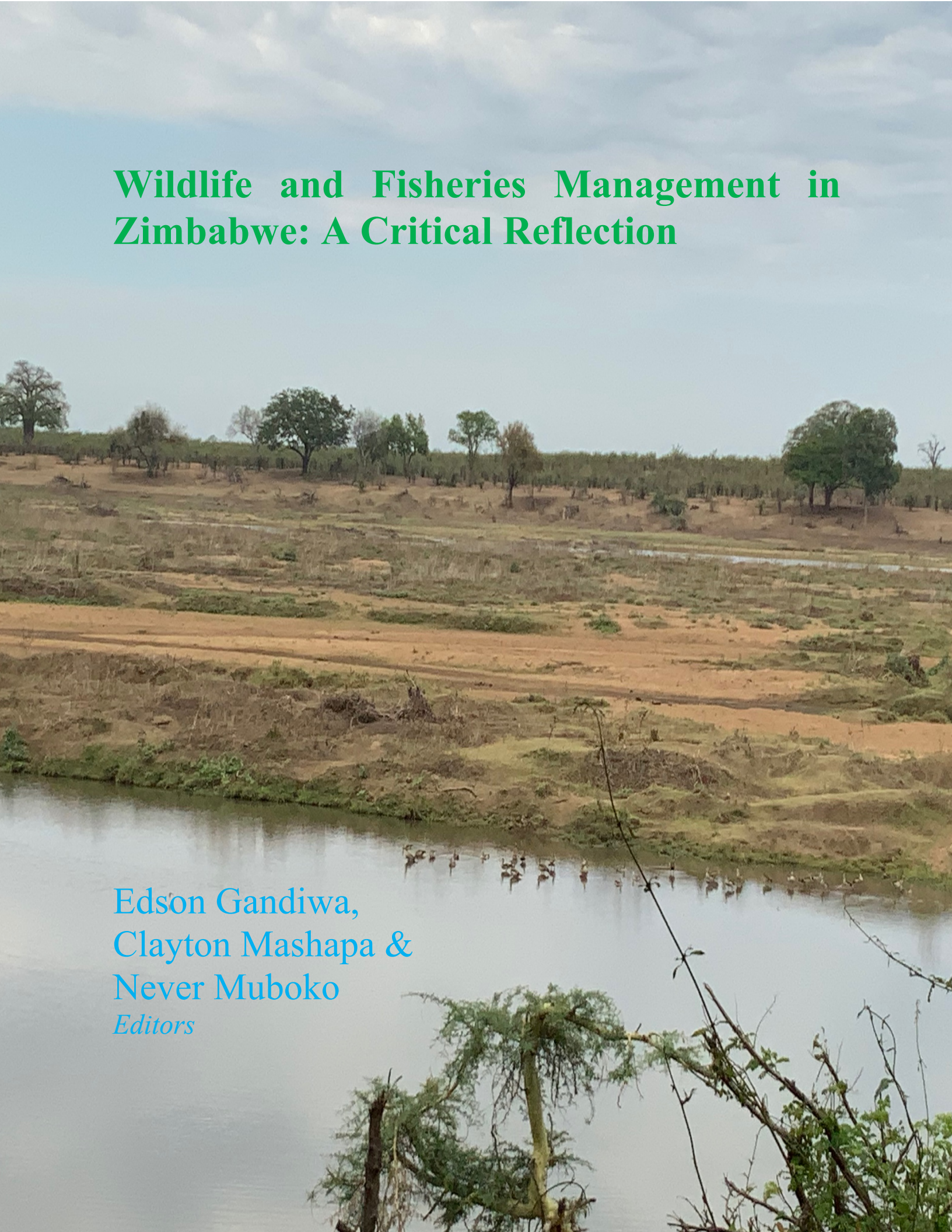
Wildlife and Fisheries Management in Zimbabwe: A Critical Reflection



Edson Gandiwa,
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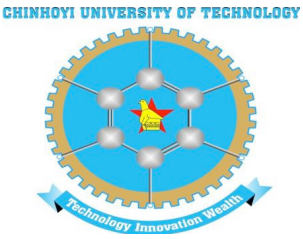

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Foreword

Dr Fulton U. Mangwanya

One of the most interesting thing about this book is a foreword that is written by me! Of course, I was not born a conservationist and those who know my background very well will be justified to ask *so what happened to him*? And *how did he get there*? Growing up on the countryside, going out fishing with the other boys, hunting birds, competing with wildlife feasting on wild fruits - naturally connected me to nature at a very tender age, but conservation was not on the list of my career options. Agriculture and the sophistication of serving in state security were more appealing for me. As I grew up, I became fond of watching wildlife documentaries in addition to crime scene investigations (commonly known as CSI) which were already on my bucket list, well, it was just a hobby-thanks to technology! I became a victim of digital media impact. Some say seeing is believing, and indeed-just watching a small screen in one`s spare moments can transform someone's mindset, perspectives, opinions, values and even priorities. Appreciating that the world we live in is under various threats and the greatest of them all being of anthropogenic origin, I developed a personal drive that I could do my part to create a better future for a planet that we borrowed from future generations through saving our vulnerable wildlife resources. As someone with a law-enforcement background, I made a personal conviction that if I get an opportunity to serve in a conservation organisation-I will pull all the strings to put a stop to illegal wildlife trade and transnational wildlife crime syndicates, a very ambitious mission!

Sometimes prayers are answered much sooner than we think; the career dream became real in 2017 when I grasped the challenge of driving the wildlife conservation agenda under Zimbabwe Parks and Wildlife Management Authority (ZimParks) as Director General. I find my story very interesting as it is testimony that one does not necessarily need to have a conservation mindset to make conservation count! In fact, in just 2 years, my experiences have been phenomenal and mind blowing. The exciting opportunities and multiplicity of complex challenges to secure Zimbabwe`s wildlife heritage makes it a worthwhile endeavour which can accommodate anyone who is determined to make a difference, just like writing or reading a fantastic book like this one!

This book is a must-read for anyone with interest to explore (or understand) topical issues in the diverse field of conservation. You will find some *wild but useful* ideas which others may want to call *innovative approaches*, and *practical strategies* for enhancing wildlife conservation in Zimbabwe and beyond. *Why wildlife*? Could be much easier to answer because of the obvious aesthetic and cultural attachment that you might have. Nevertheless, *Whose wildlife*? Is a contentious issue that needs unpacking as you will find in this book**.** When you read this book, you might acquire some Latin phrases such as *res-nullius* and confuse a few friends with new vocabulary in social circles whilst reflecting on the wildlife ownership topic.

As you might be already aware, Zimbabwe has an outspoken history of wildlife conservation which dates back to *pre-colonial* and extends into the *post-colonial* period, this book takes you through some

important reflections of the country`s wildlife journey and paradigm shifts along the process which will certainly help you make sense of the legacies that Zimbabwe cherishes or struggles with today.

Biodiversity conservation in the 21st century is faced with shifting climatic changes which some scientists have tried to communicate in emotionally charged publications and threatening headlines in the news, whether that is the inconvenient truth or they are cyclical or irreversible changes-we cannot be certain, however, as this book explores *biodiversity policy in a changing climate*, focusing on a review of legal and institutional frameworks for biodiversity management in Zimbabwe, it might help you understand some contextualised perspectives.

I got to appreciate that conservation is a global issue, a reason why there are several multilateral agreements signed by countries including Zimbabwe. On that note, the discourse cannot be complete if fundamental declarations under the United Nations Conference on Environment and Development (UNCED) which took place in Rio de Janeiro in June 1992 are not discussed. They were milestone events which brought together policy makers, practitioners, industries and even ordinary people together to define the future that accommodates all in a sustainable way and it is important to reflect on the journey towards achieving the goals and objectives of *sustainable development of African indigenous people and local communities* at a scale that we can relate-to as demonstrated in this book.

Whilst some people may see sustainable development as a mission impossible in the glaring facts of poverty and food insecurity in sub-Saharan Africa, this book may leave you hopeful when you read about the opportunities in the fisheries production and management, opportunities and challenges of those living adjacent to protected areas in Zimbabwe, reflections on the renowned Communal Areas Management Programme for Indigenous Resources (popularly known as CAMPFIRE) case study, which will inevitably drive you into the Chapter which digs deeper into rural livelihood benefits from community-based initiatives to private sector involvement.

As you read this special book, it is important to be mindful of the fact that wildlife in Zimbabwe refers to both flora and fauna and this book could not have been complete without covering *non-timber forest products and delicacies* such as mopane worm harvesting and utilisation covered in a very interesting research done in the Matabeleland region of Zimbabwe. Since this book is a product of Chinhoyi University of Technology, particularly the School of Wildlife, Ecology and Conservation, do not be surprised to find a topic such as *Quenching the Thirst for Zimbabweans*, you may want to find out how? Water is an important subject in any context.

It should be appreciated that conservation is not for conservationists only-it is everyone`s business and this book is an important resource which will help you understand why and hopefully you will not go wild about my story before you can forage on the important ideas contained herein! With their research prowess, the authors provide an enormously useful range of ideas, innovative strategies across a wide spectrum of topics with a lot of creativity and I look forward to read about technological innovations in the field of wildlife conservation in their next edition.

We are all entitled to a healthy and productive life in harmony with nature.

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Contents

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Abbreviations and acronyms

AA	Appropriate Authority
ADMADE	Administrative Management Design for Game Management Areas
AHTEG	Ad Hoc Technical Export Group
AU	Africa University
AWG-KP	Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol
CAMPFIRE	Communal Areas Management Programme for Indigenous Resources
CBD	Convention on Biological Diversity
CBNRM	Community-based natural resource management
CCMD	Climate Change Management Department
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CoP	Conference of the Parties
CPUE	Catch per unit effort
CUT	Chinhoyi University of Technology
DDT	Dichlorodiphenyltrichloroethane
DLPD	Department of Livestock Production
DNPWM	Department of National Parks and Wildlife Management
DR&SS	Department of Research and Specialist Services
EMA	Environmental Management Agency
FAO	Food and Agriculture Organisation of the United Nations
FC	Forestry Commission
FTLRP	Fast Track Land Reform Program
FZS	Frankfurt Zoological Society
GCM	Global Climate Models
GDP	Gross Domestic Product
GIS	Geographical Information Systems
GNP	Gonarezhou National Park
GoZ	Government of Zimbabwe
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
HWC	Human Wildlife Conflict
ICDPs	Integrated Conservation and Development Projects
INC	Intergovernmental Negotiating Committee
IPCC	Intergovernmental Panel on Climate Change
IPZ	Intensive Protection Zone
IUCN	International Union for Conservation of Nature
KP	Kyoto Protocol
MDC	Movement for Democratic Change
MENRM	Ministry of Environment and Natural Resources Management
MoETHI	Ministry of Environment, Tourism and Hospitality Industry
MOP 1	Meeting of the Parties to the Kyoto Protocol
MZBR	Middle Zambezi Biosphere Reserve
NAMA	Nationally Appropriate Mitigation Actions

NBSAP	National Biodiversity Strategy and Action Plan
NCCRS	National Climate Change Response Strategy
NDC	Nationally Determined Contributions
NGO	Non-governmental Organisation
NR	Natural Region
NSCCC	National Steering Committee on Climate Change
NTFPs	Non-timber forest products
NWP	National Water Policy
PA	Protected Area
PES	Payment for ecosystem services
RDC	Rural District Council
REDD	Reducing Emissions from Deforestation and Forest Degradation
SADC	Southern African Development Community
SDG	Sustainable Development Goals
SDI	Spatial Development Initiative
SLF	Sustainable Livelihoods Framework
SPSS	Statistical Package for Social Sciences
SWOT	Strength Weakness Opportunity and Threats
TFCA	Transfrontier Conservation Area
UN	United Nations
UNCBD	United Nations Convention on Biological Diversity
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
US$	United States Dollar
USA	United States of America
USFWS	United States Fish and Wildlife Services
UZ	University of Zimbabwe
WCC	World Climate Conference
WINDFALL	Wildlife Industries New Development for All
WMO	World Meteorological Organisation
WWF	World Wildlife Fund for Nature
ZANU PF	Zimbabwe African National Union Patriotic Front
ZCC	Zimbabwe Christian Church
ZDF	Zimbabwe Defence Forces
ZIMASSET	Zimbabwe Agenda for Sustainable Socio-Economic Transformation
ZIMSTAT	Zimbabwe National Statistical Agency
ZINWA	Zimbabwe National Water Authority
ZNCCRS	Zimbabwe National Climate Response Strategy
ZPWMA	Zimbabwe Parks and Wildlife Management Authority
ZRP	Zimbabwe Republic Police

Chapter 1

Wildlife ownership, access and conservation: a reflection from pre-colonial to post-colonial period in Zimbabwe

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Abstract

Wildlife is a valuable resource in Zimbabwe. This Chapter focuses on the evolution of wildlife ownership regimes, access and conservation in Zimbabwe from pre-colonial to post-colonial period. Evidence was gathered from documentary review of existing literature, primarily focusing on (un)published reports, research articles and books. Google, Google Scholar and Scopus search engines were used to search relevant literature. Study findings indicated that wildlife ownership in Zimbabwe shifted from traditional common pool resource to public and private ownership driven by the need to fulfil the concept of access and benefit sharing. The evolution of the political landscape, legal and institutional framework for management of wildlife resources influenced changes in ownership regimes. Consequently, approaches to wildlife management have also diversified from the colonial fortress conservation approach to a range of management regimes including community-based wildlife management systems. However, community-based approaches to wildlife conservation have faced a myriad of challenges due to lack of devolution and other resource governance related aspects. Despite the evolution of wildlife ownership regimes, the responsibility of maintaining and conserving the wildlife resources still rests in the hands of a few. There is need to promote integrated and innovative approaches to wildlife management to ensure successful conservation and sustainable utilisation of the resource.

Keywords: *ownership, wildlife, pre-colonial, post-colonial, Zimbabwe*

Introduction

The human-wildlife space interface

Humans and wildlife are destined to share resources and there is need to understand the interface between them to inform management strategies for sustainable utilisation of natural resources (Mashapa, 2018). According to Romero (2012), wildlife is often a more appropriate form of land use option in arid and semi-arid environments, such as the African savannahs. Although wildlife, particularly wild animals are an important and mobile resource, , some wild animals are dangerous for people to live with (Mhuriro-Mashapa et al., 2017). Human-wildlife conflict is thus identified as one of the major threats to conservation and one of the most difficult problems that conservation managers are facing across Africa (Mhuriro-Mashapa et al., 2018). In 2010, the Southern African Development Community (SADC) Technical Committee on Wildlife pronounced that human-wildlife conflict is a challenge and threat for sub-Sahara Africa's rural populations in terms of livelihoods (LeBel et al., 2011). Gandiwa et al. (2013) ascertain that human-wildlife conflicts are undermining what have been, to date, quite successful conservation programmes such as the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) in Zimbabwe.

Most challenges in wildlife conservation today are related to problem wild animals where people and wildlife utilize adjacent areas and compete for scarce resources (Sitati et al., 2005; Woodroffe, 2005). As wildlife protected areas become surrounded by expanding human settlements, human-wildlife conflicts tend to increase (Sitati et al., 2005; Hegel et al., 2009). Large wild animals generally require large home ranges, and due to their physiology and energy requirements need to consume large quantities of food and water each day (Owen-Smith, 1988). It is not surprising, therefore, that when these animals live in areas surrounded by increasing human population; they frequently compete with humans for limited resources such as space, water and food (Hegel et al., 2009). This Chapter addresses aspects of access, ownership and long-term conservation of wildlife resources using a case study of Zimbabwe. The Chapter aims to communicate sustainable wildlife management principles, referring to the sound management of wildlife species as a means to sustain their populations and habitat over time, while considering the socioeconomic needs of human populations. Data for this Chapter attempted to cover aspects in all the protected areas in the Parks and Wildlife Estates and adjacent communities across Zimbabwe.

Data collection and analysis

Data collection was based a historical perspective to allow for the tracking and evaluation of cultural, legal institutional framework for wildlife resource management and governance in protected areas in Zimbabwe. The historical perspective allowed the tracing of the developments in wildlife resource management and governance in pre-colonial and post-colonial Zimbabwe and how it is related to the changing context. Wildlife resource management and governance was reviewed mainly based on case studies and research articles drawn from Zimbabwe, with few related cases elsewhere. A documentary review of existing literature was conducted primarily focusing on (un)published reports and research articles. Google, Google Scholar and Scopus search engines were used to search relevant literature. Data were analysed qualitatively through content (thematic) analyses. A meta-synthesis technique was used to evaluate, analyse and interpret the findings from the literature review of 100 documents comprised of unpublished and research articles. To assist in classifying and grouping reports and research article documents,

content was grouped into components for analysis based on the Chapter objectives, namely, (i) access of wildlife resources, (ii) ownership of wildlife resources and, (iii) conservation of wildlife resources in protected areas of Zimbabwe. A meta-synthesis involves analysing and synthesizing key elements in each document under review and transforming the findings into new conceptualizations, interpretations and discussion for the Chapter.

Findings and Discussion

The concepts of wildlife ownership and rights

The concept of ownership presents legal implications and is semantically controversial among scholars. According to the Oxford dictionary the term 'ownership' is a noun derived from the verb to 'own' which means to have or to hold as a property. Ownership accords an individual or a group of people with the rights over the use, control, enjoyment and disposal of an object or possession. Ownership, therefore, is a legally accepted term explaining the relationship between the owner and a certain commodity or property. In Zimbabwe, there are different types of ownerships for wildlife resources, e.g., state/public ownership, private ownership and collective (communal) ownership of wildlife resources. All these ownership regimes determine the responsibilities and authority one has in wildlife resources and tied to these ownership regimes are property rights for land and wildlife resources.

To have property rights in a thing is to have a bundle of rights that defines a form of ownership. Becker (1980) identifies a list of bundles of rights that constitutes the concept of ownership:

i. Right to possess.
ii. Right to use.
iii. Right to manage.
iv. Right to income (owner foregoes personal use and allows others access).
v. Right to consume or destroy.
vi. Right to modify.
vii. Right to alienate, i.e., transfer the benefit stream.
viii. Right to transmit, i.e., to bequeath his or her interest in a benefit stream.
ix. Right to security.

