupled with challenges faced by the sector (see Chapter 2), wetland plants, though modest in monetary value have the potential to reduce households' vulnerability to agricultural shocks and stresses. In particular, cash generated from sale of plant species could assist households in diversifying and ameliorating adverse effects of seasonality of agriculture-based income. A greater involvement of women in the trade could afford them more opportunities to exercise independent economic decision-making. These results are in substantial agreement with a number of other studies (Ellis, 1998; Freese, 1997; Vormisto, 2002; Ozesmi, 2003; Olsen and Larsen, 2003).

There was a somewhat inverse relationship between household status in terms of capital assets and the contributions of plants to livelihood security. For instance, villages with the least financial assets, tended to use plants more to generate income than other groups. Similarly, where human assets were found to be low, the contributions of wetland plants to human assets were high. Given the fact that wetland plants are be used to build a variety of capital asset types, one would expect that communities such as Ha Lukase and Boritsa, with better access to wetland sites in the 'B' grazing zone would be in the best position to generate scarce financial capital through their utilization and sale. This finding is in line with that of Jones *et al.*, (2003), suggesting that the capability of villagers to access fuel, water, education and communication in sustainable ways can improve livelihoods.

From the foregoing analysis, it is clear that wetland plants form an integral part of livelihoods in Pelaneng-Bokong, and are vital for improving asset status. However, it is critical that natural reserves are prevented from diminishing to a level that they cannot support livelihoods.

7.6 Conclusions

- Wetland plants provide a source of livelihood to local households, across the livelihood spectrum and contribute significantly to building a diverse portfolio of the capital assets. However, the extent of wetland plants' contribution to local livelihoods is largely influenced by lack of alternative livelihoods and basic services, whereby lack of certain services trigger increased uses of resources.

- Wetland plants are not confined to helping people maintain their current livelihoods but could be used as inputs to other livelihood activities such as agriculture, vegetable production and beer brewing and thus improve the livelihood status of harvesters.

Chapter 8

Indigenous remedies to treat wetland over-exploitation and degradation ailments in Pelaneng-Bokong

CHAPTER 8 - INDIGENOUS REMEDIES TO TREAT WETLAND OVER-EXPLOITATION AND DEGRADATION AILMENTS IN PELANENG-BOKONG

8.0 Abstract

Poor conservation outcomes that followed decades of state-centred resource management approaches in developing countries have compelled policy makers and scholars to reconsider local level solutions. This study used livelihood surveys, focus group discussions and feedback workshops to gain insight into the indigenous management practices and determine their significance in sustaining key livelihood wetland resources in Pelaneng-Bokong, Lesotho.

The study showed that, local communities, through their own initiative, developed practices, which moved beyond the customary regulation, to incorporate management of other key livelihood species. The indigenous management practices identified by this study covered a wide resource management spectrum ranging from the more institutionalised resource rotation (Maboella) system, to the more innovative approaches that offer potential conservation functions including: matching harvest to needs; enhancing species propagation and delineating resource boundaries. However, the dependence on chieftainship, a cost-effective but power-stripped institution, is likely to render these practices ineffective. Similarly, the locals' orientation towards regulating the demand rather than the supply, poses a threat to the livelihood plants. Co-management with government and non-government organisations, aimed at building upon existing practice, however, would enhance these management practices.

8.1 Introduction

Wetlands provide many important services to human society, but are at the same time ecologically sensitive systems (Mitsch and Gooselink, 2000). This explains why in recent years much attention has been directed towards the formulation of sustainable management strategies that would ensure that one function or goal, does not negatively impact on other equally important functions (Gujja, 1999; Turner, 2000; Keddy, 2000). Nonetheless, wetlands are increasingly being degraded and some exploited at unsustainable rates. This is despite numerous national policies and international agreements. For instance, many African countries are parties to various multilateral agreements and agencies including the World Conservation Union (IUCN), World Wildlife Fund for Nature (WWF), International Waterfowl and Wetlands Bureau (IWRB) and the International Council for Bird Preservation (ICBP) (McCormick, 1989; Breen *et al.*, 1997).

Wetlands have also received attention through the signing of the Convention on Wetlands of International Importance, especially the Ramsar Convention. In Africa, this culminated in 103 Ramsar sites covering 20 billion hectares between them (UNEP, 2002). Although these initiatives show that environmental management is being addressed, they are however, rarely successful, due to a range of reasons including lack of enforcement and community involvement (Gujja, 1999; UNEP, 2002).

Meanwhile, attempts to conserve natural resources in developing countries have culminated in governments' intensification of management of resources by enacting laws and regulations specifying what rural residents may do, what they may not do and what punishments will be imposed for deviant behaviour (Berkes, 1989). Similarly, governments have tried to use environmental management as a means of controlling resources and indigenous people (Bryant and Bailey, 1997; Grove, 1993), and promote conformity to a specific set of standards (Holling and Meffe, 2006).

Approaches that manage natural resources by command and control and fail to integrate the indigenous management practices, however, have disappointing results. For instance, in some cases they have led to: abandonment of indigenous resource management practices (Berkes, 1989); loss of systems' resilience to new challenges (Holling and Meffe, 2006); and plans that cannot be implemented due to inadequate practical skills and lack of coordination (Briggs, 2003). Limited state resources to enforce management strategies have also led to further degradation (King and Fa'asili, 1995; Kennet *et al.*, 2004). It is the recurrence of poor conservation outcomes that followed decades of state-centred resource management approaches in developing countries that have forced policy makers and scholars to reconsider local level solutions (Gibson and Becker, 2000). For instance, Turnbull (2004) suggests that instead of command and control methods, the Fiji Island State uses conservation to advantage rural Fijan communities, by paying rent and compensation to rural land-owners of reserves.

Various advocates of traditional resource management promote its benefits on one or more of several fronts: increased local biodiversity (Ford and Martinez, 2000; Mauro and Hardison, 2000; Posey and Balee, 1989; Horstman and Wightman, 2001); high likelihood of compliance and low enforcement costs (McNeely, 1995; King and

Fa'asili, 1995; Colding and Folke, 2001); effective monitoring system due to detailed adaptive knowledge and proximity of users and managers to the resources, enhancing their ability to observe day to day changes (Fesse and Martinez, 2000; Berkes, Colding and Folke, 2000) and more resilient ecosystems (Holling and Meffe, 2006).

Nonetheless, the history of humans as primary agents of resource degradation has raised doubts about the role of traditional resource managers as conservationists (Smith and Wishnie, 2000). For instance, massive deforestation of Himalayan forest cover due to demographic factors, has cast a shadow on local Nepal's management abilities (Varughe, 2000). Similarly, Becker and Leon (2000) argue that, timber exploitation of the Bolivian Amazon has shown that Yu Racare people's history of conservation has not extended to timber management. Also, according to Gibson and Becker (2000), the benefits that local communities enjoy due to lack of restrictions are likely to promote unwillingness to support institutions that restrict resource use.

The effectiveness of indigenous institutions has also been questioned on the basis of their inherent internal conflicts and poor leadership, rendering them incapable of administering successful conservation program (Primack, 2002). By the same token, dependence on informal means of monitoring and sanctioning 'free-riders' has been cited as a factor which reduces the competence of local management institutions. (Smith and Wishnie, 2000). Other critics assert that traditional conservation practices are being compromised by changing socio-cultural norms and values as well as the need for economic growth. For example, Quinlan (1983) casts light on the insecure position of some of the traditional resource management institutions in developing countries, whose position has been eroded by the cumulative effect of social, economic and political change. Similarly Morapeli (1990) indicated that the symbolic role of traditional institutions has been overshadowed by the power of central governments.

Indigenous regimes have also been questioned on grounds of vulnerability to demographic and economic pressures, thus rendering them effective only in low populated and subsistence economies (Richards, 2002; DFID, 1998; Smith and Wishnie, 2000). However, proponents have counter-argued that increased population and commercialization are likely to trigger conservation awareness (Berkes *et al.*, 1998; Agrwal and Gibson, 1999; Kennet *et al.*, 2004; Lu Holt, 2005).

Notwithstanding the debate, resource managers around the world are finding that conservation is more effective when it includes local interests (Sherry and Myers, 2002). Involvement of local communities and incorporation of indigenous management practices in natural resource management also ties in well with Principle 22 or the *Rio Declaration on Environmental and Development* of 1992 which states that:

"....Indigenous people and their communities, and other local communities, have a vital role in environmental management and development because of their knowledge and traditional practices. States should recognise and duly support their identity, culture and interests and enable their effective participation in the achievement of sustainable development...' (Joonsten and Clarke, 2002). Nevertheless, to design alternative resource management systems that include locals, the context within which indigenous management practices are applied must be understood.

8.2 Objectives

To gain insight into the indigenous resource management practices and determine their role/significance in sustainable management of key livelihood wetland resources in Pelaneng-Bokong.

8.2.1 Specific Objectives

-to examine practices used by Pelaneng-Bokong inhabitants to regulate the use of wetland plants and determine plant species targeted.

-to examine the role of indigenous practices in enhancing local communities' resilience against over-exploitation of key livelihood wetland plants.

-To examine limitations and potentials of indigenous resource management practices

Prior to describing the exact methods used in this study, a description of the institutional structure for resource management is presented.

8.3 The Context of Natural Resource Management in Lesotho

Traditionally, in Lesotho, rangelands and resources found within them such as wild plants and thatching grass, were never allocated to individuals and were therefore wholly communal. Their management has its origins in the *Laws of Lerotholi* that were based on customary law and the chieftainship system. In this system, chiefs were the custodians of the natural resources, though management was done in consultation with the advisors, *Matona,* who ensured that the villagers' perceptions were taken into account (Quinlan, 1983; Morapeli, 1990). Management decisions, on the other hand, were made collectively during a public gathering, *pitso,* whereas enforcement was the prerogative of the chief and the rangers. However, Franklin (1995) reports that the importance of *pitsos* declined as early as 1884 as the number of decisions to be made increased and consultation became a more specialised function of chiefs.

Rotational grazing was a primary management tool within *Maboella* system for ensuring controlled access to resources. Local chiefs controlled access to village grazing areas ('B' and 'C' grazing areas) while principal chiefs regulated access to summer grazing areas or cattle-posts. According to Motsamai (1998), traditional measures also entailed fencing off wetlands to protect them against grazing altogether.

