UNIVERSITY OF ZIMBABWE

FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Economic valuation of selected direct and indirect use values of the Makgadikgadi wetland system, Botswana

TSHEPO SETLHOGILE

MSc. Thesis in Integrated Water Resources Management

June 2010

UNIVERSITY OF ZIMBABWE

FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

In collaboration with

ECONOMIC VALUATION OF SELECTED DIRECT AND INDIRECT USE VALUES OF THE MAKGADIKGADI WETLAND SYSTEM, BOTSWANA

By:

TSHEPO SETLHOGILE

Supervisors:

DR. RENNETH MANO
DR. JAAP W. ARNTZEN
MR. COLLIN MABIZA

A thesis submitted in partial fulfilment of the requirements for the Master of Science Degree in Integrated Water Resources Management

June 2010

DECLARATION

I, Tshepo Setlhogile declare that this thesis emanates from my own work. All the sources that I have used and quoted have been duly indicated and acknowledged by means of complete citations and references. This thesis has not been submitted before for any degree at any university.

Signed: …….. Date:……

The findings, interpretations and conclusions expressed in this study do neither reflect the views of the University of Zimbabwe, Department of Civil Engineering nor of the individual members of the MSc Examination Committee, nor of their respective employers.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES AND BOXES

LIST OF ABBREVIATIONS AND ACRONYMS

BOTASH	Botswana Ash
BWP	Botswana Pula
CAR	Centre for Applied Research
CBO	Community-Based Organisation
CBNRM	Natural Resources Management
CHA	Controlled Hunting Area
CSO	Central Statistics Office
CVM	Contingency Valuation Method
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
DWNP	Department of Wildlife and National Parks
FAO	Food and Agricultural Organisation
GNI	Gross National Income
IRR	Internal Rate of Return
IUCN	World Conservation Union
IWRM	Integrated Water Resources Management
JVP	Joint Venture Partnership
KCS	Kalahari Conservation Society
LSU	Large Stock Unit
MBGL	Metres Below Ground Level
MFDP	Ministry of Finance and Development Planning
ML	Mega Litres
NNI	Net National Income
NPV	Net Present Value
ODMP	Okavango Development Management Plan
RWL	Residual Water Level
TCM	Travel Cost Method
TEV	Total Economic Value
Ush	Ugandan Shillings
VAT	Value added Tax

WUC	Water Utilities Corporation
ZBWRUP	Zambezi Basin Wetlands Resources Conservation and Utilisation Project

DEDICATION

This work is dedicated to my late Father, Mr Keabetswe Setlhogile, my mother, Mrs Agnes Bame Setlhogile and to my lovely siblings, Arabang, Kutlo and Keabetswe. I hope this work will give you hope and aspirations for a better and educated future.

ACKNOWLEDGEMENTS

First and foremost, my greatest gratitude goes to the Lord Almighty who granted me life on this earth, the opportunity to undertake this masters' degree and carried me through the whole process. I thank Him for his everlasting blessings and guidance.

I would like to sincerely thank Dr. J. Arntzen for the inspiration and the endless support he gave me during the development and completion of this study. I am grateful to the Centre for Applied Research in Gaborone and the staff for all the support and encouragement granted during the research period. Thank you for giving me the opportunity to undertake my research project within the Makgadikgadi Framework Management Plan project that the Centre is currently working on. May I also extend my gratitude to Dr. Mano (Department of Agricultural Economics) and Mr. Mabiza (Department of Civil Engineering) for their support. I was not the greatest student, yet you still persevered and gave me support. Thank you for believing in me. Multitude of thanks also goes to Dr J. Barnes for the enthusiasm and assistance granted in developing my models. To my sponsor, WaterNet, thank you very much. To all my lecturers, thank you for showering me with knowledge and skills. The journey would not have been possible without you.

I am indebted to all my friends especially Monkgogi, Joanna and Selwana for their non-ending support and believing in me. You guys saw me through when I was at my lowest point. May the Lord bless you. To my friends and colleagues in IWRM class of 2009/2010, the journey was long and by the mercy of the Lord, we made it. Thank you guys for your support.

Finally, to my mother and my siblings, none of this would have been possible without you and your support. Thank you very much. I love you!

ABSTRACT

Economic valuation of wetlands aims to investigate public preferences for changes in the state of the wetland and the natural resources it constitutes in monetary terms. It provides a means of quantifying the direct and indirect benefits that people derive from wetlands. In addition, it informs management planning and practice about resource options, optimal allocation and also provides information for conservation of the resource. The Makgadikgadi wetland is a unique system that mostly consists of dry pans during most part of the year despite the fact that this year (2010), the pans were fairly wet. This study aimed at estimating the value of groundwater recharge and community-based natural resource management (CBNRM) activities within the Makgadikgadi wetland resource and how these services and goods contribute to the local and national economy. The Total Economic Valuation approach was adopted and this considers both the direct and indirect use values of the resource. In essence, the study concentrated on one direct use value (use of resources through CBNRM) and one indirect use value (groundwater recharge). In regards to CBNRM, three community based organizations (CBOs) were selected for the study and static and dynamic cost benefit models for these CBOs were developed. The groundwater recharge value was largely determined through desktop review and interviews with stakeholders such as representatives from the Division of Groundwater within the Department of Water Affairs. The results indicate a small positive contribution of CBOs towards the economy of Botswana and a high potential for communities to derive substantial benefits from the projects because currently benefits realised by communities are limited. CBOs involved in joint venture partnerships with tourism and hunting enterprises benefit more from utilizing the wetland's resources. With regards to groundwater recharge, recharge often occur in areas away from the physical location of the wetland and may not be easily attributable to the wetland. However, the study assessed the value taking into consideration the various sectors which rely on the groundwater resource. The groundwater recharge value is significant (about BWP 10 million) but lower when compared with the value generated by the Okavango delta (BWP 16 million). Given future increases in water demands, groundwater abstraction will exceed recharge thus hampering the availability of the resource for the future generations and maintenance of the environment.

Key words: economic valuation, community-based natural resources management, groundwater recharge, wetlands

CHAPTER ONE: INTRODUCTION

1.1 Background

Wetlands are among the earth's most important and productive resources and have therefore been termed the "kidneys of the landscape and biological supermarkets" (Barbier *et al*., 1997). This is so because of the various functions they execute in the hydrological and chemical cycles and also due to the wide ranging food webs and biodiversity that they support (McCartney and Houghton-Carr, 2009). Wetlands also directly and indirectly support livelihoods as they provide food for people and help them earn income from the use of the wetlands' resources. Management of wetlands therefore requires attention to ecological integrity of the systems, social wellbeing and security as well as economic efficiency so as to foster sustainable utilisation and conservation of the resources. However, some anthropogenic activities such as overgrazing, land clearing, burning and overexploitation of natural resources around wetlands are contributing to the deterioration and complete loss of wetlands in some parts of the world. These threaten the continuity and stability of wetland ecosystems. In turn, these may potentially also impact on communities that rely heavily upon these resources especially the rural poor and vulnerable groups of the society. In Africa, wetlands play a vital role and occupy significant parts of the rural landscape and are therefore critical to people's livelihoods (Turpie and Barnes, 2003). Examples in southern Africa include the Okavango and Zambezi deltas in Botswana and Mozambique respectively, Barotse flood plain in Zambia, eastern Caprivi wetlands in Namibia, lower Shire wetland in Malawi, Rufiji floodplain in Tanzania and the Makgadikgadi pans in Botswana which forms the core of the study at hand.

Given the significance of wetlands, it is important to understand their value in both qualitative and quantitative terms so as to guide their sustainable utilisation and management. Economic valuation is an attempt to assign quantitative values to services and goods provided by the wetland resource despite the (un) availability of market prices (Barbier *et al*., 1997; Emerton *et al*., 2004). It is an important discipline which attempts to direct attention to the use and non-use values of the resource in monetary terms. Valuation of the services and

goods provided by the wetlands is of paramount importance as it largely contributes to better decision making, illustrates the contribution of the wetland to society's wellbeing and high dependence on the resource. Furthermore, valuation is a powerful tool that can aid in catalyzing and improving the utilisation and management of wetlands (Emerton, 1998; Turpie *et al*., 1999). Economic valuation is key to promoting efficient use of water resources and conforms to the principles of Integrated Water Resources Management (IWRM) which among other things recognizes water as an economic good with a value. Once the value is clearly articulated, it would aid in directing coordinated development and management of the resource involving a wide array of stakeholders (participatory approach in the management of the resource) and this is in line with principle two of the 1992 Dublin's Principles which state that "water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels" (Global Water Partnership, 2000). In addition, results of valuation can potentially contribute to the achievement of Millennium Development Goal 7 which seeks to achieve environmental sustainability. Economic valuation is also highly recommended in the 1997-2002 Ramsar Strategic Plan which was approved during the 1996 Conference of Parties to the Ramsar Convention (Barbier *et al.,* 1997).

This study is based on the Makgadikgadi wetland system in Botswana which is an inland palustrine wetland system and is one of the largest wetlands in southern Africa. It is situated in an endoreic basin (Makgadikgadi Basin) which is transboundary in nature as it transcends into Zimbabwe on the eastern side. It is also a fundamental part of the Kalahari Basin. The wetland is unique in that it is dry for most of the year and is largely composed of pans which in their nature are dry and provide water especially after it has rained. The Makgadikgadi wetland system is endowed with rich biodiversity and when flooded, it attracts a variety of water birds including the severely globally threatened species such as the water crane, lesser flamingos and the white pelicans (McCulloch, 2003). Furthermore, the Makgadikgadi wetland system provides goods and services for the communities living in and around the wetland and also provides support to the surrounding environment. Given the various goods and services the wetland provides, there is need for coordinated and holistic management as well as sustainable utilisation of the resource. To enhance this process and to ensure

sustainability of the resource, there is need for understanding of the resource uses, various economic sectors and the importance of these to households, local communities, the overall economy and the wetland system itself. Thus economic valuation will reveal this significance and facilitate the balancing of resource utilisation and conservation for the current and future generations.

The main focus of this economic valuation study is on the community based use of the natural resources within the wetland including tourism. An additional value has also been considered (groundwater recharge) that falls within the indirect use category of the economic valuation framework.

This research was carried out as part of a wider research project: Makgadikgadi Wetland Framework Management Plan (FMP), Botswana. The FMP project was carried out by Centre for Applied Research[1] in partnership with the Department of Environmental Affairs, Ministry of Environment, Wildlife and Tourism, Gaborone.

1.2 Problem statement

Makgadikgadi is a wetland of local, national and international significance. The wetland supports the local communities mostly through agriculture, utilisation of natural resources provided by the wetland and through the indirect jobs created from sectors such as mining of the wetland's resources. However, the economic value of the resource is not academically known despite the economic, social and environmental benefits it provides. Despite the myriad stakeholders involved in the utilisation and management of the resource, there is lack of coordination and integration in the management of the Makgadikgadi (Centre for Applied Research, 2004). In addition, conflicts exist among the users especially the communities in that some do not benefit from the use of the wetland's resources such as tourism. Human-wildlife conflicts also exist in the area and this has led to loss of property and livestock which is a fundamental part of people's livelihood security in the area. Excessive extraction of the

[1] Centre for Applied Research is a private consultancy firm based in Gaborone and mainly focuses on environmental issues, sustainable development and environmental economics. For more information, visit www.car.org.bw.

groundwater resource is also significant especially around the mines, threatening the sustainability of the resource. The study will therefore determine the value of the resource in terms of the communities' use of the wetland's resource which forms part of the direct use value of the wetland as well as groundwater recharge which is an indirect use value of the wetland.

1.3 Objectives

The overall objective of the study is to determine the economic value of the goods and services provided by the Makgadikgadi wetland system and the implications for water resources management for optimal livelihoods.

The specific objectives are as follows:

1. To characterize the wetland goods and services derived from the wetland resource as well as the resource users;
2. To estimate the value generated by community based organizations (direct use value) in utilizing the wetland's resources; and
3. To estimate the groundwater recharge (indirect use value) value of the wetland system.

1.4 Justification

As indicated earlier, the Makgadikgadi is a wetland of national and international importance given the goods and services it provides, the communities it supports and also as it is part of an international basin. Many of these goods and services have a high economic value yet they have been long perceived as having little value to the society (CAR, 2004). Valuation of the palustrine wetland will foster sustainable utilisation of the resource, holistic management, preservation of the environment and will contribute largely to knowledge on the value of the resource which is currently highly limited and will ultimately inform management and policy decisions. The utilisation of the wetland should be in a sustainable manner and should conform to the principles of the Ramsar Convention, sustainable development, the Millennium Declaration as well as IWRM among other phenomena and international debates and conventions. Its management and value is therefore fundamental in ensuring that sustainability of the resource for current and future generations. Substantial information on

the tourism value of the wetland can contribute to sustainable sharing and management of the resource.

1.5 Structure of the thesis

The thesis is organized into six chapters. Chapter two presents the literature review. It generally gives an overview of wetlands, that is, what they are and the types and also gives an insight into the economic importance and valuation of wetlands as well as why valuation forms an integral part of decision making in relation to development, conservation and wise use of the resource. The chapter further discusses the adopted framework for valuing the Makgadikgadi. Chapter three gives a general overview of the Makgadikgadi wetland system in relation to its location, hydrology and the socio-economic situation. It focuses on the study area and the profiles of the selected community based organizations in the area. The fourth chapter is on the methods and analysis adopted for the study. Sampling and data collection techniques employed in the study are discussed as well as the development of the CBO enterprise models and groundwater recharge value estimates. Chapter five presents the results of the study in line with the stipulated objectives. Finally, the sixth chapter follows and gives the main conclusions and recommendations of the study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

There is a growing body of literature on wetlands, their uses and benefits as well as various factors and activities that lead to their degradation and loss. This section gives an overview of literature on wetlands, economic valuation of wetlands and its significance to integrated water resources management. Both international and regional experiences are alluded to in the empirical literature and reference is also made to the situation in Botswana, in particular, the Okavango Delta valuation study.

2.2 Definition of wetlands

There are several definitions and names given to wetlands all over the world. It is however appreciated that there has not been one universal definition which greatly goes to show the variability in wetlands' ecosystems (Chabwela, 1991). According to the Convention on Wetlands of International Importance, better known as the Ramsar Convention (1971; Article 1), wetlands are defined as:

"*areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary with water that is static, or flowing, fresh, brackish or salt, including areas of marine waters, the depth of which at low tide does not exceed six meters*".

The Convention further states that wetlands "may incorporate riparian and coastal zones adjacent to wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands" (Article 2.1).

Ramsar as the mother body governing the sustained use and management of wetlands globally, its definition has been widely accepted over the years since the inception of the Convention. However, given the various ecosystems and types of wetlands that occur in different regions, global organisations and some countries have developed their own definitions. Examples are briefly highlighted as follows:

The Fish and Wildlife Services of the United States considers wetlands as "lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water" (Cowardin *et al*. 1979; Breen *et al.* 1997).

In southern Africa, some definitions and names include:

- ***Botswana:*** Botswana has adopted the definition inscribed in the Ramsar Convention article described above. In addition to that, the Draft Wetland Policy (undated), has included permanently flooded areas, *(makgobokgobo),* areas that are yearly or even infrequently flooded (*melapo*), rivers which contain surface water for short periods of the year, springs (*metswedi*) which are perennial or exist during wet periods only, artificial wetlands such as water supply reservoirs (*matamo*) and sewage works as well as salty and brackish water. The Makgadikgadi wetland, which forms core of this study, constitutes the latter.

- ***Malawi*****:** In Malawi, a wetland is described as "any permanently or seasonally wet land in valleys, depressions, or floodplains with open herbaceous vegetation, mainly grasses and sedges, and an absence of trees" (FAO, 1996). It is commonly referred to as 'dambo' in the local language.

- ***Swaziland*****:** In Swaziland, wetlands are referred to as 'sponges' or 'bog systems', since they take up rainwater and release it slowly during the dry period. In addition, a wetland is described as "being distinguished by the presence of water, at the surface or within the root zone; wetlands commonly have soil conditions that differ from the adjacent uplands; wetlands support vegetation adapted to wet conditions and conversely are characterized by absence of flooding intolerant vegetation" (Mitsch and Gosselink, 1993).

- ***Zimbabwe:*** In Zimbabwe wetlands are also called dambos (Chichewa language), *vleis* (Afrikaans language), 'mapani' or 'matoro' (Shona language), and 'inuta' or 'amaxhaphozi' (Ndebele language) (Matiza and Chabwela, 1992). Matiza (1992) describes wetlands as : "Land which is saturated within 150 mm from the surface of the land for the major part of a season of average rainfall or exhibits the soil profile one or more of the following features: (i) mottles or rust-like stains in the root channels 150 mm or less from the surface of the land; (ii) black top soil horizons very rich in organic matter overlaying pale sands; (iii) dark grey or black heavy clay showing considerable surface cracking when dry and without marked evidence of self-mulching".

2.3 Types of wetlands

There are various types of wetlands and in southern Africa, five of these are most prominent (Chenje and Johnson, 1996 and Hirji *et al*., 2002). These resources are particularly categorized according to their common features including landscape, hydrology and water chemistry, formation as well as vegetation. These are described as follows:

a. Palustrine system

This constitutes non-tidal vegetated wetlands which are largely dominated by emergent mosses or lichens, persistent emergents, shrubs or trees. This category also includes those wetlands lacking such mentioned vegetation as well as those dominated by aquatic bed or by non-persistent emergent vegetation provided their total area is less than 8 ha, are not an active wave-formed or bedrock shoreline feature (Ecological Support services, 2002). Palustrine wetlands are mostly situated along river channels, lake shores and isolated catchments. Examples of these wetlands are marshes, swamps, ponds, pans, lagoons, dambos, fens and springs. Pans occur more in arid conditions where rain-filled depressions dry out frequently. They normally do not have established vegetation but support a wide range of biological organisms which can rapidly complete their lifecycle, can adapt to fluctuating temperatures, can cope with saline environments, and can also survive drying out conditions. The Makgadikgadi is a typical example of this type of wetland system.

b. Riverine system

This system includes land that is periodically inundated by river topping (Barbier *et al*., 1997). The system is contained in natural or artificial channels where water is usually, but not always, flowing, with the exception of all wetlands within an open channel. It is dominated by mosses or lichens, persistent emergents, shrubs or trees; with sea derived salinity in excess of .5 g/l (Ecological Support Services, 2002). It also includes habitats which are dominated by rivers, swamps, and floodplains which cover more or less 110 000 km^2 . A water meadow is one good example of such a system. In southern Africa, examples include systems in the Congo and the Zambezi river basins.

c. Lacustrine systems

These are located on dammed river channels or topographic depressions (Chenje and Johnson, 1996 and Barbier *et al*., 1997). The total area usually exceeds 8 ha and they are associated with exposed or shallow shore vegetation which comprises aquatic bed or non-persistent emergents. The amount of water in the wetlands is largely determined by rainfall patterns.

d. Estuarine system

An estuary is an area near a river mouth that contains water of mixed origin where for instance sea water is mixed with freshwater resulting from land drainage (Chenje and Johnson, 1996). The Estuarine system therefore consists of habitats with low energy and variable salinity influenced, and often semi enclosed, by land but with open, partly obstructed or sporadic access to the Marine System. The salinity may be periodically increased above that of the sea by evaporation. In the region, estuaries are common in South Africa (Orange River), Zambezi and the Congo.

e. Marine system

This consists of permanent shallow waters less than six meters deep at low tide and associated exposed coastlines. The salinity often exceeds 30 g/lm, with little or no dilution except outside the mouths of estuarine systems (Ecological Support Services, 2002). In addition, these systems are not in any way influenced by the river flows. Examples include shore lines and coral reefs.

2.3 Economic importance and valuation of wetlands

Wetlands play a vital role in enhancing economic development and improving livelihoods of the immediate communities. The sole intuitive knowledge on the importance of these resources is however insufficient to warrant sustainable utilisation of wetlands and best management practices. Economic understanding and valuation of wetlands can therefore provide means of ensuring best use of the wetland's goods and services and aid in policy and decision making that would ensure sustainability. This section aims at demonstrating the importance of valuation from a social and economic perspective.

2.3.1 Why value wetlands?

Economic valuation of environmental resources attempts to bring out public preferences for changes in the state of the environment in monetary terms (Turpie and Barnes, 2003; and Turpie *et al*., 2006). It is particularly important as it informs management planning and practice, resource options, optimal allocation and provides information for conservation of the resource. The major goal of valuation is therefore to determine people's preferences as to how much they are willing to pay for, and how much better off or worse off these people would consider themselves to be due to alterations in the supply of various goods and services provided by a particular wetland (Emerton, 1998). Therefore ultimately the purpose is to illustrate the overall economic efficiency of a selection of competing uses that wetlands provide.