These rights are enshrined in legal frameworks and can confirm or exclude traditional or indigenous rights which are sometimes referred to as informal rules as most are in unwritten form and are area or culture based.

Indigenous people's rights to wildlife

Although there is no universally agreed definition of indigenous people, the term is usually used in reference to those people or individuals who are descendants of the original people residing in a country or a certain place (Hitchcock, 1994). In Zimbabwe the term "indigenous" is not well defined in the national constitution though it makes reference in Chapter 15, paragraph 295(1) to an "Indigenous Zimbabwean". A Zimbabwean Statutory Instrument 61 of 2009 (Access to Genetic Resources and Indigenous Genetic Resource-based Knowledge) Regulation, defines an indigenous community as "*a community of persons that has inhabited Zimbabwe continuously since before the year 1890 and whose members share the same language or dialect or the same cultural values, traditions or customs*." Whichever definition one subscribes to for indigenous peoples, Hitchcock

(1994) points out that the indigenous peoples have suffered more serious abuses than any other groups of people including the denial of their rights. The recognition of such suffering and discrimination in the hands of other dominant groups led global efforts to redress such injustices. For example, in 1991 the UN General Assembly saw it fit to declare the year beginning October 1992 as the International Year for the World's Indigenous Peoples, with the aim of drawing attention and increasing efforts to address the problems faced by indigenous communities. Such problems included human rights and environmental issues. These efforts and others led to indigenous rights to natural resources including wildlife resources being recognised in several soft and hard law instruments at national and global scale. Of importance to wildlife is the United Nations Declaration of Indigenous People's Right passed on 13 September 2007 (Davis, 2008), which emphasises the self-determination and permanent sovereignty of indigenous peoples over resources in their lands and territories. The United Nations Special Rapporteur on Indigenous issues states that:

'Indigenous peoples' permanent sovereignty over natural resources might properly be described as a collective right by which the State is obligated to respect, protect, and promote the governmental and property interests of indigenous peoples in their natural resources' (Indigenous Peoples' Permanent Sovereignty over Natural Resources, 2004). Indigenous and local communities are thus not stakeholders but right holders when it comes to the ownership and control of natural resources including wildlife.

In the Zimbabwean context, the Guiding Principle 13 of the Zimbabwe National Environmental Policy and Strategies 2009 provides that: '*the best custodians of wildlife and other natural resources are those landholders, including local communities, who are able to benefit directly from the use of the wildlife on their land*.' The indigenous rights related provisions found in both the constitution of Zimbabwe Amendment (No. 20) Act of 2013 and national policies such as the National Environmental Policy and Strategies 2009 are crucial in fostering support for indigenous rights.

At the global level, the international jurisprudence and law provide for the following rights to indigenous peoples:

a. Self-determinations.
b. Freely disposing their natural resources.
c. In no case being deprived of their means of subsistence.
d. Own, develop, control and use their communal lands, territories and resources traditionally owned or otherwise occupied by them.
e. Free enjoyment of their own culture and maintain their own traditional culture.
f. Restitution of their lands and compensation for losses endured.
g. Represent themselves through their own institutions.
h. Exercise their customary law.
i. Free prior and informed consent prior to activities on their lands (Colchester, 2004).

Historical utilisation and ownership of wildlife in Zimbabwe: a case study

Before European settlement, i.e., prior to 1890, the human population in the area that later became the present Zimbabwe was low, that is, numbering a few hundred thousand people, wildlife was relatively abundant, and hunting technologies were less advanced and destructive than in later

years, so elaborate conservation measures were not necessary (Child, 1995). Although conservation measures were not strictly necessary in the early years of European settlement, certain cultural practices however did function as relatively soft conservation measures, such as taboos against consuming certain animals or hunting during certain defined periods (Child, 1995). Concepts such as *mupiro* (gift), *maninji* (bad omen), and *marambakutemwa*/*dambakurimwa* (no till area) were traditionally used to control the indiscriminate cutting down of trees and killing of animals (Mashapa et al., 2019). Harvesting of wildlife was done under a system which encompassed sustainable use strategies such as seasonal and rotational harvesting of certain resources. Some trees and animal species, e.g., the ground pangolin (*Smutsia temminckii*) was categorised as sacred and whose harvesting was not permissible except under the instruction of the chief or traditional authority (Chibememe *et al*., 2014). Mashapa et al. (2014) reported that Zimbabwean tradition prohibited the cutting of large trees and fruit tree species such as wild almond (*Berchemia discolour*), monkey orange (*Stychnos spinosa*), water-berry (*Syzygium cordatum*), and marula (*Sclerocarya birrea*). These could not be cut under any circumstances, and for large trees they were considered sacred and sites where ancestral spirits abode. Unfortunately, the weakening of the powers of traditional leaders, losses of cultural values, and economic hardship led to the breakdown of some of these positive socio-ecological biodiversity conserving values and practices, hence, negatively affecting natural resource conservation. Areas designated as royal hunting and fishing grounds were also common and harvesting of natural resources in such areas needed to be sanctioned by the chief. Such cultural norms and rules acted as checks and balances in the management of wildlife resources (Ecologist, 1993; Mashapa, 2018). During the pre-colonial times indigenous knowledge systems were used in managing landscapes and species which were owned by the whole community and passed on to the future generations.

Zimbabwe's first state protected areas were established in the early 1900s soon after the European settlement, and eventually about 13% of the country was put under state wildlife protection (Fig. 1.1; Child, 2009; Scoones et al., 2010). Even outside formally protected areas many species were conserved under the laws of the colonial administration, for example, the Game Law Amendment Act in 1891 and the Game Preservation Ordinance Act (No. 6 of 1899) required permits to hunt (Mutwira, 1989). This effectively disenfranchised African landholders as few understood the legislation (Child, 1995). Purchasing the necessary permit allowed landowners to shoot as many individuals of most species as they deemed fit to protect their agricultural interests, although they were not permitted to sell the wildlife products (Child, 1995). Despite the legal protection afforded to some species such as cheetah (*Acinonyx jubatus*), few people paid attention to the legislation and large numbers of protected animals were removed indiscriminately (Wolmer, 2005). Veterinary officials also killed hundreds of thousands of animals to eradicate livestock diseases, such as *trypanosomiasis*, which in combination with the expansion of commercial agriculture and the development associated with the increasing human population resulted in the decline of wildlife populations, and large mammals became increasingly restricted to protected areas (Child, 2009). With the onset of the private game ranching movement this trend was reversed. The first game ranches appeared in 1959, but their numbers increased rapidly after the Parks and Wildlife Act of 1975 devolved rights to utilise wildlife to the landowners, allowing them to benefit financially from the wildlife on their land by selling trophy hunts (Duffy, 2000). This was later extended to communal lands initially in the form of a project called Wildlife Industries New Development for All (WINDFALL) in 1978, which later evolved into CAMPFIRE (Child, 2009; Muboko & Murindagomo, 2014). By 2000, 20% of all commercial land was managed for wildlife,

constituting an additional 7% of the total land area to the 13% of state protected areas (Bond, 2001; du Toit, 2004).

During the pre-colonial era, ownership of wildlife, just like any other resource from nature was regarded as a common property resource subject to strict cultural control. Post-colonial, many African countries subscribe to the Roman Dutch Law which recognises the existence of three major categories of property regimes namely: Open access (*res nullius*), Private property (*res propria*), and State property (*res publica*). There is no clear-cut distinction between the categories hence they tend to overlap.

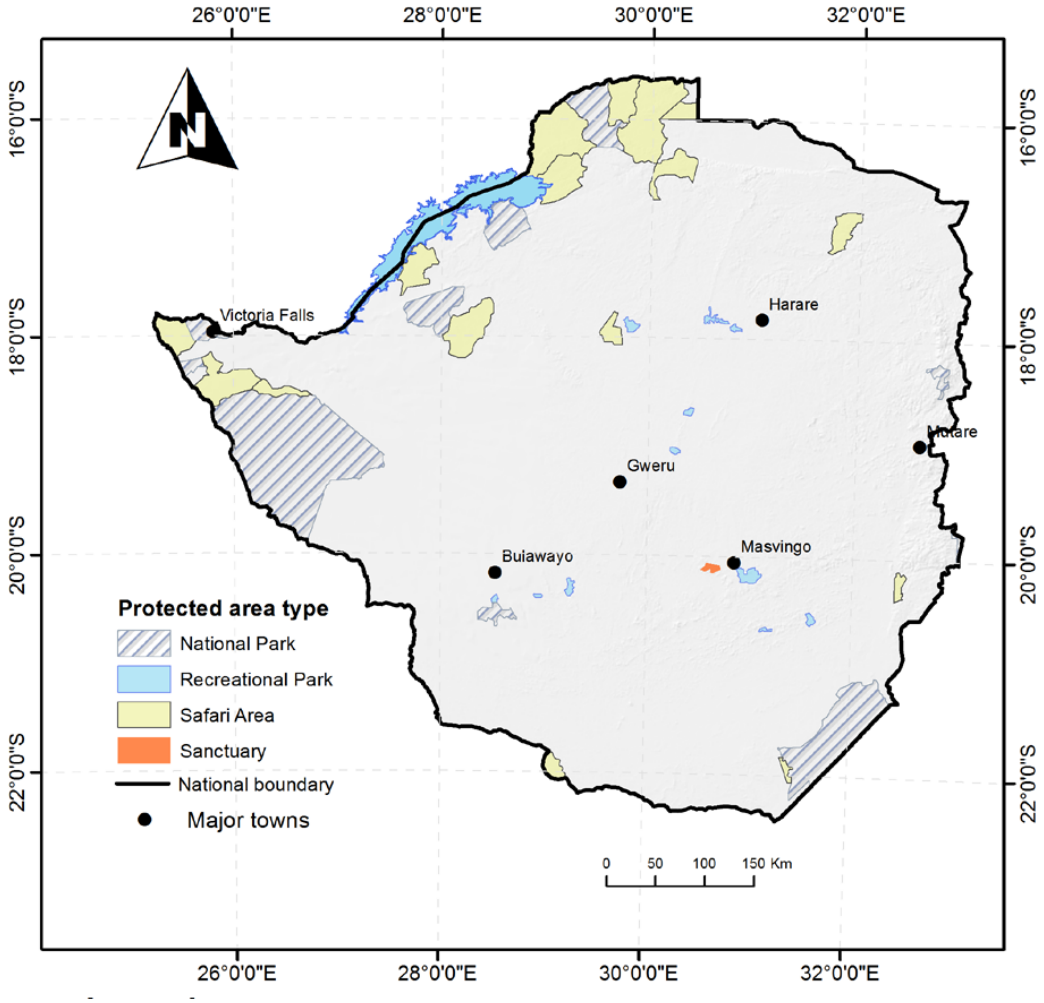

Fig. 1.1: Current coverage of protected areas in the Parks and Wildlife Estates in Zimbabwe.
Note: In addition to the four state protected area categories indicated on the legend there are also botanical gardens and reserves

Wildlife management and use rights in post-independence Zimbabwe (post-1980)
Wildlife management has traditionally followed a top-down approach with the state owning the wildlife in protected areas and enforcing wildlife legislation through state agencies. However, several innovative responses to the weaknesses in top-down wildlife management approaches have been introduced (Chenje, 2000). The Parks and Wildlife Act of 1975 is viewed as the game changer

of Zimbabwean modern policies of wildlife management. The Act put to rest the confusion that prevailed over separation of administration of parks on one hand and of wildlife outside national parks on the other. It was also a milestone in trying to provide legitimacy to commercial farmers to manage and utilise game on their own farms.

Commercial farmers were designated as "appropriate authority" for deciding the wildlife use on their land. The 1975 Parks and Wildlife Act established National Parks, botanical reserves, botanical gardens, sanctuaries, safari areas and recreational parks – all six (6) categories in which wildlife is carefully managed and species diversity protected. Under the Zimbabwe Parks and Wildlife Act of 1975 and its subsequent amendments (e.g., the Parks and Wildlife Act Chapter 20:14 of 2001) all forms of hunting are prohibited in national parks, with hunting permitted in safari areas and sanctuaries under a permit system. The Act and its associated statutory instruments form a comprehensive wildlife management framework which thrives for both preservation and conservation of wildlife in Zimbabwe.

Wildlife resources access and benefits in community-based Natural Resources Management in Zimbabwe

Community-based Natural Resource Management (CBNRM) refers to the way in which a group of people living in the same area and having common interests organise themselves to use and conserve natural resources within their area of jurisdiction (Hachieka and Kokwe, 2000; Mashapa, 2018). CBNRM is a creature of policy that engages groups of citizens in collective action towards sustainable conservation and natural resource management within and across various tenure regimes (Brunckhorst, 2010). CBNRM involves the decentralisation of environmental governance to the community. The major reason for the formation of the CBNRM regime was the growing signs of dwindling effectiveness of the government and its agencies in the management of natural resources (Bond, 1993). CBNRM, therefore, seeks to enhance the conservation of biodiversity outside protected areas and private lands while at the same time affording rural communities' benefits from the wildlife resources in their areas of jurisdiction. Matowanyika (2000) asserts that ideas of CBNRM were developed based on the following:

a) Theoretical basis, economic ideas about property rights and resources allocation or political ideas about devolution and empowerment,
b) Ideas were later refined into operational principles by scholars-practitioners working hand in hand with rural communities to implement them, and
c) The ideas were developed by giving communities the right to use natural resources and to interactively improve institutional, biological, economic and political aspects of management.

Brunckhorst (2010) argues that to be successful, CBNRM needs to meet the needs and aspirations of its community members and be ecologically and socially sustainable while evolving capacities to respond and adapt to internal and external pressures of change. The formation of CBNRM programs and local institutions responsible for management of resources was based on the growing realization of the important role that local indigenous technical and ecological knowledge can play in the management of natural resources. According to Chigwenya and Chifamba (2011) this category of knowledge systems had for long been side-lined in preference of the 'scientific' management methods, which are now seen to be insufficient to sustainably manage the resources.

Local people are regarded to be more cognizant to the intricacies of local ecological processes and practices and are also regarded to have greater interest to sustainably manage these resources, hence are better placed to manage resources than any distant corporate organization could do (Brosius et al, 1998).

According to Makombe (1993), one of the CBNRM versions, CAMPFIRE in Zimbabwe is based on the rationale that communities will invest in wildlife conservation if they can use and benefit from the resources sustainably. CAMPFIRE was conceived in the early 1980s by the then Department of National Parks and Wildlife Management, Zimbabwe (Martin, 1986). The objectives of CAMPFIRE were to:

1. Initiate a programme for the long-term development, management and sustainable utilisation of natural resources in communal areas,
2. Achieve management of resources by placing their custody and responsibility with the resident communities,
3. Allow communities to benefit directly from the exploitation of natural resources within the communal areas, and
4. To establish the administrative and institutional structures necessary to make the programme work.

To date, CAMPFIRE has been established in 58 rural districts of Zimbabwe and covers more than 50,000 km^2 of land. Participating districts are involved in wildlife management which includes protecting game, setting sport hunting quotas, drawing up of contracts with tour operators and safari hunting companies and paying dividends to beneficiary communities. Prior to the introduction of CAMPFIRE, protected areas were in danger of becoming ecological islands, threatening the maintenance of genetic resources and species diversity. The programme has reopened traditional migration routes of animals within the country, thus contributing to the conservation of biodiversity and the natural ecological environment. However, although CAMPFIRE has done well in providing opportunities for the integration and participation of modern local government structures and traditional institutions, it has not yet clearly defined what responsibility should go to which institution or level. According to Sibanda (1996:127): "CAMPFIRE *sometimes creates conflict and competition between institutions that should be complementary to each other hence retarding the growth of wildlife tourism.*"

Innovation in biodiversity conservation: looking into the future

Biodiversity conservation in the context of multiple land use practices

Increasing demand of land for farming in the modern world has challenged conservationists to adopt a paradigm shift from the fences, fines and firearms approach towards innovative approaches critical to the integration of conservation and human livelihood practices at the edge of protected areas or wildlife habitats. Some of the approaches include eco-agriculture, transfrontier conservation areas, access and benefit sharing and payment for ecosystem services.

Eco-agriculture

Eco-agriculture tries to reconcile wildlife conservation and farming. It is a novel approach which promotes the management of landscapes for both the production of food and the conservation of ecosystem services and especially wild biodiversity (McNeely and Scherr 2003). Eco-agriculture

is an approach to agriculture that is inspired by the natural ecological ecosystem for agricultural development to improve food production, resource management, the fight against desertification and human well-being (Mashapa et al., 2013). It links ecology, culture, economics, and society to sustain agricultural production, ecological healthy ecosystem services and viable communities. Its basic tenets include and are not limited to the following: promoting approaches that reduce the negative effects of farming on wild species and habitats. As an approach eco-agriculture can;

1. Enhance the quality of buffer zones and other land uses, important protected areas and transfontier parks in Zimbabwe and elsewhere.
2. Conserve and increase wild animal populations in agricultural regions with important remaining biodiversity.
3. Restore biodiversity and ecosystem functions to agricultural regions with seriously depleted ecosystems.

Such approaches need to be integrated with conservation objectives of national key biodiversity areas such as the eastern highlands, south-east lowveld of Zimbabwe and the Zambezi valley among others and especially in areas where farming communities have been established in or adjacent to protected areas. Eco-agricultural research focusing on resolving the conflict between biodiversity and agricultural production should be prioritized. The need to reconcile conservation and agricultural goals should be the priority of any sustainable development efforts at regional, national and local level.