However, the traditional system was somewhat formalised by a series of reforms instituted in the early 1930 under the British rule (Perry, 1983). For instance in 1938, following a concern over proliferation of chiefs, the colonial administration reduced both the number of chiefs as well as the number of administration areas in the country (Quinlan, 1983). The same year witnessed the establishment of a National Treasury, entitling all the gazetted chiefs a regular salary. The redefinition of chieftainship brought into question other aspects of their authority. For example, the system of *Matona,* traditionally elected by chiefs, was considered undemocratic and liable to corruption (Morapeli, 1990).

Fuelled by party politics, the system of *Matona* was finally abolished after Lesotho gained political independence in 1966, while more reforms in land tenure and resource management culminated in pieces of legislations, portraying a strong orientation

towards controls operated by central Government and in most cases backed by the international agencies.

However, Mphale *et al.*, 1999 view the strategy of eroding traditional systems and replacing them with centrally oriented resource management, without adequate capacity for enforcement, as inherently flawed. Outcomes of the reforms are described by Mdee (2004) as creation of free access to common resources due to lack of accountability and widespread non-compliance with the laws and regulations governing resource use.

By the same token, government's desire to maintain a constant flow of water in streams and rivers for purposes of exporting to South Africa, through the (LHWP) as well as to a number of downstream countries in Southern Africa that include Namibia and Botswana, has shifted the focus of wetland development and management from wise use to strict preservation (Mokuku and Letsie, 2001; Mokuku, 2002). Yet the long history of successful management of resources in other parts of the world suggests that involvement of communities might be an alternative way to approach resource management, (Pretty and Smith, 2004). The question that remains unsolved, therefore, is whether there are management practices in place that could enhance the local's ability to play a greater role in management of key livelihood resources.

8.4 Materials and Methods

Data used for this chapter was collected through livelihood surveys, in-depth discussions with key informants and community feed-back workshops following the broad approach outlined in Chapter 2, Sections 2.4.4 and 2.4.10.

8.4.1 Livelihood Surveys

The survey was undertaken at the beginning of the data collection process in June and July 2004. One-hundred and eighty-eight, self-appointed households, representing an estimated 26% of total population at Pelaneng-Bokong, were interviewed. The interviewees came from six villages, namely Ha Poli, Ha Lukase and Ha Lejone with the RMA and Ha Tlholo, Ha Lesaoana and Boritsa within the communal areas. A structured interview covering topics related to whether or not the use of individual plants were regulated, institutions responsible for regulating the use of these plants;

strategies used to regulate the use of plants and household's perceptions on the effectiveness of different strategies, was administered in the local language.

8.4.2 Key Informant discussions

Key informant interviews are qualitative, in-depth interviews with people who have expert knowledge in certain areas (Carter and Beaulieu, 1992). In this study key informants were used to enable validation and in-depth analysis of management practices identified through the livelihood surveys. Since the intention was to collect as much data as possible on management practices to, the selection of informants included specific resource users such as herders and craft makers, more likely to be influenced by such practices. Also, elderly people with an empirical knowledge of plants and management systems and local authorities responsible for the management of natural resources at the local level and thus, better placed to evaluate the system as a whole than individuals were selected. A total of 24 key informants were selected (Table 6.1).

Table 8.1 The spread of key informants and their gender, across the six sampled villages

Village	Key informants				
	Local authorities	**Elderly**	**Craft Makers**	**Herders**	**Total**
Ha Poli	1 man	1 man 1 woman	1 woman	1 boy	5
Ha Lukase	1 man	1 woman	1 woman	1 boy	4
Ha Lejone	1 man and woman	1 man and woman	1 woman	1 man	6
Ha Tlholo	1 man	1 man	-	1 boy	3
Lesaoana	1 man and woman	-	1 man and woman	1 boy	5
Boritsa	1 woman	1 man and women	1 man 1 woman	1 boy	6
Total	8	8	7	6	

The interviews sessions were made as informal as possible to preserve interviewee spontaneity (Tardio *et al.*, 2005) and discussions centred on the following thematic areas:

-Resources targeted for protection.
-Functions of different management practices.
-Implementation strategies.
-Monitoring and sanctioning processes.
-Perceived advantages and limitations

8.4.3 Feedback Workshops

At the end of the data collection phase, in August 2005, following a preliminary analysis of data, a report was prepared and presented in a workshop forum to the surveyed communities. A series of three, one-day workshops were conducted, with the following objectives:

- To disseminate preliminary research findings to the communities and local authorities that participated in the study.

- To seek and gather community's opinion on the study findings,

- To explore locals' views on the effectiveness of the existing administration, and

- To allow participating local communities to better understand each other's perspective, find common understanding and jointly develop priorities for management.

Of the three workshops, the first one was held at Boritsa and was attended by 78 local people. The second workshop, with 40 participants covered both Ha Tlholo and Ha Lesaoana, whereas the third recorded 38 attendees and included the three RMA villages, Ha Lejone, Ha Lukase and Ha Tlholo.

Each workshop was organised into three sessions. The first session covered the background, justification, objectives and an overview of the methodology employed by the study, followed by a presentation of the preliminary findings. The third session was used as a forum for community members to present their perceptions on strategies meant to balance conservation and livelihood needs regarding wetland plants. It was in this forum, where issues pertaining to management practices were discussed. Each session was followed by focus groups discussions and plenary session.

8.5 Analysis

Livelihood surveys data was analysed using SPSS statistical package version 10 (Pallant, 2001). For the Key Informants' data; analytical categories were used to describe and explain social phenomena (Wilms and Johnson, 1996; Pope *et al.*, 2000). This entailed listing responses per discussion point. This allowed for grouping together, categories of responses that seemed to belong together. These were then coded with a key word or theme, which were then re-categorised, quantified and transformed to percentages. A similar method was used by Carter and Beaulieu (1992), Mountain States Group (1999) and Colding and Folke (2001).

In regard to the workshops, each group was required to record key issues emanating from the discussions on the flip chart and these were presented and discussed during the plenary sessions. For analysis, flip chart notes, together with the workshop proceedings were read and reread to identify and index themes and categories. Categories were further refined and reduced in number by grouping them together. This kind of analysis has an advantage of producing categories of responses that are not prescribed but rather grounded in the emergent data and thus likely to be free from interviewer bias. In this study, data analysis took place alongside data collection and thus, allowed questions to be refined and new avenues of inquiry to develop.

Due to the predominantly qualitative nature of the study design, numerical comparisons were never intended to provide any form of definitive or statistically viable comparisons, and hence should be treated as no more than useful indicators of central themes.

8.6 Results

8.6.1 Indigenous Management Practices in Pelaneng-Bokong

Table 8.2 lists the indigenous management practices grouped according the associated conservation functions. These were identified by local communities during the livelihood surveys and further discussed and confirmed with panel groups, key informants and the general community during the feedback workshops. A total of 10 practices with 5 conservation functions were recorded. These practices were employed to try and balance supply and demand of key livelihood resources while simultaneously ensuring their regeneration. This entailed restraining harvest, curtailing the number of harvesters while at the same time instituting measures to avoid wastage and encourage species propagation. Practices ranged from the relatively more institutionalised resource rotation *maboella* system to the more innovative ones, such as 'harvesting for immediate consumption'.

Table 8.2 Practices used manage livelihood plant species across the six study villages in Pelaneng-Bokong, associated conservation functions and wetland species targeted for protection. Values represent the percentage of the number of times a given practice was cited by local communities. NB Interviewees cited more than one practice

Function	Practice	Protected species	Frequency of citation (%)
Avoid over-use of resources	Rotate harvest of species	*Merxmuellera drakensbergensi, Juncus glaucus and Carex cognata*	38
Matching resource base to human population	Seek permission to harvest	*Merxmuellera drakensbergensi*	70
	Determine and agree on a stage at which plant material can be used as fire wood	*Merxmuellera drakensbergensi*	4
	Set harvesting quotas	*Merxmuellera drakensbergensi*	3
Match harvest to needs	Harvest for immediate use and discourage stock piling	*Merxmuellera drakensbergensi,* *All medicinal*	13

		plants	
Delineate resource boundaries	Deny outsiders access to key livelihood resources	*Merxmuellera drakensbergensi, Scripus ficinoides, Fingerhuthia sesleformis, Gunnera perpensa*	10
Enhance species propagation	Harvesting species after seed dispersal	*Scripus ficinoides, Fingerhuthia sesleformis,*	3
	Deliberate dispersal of plant inflorescence	*Gunnera perpensa*	
	Banning of destructive harvesting tools	*All species*	6
	Burning	*Merxmuellera drakensbergensi and Carex cognata*	22

Overall, resource management practices seemed to be more prevalent in RMA communities, having been cited by almost twice as many respondents (67%) than in communal areas (see figure 8.1). Similarly, the most dominant practice in both management regimes, seeking permission to harvest, was more prominent within the RMA than communal areas. Conversely burning was practiced more in communal areas (7.4%) than RMA (4.2%) while restrictions on fire wood were limited to the RMA.