Traditionally wetlands have received little attention in-terms of the economic value they generate which explains why, in some cases, management and conservation efforts have been futile. Evidence of this is that many wetlands worldwide are dwindling and being degraded (Emerton, 2003). In addition, wetlands' degradation and loss have been to a variety of reasons. The most prominent factors are due to direct human activities such as over exploitation, ploughing for agriculture, land clearing, dam/canals/ flood storage developments and population increase which ultimately lead to growing demands for water and hydropower (Turpie and Barnes, 2003; Matiza and Chabwela, 1992). One of the most devastating factors is agricultural policies which are biased towards intensive farming in wetland areas or which advocate for diversion of wetland waters for irrigation purposes. In addition, climate

variability and climate change are envisaged to have an impact on wetlands (UNFCCC, 2002). Moreover, given the climatic conditions in the region, southern Africa is one of the regions that will be most affected by the predicted climate change impacts (UNFCCC, 2002). Although there are uncertainties as to when the effects will occur and the approximate magnitude, adaptations options for coping with variability at present could help in reducing the impact of climate change in the future.

Despite the myriad of influences that exacerbate wetlands' alteration and loss, economic valuation of these resources can provide an influential means for placing them on the agenda of conservation, management, planning and development decision makers. Valuation makes the goods and services provided by wetlands to be comparable with other sectors of the economy especially during investment appraisals, planning, and policy developments when other resource use decisions are made. Furthermore, Barbier (1994) alludes that proper valuation of wetlands environmental goods and services can yield significant economic returns that can significantly surpass the economic gains from activities which are based on ecosystem conversion or degradation such as dam construction. Emerton (1998) summarised the major reasons why wetland valuation is important and a prerequisite for sustainable development and IWRM among others. These are indicated in Box 2.1.

Box 2.1: Importance of valuation

Valuation of wetlands is critical as it helps:

- reveal the high value associated with the conservation of conservation and the quantifiable economic benefits that can be realized by stakeholders across board;
- shows the costs incurred due to wetlands' degradation and loss. These costs are in relation to economic efficiency, equity, development growth and livelihood security;
- substantiates why wetlands should be conserved as an economically beneficial investment and viable land-use option to the relevant stakeholders such as government and the private sector;
- enhances the conservation of wetlands through the integration of business and economic concerns into conservation strategies and policies;
- provides incentives for wetlands' conservation such that those who bear the costs of conservation or use wetlands in a sustainable manner accrue substantial economic benefits;
- identify sustainable sources of funding and financing mechanisms to enable conservation of wetlands and this should be done at all levels.

Source: Emerton (1998)

2.3.2 Wetlands' economic values

The most commonly used framework for identifying, categorising and valuing environmental goods and services is the Total Economic Valuation (TEV) framework (Barbier *et al*., 1997; Turpie *et al.*, 2006; Hirji *et al*., 2002). Unlike traditional economic concepts of valuing wetlands' goods and services that only considered direct economic benefits derived from the resources, this approach also takes into consideration the subsistence and non-market values, ecological functions and non-use benefits associated with wetlands. In addition, TEV reveals the high and wide-ranging economic costs associated with the degradation of wetlands which exceeds by far beyond the loss of direct use value of the resource (Emerton, 2003). It is important to capture the TEV of economic benefits generated by the wetland's environmental goods and services so as to quantify in monetary terms and weigh against costs associated with conserving these goods and services (Birol *et al*., 2009). Figure 2.1 illustrates the total economic value of wetland systems.

- *Use value* –This comprises of direct consumptive and non-consumptive uses of the wetland system (Hirji *et al*, 2002) and indirect use value. The direct use values largely depend on the degree to which the services and goods are utilized, in what way and by how many people. The direct consumptive use values occur due to harvesting of the resource itself as well as from the harvesting of resources associated with the wetland. These can thus be for subsistence and commercial purposes such as agriculture and domestic use among others. On the other hand, non-consumptive values include transportation, tourism and fishing among others (Nunes and van den Bergh, 2001). The indirect use values are related to the ecological functions or services of the wetland. These maintain and protect natural and human systems through services such as maintenance of water quality and flow, flood attenuation and storm protection, nutrient retention and cycling, carbon sequestration other biotic influences (Turpie *et al.*, 2006; Acharya, 2002).

- *Non-use value* –"The *option value* is the value of a resource or ecosystem as potential *future* direct or indirect use" (Department of Environmental Affairs, 2006. Pp. 27). This value is expressed in terms of the people's willingness to pay to have the resource retained for a particular option. The options in this case may include pharmaceutical purposes and leisure (Hirji *et al.*, 2002; Emerton, 2003). Society may also place a value on the wetland simply because it exists regardless of whether they use the resource or not and this denotes the *existence value*. This takes into consideration the possible future use of the wetland by future generations. The existence value is often expressed by the global community as opposed to the local people and this may be through donations to conservation organisations or the money paid out for debt-nature swaps. For instance, in 1989, an amount of US$4.5 million was paid for the Kafue and Bangweulu wetlands in Zambia by international donors mainly for the activities that would facilitate the conservation and wise use of the wetlands (Hirji *et al*., 2002)

All the direct, indirect and envisaged benefits derived from wetlands therefore have an economic value since they play a crucial role or contribute highly to the economy and people's livelihood security. These benefits differ from wetland to wetland and are also

influenced by the geographical, hydrological characteristics and the use to which the wetland is put to.

DIRECT VALUES	INDIRECT VALUES	OPTION VALUES	NON-USE VALUES
Production and consumption goods such as: Water, Fish, Firewood, Building poles, Thatch, Wild foods Medicines, Crops, Pasture, Transport, Recreation, *… etc …*	**Ecosystem functions and services such as:** Water quality and flow, Water storage and recharge; Nutrient cycling; Flood attenuation, Micro-climate, *… etc …*	**Premium placed on possible future uses or applications, such as:** Agricultural, Industrial, Leisure, Pharmaceutical, Water use, *… etc …*	**Intrinsic significance of resources and ecosystems in terms of:** Cultural value, Aesthetic value, Heritage value, Bequest value, *… etc …*

Source: Emerton (1998)

Figure 2.1: Total Economic Value of Wetlands

2.4 Wetlands' valuation techniques

There are various valuation methods that have been developed to quantify the benefits derived from wetlands' along with other environmental goods and services despite the complexities of assigning monetary values on these because most of them do not have a market price (Ojeda *et al*., 2008; Department of Environmental Affairs, 2006). The methods are categorised into surrogate market approaches, simulated market as well as market value approaches and these are discussed in the section that follows. It is however important to mention the importance of market prices when discussing valuation. Market prices indicate how much the wetlands products and services can be sold or purchased and thus reflect how much people are willing to pay for these goods (Turpie *et al.*, 1999). Where available, for instance, the prices of fuel-wood

and fish among others, can thus be used to reflect the incomes accruing from the sale of these goods hence reveal the value of the resource. However, where available, market prices are often complex to apply when valuing wetlands good and services especially in cases where the goods do not have a market which is usually the case especially with those products used for subsistence purposes which are never sold (Emerton, 1998). Furthermore, some of the products may be subject to price distortions due to subsidies imposed by the government, taxes and monopolies and thus do not reflect the true value of the resource. An example is the case of agricultural products in Botswana where the government heavily subsidises crops through for instance, the provision of free seeds to farmers and equipment like tractors.

Therefore where markets do not exist, and to circumvent the problems associated with price distortions, alternative means can be sought and these approaches are discussed as follows.

1. Market value approaches

- *Replacement costs*

Given that some wetland goods and services may not have markets, more often they have alternatives that can be purchased or sold. In addition, if the services are not available, they can be replaced by other means (Turpie *et al*., 1999). These costs can be used as a proxy for wetland resources and ecosystem values (Emerton, 2003).

- *Mitigative or avertive costs*

These deduce the value of wetlands' goods and services by determining the costs of restoring damaged resources to their original state or economic damage avoided (Department of Environmental Affairs, 2006). These mitigative costs can thus be used as indicators of the value of conserving wetlands in terms of costs avoided. This is mostly suitable for valuing the amount of pollution that is imposed on the water resources and the amount of costs incurred when restoring this damage.

- *Defensive expenditures*

In cases where wetlands' degradation leads to defensive expenditures, these expenditures can be taken as an alternative for the value of the environmental service that is ultimately being replaced by the defense measures (Hirji *et al*., 2002).

- *Change in production*

This applies to the effects imposed on the productive use of the wetlands' resources such as irrigated agriculture due to changes in the environment. This transformation is measured as the market value of what has been gained or lost. Information is therefore required on the production levels before and after the change.

- *Value added approach*

This is applied when the resource provides an input that does not have a price into the production process (Turpie *et al*., 1999). Therefore, it is possible to ascertain how much this input contributes to production at local and national level, the latter being gross domestic product. Examples include aesthetic value of the wetland as an input into a tourism operation in a particular area or the contribution of rangelands to the production of cattle.

2. Surrogate market approaches

- *Hedonic pricing method*

This method assumes that a difference in environmental quality can be valued through property prices (Department of Environmental Affairs, 2006; Hirji *et al*., 2002). This method assesses the differentials in property prices and wages between locations, and isolates the proportion of this difference that can be attributed to the existence or quality of the goods and services afforded by wetland systems (Emerton, 2003). The method considers observed prices contained in the characteristics each good or service which gives an insight into the implicit value placed on the characteristics that make up these services and goods. When assessing the rate of pollution near a particular wetland or associated water point for instance, the value of the properties around this source would be considered and be compared to property which is not in proximity to such conditions. In essence, the value of the property

near the polluted source would be less than the one that is located elsewhere or near a healthy wetland, all other things held constant. The method requires vigilant design and considerable statistical analysis and expertise to separate the environmental variable from the other determinants of property prices.

- *Travel cost method (TCM)*

It measures the value of the resource through the travel costs and considers the people's willingness to pay to use the natural resource (Hirji *et al*., 2002). The higher the amount the consumer is willing to spend on travelling to a certain site, the higher the value of that resource. Willingness to spend is solicited through a survey among consumers and can also be established through other parameters such as time spent in reaching the site, the levels of income, the number of visitors, and the number of visits are considered in the analysis. After statistical analysis, the demand curves are derived which can thus be used to estimate the value. The TCM value can be computed as follows:

$$TCM\ Value = number\ of\ visitors_i * number\ of\ visits_i * average\ travel\ costs_i.$$

Where:
i = category of visitors

The travel cost method can be very subjective especially when travellers use modes of transport such as bicycles and thus the value can be underestimated (Hirji *et al., 2002*). In addition, people may visit several sites on one trip and it may be difficult to segregate the values.

3. *Simulated market approaches*

The contingent valuation method (CVM) is used to derive values of wetlands' goods and services and can also infer intangible values (Emerton *et al*., 2004). The method involves undertaking a survey among a representative sample where a questionnaire is used to solicit people's willingness to pay to gain or prevent a loss of an environmental good or their willingness to accept compensation for loss of a particular environmental service or good. This method can be used to value indirect and direct goods and services and is also suitable for

valuing option and existence value of natural resources. This method is however biased because it relies on people's perceptions rather than observing the behaviour of the market.

In addition to these three main categories of valuing wetlands, Turpie *et al.* (1999) alludes that it is also possible to infer the results of other studies of comparable areas to a particular wetland that is under consideration. This is referred to as the benefits' transfer approach. After transferring the benefits, an assumption is then made that the adjusted estimate of economic value can thus be used as an estimate of the wetland good at hand. Benefits transfer can be undertake in three ways: a) transferring mean unit values; b) transferring adjusted unit values; and c) transferring the demand function.

Various valuation methods can thus be used to solicit the value of the benefits associated with the wetland system. However, all these values have their merits and challenges and the choice to use one clearly depends on the user, the intended use and the characteristics of the wetland under consideration.

2.5 Empirical literature

In relation to the type of wetland system that encompasses the Makgadikgadi, not a significant number of valuation studies have been undertaken. This could be due to the fact that these systems are characterized by salt pans which are dry in the most part of the year. However studies regarding floodplains, swamps, marshes and deltas have been carried out internationally and at national level as well.

Mekong River is a transboundary river basin shared by Cambodia, Laos, Vietnam and Thailand. Along this river, precisely in Cambodia, lies Stoeng Treng Ramsar site which is about 14 600 ha in size and extends 37 km in length along this river (Bhattarai, 2005). The Ramsar site constitutes rocky streams, small islands, sandy inlents and riverine forests. Furthermore, the site hosts habitat for some globally threatened and rare fish species such as the Giant cat fish. Among the myriad resources derived from Stoeng Treng, fisheries are the

most important particularly to the poor rural communities (Bhattarai, 2005). However, these resources are reported to be dwindling due to overexploitation, illegal practices by outsiders as well as increasing populations (Boge, 2006; Wolf, 1999). In determining the economic values of the resources within the wetland, Bhatarrai (2005) applied economic analysis and participatory rapid appraisal (PRA) techniques to assess the total economic value of the wetland. The study focused on Veun Sean, a village within Stoeng Treng. It was found that the total value of the wetland to a household in Veun Sean was $3 200 per annum. Moreover, given the significance of fish resources to the locals, these were highly valued thus generated a value of $425 per household per annum for a poorer household, fisheries were worth about $650 per year.

The study clearly indicated the economic value of the wetland to the local communities at the lower level. However, it failed to assess the aggregate for the entire communities surrounding the wetland. Furthermore, other functions of the wetland such as groundwater recharge are not alluded to in the findings.

In Sri Lanka, Emerton and Kekulandala (2002) explored the total economic value of Muthurajawela wetland. This coastal wetland is situated north of Colombo and covers an area of 3 068 ha along the Indian Ocean. It is the largest saline coastal peat marsh in Sri Lanka and part of it is declared a sanctuary hence it is protected by the State. The wetland is rich in biodiversity and has therefore high ecological significance. Among its uses, this wetland supports more than 300 000 people as well as the various industries in Colombo. It is also important for waste treatment and purification, water storage, flood attenuation and is also a source of freshwater supplies (Mahanama, 2000). These benefits have been quantified and the values are presented in Table 2.1. The table indicates that wetland services constitute the largest value of Muthurajawela marsh (about US$ 7 million per annum) while the direct use values account for more than half a million dollars. Despite the high value associated with this wetland, there are concerns about it being degraded, encroached and disappearing because of infrastructural development and other anthropogenic activities (Emerton and Kekulandala (2002). Therefore, to foster restoration of the wetland, the study recommended attractive economic incentives such as value added and revenue generating activities that

could assist the local communities involved in the restoration of the wetland. It also called for sustainable use and stringent conservation measures for the protection of the wetland.

Table 2.1: Economic value of Muthurajawela wetland, Sri Lanka

	Value ($ /year)	***Value ($/ha/year)***
Flood attenuation	5,394,556	1,758
Industrial wastewater treatment	1,803,444	588
Agricultural production	336,556	110
Support to downstream fisheries	222,222	72
Firewood	88,444	29
Fishing	69,556	23
Leisure, recreation	58,667	19
Domestic sewage treatment	48,000	16
Freshwater supplies	42,000	14
TOTAL	***8,072,111***	***2,631***

Source: Emerton and Kekulandala (2002).

Through the IUCN's wetland initiative in East Africa, valuation studies have been undertaken in wetlands in eastern Africa. In Uganda, Nakivubo wetland which is located in the capital city of Kampala, has been valued for the goods and services it provides which ultimately supports economic activities in Kampala (Emerton *et al*., 1998). The major resources provided by this wetland include water, soils, land, as well as plants and animals and some of these are particularly used for crop cultivation, harvesting of papyrus, fish farming as well as brick making. As one of the direct use values of the wetland, cultivation is of utmost importance to the surrounding communities. The total crop area constitutes some 2 km^2 of the total wetland area which is equivalent to 38%[2]. At the time the study was undertaken, it was indicated that on an annual basis, the gross value of crop production was about USh 200 million and the resulting economic value thus considered additional value generated by irrigated crops as well as the productivity added by wetland borne nutrients and sediments (Emerton *et al*., 1998). In regards to harvesting of papyrus, income from this activity is generated mainly through the sale of raw materials to artisans and through production of

[2] This figure was calculated in 1998. It is therefore noted that this might have changed over the years.

rough and fine mats. It is estimated that about 180 tonnes of bundles of papyrus is harvested per annum. It is important to note that without this wetland, this activity would not exist in the Kampala area (Emerton *et al*., 1998). Although minute, brick making and fish farming also constitute the direct use values of the wetland.

In relation to wetland services provided by this wetland, the most prominent ones are purification and treatment of wastewater. Emerton *et al*., (1998) indicate that Nakivubo wetland maintains the quality of water supply of Kampala by physically, biologically and chemically removing pollutants and sediments from the wastewater that passes through the wetland. The wastewater is generated mainly by households as well as industries.

Having mentioned the services and goods provided by the wetland, Table 2.2 summarises the total value associated with the wetland. It is indicated that the total economic benefits were worth USh 3 billion per annum, the most value being generated by water treatment and purification services (USh 3 million and 5 million per hectare per annum respectively). Crop cultivation contributed approximately two thirds of the value of resource utilisation activities. The values do not include all the direct and indirect uses of the wetland and therefore only gives a partial view of the economic value of the wetland. Particularly, most of the indirect use values such as groundwater recharge as well as the non-use values associated with the existence of the wetland were not depicted.

Table 2.2: Economic value of Nakivubo wetland, Kampala (Uganda)

Economic benefits	Economic value(Ush million/year	Value per unit area (Ush million/ha)
Wetland resources		
Crop cultivation	110.13	1.11
Harvesting of papyrus	17.41	1.14 - 4.29
Brick making	32.00	2.5
Fish farming	6.07	0.32 - 1.87
Total direct values	***165.61***	
Wetland services		
Water treatment and purification	1,597.88 - 2,664.13	3.02 - 5.04
Less the costs of purification	350.10	
Total indirect use values	***1,247.78 - 2,314.03***	
Total wetland value	***1,763.49 - 2,479.64***	

Source: Emerton (1998)

Turpie *et al*., (1999) conducted a study under the World Conservation Union's (IUCN) Zambezi Basin Wetlands Resource Conservation and Utilisation Project(ZBWRUP) to determine the economic value of wetlands in the Zambezi basin, that is, the Barotsi flood plains, the Chobe-Caprivi, Lower Shire wetlands and the Zambezi delta in Mozambique. The main components of value that was solicited was in regards to livestock, crops, use of natural resources (veld products), fisheries, wildlife, tourism, ecological functions as well as the option and existence values. Static and dynamic economic and financial models were applied in an effort to assess the value of the wetlands. The study found that the tourism value was assessed for the Chobe –Caprivi wetlands only as it was limited in other study areas. The Caprivi has a number of tourism attractions and therefore a popular tourism destination. The main attractions are fishing, bird watching, cultural activities, game viewing and also en-route points to Botswana and Zimbabwe. The tourism value was estimated using static and dynamic models to determine the financial and economic returns to lodges in the area. The total net economic value for the lodges was estimated to be US$ 785 637 per annum. The authors however caution that 20% of this value can be attributed to the wetland areas but allude that it is complex to apportion how much is directly as a result of the wetlands area. The study however failed to consider the value of CBNRM projects undertaken in the area

costs related to tourism which are very important when quantifying the tourism value. These costs include the external costs borne by the local communities (e.g. loss of cultural value or exclusion from traditional access to parks, human wildlife conflicts) and environmental costs as well.

In-terms of the ecological functions, the Caprivi generated an estimated value ranging from US$22 million while the Zambezi delta contributed US$ 80 million. In particular, groundwater recharge value was estimated to be more than US$ 16.4 million covering boreholes and shallow dug wells. In total, the indirect use value generated in the entire Zambezi wetlands was about US$ 182.4 million per annum. These functions are the most difficult to quantify as they require thorough ecological and hydrological understanding of the area.

Similar work was conducted in the world's renowned and largest inland wetland, the Okavango Delta as part of the development of the Okavango Delta Management Plan (ODMP) through IUCN support (Turpie *et al.,* 2006). The study determined the economic value of the Okavango using a similar approach as for the Zambezi basin wetlands. For the tourism value, three models were considered, being the ecotourism enterprise model, the community-based natural resources management (CBNRM) model as well as a safari hunting model. Turnover was then estimated for the various types of enterprises within the delta. The total tourism value of the delta is BWP 1 115 million with a direct contribution of BWP 401 million to the gross national product. The study indicates that of the total tourism value, a large portion is attributed to photographic tourism companies (80% of the value), while 15.5% and 3.5% is contributed by hunting safaris and CBNRM activities respectively. In regards, to the ecological functions, groundwater recharge for the delta was valued at BWP 16 million with abstraction amounts being estimated at about 5.8 million cubic metres per annum.