Unlike the previous thinking which considers people and their farming activities as threats to biodiversity conservation, McNeely and Scherr (2003) see an opportunity for complementarities and for striking a win-win situation between biodiversity and the people. Through practicing eco-agriculture, agricultural fields (grazing land, production forests and fisheries) can become more productive and provide habitats or corridors which can be managed to achieve both agricultural production goals and conservation goals. To achieve this, a number of strategies need to be employed, and these may include;

- Creation of biodiversity reserves that benefit local farming communities. In this case new biodiversity reserves can be established in agricultural regions to benefit local farmers and their communities.
- Development of habitat networks in unfarmed or partially farmed areas, this include both communal and private farming areas including conservancies.
- Reducing or reversing conversion of wild lands to agriculture by optimising or increasing farming productivity on existing areas.
- Minimize agricultural pollution. There is need to minimize pollution of habitat through more eco-friendly and resource-efficient methods of managing nutrients, pests, and waste and installation of farm and waterway filters.
- Modify management of soil, water and vegetation resources. Farmers can modify the management of their critical resources (soil, water, and vegetation) to enhance habitat quality in and around farms (Mashapa et al., 2013).
- Modify farming system to mimic natural ecosystems. Economically useful trees, shrubs, and perennial grasses can be integrated into farms in ways that mimic the natural vegetative

structure and ecological functions, to create suitable habitat niches for wildlife (McNeely and Scherr 2003).

Thus, eco-agriculture is in line with other national policies, particularly the Wildlife Based Land Reform Policy (2006) whose vision is to maximize livelihood options of resettled farmers, by integrating game ranching as a viable form of land use in Natural Regions IV and V. The main objectives of the Wildlife Based Land Reform Policy are:

- To ensure more equitable access by most Zimbabweans to land and wildlife resources and to business opportunities that stem from these resources.
- To maintain a proportion of land outside protected areas under wildlife utilization.
- To enhance a diversity of land uses through wildlife production.
- To develop and implement appropriate institutional arrangements for wildlife-based land reform (Chibememe, 2014; Muboko and Murindagomo, 2014; GoZ, 2006).

To this end the Zimbabwe's fast track land reform programme and its associated policies have offered a window of opportunity for the adoption and implementation of eco-agriculture in the country's biodiversity rich dry regions.

Transfrontier Conservation Areas (TFCAs) and ecosystem protection

Ecosystems generally do not conform to national or political boundaries (Spierenburg et al., 2008). For this reason, conservation is moving further 'beyond the boundaries' and transfrontier conservation is becoming a dominant theme where practically all international conservation organisations have embraced TFCAs in recognition of their role in conserving biodiversity, socioeconomic development and promoting a culture of peace (Wolmer, 2003; Muboko, 2017). TFCAs cover relatively large tracts of land, overlapping frontiers between two or more countries and embracing natural systems encompassing one or more protected areas (Sandwith et al., 2001). With about eighteen TFCAs, at various stages, being implemented across the Southern African Development Community (SADC) region, it has been argued that TFCAs cover very large areas of the region as a profitable and sustainable system of land use (Hanks and Myburgh, 2015; Muboko, 2017). TFCAs promote cross-border cooperation which ensures better control of problems such as fire, pests, invasive alien species, poaching and smuggling, all of which can impact on biodiversity conservation (Sandwith *et al*., 2001). Furthermore, TFCAs can take full advantage of cost savings associated with the sharing of equipment, managerial and research staff, tourist reservations and tourism marketing across international boundaries which has the potential to reduce national budgets for conservation activities (Hank, 2003).

TFCAs can contribute to poverty alleviation through generating income from adventure nature-based tourism in remote destinations, creation of jobs in and around the TFCAs, and food and income from the consumptive use of natural resources (Hanks, 2003). Moreover, the promotion of poverty alleviation has the potential to slow or even halt habitat loss (Hanks, 2003). However, TFCAs have often been criticised for their role in the marginalisation, displacement and alienation of communities (Dzingirai, 2004, Milgroom and Spierenburg, 2008). Some of the communities have little to no bargaining power and the restrictions on land use options and the increased presence of wild animals in the area often threaten their livelihoods (Spierenburg et al., 2008;

Mhuriro-Mashapa et al., 2018). Büscher (2010) argues that many of the supposed multiple positive effects of TFCAs on conservation and community benefits have not yet materialised.

Payment for ecosystem services

The payment for ecosystem services (PES) approach has increasingly been recognised as an innovative approach for promoting the conservation and sustainable use of biodiversity. Wildlife related ecosystem benefits include the following: clean air and water, carbon sequestration, medicinal herbs, soil stabilisation among others (Wynberg and Hauck, 2013; Frost and Bond, 2008; Nkhata et al., 2012). Emphasis in contemporary conservation debate has been on trying to recognise and promote the role of such services in both wildlife and protected area management. Frost and Bond (2008) believe that being a novel approach aimed at achieving conservation goals, there is need to experiment and adapt the approach before it enters the mainstream conservation field. Countries such as Zimbabwe can take advantage of the opportunity presented by this approach to foster a new conservation approach that has the potential to address complex contemporary environmental changes facing mother earth. Such challenges include climate change, poaching, population explosion, poverty among others.

Conclusions

We reviewed aspects of access, ownership and conservation of wildlife resources focusing mainly on Zimbabwe from pre-colonial to post-colonial period. We report that communities moved from the era of collective resource access and sharing, to institutional fencing of wildlife during colonialism, and then the evolution of community-based wildlife management, which in some African countries was intensified in the post-colonial period. Finally, TFCAs have evolved as a profitable and sustainable system of land use in recognition of their role in enhancing conservation and human livelihoods. Changes in ownership regimes were necessitated by the evolution of the political, legal and institutional framework for management of wildlife resources. However, the responsibility of maintaining, conserving and benefiting from the wildlife resources still resides in the hands of a few. Community based approaches to wildlife conservation are facing challenges mainly stemming from lack of devolution and other governance related aspects, aspects which can be addressed.

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Chapter 2

Protected areas and biodiversity conservation in Zimbabwe: history, threats and challenges

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Abstract

The aim of this Chapter is to highlight the forms of wildlife resource conservation, history and PA resource management regimes, and the threats and challenges to biodiversity in protected areas in Zimbabwe. The study was mainly informed by a documentary review of existing literature focussing on peer-reviewed journal articles, books, edited book chapters, relevant policy, laws, programmes and implementation strategies related to resource conservation, protected area management, threats and challenges to biodiversity conservation. Four forms of resource management regimes are identified, i.e., state protected areas, areas under communal lands, private land, as well as transfrontier conservation areas. The establishment and management of protected areas follow an evolution of various legislative instruments that ascribed biodiversity management and rights to different institutions. Transfrontier conservation areas and partnerships are important emerging conservation arrangements promoting collaborative biodiversity conservation. However, loose coordination and fragmented legislation in natural resource management is one of the challenges facing current conservation efforts. Also, habitat loss, land use conflicts, invasive species, climate change and illegal harvesting of resources are seen to pose serious threats to biodiversity conservation. In order to promote sustainability of resource management in PAs, the Chapter recommends the following: (i) devolution of natural resource management rights to local people as an important incentivizing strategy for community participation in biodiversity conservation, (ii) promoting sustainable financing mechanisms for protected areas through increased revenue generation streams such as product diversification and onsite revenue retention initiatives, (iii) realignment and harmonization of environmental legislation and institutions to eradicate resource management conflicts and foster efficient collaboration.

Keywords: *Anthropogenic disturbances, Biodiversity conservation, Resource management regimes, Protected area.*

Introduction

Biodiversity is the variety of life forms, the ecological roles they perform and the genetic diversity they contain (Millennium Ecosystem Assessment, 2005). It is important to conserve biodiversity for two main reasons. Firstly, biodiversity has an intrinsic value making it worth protecting regardless of its utilitarian value to humans. Secondly, biodiversity performs several ecological services for humankind that have socio-economic, aesthetic, and recreational value (Daily, 1997). The intrinsic and use values of biodiversity frames the human struggle, as governments attempt to exclude communities from conservation areas (Adams and Hutton, 2007). Thus, biodiversity is to a large extent entangled in historical political processes, that cascade from the global to the local level. In Zimbabwe, biodiversity conservation is part of the broader political discourse, which is overall guided by the will of the state to consolidate its hegemony and legitimacy over and among functionally differentiated civil society and the related institutions of both state and non-state actors (Hill, 2010). Thus, this paper analyses the history, status, threats and challenges to biodiversity conservation in Zimbabwe.

In principle biodiversity in Zimbabwe is under state property unless ownership rights have been expressly transferred to private or communal owners. The state constructs, modifies and implements environmental policies and laws. The state reserves the right to extend its authority on other biodiversity conservation entities such as communal people, national parks, safari operators, conservation groups, commercial game ranchers and internationally based environmental organizations. In Zimbabwe, biodiversity policies have been evolving from a protectionist approach to one that appreciates the role of communities and sustainable utilization. Such a shift in policy raises questions on the nature of relationship between the protected areas and the surrounding communities. Achieving a 'win-win' scenario by balancing out conservation and community interests is a daunting task (Murphree, 1990; Adams and Hutton, 2007). Zimbabwe's environmental programs have been hailed by scholars as advocating for grassroots control over natural resources (Martin, 1986; Murphree, 1990; Child, 1995; Gandiwa et al., 2013). The establishment of wildlife utilization programs, such as the Zimbabwe's Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) in agriculturally marginal rural areas also serves the interests of both biodiversity conservation and livelihoods improvement in these otherwise agriculturally marginal areas.

The Parks and Wildlife Act 14 of 1975 marked a change in government policy towards ownership of wildlife resources in Zimbabwe, as it marked a policy paradigm shift and formed the basis of the country`s prevailing wildlife conservation regime. The Act officially recognized that wildlife is the property of those who lived on the land with it (GOZ, 1996). In theory, it transferred ownership of wildlife living on private property and later in communal areas of Zimbabwe to the people living there. Through the same Act, a reversal of the royal game principle, which had been operating in the communal areas since 1898 was observed (Taylor, 1992). In both the commercial and the communal areas, the then Department of National Parks and Wildlife Management (DNPWM) now the Zimbabwe Parks and Wildlife Management Authority (ZPWMA) maintains jurisdiction over wildlife control and use (e.g., hunting or ranching). However, in generally the ZPWMA restricts itself to giving technical advice and services to commercial farmers and to encouraging the development of wildlife management in agriculturally marginal communal areas. Wildlife and protected areas are accepted as renewable resources that can and should be used

correctly on a sustainable basis for the benefit of both the people and the resources. These benefits may take different forms such as in aesthetic , scientific, cultural, and recreational values, or they may take material forms such as enhanced productivity from land (Government of Zimbabwe, 1987). The aim of the Chapter is to highlight the forms of wildlife resource conservation, history and PA resource management regimes, and the threats and challenges to biodiversity in protected areas in Zimbabwe.

Methods

This Chapter was approached from a historical perspective which provided an opportunity to follow the origin of protected areas and biodiversity conservation policy in Zimbabwe and its outcome. Data collection for the Chapter was through a desk top review of peer-reviewed journal articles, books, edited book chapters, relevant policy, laws, programmes and implementation strategies related to resource conservation, protected area management and threats and challenges to biodiversity following methods by Muboko and Murindagomo (2014).

Results and Discussion

Forms of resource conservation across different land tenure systems

After the successes of protected area approaches in biodiversity conservation in the United States of America in the late nineteenth century, the fortress conservation concept spread throughout the world (Adams and Hutton, 2007). In Zimbabwe, the state protected areas categories (i.e., national parks, safari areas, recreational parks, sanctuaries, botanical gardens, and botanical reserves) areas were established in the 1970s (Fig. 2.1). At this stage the central philosophy was fortress conservation, i.e., to keep nature pristine by excluding local poor communities from accessing park area resources (Hulme and Murphree, 2001). Thus, the local poor people who formerly relied on the natural services of biodiversity for subsistence were excluded and alienated from biodiversity management and use. Laws and policies were passed by the government to facilitate the establishment of protected areas that were free from human interference. Thus, the then Zimbabwe Parks and Wildlife Act 14 of 1975 was instrumental in the establishment of various protected area categories, based on different management objectives. Uncontrolled consumptive use was restricted, and non-consumptive utilization of protected areas was encouraged.

Biodiversity conservation in Zimbabwe is done both in-situ and ex-situ. In-situ conservation occurs in the gazette areas, national parks, and other protected areas (Fig. 2.1) while ex-situ conservation is achieved mostly through seed banks, resource conservation stands and botanical gardens.

Wildlife management regimes in Zimbabwe consist of a protected areas network covering about 28% of the country`s land area. This PA network can be classified according to land tenure type which include the parks and wildlife estate, constituting about 13% of Zimbabwe's land, gazetted forests (3%), conservancies and private game parks (1.9%) and the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) constituting about 11.9% of Zimbabwe's land area (Ministry of Environment Water and Climate, 2014) (Fig. 2.2). The parks and wildlife estates, indicated before, are State land where wildlife is managed directly by the Zimbabwe Parks and Wildlife Management Authority. Gazetted forest areas are also State lands managed by the Forestry Commission, particularly for the protection of indigenous forests and wildlife species

residing therein. Private land are those areas where wildlife is managed by legal individuals, companies or other entities with tenure or authority over the land, while communal land constitutes State land where individual land holding is achieved through membership rights to a community, e.g., a village and resource management is implemented through a village development committee under the supervision of the Rural District Councils as the appropriate authority. Wildlife management in communal areas is facilitated through the CAMPFIRE program, which promotes sustainable use. The sustainable use concept is supported by various national policies and international conventions, e.g. the Convention on Biological Diversity (CBD). Zimbabwe is one of the over 196 parties that have signed and ratified the CBD whose thrust is biodiversity conservation, its sustainable use and the equitable sharing of the resultant benefits.

There are also state protected resource conservation stands, which are established for tree species that are threatened by over exploitation and whose population structure is heavily fragmented (Campbell et al., 1991). Such species include *Chlorophora excelsa* which has a few trees left in Gonarezhou National Park, *Bivinia jalbertii* with a relic population left in the Ngundu Hills and *Warburgia salutaris* in the Chipinge area (Anderson et al., 1993). However, for species that do not survive if planted outside their natural range, enrichment planting is being encouraged. In some cases, such sites are gazetted as special conservation areas to ensure the continuation of the species. As a result of this, some 27 sites were gazetted under the then Natural Resources Act of 1941 as special areas of endemism or representatives of certain vegetation/species types on privately owned land in Zimbabwe. The Natural Resources Act has since been repealed and replaced by the Environmental Management Act (Chapter 20:27) of 2002.

In the 1980s, social-ecological justice advocates argued against the protected area philosophy of excluding poor communities with concerns on issues like human displacement, cutting off humans from culturally important places within PAs, depriving communities of their right to benefit from natural resources and others (Hulme and Murphree, 2001). The advocates proposed that conservation can best be achieved by giving rural people a direct economic interest in the survival of species, thus literally linking conservation success to secured livelihoods (Hulme and Murphree, 2001; Adams and Hutton, 2007). In Zimbabwe, the current Parks and Wildlife Act (Chapter 20:14) of 2001 and its subsequent amendments provides the legal framework for the management of wildlife on private land and communal lands. Appropriate Authority (AA), which is granted in terms of the Parks and Wildlife Act (Chapter 20:14) of 2001 offer privileges to owners of private entities and Rural District Councils (RDC) to utilize and exploit wildlife on their land. Such an arrangement has given communities incentives to sustainably manage wildlife resources through the formation of conservancies/game ranches on private land and participation in the internationally acclaimed Communal Area Management Programme for Indigenous Resources (CAMPFIRE) programme in communal areas (Fig. 2.2). CAMPFIRE has been the focus of numerous studies that focus on the ecological conservation and the financial benefits accrued (Martin, 1986; Murphree, 1990; Hulme and Murphree, 2001; Child, 1995; Gandiwa et al., 2013).