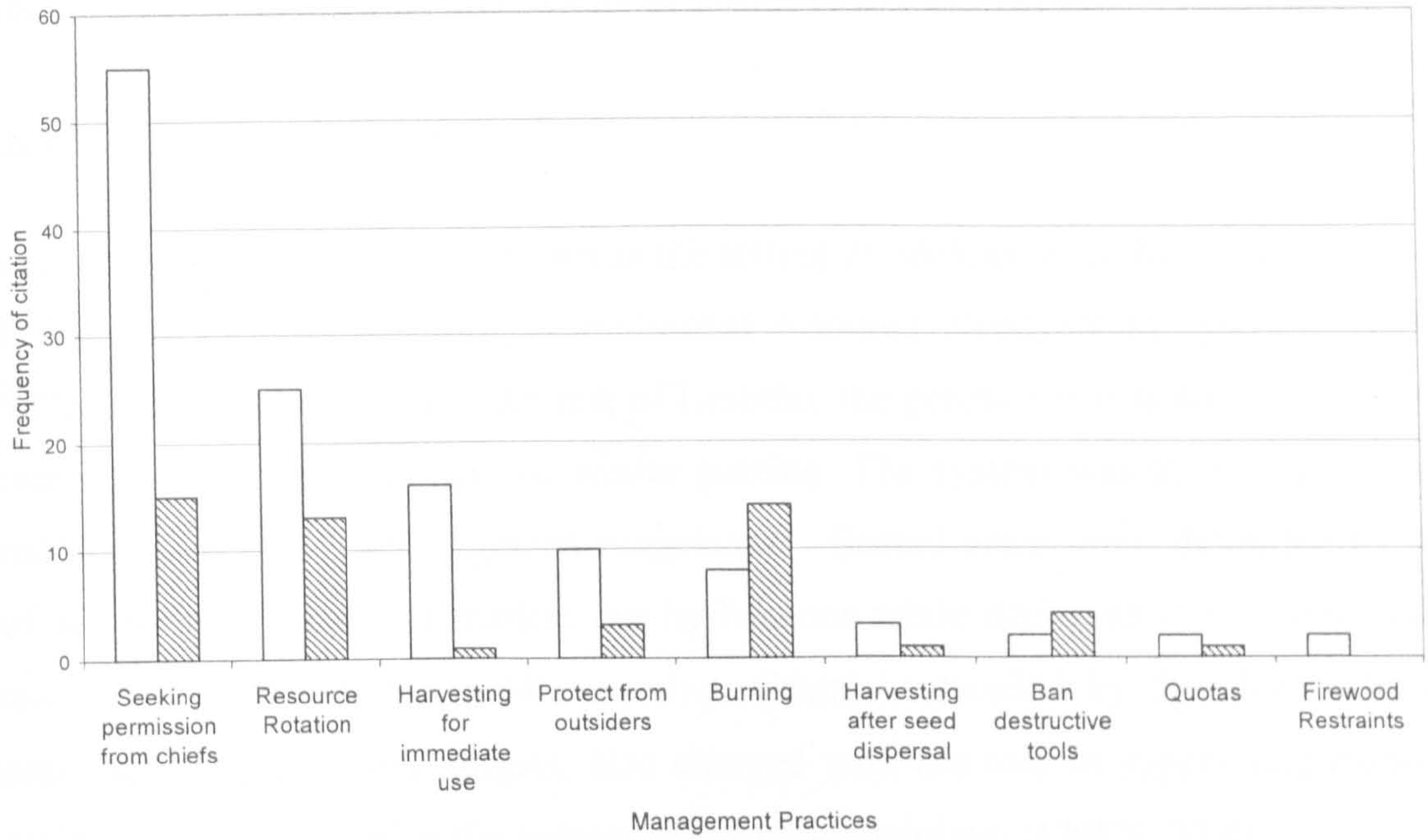


Figure 8.1. Variation between the RMA and communal areas in regard to how frequently local communities from each area cited the given management practices. The values represent the number of times (%) each management practice was cited. The RMA are represented by clean bar charts and communal areas by shaded bars.

8.6.2 Species Protected by the Identified Management Practices

Whereas the identified management practices were targeted at almost all key livelihood species, Moseha (*Merxmuellera drakensbergensis)* was prominent, having been cited as a target species under most (70%) of the indigenous practices (Table 8.1). In contrast, food and medicinal plants were the least protected. For instance, none of identified practices were intended for conservation of vegetables. With regard to medicinal plants, only two protective measures, harvesting for immediate needs and banning of destructive tools were prescribed. However, an exception here was Qobo (*Gunnera perpensa),* which was not supposed to be collected by outsiders and propagation of which was enhanced by deliberate dispersal of its inflorescence.

8.6.3 Opportunities and limitations of Indigenous Management Practices

8.6.3.1 Resource Rotation

Resource rotation, commonly known as the setting of *Maboella,* in the study area, is one of the most widespread tools of traditional resource management systems (Berkes, 1989). In the study area, like the rest of Lesotho, the practice was used traditionally to reserve pasture for rotational and winter grazing. The system was mainly designed to enable recovery of heavily grazed rangelands. Rested areas were delimited by well defined natural features or marked out by beacons while decisions to set aside certain areas were discussed in a public meeting, (*khotla*), attended by the chief, advisors, community members and rangers, also charged with the role of supervising *maboella* and impounding and fining the owners of trespassing animals (NES, 2000).

Results from this study suggest that the practice ensured rotational management of grazed wetland resources between the mountainous areas ('A' zone), foothills ('B' zone) and areas adjacent to the villages ('C' zones). Thus, hypothetically, *Maboella* can function to reduce destructive potential of livestock trampling. This problem is extensively documented worldwide (e.g. Welsh Office Agriculture Department, 1992; Kent, 1994; Kotze and Breen, 1996) and specifically in Lesotho (eg. Guillarmord 1962 & 1972; Hall *et al.*, 1999; Nüsser & Grab, 2003). These authors have indicated that trampling can create depressions with resultant collapse of underground tunnels and consequent desiccation, soil erosion and extinction of wetland flora. Additionally, the core principles of the practice are based on cultural norms, and hence, they are not only entirely familiar to the study area inhabitants, but do not depend on government for promulgation and enforcement.

However, limitations posed by the practice included the fact that closed seasons did not necessarily mean abstaining from harvesting other non-grazed resources. Also, the practice seemed *ad hoc* in the sense that it did not seem to be based on specific data on species growth cycle and recovery periods.

8.6.3.2 Seeking Permission to Harvest from Chiefs

Given that resource management needs enforcement to be effective, recognition of chiefs as central to regulating harvest of key livelihood resources, presents a cost-effective opportunity to protect resources using the indigenous political system. This is more so in Lesotho where chiefs represent the King, who owns the land on behalf of the nation. Chiefs thus serve as the local apex of a resource management system that draws authority from community consultation and from the King's ownership of the resources (Turner, 2003).

Nonetheless, the chiefs' role should be viewed against attempts to centralise resource management, which in most cases entailed enactment of new institutional arrangements (Turner, 2003; Richards, 2002 Morapeli, 1990; Mdee, 2004). For instance, while in Pelaneng-Bokong chiefs seem to have somehow retained control, despite lack of support from external authorities, their insecure position casts a shadow on their long-term effectiveness.

8.6.3.3 Harvesting for Consumption

The practice of limiting harvest to perceived needs in order to minimise off-take and avoid wastage is common in the literature of indigenous conservation (Sherry and Myers, 2002). In the study area the use of this strategy was limited to medicinal plants and Moseha (*Merxmuellera drakensbergensis)*. The practice was largely implemented by banning destructive tools and designating manual, hand-held tools that allowed for selective harvesting, as the only legal tools allowed for harvesting grasses and roots respectively.

Harvesting for consumption, has however been criticised as lacking in conservation ethics and its utility limited to just avoiding wanton destruction of unneeded resources (Smith and Winshie, 2000).

8.6.3.4 Denying Non-Community Members Access to Resources

Recently, concerns about wild plants which were reportedly harvested to extinction by traders, have been raised in Lesotho (NES, 1995; Mokuku, 1997; Mdee, 2004; NES,

2000). To a greater extend transgressors have been found to come from outside the community (Letsie, 1993; Letśela *et al.*, 2003). While the government has attempted to address this issue by proposing an establishment of a series of protected areas, in the study area the urgency for protection culminated in measures aimed at protecting the integrity of resource boundaries to prevent resource exploitation by outsiders.

According to Gibson and Becker (2000) this strategy serves to match resources to human population and hence, a critical requirement for successful natural resource management. However, in Pelaneng-Bokong, the practice seems to be largely people rather than resource oriented, confining its application to outsiders and hence limiting its conservational functions.

8.6.3.5 Harvesting after Seed Dispersal

This practice was used to govern the timing of resource harvest, especially during crucial stages of plant development, thus, clearly linked to conservation. However, in some ways the practice can be described as opportunistic since it was confined to plants which are unusable prior or after seed dispersal. For example, despite its year round availability, Semetsing (*Rorippa narstutium acquatica),* was described as unpalatable before dispersing seeds. Similalrly, it took dispersal for both Loli (*Scripus ficinoides)* and *Thitapoho* (*Fingerhuthia sesleriformis)* to attain the required flexibility for making hand-crafts.

Regarding Qobo (*Gunnera perpensa),* the Pelaneng-Bokong residents acted as seed dispersers since the use of this species as a snack, entailed discarding the inflorescence.

This practice, despite being used opportunistically, is crucial for species regeneration and if implemented, could help maintain high abundance of levels of species. However, its full potential lies in the locals' ability to extend it to other species.

8.6.3.6 Using dead plant material for firewood

Due to the shortage of firewood in the study area, grassy species such as Moseha (*Merxmuellera drakensbergensis)* become important source of firewood. However, given that they are poor fuel species, they have to be harvested in relatively large

quantities, thus making it susceptible to overexploitation. In this context, restraining practices, which entailed limiting use of firewood to dead plant materials, and using Moseha as fire wood only during funerals and cultural ceremonies only, as opposed to everyday use, served to reduce harvesting pressure.

Eliminating dead plant material can serve a dual community and conservation purpose. For example, it could promote growth of green shoots, roots and rhizomes, which are then available to foraging livestock (Kent, 1994), while at the same time avoiding consequences of livestock trampling

8.6.3.7 Burning

Respondents indicated that burning was used as means of reducing tussock biomass and ensuring timely resurgence of light demanding herbaceous plants.

Although the role of fire in enhancing biodiversity is widely accepted, in the context of wetlands, regular burning may have irreversible effects. These include reduced cover, reduced water table and loss of the wetland's ability to trap and retain water. It is due to these concerns that a number of studies have cautioned against the practice (e.g. Kent, 1994; Kirkpatric *et al.*, 2005; Lunt *et al.*, 2005). In Lesotho, on the other hand, burning has been associated with wetland desiccation (Nüssser and Grab, 1995; Majoro *et al.*, 1999; Hall *et al.*, 1999).

8.6.3.7 Setting Harvesting Quotas

Respondents indicated that this strategy was only used when fodder resources were scarce and was mostly applicable to Moseha (*Merxmuellera drakensbergensis)* and Lesuoane (*Carex cognata)*. These forage species were commonly cut and pen fed to milking cows, calves and other livestock, which due to various reasons remained within the 'C' area throughout summer when the rest move to 'A'. Setting of harvesting quotas thus involved discussion between resource users and allowable quantities as well as agreements regarding species on which the practice should be applied.