It is not surprising that tourism takes a significant chunk of the total economic value of the delta since the delta has a wide variety of tourism activities which have over the years made a significant impact to the tourism sector in Botswana.

2.6 Conclusions

This chapter has given an indication on the significance of wetlands in contributing to improved livelihoods, ecological integrity as well as economic growth and development. Despite this importance and the efforts exerted by the RAMSAR Convention in advocating for conservation and management of wetlands throughout the world, wetlands are still undergoing degradation and loss due to, among others, human predation, biased resource use policies, over abstraction, economic development and increased water demands. The critical value of wetlands thus needs to be recognized and understood by all stakeholders including the local populations so that they appreciate the significance of the resource. Literature indicates that this recognition and understanding should ideally go beyond the surface by integrating valuation in policies and decision making and as such, balances between utilization and management would be ensured. It is also appreciated that valuation can be complex especially in regards to the indirect use values of the wetlands hence in most cases, remarkable work on partial valuation of wetlands have been largely undertaken. The studies reviewed have however indicated a limitation in economic valuation efforts, that is, most studies do not incorporate utilisation of the wetlands' resources through CBNRM projects. Furthermore, valuation of wetland services is also limited, particularly, groundwater recharge. In addition, values of pans are also not readily available in literature. However, given these gaps, it is of paramount importance that such assessments be embarked on hence the motivation behind this study.

CHAPTER THREE: DESCRIPTION OF THE STUDY AREA

3.1 Introduction

The chapter gives a description of the study area in terms of the physical and socio-economic characteristics of the area. It further gives background information on the CBNRM programme in the Makgadikgadi area particularly focussing on the operating community-based organisations (CBOs). In addition, the ecological and hydrological aspects of the wetland are discussed.

Botswana is a landlocked, semi-arid country located at the centre of southern Africa. She is bordered to the south-east by the Republic of South Africa, to the north-east by Zimbabwe, to the north-west by Namibia to the north by Zambia. The country covers approximately 582 000 km^2 and has a population of 1,719,996 (Central Statistics Office (CSO), 2006). The population growth rate is 2.4 % while the population density is 2.9 persons/km^2.

The country's landscape is an almost uniform plateau with an average altitude of 1,000 m; elevation ranges between 700 m and 1,300 m (Ecological Support Services, 2002). The lowest parts of the plateau surface are the Ngami area and swamps of the Okavango River in the northwest, the salty pans of the Makgadikgadi wetlands in the northeast and the area between the Shashe and the Limpopo Rivers in the east. Rainfall is quite variable in Botswana and the mean rainfall is about 650 mm/annum in the north and 250 mm/annum in the extreme south western part of the country. Since the climate is dry and semi-arid, most streams and rivers are ephemeral and therefore most valleys are usually dry except after the rains. Surface water is generally limited in most of western and northern Botswana, except around the Okavango Delta and Chobe River. Ground water is also limited and recharge is low (DEA and CAR, 2006). The Okavango and Chobe Rivers are the only perennial rivers with their sources outside the country. In the central parts of Kgalagadi, there are several fossil valleys, created during periods of higher rainfall in the past. There is very little surface water in the western part of Botswana. Groundwater is therefore the major source of water for most of the rural population and the mining sector.

3.2 The Makgadikgadi Wetland area

The Makgadikgadi pans are situated in the Makgadikgadi Basin in the north eastern and central parts of Botswana. The catchment area of the wetland system is vast as it extends into Zimbabwe through the Nata River system. It is also linked to the main Okavango drainage system through the Boteti River. The map of the area is shown in Figure 3.2. The total surface area of the wetland area is 25,900 km^2 including settlements (Eco-logical Support Services, 2002). The wetland system is composed of two seasonally inundated pans being the Ntwetwe and the Sua Pans (Figure 3.1) with subsequent smaller pans in the area. The two major pans constitute 8,000 km^2 and 6,000 km^2 respectively. These pans are surrounded by grasslands, tree and bush savanna as well as Mophane woodlands and they are also fed by five seasonal rivers, the main one being the Nata River (McCulloch *et al*., 2008).

There are about twenty eight settlements in the area with two urban towns, Orapa in the western part of the wetlands and Sowa Town in the east. These urban centres areas have populations of 9,151 and 2,879 respectively (CSO, 2001). The entire area constitutes a population of 87,487 based on the population census data of 2001.

Figure 3.1: An image of the Makgadikgadi Pans

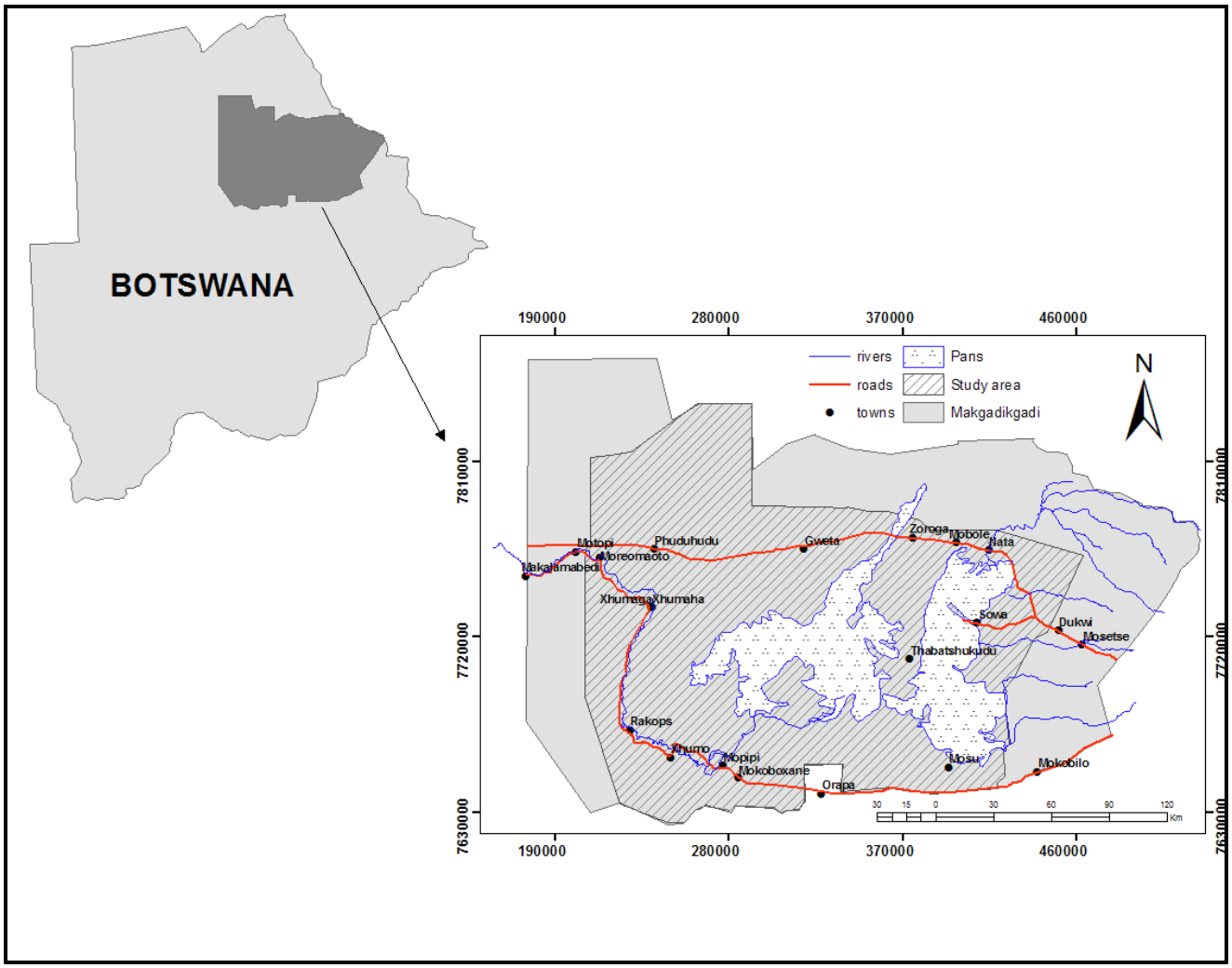


Figure 3.2: Makgadikgadi wetland area

The communities rely heavily upon traditional livelihoods activities mainly arable and livestock farming as well as collection of veld products. Employment in the public sector is common and there is limited employment of the local communities in the mining sector because of the need for high skilled manpower in the sector. Social welfare programmes also play an important role in availing income for the communities. This is mainly through programmes such as drought relief or Ipelegeng which are similarly undertaken in other villages throughout the country at large. Although limited, tourism plays a significant role in the Makgadikgadi as the wetlands provide a pristine tourism areas and abundant biodiversity which are vital for enhancing the tourism sector in the region. The Makgadikgadi National

Park and the Nata Bird Sanctuary offer a vast array of wildlife and bird species some of which are regarded as being rare. Other wildlife endowed areas are the Wildlife Management Areas which are also utilised by the communities of, for instance, Phuduhudu, through hunting quotas obtained from the Department of Wildlife and National Parks (DWNP).

3.3 Hydrology of the wetland system

The Makgadikgadi wetland is characterised mainly by pans. These occur in arid regions where rainfall is minimal. The area receives rainfall in the form of direct rain contributions in the form of surface and subsurface flows (Bryant *et al*., 2007). The hydrological regime of this unique wetland is thus determined by internal drainage controls such as surface and groundwater as well as external factors such as climate variability. However, rainfall forms an important determinant of the system particularly for maintaining water bodies and the water birds that highly rely upon the system. Rainfall is highly variable and average annual rainfall is 400 mm with Rakops village being the driest in the region (Ecological Support Services, 2002). Furthermore, rainfall patterns in the Makgadikgadi are linked to the Elnino Southern Oscillation cycles in the Pacific Ocean as well as sea surface temperatures associated with the Indian Ocean (Bryant *et al*., 2007).

In terms of the surface water flows, all rivers discharging into the Makgadikgadi system are ephemeral including Nata, Semowane, Mosetse, Lephashe and Mosope and Boteti among others. There have been floods associated with some of these rivers and these have contributed to the wet environment of the pans (Bryant *et al*., 2007; McFarlane and Eckardt 2008). Other contributing factors include wet mud, hydrated salts as well as groundwater pulses. The Department of Water Affairs keeps flow records and maintains five flow records in the Makgadikgadi (Ecological Support Services, 2002) and flow data for four rivers at five stations are indicated in Table 3.1.

In terms of groundwater, the Makgadikgadi wetland has mostly shallow wells and minimal deeper saline brine. The quality of groundwater resources is variable and in some areas, very saline given the occurrence of salt pans. Groundwater is therefore an important source of

water for the communities and industrial activities around the Makgadikgadi particularly soda ash and diamond mines located in the area. The importance of the resource is discussed in later sections in this document.

Table 3.1: Flow records in the Makgadikgadi

Station name	***ID #***	***Records***	***Annual Mean (Mm^3)***	***Recorded Maximum (Mm^3)***	***Minimum (Mm^3)***
Nata River at Nata Old Bridge	5311	1969 - 1999	159.6	596.4	0.0
Mosetse River at Mosetse	5211	1969 – 1999	7.59	73.6	0.0
Mosupe River at Matsitama	5111	1070 – 1999	24.28	35.18	0.0
Boteti River at Rakops	8122	1971 – 1991	167.5	704.92	0.0
Boteti River at Samedupi	8112	1970 – 1991	255.8	720.0	0.0

Source: Ecological Support Services, 2002

3.4 Ecological regime of the Makgadikgadi wetland

The Makgadikgadi is endowed with a variety of ecological habitats which provides for a diversity of flora and fauna. These are important for maintaining the ecological integrity of the wetland system and its surrounding areas as well as for sustaining people's livelihoods. The flora includes woody vegetation, short bush and tree savanna and various grass species. Just like most parts of northern Botswana, woodland Mophane is very common in the Makgadikgadi area (Ecological Support Services, 2002). Acacia tree species also commonly occur in the area. Although limited, baobab, hoodia and palm trees are found in designated parts of the Makgadikgadi especially along the eastern margins of the Makgadikgadi National Park. Palm trees are used for decorating houses and as well as baskets and crafts' weaving. Hoodia is well known for suppressing appetite and therefore it is an important commercial resource. In terms of grasses, dominant grasses include *Digitaria* and *Anthephorsa* species which mostly occur in the grassland savanna whereas the *Cynodon dactylon* is common around settlements (Ecological Support Services, 2002). *Anthephorsa* is highly important as it is used for feeding livestock and is suitable for wildlife as well.

There are different types of animals which are found in the Makgadikgadi area. In terms of the mammals, there are more than twenty-five families of small to large sized mammals with about sixty-seven species (Ecological Support Services, 2002). Colleagues from the wider FMP project gathered wildlife population data for the Makgadikgadi area using wildlife census data and these are illustrated in Table 3.2. The data ranges from 2001 to 2006. The data however excludes estimates for hippo, rhino and bushbuck. Zebra and wildebeest within the Makgadikgadi ecosystem occur predominately in the protected areas such as the Makgadikgadi National Park and within the wildlife management areas. These animals are the most common mammals in the area as well as springbok and ostriches. Some of the animals are problematic and thus are a source of conflicts especially with the surrounding communities. Human wildlife conflicts are very common especially in relation to predators which in some cases destroy people's livestock and property. Such problematic animals include elephants, wild dogs and hyenas.

Table 3.2: Wildlife population estimates for species within the Makgadikgadi (1996-2006)[3]

	1996	***1999***	***2001***	***2002***	***2003***	***2004***	***2006***
African elephant	323	1,023	728	355	904	1,305	1,561
Burchell's zebra	12,124	29,123	15,974	13,766	13,519	20,137	18,249
Giraffe	1,209	1,597	657	697	411	913	1,139
Blue wildebeest	3,391	19,605	3,949	10,314	8,009	3,071	10,843
Cape buffalo							92
Common duiker	170	217	220	232	417	115	104
Eland		96		124	34	10	43
Gemsbok	1,311	1,571	1,657	2,186	1,842	2,398	3,148
Greater kudu	3,539	1,909	2,187	1,604	1,500	1,525	1,166
Impala			292	941	1,001		245
Red hartebeest	1,994	754	349	1,377	513	189	339
Roan							11
Sable	133						
Springbok	6,170	2,214	8,096	332	2,141	1,764	3,938
Steenbok	1,467	2,409	827	1,846	1,406	368	767
Ostrich	4,869	4,046	5,526	7,119	4,689	3,089	6,625

[3] Based on the aerial census data from the Department of Wildlife and National Parks

The Makgadikgadi wetland is also rich in avifauna (birds) and supports more than 20 000 water birds and has been designated an Important Bird Area (IBA) by BirdLife Botswana (McCulloch *et al*., 2007). This wetland system and its surrounding terrestrial environment support about three hundred and eighty-five bird species. The wetland system attracts globally threatened species such as the Wattled Crane and Lesser flamingo as it provides food and serves as a breeding ground for some of these birds. The IUCN has compiled a list of globally threatened and rare bird species and some of the birds indicate din the list occur in the Makgadikgadi wetland system. According to this Red Data List, the Makgadikgadi has seven very rare species (category A), thirty-nine which fall in category B rarerities, seven vulnerable species and eleven near threatened bird species (IUCN Red Data List website. 2009; McCulloch *et al*., 2007). Figure 3.3 shows an aerial photograph of a crèche of flamingo chicks in the Makgadikgadi.

Source: McCulloch *et al*., 2007

Figure 3.3: A crèche of flamingo chicks in the Makgadikgadi pans

3.5 Formation of pans

Given that the major prominent features of the Makgadikgadi wetland are pans, it therefore crucial that their formation be discussed so as to aid understanding of these features. Numerous pans of varying types and sizes occur in the Makgadikgadi wetland system and three categories are recognized: recharge pans, discharge pans and sumps. *Recharge pans* are a few kilometres in diameter and are the loci of infiltration of surface water which shifts fractured materials downstream such that physical collapse of the land surface occurs (Ecological Support Services, 2002). Fracture related discharge points can occur at the bottom of the slopes and this is where freshwater reaches the surface. Where this occurs, game can excavate the surface and this form the *discharge pans*. In relation to *sumps,* inundation can occur due to rainfall, run-off and groundwater discharge (Ecological Support Services, 2002). However, due to evaporation, the surface area can dry out such that deflation eventually removes fines from the surface of the pans, and when deflation stops, recharge does not take place and thus salinity occurs.

3.6 Profiles of the Community Based Organisations

A Community Based Organisation (CBO) is a legal entity representative of and accountable to members of a community (Taylor, 2002). For the purposes of this study, this encompasses communities involved in natural resources management and represents the community's interest in natural resources management as well as implementing any management decisions taken. When a CBO is registered, legally recognized and has a constitution, it may also be termed as a Trust.

CBOs in Botswana have largely been developed to foster CBNRM. This programme is common across the African region and historically it was developed mainly out of concern for deteriorating wildlife resources, after the realisation that existing management approaches were insufficient (Taylor, 2002). In Botswana, CBNRM was first introduced in 1990 for the management of wildlife resources. Since the late 1990s, the country experienced a growth in registered CBOs and currently more than hundred CBOs exist (Johnson, 2009). Furthermore, there is now diversification of the natural resource base as some projects are directed towards the use of rangeland resources other than wildlife such as veld products.

The CBOs selected for the study (Nata Conservation Trust, Gaing-O Community Trust and Xhauxhwatubi Development Trust) have varying characteristics and profiles. They vary greatly with the coverage or the size in which each of them operates and the activities they engage in.

Nata Conservation Trust was formed in 1988 but became operational in 1992. Prior to its formation, a number of stakeholders including the Kalahari Conservation Society as well as BirdLife Botswana realised the need to conserve the Nata Bird Sanctuary and the importance of involving communities in the management of this area. Thereafter, intensive efforts were made to raise awareness among the communities and educate them on the importance of natural resources management. This led to the formation of the Trust. The Trust encompasses the villages of Nata, Sepako and Maposa in the western side of the Makgadikgadi and manages the Nata Sanctuary with an area of 230 km^2 and is a prime area for birds. The Trust engages in sustainable utilization and conservation of the sanctuary. The sanctuary is operated like a tourism entity and therefore generates revenues for the Trust and also creates employment for the local communities.

Xhauxhwatubi Development Trust covers Phuduhudu village and has been granted a head lease to hold user rights for hunting and photographic tourism in controlled hunting area (CHA) NG49 which is about 113 km^2 in size. The Trust annually receives a hunting quota (Appendix 1) from the Department of Wildlife and National Parks (DWNP) that determines the value of their commercial hunting potential. Hunting is the major commercial activity of the Trust, and commercial photo safaris have largely remained underdeveloped but there are plans to revive this activity in the near future. The community engages a private company through joint venture agreements for the utilisation of the hunting area. In that regard, the joint venture partner pays out a land rental as well as money for the hunting quota received from the Trust on behalf of the community. Since inception, Xhauxhwatubi has entered into a joint venture partnership (JVP) with one company, Out of Africa Safaris. Through the user rights and hunting activities, the Trust generates significant amount of revenues as compared to the other two CBOs. For instance, in 2005, the Trust obtained about BWP 1.2 million from such activities.

Gaing-O Trust was established in 1997 by the community of Mmatshumo primarily because of the need to preserve and manage Lekhubu Island. Traditionally, the island has an ancestral and cultural value thus very important to the local community as it is utilised by some segments of the society for performing rituals and prayers. There are ruins, granite rocks, fossils of lion footprints, stone age tools, big baobab trees and these are termed as attractions on this site. There was great concern for the island because of the significant numbers of unregulated tourists in the area as well as locals and livestock invasion thereby hampering the sustainability of the area. Since the exact area of operation for Gaing-O could not be established, it was assumed that the Nata Sanctuary is three times the area where Gaing-O operates. Lekhubu Island is the main source of revenues as tourists undertake camping as well as day visits at the site. On average, the Trust receives about 2,550 visitors on an annual basis generating about BWP 200,000 in revenue. The money is mostly used for meeting the operations of the trust and ensuring that the employees receive their remunerations. The Trust does not engage in JVPs but there are future prospects for such arrangements.

CHAPTER FOUR: METHODOLOGY

4.1 Introduction

This section outlines the methodological approaches that were used in the research. Section 4.2 focuses on the direct use value in relation to CBNRM in the area and as such, three villages were selected in determining the value generated by CBNRM. The approach used in determining the value of groundwater recharge is described in Section 4.3. Recharge has been estimated as a percentage of abstraction in all the cases. It has been assumed that for the livestock and settlements boreholes, abstraction does not exceed recharge primarily because the settlements are small.