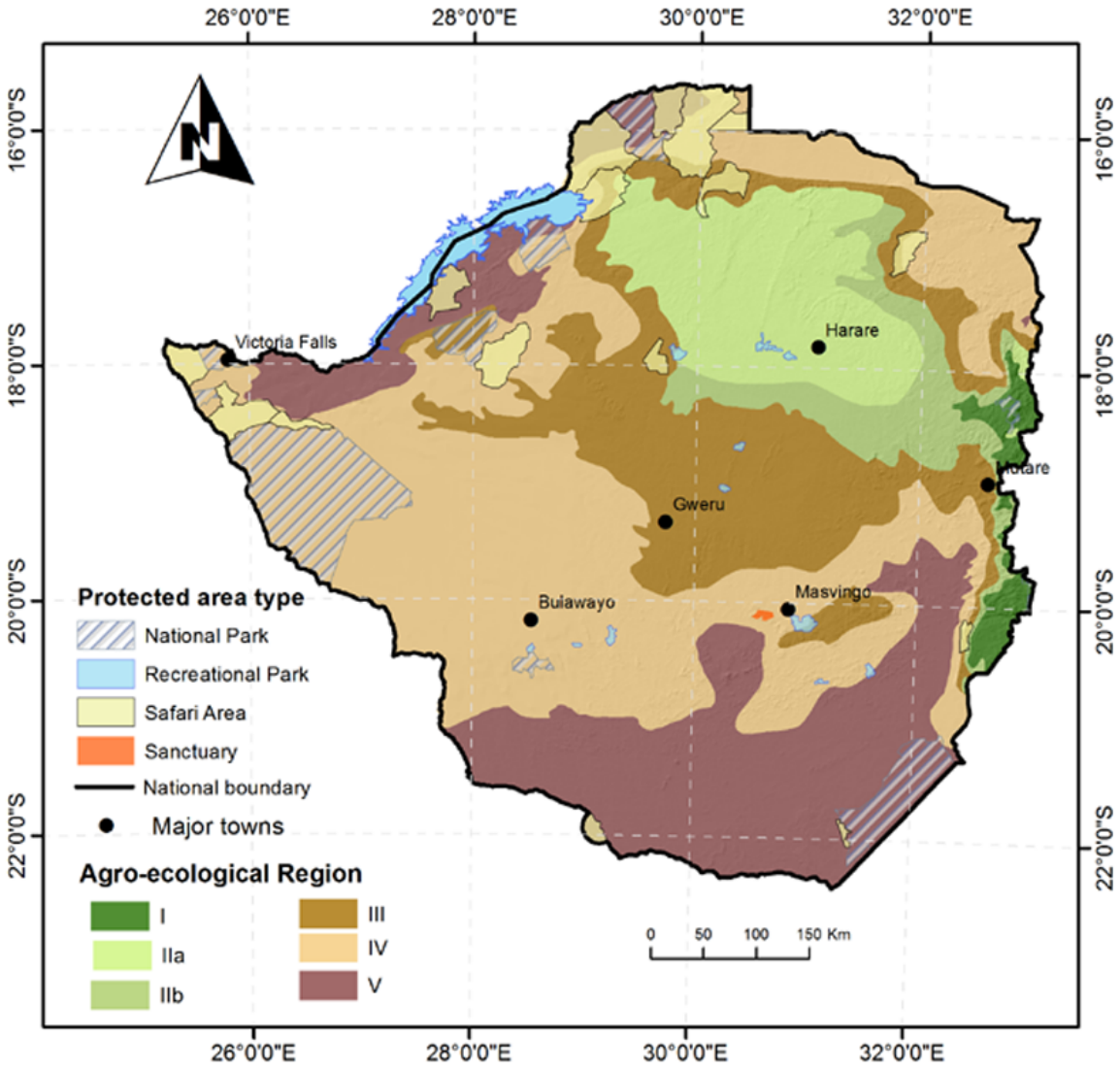

Fig. 2.1: Major protected areas and old agro-ecological regions of Zimbabwe

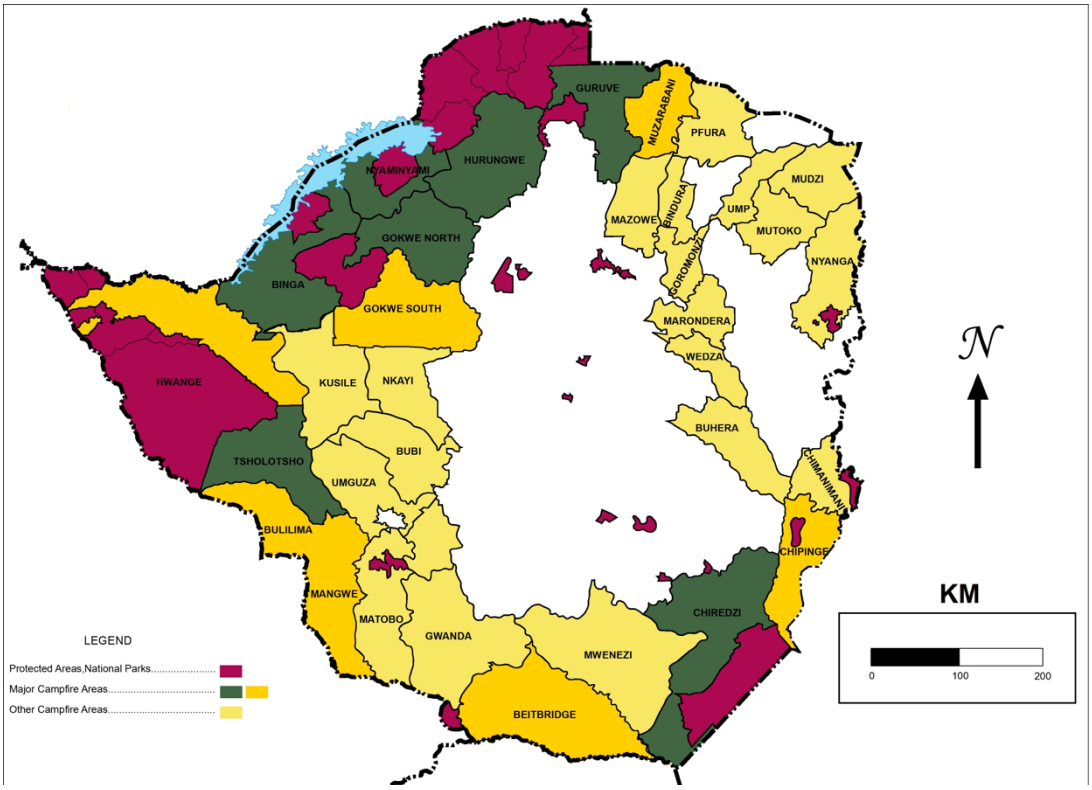

Fig. 2.2: Location of major CAMPFIRE areas across Zimbabwe. Source: Mukarati (2008).

Transfrontier conservation areas **(TFCAs)**

The transboundary management of natural resources, particularly of water and wildlife, and the associated development of transfrontier conservation areas (TFCAs) has been a major focus of research in southern Africa (Cumming, 1999). The SADC Protocol on Wildlife Conservation and Law Enforcement of 1999 defined a transfrontier conservation area as a component of large ecological region that straddles the boundaries of two or more countries encompassing one or more protected areas as well as multiple resource use areas. Transboundary natural resource management and TFCA development has also been closely linked to emerging Spatial Development Initiatives (SDIs) and corridors within southern Africa (Griffin et al., 2000). TFCAs bring together established biodiversity areas within adjacent countries to manage them as integrated units across international boundaries (MEWC, 2014).

A key economic driver linking these conservation and infrastructure development initiatives is wildlife-based tourism that seeks to significantly increase returns from marginal lands in a sector where southern Africa enjoys a global comparative advantage. However, the management of wildlife and livestock diseases within the larger transboundary landscapes that are envisaged remains unresolved and an issue of major concern to other economic sectors in the region. The interactions at the interface between animal health, human livelihoods and health and ecosystem services are also poorly understood; with the result that policy development and implementation is compromised by a lack of appropriate information and understanding of the complex systems and issues involved. It is important to note that in order to implement the SADC Protocol on Wildlife Conservation and Law Enforcement of 1999, by 2013 eighteen potential and existing

Transfrontier Conservation Areas (TFCAs) have been either established or are at different levels of development in the SADC region involving 12 continental African member states, covering about 120 million hectares (Hanks & Myburgh, 2015; Muboko, 2017). Currently, Zimbabwe is pursuing six TFCAs which are at different developmental stages (Table 2.1). The TFCAs include many national parks, neighbouring game reserves, hunting areas and conservancies, mostly occurring within an intervening matrix of land under traditional communal tenure. The area includes several land use/land tenure regimes encompassing state, private and communal resource management systems. It also comprises a complex system of established and evolving conservancies and game ranches on freehold land, small-scale agro-pastoral farming areas under communal tenure, large scale commercial irrigation schemes, and smaller irrigation schemes within the communal and resettlement areas.

Table 2.1: Transfrontier conservation areas in Zimbabwe

Year of establishment or initiation	Name of protected area	Status as at year 2020
2001	Chimanimani	MoU signed
2002	Great Limpopo Transfrontier Conservation Area (GLTFCA)	Treaty signed
2004	Greater Mapungubwe	MoU signed
2010	ZIMOZA (Zimbabwe, Mozambique and Zambia TFCA)	Conceptual
2011	Kavango Zambezi	Treaty signed
2013	Lower Zambezi Mana Pools	Conceptual

Source: Peace Parks Foundation (www.peaceparks.org)

Management of protected areas in Zimbabwe

Protected area management is an ancient discipline that evolved from earliest concerns for biodiversity protection among early naturalists and hunters. The International Union for Nature Conservation (IUCN) later came up with a definition for a protected area which states that a protected area is an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means (Dudley, 2008). Based on the provisions in the IUCN guidelines for establishment and management of protected areas that a country can develop its own criteria for protected area designation, Zimbabwe has developed its own criteria for PA designation in line

with her management objectives. In addition to the various PA categories mentioned before, one biosphere reserve, the Middle Zambezi, was established in 2010. The designation of these protected areas is enshrined in the Parks and Wildlife Act (Chapter 20.14) of 2001, the Forestry Act (Chapter 19:05) of 2002, which also serve as enforcement legislative mechanisms together with the Environmental Management Act (Chapter 20:27) of 2002 and other conservation-based legislation (Table 2.2). However, PA types under private and communal resource management are not adequately covered by this legislative system and this has resulted in the lack of recognition of these important conservation initiatives.

Table 2.2. Some Conservation related legislation and institutional framework in Zimbabwe

Year of establishment	Name of Act /Policy or institution
1913	'Water Ordinance' to ration public water
1913	'Herbage Preservation Ordinance' to prevent indiscriminate veld burning that 'caused accelerated soil erosion'
1974 (amended 2001)	The Trapping of Animals (Control) Act, (Chapter 20:21)
1931	Land Apportionment Act of 1931
1931	Rhodesian Agricultural Union appointed a Soil Erosion Committee which recommended district conservation boards' establishment
1938	Appointment of the Natural Resources (Parliamentary) Commission, under Justice McIlwaine
1941 (as amended 1996)	Natural Resources Act (Chapter 20:13)
1960	Formation of Conservation Committees
1960	Wildlife Conservation Act
1969	Land Tenure Act
1971	Atmospheric Pollution Prevention Act
1975	Parks and Wildlife Act 20: 14 of 1975
1976	Full blown Department of Natural Resources.
1976	Water Pollution Control Act
1978	Project WINDFALL (Wildlife Industries New Development for All)
1988	Rural District Councils Act (Chapter 29:13) 1988
1982	Communal Land Act (Chapter 20:04)
1987	Communal Land Forest Produce Act (Chapter 19:04)
1992	Policy for Wildlife
1996 1987	The Firearms Act (Chapter 10:09) Communal Land Forest Produce Act
1996 2001 (Amended)	The Parks and Wildlife Act (Chapter 20:14)
1996	Trapping of Animal (Control) Act (Chapter 20:21)
1998	Water Act (Chapter 20:24) Water Act
2001	National Museums and Monuments Act (Chapter 25:11)
2001	Traditional Leaders Act (Chapter 29:17),
2002 20056 (Amended)	Environmental Management Act (Chapter 20:27)
2004	Forest Based Land Reform Policy
2005 (Adoption) 2009 (Gazetted)	National Environmental Policy and Strategies
2006	Wildlife Based Land Reform Policy

2005	Forest Based Land Reform Policy
2013	National Biodiversity Strategy Action Plan
2013	Zimbabwe National Climate Change Response Strategy

Note: adapted and modified from Chibememe et al. (2014).

Protected area management in the country is achieved through various management objectives based on the various protected area designations. There are different institutions and organizations which are responsible for the management of protected areas across the various PA designations in the country. The country adopted different protected area management approaches, especially to increase responsibility and increase participation in protected area management (National Report 2010). These include management by government departments and agencies, parastatals, nongovernmental organizations (NGO), the private sector and community groupings. In most cases this is achieved through collaborative arrangements including partnership and joint ventures among right holders and different stakeholders.

Such partnerships include the Public Private partnerships in the management of both Wildlife and forest resources. Examples include the Umfurudzi Park which has a partnership between the ZPWMA and a private company, Unifreight and also the Gonarezhou Trust, which is a partnership between ZPWMA and Frankfurt Zoological Society (FZS) in the management of the Gonarezhou National Park. A variety of partnership options for wildlife ranches and conservancies have been proposed under the wildlife-based land reform policy (Table 2.3). Partnership schemes are important in wildlife conservation as possibilities for resource pooling for more effective protected area management become more feasible. The other benefits of partnerships include development of human capital; better access to information; innovation and creativity. However, partnership agreements might also provide a way for conflict in protected area management due to incompatible goals among partners and, they present implementation challenges and requires time investment in trust building and maintenance of these partners.

Decision making for conservation and sustainable use of natural resources in Zimbabwe is held at national level through the ministry responsible for environmental affairs and currently this responsibility lies with the Ministry of Environment, Tourism and Hospitality Industry (MoETHI). Various government departments, agencies, and parastatals under the MoETHI namely the Zimbabwe Parks and Wildlife Management Authority (ZPWMA), Forest Commission (FC) and EMA are important in protected areas management in Zimbabwe. The ZPWMA derives its mandate from the Parks and Wildlife Act (Chapter 20:14), as amended in 2001 and its subsidiary statutory instruments. The Act empowers the Authority to manage Zimbabwe's wildlife resources effectively and profitably for the benefit of present and future generations. The Forest Commission is mandated under the Forest Act (Chapter 19:05), as amended in 2002 to provide regulation, management, and capacity enhancement within Zimbabwe's forestry sector. The Environmental Management Agency is an important government arm responsible for the enforcement of the EMA Act (Chapter 20: 27) through monitoring human interference with the environment outside PAs, thus playing an important role in combating deforestation as well as protection of wetlands, particularly those that are not yet recognized as Ramsar sites. The most recent document which addresses the need for sustainable management of wildlife and forest resources is the National Biodiversity Strategy and Action Plan (2014). In addition, other supportive national strategic

documents such as the Zimbabwe National Climate Change Response Strategy (2013) address issues related to climate change mitigation and adaptation across all sectors of the economy including wildlife.

Community involvement in protected area management in the country is facilitated through the Parks and Wildlife Act (Chapter 20:14) of 2001 and its later amendments, which gives RDCs appropriate authority for the management of natural resources in their areas of jurisdiction by creating CAMPFIRE areas to promote community based natural resource management (Jeke, 2014). Post donor CAMPFIRE experiences point to the resilience of the programme as it continues to operate in most rural districts. CBNRM initiatives are a key strategy in tackling biodiversity conservation threats as they provide incentives to local communities to self-organise and support conservation programmes (Tchakatumba et al.,2019). However, decentralization and devolution of protected area management and natural resource user rights is important in ensuring broader participation by local communities and other stakeholders. The concept of devolution is also in line with the new protected area management paradigm for inclusive protected area management. In addition, decentralization and devolution also ensure a fairer resource distribution mechanism by giving various stakeholders management and resource use opportunities (National Report, 2010). This is consistent with section 264(2) (d and e) of the Zimbabwean Constitution and thus is in keeping with the spirit, purpose and object of the supreme law of the country.

The involvement of the private sector in protected area management is also important in providing means for high level investment in protected area management by giving private companies and trusts ownership and management rights over protected areas. This investment can also lead to sound management, for example, the Malilangwe, Bubye River and the Save valley conservancies are well reputed for effective management. The private sector thus plays an important role in the conservation of threatened and endangered species through capital injection which promote effective anti-poaching, breeding and stocking exercises. Involvement of NGOs is also important in improving the effectiveness of protected area management in the country by providing means for capacity building and technical support, for example, NGOs such the World Wide Fund for Nature (WWF) play an important role in capacitating protected area managers in the country through a variety of financial and technical support systems.

The differentiation among protected area designations in the country also provides a mechanism for harnessing a variety of sources of incomes to finance the management of these protected areas through a wider range of both services and rates to the world`s heterogeneous client base. For example, the private sector can charge higher rates and offer exclusive services while the ZPWMA is able to attract low client volumes and still offer high quality services at much affordable rates. Service differentiation is also necessitated by these different protected area designations and the provision of various resource use and protection options such as trophy hunting in safari areas, endangered species protection in sanctuaries and Intensive Protection Zones (IPZ) and ecosystem maintenance in national parks. These various provisions provide opportunities for diverse revenue streams which can contribute to effective protected area management.

Table 2.3: Proposed partnership to be implemented in areas under wildlife land use in the context of the 2006 wildlife-based land reform programme

Type of partnership	Description
Operator team up with local communities (Private-community partnership [PCP])	Partnership is between the existing wildlife ranch or conservancy operators and their communal neighbours; ZPWMA are not a direct commercial partner in the venture & revert to their current regulatory and advisory role.
Operator team up with local community & a consortia of local investors (existing & new private operator-community partnership [PICP]	Partnership is between the existing operator, their communal neighbours, & indigenous investors; ZPWMA are not a direct commercial participant in the venture and will remain with its current regulatory and advisory. The corporate model through share transfer is the basis for implementing this option.
Operator team up with ZPWMA & communities (Private- Public-community partnership [PPCP])	This is a three-way partnership between the existing operators, plus local communities and ZPWMA, with all contributing some form of capital/assets and deriving benefits.

Threats and challenges to biodiversity

Threats and challenges to biodiversity in protected areas are diverse, but here we outline key threats facing developing countries with specific focus on Zimbabwe. These threats and challenges are both induced by anthropogenic and natural causes, but the two can overlap. Major human induced threats and challenges include, but not limited to habitat loss and change; land use conflicts; invasive alien species; over-exploitation of natural resources; illegal harvesting; limited community participation in protected area management; financial and management incapacitation; fragmented or weak biodiversity and protected area policies and laws. Naturally induced threats and challenges include the effects of climate change and at times invasive alien species.

Habitat loss and change in Zimbabwe

Habitat loss and alteration is a growing threat to biodiversity conservation and several causes are attributed to this. The major factor is the human element where anthropogenic activities largely influenced by the rapidly growing human population are a major concern among disturbance regimes. Illegal settlements and the rapid expansion of residential areas in most urban centres has resulted in the loss of land cover, wetland destruction and associated biodiversity (MoEWC, 2014). An increase in the population of newly resettled areas has resulted in accelerated clearance of forests and woodlands for cultivation. Newly settled farmers on former game farms and in plantations and gazetted forests have converted land to cropping, which has contributed to habitat loss for wildlife (MoEWC 2013). There is also increased threat to woody vegetation species composition and structure due to the cutting down of trees for tobacco curing leading to significant habitat modification.

The Fast Track Land Reform Program (FTLRP) has significantly influenced human encroachment and transformation of wildlife areas. For example, in northern Gonarezhou National Park, Zimbabwe, the Chitsa people encroached into the park and settled leading to habitat loss and reduction in the park area (Gandiwa et al., 2013). Several families have also been resettled in wildlife areas and gazetted forests such as the Save Valley Conservancy, Chiredzi River Conservancy, Mafungabutsi forest, Chirisa Safari Area, etc. Habitat loss also threatens the survival of animal species and reduces the quality of the protected area. Encroachment also results in competition for grazing land between livestock and game animals and fuels the spread of diseases such as anthrax, bovine tuberculosis and foot and mouth leading to Human Wildlife Conflict (HWC). Human encroachment, fragmentation of ecosystems, logging, mining and agriculture pose serious threats to ecosystems in the wildlife estates as they transform habitats and drive away resident wild animal species. Some activities like road construction and other infrastructure development often result in fragmentation of ecosystems and habitats, obstructing migratory routes to breeding and feeding grounds. Fire is also a huge threat to habitat alterations and quality in protected areas as unplanned fires often have devastating impacts on protected area vegetation communities and animal species.