The significance of the practice lies in its ability to reduce or even eliminate the incentive for households or individuals to harvest all, thus militating against the free-rider problem. However, without data on species abundance levels and harvestable quantities, the practice becomes *ad hoc*, prohibiting a planned pattern of resource management.

8.7 Discussion

This study used data from livelihood surveys, focus group discussions and feedback workshops to gain insight into the indigenous management practices and determine their significance in enhancing the local's resilience against challenges posed by over-exploitation of key livelihood wetland resources in Pelaneng-Bokong. The results of the study showed that local communities, through their own initiative, have developed practices, which though based on customary practices, seemed to have moved beyond customary regulation of grazing resources to incorporate management of other key livelihood species. The practices offered potential conservation functions that included matching the resource base to human population; matching harvest to needs; delineating resource boundaries and enhancing species propagation. The practices themselves were found to covering a wide resource management spectrum ranging from the more institutionalised *maboella* system – resource rotation, to the more innovative ones, such as 'harvesting for immediate consumption'.

The results suggest that communities were responding positively to increasing exploitation pressure, given that most restrictions were instituted when the resource base was deemed to be decreasing. This is evidenced by prominence of management practices within the RMA, which has, due to recent infrastructure improvements by the Lesotho Highlands Water Project (LHWP), experienced a high influx of in-migration, hence simultaneously increasing the likelihood of over-exploitation of valuable resources by outsiders and increasing awareness for conservation. These findings are entirely consistent with those of Lu Holt (2005).

The fact that Moseha (*Merxmuellera drakensbegensis),* the most highly demanded species in the study area, was afforded highest protection by the identified management techniques, was further evidence that, if adhered to, local management practices may offer local protection to species and build their resilience against demographic and

commercial pressures. This is in contrast to Semetsing (*Rorippa narstutium acquatica)*, which is in lower demand and which enjoys a lower level of protection. This findings echo numerous studies, (see also example, DFID, 1998; Smith and Winshie, 2000; Gibson and Becker, 2000; Lu Holt, 2005), which indicate that the prescence of adequate substitutes and high abundance levels make deliberate conservation less likely to occur.

The prominence of the practice of seeking harvesting permission from chiefs underscores their pivotal role in traditional resource management (Sherry and Myers, 2002. However, given their insecure position as a result of many reforms, dependence on traditional leaders could hinder the effectiveness of local management practices (Turner, 2003; Quinlan, 1990; Morapeli, 1990; Berkes *et al.*, 1990; Ostrom, 1990). This has significant implications for co-management partnerships with the government. However, the likelihood of co-management in Lesotho is minimal due to a history of failed attempts to reconcile the traditional system and government structures (Turner, 2003; Mdee, 2004). More imaginative ways are needed to integrate local and state-centred management approaches.

Nonetheless, Pelaneng-Bokong experiences show that though locals' undertakings may promote local conservation of key livelihood resources, it does not mean that indigenous people have all the knowledge needed to efficiently manage the wetland resource. For example, practices including setting of quotas, resource rotation, burning and enhancing propagation, despite their conservation orientation, seem to be skewed towards regulating the demand as opposed to enhancing the supply of resources. This problem partly stems from lack of data on critical factors including species' life cycle, abundance levels and allowable harvests. This information would enhance the locals' capacity to design appropriate management practise.

Results reported in this study have brought to light snapshot information required to understand how challenges associated with exploitation of valuable species are being dealt with locally. However, to determine the extent to which they are being utilized as well as their effectiveness, more research needs to be conducted. Additionally, more studies, in areas where there are more markets for wild plants may be necessary to ascertain whether management practices identified in this study form a representative trend or whether they are an indication of more complex processes.

8.8 Conclusions

- While community management practices are potentially ustainable, the communal land tenure system, which gives people from outside the community access to plants, places a limitation on these management systems. More secure and negotiated access is required for wetland plants to be efficiently managed and to provide long-term benefits to individual communities.

- The effectiveness of indigenous management practices, to a large extent, depends on Government willingness to integrate indigenous knowledge into collaborative management agreements as well as combining de jure with de facto land use management and institutions.

- To be effective, the practices might have to be geared at balancing the demand and supply both locally and outside the community. This may require better organisation among community members to ensure that they adhere to agreements and do not abuse their access. There may also be a case for the development of community based resource assessment and monitoring activities.

- There may be scope to explore agri-environmental compensation schemes, whereby household are compensated for setting aside some wetlands to give them chance to regenerate.

Chapter 9

General discussions & conclusions

CHAPTER 9 - GENERAL DISCUSSIONS AND CONCLUSIONS

9.0 Introduction

For more than a decade, many authors have noted the warning on species loss and resultant degradation of ecosystems such as wetlands, attributed largely due to human disturbances (Meyer, 2006; Funnell and Parish, 1999). Such concerns, in most cases, have culminated in policy measures aimed at separating human beings from the same resources that sustain their livelihoods (Agrawal and Gibson, 1999; Salafsky and Wollenberg, 2000; Scherr, 2000). In Lesotho such concerns are centred on conflicting interests over the role of wetlands. On one hand they are an important hydrological reservoir and watershed for most Southern Africa and a vital component of the Lesotho Highland Water Project. On the other hand it is estimated that wetland plants are a vital livelihood source for about 93 per cent of rural households residing in mountain areas (Majoro *et al.*, 1999). It is the challenge to maintain constant supply of water as well as well-vegetated wetlands that has culminated in a strategy to establish ecosystem based protected area system.

While such a move is to be commended, particularly from the water conservation point of view, it seems to have a strong orientation towards regulation and control (Funnell and Parish, 2001). It also does not seem to give due recognition to specific wetlands resources that are important locally. Ignoring the dependence role of these ecosystems in the discourse on conservation is likely to compromise livelihoods and undermine long-sustainability of conservation activities. Understanding the driving forces behind these processes should be the focus of conservation efforts. In an attempt to understand the importance and contributions of high altitude wetland species to local livelihoods, this study provided the means to address the following key questions relating to some fundamental issues identified within the natural resource livelihood discourse:

- How important are the high altitude wetland plant species to local livelihoods and what contributions do they make to the local capital assets in Pelaneng-Bokong study area in Lesotho;
- How abundant are these plants and how are they distributed spatially;

- What are the harvesting, trading and marketing patterns and what is the role of indigenous management practices in sustaining wetland resources?
- What is the role of indigenous management practices in sustaining these resources?

The context for this work, in the form of historical and contemporary approaches to resource conservation as well the description of some of the salient features of the study area are provided in the opening chapters (Chapters 1, 2 and 3). This chapter brings together and summarises the key findings and theoretical discussions found in Chapters 4 – 8, with particular reference to objectives and key question posed at the beginning of the study (Chapter 1, Section 1.3 and 1.4). It is hoped that this broad synthesis will provide the background that will lead into a more applied and practical consideration of the implications of the findings for policy and development. The chapter concludes by drawing lessons from this study and relating them to the common wisdom regarding wild plants and their contribution to the local livelihood portfolios.

9.1 Vegetative patterns

The study investigated the variability in the distribution and abundance of wetland plant species with a particular focus on the key livelihood species (Chapter 4). The prevalence of indicator and endangered species in relation to the three management regimes and grazing zones during both the dry and wet seasons were evaluated.

The studied wetland sites harboured a total of 108 species (36 families) with at least twenty-two (20%) perceived as having a livelihood value. Harvested wetland species were found to be common and widespread within both the RMA and communal areas. They were particularly more common in grazing zones B and C and were poorly represented in the Nature Reserve.

The variability in distribution of resources suggests that the RMA and communal areas can offer more possibilities for pursuing wetland-based livelihoods; it could also offer harvesters a choice of harvesting locations and thus reduce over-exploitation at any one place. Distributed availability is also more likely to provide harvesters with sustained livelihoods.

Given this information, it could be argued that with some effort and commitment by the government utilization of wetland resources could be recognised as a viable contribution to livelihoods. However, the chances of promoting such resource-based livelihoods in Lesotho and other countries where the policy is geared to preserving the wetland resources are minimal. For instance, it is clearly stated in both the Land Policy Review Commission (GOL, 1987), and National Water Policy (GOL, 1997), that wetlands should be treated as restricted areas to be patrolled (possibly by the army) and that severe penalties will be levied on transgressors.

This work on vegetative patterns revealed a high prevalence of alien species on communal areas, particularly in grazing Zone C indicating past disturbance. Incidentally this is where most of the livelihood species occur. This is an example of the risks associated with resource-based livelihoods as the evidence of disturbances and invasion of alien species could negatively affect livelihoods. These areas should be considered prime targets for conservation or management measures.

A question arises regarding the occurrence of invasive species – should their presence be attributed to over-harvesting and other non-sustainable practices by local communities or are they a result of the establishment of both the RMA and Bokong nature reserve on the prime communal grazing areas? The establishment of the RMA and the creation of the nature reserve have not only removed the people's freedom to use all of the resources equally but also intensified the harvesting pressure in the communal areas. This is a typical example of a situation where the very actions taken to forestall species extinction crisis in one area serve to amplify the problem in another while the people get blamed unfairly for the so-called irresponsible use of resources. Issues like this should not be ignored; instead they should be researched and verified to ensure that lessons from past experiences are taken on board.

In general endangered species are found in small numbers in few locations, meaning that any change (whether natural or induced) could negatively impact them. Interestingly, in this study, species such as Moseha (*Merxmuellera drakensbergensis)* and Qobo (*Gunnera perpensa*), which were found to be relatively abundant (Chapter 4), are among those featuring on the endangered species list – is it because the people compiling the list assumed that widespread multiple use inevitably leads to extinction?

This highlights the tension that exists between local abundance and national level perceptions and the consequent restrictions that lead from this.

Ironically none of the endangered species were identified in Bokong Nature Reserve. Again, this raises serious questions regarding what exactly is being protected in this area, and further doubts on the justification for protected areas and their perceived role in biodiversity conservation (Chapter 3).

While environmental factors, particularly altitude and associated moisture levels have been used in various studies to explain the distributional pattern of species (Austin, 1978; Van Zinderen Bakker,1994; Nusser, 2002), the results of this study have revealed that changes in species composition and species richness are not always associated with altitude and rainfall. However, the extent to which this pattern is a reflection of human impact or natural phenomenon is difficult to evaluate in the absence of sound historical data. This highlights the importance of multiple-stratification sampling approaches in studying vegetation patterns in order to minimise the chances of omitting important spatial and management variations likely to influence wetland resources. It also underscores the need to undertake studies involving both ecosystem properties and individual species responses (Bedford *et al.*, 1999).