4.2 Estimation of the direct use value of the wetland's resources to the CBOs

a. Sampling of villages

Three Community Based Organisations (CBOs) within the Makgadikgadi were selected: Gaing-O Community Trust in Mmatshumo, Nata Conservation Trust in Nata and Xhauxhwatubi Development Trust in Phuduhudu. These are the only three operating CBOs in the region and are fairly established. Among the villages selected for the wider Makgadikgadi Framework Management Plan project, Mmatshumo and Nata were some of the villages visited. Demographic data for the three villages is summarised in Table 4.1.

Table 4.1: Village population sizes

Villages	Population	Households	Households size	Female	Male	Male Headed Households	Female headed households
Mmatshumo	865	190	4.6	375	490	113	77
Phuduhudu	377	-*	*-	*-	*-	*-	*
Nata	4 150	923	4	1 875	2 275	529	394

*No data

Source: Central Statistics Office, 2001

b. Data collection

Field work is mainly undertaken so as to collect primary data (Jonker and Manzungu, 2008) and therefore this formed a significant part of the study at hand. Focus group discussions and interviews were undertaken with the communities, trust members and other stakeholders. These were used to gain insights as to how the wetland is utilized, how the trusts operate, their activities, challenges, benefits and prospects for the future. Structured and semi-structured interviews were conducted. In total, sixteen focus group discussions were undertaken and interviews were held with the chiefs, members of the Trusts, representatives from the following government departments: Department of Tourism, Department of Environmental Affairs, Department of Veterinary Services, Department of Crops and Extension Services. With regards to non-governmental organisations, an interview was held with a representative from the Kalahari Conservation Society which mainly supports conservation activities in the country as well and CBNRM projects. Furthermore, in February, the annual National CBNRM Forum was held in Gaborone and I had the opportunity to attend and meet with some of the CBO members as well as national stakeholders relevant to the study.

In relation to Xhauxhwatubi Development Trust, the village could not be visited due to time constraints therefore data was mainly attained through telephone interviews with the Trust Manager and a representative from the Department of Wildlife and National Parks. Field visits and observations were undertaken to gather data required for the study. Observation is essential as it allows the researcher to learn through personal experience and hence can yield in attaining more information.

In terms of the financial information, financial reports were obtained through the Trusts' book keepers and supporting stakeholders. For Nata Community Trust, the financial data was not readily available from the trust but rather it was intensively sought through their past project facilitators and supporters, in this case, Kalahari Conservation Society (KCS). Their records dated as far as 1992 and therefore the data attained was fairly substantial for utilization in the development of the CBO models. In addition to what was available from the

KCS, some of the information was sourced from the Trust manager especially where the already obtained data was not clear. Information on donor funding was very scanty and hence there are various gaps for a number of years. However, what was available was utilized with some assumptions. For Gaing-O Trust, data was only available for 2009 as they had no access to the past records. Nevertheless the data was useful for the modelling. Donor funding data was available for a number of years (1997 to 2010).

c. Development of the CBO Enterprise models

Community Based Organisations' Enterprise models were developed based on those of Barnes (2001, 2008), Barnes *et al.*, (2002) and Turpie *et al.,* (2006). They largely follow the models developed for the CBNRM programme in Namibia and those in the Okavango Ramsar site. The enterprise models consist of financial and economic models clearly detailing static, dynamic, budget and cost-benefit excel spread sheet models. These models are purely based on empirical data and assumptions brought together through interviews with the trust operators and resource users as well as through assessment of their financial records. The CBO enterprise models measure both the financial and economic efficiency of the projects. The former is measured so as to assess the profitability of the project from the project and investors' perspective and in this case, the measures are annual net income, financial rate of return and the financial net present value. In addition, the financial profitability is measured from a point of view of the community itself, that is, how much they are accruing from a project as a community. Measuring economic efficiency on the other hand considers contribution of the project to gross and net national incomes, economic rate of return as well as the economic net present values in economic prices. Ultimately these would show the economic value of these projects as an investment based on the costs and benefits that are directly associated with the projects and their use of the wetland's resources.

i. Static budget models

Static budget models depict an annual income statement for the enterprise at full production. The static *financial* models therefore measure the annual financial net profit attained while the enterprise was at full production. These take into account depreciation on owned capital,

interest and amortization on borrowed capital, government fees, rentals and royalties received by the CBOs. The static *economic* models on the other hand, measured the annual change in value added to the gross national income (GNI). This was calculated as gross output less intermediate expenditures, leaving all the income earned by the enterprise's internal factors of production including the labour, land, capital and entrepreneurship involved in the enterprise. The value added thus included the annual profits, salaries and wages, payments to and of capital, rentals, royalties, and taxes resulting from the enterprise activities all measured at their opportunity cost to the nation. Calculation of GNI as a measure of *national* as opposed to *domestic* income, considered foreign inflows and outflows. The most important measure for the static budget models as indicated was the GNI, but also measured was the net national income (NNI), which was GNI less depreciation.

In order to value the inputs and outputs so as to reflect the opportunity costs, shadow pricing was applied. Shadow pricing, as applied in the economic analysis, involved adjustments to allow for unemployment, excess demand for foreign exchange, and domestic transfers. Thus the values were measured from the perspective of society.

ii. Dynamic cost-befit models

The dynamic cost-benefit models in this case measure financial and economic returns over five, seven and ten year periods. In appraising projects, the resultant measures are the Internal Rate of Return (IRR) and the Net Present Value (NPV). The NPV analyses the overall value or viability of a project, taking into consideration the time value of money at the opportunity cost of capital or discount rate. The IRR is the discount rate at which the NPV is equivalent to zero. Therefore should the NPV be negative and the IRR less than the discount rate, then the project is deemed as being non-viable, earning less than the next best investment. Moreover, the higher the IRR, or if the IRR is greater than the discount rate, then the project is more desirable to invest in. The benefits and costs flows were in constant prices, excluding inflation, and they were discounted at a real rate of 10 % for both financial and economic models. The 10 % discount rate is the preferred rate in Botswana as stipulated in the Ministry of Finance and Development Planning's Handbook for Planning and Bank of Botswana

(MFDP, 1995). All capital expenditures were included and depreciation or appreciation of capital value was accounted for in the asset residual value in the final year of the cost benefit analysis.

Detailed methodological description of the components of the models is illustrated in this section.

iii. Assumptions

For each enterprise model, the following have been considered:

- The type of production system;
- Game density where there is considerable wildlife in the respective areas;
- The carrying capacity of the land;
- The coverage of the trust or the size of the area that the trust operates in. For the Nata Conservation Trust, this has been assumed to be the size of the Nata Sanctuary (230 km^2) which is currently being managed by the Trust. The activities of this trust are mostly associated with the sanctuary. For Gaing-O Community Trust, the size of the area of operation is not clear. Therefore, taking the area of Nata sanctuary as a base case, it has thus been assumed that the Lekhubu island area where the Gaing-O operates is four times smaller than the sanctuary. Therefore the area is on average 58 km^2 ;
- Household dividends – no dividends accrue to individual households;
- No resource royalties and land rentals accrue to landholders (landboards government, etc)
- The manpower needs for each project are stipulated as follows: one manager, four skilled labourers as well as four unskilled labourers.
- A general shadow price for managers (1), skilled (1) and unskilled labour (0.50) of the market price. This reflects the unemployment and social pressure for higher wages.
- A foreign exchange premium has been added to the tradable goods in the economic models so as to account for excess demand for traded and tradable goods and services in the market. A premium of 6 % has been considered;

- The net effect of VAT was treated as a general sales tax, adjusted at 10 %;
- The static economic model includes an opportunity cost of capital of 10% but land opportunity costs have been excluded;
- The adopted discount rate of 10 % for the analysis of costs and benefits is in line with the rate currently used in Botswana (MFDP, 1995).

iv. Description of the models

1. Static financial and economic models

Firstly, from the financial data and observations, capital and recurrent expenditures have been obtained and these depict the costs that the trusts incurred in running the projects. In terms of capital requirements, three types of capital have been identified.

- Fixed capital includes all the real and physical assets which stay in the business/projected permanently or over a long period of time. Within the fixed assets there are domestic and tradable items and the latter accounts for all those fixed assets which can be easily traded in the market such fences while domestic ones include buildings and boreholes among others.
- Movable capital are those capital goods which can be easily moved. For instance, vehicles, machinery and office equipment.
- Working capital is the financial resources required to start operating the business or the project. It is therefore a portion of the normal recurrent costs.

Secondly, the sales at full production were also calculated based on the revenues generated by the trusts over the years. For Gaing-O and Nata trusts, income was mostly generated through gate entry fees and camping activities while Xhauxhwatubi Trust generated its income through hunting quota revenues and rentals from the joint venture partner.

Thirdly, the recurrent costs were divided into variable and overhead costs when the enterprise is at full production. Variable expenditures varied with production while overhead costs were

fixed, and related to the basic operation of the enterprise. The overheads comprised salaries and wages, maintenance and repairs and insurance among others.

In calculating the total figures for the various years as in the case of Nata Trust, the available figures from the various years were averaged so as to arrive at a single figure for the respective costs and income components.

The resulting financial model therefore indicated the annual financial output or gross income as well as the annual net cash income. Deducting the variable costs from the gross income gave the *gross margin*. The *net cash income* was therefore calculated as the gross margin minus the total overhead or fixed costs.

As described above, for the static economic models, the annual economic costs were deducted from the gross output to get annual *net economic benefits* or the *gross value added* to *GNI.* When depreciation was subtracted, the result was the *net value added*. These values were at opportunity cost to the society.

To get the aggregate values for a typical CBO in the area, a separate model was developed using the information derived for all the three CBOs. Thus for the estimation of for instance, the gross value added for a typical CBO, the gross value added from this model was multiplied by three so as to get the aggregate for all the three CBOs. This model give sa general picture as to what value a CBO in the Makgadikgadi area generates from utilising the resources within the wetland.

2. Depreciation and stock projections

Wildlife stocks in the CBO areas have been projected based on the premise that in Botswana, communities are given rights to utilize the resources within specific areas. The communities are investing money in the conservation and management of the wildlife stocks in their areas. The models therefore include the stock projections as well as the increased values of the assets. For tracking changes in stock numbers and stock value the stocks were assumed to grow at species specific growth rates within the long term rangeland carrying capacities,

measured in hectares per large stock unit (LSU) equivalent. The LSU equivalent is a unit of biomass reflecting the metabolic or energy using equivalent of a 450 kg domestic ox.

It has been assumed that depreciation and appreciation of assets was only realisable at the end of the dynamic model (5, 7 and 10 year models).

3. Loans

The models include a table on loans which is aimed at tracking loans and repayments for the measurement of national income change. However, this did not apply to the CBOs in the Makgadikgadi area.

4. Dynamic models

As indicated earlier, the dynamic models measured the efficiency of the projects over a given period of time and in this case, over five, seven and ten year investment periods. This analysis was carried out to measure private returns for the project itself, those for the community alone, and at the national level. For the financial model, the items that formed part of the model are illustrated in Appendix 2. In addition, tables depicting the planned subsidies to the communities have also been developed. On these models, income from the perspective of the community is measured. This was done by subtracting the subsidies provided by government and donor organisations from a cross section of the cost benefit models. Thus the returns to the community are measured.

The expenditures on the community financial analysis models were therefore calculated as the initial expenditures (project financial analysis) minus the subsidies on expenditures or contributions from donors and government. This resulted in the estimation of the community financial IRR and NPV, thus indicating the profitability or attractiveness of the investment from a community's perspective. The economic analysis followed the same procedure as the financial analysis in terms of spreading the costs and benefits over the stipulated period of time.

As explained earlier, the costs and benefits in this case have been subjected to foreign exchange and tax adjustments so as to derive the overall economic costs. After deriving the

net benefits/costs, the economic measures (NPV and IRR) were then estimated at a 10 % discount rate.

The models were tested through a sensitivity analysis by changing some variables. This was undertaken in-order to determine the robustness of the models and the strength of the conclusions that could be attained from them.

4.3 Estimation of the groundwater recharge

a. Livestock

Livestock data was attained from the Nata and Letlhakane Departments of Veterinary Services as well as from the national livestock census data of 2006. The Veterinary Services provided information for the various cattle crushes mainly located at the cattle posts. The cattle crush data however has limitations in that although small stock have been enumerated, a significant proportion of the stock is found around the villages. In Botswana, most of the small stock is kept in the village grazing area as opposed to cattle which in most cases are kept at the cattle posts. In contrast, the agricultural statistics data captures information around the villages as well as from the cattle posts. Data from the agricultural statistics is given by the agricultural sub-district, in this case: Letlhakane, Ngamiland East and Tutume. A proportion of these districts fall within the Makgadikgadi project area and therefore the following assumptions have been made:

- For the Letlhakane district, 71.5 % of the livestock falls within the project area and is evenly distributed;
- For Tutume district, 17 % of the livestock falls within the project area; and
- 6% of livestock in Ngamiland East district falls in the Makgadikgadi Framework Management Plan project area.

In estimating the water consumption by livestock, daily water requirements per head of livestock ware used as designed by the Ministry of Local Government. This is illustrated in Table 4.2.

Table 4.2: Water requirements per head of livestock

	Daily (l)	***Annual (m^3)***
Cattle	50	18.25
Goats	5	1.825
Sheep	5	1.825
Donkeys	20	7.3

Source: Lange and Hassan, 2006

For each type of livestock, the water requirements have been multiplied by the number of animals in that category so as to derive how much water they consume. Taking into consideration that animals do not drink from boreholes all year round, it has been assumed that 75 % of the year, livestock drink from groundwater resources and the rest of the time they get water from surface water resources assuming it rains. The total abstraction for livestock consumption has therefore been assumed to be equivalent to the recharge.

b. Mining

The Orapa Diamond Mine and BOTASH have been considered as some of the water users in the Makgadikgadi area. BOTASH has its own well field and buys potable water from the Dukwi well fields through the Water Utilities Corporation. For BOTASH, average water abstractions have been estimated based on the annual abstraction data from CSO (2009). From literature, it is known that recharge attributes 33 % of the total water usage by BOTASH mining activities. In regards to the Orapa mine, two well fields have been considered as they fall within the project area (well fields 2 and 4). A quarter of the average total water abstractions from these well fields for 2007 and 2008 have thus been considered for the recharge value.

c. Wildlife

Nine boreholes within the Makgadikgadi National Park are currently operational. Information about the boreholes was available in regard to their capacities and pumping rates. Daily pumping rates have thus been considered and the total rate was multiplied by 365 days to derive the annual abstraction from the boreholes. It has been assumed that the boreholes pump water at least four hours per day.

d. Settlements

Sixteen settlements were selected for the study. The information required were water consumption data and the number of people occupying the area. The last Population Census was undertaken in 2001 but over the years, projections were made for the various settlements in the country. The overall annual population growth rate of Botswana is 2.4 % (CSO, 2006). However, for the rural areas, the growth rate is around 2.1 % because of factors such as urbanization. This factor has been used in projecting 2009 population for the settlements at hand. For the water consumption, in the absence of exact water consumption figures for each settlement, daily per capita water demands are required to enable the estimation of water consumption. In essence, the Review of the National Water Master Plan (2006) stipulated the suggested water demand figures as designed by the Department of Water Affairs (DWA) for use in the entire country. The design manual by DWA has suggested the following figures:

Table 4.3: Estimated household water consumption

	l/c/d
House connections	60
Yard connections	125
Standpipes	30
Total	71.7

Source: SMEC and EHES, 2006

Using the above information, total annual water demand in m^3 was estimated as follows:

$$\text{TWD} = \frac{av.p.c/a}{1000l}$$

Where:

TWD = total water demand

a*v.p.c* = average per capita water consumption

a = annum

l = litres

Water abstraction has been assumed not to exceed recharge given that most settlements are small. Therefore, the recharge rate has been assumed to be 65 % of the total groundwater abstraction.

e. Costs

The costs of water vary by sector and institution. For this study, the water costs have thus been estimated based on those from the Maun Groundwater Development Project and those used in the economic valuation of the Okavango wetland (Turpie *et al*., 2006). A value of P2.75 / m^3 has therefore been used as the unit value of groundwater in the Makgadikgadi area.

f. Overall groundwater recharge value

Given the abstractions and recharge estimates, the value of groundwater recharge for the Makgadikgadi Wetland system was arrived at. This was calculated by multiplying the sum of the recharge /abstractions values by the unit value of groundwater.

g. Sensitivity analysis

A sensitivity analysis was undertaken to determine the effects of changes in the livestock numbers, changes in the unit price of water and the percentage changes of groundwater recharge as a result of mining activities.

CHAPTER FIVE: RESULTS AND DISCUSSIONS

5.1 Introduction

This chapter presents the major findings and a discussion of the results that were obtained from the research around specific objectives. As outlined in Chapter 1, this research was centred on three objectives. The results on the first objective on characterisation of current wetland users and types of goods and services presently harvested are presented in Section 5.2 of this chapter. In Section 5.3, findings on the second objective which sought to estimate the direct use value of wetlands resources to specific community based organizations are presented using tables and graphical presentations. The detailed analyses are attached in the Appendices 3 through 4. The third and final objective of the study was estimating the recharge value of wetland system given that the different values of water by different integrated wetland water resource users who include mines, settlements, livestock sector and the wildlife within the Makgadikgadi National Park. The findings on this objective are in Section 5.4.

5.2 Characterisation of Makgadikgadi wetland resources for different resource users

5.2.1 Characterisation of wetlands users

The Makgadikgadi wetland is one of the largest wetland systems in the region and serves a variety of purposes given the various goods and services it provides. In this regard, the resources provided by the wetland are important to a number of stakeholders and resource users. The resource users and how they utilize the wetland are outlined in Table 5.1.

Given the location of the wetland, the major users are the local communities particularly the farmers and the natural resource harvesters. Agriculture is a major activity around the wetland and a major source of livelihoods for the rural communities. Farmers are engaged in both crop and livestock farming for subsistence and on a limited scale, for commercial purposes. This concurs with the findings of a study carried out on the Okavango delta and wetlands on the Zambezi basin by Turpie *et al*., in 1999 and 2006. Commercial farmers are limited because of lack of access to the market as well as lack of resources to start up

commercial farms. Commercial farmers are therefore those who are regarded as being the wealthy members of the society and more than 60 % of these farmers are not originally from the Makgadikgadi area. These are individuals who acquired land for farming in these areas and have thus benefited from using the wetland's resources.

In regards to the use of natural resources, the local communities are also highly reliant upon the wetland area for its range resources. Natural resource harvesters range form the youth to the elderly women and men. As remarked by Turpie and others (2006) on the economic use value of the Okavango delta, natural resources' products as a result of the existence of wetlands form a critical part of the local communities' way of life. With most wetlands in southern Africa, fishermen are by far the most common particularly because of the vast waters supplied by wetlands (Hirji *et al*., 2002; Turpie and Barnes, 2003). However, in the case of the Makgadikgadi, where the wetland is dry for most of the year, fishing is not significant. Natural resource users are mostly collect wild foods, plants, grasses, firewood and medicinal plants.

The wetland area is endowed with minerals including diamonds and soda ash and as such, two of the largest mines in the country are located in this area (Orapa diamond mine and BOTASH). From this view point, these contribute significantly to the local and national economy through the revenues and employment opportunities generated. The Makgadikgadi is also an important area for tourism as it possesses rare biodiversity such as birds (especially flamingos) as indicated in the important bird life monitoring activities of the Bird Life organisation in Botswana (McCulloch *et al.*, 2007). Furthermore, wildlife resources and the attractive salt pans are also prominent features of the wetland area. Some of the wild animals roam in the wild while some are protected by the government as they are found in national parks and sanctuaries. However, most of the tourism establishments in the area consist of medium-scale lodges and camps which offer services such as game drives, bird-watching, walking safaris, historical tours, horseback riding, quad-bike riding, restaurants, curio shops, and bar facilities. Camping sites and hunting camps are also present. Due to the tourism attractions that the area possesses and the abundance of wildlife and other biodiversity, the communities through the CBNRM programme, are also users of the wetland's goods and

services. As mentioned in Chapter three, there are eight CBNRM projects in the entire Makgadikgadi area with only three CBOs being active.