Land use conflicts

Protected area managers face a serious challenge from competing land use options such as mining, construction and agriculture. These competing land use options sometimes result in land conversion and loss of protected areas. In recent years, protected areas in Zimbabwe have witnessed increasing land use conflicts and this can be attributed to poor and or absence of proper land use planning. This problem is also manifesting itself in the form of increasing incidents of human-wildlife conflicts such as crop raiding, livestock predation, loss of human life, property destruction and poaching (ZPWMA, 2014). The demand for land appears to be increasing particularly for communities living adjacent to the parks and wildlife estate. There have been cases of illegal settlements in Gonarezhou National Park, and Chegutu and Charara Safari areas (ZPWMA, 2013). Large portions of protected areas have also been allocated and occupied by people for settlement under the FTLRP, including parts of the country`s biodiversity hot spot, e.g., the Save Valley Conservancy.

Mining possess serious threats to biodiversity in many protected areas where prospecting for minerals has been done. In some instances, there is prevalence of illegal mining in protected areas such as the illegal artisanal mining activities in Chimanimani National Park, Chegutu Safari Area, Chewore Safari Area, and Umfurudzi Park. Land use changes related to agricultural practices and artisanal gold panning have also occurred within the buffer zone of the Middle Zambezi Biosphere Reserve (MZBR). Mining activities fuel land degradation, habitat loss and pollution of water bodies in protected areas thus threatening both terrestrial and aquatic ecosystems. The process of land use change is an outcome of complex interactions between biophysical and societal processes. In the face of increasing resource exploitation, it is becoming increasingly difficult to balance biodiversity conservation and socio-economic welfare of the local communities. Local people require financial investment and land, two commodities that are in short supply. Thus, deciding on the nature of incentives and distribution in the community for conservation goals is difficult because local communities need alternative income generating activities for conservation to be a success. As a result, protected areas are under threat from small scale mining especially open cast

and gold panning, land clearing for agriculture resulting in serious damage to aquatic fauna and riverine ecosystems. Agricultural practices in river catchment areas are leading to siltation of rivers and dams in protected areas reducing water quality and availability to wildlife.

Invasive alien species

Despite the widespread occurrence of invasive alien species in Zimbabwe, the then Ministry of Environment, Water and Climate (2014) acknowledged that there is limited data on plant and animal invasive species available. However, many environmental experts concur that invasive alien species damage croplands, grazing land, forests and aquatic ecosystems. Invasive species such as *Lantana camara*, jumping chola (*Cylindropuntia fulgida*) and the Black wattle (*Accacia mearnsii*) are a threat to biodiversity conservation. These plant species have invasive characteristics which outcompete and displace native species in protected areas subsequently transforming wildlife habitats. Water hyacinth (*Eichhornia crassipes*) has also caused devastating impacts on several lakes in the country, reducing aquatic habitat quality and affecting water-based conservation operations. Fast-growing exotic tree species, such as pine (*Pinus patula*), wattle (*Acacia mearnsii*), *Lantana camara*, guava (*Psidium guajava*), gum trees *(Eucalyptus*), *Jacaranda mimosifolia,* white cedar (*Melia azedarach*) and cypruss, are slowly becoming invasive in the Afromontane forests, grasslands, miombo woodlands and streambanks (MEWC 2013). These are harmful to native biodiversity as predators, parasites, disease vectors and/or direct competitors for growth factors. In several water bodies, the diversity of fish species has significantly declined due to colonization by the Nile perch (*Oreochromis niloticus*) whose characteristics are highly invasive. The red claw cray fish (*Cherax quadricarinatus*) is also another invasive fish species posing challenges for fisheries in Lake Kariba due to its predation on Kapenta which an economically important species for fisheries is. The loss of biodiversity due to action of invasive species reduces stability as ecosystems become homogenised.

Climate change and variability

Atmospheric pollution is one of the major threats to aquatic and terrestrial ecosystems as it is the main cause of global warming. Global warming has caused a gradual reduction in annual rainfall across Africa over the last 50 years (Shrader et al., 2010). Reduction in the amount of rainfall being received could reduce the distribution and availability of both food and surface water for animal species (Shrader et al., 2010). In recent years, the effects of climate change in Zimbabwe have been seen in recurrence of severe droughts, floods in low-lying areas and shifting of seasons (MEWC, 2014). In 2011 a combination of high temperatures, shortage of food and water resulted in the death of 165 elephants in Hwange National Park (ZPWMA, 2016). Climate change is one of the principal threats to biodiversity in protected areas. Climate change threatens some of the large, protected areas that have been designated to conserve much of Africa's magnificent biodiversity (Case, 2006). Its terrestrial impacts include shifting ranges of species and habitats, altered migration patterns and timings, increased intensity of storms, fires, and flooding. Climate change has affected the distribution of aquatic species and functioning of habitats in major parks such as Gonarezhou National Park. Climate change has also led to habitat expansion and shrinkage of home ranges for some species in protected areas. Sensitive habitats such as riparian zones and natural water pans are most vulnerable to climate change and variability (Gandiwa and Zisadza, 2010).

Drought, a proximate driver which directly affects animal populations (Scholes, 2011) is expected be the major problem facing Zimbabwe (Levina, 2006). Chamaille-Jammes et al. (2007) revealed that during the 20th century, droughts have worsened in Hwange National Park (HNP), Zimbabwe. Droughts have affected forage and surface water availability. Such observations threaten the conservation status of HNP (Chamaille-Jammes et al., 2007). Projections of precipitation and runoff in Africa suggest a decrease of up to 10% in precipitation in most of southern Africa (including Zimbabwe) by 2050 (Levina. 2006). Drought has caused large herbivore death during the 1982/83 and 1991/92 season (Gandiwa and Zisadza, 2010). Approximately 1500 elephants died during the 1991-1992 drought (Tafangenyasha, 1997) and numerous species also suffered significant mortality (Leggett, 1994). Very large mammals (body weight of 50kg and above) (Scholte, 2011) such as elephant, buffalo, hippo and large antelopes have a low capacity to resist drought (Gandiwa and Zisadza, 2010) and are likely to be more threatened by climate change (Magadza, 1994). Buffalos are vulnerable to drought (Scholte 2011). Studies have shown that the Zambezi Valley is experiencing climate variability and an increase in these events is expected (Chagutah, 2007; Magadza, 2000). Rainfall in the middle Zambezi valley is very variable and erratic and this could influence the abundance and distribution of large mammals in protected areas like Mana Pools National Park (MNP, 2009). In addition in MNP during the dry season water availability is restricted to riverine woodlands and a few springs near the escarpment (ZPWMA, 2009). Thus, mammals tend to congregate in these areas. Large herbivores in particular, elephant (*Loxodonta africana*), buffalo (*Syncerus caffer*), roan (*Hippotragus equinus*,) zebra (*Equus quagga*), eland (*Tragelaphus oryx*), and sable (*Hippotragus niger*) could be under threat from the periodic droughts.

Noticeable changes in large mammal population in the Zambezi riverine woodlands and adjacent areas due to drought have been observed (Dunham, 1994). Bosongo et al. (2014) has shown that the Zambezi Valley is experiencing climate variability and an increase in these events is expected. Biodiversity in the Middle Zambezi Valley (that includes the Middle Zambezi Biosphere Reserve) is under threat from climate change, increasing human population and illegal harvesting of wildlife resources (Magadza, 2013) and related land use changes. Rainfall in the MZBR is very variable and this could influence the abundance and distribution of large herbivores (ZPWMA, 2009). Ndebele-Murisa et al. (2011) investigated the influence of climatic variables (rainfall, temperature and evaporation rates) and lake water levels on the stocks of the sardine fish species *Limnothrissa miodon* (Boulenger), commonly known as Kapenta in Lake Kariba. The study reveled that continual warming and climate variability plays an influential role in Kapenta production. The decreasing rainfall trends and increasing evaporation rates are attributed to the decrease in lake productivity. Significant changes in gillnet fish catch species composition in the Sanyati Basin of Lake Kariba have also been reported due to climate change impacts on lake productivity, favouring fish species with high resilience.

Over-exploitation of natural resources

The demand from a growing middle class and intense poverty in the region creates a strong incentive for continued over exploitation of natural resources. Although, wildlife harvesting is monitored under various mechanisms such as the use of quotas and regulatory instruments, there is high propensity among resource users to exceed sustainable thresholds. The inadequacy of scientific data in the quota setting process often results in overutilization of resources as these quotas become mere figures which is unsustainable. It is a case of economic incentives and

profiteering at the expense of ecological sustainability. Overfishing in many water bodies also occur and has also resulted in declining fish populations in the Zambezi River and Lake Kariba, causing reduced fish catches (Mahere, 2012). There has been a decline in fish species composition in gillnet and artisanal fisheries catch in several lakes, including Lake Kariba, Lake Chivero, and Darwendale. Lack of enough staff and infrastructure makes it virtually impossible to police overharvesting of resources particularly driven by greed which is most certainly unsustainable. Bushmeat hunting and indiscriminate killing by poachers particularly for trade all can lead to local extinction of some species. Bush meat hunting and illegal trade in endangered species remains top of the list of threats to protected area management effectiveness.

Deforestation has been occurring at alarming levels since 2011 in peri-urban areas due to commercialization of fuelwood by desperate urban residents. The need for fuel in urban areas has been exacerbated by shortage of other sources of energy such as electricity power in Zimbabwe (MEWC, 2014; Muboko et al., 2014). Fuel wood is a primary energy source for almost half the world's population and is the net cause of degradation and cause of deforestation in urban parks. Non-timber forest products, such as honey and wild fruits, that provide safety nets for rural communities during drought years and medicinal plants, are being harvested unsustainably by urban residents for commercial trade (Madzara, 2013).

Humans also exert bottom-up controls on large wild herbivore abundances through altering resource availability (Gandiwa, 2013). Anthropogenic related disturbances, for example, livestock grazing, fires and settlements have been observed to influence the density and distribution of large herbivores in Gonarezhou National Park (GNP) (Gandiwa and Zisadza, 2010). The Middle Zambezi eco-region faces threats from mining, land use changes especially conversion to agriculture, uncontrolled elephant populations, wildlife and timber poaching and invasive alien plant species (GOZ, 2013). The Worldwide Fund for nature (WWF, 2012) reported that poaching and extractive industries threaten biodiversity in Mana Pools National Park. The Middle Zambezi Biosphere Reserve is also under threat from a myriad of environmental stressors such as overuse of biological resources, excessive herbivory by elephants and uneven water distribution (ZPWMA, 2009). Such activities could affect woody vegetation and large mammal dynamics and distribution within the biosphere reserve.

Illegal harvesting

One of the challenges being faced in PA management include illegal harvesting in the form of illegal logging and poaching. Illegal logging is a serious threat in forest areas where there is large scale cutting down of trees for timber and firewood (Katerere et al., 1999). The situation is aggravated by the persistence of an expanding small-scale furniture industry and the increasing demand for hard wood timber in timber furniture manufacturing companies as well as power shortage which has resulted in an increased demand for timber. Both commercial and subsistence poaching of wildlife species and their illegal trafficking stand as one of the major threats affecting biodiversity and protected area management in Zimbabwe. Since 2010, poaching has assumed sophisticated levels, with organized syndicates using chemicals to kill wildlife (MEWC, 2014). Cyanide poisoning of natural salt lick points resulted in the death of 115 elephants as well as scavenging animals and birds that consumed the carcasses in HNP and the adjacent Forestry area in 2013 (Muboko et al., 2014; ZPWMA, 2013). Poaching is particularly a big threat to conservation of species such as elephant, rhinoceros, pangolin that are well sought after in illegal wildlife

markets across the world. For instance, excessive rhino poaching has led to interventions such as dehorning which however comes with additional conservation costs and loss of aesthetic value of the species. Elephant poaching using sophisticated methods such as cyanide poisoning and sophisticated tactics have devastating impacts on entire ecosystems, affecting other species such as carnivores and birds of prey which feed on the poisoned carcasses.

Limited community participation in protected area management

Another challenge facing protected areas in the country is finding effective means to integrate local communities to actively participate in wildlife management. Despite the existence of the CAMPFIRE programme, community participation is more passive and limited to only receiving benefits than being actively involved in decision making (Gandiwa et al., 2013). Furthermore, the formulation and purported implementation of the wildlife-based land reform policy have done very little to excite and improve the inclusion of local communities. Most of the partnership arrangements have largely benefitted the local authorities, private sector, political big weights and the rural elites. Therefore, community participation is largely tokenistic in nature and too rhetoric. In addition, there are few successful community-initiated PA management projects or models in the country to foster active participation from local communities. The situation is similar in most southern African countries except for countries like Namibia where there is a thriving community conservancy system.

The incorporation of the social and economic objectives in protected area management remains a challenge in the country despite such commitments being evident. Except for the CAMPFIRE programme there are few other mechanisms designed to have local people and their livelihoods incorporated in protected area management. The major challenge is finding the best approach to have local people`s committed participation back in protected area management and conservation (CBD, 2008). Most of the protected areas in the country to date still excludes local communities and exhibit a protectionist outlook in PA management through fences, firearms and fines. There is no effective communication between protected area managers and local people to spearhead collaborative management. The exclusion of local communities in biodiversity conservation poses a big threat to the persistence of species in the country where about 80% of the country`s biodiversity lies outside protected areas. Community involvement would therefore provide one of the potential means to effectively conserve biodiversity.

Financial constraints and Management incapacitation

In Zimbabwe, since the year 2000, biodiversity conservation, continued to experience diminishing external financial support, not only from the Central Government, but also from the corporate sector and renowned environmental non-governmental organizations. The decline of donor support in biodiversity conservation was linked to the perceived bad publicity and related sanctions the country has been receiving since 2000. The adverse macro-economic environment has witnessed huge negative impacts on biodiversity conservation. The generation of revenue through sustainable wildlife utilisation is also compromised by international trade bans that come with trade restrictions under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). Examples include the prohibition of Zimbabwean hunted elephant trophies by countries such as the United States of America, Australia, New Zealand and China. Revenue generated from wildlife utilisation is expected to be reinvested into financing biodiversity conservation and related activities.

Management incapacitation in some instances results from staff shortages and loss of critical skills, incompetence and corruption among other factors. This has serious impacts in protected areas such as safari areas where trophy hunting occurs and management is more concerned with economic gains at the expense of conservation objectives (Muposhi et al., 2015). The monitoring of the quota setting process for sustainable off-takes is also hampered by the lack of enough human capital in the form of ecologists to conduct comprehensive ecological assessments on all hunting concessions. Wildlife management operations such as effective anti-poaching programmes require substantial financial resources to establish an efficient law enforcement system. Lack of adequate financial resources has left several wildlife management properties including the parks and wildlife estates understaffed leading to limited patrol effort and the prevalence of poaching.

Fragmented or weak biodiversity and protected area policies and laws

Fragmentation in biodiversity and protected area policies and laws also results in challenges, constrains and barriers in the conservation of biodiversity. Perverse incentives, inappropriate natural resource policies, unregulated land development and inadequate land use planning all constrain the ability of conservation managers to design and implement effective sustainable landscapes. Again, penalties handed down by the courts for contravening wildlife laws are often condemned as not deterrent enough, hence posing a challenge to biodiversity conservation. The issue of lack of implementation of the key conservation related provisions of Zimbabwe's new constitution cannot be over emphasised. The Parks and Wildlife Act (Chapter 20: 14) of 2001 and its subsequent amendments predates the country`s 2013 constitution, hence need to be realigned with the new constitution to cater for developments and expectations in the socio-economic sector. The existence of fragmented laws regulating protected area management is also a major setback in the management and development of protected areas where there may be conflicting provisions in the various legislative instruments being used in the management of a single protected area. For instance, the management of heritage sites in parks and wildlife estates by the National Museums and Monuments department overlaps or competes with the operations of a given protected area. There is need for provision of mechanisms that harmonises the various legislative instruments that regulates to biodiversity conservation such as the Parks and Wildlife Act (Chapter 20:14), EMA Act, Forestry Act (Chapter 19:05) and the National Museums and Monuments Act (Chapter 25:11) to remove conflicts in protected area management in the country.

Conclusion and Recommendations

Based on the reviewed literature, it can be concluded that PA establishment and management in Zimbabwe has legal foundations based on early colonial regimes that were centred on a protectionist approach where local people were alienated from PA management. The exclusion of local communities in natural resource management continues to threaten biodiversity conservation in the country due to lack of incentives for communities to effectively manage, conserve and benefit from biodiversity outside protected areas in the country. Several threats to protected area management and biodiversity conservation in the country are human induced.

This Chapter recommends the harmonization of various legislative mechanisms regulating PA management in the country to create a platform for unidirectional operation and implementation of conservation strategies without conflict of interests among conservation groups. The devolution of PA management and biodiversity conservation rights which is hinged at government level

(RDC) to local communities is also recommended to provide sense entitlement and mechanisms for direct benefits incentives for biodiversity conservation. For effective management of protected areas, streams for revenue generation should be increased including onsite revenue generation and retention to allow management to address specific needs and challenges.