9.2 Harvesting Patterns

Ecosystem degradation and species extinction have often been associated with alleged unsustainable harvest practices by local communities (Burwell, 1995). For instance, Robinson (1993) argued that, '....it is naïve to imagine human beings in the modern world living as part of the natural community and taking no more from nature than nature can replenish'. This thesis investigated seasonal and spatial variability in harvesting patterns of the key livelihood wetland vegetation within the six study villages, across the two management regimes and attempted to assess whether indeed people are as greedy and irresponsible as some authors believe.

At the risk of generalising complex issues, it could be argued that the results of this study showed that current harvesting practices in Pelaneng-Bokong did not have obvious destructive effects on harvested plants and the ecosystem. This is despite the wide range of livelihood roles played by wetland species including firewood for

cooking and heating the house, fencing, construction, food, medicine and fodder that these plants fulfilled. The most intensively harvested species was *Merxmuellera drakensbergensis.* It is important because of its multiple uses, abundance and accessibility to the majority of households. This finding suggests that it is possible that harvesting for some species might enhance regeneration. This highlights the role of disturbance and necessitates careful consideration of management approaches that deny or limit local communities' access to resources.

Given that highest number of harvesting events were recorded in communal areas and grazing zone C, it would be logical to assume that that this would be translated into equally high volume of harvested plants. However, this was not the case; the highest harvested quantities occurred within the RMA regime and grazing zone B. On the one hand this could be interpreted as a shortage of livelihood plants in communal areas, on the other hand the numerous harvesting incidences and associated low quantities could mean that the people are adopting a 'little and often' approach to harvesting. These findings re-emphasize the complex relationship between resource distribution and use and highlight the fact that simple definitions of resource exploitation and resource inventories could be misleading. It also emphasizes the point that it is unfair to assume that people and communities with a relatively heavy dependence on plant resources are likely to degrade their environment.

It was shown that harvesting patterns were largely dictated by agricultural activities and the labour requirements thereof. This suggests that harvesting of wetland plants in this context is a peripheral activity, to be fitted in and around other more important livelihood activities. It does not however, mean that the value of wetland plants is peripheral or insignificant, but rather accentuates their role in diversifying and augmenting other livelihood sources. This 'placing' of wetland resources in livelihood strategies is critical and has significant implications for community-based interventions (Twyman, 2000).

The study revealed that very few changes have occurred in traditional harvesting techniques over years. The hand tools such sickles, knives, wooden sticks or metal rods, have according to the respondents been in use for as long as they could remember. Selective harvesting has positive implications for the regeneration of plants since it

allowed harvesters to cut fewer plants with minimal disturbance and waste. More importantly, these techniques were found to be accessible to most community members and thus ensured equal access to resources. However, they do not allow for the large-scale harvesting often required by profit-making ventures. So while harvesting techniques are sustainable, they may also limit future prospects for expanding resource-based livelihoods – suggesting a need for alternative livelihoods (MAPOSDA, 2003; Wyn Jones and Young, 2004).

9.3 Trade patterns

The decline in wetland species in Lesotho has been blamed on uncontrolled harvesting and trade (eg. Letsie, 1993; NES, 2000). However, the extent of trade reported in this study provided little quantitative evidence to support this claim. Instead the findings showed that although the majority (90%) of livelihood species could be traded, few (15%) rural dwellers were actually engaged in wetland plant trade, with *Merxmuellera drakensbergensis* being the most popularly traded and most plant material traded per panel members during the study period constituted only 62 Kg per month for sedges and 0.5Kg for medicinal plants. This suggests trade has limited impact on harvested plants. However it is unclear where the alleged massive and uncontrolled trade (Letsie, 1993, NES, 1995) that is supposedly contributing to species extinction and wetland degradation took place, and whether it coincided with this study area. If it is true, then this has serious implications on the wider communal land tenure system and the ability of the local people to regulate the use of their resources.

The markets identified for wetland plants and products in the area were limited to farm-gates and neighbouring villages since transport costs to urban markets were considered too high. This highlights the importance of local markets and their potential role in improving local livelihood strategies. While these markets may only be adequate for current harvesting patterns largely geared towards meeting subsistence needs, if bigger enterprises were to be encouraged, the possibility of expanding markets would have implications as suggested earlier.

Earnings from trading wetland plants tended to be modest, below the minimum wage and poverty line but nonetheless important for the households engaged in the activity. The income generated was particularly important for education in the sense that trading

households used the cash generated to buy school stationery including exercise books, pens and exam sheets, thus contributing to the human assets. It was also used for purchasing household goods including paraffin and candles for lighting, cooking oil, salt, matches, sugar and soap. More importantly money earned from wetland plants trade was invested in community-based loan and burial societies. Although the finding highlights the importance of wetland plants for local communities, it is questionable whether these financial returns are enough to persuade them not to transform the wetlands into other, more productive land uses. In other words, are these levels of returns sufficient incentive for conservation?

Perhaps these questions are best addressed within the context of livelihoods in Lesotho and the study area. For instance, given the problems associated with crop (Section 2.2.3.1), and livestock farming (Section 2.2.3.2), as well as the dire lack of alternative employment opportunities (Section 2.2.3.3), wetland plant trade might be viewed as an additional means of making a living given the few opportunities available. Trade in wetland plants might could also complement rural development and improve local livelihoods if a supportive policy environment that recognizes the importance of plant trade were created. However, it would be simplistic to assume that increased trade would in all instances not impact on the harvested resources or be conducted in an equitable fashion. Therefore the study should be replicated in more populous areas, with diverse income sources and efficient marketing system to gain additional understanding of the implication of possible expansion. Under no circumstances should the results of this study be interpreted as a carte blanche for expansion and use of wetlands as a livelihood option.

9.6 Livelihood values and contribution of wetland plants to local livelihoods

In Lesotho, attempts to avert species loss, degradation of wetland ecosystems driven by the need to maintain revenue generated through the sale of water to South Africa, culminated in conservation measures that focussed almost entirely on the eco-hydrological values not the livelihood values of these resources. In order to understand the complexity of the issues, this study examined the local driving forces on utilization of wetland resources and introduced an additional element of livelihood values by investigating the contribution of wetland plant species to local livelihoods.

It was revealed that wetland plants were used across the livelihood spectrum, but more so by households which relied on agriculture their main source of livelihood source. Infrastructural services were found to be skewed towards the RMA villages, and this had a profound influence on the status of overall capital assets and the contribution of wetland plants to the local livelihood portfolios. For instance, wetland plants generally seemed to have contributed most to the human assets. However in villages such as Boritsa where access to human assets (eg. Hospitals, clinics) was limited, the contribution in the form of use of medicinal plants tended to be more pronounced. Likewise, trading in wetland plants was found to be more prevalent within villages (Ha Lukase and Boritsa) with limited financial assets. One of the most significant contributions of the wetland plants was to the social assets, where the importance of key livelihood plants seems to have driven the communities' ability to manage the plant base in a responsible manner (Chapter 8). The findings suggest that wetland resources make an invaluable contribution to local livelihood portfolios. But there is a suggestion that this is a result of the inadequacies of government provision and lack of alternative employment and poor infrastructure which led to a reliance on the resource base. This raises a serious policy implication related to the responsibility of the state in providing basic services, which in this context might alleviate pressure on the natural resource base.

Numerous tangible and intangible livelihood benefits from wetland plants were revealed, demonstrating that these plants make a difference to livelihood security of the rural households (Chapter 7, Section 7.4.2.2). These included, broadening the income base, augmenting and reinforcing other livelihood activities such as crop and livestock farming, investment in the next generation, investments in vegetable production, local beer-brewing and pottery as well coping strategies against harsh periods such as in winter, during drought and snow. When assessed within the context of livelihood pathways, the three broad types of livelihood strategies, 'hanging in', 'stepping up' and 'stepping out' (Dorward *et al*, 2004) were noted. In other words, wetland plants are not confined to helping household engaged in harvesting to maintain livelihood levels (hanging in). Wetland plants are used for fencing vegetable production and for providing fire wood for beer brewing and pottery businesses, are regarded as investments to increase production and improve livelihoods (stepping up). The use of income generated from sale of products to buy school requirements is, in a way

providing households engaged in these activities with a base to move into other different activities (stepping out). Focussing exclusively on and prioritising eco-hydrological values without giving due consideration to these issues and without ensuring adequate alternatives can therefore compromise livelihoods and undermine the long-term sustainability of resources.

9.6.1 The importance of context

The contribution of wetland plants to livelihood portfolios need to be appreciated and assessed within the broader socio-economic context within which this livelihood is being pursued (Chapter 2). Without this contextualization it is difficult to make judgements regarding the role that these plants play in people's livelihoods. For instance, in the context of Pelaneng-Bokong where there are limited livelihood opportunities, contributions of wetland plants in providing basic services such as food, shelter, medicinal plants assume added significance. When considered within the context of HIV/AIDS which has placed tremendous pressure on rural households they are even more significant, especially with regard to loss of labour and income, resulting in food insecurities, postponement and sometimes abandonment of some farming activities. In such cases the 'safety-net' functions provided by these plants in the form of food, medicine and income become even more important and must be recognized.

9.7 Management practices

One of the objectives of this thesis was to gain insight into the indigenous resource management practices and determine their role in responsible management of key livelihood wetland resources in Pelaneng-Bokong. The existence of resource management practices meant to discourage over-use of key livelihood species, match resource base to human population, establish resource boundaries and enhance species propagation were revealed. The practices entailed resource rotation, seeking permission from chiefs, establishing resource boundaries, setting harvesting quotas and forestalling free-riding. Most practices were geared towards protecting *Merxmuellera drakensbergensis* which happens to be the most abundant (Chapter 4), intensively harvested (Chapter 5), traded (Chapter 6), valued (Chapter 7), generated the highest income and mystifyingly was also listed an 'endangered species' by the government! The protection afforded locally to this species highlights the importance of local knowledge about the dynamics of the local resource base. More importantly, these

results indicated that issues of rights and control of wetland plants have become important in Pelaneng-Bokong. They also indicate the ability of local communities to respond positively to issues related to imbalances in demand and supply of plants and the importance of harmonizing livelihoods with conservation, a positive move that the government can build upon to link livelihoods with conservation.