Table 5.1: Characterization of the wetland's resource users

Users	***Resources used***
1. Agriculture: • Arable • Livestock	Soil, rangelands and water resources
2. Natural resources harvesters	Mopane worms, grass, firewood, wild foods, medicinal plants and fruits for beer brewing and crafting.
3. Mines: • Diamonds • Soda ash	Minerals, water resources
4. Tourism	Biodiversity: pans, birds, rivers, wild animals, rangelands
5. Wildlife	
6. Community Based Organisations	Biodiversity

5.2.2 Characterisation of the wetland's goods and services

As one of the largest wetland systems in the country, the Makgadikgadi is among the region's most productive ecosystems. The characteristics and features of this system can be categorized according to its functions, components and qualities. The functions include nutrient cycling, wildlife refuge and groundwater recharge among others. The components of the system are the biotic and the non-biotic features which comprise of water, plants, water, soil and animals. The attributes or qualities of the wetland system include the diverse range of living organisms found in the system.

In essence, the Makgadikgadi wetland system directly and indirectly supports thousands of people living in and around the wetland in various ways through the goods and services it

provides. These goods and services can be divided into direct and indirect benefits within the framework of Total Economic Value and these are illustrated in Figure 5.1. According to the focus group discussions with the resource users, for the direct benefits, agriculture is considered to be the most important activity especially livestock farming. Not only are they the most important source of income to the rural communities, cattle also provide meat, milk, and draught power. They are also indicators of wealth and prestige as well as cultural heritage and therefore significantly contributes to improving people's livelihoods. In most cases, livestock is kept at the cattle posts which are far outside the villages and these are centred around water points. Crop farming is also undertaken in the Makgadikgadi area as well. Dryland farming is the most common form of crop farming but households in areas like Rakops and Xhumaga practise floodplain (*molapo*) farming in areas that are seasonally flooded. The average size of fields in the Makgadikgadi is 3.5 ha / household and the crops grown include maize, sorghum, millet, beans and melons among others. The cropping season starts in November and harvesting is between March and April and in a good year, farmers can plough as much as 5 hectares. The produce is mostly utilised for household consumption and sold locally, and to a lesser extent to Botswana Agricultural Marketing Board (BAMB).

Figure 5.1: Various uses of the Makgadikgadi wetland: top left- livestock farming; top right- wildlife/tourism; bottom left - mining of salt and soda ash; and bottom right – crop farming.

The local communities also engage in the collection and utilization of veld products. The area is endowed with a variety of veld products including grass, *imbrasia belina* (mopane worms) wild fruits, firewood, medicinal plants and those used for brewing traditional beer. Although the communities still regard this sector as playing a vital role in their livelihoods, the importance of sector has generally declined over the years due to the depletion of resources and loss of access to resources (Turpie *et al.,* 2006).

Grasses are used extensively in the area mainly for thatching, making traditional brooms and on a limited scale, for building of fences. Harvesting of grasses is undertaken for both subsistence and commercial by the local communities. From the focus group discussions, it is evident that thatching grass is one of the most important veld products in the area. However, due to its high demand, the critical species suitable for thatching such as *Tshikitshane* are currently limited. This is so because harvesting of grass is not only undertaken by the local communities but by outsiders as well therefore the sustainability of the resource calls for concern. Although there are several laws that guide the utilisation of resources such as grasses in Botswana, there is no law that inhibits outsiders from accessing the local resource as well as stipulating how much should be harvested in a particular area. Management is left to the local authorities but currently these management systems are weak owing to mainly loss of traditional leadership powers and increasing demand for the resource.

Mopane worms are a source of food for most households and are therefore collected in large quantities in the December and April seasons. These worms are also critical for commercial utilisation as they are sold locally and to outsiders who do not have access to the resource. Mopane worms are mostly available in the northern and north eastern parts of the Makgadikgadi wetland area therefore in areas around Rakops, these worms are not collected and therefore less important to people's livelihoods. In some areas such as Gweta, collectors alluded that recently, they have had to travel long distances to reach the resource and are therefore forced to stay out for up to a month harvesting the worms and then selling them to outside areas. Furthermore, these edible worms are also collected by outsiders who eventually sell the worms as far as Gaborone and South Africa. The participants alluded however that these traders sell the worms at

far higher prices and possibly accrue significant returns from this activity. Locally, a 20 kg bag is sold on average for BWP 250.

Firewood is another important resource for the local communities and it is utilized mainly for cooking, heating and lighting. According to CSO (2001), about fifty percent of households in the study area use firewood for cooking. The wetland area provides poles and timber which are mainly used for house and fence construction as well as for the production of wooden products such as mortar and pestle as well as furniture. Considering that the wetland is largely comprised of pans, salt is therefore one of the prominent resources in the area. Salt is commonly collected in the villages of Mmatshumo and Nata and it is mostly used as supplementary feeds for livestock, in cooking and has medicinal value as well.

Fishing and hunting are other direct benefits attained from the wetland. Fishing takes place mainly along the Nata River, and is practiced all year round, but particularly after heavy rains. Unlike areas around the Okavango delta, (Turpie *et al.,* 2006), harvesting of palm leaves is minimal in the Makgadikgadi area. Where available, they are used for basket weaving and making other crafts.

Another important direct benefit of the wetland goods and services is tourism although it is relatively undeveloped and its potential has hardly been tapped. Most of the tourism establishments comprise of medium-scale lodges and camps which offer services such as game drives, bird-watching, walking safaris, historical tours, horseback riding, quad-bike riding, and use of restaurant, pool, craft shop and bar facilities. Camping sites and hunting camps offering guided big game trophy hunting are also present. There are about twenty campsites of which 75 % are privately owned and the remaining are owned by the state. High end tourism is offered at some of these camps while for the ones operated by the state, activities are concentrated on wilderness safaris.

Communities also directly utilise the wetland's resource through the CBNRM programme and currently eight of such projects exist but only three are operational. The main activities are photographic tourism, biodiversity management and to a less extent hunting though joint

venture partnerships with private companies. Further information about the CBNRM programme in the area is explained in Chapter 3. However, the table below indicates the type of activities that the active CBOs are engaged in.

Table 5.2: Characteristics of the operational CBOs in the Makgadikgadi area (2010)

Name of CBO	***Date registered***	***Villages Covered***	***Current activities***	***Planned activities***
Nata Conservation Trust	1992	Nata, Sepako, Maposa, Manxotae	• Photographic tourism in Nata Sanctuary; • Craft production; • Management of a Campsite.	• Development and Management of a lodge in the sanctuary; • Photographic tourism in CT 5.
Gaing-O Community Trust	1997	Mmatshumo	• Photographic tourism on Lekhubu Island (a National Monument); • Management of a Campsite; • Selling crafts and firewood.	• Development of a lodge.
Xhauxhwatubi Development Trust	2002	Phuduhudu Size of the CHA: 113 km^2	• Hunting and photographic tourism in NG 49; • Sponsorships, funeral contributions, accommodation, houses and toilets for the elderly.	

Apart from using the wetlands directly, people benefit from wetland functions or services and this constitutes the indirect benefits. These indirect benefits are rooted in the ecological production functioning of the wetland system (Barbier *et al*., 1997; Emerton, 2003; Turner *et al*., 1998). The indirect benefits of the Makgadikgadi therefore include groundwater recharge, wildlife refuge, birdlife migration, carbon sequestration, water purification as well as research

and education. In addition, the wetland generates existence and option values which are largely associated with future utilizations and the mere fact that the wetland exists.

From the discussion, it is apparent that the Makgadikgadi provides various services and goods which are a critical to the livelihoods of the communities living in and around the wetland. In particular, agriculture and the collection of natural resources such as mopane worms are the most critical goods that support people's livelihoods. Furthermore, through these services and goods, the wider economy can also be affected through generation of income, employment and development opportunities. The environment is another beneficiary mainly through the ecological and production functions that the wetland provides. These ecological and production functions are but not well documented in terms of the value they generate. It is however anticipated that the results of the wider FMP project will demonstrate the economic value of these functions and therefore give a better understanding of the Makgadikgadi system. The value of groundwater recharge is however discussed in Section 5.4.

5.3 Estimated direct use value of wetland resources to different CBOs

As indicated in previous sections, three CBOs were selected for the study. Comprehensive information about these CBOs is provided in Chapter 3. However, the results of the valuation of natural resource use by these CBOs are given in this section with reference to the CBO enterprise models. Financial and economic analyses of the direct uses by these CBOs are presented and discussed in this section.

5.3.1 Financial models

The results obtained from the financial models are given from the view point of the project investment, project income as well as community income. The financial values therefore indicate whether the project at hand is viable to the community and the project itself. The financial values depicted on the table reflect the returns that accrue to the project investor, that is, government, donors and the community. They give a clearer indication of the financial viability of the project. All the contributions from donors as well as resources paid

out to the communities have been treated as costs. Table 5.2 illustrates the results for the three CBOs.

Table 5.2: Base case financial values for the three operating CBOs in the Makgadikgadi area (BWP, 2010)

	Nata	***Gaing-O***	***Xhauxhwatubi***
Total financial capital	1, 117960	1,595,084	1,791,507
Capital investment per hectare	49	275.01	158.82
Financial gross income	167,598	444,980	1,271,750
Fixed financial costs	228,971	354,092	511,222
Variable financial costs	29,748	130,510	140,574
Annual net cash income	-91,122	-39,622	619,953
Financial rate of return	7.41%	6.16%	14.60%
Financial net present value[1]	-294813	-627,322	820,855

1. Using a discount rate of 10%

The financial returns for Xhauxhwatubi Trust are more favourable than the other two trusts. Although the trust incurs substantial financial costs, the income generated is still significant. The financial capital invested into the project is also considerable but despite that, the net benefits are significant. Furthermore, the Trust generates a positive net present value signifying the significance of the project and its financial viability over a ten year investment period. It is noted that Xhauxhwatubi has access to favourable resource conditions and on the overall the area has prime wildlife tourism potential hence the high returns.

Gaing-O and Nata both generate negative net present values and low rates of return with Gaing-O generating the least. The two trusts incur least capital financial costs although the difference is not that pronounced as compared with the high income generating Trust. The direct economic gross value added to national income by the CBNRM programme activities in the Makgadikgadi area therefore amounts to some BWP 990,000.

In regard to the community financial values, these indicate the extent to which communities have an incentive to invest in the project (Table 5.3). The results show that the Gaing-O and Xhauxhwatubi Trusts can derive positive returns on their investments. They are also getting a higher rate of return on whatever they are investing in. The annual cash income that may

accrue to the Nata Trust community is minute and thus the communities may have little interest in investing in the project. On the ground, the communities expressed little interest in the project because currently they do not gain much from the project thus deemed it as being less significant to the community. However, they are hopeful that the envisaged investment in the sanctuary might improve the situation.

It is notable that the current arrangements do not provide for distribution of benefits to the individual households but to the wider community at large. This is primarily because there are no benefit distribution mechanisms in place and there is poor involvement of the community members in decision making processes on how the revenues generated could be spent. Most of the benefits accrue to the members and employees of the CBO. However, with proper benefit distribution mechanisms in place, such arrangements could help realise poverty alleviation and livelihoods improvement at household levels. Xhauxhwatubi Trust extends assistance to individual households in times of deaths where the Trust contributes towards burial and distributes food handouts.

Donor and government funding is the most dominant feature of the community financial analysis because most of these projects rely on donors especially for capital and to some extent operation costs. Therefore the returns accrued by the communities are considerable if the subsidies attained are substantial.

Table 5.3: Base case financial returns to the community (2010)

	Nata Trust	***Gaing-O Trust***	***Xhauxhwatubi Trust***
Annual community cash income (BWP)	-27,733	86,397	849,953
Cash income (BWP / ha)	-1.21	14.90	75.35
Financial rate of return (%)	11.55%	17.59%	34.12%
Financial net present value (BWP)	147,901	796,613	2,505,170

5.3.2 Economic models

The economic values give an indication of the viability of the projects from the perspective of the nation at large, in this case, national development or national income. The projects are economically efficient and contribute positively to the national economy of Botswana (Table 5.4). In the analysis, the return in national income and excludes donor contributions from outside the country. This return thus reflects the direct use value of the projects. Xhauxhwatubi Trust has more capital requirements and generates the highest returns to the national economy. The annual net benefits as well as the net present value are significantly higher for Xhauxhwatubi as compared to the other trusts.

Table 5.4: Base case economic values for the three operating CBOs in the Makgadikgadi area (BWP, 2010)

	Nata	***Gaing-O***	***Xhauxhwatubi***
Total economic capital	1,027,812	1,474,320	1,656,321
Total economic capital per hectare	45	254.19	146.84
Annual gross value added	-28,550	133,927	920,772
Annual net value added	-110,012	-12,091	757,139
Net value added per hectare	-4.78	-2.08	67.12
Economic rate of return	10.81%	11%	27%
Economic net present value	77,312	180,912	2,326,942
Number of jobs created	9	10	14
Economic capital cost per job	114,201	163,813	184,036

5.3.3 Sensitivity Analysis

A sensitivity analysis was performed on the models to test for their robustness in response to changes in certain parameters. This gives an indication of the legitimacy of the conclusions drawn from the results obtained from the research.

Changes were made to the Nata Conservation Trust CBO models and the variations were in effect to the capital expenditures, the increase in income as well as a change in the discount rate. A 50 % variation in the capital expenditures affects the economic and financial viability

of the project in a significant way. According to Table 5.5, a 50 % decrease in the capital requirements results in an increase in the rate of return economically and financially whereas the viability is weakened after considerable changes in the capital costs. This severely affects the project's financial viability as compared to the economic and community's perspectives. In fact, the rate of return from the point of view of the community fairs higher thus the results clearly show that economic and community returns are highly sensitive to changes in capital expenditures. Conversely, in regards to the net present values, the effect of a 50 % decrease in the capital costs yields much higher net present values. However, with a 50 % increase in the costs, the NPVs are much lower with the financial viability being the most compromised.

Table 5.5: Effects of change in capital expenditures for the Nata Trust

	IRR (%)			*NPV (BWP)*		
Capital expenditure	Economic	Project	Community	Economic	Project	Community
50 % of base case	18.72%	13.06%	21.58%	577,164	253,955	696,669
Base case	10.81%	7.41%	11.55%	77,312	-294,813	147,901
150 % of base case	6.55%	4.07%	6.82%	-422,542	-843,583	-400,869

The changes in income were also tested premised on the envisaged future investments on the Nata sanctuary and on CT11. A private company has proposed to invest in the sanctuary and will be partnering with the trust in ensuring to ensure that the community benefits from the tourism developments as well. The developments will include a lodge as well as a campsite in the sanctuary. The community will fully own the lodge as per the development plan. In light of this investment, this will generate significant returns to the trust and the wider communities. For the sensitivity analysis, income from the tourism rentals, the lodge and royalties have thus been considered. Table 5.6 illustrates sensitivity results of the changes in trust income and costs in relation to the distribution of benefits to the community. The results indicate strong sensitivity towards such a change in income. The Community and economic values and returns are more sensitive to the changes depicted. The community and economic returns are about 25 % and 36 % respectively where as the project's rate of return ranges low with 10 %. Similarly, the net present values from the perspective of the economy and the

community range between BWP 1.5 million and BWP 2 million. Although the project's response to income is positive, the effect is still quite moderate. With increased income, the Trust would have sufficient income that they could distribute to the community, either in general, or at household level. The cash income realised by the community would also be significantly higher. Should the investment be approved, Nata Trust could indeed be revived and contribute towards the development and improvements of livelihoods of the local communities through the incomes generated, employment and investment opportunities that could arise as a result of the foreseen investment.

Table 5.6: Effects of changes in income generated by the Nata Trust

	Nata Conservation Trust
Total economic capital	1,117, 960
Total economic capital per hectare	29
Annual gross value added	501,450
Annual net value added	419,988
Economic rate of return	35.17%
Financial rate of return	10.31%
Economic net present value	1,957,394
Financial net present value	42,383
Community net present value	1,459,357
Community development	150,000

5.3.4 Conclusions

CBNRM activities are prominent in the Makgadikgadi area with only three CBOs being operational. These CBOs are involved in activities such as photographic tourism, biodiversity management and wildlife hunting. From the models developed, the financial and economic values derived indicate the significance of the three trusts in-terms of the revenues generated through the use of the resources within and around the wetland area. Furthermore, the models also illustrate the incentives for communities to manage their resources sustainably through CBNRM. Despite the wide range of potentially high revenue generating activities that the CBOs are engaged in as well the significant amounts of revenues invested by the donors, the communities do not receive substantial benefits from these projects particularly at household

level. Some of the contributing factors to such skewed distribution of benefits are mismanagement of the financial resources and poor governance. Governance of CBOs has been a major challenge in Botswana as indicated in several reports (Arntzen *et al*., 2003; Rosemeijer, 2003; von Malitz, 2007). It has however been difficult for the Government to monitor the activities of some of the CBOs as well as ensuring that the CBOs manage community resources equitably. However, bearing this in mind, unless transparent benefit distribution mechanisms are in place, the local communities will lose hope in CBNRM projects and thus will hamper the intended objectives of CBRNM which includes among others, rural development and poverty reduction.

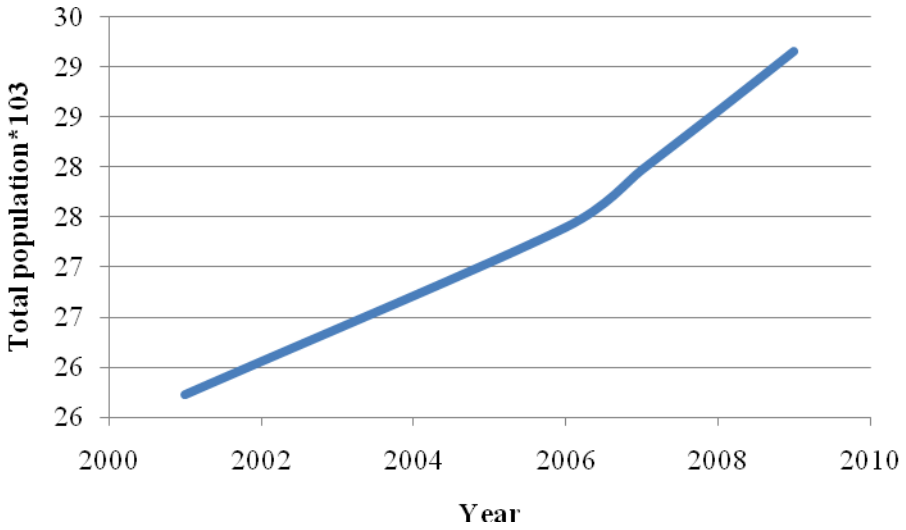
5.4 Groundwater recharge

Literature indicates that wetlands have a role to play in groundwater recharge (Barbier *et al*, 1997; Bullock and Acreman, 2003; Brander *et al*., 2006; Turpie *et al*., 2006). Some wetlands hold water over a wide area such that where it contributes to groundwater recharge it consequently becomes available for abstraction and hence water supply for the surrounding areas. Although recharge usually occurs at higher elevations, some wetlands can provide a valuable service of replenishing groundwater supplies. The Makgadikgadi wetland system also provides this service. There are various sectors that rely on groundwater in the Makgadikgadi and these are as follows: settlements (for domestic and commercial utilization), livestock, mining and to a small extent wildlife. For mining, the study has considered a portion of the Orapa diamond mines which derive some of the water from the Orapa well fields that are within the Makgadikgadi Framework Management Plan project boundary. In regards to the Botswana Soda Ash mine (BOTASH), water abstraction is for potable water supply, brackish water and brine. However, brine is used for the production of soda and salt and therefore not considered in the research. Sixteen settlements within the project boundary were considered. All the villages get their water supply from boreholes. Water is supplied by the District Councils (DCs), Water Affairs (DWA) and the Water Utilities Corporation (WUC) as well self providers in some cases. Most of the villages are supplied through the DCs while the Sowa Township is supplied by WUC. With regard to the livestock sector, the study has considered cattle, goats, sheep, horses and donkeys and the water is mainly provided by the farmers themselves. Wildlife is another water user in the

Makgadikgadi. In 2007/2008, the Department of Wildlife and National Parks through the Kalahari Conservation Society developed ten boreholes in the Makgadikgadi National Park which are pumped through solar power. This was an important development that has contributed to additional water supply for the wildlife within the park.

Settlements

Groundwater is the main source of potable water supply in Botswana and about 80% of the rural population relies entirely on these resources. Therefore, groundwater is highly crucial to many individuals and communities largely for the supply of water for domestic and agricultural purposes among others. Out of the sixteen settlements, fifteen were only considered in determining the water consumption levels since the other one (Sowa Township) is not supplied water through groundwater resources. The majority of villages in Botswana rely on groundwater resources and this is inclusive of villages in the Makgadikgadi (SMEC and EHES, 2006). Sowa Township was excluded largely because it does not derive potable water supply from a groundwater source. The population projections for 2009 are indicated in Figure 5.2 and these projections were generated using the 2001 population data as a base case.