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Chapter 3

Climate change and biodiversity policy: a review of legal and institutional frameworks in Zimbabwe

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Abstract

This Chapter aims to explore the extent to which legal and institutional frameworks for biodiversity management in Zimbabwe mainstream climate change adaptation and mitigation issues. This Chapter focused on mainstreaming of biodiversity and wildlife issues in international and regional climate change policies and how it cascades to the national level in Zimbabwe. A desk top research approach was adopted. Primary literature focusing on legal and policy issues on biodiversity/ wildlife and climate change in Zimbabwe was systematically reviewed. Findings from the review reveal that key international biodiversity related policy instruments such as the United Nations Convection on Biological Diversity (UNCBD) address the climate change agenda. International institutions, which inform local wildlife management plans, are more advanced in mainstreaming biodiversity/ wildlife in the context of climate change than the case at the local level. In Zimbabwe, key biodiversity policy instruments that were developed prior to 2010, particularly the Wildlife Policy and the Parks and Wildlife Act do not address climate change issues. However, the National Constitution, the National Climate Change Response Strategy (NCCRS) as well as the Zimbabwe's National Biodiversity Strategy and Action Plan (NBSAP) 2013-2020 contain sections related to biodiversity and climate change. In conclusion, there are opportunities for mainstreaming climate change issues in biodiversity frameworks and institutional structures in Zimbabwe. Although the government via the responsible ministry has put in place an overarching climate change policy and strategy, there is need to strengthen climate change action in the biodiversity/wildlife sector particularly adaptation and mitigation. Future studies should focus on the contribution of local policies, projects and programmes aimed at promoting climate change adaptation and mitigation in the wildlife sector.

Keywords*: adaptation, disaster, institutions, mitigation, wildlife*

Introduction

Climate change presents challenges to both human and the natural systems through accelerated changes that present perturbations to these systems. Staudinger *et al.* (2013) noted that ecosystems, and the biodiversity and services they support, are inherently dependent on climate. During the twentieth century, scholars have documented several climate change impacts on biodiversity and related ecological systems, and impacts are expected to increase as climate change persists (Staudinger *et al.,* 2013). The scale and intensity of climate change perturbations makes it one of the greatest challenges confronting humanity and environmental systems, which are relied on for adaptation (Ikeme, 2003, Agrawal et al., 2008). To combat climate change and address its impacts on human and natural systems, several cross-scalar players have been engaged from the global to the village level. These players have been engaged over-time, hence the shifting discourses that mirror changing policy and laws. The dynamics in climate change discourses has shifted from the blame game, which was characterised by blaming human activities for climate change. Scientific discourses shifted to focus on vulnerability of human and ecological systems.

Today literature on climate change grapples with the discourses of coping and adaptation of both human and natural systems (Ikeme, 2003). Thus, climate change is one of the biggest challenges and threats that humanity has ever faced and threatens an already changing biodiversity (Loreau *et al.,* 2006). We assume a dialectical relationship between humans and biodiversity in the context of climate change induced changes and varying levels of vulnerability and resilience to these changes. Thus, considerations of climate change impacts on humans and the natural biodiversity, and climate change vulnerable human communities are important for biodiversity conservation (Loreau *et al.,* 2006). Due to the shifts in discourses, climate change and its effects has been conceptualised differently by organisations and scientists over time. The United Nations Framework Convention on Climate Change (UNFCCC, 1992:3) defines climate change as:

> *"a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods"*.

This definition slightly differs from the definition of the Intergovernmental Panel on Climate Change (IPCC, 1998), which refers to climate change as a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. The IPCC's definition therefore refers to any change in climate over time, irrespective of the causes –whether due to natural variability or anthropogenic causes.

Global Climate Models (GCM) indicate that most of Southern Africa, including Zimbabwe, is likely to experience higher temperatures (2-4^{0}C higher than the 1961-1990 baseline) in the coming decades but the picture for rainfall is less clear (Brown et al, 2013). While average annual rainfall appears to have changed little over the last 50 years, droughts and floods have become more frequent and severe and the onset of the rains less dependable (Claire, 2011). Meteorological records demonstrate that Zimbabwe is already experiencing climate changes - as more variable rainfall, and more frequent and intense extreme weather events (including droughts, floods, and tropical storms) (Brown et al., 2013). These shifts in climate variables such as rainfall, temperature,

wind speeds, transpiration rates and extreme weather conditions pose serious threats to biodiversity. Studies that exist on the effects of climate change on wildlife show a mixed picture as some wildlife might thrive and other might be threatened by extinction (Hobbs, 2000). Without going into the details of these two arguments, climate change exacerbates changes in biodiversity through; extinctions, changes in species' ranges, mismatches in their phenology (e.g., timing of pollination and flowering), and population declines (Sheikh et al., 2007; Roots et al., 2003). It should be noted however that with differences across biomes and species, it is difficult to generalize about the overall impacts of climate change on biodiversity, wildlife, and ecosystems (Sheikh et al., 2007). Figure 3.1 shows the interaction between climate change and other key drivers of biodiversity change.

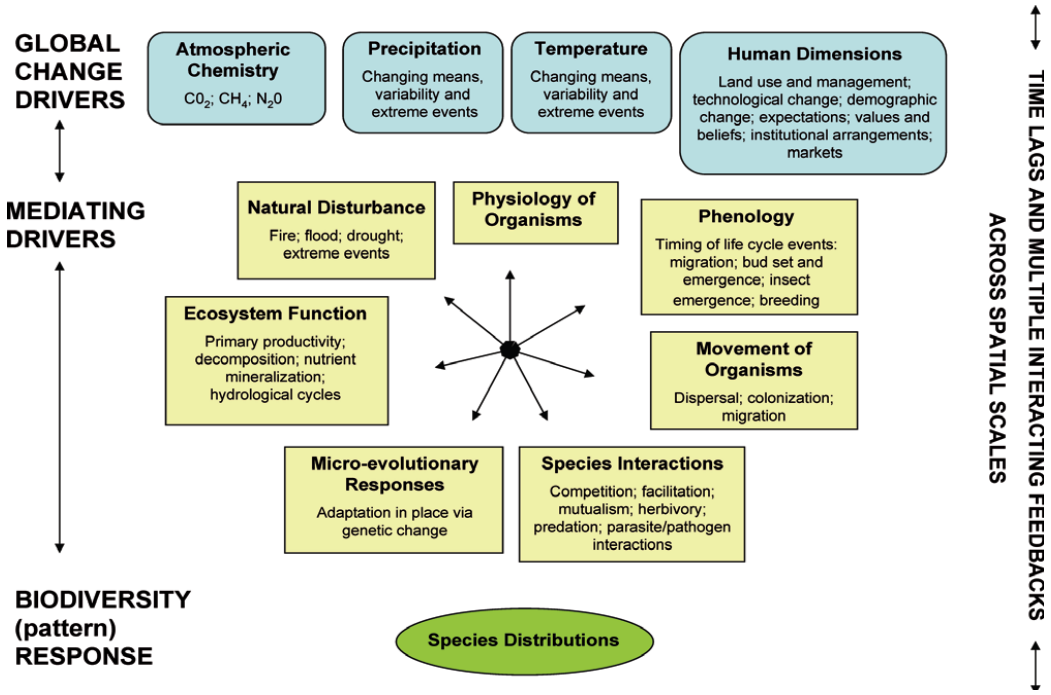

Fig. 3.1: Diagrammatic representation of some of the global change drivers, mediating drivers and biodiversity (pattern) responses in terrestrial ecosystems
Source: Hagerman & Chan (2009:2).

Due to the shared global space and the interlinking of human and environmental systems, climate change is a global concern. Anthropogenic factors are critical not only in as drivers of climate change (Fig. 3.1) but also in contributing towards responding to impacts. Climate change does not respect politically constructed boundaries. Thus, no single community or country can deal with it on its own. However, this is not to underplay the positive and negative contributions of countries to climate change. At the global scale international pacts, treaties and laws have been created to create a framework within which to reduce climate change and seldom assist in adaptation. These macro policy and legal instruments demonstrate the commitments to deal with the reduction of climate change effects. Many African countries, including Zimbabwe, are beginning to develop national frameworks for responding to climate change, intended to guide adaptation projects and programmes. Many of these support projects that help civil society participate in identifying adaptation priorities and defining adaptation actions, thus drawing on valuable local knowledge

(WWF, 2015). However, limited focus has been on the biodiversity related local adaptation strategies. International policy and legal instruments guide the national level policy making on climate change. To date, the climate change agenda is no longer confined to scientists, but it is now a developmental issue at the global and national scale.

This study focused on the historical developments on climate change policies and the extent to which the wildlife sector in Zimbabwe has mainstreamed the climate change agenda. The following questions were addressed: 1. What are the timelines for the evolution of international climate change events? 2. What are the historical developments in terms of incorporation of climate change agenda in Zimbabwean biodiversity/wildlife policies? 3. To what extent do Zimbabwean biodiversity/wildlife related institutions and policies mainstream climate change adaptation and mitigation?

Materials and methods

Research approach

We approached this review from a historical perspective (Gandiwa et al., 2014) to allow for the tracking and evaluation of legal and institutional frameworks for climate change and biodiversity governance. The historical perspective allowed us to trace the developments in the evolution of international climate change policy how this cascade into the Zimbabwean scenario. The Chapter aims to assess the extent to which Zimbabwe incorporates the climate change agenda in biodiversity related policies.

Data collection and analysis

Data collection for this Chapter adopted a desk top approach. The data collection is mainly literature based focusing on several biodiversity/ wildlife as well as climate change related legal and policy documents that have been developed at international and local scale (Zimbabwe). Local policies considered both those from the pre-independence and post-independence regimes. Policy documents were retrieved based on their availability on the internet and from the local government publishing house. The retrieved and examined legal and policy documents are presented in Table 3.1. Key words such as “biodiversity” and ‘wildlife” were searched in the available documents. In this review, we did not carry out a detailed analysis of policies. The authors also conducted a detailed scan of the retrieved Zimbabwean policies to assess whether biodiversity/wildlife related legislation mainstream climate change. A keyword word and phrase search were applied with the following words and/or phrases related to climate change in the policy and legislative documents: “climate change “, “adaptation”, “mitigation”, “global warming” and “greenhouse gas emissions”. National climate policy documents were also scanned for the following key words; “biodiversity”, “wildlife”, “flora”, “fauna” or “forests”. We also searched information on climate change and biodiversity governance extracted from official biodiversity related websites, scholarly peer reviewed journal articles, books, edited book chapters, and technical reports. The major aim was to do an institutional and policy audit to identify sections in biodiversity/wildlife policy documents as well as legislative instruments addressing climate change. Data were qualitatively analysed and presented along major themes related to legal and institutional frameworks for climate change and biodiversity management.

Findings

The trajectory of the climate change agenda and policy

From as 1979 to date, climate change issues have been dealt with at a global level, notably through the United Nations Frameworks Convention on Climate Change (UNFCCC). Numerous decisions have been made on combating climate change by reduction in emissions to promote of resilience amongst both natural and human systems. The Convention has changed hands from the Intergovernmental Negotiating Committee (INC) to the Conference of the Parties (CoP). The climate change agenda and policy has had long trajectory from the 1970s to date (Table 3.1). The scientific communities were the first to raise international alarm on the impacts of climate change.

Table 3.1: Timelines for key events in the evolution of international climate change policy

Year	Developments/ events on climate change
1979	The first World Climate Conference (WCC) takes place.
1988	The Intergovernmental Panel on Climate Change (IPCC) is set up
1990	IPCC's first assessment report released. IPCC and second World Climate Conference call for a global treaty on climate change. United Nations General Assembly negotiations on a framework convention begin.
1991	First meeting of the Intergovernmental Negotiating Committee (INC) takes place.
1992	The INC adopts UNFCCC text. At the Earth Summit in Rio de Janeiro, the UNFCCC is opened for signature along with its sister Rio Conventions, UNCBD and UNCCD.
1994	Establishment and enacting of UNFCCC
1995	The first Conference of the Parties (CoP 1) takes place in Berlin
1996	The UNFCCC Secretariat is set up to support action under the Convention
1997	Kyoto Protocol formally adopted in December at CoP3
2001	Release of IPCC's Third Assessment Report. Bonn Agreements adopted, based on the Buenos Aires Plan of Action of 1998. Marrakesh accords adopted at CoP7, detailing rules for implementation of Kyoto Protocol, setting up new funding and planning instruments for adaptation, and establishing a technology transfer framework. Establishment of an Ad Hoc Technical Export Group (AHTEG) by the Scientific, Technical and Technological Advice to assess interlink ages between biodiversity and climate change.
2005	Entry into force of the Kyoto Protocol. The first Meeting of the Parties to the Kyoto Protocol (MOP 1) takes place in Montreal. In accordance with Kyoto Protocol (KP) requirements, Parties launched negotiations on the next phase of the KP under the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto protocol. What was to become the Nairobi Work Programme on Adaptation (it would receive its name in 2006, one year later) is accepted and agreed on
2007	IPCC's Fourth Assessment Report released. Climate science entered popular consciousness. At CoP13, Parties agreed on the Bali Road Map, which charted the way towards a post-2012 outcome in two work streams: the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP), and another under the Convention, known as the Ad Hoc Working Group on Long Term Cooperative Action Under the Convention
2009	Copenhagen Accord drafted at CoP15 in Copenhagen. This was taken note of by the CoP. Countries later submitted emissions reductions pledges or mitigation action pledges, all non-binding.
2010	Cancun Agreements drafted and largely accepted by the CoP, at CoP16.
2011	The Durban Platform for Enhanced Action drafted and accepted by the CoP, at CoP17
2012	Doha Climate Conference Opens Gateway to Greater Ambition and Action on Climate Change Sun, Dec 9, 2012 At the end of the Doha Climate Conference, countries have successfully launched a new commitment period under the Kyoto Protocol, agreed a firm timetable to adopt a universal climate

	agreement by 2015 and agreed a path to raise necessary ambition to respond to climate change. The Doha Amendment to the Kyoto Protocol is adopted by the CMP at CoP18
2013	CoP 19 CoP19/CMP9 United Nations Climate Change Conference - Warsaw, November 2013
2014	CoP 20 Lima, Peru, 1 - 12 December, 2014
	The 5th IPCC Assessment Report (AR5) published in 2014.
2015	CoP 21, Paris 30 November- 13 December 2015. Countries required to propose intended determined contributions, that is legally binding statements of the amounts of greenhouse gases that a country proposes to emit from various sectors of their economy.
2016	CoP 22, Bab Ighli, Marrakech, Morocco from 7-18 November 2016 Climate Change Conference.
2017	CoP 23, 6-17 November in Bonn, Germany
2018	CoP 24, Katowice from 2 to 15 December 2018
2019	CoP 25/CMP 15/ CMA 2 will take place from 2-13 December 2019.

Adapted from United Nations (2019).

In 1979, the first World Climate Conference (WCC) took place in Geneva and declared climate change as a serious problem that required the attention of all governments (UNFCCC, 1997). Scientific data on the climatic conditions was presented and it was realised that climate change was a challenge to the natural environment. The WCC issued a declaration calling on the worlds governments to foresee and prevent man made changes in climate that might be adverse to the wellbeing of humanity. The preventative issues of climate change were the *loci* of the convention. The impacts of climate change on biodiversity were assumed to be manageable and self-regulate when the climate change has stabilised. At this stage the parties to the convention appreciated the lack of knowledge on climate change at the time. The conference triggered the desire to gather more evidence on climate change and its impacts.

Several intergovernmental climate change conferences were done from the 1982 to early 1990s. During the mid to late 1980s, an emerging body of scientific evidence demonstrated that man-made global warming was indeed happening, with severe consequences for current climate patterns predicted (UN, 2016). In this context the United Nations Environment Programme (UNEP) and the World Meteorological Organisation (WMO) set up an Intergovernmental Panel on Climate Change (IPCC) in 1988 to synthesise the scientific evidence for (or against) human induced climate change (Table 3.1). To this end, the 1st IPCC Assessment Report (1990) presented convincing scientific evidence that climate change was a reality with potential detrimental effects on biodiversity and humanity. Although at this stage the full extent of the impacts on natural and human systems was still limited, the evidence demonstrated rapid changes in temperature and water levels would be disastrous for biotic and abiotic systems. To this end, climate change has been acknowledged as "one of the greatest challenges of our time" by the United Nations (UNEP, 2012).

The Intergovernmental Negotiating Committee (INC) was instituted in 1991(UNEP, 2012). The key function of the INC was to handle the preparatory work to the Convention. One of their achievements was to prepare for the convention through discussions of matters relating to commitments, arrangements for the financial mechanism, technical and financial support to developing countries and procedural and institutional matters (UNEP, 2012).

The first IPCC report created a platform for international negotiations on climate change by governments, scientists, environmentalists and others. The IPCC report became the launch pad for

the next stage in climate change conventions, which was the Earth Summit in Rio held in 1992 in Rio de Janeiro. A total of 154 states signed the Rio de Janeiro Declaration, Agenda 21 and the Convention on Biological Diversity and Forest Principles (CBD, 2015). The Stockholm Declaration of 1972, elevated biodiversity concerns to the international forum and raised the connectivity and the inter-reliance of ecosystems across international spaces. The Earth Summit in Rio de Janeiro became the next most important convention signed on biodiversity and environmental conservation. The Rio de Janeiro drew attention to the threats on biodiversity resulting from the changing climatic conditions and anthropogenic pressures. Other international agreements that mushroomed from the Earth Summit include the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC is the key convention governing the global efforts to combat climate change. The convention was launched in when, developed and developing countries convened to cooperatively consider what they could do to limit average global temperature increases and the resulting climate change, and to cope with whatever impacts were, by then, inevitable. The ultimate objective of the UNFCC was the stabilising of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system (UNFCCC, 2015). Such a level should be reached within a timeframe enough to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and enable economic development to proceed in a sustainable manner.