Since some of these practices are not new and have been used with varying levels of success in different resource management contexts in the past, the likelihood of their success this time around is best discussed in the context of past experiences. For example although rotational grazing system (Chapter 8) was used historically, it has been blamed for degradation of wetlands due to trampling, particularly those located within the A region (Van Zinderen Bakker, 1981; Schwabe, 1995; Majoro, 1999; Guillarmord, 1962). When questioned on the issue, the respondents pointed out that it was difficult to control resource use within the A region since various communities from different districts were entitled to use this region, thus rendering it 'open access'. While on one hand this explains the relatively better conditions of wetland sites (personal observation) which are under the jurisdiction of one chief, it also shifts part of the blame on the communal land tenure system. However, conventional views, reflecting 'the tragedy of the commons' (Hardin, 1989), and the need to control animal numbers and movements, especially under common property regimes (Nusser, 2002), are controversial, and have been challenged (e.g. Scoones, 1995; Leach and Mearns, 1996). A degree of desiccation of some wetlands, particularly in grazing zone A was observed during this study, however, the extent to which could be attributed to a rotational management system remains unclear. But it highlights the need for further research on these practices to identify conditions that might contribute to potential problems and opportunities. Additionally, most practises are dependent on traditional leaders (chiefs) for implementation and monitoring. While this finding illustrates the continued influence of the chiefs, the fact that the recently introduced government structures do not seem to recognize chieftainship (Chapter 8) might undervalue these initiatives.

9.8 Concluding Remarks: Lessons from this study

The thesis has demonstrated that wetland plants make a small but significant contribution to the local livelihood portfolios and that there is a scope for supporting

livelihoods through wetland plants in the study area (Chapter 7, Section 7.4.2.2). However, some of the insights gained from this research contrast with prevailing viewpoints found in the literature on values of wild plants, particularly NTFPs literature and these are summarized in Table 9.1.

Table 9.1 Key findings and insights gained from this research assessed against some of the prevailing viewpoints found in literature with respect to values of natural resources.

Findings and insights from the current study	**Prevailing viewpoints**
1. Key livelihood plants are common and widely distributed on wetlands found near the homesteads (Chapter 4).	1. The supply of many livelihood species is low compared with demand due to naturally low abundance level of species in the wild and to over-harvesting. (Coughanowr, 1998; Davis, 1993)
2. The most intensively harvested species *Merxmuellera drakensbergensis* happens to be the widely distributed and most abundant. Medicinal plants are least harvested and least traded (Chapter 5 & 6).	2. Medicinal plants are one of the most intensively harvested species. They have also been recognized for their role in improving the economic status of rural people who sell these plants in markets worldwide (Kala, 2005; Letsie, 1993; NES, 1995)
3. Wetland plants are used across the livelihood spectrum (Chapter 7).	3. It is households at the lowest income bracket that benefit from the use of natural resources (Letsela *et al.*, 2003; Ellanna and Wheeler, 1998; Neuman and Hirsch, 2000: Marshall and Newton, 2003; Grundy, 2003).
4. Contributions of wetland resources to livelihood assets is somewhat related to the overall asset status of the local communities, which in turn is influenced by access to infrastructure and services (Chapter 7). There is a dynamic synergy between one form of livelihood capital and another whereby wetland plants can impact on the degree and level of other capital assets	4. Contributions of natural resources are judged largely from a financial or economic perspective (Freese, 1997 & 1988; Barbier *et al*, 1995; Majoro, 1997). 5. Wetland and other wild plants are analysed in terms of their practical uses. (Byron and Arnold, 1999; Green, 2000; Boehm *et a*l., 1990; Guillarmord, 1966; Maliehe, 1997; Talukdar, 1988)

6. Wetland plants do not only help rural communities to maintain livelihoods but in some cases they have been used as investments on other livelihood sources (Chapter 7).	6. Local people are more likely to use plants to maintain their vulnerable livelihoods (Arnold, 2002a; Neumann and Hirsch, 2000; Kozayani and Frost, 2000)
7. A significant proportion of livelihood plants were used for subsistence needs rather than trade (Chapter 6 & 7).	7. Exploitation of natural resources is driven by market demand and increased economic gain (Bishop and Scoones, 1994; May and Barata, 2004; Soehartono and Newton, 2002).
8. The harvesting intensity of wetland plants measured in terms of the number of harvesters, harvesting events, harvested volume of plant material, seasonal harvesting patterns and harvesting techniques used were relatively low and did not constitute a significant threat to the species regenerative capacity (Chapter 5).	8. Wild plants are over-harvested by poor people who in turn impoverish the environmental resources and make their survival even more difficult (Majoro, 1997; Hardin, 1915; WECD, 1987).
9.Wetland plants trade, determined by traders, trading events and quantities of plant material traded were low and did not show obvious destructive effects on most of the key livelihood plants and on their natural environment (Chapter 6).	9. Volume of resources harvested and commercialised is generating great pressure on resources (Glaser, 2003; Brown and Laband, 2006; Gibbs, 2000) Trade in wild plants is seldom assessed within the context of the overall livelihood portfolio needs of households instead trading is viewed as a business activity and judged on its economic success (Barbier *et al.*, 1995; Constanza, 1996; Freese, 1996; Cunningham, 1987).
10. Local markets, though important and accessible to most community members, are not well developed and their development is hampered by low local purchasing power (Chapter 6).	10 Local endogenous markets are stable, reliable and can result in redistribution of wealth within the community (Arnorld and Townson, 1998; Neumann and Hirsch, 2000; Shackleton, 2005).
11. The financial returns and hence the perceived value generated from wetland plants trade might be too low to prevent wetland transformation to other land uses (Chapter 6 & 7).	11. Commercial use of wild plants is an effective conservation tool and an incentive for people to protect and maintain wild species responsibly (Peters *et al.*, 1989; Child, 2000; Dasgupta *et al.*, 2000; Neumann and Hirsch, 2000)

12. Income generated through wetland plants trade though modest remains significant in broadening the income base and providing households engaged in trade opportunities to invest in other livelihood activities (Chapter 7).	12. Income generated by wild plants is often not evaluated in the context of the asset status of households engaged in trade and its contribution to the livelihood assets. Returns from trade of wild plants are assumed to be lower than that generated from other activities; this seriously undervalues its role.(Arnorld, 2002a; Mutamba *et al.*, 2000; Mutamba, 2000; Kozanayi and Frost, 2002)
13. There are innovative indigenous management practices in place employed to balance supply and demand of key livelihood resources while simultaneously ensuring their regeneration. Moseha (*Merxmuellera drakensbergensis)* was the most highly protected species (Chapter 8).	13. Indigenous regimes are often vulnerable to demographic and economic pressures, rendering them effective only in low populated and subsistence economies (Smith and Wishnie, 2000; Varughe, 2000; Primack, 2000; Richard, 2002).

While the differing conclusions by the different studies cited in Table 9.1 might have been due to differences in contexts, they can also be attributable to the fact that research on livelihood values of wild plants to date has been largely focused on NTFPs as opposed to the wetland ecosystems. Placing wetland plants in the context of livelihood portfolios has also given a deeper insight into their values and contributions beyond the economic and financial gains and provided the forum for assessing the actual interface between local livelihoods and biodiversity.

Most importantly, the location of the study area in the rural, subsistence and mountainous environment with relatively poor infrastructure and with very few trade opportunities might have biased the results in the sense that much of the existing literature is based on the work from areas with stronger trade inclinations and supporting infrastructure. It is therefore very important that policy makers who may

well be versed in the NFTP discourse should not assume that conclusions are 'one size fits all', and need to consider the wetlands resources in their context.

Perhaps the biggest contributor to the differences between the findings of this study and the prevailing viewpoints is the way in which most research studies are generalised in search for regularity and theories. Some of these differences have potential implications for livelihoods and subsequent planning of projects and policies that attempt to enhance resource-based livelihoods. For instance the prevailing viewpoint on the scarcity of the key livelihood species (Table 9.1 Viewpoint 1) is based on the assumption that wild species, especially medicinal plants (Table 9.1 Viewpoint 2), are endangered by over-exploitation. Others argue that poverty leads to over-harvesting (Table 9.1 Viewpoint 8) and that trade also has a negative impact (Table 9.1 Viewpoint 9). In some cases the existing risk categorisation of these species may be because so few ecological studies pertaining to livelihood species' patterns, distributions and population trends over time have been conducted. In contrast, this study found that the most intensively harvested species in Pelaneng-Bokong was *Merxmuellera drakensbergensis* (Table 9.1 Finding 2). It was also demonstrated that, livelihood plants are exploited mainly for self-consumption and at the current harvesting level, the pressure on the wetland seems to be ecologically sustainable (Finding 1, 7, 8 and 9). Unfortunately it is the doom-laden prognosis for the future of species that has been used to justify policies that prohibit locals from exploiting the resources, often without valid alternatives. In Lesotho, for example, the belief that wetland plants suffer the threat of extinction, has culminated in a situation where a protected area has been established at an area where livelihood plants do not occur naturally, thus raising serious implications of what exactly is being protected.

The perception that species which can be exploited for economic gain are often threatened with ultimate extinction (Viewpoint 7) and the counter-argument that commercial use of wild plants is an effective conservation tool (Viewpoint 11), might be rooted in the widely-held views on poverty-environment relationships, traced from Thomas Malthus' predictions of doom (Hardin, 1915), and the misconceptions about poor local peasants as key contributors to environmental degradation. In most cases these viewpoints are based on valid, well-researched studies. This study however, demonstrated that in some contexts, subsistence needs could be more important and that

financial returns generated from commercialisation of plants might be too low to act as an incentive for conservation (Finding 7, 9, 11 and 12). This contrast has important implications since it portrays a biased focus on species that are in high demand and well marketed. However, such studies neither depict the entire spectrum of ecosystems used nor do they show full range of strategies employed by participants in subsistence based economies in the harvest and utilization of resources, particularly wetland areas.