Source: CSO, 2001 and own calculations

Figure 5.2: Population projections for the Makgadikgadi area

Given the per capita water demand figures stipulated by the Ministry of Local Government, the total annual groundwater abstraction for the settlements is estimated at 0.76 Mm^3 for 2009. In light of these estimates, the recharge is estimated to be 0.5 Mm^3 per annum. This constitutes at least 65 % of the total abstraction for the settlements.

Livestock

Agriculture forms a critical part of the economy of Botswana and livestock is essential to this activity. A significant proportion of the rural dwellers (about 68 %) are largely involved in livestock keeping for various purposes including sales, household consumption, gifts and drought power. Its importance is additionally enhanced by its cultural function. Despite the decline in the contribution of livestock farming to the economy of Botswana, with better management, the industry is still seen as having the potential to reduce vulnerability and poverty among the rural population (DEA and CAR, 2007; and CSO, 2009). Given this, it is therefore expected that the demand for water for livestock will increase in the future. The agricultural sector is among the largest water consumers in the country and in 2003, it accounted for about 37 % of the total water consumption in Botswana (DEA and CAR,

2006). Total livestock water demands for the country are projected to be 0.2 Mm^3 / annum for the period between 2005 and 2015 and these are spatially and rurally based.

For the Makgadikgadi region, livestock numbers vary according to the figures obtained from the agricultural statistics and the Department of veterinary services. According to the agricultural statistics, the total livestock numbers were 272,718 in the Makgadikgadi while using cattle crush data for 2009, it has been estimated that livestock numbers stand at 179,566. Both figures have been used in the estimation of water consumption by livestock under this study. Livestock water consumption estimates are therefore summarised in Table 5.8. An assumption has been made that livestock drink from a groundwater resource at least three quarters of the year (nine months). It has also been assumed that water abstraction for livestock does not exceed recharge and therefore abstraction is equivalent to recharge.

Table 5.8: Livestock water consumption in the Makgadikgadi (Mm^3/annum)

	Cattle crush (2009)	***Agricultural statistics (2006)***
Cattle	2.08	2.76
Goats	0.03	0.18
Sheep	0.06	0.01
Donkeys	0.04	0.11
Horses	0.07	0.03
Totals	2.28	3.08
Nine months consumption	1.71	2.31

Wildlife

The Makgadikgadi National Park is located in the Boteti Sub-District adjacent to Xhumaga village and the main physiographic feature of this area is the Boteti River. The river was traditionally the main source of water for wildlife within the park especially during dry periods. However, since 1991, the river had gone dry immensely threatening the survival of wildlife in the park. Furthermore, the government proposed fencing of the park on the western boundary (2004-2006) and this also severely threatened the availability of water for the game animals. In light of these challenges, the DWNP in conjunction with the KCS developed nine boreholes and five watering holes in the park to increase access to water for

the survival of the wildlife. The details of the boreholes are indicated in Table 5.9. The hourly water abstractions from the boreholes is 53.88 m^3 and assuming that the boreholes pump water at least fours hours a day, the total annual water abstractions are estimated at 78,645 m^3 . These boreholes have been installed with solar pumps and therefore when the solar power is insufficient, pumping is very limited hence the low number of pumping hours. Since this estimate is low, the recharge level has therefore been assumed to be equivalent to the recharge.

Table 5.9: Makgadikgadi National Park borehole info

BH no.	***Depth (mbgl)***	***Recommended yield (m^3/d)***	***Test pumping yield (m/hr)***	***RWL[1]***
Z10423	29	53	8	12.7
Z10424	31	49	12	12.3
Z10425	35	42	7.5	12.65
Z10426	38	52	12	12.1
Z10428	44	28	9.56	18
Z10430	53	45	1.44	16
Z10431	48.5	33	1.28	26.95
Z10432	45	50	1.8	17.6
Z10433	39	54	0.3	15.44
Abstraction/pumping			53.88	

[1] RWL is the Residual Water Level

Source: Water Surveys Botswana (Pty) Ltd, 2007

Mining

BOTASH and Orapa diamond mines rely solely on groundwater for the production and processing of minerals. BOTASH uses process water from its own well field within the Makgadikagdi and obtains potable water from the Dukwi well field through WUC. According to information obtained on the ground, the abstraction from its own well field is on average around 600 ML per annum with an estimated recharge of 200 ML. From the supply of potable water, the abstraction is estimated to be around 302 ML per annum on average.

The Orapa diamond mines also source water from their own well fields. The estimated abstraction rate from these well fields is 1.36 Mm^3 /annum with an estimated recharge of s340 ML (a quarter of the abstraction). Groundwater depletion around the mines is common especially around the DEBSWANA mines hence the 25 % assumption has been applied as accruing to the recharge.

In light of the estimated abstraction and recharge levels by the various sectors, the annual groundwater value was estimated. Considerations have been made with respect to the numbers of livestock and the period of time they consume water in a year. Using the data from the Department of Veterinary services, the nine month livestock water consumption assumption and the BWP 2,75 / m^3 cost of groundwater, the Makgadikgadi wetland system is estimated to give a groundwater recharge service of BWP 8.6 million as indicated in the table below.

Table 5.11: Groundwater recharge value of the Makgadikgadi

Consumption/recharge by sector **-** m^3 *(2009)*	***Cattle crush (9 months)***	***Agricultural statistics (9 months)***
Domestic	495,833	495,833
Livestock	1,708,407	2,313,515
MNP	78,665	78,665
Mining	837,642	837,642
Total consumption (Mm^3)	**3.12**	**3.73**
Total groundwater recharge value (BWP million)	**8.58**	**10.25**

The recharge values do not vary significantly regardless of the different livestock numbers from the two sources. Mining and the livestock sectors are undoubtedly the highest water users in the region as indicated in the table hence contribute significantly to the overall recharge (more than 80 %).The groundwater recharge value for the Makgadikgadi wetland is lower if compared with the BWP 16 million value estimated for the Okavango delta in 2006. The discrepancy is largely related to the sizes of the two systems, temporal variability of ecosystems that the wetlands encompass as well as the population and livestock numbers.

The Makgadikgadi mostly consists of pans while the Okavango is full of marsh and swamps with large waters flooding the area.

For the sensitivity analysis, effects of changes in the price of water and the percentage groundwater recharge attributed by mining activities were assessed. An increase in the price of water (P4 / m^3) resulted in an increase in the overall value of groundwater recharge value of about BWP 12.5 million. A decline in the cost of water yielded some BWP 4.7 million indicating that with a significant decrease in the unit cost of groundwater, the recharge value goes down as well. The results of the analysis are indicated in Figure 5.3.

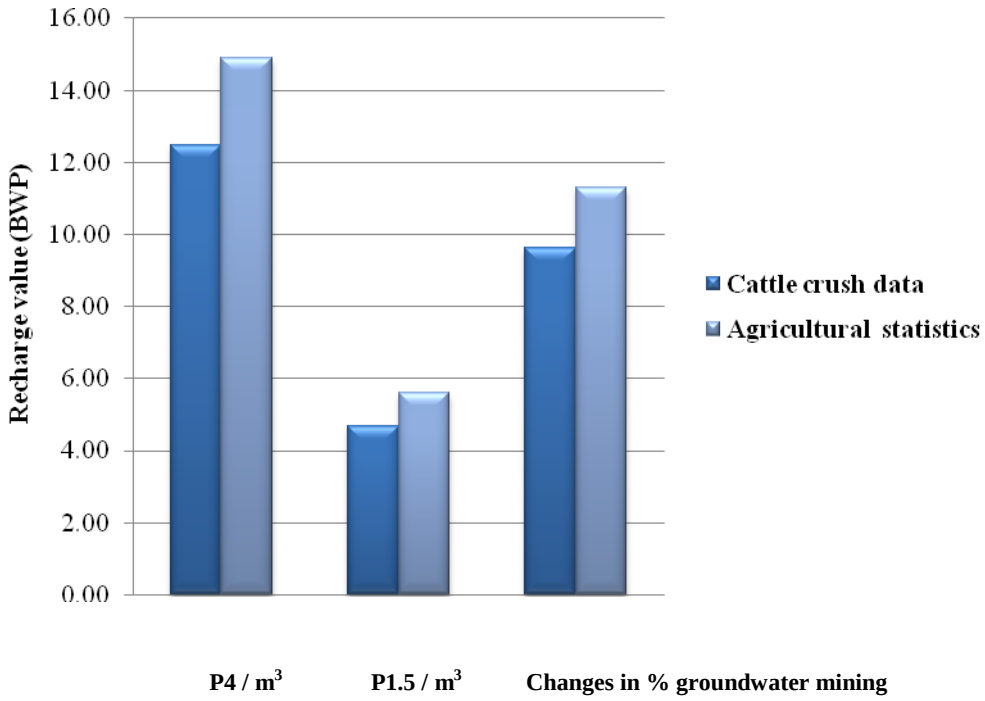


Figure 5.3: Ground water recharge values after a sensitivity analysis

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This final chapter gives the conclusions and recommendations of the study inline with the stipulated objectives. The study aimed at determining the economic value of the goods and services provided by the Makgadikgadi wetland system and specifically, the objectives were to:

1. characterize the wetland goods and services derived from the wetland resource as well as the resource users;
2. estimate the value generated by community based organizations (direct use value) in utilizing the wetland's resources; and
3. estimate the groundwater recharge (indirect use value) value of the wetland system.

6.2 Main conclusions

From the study, one can conclude that:

1. The Makgadikgadi is home to about 30 000 people who are highly dependent upon the resources found on the wetland. The wetland is used as source of livelihoods through the varying uses identified in the study thus significantly contributing to poverty reduction and rural development. In addition, other uses identified are equally important in that they enhance economic development: mining , agriculture, natural resource use and tourism among others;

2. The research demonstrates a high consumptive use of the wetland in terms of the communities' use of the resources within the wetland. This value is demonstrated through the community management projects apparent in the area thus illustrated by

the revenues, gross benefits and net present values derived. Hunting and tourism based projects generate high values both financially and economically largely because of the resources royalties and rents derived from leasing of land and high value hunting quotas. Although CBNRM is not pronounced, as demonstrated by the only three operating CBOs in the area, there is potential for further development of CBOs given the availability of resources within the wetland and the willingness from the communities. Through community development and management of the wetland resources, sustainable development and hence IWRM would be enhanced; and

3. The Makgadikgadi wetland has a considerable groundwater recharge value. Although it is complex to assign a monetary value to this component, it is an equally important function of the wetland system along with other ecological and hydrological functions of the wetland. Given future increases in water demands, groundwater abstraction will exceed recharge thus hampering the availability of the resource for the future generations and maintenance of the environment.

6.3 Recommendations

The study therefore recommends that:

1. Given the various uses and benefits that the wetland is bestowed with, it is critical that optimal management of the wetland be fostered through the wise use, sustainable management and integrated water resources management techniques. These can include economic instruments that facilitate reinforcing incentives for conservation and wise use of the wetland. The incentives should however not make members of the community worse off. Furthermore, funding mechanisms for the management of the wetland should be sought (partnerships with the private sector, charges and user fees);

2. In light of the significance of the direct use value of the Makgadikgadi wetland particularly in relation to utilisation of the wetland's resources through CBNRM as well as its importance in rural development, poverty alleviation, natural resources

management and economic diversification, further development of projects in the Makgadikgadi is therefore ideal. In addition, community water resources management projects should be encouraged to enhance understanding and realization of benefits of IWRM. Capacity building of CBOs in water resources management should therefore be promoted;

3. Direct and indirect use values of the wetland should be recognised in national wetlands strategies, natural resource management, IWRM policies and strategies as well as economic and development procedures. These values could be reflected, for instance in the prices of products derived from the wetland. In essence, inclusion of values in decision making would facilitate informed coordination, sustainable utilization and management of the resources within and around the wetland area; and

4. On-going research should be carried out on groundwater recharge so as to improve understanding of this value component which could eventually emphasise the need to sustainably utilise and protect the wetland.

REFERENCES

Acharya,G., (2002). 'Approaches to Valuing the Hidden Hydrological Services of Wetland ecosystems'. *Ecological Economics*. Vol.31:1, pp. 63-74.

Arntzen, J.W., Molokomme, D.L., Terry, E.M., Moleele, N., Tshosa, O. And Mazambani, D., (2003). *Final report of the Review of Community-Based Natural Resources Management in Botswana.* Report prepared by the Centre for Applied Research for the National CBNRM Forum. Kalahari Conservation Society. Gaborone, Botswana.

Barbier, E.B., (1994). 'Valuing Environmental Functions: tropical wetlands'. *Land Economics*. Vol. 70:2, pp. 155-73.

Barbier, E.B., Acreman, N., and Knowler, D., (1997). '*Economic Valuation of Wetlands: a guide for policy makers and planners*'. Ramsar Convention Bureau. Gland, Switzerland.

Barnes, J.I., (2008). 'Community-based Tourism and Natural Resource Management in Namibia: local and national economic impacts'. In: Spenceley, A., (ed). *Responsible tourism: Critical issues for conservation and development*. Earthscan, London, UK. 343-357.

Barnes, J.I., Cannon, J., and Morrison, K., (2001). '*Economic Returns to Selected Land Uses in Ngamiland, Botswana*'. Conservation International, Washington, DC, USA. 166pp. (Unpublished report).

Barnes, J.I., and MacGregor, J., (2002). 'Economic Efficiency and Incentives for Change within Namibia's Community Wildlife Use Initiatives'. *World Development*. Vol. 30:4, pp. 667-681.

Bhatarrai, M., (2005). '*Veun sean village, Stoeng treng Ramsar site, Cambodia: Rapid participatory assessment for Wetland valuation'*. IUCN Asia RegionalEnvironmental Economics Programme and the UNDP/IUCN/MRC Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme.

Birol, E., Koundouri, P. and Kountouris, Y., (2009). 'Assessing the Economic Viability of Alternative Water Resources in Water Scarce Regions: combining economic valuation, cost-benefit analysis and discounting'. *Ecological Economics* (Article in Press, corrected proof).

Böge, (2006). *'Water governance in southern Africa- Cooperation and conflict prevention in transboundary river basin'*. BICC: Bonn.

Brander, L.M., Raymond, J.G.M. and Vermaat, J., (2006). 'The Empirics of Wetland Valuation: a comprehensive summary and a meta-analysis of the literature'. *Environmental & Resource Economics*. Vol. 33, pp. 223–250.

Breen, C.M., Quinn, N.W., and Mander, J.J. (Eds), (1997). '*Wetlands conservation and management in Southern Africa: challenges and opportunities*'. Summary of the SADC wetlands conservation survey reports. IUCN.

Bryant R.G., Bigg G., Mahowald N., Eckardt, F.D. and Ross S., (2007). 'Climate Controls on Dust Emissions from S African sources'. *Journal of Geophysical Research - Atmospheres*. Vol. 23, Issue 6, pp. 1563-1580.

Bullock and Acreman (2003). 'Role of Wetlands in the Hydrological Cycle'. *Hydrology and Earth System Sciences*. Vol. 7: 3, pp. 358-389.

Central Statistics Office, (2001). '*Botswana 2001 Population Census report*'. Ministry Of Finanace and Development Planning. Gaborone.

Central Statistics Office, (2006). '*Botswana Population Projections 2001-2031*'. Ministry of Finance and Development Planning. Gaborone.

Central Statistics Office, (2009). '*Botswana Water Statistics*'. Ministry of Finance and Development Planning. Gaborone, Botswana.

Central Statistics Office, (2010). '*2006 Annual Agricultural Survey Report*'. Ministry of Finance and Development Planning. Gaborone, Botswana.

Centre for Applied Research, (2004). '*Project Formulation Mission Makgadikgadi Wetland Management*'. NCSA and IUCN ROSA.

Chabwela, H.N., (1991). '*Wetlands*'. A conservation Programme for Southern Africa. A report document, Vol.II. SADC and IUCN.

Chenje, M. and Johnson, P., (eds), (1996). '*Water in Southern Africa*'. SADC/IUCN/SARDC. Maseru/Harare.

Cowardin, L.M., Carter, V., Golet, F.C. and La Roe, E.T., (1979). '*Classification of wetland and deepwater habitats of the United States*'. US Department of Interior, Fish and Wildlife Services. Biological service programme. FWS/UBS-79/31.

Department of Environmental Affairs and Centre for Applied Research, (2006).*'Introduction in Environmental Economics*'. A short course offered by the Department of Environmental Affairs, Ministry of Environment, Wildlife and Tourism in association with the Centre for Applied Research. Gaborone, Botswana.

Department of Environmental Affairs and Centre for Applied Research, (2007). '*Natural Resources Accounting of Botswana's Livestock sector*'. Ministry of Environment, Wildlife and Tourism. Gaborone, Botswana.

Eco-logical Support Services, (2002). '*Site Survey for the Development of an Integrated Wetland Management Plan for the Makgadikgadi Palustrine Wetland System*'. NCSA and IUCN, Gaborone.

Emerton, L., (1998). '*Economic Tools for Valuing Wetlands in Eastern Africa*'. IUCN Economics and Biodiversity programme for East Africa

Emerton, L., (2003). '*Valuing Wetlands in Decision Making: where are we now?*' Wetland valuation issues Paper No. 1. The World Conservation Union.

Emerton, L., Iyango, L., Luwum, P. and Malinga, A., (1998). '*The Present Economic Value of Nakivubo Urban Wetland, Uganda'*. IUCN, Eastern Africa Regional Office, Nairobi and National Wetlands Programme, Wetlands Inspectorate Division, Ministry of Water, Land and Enviornment, Kampala

Emerton, L. and Kekulandala, B., (2002). *'Assessment of the EconomicValue of Muthurajawela Wetland'* . IUCN — The World Conservation Union, Sri Lanka Country Office andRegional Environmental Economics Programme Asia,Colombo.

Emerton, L., Bos, G. and Value, E., (2004). '*Counting Ecosystems as an Economic Part of Water Infrastructure*'. IUCN, Gland, Switzerland and Cambridge, UK.

Food and Agricultural Organisation, (1996). '*Socio-economic and production system study of wetland use*'. Main text and working papers 1 and 2.

Global Water Partnership, (2000). '*Integrated Water Resources Management*'. GWP Technical Advisory Technical Paper No. 4. Stockholm, Sweden.

Hirji R., Johnson, P., Maro, P., and Chiuta, T.M. (eds) (2002). '*Defining and Mainstreaming Environmental Sustainability in Water Resources Management in Southern Africa*'. SADC, IUCN, SARDC, World Bank, Maseru/ Harare/Washington DC.

Jonker, L. and Manzungu, E., (2008). '*Playing the Water Dance: a guide to conducting and reporting interdisciplinary research in water resources management*'. Sun Press. Stellenbosch.

Johnson, S., (2009). '*State of CBNRM Report 2009*'. Kalahari Conservation Society. Gaborone, Botswana.

Lange, G.M. and Hassan, R., (2006). '*The Economics of Water Management in southern Africa: an environmental accounting approach*'. Edward Elgar Publishing. United States of America.

Mahanama, M. (2000). '*Planning and management aspects in Muthurajawela and Negombo Lagoon*'. Workshop onEffective Management for Biodiversity Conservation in Sri Lankan Wetlands: Muthurajawela Marsh, Negombo Lagoon and Chilaw Lagoon. Report 55, Centre for the Economics and Management of Aquatic Resources, University of Portsmouth.

Matiza, T., (1992). '*The utilization and status of dambos in the Southern Africa: a Zimbabwe case study*'. In: Matiza, T. and Chabwela, H.N. (eds) 1992. Wetlands conservation conference for Southern Africa. Proceedings. IUCN, Gland. Switzerland.

Matiza, H. and Chabwela, N.,(eds) (1992). '*Proceedings of the first SADCC Wetlands Conference. Southern African Development Coordination Conference*'. IUCN Wetlands Programme.

McCulloch, G.P., (2003). '*The Ecology of Sua Pan and its flamingo populations*'. PhD thesis, University of Dublin Trinity College Dublin and Ministry of Environment, Wildlife and Tourism.

McCulloch, G.P., Irvine, K., Eckardt, F.D. and Bryant, R., (2008). 'Hydrochemical Fluctuations and Crustacean Community Composition in an Ephemeral Saline Lake (Sua Pan, Makgadikgadi, Botswana)'. *Hydrobiologia*. Vol. 596, pp. 31-46.

McCulloch, G.P., Hancock, P. and Bridges, B., (2007). '*Makgadikgadi Pans Important Bird Area Monitoring Report*, 2007'. Birdlife Botswana. Gaborone, Botswana.