The desire to bring into equilibrium the emissions and the ability of biodiversity natural change either to neutralise or to allow natural evolution of wild animals and human societies deserves credit. It created a foundation for other convention structures that superseded the INC that instituted the UNFCC. The principle of stabilising better still reduction in greenhouse gases emission was valued and recommended to other structures as indicated in article 2. Article 2 of the UNFCCC (1992:9) states that the:

> *"Major objective of the convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate systems"*

The Intergovernmental Negotiating Committee (INC) was dissolved after its 11th and final session in February 1995, and the Conference of the Parties (CoP) became the Convention's ultimate authority (UNEP, 2015). The CoP's role is to promote and review the implementation of the convention. Thus, CoP was to periodically review existing commitments, new scientific findings and the national climate change programmes. Using this information, the CoP can affect and adopt new commitments from the international governments that have rectified the convention. The Conference of the Parties held its first session in Berlin from 28 March to 7 April 1995 (UNEP, 2015). The CoP-1 achieved two things; firstly, it was acknowledged that the convention for developed countries were inadequate and CoP-1 launched the 'Berlin Mandate' talks on commitments and secondly, they reviewed the first round of national communications and dealt with institutional and financial machinery needed to carry out the activities that address the objectives of the convention. Important to note is that Zimbabwe is a signatory to the Convention. Thus, the country has an obligation to address the objectives of the UNFCCC.

By 1995, countries realized that emission reductions provisions in the Convention were inadequate. With this reality the CoP adopted new commitments to new emission levels for the developed countries. They launched negotiations to strengthen the global response to climate change, and, two years later, adopted the Kyoto Protocol of 1997 (UNEP, 2015). The Protocol stipulated those industrialised countries were to reduce their collective emissions of six greenhouse gases by 5.2% by 2008-2012, calculated as an average over these five years (UNEP, 2015). These reductions were to be achieved through clean development mechanisms, an emission trading regime, and a joint implementation. The negotiations efforts on the structure and the institutional issues in emission reduction started at CoP-3 in December 1997 and were finished in 2005 at CoP 8. In 2005, the Kyoto Protocol was completed and enacted to legally bind developed countries to emission reduction targets.

The Protocol's first commitment period started in 2008 and ended in 2012 (UNFCCC Secretariat, 2014). The second commitment period began on 1 January 2013 but was extended to 2020. At the international level, the United Nations Framework Convention on Climate Change (UNFCCC) of 1992 and the Kyoto Protocol of 1997 were adopted with the objective of reducing greenhouse gases that cause climate change. However, the problem at the international level is that there is no long-term, clear and universally agreed multilateral framework that charts a course for avoiding dangerous climate change activities as the current treaty expires in 2012. Major polluting countries like United States of America did not ratify the Kyoto Protocol. Environmental economists also question the Kyoto Protocol as they see the costs of the Protocol as outweighing the benefits while others believe that the standards which Kyoto set were too optimistic, highly inequitable and inefficient and can do little to curb greenhouse gas emissions. To date there are 195 Parties to the UNFCCC and 192 Parties to the Kyoto Protocol (UNFCCC Secretariat, 2014). During the 2009 and 2010 climate change negotiations, countries agreed to address the urgent need to reduce greenhouse gas emissions (UNFCCC Secretariat, 2016). In addition, industrialized countries committed to implementing "quantified *economy-wide emissions targets for 2020 in line with their leadership role*" (UNFCCC Secretariat, 2016). On the other hand, during CoP 13 (Bali Action Plan), developing countries agreed to develop "*Nationally Appropriate Mitigation Actions (NAMAs) in line with their national development objectives*" while aiming "*to reduce their emissions below business as usual by 2020*" (UNFCCC Secretariat, 2016). The NAMAs are achieved partially through reducing emissions from deforestation and forest degradation (REDD) (Zhakata, 2017).

Since the Paris agreement in 2015 (Table 3.1), two key international climate related governance frameworks have been launched namely: the Sustainable Development Goals/ Agenda 2020 and the Sendai Framework for Disaster Reduction (Zhakata, 2017). Some of the Sustainable Development Goals (SDGs) have since been domesticated in the African context as Agenda 2063: The Africa We Want which includes several aspirations and actions, including climate change (African Union Commission, 2015). Aspiration 1 focuses on "A prosperous Africa based on inclusive growth and sustainable development" of which section 17 notes that:

> *"Africa will participate in global efforts for climate change mitigation that support and broaden the policy space for sustainable development on the continent. Africa shall continue to speak with one voice and unity of purpose in advancing its position and interests on climate change" (African Union Commission, 2015:4).*

To date, the UNFCCC (2019) notes that the Paris Agreement sets the ambitious goal of limiting global warming to well below 2°C while pursuing efforts to limit the increase to 1.5°C. According to the Intergovernmental Panel on Climate Change, achieving the limit of warming to 1.5°C means respective parties will need to lower CO_2 emissions by about 45% by 2030 (compared to 2010 levels) (UNFCCC, 2019). Even limiting global warming to 2°C will require nothing less than transitioning to a carbon-neutral economy by the middle of this century – only several decades from now (UNFCCC, 2019). The Katowice package set out the essential procedures and mechanisms that will make the Paris Agreement operational (UNFCCC, 2018). The UN Climate Change Conference in Bonn (CoP23, 6–17 November 2017) was designed to increase climate action and more sustainable development at all levels of society including the biodiversity sector.

Biodiversity and the United Nations Framework on Convention on Climate Change

This section highlights the specific decisions made and adopted by CBD conference of parties that form part of the convention. It is inevitable that when one talks of climate change, they also refer to 'biodiversity' since the two systems relate and depend on the condition of the other. It is interesting to note that the UNFCCC and the CBD were all formulated during the 1992 Rio Conference and as such they developed in parallel context. However, it took 12 years for the CBD to incorporate climate change agenda in biodiversity management proceedings. At the early stages of the UNFCCC the impacts of climate change on biodiversity were limited to maritime changes. With more research in the 1990's IPCC demonstrated the impacts of climate change on tropical, temperate, and arctic regions (IPCC, 1990). The importance of biodiversity in the context of climate change cannot be ignored in contemporary Africa given that poor communities rely on the biosphere for survival. Since 2004, the Convention of Biological Diversity Conference of parties has made several decisions related to biodiversity and climate change. The Convention on Biological Diversity and the United Nations Framework Convention on Climate Change acknowledge that ecosystems play a key role in the global carbon cycle and in adapting to climate change therefore it is essential to conserve them.

Legal and institutional framework for climate change and biodiversity management in Zimbabwe

Institutional arrangements for climate change governance: historical perspectives

A Chinese proverb goes, 'when business is bad paint the shop'. When new perturbations (such as climate change) strike, unfortunately the response has been to create new institutional structures in order to deal with the new needs. The creation of a new shop in the place of the old one should be the last resort after repainting the shop. Thus, creating new structures should be the last resort after institutional engineering of existing ones to consider the new reality have failed. Institutions can either be a set of laws or organisations with the primary function of providing a framework for policy and legislation to be implemented. (Chagutah, 2010).

In Zimbabwe, the National Steering Committee on Climate Change (NSCCC) was established under the Office of the President and Cabinet to oversee all decisions on climate change policy (SARUA, 2014; Chagutah, 2010). The National Steering Committee on Climate Change was established in 1996 to assist the government in designing of climate change policies and coordination of specific climate change projects (Chagutah, 2010). The government established

the National Steering Committee on Climate Change (NSCCC) to institutionalise climate change issues in line with the Conventions decisions in areas such as biodiversity. The NSCCC has adopted a multi-sectoral approach and utilise existing departments. The office has been responsible for the coordination, administration, and preparation of Zimbabwe's Initial Communication to the UNFCCC (Chagutah, 2010). The office represents the country in all climate change matters at regional and international fora. To date, the National Climate Change Office, in conjunction with other government ministries, civil society organisations, academic institutions and the private sector developed a Climate Change Response Strategy.

Although the establishment of the National Steering Committee on Climate Change (NSCCC) represents the 'reconstruction of a shop' paradigm 'when business is bad', it has adopted a multi-sectoral approach in its operations. The NSCCC works with other established institutions like the Environmental Management Agency (EMA), the Zimbabwe Parks and Wildlife Management Authority (ZPWMA), Disaster Risk Management Department, the Meteorological Department, the Department of Civil Protection, the National Early Warning Unit, and the Zimbabwe Vulnerability Assessment Committee (SARUA, 2014). The ZPWMA has the mandate to mainstream climate change issues in the protected areas throughout the country. Research and training on climate change issues was mandated to the Environmental Management Agency as supported by the Environmental Management Act (2002).

In accordance with the "common but differentiated responsibilities" approach there is need for Zimbabwe to do its part and contribute to reducing global warming through adopting viable and comprehensive policy, legal, economic, and political reforms. This can be achieved if policy advocacy is informed by accurate and credible evidence and data to influence policy changes and positive incentives for reduction of emissions, promote public private sector funding and investment in technology. Zimbabwe submitted its intended determined contributions in September 2015, in line with the 2015 Paris Agreement. The intended determined contributions have since become the Nationally Determined Contributions (NDCs) and are legally binding under the Paris Agreement. The NDCs focus on mitigation (energy sector) and adaptation actions that enhance resilience in all sensitive socio-economic sectors such as agriculture and forestry. Several policies support this initiative e.g., the Biofuels Policy, National Climate Policy, Renewable Energy Policy and the Forestry Policy and transport Policy (Zhakata, 2017).

The Zimbabwean government is therefore committed to addressing climate change towards achieving Sustainable development Goals, including Climate Action (SGD 17), and achieving obligations under the Paris Agreement, especially the NDCs.

Mainstreaming climate change in biodiversity policies: Zimbabwe's position

In principle Zimbabwe's biodiversity policies and laws are supposed to conform to international and regional conventions/ agreements instruments that it has signed and rectified. This having been said, this section of the Chapter will interrogate the ground situation and assess progress of the country in mainstreaming issues of climate change and biodiversity. Zimbabwe is a signatory to several biodiversity treaties and on the other climate change treaties.

Zimbabwe is a signatory to the UNFCCC. The country also signed and ratified the UNFCCC in 1992 and the Kyoto Protocol 2009 (Brown et al., 2012). According to Stringer et al (2009), the

UNFCC requires least developed countries to undertake National Adaptation Programmes of Action (NAPAs) as policy frameworks dedicated to the identification and prioritisation of critically important adaptation activities. However, since Zimbabwe is not classified under least developed countries, it does not have a NAPA. Instead, the country has provided national communications to the UNFCC with regards to detailing activities that have been undertaken to implement climate change activities. The country submitted its first national communication on impacts and adaptation in the agriculture, forestry water resources, and human and health sectors in 1998 (Brown et al., 2012).

In 2009, Zimbabwe began to prepare and submitted its second national communication which included vulnerability and adaptation on ecosystems, human settlements, public health water resources and wildlife (Brown et al, 2012). The then Ministry of Environment and Natural Resources Management (MENRM) submitted the Second National Communication in 2013. The communication assessed vulnerability and adaptation capacity to climate change for key sectors in economy such as agriculture, biodiversity, rangelands, water resources, health and human settlements and tourism (Nachmany et al., 2016).

In 2013, Zimbabwe launched the draft National Climate Change Response Strategy (NCCRS, 2013) which provides a framework for a comprehensive and strategic approach on aspects of adaptation, mitigation, technology, financing, public education and awareness. The strategy further includes a National Action Plan for adaptation and mitigation (SARUA, 2014). SARUA (2014) reports that *"Zimbabwe's 2012–2015 Medium Term Plan (MTP) recognises that climate change poses a significant and complex challenge to social and economic development, calling for climate-smart policies and placing climate change concerns at the centre of development strategies, plans and programmes in all sectors of the economy''.* Let us hasten to point out that the wording of the above quotation promotes integration of climate change in socio-economic spheres, thus catering for human adaptation not biodiversity. One may argue that biodiversity is embedded in the development discourse. But given the wide-ranging impacts of climate change on the natural environment and the vagueness associated with the concept of 'development' biodiversity statutes and policies should streamline climate change as an entity (Kontinen and Seppänen, 2003).

The Biodiversity Project office coordinates all national biodiversity projects and conducts research on ways of sustainably managing our biological resources through financing from the Convention on Biological Diversity (CBD) (Ministry of Environment, Water and Climate, 2016). The MEWC administers several Acts some of which have a direct bearing on biodiversity management. To date, it is interesting to note that although the Zimbabwe Parks and Wildlife management Authority does not fall under the Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement, The Climate Change Management Department (CCMD) provides support towards climate proof for all socio-economic sectors (including the wildlife sector)of Zimbabwe through effective climate change management. A summary of the environmental laws and key policies is provided in Table 3.2. Findings from the word search indicate that the wildlife related national legal instruments presented in Table 3.2 do not directly address climate change adaptation and mitigation. However, the policies and laws have a stake in the management of the natural environment specifically wildlife resources.

Table 3.2: Summary of climate change adaptation and mitigation provisions in key biodiversity related legal and institutional frameworks, Zimbabwe

Policy/Act	Year	Provisions on climate change
Parks and Wildlife Act (Chapter 20:14)	1996, amended 2001	Nil
Policy for Wildlife Zimbabwe	1999	Nil
Wildlife Based Land Reform Policy	2006	Nil
Forest Based Land Reform Policy	2004	Nil
National Museums and Monuments Act (Chapter 25:11) 2001	2001	Nil
Forest Act (Chapter 19:05)	2002	Control and management of state forests. It also provides for the setting aside of state forests, protection of private forests, trees and forest produce, control of tree cutting for mining purposes, conservation of timber resources and the compulsory afforestation of private land
Communal Land Act (Chapter 20:04) 1982	1982	Nil
Communal Land Forest Produce Act (Chapter 19:04)	1987	Nil
Rural District Act (Chapter 29:13)	1998	Nil
Environmental Management Act (Chapter 20:27)	2002	
National Environmental Policy and Strategies	2009	
Constitution of Zimbabwe	2013	Nil
National Climate Change Response Strategy	2015	Yes
National Biodiversity Strategy Action Plans	2013-2020	Yes
Zimbabwe Climate Policy	2016	Yes

Source: Authors

Zimbabwe's response: The National Biodiversity Strategy and Action Plans

In line with the CBD requirements, to date, Zimbabwe developed NBSAPs in 1998 and 2013 respectively. The 1998 NBSAP does not mainstream climate change issues. However, the current NBSAP (2013-2020) recognises climate change as one of the threats to the integrity of the protected area network and its capacity to sustain revenue generation. The Strategy is designed to provide a road map for all stakeholders involved in conserving biodiversity. According to the IPCC (2007), projections from general circulation models show that Zimbabwe will warm up by 2-4 °C by 2050 whilst rainfall will decline by 18% (NBSAP, 1998). Eco-region which are facing threats from climate change include: the Kalahari *Acacia*/*Baikiaea* woodland, *Zambeziana Baikiaea* woodland, and the Zambezian & mopane woodland (NBSAP, 2013). The NBSAP recognizes climate change as one of the major threats to biodiversity (NBSAP) some of the observed impacts

of climate change, underlying causes and results are highlighted in the Box 1. The wildlife sector is therefore one of the most vulnerable sectors to climate change.

Part 3.2 of the NBSAP (2013) highlights the need for the biodiversity sector to adopt ecosystem-based adaptation strategies towards climate change. The NBSAP also emphasize the need to respond to climate change through adaptation and mitigation. Some of the practices and projects related to mitigation and adaptation include agro-biodiversity, Reducing Emissions from Deforestation and Forest Degradation (REDD+) and the implementation of clean development mechanisms (NBSAP, 2013).

Box 1 Causes and impacts of climate change on biodiversity

Underlying causes

Mainly through changes in temperature and rainfall, increased floods and droughts resulting in changes in species composition, ranges, densities and growth rates; increased species migration; increased frequency and intensity of forest fires resulting in loss of vegetation cover and biodiversity; Increased reliance on natural resources (trees and forests) for livelihoods resulting in overexploitation; decreasing water availability and quality

Observed impacts

- Decline is plant diversity
- Alterations of forest & grassland ecosystems
- Changes in animal diversity especially long-lived species
- Phenological changes

Projected Impacts

Species extinction of already threatened species, increased vulnerability for species, with low productivity and population numbers, restricted and patchy habitats, and limited ecosystem ranges

Source: NBSAP (2008:36)

The NBSAP noted that some of the impacts will be exacerbated by other stressors such as land use changes**.** Although the country has made efforts to come up with the NBSAPs, to date all the legal and policy instruments (Table 3.2) which are directly linked to biodiversity and/ the wildlife sector do not mention/ address the climate change agenda.

Mainstreaming Biodiversity and wildlife management in the Zimbabwe Climate Policy

The recent Zimbabwe Climate Policy (2016) recognizes the need to incorporate adaptation and mitigation issues in the biodiversity conservation and the wildlife sector at large (Box 2). Actions which are highlighted in Box 2 compliment with the climate change challenges which are highlighted in Box 1 by providing technical and practical strategies for promoting climate change adaptation and mitigation in the wildlife sector.

Box 2: Forestry and Biodiversity Sector

Zimbabwe's forestry sector contributes 4.1% of the national gross domestic product (GDP) and over 4 million people depend on forestry resources for their livelihoods. The forestry sector also provides options for adaptation through non carbon benefits. Whilst tourism in Zimbabwe is one of the economy pillars it leverages on the forestry and biodiversity sectors. Thus, climate change and climate variability could have a profound effect on the tourism sector through impacts on forestry and biodiversity. Therefore, the Government shall:

3.32. Conserve and enhance forestry resources which act as both sinks and reservoirs of greenhouse gases.

3.33. Strengthen afforestation programmes that promote drought and heat tolerant tree species.

3.34. Strengthen research capacity in forest ecosystem resilience to facilitate adaptation efforts to climate change.

3.35. Establish permanent forest ecosystem monitoring plots to monitor possible signs of forest dieback to effectively plan afforestation programmes based on appropriate species.

3.36. Promote research to reduce the existing gaps in knowledge on forest ecosystems and climate change, as well as on forest threats such as fires.

3.37. Promote improved understanding of the role played by forests in supporting livelihoods through timber and non-timber products; and of the effects that climate change could have on those livelihoods.

3.38. Strengthen framework for Reducing Emission from Deforestation and Forest Degradation (REDD+) and other financing mechanisms.

3.39. Strengthen enforcement and other measures to reduce deforestation and forest degradation.

3.40. Support research to enhance understanding of climate change impacts on wildlife and adaptive management planning for key wildlife species.

3.41. Monitor and reduce the prevalence of invasive plant species.

3.42. Strengthen the use of Geographic Information Science (GIS) and Earth Observation Technologies in forest and biodiversity assessment.