It is commonly accepted that the importance of the natural resource base is of economic contribution. However this study's findings emphasize the importance of wetland plants to rural households even though this is not measured in the conventional household income analyses (Finding 4 and Overview 4). Furthermore, many authors focus on the practical use of plants (Viewpoint 5). This suggests that measures of rural household welfare and non-financial contributions of plants are significantly under estimated (Finding 5 and Viewpoint 5 and 12) and confirms the viewpoint of (Campbell and Luckert, 2002). In the few cases where the wider contributions are appreciated, they are often associated with people at the lowest income bracket (Viewpoint 3) or for their practial uses alone (Viewpoint 5), which though valid in other contexts, might not be necessarily the same in areas like Pelaneng-Bokong where these resources are often used to augment other livelihood activities and thus used across all the livelihood spectrum (Findings 3, 5 and 6). The implications of this are significant in that decisions regarding these resources will go on without quality and site specific information.

During the 1960s and 1970s numerous studies were conducted in traditional markets that challenged some commonly held views that the activities of rural traders were exploitative and unproductive (Campbell and Luckert, 2002). This might have triggered extreme counter-arguments portraying them as stable and reliable (Viewpoint 10). However, paucity of information information about rural markets persists, thus rendering generalisation about them a problem. For example in this study, one of the major problems limiting local markets was found to be the low purchasing power of local communities as a result of few income opportunities in the area (Table 9.1 Viewpoint 10). This goes to show the importance of contextualising issues in the planning of projects and policies that attempt to address the felt needs of the rural people.

Given these considerations, the take home message here is that context-specific research can provide valuable insights particularly when dealing with inter-disciplinary issues combining social, economic and ecological systems. While it is beyond the scope of this thesis to state how this can be achieved, one general requirement would be to ensure that our understanding of natural resource use at the local level clearly acknowledges that, given the complexity of ecological and socio-economic issues, there will always be uncertainties. For instance, even though this thesis has largely depicted an optimistic picture regarding indigenous management systems and their potential for sustainable management of key livelihood wetland plants (Finding 13), it does not imply that all management practices in rural communities in Lesotho can potentially balance the supply and demand of resources. Instead, varying circumstances in the same communities can weaken these systems and render them vulnerable to other pressures (Viewpoint 13). This highlights the need for site specific solutions and the dangers of over-generalisation.

Based on the foregoing analysis one can argue that, while we may strive for certainty, on interdisciplinary issues related to the conservation and use of wild plants, this will always remain an illusive goal. A case by case approach in which each situation is analysed on its own merit is therefore a necessity (Fortman *et al.*, 2001 in Shackleton, 2005).

9.9 Recommendations for further research

This study has provided sufficient evidence to make general conclusions that in some rural contexts, key livelihood wetland plants are common and widespread and that, it is possible to secure subsistence and modest commercial benefits from natural resources without over-exploiting them. In other words, it is possible to harmonize conservation and livelihood values. The findings further revealed that wetland plants contribute not only to the financial assets but across the livelihood portfolio spectrum.

With regard to management of these resources, this thesis has demonstrated that local management practices can adapt to, and be used to address resource management problems related to competition and resource over-exploitation. In this context the following areas of research should be further explored to ensure long-term harmonisation of livelihood and conservation agendas:

- Comparative studies of wetland vegetation patterns at other sites to determine the extent to which the patterns revealed by this study are applicable in other wetlands beyond the study area in Lesotho and elsewhere.
- Studies on characteristics of key livelihood species and allowable harvesting rates, harvesting techniques and limits.
- Replicate this study in more populous areas which have better infrastructure, diverse income sources and efficient marketing system to analyse and compare the effects of more intense trade on wild plants in different settings.
- Detailed studies to help ascertain whether management practices identified in this study form a representative trend for other communities and to document the practical implementation experiences of local community members.

Taken together the results of this study indicate that wetland plants, particularly *Merxmuellera drakensbergensis,* form an integral part of livelihoods in Pelaneng-Bokong, and are vital for improving local asset status. It is critical therefore, that these plants are prevented from diminishing to a level that they cannot support livelihoods. This highlights the importance of existing management institutions and practices for ensuring responsible management of such ecosystems. Such practices that have already gained social acceptability often have more chances of success than government controls imposed in a top-down fashion as demonstrated here by the lack of livelihood species in the nature reserve. However, there is an obligation on the part of the state to establish conditions in which communities, particularly those who use wetland plants to make ends meet due to lack of alternative livelihood option can yield efficient resource management outcomes.

The role of wetlands as sources of water for Lesotho and Southern African region is critical and has significant implications, so maintaining the health of wetlands to secure sources of freshwater, is critical. It is crucial therefore that these ecosystems are protected as well rather than just focusing simply on livelihood values. This would mean harmonizing the two conservation and livelihood goals to allow people to meet their needs without harming the wetlands. This means that in areas where the people are directly dependent upon these ecosystems for survival, national governments as well as

the international community should provide a variety of solutions to relieve the poor of the burden of conservation intended to benefit the many. For instance, innovative approaches could also be tried where local communities could be offered a percentage of royalties generated by sale of water to South Africa to improve their local asset base and simultaneously decrease the contribution of wetlands to the livelihood portfolios. However, such strategies should be holistic in nature and incorporate the local assets status as well as the contribution of wetland plants. More importantly, they should be adopted with full involvement of all stakeholders in the process.

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Appendices

APPENDICES

Appendix 2.1 QUESTIONNAIRE 1 – LIVELIHOOD SURVEY

A. INTERVIEW INFORMATION

Enumerator	Date of Interview
Village	Management Regime:
Household Head	Questionnaire checked. Date/Sign:
Respondent's Name	Questionnaire entered. Date/Sign:

B. DETAILS OF HOUSEHOLD MEMBERS

Sex	Marital Status	Occupation	Rel. Head

B. LIVELIHOOD ACTIVITIES

1. What are the your households sources of income/welfare? And how important are they to this household?

Livelihood Activity	**Dependency**		**Importance of livelihood activity**
	Full time	Part time	

C. WETLANDS RELATED LIVELIHOOD ACTIVITIES

2. Is there anybody in this household utilizing wetlands resources?

1.YES
2. NO

3. Which wetlands resources does your household use and what are they used for

Wetland Resource	**Uses**	**How wetlands resources are used**

4. When (times of the year and occasions) are wetlands resources most important to you this household?

Wetland Resource	**When important**

D. MANAGEMENT RELATED TO HARVESTING OF WETLANDS RESOURCES

5. I Is the harvesting/extraction of wetlands resources regulated?

1. YES
2. NO

6. If yes, by who and how?

How regulated	Institution responsible	How effective

Appendix 2.2 QUESTIONNAIRE 2: PANEL SURVEYS

E. INTERVIEW INFORMATION

Enumerator	Date of Interview
Village	Management Regime:
Household Head	Questionnaire checked. Date/Sign:
Respondent's Name	Questionnaire entered. Date/Sign:

F. DETAILS OF RESPONDENT

Sex	Marital Status	Occupation	Rel. Head

G. PREFERENCES AND INTENSITY OF USE OF WETLANDS RESOURCES

1. How many trips did you make to the wetland sites in the last month? What and how much was harvested?

Wetland site visited	No of times visited this month	Resources harvested or collected	Quantity Harvested	How resources were used	Member of household involved in harvesting

D. MOTIVATIONS FOR HARVESTING/EXTRACTING WETLANDS RESOURCES

2. Why did you choose to harvest these resources last month?

Wetland Resource	How used

E. HARVESTING TECHNIQUES AND BIODIVERSITY CONSERVATION

3. How are different wetlands products harvested?

Wetland Resource	Harvesting Technique

3. Did you do anything special to ensure sustained yields of wetlands resources?

Wetland Resource	Technique used to ensure sustained yields

H. WETLANDS' RESOURCES AND MARKETS

4. How did you market wetlands resources last month?

Wetland resources/by products	Market Channel	Sold for how much?	Bartered for what?

5. Which market channel did you choose and why?

Wetlands resource	Market channel	Why preferred

G. VALUE ADDING

6. Do you sell/consume/barter harvested wetlands resources fresh or do you do something to it before selling?

Wetland resource	No value added (tick)	Value Adding Activity	Labour/Time spent	Inputs used (prices)

7. If you do not sell at farm gate, how do the products reach the market?
   a. Own transport ☐
   b. Hired vehicle ☐
   c. Cart ☐
   d. Other means (specify) _____

8. Do you have to store your products before selling them?
   1. Yes
   2. No.

9. If yes, why and which storage facilities do you use?
   _____
   _____

10. Did your storage facilities keep the product in good condition last month?
    1. Yes
    2. No.

(ask to cooperative members only)

11. Last month did you sell your produce alone or with cooperative members?
    1. Alone ☐
    2. With other cooperative / commodity group member ☐

12. What were the **problems** and / or **benefits** associated with the cooperative in last month? _____
    _____
    ___

I. IMPORTANCE OF WETLANDS PRODUCTS TO RURAL HOUSEHOLDS

13. Last month, how did you spend income derived from wetlands products?
    a. Purchase food items.
    b. Pay for the children's school fees.
    c. Purchase clothing.
    d. Pay medical fees.
    e. Purchase fuel
    f. Pay contributions for a funeral society
    g. Gifts
    h. Support relatives
    i. Bartering

14. In what ways did the use of harvested wetland resources accentuate other livelihood sources last month?

1.
2.
3.

J. OTHER LIVELIHOOD ACTIVITIES

14. What other livelihood activities did you engage in last month?

Activity	Labour/days	Inputs	Price

Appendix 2.3: List of Disturbance Indicator and Endangered Species

Common Name	Scientific Name
1. Indicators species	
Phefo	*Helicyrysum flaganii*
Lengana	*Artemesia afra*
Hlabahlabane	*Circium vulgare*
Bohome	*Cynoglossum hispida*
Moferefere	*Senecio asperalus*
Khotolia	*Senecio harveyanus*
Lechuchutha	*Tagetes minuta*
Khoara	*Geranium caffrum*
2. Endangered species	
Khapumpu	*Eucomis automnalis*
Khoara	*Geranium caffrum*
Koena-ea-liliba	*Mentha aquatica*
Moseha	*Merxmuellera drakensbergensis*
Qobo	*Gunnera perpensa*
Moli	*Hyposis sp.*

Source: Legal Notice No. 93 of 2004 (NES, 2004)

Appendix 4.1. Plant species composition, distribution and occurrence (presence /m²) for 29 sampled wetlands, across the three management regimes (Communal areas, RMA and Nature Reserve) and across the A, B and C grazing zones, in Pelaneng-Bokong study area, Lesotho.