McFarlane M.J. and Eckardt F.D., (2008). 'Lake Deception : A New Makgadikgadi Palaeo lake'. *Botswana Notes and Records.* Vol. 38, pp. 195-201.

Ministry Of Finance and Development Planning, (1996). Botswana National Planning Handbook. MFDP, Gaborone, Botswana.

Nunes, P.A.L.D. and van den Berg, J.C.J.M., (2001). 'Economic Valuation of Biodiversity: sense or nonsense?' *Ecological Economics*. Vol. 39:2, pp. 203-222.

Ojeda, M.I., Mayer, A.S. and Solomon, B.D., (2008). 'Economic Valuation of Environmental Services Sustained by Water Flows in the Yaqui River Delta'. *Ecological Economics*. Vol. 65:1, pp 155-166.

Ramsar Bureau, (1971). '*Convention on Wetlands of International Importance*'. Gland, Switzerland.

Rosemeijer, N., (2003). '*CBNRM in Botswana- Revising the assumptions after 10 years of implementation'*. Paper presented at the World Parks Congress in Durban, South Africa in 2003. IUCN/SNV CBNRM Support Programme, c/o Kalahari Conservation Society. Gaborone, Botswana.

SMEC and EHES, (2006). '*National Water Master Plan Review'*. Ministry of Minerals, Energy and Water Resources. Gaborone, Botswana.

Taylor M., (2002). '*Comparative Analysis of CBNRM Movements in Southern Africa*'. Gaborone, Botswana.

Turpie, J.K., Smith, B., Emerton, L. and Barnes, J.I., (1999). '*Economic Value of the Zambezi Basin Wetlands'*. IUCN ROSA – Zambezi Basin Wetlands Conservation and Resource Utilisation Project. Unpublished report.

Turpie, J.K. and Barnes, J.I. 2003. '*Balancing Ecology and Economics in the Multiple Use of Wetlands on Communal lands*'. Proceedings of the 7th International Rangelands Congress, Durban, South Africa, 26 July – 1 August 2003. 1932-1941.

Turpie, J.K., Barnes,J.I., Arntzen, J.A., Nherera, B., Lange,G.M. and Buzwani, B., (2006). '*Economic Valuation of the Okavango Delta and Implications for Management*'. IUCN. Gaborone, Botswana.

Turner, R.K., van den Bergh, J.C., Barendregt, T.M. and Maltby, A., (1998). '*Ecological-Economic Analysis of Wetlands*: science and social science integration'. Global Wetlands Network.

United Nations Convention on Climate Change, (2002). '*Climate change information toolkit'*. UNEP and UNFCCC.

Von Malitz, G., (2007). '*Integrating Community-Based Natural Resources Management into UNCCD Desertification Strategies:* experiences in selected southern African countries'. USAID-FRAME, IRG and IUCN.

Water Surveys, (2007). '*Water Development in the Makgadikgadi National Park*'. Kalahari Conservation Society. Gaborone, Botswana.

Wolf, A., (1999). Criteria for Equitable Allocations: The heart of in international water conflict. *Natural Resources Forum*, Vol. 23, No.1:3-30.

APPENDICES

Appendix 1: 2010 community hunting quota for Xhauhwatubi Development Trust

Species	*Hunting quota (NG49)*
Arican Elephant	22
Burchell's Zebra	2
Blue Wildebeest	1
Cape Buffalo	7
Duiker	0
Eland	0
Gemsbok	2
Greater Kudu	3
Impala	0
Red Hartebeest	0
Springbok	1
Steenbok	15
Ostrich	2
Warthog	2
Porcupine	0
Monkey,vervet	0
Baboon	5
Crocodile	0
Lion	0
Leopard	0
Hyaena,spotted	1
Caracal	0
Fox,bateared	0
Jackal,black backed	2
Jackal, sidestriped	1
Total	66

Source: Department of Wildlife and National Parks, Botswana.

Appendix 2: A template for the project financial analysis

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
EXPENDITURE						
Capital Expenditure						
Variable Expenditure						
Overhead Expenditure						
TOTAL EXPENDITURE						
INCOME						
Gross Income						
Asset Residual Value						
TOTAL INCOME						
NET BENEFIT/COST						
PROJ. FINANCIAL RATE OF RETURN (FRR) OVER 5 YEARS						
PROJ. NET PRESENT VALUE (NPV) @ 10%						

Appendix 3: Summary results for the CBOs

TABLE 1: SUMMARY OF RESULTS OF THE ECONOMIC/FINANCIAL ANALYSIS FOR THE NATA CONSERVATION TRUST

ITEM	UNITS	TOTAL
Trust extent	Hectares	23000
Wldlife /stock	Large Stock Units (LSU)	771

BWP

ITEM	% of TCI	BWP/LSU	BWP/HECTARE	B$
Total Financial Capital (TCI)	-	1,449	49	1,117,960
Financial Gross Income	0.15	217	7	167,598
Variable Financial Costs	-	39	1	29,748
Fixed Financial Costs	-	297	10	228,971
Net Cash Income	-0.08	-118	-4	-91,122
Community Cash Income	-0.02	-36	-1	-27,733
Land Rental	-	0	0	0
Resource Royalty	-	0	0	0
Project FRR (@ 10 Years)	-	-	-	7.41%
Community FRR (@ 10 Years)				11.55%
Project FNPV (@ 10%, @ 10 Years)	-	-	-12.82	-294,813
Community FNPV (@ 10%, @ 10 Years)			6.43	147,901
Total Economic Capital	-	1,332.33	44.69	1,027,812
Economic Gross Income	0.17	228.60	7.67	176,350
Economic Costs	0.20	265.61	8.91	204,900
Net Economic Benefit	-0.03	-37.008787	-1.24	-28,550
Net Value Added	-0.11	-142.6054	-4.78	-110,012
ERR (@ 10 Years)	-	-	-	10.81%
ENPV (@ 10%, @ 10 Years)	-	-	3.36	77,312
Economic Capital Cost/Job	-	-	-	114,201
Domestic Resource Cost Ratio	-	-	-	1.75

TABLE 2: SUMMARY OF RESULTS FOR GAING-O COMMUNITY TRUST

ITEM	UNITS	TOTAL
Trust extent	Hectares	5800
Wildlife stock	Large Stock Units (LSU)	771

BWP

ITEM	% of TCI	BWP/LSU	BWP/HECTARE	BWP
Total Financial Capital (TCI)	-	2067.67	275.01	1,595,084
Financial Gross Income	27.90%	576.82	76.72	444,980
Variable Financial Costs	-	169.18	22.50	130,510
Fixed Financial Costs	-	459.00	61.05	354,092
Net Cash Income	-0.02	-51.36	-6.83	-39,622
Community Cash Income	0.05	111.99	14.90	86,397
Land Rental	-	12.96	1.72	10,000
Resource Royalty	-	0	0	0
Project FRR (@ 10 Years)	-	-	-	6.16%
Community FRR (@ 10 Years)				17.59%
Project FNPV (@ 10%, @ 10 Years)	-	-	-108.16	-627,322
Community FNPV (@ 10%, @ 10 Years)			137.35	796,613
Total Economic Capital	-	1911.12	254.19	1,474,320
Economic Gross Income	0.32	610.83	81.25	471,223
Economic Costs	0.23	437.23	58.15	337,296
Net Economic Benefit	0.09	173.61	23.09	133,927
Net Value Added	-0.01	-15.67	-2.08	-12,091
ERR (@ 10 Years)	-	-	-	0
ENPV (@ 10%, @ 10 Years)	-	-	31.1916907	180,912
Economic Capital Cost/Job	-	-	-	163,813
Domestic Resource Cost Ratio	-	-	-	0.97

Appendix 4: Xhauxhwatubi Trust Investment model

FINANCIAL/ECONOMIC MODEL - XHAUXHWATUBI DEVELOPMENT TRUST

ASSUMPTIONS*

Production System:	A community-based trust in a community hunting area. It engages in community hunting and photographic touriism in Controlled Hunting Area NG49. This is largely undertaken through a Joint Venture Partnership											
Game Density:	100%	11.30	LSU Equivalents/Sq. Km. or,				9	Hectares per LSU Equivalent				
Carrying Capacity:	100%		Tourist Beds/Sq. Km. or,				#DIV/0!	Ha. per Tourist Bed				
Conservacy Size:	11280	Hectares or,		113	Square Kilometres		Core Wildlife Area Size		6824			
Tourist Category:	Overseas	35%		Regional	35%		Resident	5%		Citizen	25%	
	Adults	100%		Children	0%							
Occupancy Rate:	100%	30.0%		Average Length of Stay:			4 Days					
Daily Tariffs (BWP):	100%	Overseas	350	Regional	350	Resident	350	Citizen	350			
		Children	75%	of Adult Price								
Capital Item Prices:	100%	(Variation from Normal for Sensitivity Analysis)										
Capital Sources:	100%	Loan =	0%	Equity =	100%	and:	100%	Foreign	0%	Domestic	100%	
Interest Rates:	Rate for Capital Loans:		9%		Rate for Working Capital Loans:			12%				
Working Capital as Proportion of Annual Operating Costs:			0%									
Park Entry Fees:	100%	Fee per Tourist Night/Day: BWP		30.00								
Household Dividends:	450	Households @	BW 0									
Land Rental and Resource Royalty (BWP	100%	Rental:	0.00	per Ha.	100%	Royalty:	0%					
Manpower Needs:	100%		Managers	1	Skilled Labour	4	Unskilled Labour	4				
	100%		Management:		Foreign	0%	Citizen	100%				
Shadow Wage Adjustment:	100%	Managers	1.00	Skilled Labour	1.00	100%	Unskilled Labour	0.50				
Foreign Exchange Premium:	100%	6%		Adjustment Factor =	1.06							
Tax Adjustments:	100%	General Sales Tax:	10%	Import Taxes: from SACU:	0%	to SACU	n/a					
Discount Rates:	100%	Financial Discount Rate:	10%	Economic Discount Rate:	10%							
Opportunity Cost of Capital	100%	8%										

TABLE 1: CAPITAL REQUIREMENTS

ITEM		QUANT.	PRICE BWP	FINAN. COST	LIFE Years	AMORT. + INT.	DEPREC-IATION	ECON. DEPR.	FOREX ADJ.	TAX ADJ.	ECON. COST
FIXED CAPITAL											
DOMESTIC ITEMS											
Houses Manager		1	50000	50000	40	5477	1250	1125	1.00	0.90	45,000
Ablution blocks		1	70,000	70,000	40	7,668	1,750	1,575	1.00	0.90	63,000
Buildings		1	185,802	185,802	40	20,354	4,645	4,181	1.00	0.90	167,222
Cultural village/campsite/lodge		1	575,000	575,000	40	62,989	14,375	12,938	1.00	0.90	517,500
Boreholes		1	50000	50,000	40	5,477	1,250	1,125	1.00	0.90	45,000
Reservoirs		0	0	0	40	0	0	0	1.00	0.90	0
Reticulation/Pans		0	0	0	40	0	0	0	1.00	0.90	0
Road Maintenance	(km)	0	0	0	40	0	0	0	1.00	0.90	0
Hiking Trails	(km)	0	0	0	40	0	0	0	1.00	0.90	0
Transaction Costs		0	0	0	40	0	0	0	1.00	0.90	0
CONTINGENCIES @ 5%				46,540	40	5,098	1,164	1,047	1.00	0.90	41,886
SUBTOTAL DOMESTIC ITEMS				977,342							879,608
TRADABLE ITEMS											
Boma/Pens		0	15000	0	20	0	0	0	1.06	0.90	0
Campsite		0	100000	0	15	0	0	0	1.06	0.90	0
Pump/Windmill		1	140,800	140,800	15	17,467	9,387	8,955	1.06	0.90	134,323
Fencing Perimeter	(km)	0	4510	0	15	0	0	0	1.06	0.90	0
Other Items		0	2050	0	15	0	0	0	1.06	0.90	0
CONTINGENCIES @ 5%				7,040	15	873	469	448	1.06	0.90	6,716
SUBTOTAL TRADABLES				147,840							141,039
SUBTOTAL- FIXED CAPITAL				1,125,182							1,020,647
MOVABLE CAPITAL											
TRADABLE ITEMS											
LDVs/Trucks		1	330750	330,750	4	102,092	82,688	78,884	1.06	0.90	315,536
Tools/Office Equipment		1	80,000	80,000	6	17,834	13,333	12,720	1.06	0.90	76,320
Other equipment		1	45,000	45,000	6	10,031	7,500	7,155	1.06	0.90	42,930
Training		1	150000	150,000	6	33,438	25,000	23,850	1.06	0.90	143,100
CONTINGENCIES @ 10%				60,575	6	13,503	10,096	9,631	1.06	0.90	57,789
SUBTOTAL TRADABLES				666,325							635,674
DOMESTIC ITEMS			ECON.	FIN.							
Stock : Small Game	Batch	0	0	0	40	0			1.00	0.90	0
: Large Game	Batch	0	0	0	40	0			1.00	0.90	0
: Big Five		0	0	0	40	0			1.00	0.90	0
: Cattle		0	0	0	40	0			1.00	0.90	0
Horses and Donkeys		0	0	0	40	0			1.00	0.90	0
CONTINGENCIES @ 10%				0	40	0			1.00	0.90	0
SUBTOTAL- DOMESTIC ITEMS				0							0
SUBTOTAL- MOVABLE CAPITAL				666,325							635,674
WORKING CAPITAL				LOAN	INTEREST						
VARIABLE				0	0				1.06	1.00	0
OVERHEAD				0	0				1.06	1.00	0
SUBTOTAL- WORKING CAPITAL				0	0						0
TOTALS				1,791,507	0	302,304	172,906	163,633			1,656,321

TABLE 2: STOCK COMPOSITION BY SPECIES AT FULL PRODUCTION

ITEM	HEAD	POT. OFF-TAKE (%)	POT. OFF-TAKE (NO.)	OFF-TAKE (%)	OFF-TAKE (NO.)	PROP. LIVE	LSU FACTOR	LSU
Buffalo	0	6.60%	0	3.30%	0	0	1.00	0
Crocodile	0	23.50%	0	11.75%	0	0	0.07	0
Eland	15	6.70%	1	3.35%	1	0	1.00	15
Elephant	0	3.10%	0	1.55%	0	0	3.33	0
Hartebeest	10	10.20%	1	5.10%	1	0	0.26	3
Impala	112	14.65%	16	7.33%	8	3	0.14	16
Kudu	193	9.90%	19	4.95%	10	6	0.45	87
Leopard	23	15.00%	3	7.50%	2	1	0.00	0
Lion	0	12.00%	0	6.00%	0	0	0.00	0
Oryx	70	9.40%	7	4.70%	3	3	0.40	28
Ostrich	147	10.00%	15	5.00%	7	4	0.26	38
Springbok	602	16.00%	96	8.00%	48	18	0.08	48
Steenbok	1805	27.70%	500	13.85%	250	5	0.06	108
Warthog	131	14.40%	19	7.20%	9	4	0.18	24
Wild dog	0	15.00%	0	7.50%	0	0	0.00	0
Wildebeest	100	9.60%	10	4.80%	5	3	0.40	40
Zebra	560	8.40%	47	4.20%	24	24	0.63	353
Cattle	0	15.00%	0	7.50%	0	0	1.00	0
Goats	0	45.00%	0	22.50%	0	0	0.11	0
Donkeys/horses	19	10.00%	2	5.00%	1	0	0.63	12
TOTAL	3787		736		368	73		771

STOCK DENSITY ON 11.30 LSU PER SQ.KM.; CONSERVANCY SIZE: 6824 HECTARES

TABLE 3: SALES AT FULL PRODUCTION

ITEM	QUANTITY	@	VALUE (BWP)	FINANCIAL VALUE	FOREX ADJ.	TAX ADJ.	ECON. VALUE
Trophy Hunting Rental	0 camp	@	21,500	0	1.06	1.00	0
Trophy Hunting: Royal	0	@	67,500	0	1.06	1.00	0
Hunting quota:	1 quotaa	@	872,250	872,250	1.06	1.00	924,585
Land Rentals	1	@	250,000	250,000	1.06	1.00	265,000
Campsite Net Income	0 site	@	269,675	0	1.06	1.00	0
Tourism Rentals - Othe	0 site	@	210,420	0	1.06	1.00	0
Live Game Sales (birds	1 birds	@	8,000	8,000	1.06	1.00	8,480
Venison: Biltong	0 animals	@	327	0	1.06	1.00	0
Livestock sales	0 animals	@	0	0	1.06	1.00	0
Crafts	0 units	@	33,396	0	1.06	1.00	0
Poles	0 h'holds	@	525	0	1.00	1.00	0
Community developme	1	@	141,500	141,500	1.00	1.00	141,500
TOTALS			GROSS INCOME	1,271,750			1,339,565

TABLE 4: VARIABLE EXPENDITURE AT FULL PRODUCTION

ITEM	FINANCIAL VALUES BWP/LSU	BWP/HA.	VALUE	FOREX ADJ.	TAX ADJ.	ECONOMIC VALUES BWP/LSU	BWP/HA	VALUE
TRADABLE ITEMS								
Marketing Costs: Advertising	7.97	0.90	6,150	1.06	0.90	7.61	0.86	5,867
: Agents Fees	0.00	0.00	0	1.06	0.90	0.00	0.00	0
Campsite Running Costs : Accomodation	24.33	2.75	18,773	1.06	0.90	23.22	2.62	17,909
: Utilities	14.45	1.63	11,144	1.06	0.90	13.78	1.56	10,632
Temporary employment	21.72	2.46	16,756	1.06	0.90	20.72	2.34	15,985
: Bar	0.00	0.00	0	1.06	0.90	0.00	0.00	0
: Crafts	0.00	0.00	0	1.06	0.90	0.00	0.00	0
Fodder and Supplements	0.00	0.00	0	1.06	0.90	0.00	0.00	0
Other Costs : Office Supplies	32.07	3.62	24,737	1.06	0.90	30.59	3.46	23,599
: Capture Team	0.00	0.00	0	1.06	0.90	0.00	0.00	0
: Biltong Distribution	0.00	0.00	0	1.06	0.90	0.00	0.00	0
: Live Game Distribution	0.00	0.00	0	1.06	0.90	0.00	0.00	0
Consultancies, Travel and Training	7.78	0.88	6,000	1.06	0.90	7.42	0.84	5,724
General Vehicle Running Costs	25.93	2.93	20,000	1.06	0.90	24.73	2.80	19,080
SUBTOTAL TRADABLES	134.24	15.18	103,561			128.07	14.48	98,797
DOMESTIC ITEMS								
Veterinary and Medicine Costs	0.01	0.00	7	1.00	0.90	0.01	0.00	6
Meat Board Levy	0.01	0.00	7	1.00	1.00	0.00	0.00	0
Bank Fees	9.07	1.03	7,000	1.00	1.00	0.00	0.00	0
Sales Tax	38.89	4.40	30,000	1.00	1.00	0.00	0.00	0
SUBTOTAL DOMESTIC ITEMS	47.98	5.42	37,014			0.01	0.00	6
TOTAL VARIABLE EXPENDITURE	182.22	20.60	140,574			128.08	14.48	98803

TABLE 5: OPERATING OVERHEAD EXPENDITURE AT FULL PRODUCTION

ITEM	FINANCIAL VALUES BWP/LSU	BWP/HA.	VALUE	FOREX ADJ.	TAX ADJ.	ECONOMIC VALUES BWP/LSU	BWP/HA	VALUE
DOMESTIC ITEMS								
Salaries and Wages:	233.33	26.38	180,000	1.00	1.00	233.33	26.38	90,000
: Skilled Labour	0.00	0.00		1.00	1.00	0.00	0.00	0
: Managers	0.00	0.00		1.00	1.00	0.00	0.00	0
Administration	6.48	0.73	5,000	1.00	0.90	6.48	0.73	4,500
Maintenance and Repairs	64.81	7.33	50,000	1.00	0.90	64.81	7.33	45,000
Insurance	43.19	4.88	33,316	1.00	0.90	43.19	4.88	29,985
Miscellaneous Fixed Costs	25.93	2.93	20,000	1.00	0.90	25.93	2.93	18,000
TOTAL OPERATING OVERHEAD EXPENDITU	373.74	42.25	288,316			373.74	42.25	187,485

TABLE 6: STATIC FINANCIAL MODEL (AT FULL PRODUCTION)

ITEM	UNITS		TOTAL
Conservancy Extent	Hectares		11,280
Conservancy Stock	Large Stock Units (LSU)		771
Total Capital Requirement	BWP		1,791,507
	BWP/LSU	BWP/HA.	BWP
GROSS INCOME	1648.54	112.74	1,271,750
VARIABLE COSTS	182.22	12.46	140,574
GROSS MARGIN	1466.32	100.28	1,131,176
OVERHEAD COSTS			
Overhead Operating Costs	373.74	25.56	288,316
Loan Amortisation and Interest	0.00	0.00	0
Provisions for Capital Replacement	224.13	15.33	172,906
Interest on Variable Working Capital	0.00	0.00	0
Interest on Overhead Working Capital	0.00	0.00	0
Community expenditures	64.81	4.43	50,000
Resource Royalty	0.00	0.00	0
TOTAL OVERHEAD COSTS	662.69	45.32	511,222
NET CASH INCOME	803.63	54.96	619,953
NET CASH INCOME/BWP100 TOTAL CAPITAL INVESTMENT	34.61		
"TOTAL BENEFITS"*/BWP100 TOTAL CAPITAL INVESTMENT	49.51		
"TOTAL BENEFITS"*/HECTARE	78.63		

TABLE 7: STATIC ECONOMIC MODEL (AT FULL PRODUCTION)

ITEM	UNITS		TOTAL
Conservancy Extent	Hectares		11,280
Conservancy Stock	Large Stock Units (LSU)		771
Total Initial Capital Requirement	BWP		1,656,321
Economic Depreciation Cost	BWP		163,633
Foreign Financing (Prorated)	BWP		0
Foreign Amortisation	BWP		0
Foreign Capital Replacement Provision	BWP		0
Foreign Interest Cost	BWP		0
Domestic Interest Cost	BWP		137,161
ECONOMIC BENEFITS	BWP/LSU	BWP/HECTARE	BWP
Gross Income	1736.44	118.76	1,339,565
ECONOMIC COSTS			
DOMESTIC COMPONENT			
Shadow Unskilled Citizen Wages	116.66	7.98	90,000
Other Citizen Wages	0.00	0.00	0
Opportunity Cost of Capital	171.76	11.75	132,506
Other Domestic Economic Costs	126.37	8.64	97,491
SUBTOTAL DOMESTIC COMPONENT	414.80	28.37	319,996
TRADABLE COMPONENT			
Foreign Remuneration	0.00	0.00	0
Foreign Services	2.66	0.18	2,053
Foreign Interest	0.00	0.00	0
Foreign Lease Payments	0.00	0.00	0
Foreign Rentals	0.00	0.00	0
Foreign Net Income	0.00	0.00	0
Other Tradable Economic Costs	125.41	8.58	96,743
SUBTOTAL TRADABLE COMPONENT	128.07	8.76	98,797
TOTAL ECONOMIC COSTS	542.87	37.13	418,793
NET ECONOMIC BENEFIT (Gross Value Added)	1193.57	81.63	920,772
NET VALUE ADDED (Excluding Depreciation)	981.46	67.12	757,139
DOMESTIC RESOURCE COST RATIO =	0.37		
NET VALUE ADDED/BWP100 TOTAL CAPITAL COST =	45.71		
CAPITAL COST/EMPLOYMENT OPPORTUNITY CREATED =	184036		
NUMBER OF EMPLOYMENT OPPORTUNITIES/1000 HA.	0.80		

TABLE 9: STOCK PROJECTION

STOCK ON HAND (NO.)	Growth	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Buffalo	6.60%	0	0	0	0	0	0	0	0	0	0	0
Crocodile	23.50%	0	0	0	0	0	0	0	0	0	0	0
Eland	6.70%	8	8	9	10	10	11	12	12	13	14	15
Elephant	3.10%	0	0	0	0	0	0	0	0	0	0	0
Hartebeest	10.20%	4	4	5	5	6	6	7	7	8	9	10
Impala	14.65%	28	33	37	43	49	56	65	74	85	97	112
Kudu	9.90%	75	82	91	100	109	120	132	145	160	175	193
Leopard	15.00%	6	7	8	9	10	11	13	15	17	20	23
Lion	12.00%	0	0	0	0	0	0	0	0	0	0	0
Oryx	9.40%	28	31	34	37	41	45	49	53	58	64	70
Ostrich	10.00%	57	63	69	76	83	92	101	111	122	134	147
Springbok	16.00%	136	158	184	213	247	287	332	386	447	519	602
Steenbok	27.70%	156	200	255	326	416	531	679	867	1107	1413	1805
Warthog	14.40%	34	39	45	51	58	67	76	87	100	114	131
Wild dog	15.00%	0	0	0	0	0	0	0	0	0	0	0
Wildebeest	9.60%	40	44	48	52	57	63	69	76	83	91	100
Zebra	8.40%	250	271	294	319	345	374	406	440	477	517	560
Cattle	15.00%	0	0	0	0	0	0	0	0	0	0	0
Goats	45.00%	0	0	0	0	0	0	0	0	0	0	0
Donkeys/horses	10.00%	8	8	9	10	11	12	13	15	16	18	19
TOTALS		831	948	1086	1250	1444	1676	1954	2288	2694	3186	3787

LSU ON HAND (NO.)	LSU FAC.	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Buffalo	1.00	0	0	0	0	0	0	0	0	0	0	0
Crocodile	0.07	0	0	0	0	0	0	0	0	0	0	0
Eland	1.00	8	8	9	10	10	11	12	12	13	14	15
Elephant	3.33	0	0	0	0	0	0	0	0	0	0	0
Hartebeest	0.26	1	1	1	1	1	2	2	2	2	2	3
Impala	0.14	4	5	5	6	7	8	9	10	12	14	16
Kudu	0.45	34	37	41	45	49	54	59	65	72	79	87
Leopard	0.00	0	0	0	0	0	0	0	0	0	0	0
Lion	0.00	0	0	0	0	0	0	0	0	0	0	0
Oryx	0.40	11	12	14	15	16	18	19	21	23	26	28
Ostrich	0.26	15	16	18	20	22	24	26	29	32	35	38
Springbok	0.08	11	13	15	17	20	23	27	31	36	42	48
Steenbok	0.06	9	12	15	20	25	32	41	52	66	85	108
Warthog	0.18	6	7	8	9	11	12	14	16	18	21	24
Wild dog	0.00	0	0	0	0	0	0	0	0	0	0	0
Wildebeest	0.40	16	17	19	21	23	25	28	30	33	36	40
Zebra	0.63	158	171	185	201	218	236	256	277	300	326	353
Cattle	1.00	0	0	0	0	0	0	0	0	0	0	0
Goats	0.11	0	0	0	0	0	0	0	0	0	0	0
Donkeys/horses	0.63	5	5	6	6	7	8	8	9	10	11	12
TOTALS		277	305	336	370	408	452	500	555	618	689	771
Stocking rate		38.8	35.3	32.1	29.1	26.4	23.8	21.5	19.4	17.4	15.6	14.0

STOCK PROJECTION (Continued)

VALUE OF STOCK (BWP)	VAL. /UNIT	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Buffalo	1,154	0	0	0	0	0	0	0	0	0	0	0
Crocodile	2,500	0	0	0	0	0	0	0	0	0	0	0
Eland	928	7,283	7,771	8,291	8,847	9,440	10,072	10,747	11,467	12,235	13,055	13,930
Elephant	4,115	0	0	0	0	0	0	0	0	0	0	0
Hartebeest	1,375	5,212	5,744	6,330	6,975	7,687	8,471	9,335	10,287	11,336	12,492	13,767
Impala	160	4,543	5,209	5,972	6,847	7,850	8,999	10,318	11,829	13,563	15,549	17,827
Kudu	496	37,196	40,878	44,925	49,372	54,260	59,632	65,536	72,024	79,154	86,990	95,602
Leopard	425	2,418	2,781	3,198	3,677	4,229	4,863	5,593	6,432	7,397	8,506	9,782
Lion	582	0	0	0	0	0	0	0	0	0	0	0
Oryx	1,504	42,770	46,790	51,188	56,000	61,264	67,023	73,323	80,215	87,756	96,005	105,029
Ostrich	225	12,819	14,101	15,511	17,062	18,768	20,645	22,709	24,980	27,478	30,226	33,249
Springbok	5,750	784,657	910,202	1,055,835	1,224,768	1,420,731	1,648,048	1,911,736	2,217,613	2,572,431	2,984,020	3,461,464
Steenbok	85	13,231	16,896	21,576	27,553	35,185	44,931	57,377	73,270	93,566	119,484	152,581
Warthog	133	4,527	5,179	5,925	6,778	7,754	8,870	10,148	11,609	13,281	15,193	17,381
Wild dog	100	0	0	0	0	0	0	0	0	0	0	0
Wildebeest	491	19,556	21,433	23,490	25,745	28,217	30,926	33,895	37,149	40,715	44,624	48,907
Zebra	606	151,503	164,230	178,025	192,979	209,189	226,761	245,809	266,457	288,839	313,102	339,403
Cattle	800	0	0	0	0	0	0	0	0	0	0	0
Goats	50	0	0	0	0	0	0	0	0	0	0	0
Donkeys/horses	20	150	165	182	200	220	242	266	292	322	354	389
TOTAL VALUE OF STOCK		1,085,864	1,241,377	1,420,447	1,626,803	1,864,793	2,139,483	2,456,790	2,823,625	3,248,073	3,739,601	4,309,310
% OF FINAL RESID. VAL.		25.20%	28.81%	32.96%	37.75%	43.27%	49.65%	57.01%	65.52%	75.37%	86.78%	100.00%

TABLE 10: PROJECT FINANCIAL ANALYSIS - 5 YEARS (BWP, 2010)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
EXPENDITURE						
Capital Expenditure	1,240,762	550,745	0	0	330,750	0
Variable Expenditure	14,057	84,344	140,574	140,574	140,574	140,574
Overhead Expenditure	338,316	338,316	338,316	338,316	338,316	338,316
TOTAL EXPENDITURE	1,593,135	973,406	478,890	478,890	809,640	478,890
INCOME						
Gross Income	320,457	366,351	419,198	480,097	550,332	631,398
Asset Residual Value	0	0	0	0	0	3,427,704
TOTAL INCOME	320,457	366,351	419,198	480,097	550,332	4,059,102
NET BENEFIT/COST	-1,272,679	-607,055	-59,693	1,207	-259,309	3,580,211

PROJ. FINANCIAL RATE OF RETURN (FRR) OVER 5 YEARS	=	12.07%
PROJ. NET PRESENT VALUE (NPV) @ 10.00%	=	157,223

TABLE 11: PROJECT FINANCIAL ANALYSIS - 7 YEARS (BWP, 2010)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
EXPENDITURE								
Capital Expenditure	1,240,762	550,745	0	0	330,750	0	234,903	100,673
Variable Expenditure	14,057	84,344	140,574	140,574	140,574	140,574	140,574	140,574
Overhead Expenditure	338,316	338,316	338,316	338,316	338,316	338,316	338,316	338,316
TOTAL EXPENDITURE	1,593,135	973,406	478,890	478,890	809,640	478,890	713,793	579,563
INCOME								
Gross Income	320,457	366,351	419,198	480,097	550,332	631,398	725,040	833,299
Asset Residual Value	0	0	0	0	0	0	0	4,101,608
TOTAL INCOME	320,457	366,351	419,198	480,097	550,332	631,398	725,040	4,934,907
NET BENEFIT/COST	-1,272,679	-607,055	-59,693	1,207	-259,309	152,507	11,247	4,355,345

PROJ. FINANCIAL RATE OF RETURN (FRR) OVER 7 YEARS	=	12.32%		
PROJ. NET PRESENT VALUE (NPV) @ 10.00%	=	259946	Per Hectare =	

TABLE 12: PROJECT FINANCIAL ANALYSIS - 10 YEARS (BWP, 2010)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
EXPENDITURE											
Capital Expenditure	1,240,762	550,745	0	0	330,750	0	234,903	100,673	330,750	0	0
Variable Expenditure	14,057	84,344	140,574	140,574	140,574	140,574	140,574	140,574	140,574	140,574	140,574
Overhead Expenditure	338,316	338,316	338,316	338,316	338,316	338,316	338,316	338,316	338,316	338,316	338,316
TOTAL EXPENDITURE	1,593,135	973,406	478,890	478,890	809,640	478,890	713,793	579,563	809,640	478,890	478,890
INCOME											
Gross Income	320,457	366,351	419,198	480,097	550,332	631,398	725,040	833,299	958,561	1,103,619	1,271,750
Asset Residual Value	0	0	0	0	0	0	0	0	0	0	5,399,325
TOTAL INCOME	320,457	366,351	419,198	480,097	550,332	631,398	725,040	833,299	958,561	1,103,619	6,671,075
NET BENEFIT/COST	-1,272,679	-607,055	-59,693	1,207	-259,309	152,507	11,247	253,736	148,921	624,729	6,192,185

PROJ. FINANCIAL RATE OF RETURN (FRR) OVER 10 YEARS	=	14.60%			
PROJ. NET PRESENT VALUE (NPV) @ 10.00%	=	820855	Per Hectare =	72.77	

TABLE 13: PLANNED SUBSIDIES TO COMMUNITY (BWP, 2010)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
SUBSIDIES ON EXPENDITURE											
On Capital Expenditure	804,710	357,192	0	0	214,512	0	152,349	65,292	214,512	0	0
On Variable Expenditure	0	0	0	0	0	0	0	0	0	0	0
On Overhead Expenditure	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXPENDITURE	804,710	357,192	0	0	214,512	0	152,349	65,292	214,512	0	0
SUBSIDIES ON INCOME											
On Gross Income	0	0	0	0	0	0	0	0	0	0	0
On Asset Residual Value	0	0	0	0	0	0	0	0	0	0	0
TOTAL INCOME	0	0	0	0	0	0	0	0	0	0	0
TOTAL SUBSIDIES	804,710	357,192	0	0	214,512	0	152,349	65,292	214,512	0	0

TABLE 14: COMMUNITY FINANCIAL ANALYSIS - 5 YEARS (BWP, 2010)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
EXPENDITURE						
Capital Expenditure	436,051	193,553	0	0	116,238	0
Variable Expenditure	14,057	84,344	140,574	140,574	140,574	140,574
Overhead Expenditure	288,316	288,316	288,316	288,316	288,316	288,316
TOTAL EXPENDITURE	738,425	566,214	428,890	428,890	545,129	428,890
INCOME						
Gross Income	320,457	366,351	419,198	480,097	550,332	631,398
Asset Residual Value	0	0	0	0	0	3,427,704
TOTAL INCOME	320,457	366,351	419,198	480,097	550,332	4,059,102
NET BENEFIT/COST	-417,968	-199,863	-9,693	51,207	5,203	3,630,211

COMM. FINANCIAL RATE OF RETURN (FRR) OVER 5 YEARS	=	46.30%
COMM. NET PRESENT VALUE (NPV) @ 10.00%	=	1534936

TABLE 15: COMMUNITY FINANCIAL ANALYSIS - 10 YEARS (BWP, 2010)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
EXPENDITURE											
Capital Expenditure	436,051	193,553	0	0	116,238	0	82,554	35,380	116,238	0	0
Variable Expenditure	14,057	84,344	140,574	140,574	140,574	140,574	140,574	140,574	140,574	140,574	140,574
Overhead Expenditure	288,316	288,316	288,316	288,316	288,316	288,316	288,316	288,316	288,316	288,316	288,316
TOTAL EXPENDITURE	738,425	566,214	428,890	428,890	545,129	428,890	511,444	464,271	545,129	428,890	428,890
INCOME											
Gross Income	320,457	366,351	419,198	480,097	550,332	631,398	725,040	833,299	958,561	1,103,619	1,271,750
Asset Residual Value	0	0	0	0	0	0	0	0	0	0	5,399,325
TOTAL INCOME	320,457	366,351	419,198	480,097	550,332	631,398	725,040	833,299	958,561	1,103,619	6,671,075
NET BENEFIT/COST	-417,968	-199,863	-9,693	51,207	5,203	202,507	213,596	369,029	413,432	674,729	6,242,185

COMM. FINANCIAL RATE OF RETURN (FRR) OVER 10 YEARS	=	34.12%		
COMM. NET PRESENT VALUE (NPV) @ 10.00%	=	2,505,170	Per Hectare =	222.09

TABLE 16: ECONOMIC ANALYSIS - 5 YEARS (BWP, 2010)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ECONOMIC COSTS						
Capital Expenditure	1,152,021	504,300	0	0	315,536	0
Unskilled Wages	90,000	90,000	90,000	90,000	90,000	90,000
Other Domestic Costs	38,996	58,494	77,993	97,491	97,491	97,491
Tradable Costs	9,880	39,519	79,037	98,797	98,797	98,797
Foreign Amortisation	0	0	0	0	0	0
Foreign Profits	0	0	0	0	0	0
Foreign Loans Outst.	0	0	0	0	0	0
TOTAL COSTS	1,290,897	692,314	247,030	286,288	601,823	286,288
ECONOMIC BENEFITS						
Gross Income	337,545	385,887	441,551	505,698	579,678	665,066
Asset Residual Value	0	0	0	0	0	3,107,790
Foreign Financing	0	0	0	0	0	0
TOTAL BENEFITS	337,545	385,887	441,551	505,698	579,678	3,772,857
NET BENEFIT/COST	-953,352	-306,427	194,521	219,410	-22,145	3,486,569

ECONOMIC RATE OF RETURN (ERR) OVER 5 YEARS	=	28.91%	
NET PRESENT VALUE (NPV) @ 10.00%	=	1130404	

TABLE 17: ECONOMIC ANALYSIS - 10 YEARS (BWP, 2010)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
ECONOMIC COSTS											
Capital Expenditure	1,152,021	504,300	0	0	315,536	0	224,097	96,042	315,536	0	0
Unskilled Wages	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000
Other Domestic Costs	38,996	58,494	77,993	97,491	97,491	97,491	97,491	97,491	97,491	97,491	97,491
Tradable Costs	9,880	39,519	79,037	98,797	98,797	98,797	98,797	98,797	98,797	98,797	98,797
Foreign Amortisation	0	0	0	0	0	0	0	0	0	0	0
Foreign Profits	0	0	0	0	0	0	0	0	0	0	0
Foreign Loans Outst.	0	0	0	0	0	0	0	0	0	0	0
TOTAL COSTS	1,290,897	692,314	247,030	286,288	601,823	286,288	510,385	382,329	601,823	286,288	286,288
ECONOMIC BENEFITS											
Gross Income	337,545	385,887	441,551	505,698	579,678	665,066	763,702	877,734	1,009,675	1,162,469	1,339,565
Asset Residual Value	0	0	0	0	0	0	0	0	0	0	4,878,143
Foreign Financing	0	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	337,545	385,887	441,551	505,698	579,678	665,066	763,702	877,734	1,009,675	1,162,469	6,217,708
NET BENEFIT/COST	-953,352	-306,427	194,521	219,410	-22,145	378,779	253,318	495,405	407,852	876,181	5,931,421

ECONOMIC RATE OF RETURN (ERR) OVER 10 YEARS	=	26.97%			
NET PRESENT VALUE (NPV) @ 10.00%	=	2,326,942	Per Hectare =	206.29	

TABLE 18: SUMMARY OF RESULTS OF THE FINANCIAL/ECONOMIC ANALYSISFOR THE XHAUXHWATUBI TRUST				
ITEM	UNITS		TOTAL	
Trust extent	Hectares			11280
Wildlife stock	Large Stock Units (LSU)			771
ITEM	% of TCI	BWP/LSU	BWP/HECTARE	BWP
Total Financial Capital (TCI)	-	2322.29	158.82	1,791,507
Financial Gross Income	70.99%	1648.54	112.74	1,271,750
Variable Financial Costs	-	182.22	12.46	140,574
Fixed Financial Costs	-	662.69	45.32	511,222
Net Cash Income	0.35	803.63	54.96	619,953
Community Cash Income	0.47	1101.77	75.35	849,953
Community expenditures	-	64.81	4.43	50,000
Resource Royalty	-	0	0	0
Project FRR (@ 10 Years)	-	-	-	14.60%
Community FRR (@ 10 Years)				34.12%
Project FNPV (@ 10%, @ 10 Years)	-	-	72.77	820,855
Community FNPV (@ 10%, @ 10 Years)			222.09	2,505,170
Total Economic Capital	-	2147.05	146.84	1,656,321
Economic Gross Income	0.81	1736.44	118.76	1,339,565
Economic Costs	0.25	542.87	37.13	418,793
Net Economic Benefit	0.56	1193.57	81.63	920,772
Net Value Added	0.46	981.46	67.12	757,139
ERR (@ 10 Years)	-	-	-	27
ENPV (@ 10%, @ 10 Years)	-	-	206.289148	2,326,942
Economic Capital Cost/Job	-	-	-	184,036
Domestic Resource Cost Ratio	-	-	-	0.37