A COMMUNAL AREAS

Sampled wetland site	Zone	Plant Species	Species Occurrence %
Perekising	C	Moseha *(Mermuellera drakensbergensis)*	39
		Sechaba *(Eliocharis dregena)*	92
		Rororo *(Juncus glaucus)*	31
		Lechuchutha *(Targetes minuta)*	23
		Moriri-oa-matlapa *(Bryum sp.)*	15
		Cotula palodosum	
		Phefo *(Helicrysum flanaganii)*	85
		Lesuoane *(Carex cognata)*	92
		Moluoane *(Salix mucronata)*	8
		Leshala/Moarubetso *(Haplocarpha nervosa)*	8
		Letsiri *(Festuca caprina)*	8
		Lengana (Artemisia afra)	8
		Khotolia (Senecio harveyannus)	8
		Hlabahlabane (Cirsium vulgare)	8
Boritsana	C	Moseha (Merxmuellera drakensbergensis)	100
		Seboku *(Themeda triandra)*	6
		Selae/semetsing (*Rorippa narstutum acquatica)*	6
		Leshala/Moarubetso *(Haplocarpha nervosa)*	6
		Moriri-oa-matlapa *(Bryum sp.)*	6
		Lechuchutha *(Targetes minuta*	6
		Phefo *(Helicrysum flanaganii)*	18
		Lelothoane	6
		Lesuoane *(Carex cognata)*	41
		Moopotsane	6
		Hlabahlabane *(Cirsium vulgar)*	2
		Rororo (*Juncus glaucus)*	12
Thlolo1	C	Tsaane (*Eragrostis curvula)*	6
		Seboku (Themeda triandra)	6
		Lesuoane (Carex cognata)	94
		Selae/semetsing (*Rorippa narstutum acquatica)*	22
		Rororo (*Juncus glaucus)*	28
		Sechaba *(Eliocharis dregena)*	39
		Moriri-oa-matlapa *(Bryum sp.)*	6
		Moluoane (*Salix mucronata)*	11
		Moelela (*Tulbaghia acitolaba)*	6
		Khamakhamane (*Rumex lanceolatus*	39
		Phefo *(Helicrysum flanaganii)*	11
		Joang-ba-matša (*Potamogeton pasillis)*	17
		Khotolia (*Scenecio harveyannus*	28
		Lechuchutha *(Targetes minuta*	22
Tlholo 2	C	Thitapoho (*Fingerhuthia sesleformis*	16
		Loli	16
		Rororo (*Juncus glaucus)*	24
		Sechaba (*Eleocharis dregeana*)	100
		Khotolia (*Scenecio harveyannus*	16
		Seboku (*Themeda triandra)*	4
		Joang-ba-matša (*Potamogeton pasillis)*	16
		Koena-ea-liliba	8
		Khamakhamane (*Rumex lanceolatus*	16
		Selae/semetsing (*Rorippa narstutum acquatica)*	20
		Lesuoane *(Carex cognata)*	60
		Leratatau (*Asparagus lacirinnus)*	8
Boritsa 3	B	Lesuoane *(Carex cognata)*	18
		Rororo (*Juncus glaucus)*	27

		Sechaba (*Eleocharis dregeana*)	68
		Khotolia (*Scenecio harveyannus*	36
		Thitapoho (*Fingerhuthia sesleformis)*	36
		Khamakhamane (*Rumex lanceolatus)*	23
		Moseha (Merxmuellera drakensbergensis)	22
		Seboku (*Themeda triandra)*	14
		Rororo (*Juncus glaucus)*	14
Lesaoana 1	A	Sechaba (*Eleocharis dregeana*)	80
		Moriri-oa-matlapa *(Bryum sp.)*	10
		Moseha (*Merxmuellera drakensbergensis)*	30
		Maseema *(Gymnopentzia bifurcata*	10
		Loli (*Scripus ficinoides)*	10
Lesaoana 2	A	Rororo (*Juncus glaucus)*	100
		Sechaba (*Eleocharis dregeana*)	50
		Khotolia (*Scenecio harveyannus*	10
		Leshala/Moarubetso *(Haplocarpha nervosa)*	10
		Lesuoane *(Carex cognata)*	50
		Moriri-oa-matlapa *(Bryum sp.)*	50
		Marama-a-Baroetsana (*Sebaea marlothii)*	10
		Maseema *(Gymnopentzia bifurcata*	10
Boritsa 1	A	Moseha (Merxmuellera drakensbergensis)	100
		Maseema *(Gymnopentzia bifurcata*	17
		Phefo *(Helicrysum flanaganii)*	17
Boritsa 2	A	Moseha (Merxmuellera drakensbergensis)	95
		Maseema *(Gymnopentzia bifurcata*	53
		Khotolia (*Scenecio harveyannus)*	74
		Letloepe-la-Khoho (	11
		Qobo (*Gunnera perpensa)*	11
		Koena-ea-Liliba (	74
		Lechuchutha *(Targetes minuta)*	5
		Phefo *(Helicrysum flanaganii)*	5
		Moferefere (*Scenecio asperalus)*	5
Mahlasela	A	*Helichrysium praecurrens*	29
		Moseha (Merxmuellera disticha)	35
		Serelilenyana (*Grassula setulosa*)	35
		Mahlo-a-konyana-a-loti (Lobelia galpinii)	18
		Cyperus sp.	59
		Letsiri-le-lenyenyane (*Pentaschitis galpinii)*	18
		Leshala/Moarubetso(*Haplocarpha nervosa)*	24
		Moriri-oa-matlapa *(Bryum sp.)*	29
		Letsiri (*Festuca caprina)*	18
		Ngope-se-tšoha/Tlhapi-e-kholo (*Geranium multisectum)*	18
		Lecha-feela *(Eumorphia prostrate)*	12
		Lijo-tsa-lihohoana (*Aponogeton junceus)*	12
		Marama-a-baroetsana (*Sebaea marlothii)*	12
		Gause grass (*Catalepis gracillis)*	12
		Rororo (*Juncus glaucus)*	6
		Tlhapi-ea-loti/Qojoana-ea-Lesotho (*Geum capensi*)	18
		Tlhapi (*Rannuculus mutifidus)*	6
		Pheshoana-ea-Loti (*Helichrysum trilineatum)*	6
		Pulumo-tśoeu (*Helichrysum psilolepis)*	12
Fanana 1			
	A	Letsiri (*Festuca caprina)*	25
		Moseha (Merxmuellera disticha)	75
		Mahlo-a-konyana-a-loti (*Lobelia galpinii)*	50
		Lijo-tsa-lihohoana (*Aponogeton junceus)*	75
		Moriri-oa-matlapa *(Bryum sp.)*	25
		Tlhapi-ea-loti/Qojoana-ea-Lesotho (*Geum capensi*)	25
		Serelilenyana (*Grassula setulosa*	50
		Boshoane (*Koeleria capensis)*	25
		Lecha-feela (*Eumorphia prostrata)*	50
		Ngope-se-tšoha/Tlhapi-e-Kholo (*Geranium multisectum)*	25
		Letsiri-le-lenyenyana (*Pentaschitis galpinii)*	25
		Lesuoane (*Carex zuluensis)*	25
Fanana 2	A	Moseha (*Merxmuellera disticha)*	50
		Boshoane (*Koeleria capensis)*	25
		Lesookoana (*Alepedia pussila)*	25

Marama-a-baroetsana (*Sebaea marlothii)*	50
Molalahlolo (*Merxmuellera stereophyla)*	
Gause grass (*Catalepis gracillis*	25
Qoqobala (*Cerastium capense)*	25
Lesuoane (*Carex zuluensis)*	25
Lecha-feela (*Eumorphia prostrata*	25
Pheshoana-ea-Loti (*Helichrysum trilineatum)*	25
Tlhapi-ea-loti/Qojoana-ea-Lesotho (*Geum capensi*)	25
Phefo (*Helichrysum flanaganii)*	25
Sedge (*Cyperus sp)*	25
Leshala/Moarubetso (*Haplocarpha nervosa)*	25

Appendix 6.1 Checklist for wetland plants' contribution to the capital assets

Type of Assets	Relevant Question	Method
Financial	-Do harvested wetland plants generate employment for rural communities? -Are preferred species a source of income locally? -Is income derived from harvested species saved? -how are harvested species used as investments on other income generating activities?	-Panel surveys -FGD -Market Surveys -Livelihood Surveys
Human	-How many people within the household are involved in wetlands resources harvesting activities? -Do you ever hire additional labour for harvesting/ processing activities (labour market)? -Has wetlands species harvesting led to investments in education, skills development and health? -Are wetland plants used to increase access to food locally? -Are wetland plants used to improve health facilities for the community? -Do harvested wetland plants encourage development of new skills and partnerships?	-Panel Surveys -FGD -Marketing surveys -Livelihood Surveys
Natural Assets	-Do harvesting techniques used allow for plant regeneration? And if so, how? -To what extent do volumes harvested/marketed to allow for regeneration of plants? -To what extent do proportions of harvesters/retailers endanger wetland plants reproduction? - Do value adding activities enhance wetlands plant values? Implications of adding value as opposed to selling raw plants?	-Panel Surveys, FGD and Key informants -Seasonal Calendars -Elders and local authorities

	-To what extent does seasonal fluctuation on availability encourage over-exploitation?	
Social and Political Assets	-To what extent do harvested wetlands resources encourage cooperation and networking between community members? -What is the role of indigenous institutions in controlling and regulating harvest? -Does the land tenure system encourage sustainable resource management? -Does the community have social taboos/beliefs, informal arrangements to ensure sustained yields of wetlands resources?	-Market surveys - Panel surveys and FGDs -Elders, Historical mapping
Physical	-Has wetland plants trade afforded increased market opportunities? -To what extent has the trade encouraged investments in improved communication and transport? -Has wetland plants afforded access to shelter and energy?	-Panel surveys, market surveys and livelihood surveys

Adapted from Miranda, M., Porras T. and Moreno M.L. (2003