Source: adopted from the Zimbabwe Climate Policy (2016:11-12)

Discussion

International policies on climate change and biodiversity are committed to mainstreaming climate change in biodiversity conservation and vice versa. Although the UNFCCC and the CBD were all formulated during the 1992 Rio Conference, it took 12 years for the CBD to incorporate climate change agenda in biodiversity management proceedings. At the early stages of the UNFCCC the impacts of climate change on biodiversity were limited to maritime changes but to date, evidence from IPCC reports indicate that all ecosystems and biomes are under scrutiny. To date, commitment shown by the statutes of the overarching international policy on biodiversity, i.e., the CBD are reflected in the Aichi Biodiversity Targets (2010-2030). According to the CBD secretariat (2015), each member state has a mandate to develop and adopt as a policy instrument an updated National Biodiversity Strategy Action Plan in line with the Aichi Biodiversity Target 17 (CBD Secretariat, 2015). The NBSAP or an equivalent instrument is mainstreamed into the planning and activities of all environmental sectors whose activities can have an impact (positive and negative) on biodiversity.

Zimbabwe has largely shown commitment to the CBD statutes through development of the NBSAP. However, it took long for the country to mainstream climate change in biodiversity sector. In addition, there is a disparity between policy and practice. The major challenge is implementation of strategies in the policy instruments which is hampered by lack of financial resources and other logistical factors. It goes without saying Zimbabwe has environmental laws most of which influence biodiversity/ wildlife management. Although the other key biodiversity related legal instruments do not directly address the issues of climate change, in principle they all have a stake in the management of the natural environment. The Communal Land Act, the National museums Act and the Rural District Act relate to biodiversity issues in a limited sense because they relate to natural resources property regimes. Furthermore, these legal institutions empower these authorities to exercise jurisdiction on behalf of the state amongst the commons. While, The Parks and Wildlife Act, Forest Act, Communal Land Forest Produce Act, the Environmental Management Act of 2002 have direct *de jure* regulations on natural resources management and environmental protection including biodiversity, unfortunately climate change considerations are not awarded special attention. Chapter 20 section 27 of the Environmental Management Act (2002) has provisions which are relevant to climate change. However, most sectoral legislation does not directly include the term “climate change” or any other closely related terms in their provisions. Such an approach is tantamount to covering a fire with a paper board and admiring the top surface of the board.

Although the legal framework on biodiversity does not directly engage with climate change discourses and issues, by default the Meteorological Services Act (1990); the Civil Protection (against disaster risks) Act (1989) deals with climate change. The meteorological Services Act directly deals with the collection and analysis of climatic data for use by other sectors and government. This data was mainly used to determine rainfall and temperature regimes that might have a bearing on agriculture primarily. However recently, environmental scientists are increasingly using the meteorological services data set in their various fields examples include Magadza (2010).The lack of climate change issues in the environmental laws demonstrates that climate change has been adopted at the researcher and lower levels and not as much at the legal level.

The Civil Protection Act does not specifically address climate change catastrophes. Climate related disasters such as floods and droughts are considered and dealt with as any other disaster under this Act. This ignores the fact that climate related catastrophes are different from all others in the sense that they recur and are becoming more frequent. The increase in intensity and frequency of climate related disasters requires systematic planning and response to enable adaptation of human and natural systems. Although Zimbabwe has administrative structures for climate change governance, the top-down approach does not allow for grassroots level participation in making decisions related to climate change adaptation and mitigation. Davis (2011) argues that addressing climate change issues requires new institutions and coordination mechanisms to ensure success of adaptation and mitigation strategies. Interestingly, recent policy instruments such as the Zimbabwe Agenda for Sustainable Socio-Economic Transformation (ZIMASSET) recognize the biodiversity sector as one of the tools towards achieving national economic goals.

We therefore advocate for the mainstreaming of climate change in biodiversity laws and policies because there is space and for a plethora of sectors to benefit from serious consideration of climate change. Conceptualisation and integration of climate change in all relevant sectors will enable preparedness and enhanced adaptation strategies to perturbations. The following sectoral policies are relevant to climate change issues in Zimbabwe: Agriculture, Land Reform, Wildlife Reform, Forestry, Drought Mitigation, National Disaster Management, Energy and Transport. The National Climate Response Strategy recognizes the role of the national Policy and programme on Drought Mitigation; the Draft Disaster Risk Management Policy and Strategy; the Science and, Technology and Innovation Policy, the Water Policy towards climate change action (Zhakata, 2017). At a policy and programming level the issue of climate change is quickly being taken up. This is evidenced by the recent incorporation of forestry and biodiversity sector in the recent Zimbabwe Climate Policy. The government is committed to several actions (Box 1) which promote adaptation and mitigation in the biodiversity and wildlife sector. This could be because of the huge amounts of funding being directed towards climate change mitigation and systems adaptation.

Conclusion

This Chapter presented a condensed chronology of the attempt by international and regional conventions to integrate and mainstream climate change in biodiversity policy. The chronology demonstrates the changes in conventions integration of climate change in biodiversity issues. Initially biodiversity was a victim of the changing climatic conditions, research advanced this understanding though understanding the impacts of changing conditions on the natural environment then to attempts to enhance resilience amongst the human and natural systems. The long holding principle is the focus on emission reduction to levels that allows natural systems recovery or adaptation to the new conditions either by evolution or migration.

Although the government has put in place an overarching policy and strategy to address climate change across all sectors of the environment, the country still has a way to go to mainstream climate change in biodiversity/ wildlife legal frameworks since the legal structure is silent on this matter. Zimbabwean wildlife policies (specifically the Parks and Wildlife Act of 1975) still confirm to the pre-colonial old generation biodiversity governance era such that they have not developed in line with the changing biodiversity threats. Although wildlife policies are relevant to the environment, they do not directly incorporate provisions on climate change adaptation. In the

formulation of policies and other measures against climate change in the country, adaptation should be integrated and articulated in those frameworks as the currently adequate approach.

The Chapter demonstrate that Zimbabwe has a lot of ground to be covered in mainstreaming climate change issues in the wildlife sector. Considering that the government has already launched the inaugural Zimbabwe Climate Policy (2016), there is need for the wildlife policies to be aligned with the climate policy to facilitate climate action in the wildlife sector. To this end, there is need to revisit and reformulate wildlife policies to incorporate prevailing global biodiversity threats. However, scientists, activists and sectoral policies are beginning to engage climate change impacts on biodiversity in their work. The other opportunity for mainstreaming climate change in biodiversity is the existence of a plethora of sectors or departments dealing with environmental issues in one way or the other. Although this can be an advantage, care should be taken to avoid institutional duplication and conflicts rendering the effort fruitless.

This Chapter makes the following recommendations for the effective mainstreaming of climate change in biodiversity conservation effectively creating a framework and institutional structure. Despite limited knowledge on the impacts, response and long-term adaptation of the natural systems to climate change, the worst-case scenario can be assumed and legal frameworks instituted in order to conserve biodiversity under changing conditions. The development of comprehensive biodiversity inventory and monitoring systems to determine biodiversity levels and changes, land use changes and biodiversity adaptation. More research is needed to understand the interface between poor rural communities and biodiversity in the context of climate change. Although the human and natural systems might appear unrelated, in fact they interact, and both are affected negatively by climate change. The Climate Change Management Department should create the legal and policy framework on climate change and biodiversity and work on the institutional settings such as implementing institutions and financing the action plans to achieve acceptable conservation levels in the context of climate change. The wildlife industry comprises both public and private operators. Thus, future studies should focus on the roles and responsibilities of both public and private stakeholders in climate change adaptation and mitigation.

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Chapter 4

Fisheries production and management in Zimbabwe: Status, challenges, and future

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Abstract

This Chapter sought to establish the status of the fishery sector in Zimbabwe, the nature and roles of institutions involved in its management, as well as evaluate its strengths, weaknesses, opportunities, and threats as a basis upon which improved strategies may be developed. Eighty–four respondents from eleven districts of the country, and five key informants participated in surveys to address these objectives. We also carried out intensive literature review. Our results showed that despite Zimbabwe being a landlocked country, its fishery sector has an important socio-economic role in food nutrition, employment creation, and as a source of revenue from fishing and eco-tourism. However, although aquaculture has been increasing since early 2000, generally there are declines in production due to lack of technical expertise, shortages of financial capital, ineffective institutions, overfishing and pollution among other factors. Using Lake Kariba as a case study we also showed that climate change adversely affects biotic interactions in aquatic ecosystems. We then suggest mainstreaming fisheries programmes into national development strategies and strengthening institutional coordination within government departments and across different ministries as some of the policy strategies aimed at enhancing the fisheries industry for sustainable livelihoods.

Keywords*: Aquaculture, capture fisheries, climate change, recreational fisheries, SWOT analysis*

Introduction

The socio-economic importance of the fisheries resource in Zimbabwe includes food nutrition and security, employment creation, diversification, and eco-tourism. Although Zimbabwe is a landlocked country, it has vibrant commercial and artisanal fisheries, and a developing aquaculture. Production and management strategies employed in these fisheries aim for sustainable exploitation that ensures conservation of the fish genetic resource. However, in recent years, fisheries development in Zimbabwe, as in the rest of the world has been declining due to various factors (IPCC, 2007; Mhlanga and Mhlanga, 2013; Al Mamun *et al*., 2016; Stanford *et al*., 2017). For instance, climate change and variability have been shown to reduce phytoplankton productivity and fish production (Alheit & Niquen, 2004; Atkinson *et al*., 2004; Barnard *et al*., 2004; Beardell and Raven, 2004; Hays *et al*., 2005; Taylor, 2008; Thompson *et al*., 2008; Ndebele-Murisa, 2011a, 2011b). Escalating human populations and improved technologies cause over-exploitation of the fishery resource (Berg *et al*., 1996). Public management and administration have also changed dramatically in recent decades, with adverse impacts on fisheries development (Muchapondwa and Stage, 2015; Stanford *et al*., 2017). Therefore, faced with a deteriorating fisheries industry, we assert that a review of the status, and production and management challenges is a basis upon which improved strategies may be developed.

Fisheries management in Zimbabwe falls under the same legislation as wildlife and other natural resources. The principal legislation act governing management is the Parks and Wildlife Act (Chapter 20:14 of 1996, as amended) (MENRM, 2010). This act is enforced through the Parks and Wildlife Management Authority of Zimbabwe (ZPWMA). There are also provisions on aquaculture development and trade of aquatic animals under the Livestock Development Policy of the Ministry of Agriculture, Mechanization and Irrigation Development (FAO, 2017). The Department of Research and Specialist Services (DR&SS), the Department of Livestock Production (DLPD) and Rural District Councils (RDCs) also have other various roles. Lake Chivero, Lake Mutirikwi and Lake Manyame are some of the large reservoirs in which commercial fish production occurs, commonly that of *Oreochromis macrochir* (Green-headed Tilapia)*, Tilapia rendalli* (Red-breasted Tilapia) and *Oreochromis mossambicus* (Mozambique Tilapia) (FAO, 2003a). Subsistence production occurs in the smaller dams, rivers and ponds. *Limnothrissa miodon* (kapenta) is the main species within the pelagic zone of Lake Kariba. Any efforts in improving sustainable fish production will also increase government and foreign exchange revenue, and consequently the livelihoods of both rural and urban people of Zimbabwe.

Although impacts of global warming on the productivity of fisheries in Zimbabwean lakes and dams have been widely studied and debated, they remain poorly understood (Magadza, 2011; Ndebele-Murisa *et al*., 2011a; Marshall, 2012a; 2012b; Mahere *et al*., 2014). In our opinion, we assert that more empirical evidence is vital to understand limnological ecosystems in relation to fisheries management. For instance, different lakes and dams are predicted to respond differently to global warming effects due to various factors like depth, size, geographical location and the effects of season. However, these responses have been indicated to be unpredictable (Mahere *et al.,* 2014). Under such a scenario, management of fisheries will need to be highly adaptable. We also suggest that the interaction of overfishing in in-land lakes and the impacts of global warming should be well investigated. Factors that limit participation and involvement of other relevant stakeholders, consequently leading to low production of artisanal fisheries on the dams, should

also be addressed (Mhlanga and Mhlanga, 2013). Thus, we assert that there is need for a shift in both policy and technological approaches towards more efficient and effective strategies.

In this Chapter, we establish the status of fisheries in Zimbabwe with regards to the different types of fisheries and aquatic resources, trade and markets. We also review the roles of organisations involved in fisheries management. Specifically, we highlight the role of the ZPWMA, and state fisheries management measures as stated in the Parks and Wildlife Act (MENRM, 2010). These are the measures currently being employed for fisheries management. To improve our understanding of the strengths, current and anticipated constraints, and future possibilities of the fishery industry, we carry out a Strength-Weakness-Opportunity-Threat (SWOT) analysis (Henricks, 1999; Houben *et al*., 1999). Thus, we explore and explain production and management factors affecting fisheries development. Lastly, we make recommendations on how to address these issues to improve future management for enhanced fisheries.

Materials and methods

Study area

This Chapter covered all five agro-ecological zones of Zimbabwe. Agro-ecological classification is also known as natural region (NR) classification, and it divides the country into five regions based on mean annual rainfall, soil quality and vegetation among other factors (Vincent & Thomas 1960; Mugandani *et al*., 2012).Specifically, the study was in selected wards of Chipinge, Marondera, Mazowe, Beatrice, Chegutu, Mt Darwin, Bikita, Mshagashe, Matopos, Beitbridge and Chivi (Fig. 4.1).Zimbabwe is a Southern African land locked country covering approximately 39 million hectares. It is bordered by Zambia in the north, South Africa in the south, Botswana in the southwest and Mozambique in the east and northeast. Zimbabwe lies between 15 and 22° South latitude and 26 and 34° East longitude.

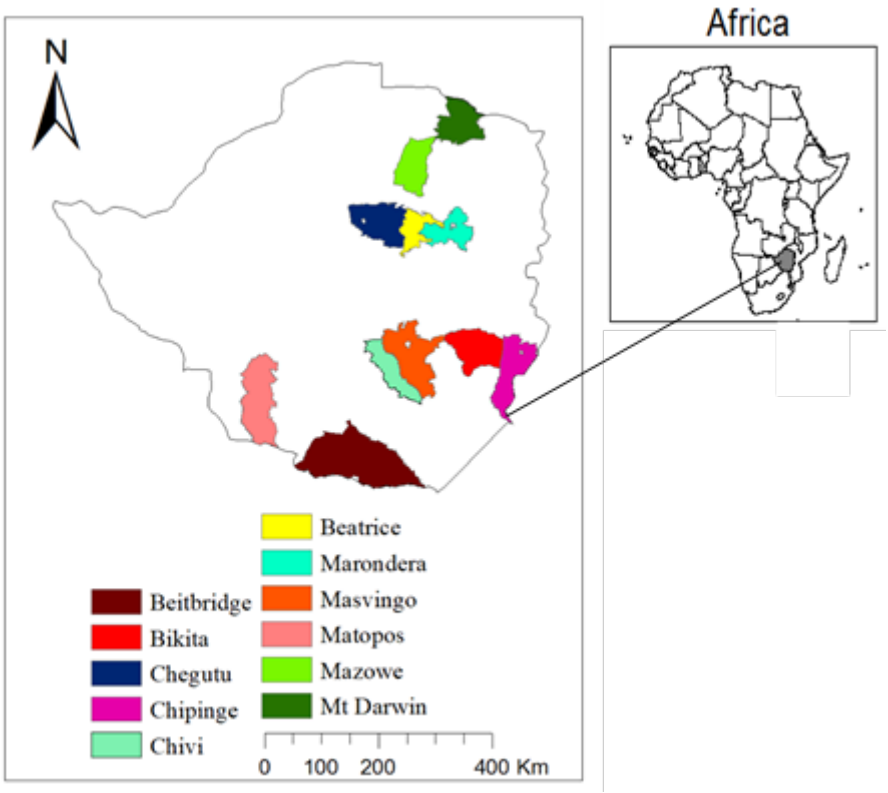

Fig. 4.1: Map of Zimbabwe showing areas of focus

Data collection

We interviewed five key informants from DR & SS, DLPD, and ZPWMA in 2016 on the status of fisheries in Zimbabwe, and management and development issues. Additional data was obtained from extensive literature review of scientific publications on reputable search engines such as Google Scholar and Science Direct. Other fisheries reports and documentations, especially on Lake Kariba as a case study were used. Within the areas selected for individual questionnaires, eighty-four respondents were randomly selected to participate in the surveys. The surveys were administered as qualitative and quantitative individual questionnaires divided into 3 sections: (1) socio-demography (2) prevailing aquaculture and other agricultural practices (3) production challenges and suggested solutions. A pre-test was done to evaluate the questionnaire and modify it accordingly.

Data Analysis

For data analysis we used IBM SPSS (2012). The status of fisheries in Zimbabwe was also analysed in terms of its strengths, weaknesses, opportunities, and threats (SWOT Analysis).

Results and Discussion

Status of fisheries in Zimbabwe

Aquatic resources

The fisheries sector in Zimbabwe is composed of capture fisheries, aquaculture and recreational fisheries. Zimbabwe is endowed with approximately 144 fish species, comprising 114 endemic and 30 exotic (FAO, 2007). Although the country is landlocked, it has a total water surface area of over 3 910 km^2in which capture fisheries, and or fish farming have been practiced over the years (FAO, 2017). This occurs in more than 12 000 dams that have been built in different areas for irrigation, electricity, mining, industrial production and livestock production. Table 4.1 shows the net storage capacity of the major dams in the seven water catchment areas of Zimbabwe.

Table 4.1: Catchment state of major dams in Zimbabwe

Catchment	Net capacity (10^6m^3)
Gwayi	80.7
Manyame	1281.4
Mazowe	248.6
Mzingwane	1082.9
Runde	2247.3
Sanyati	440.5
Save	771.8
Total	6153.2

Source: Zimbabwe National Water Authority (2009)

Per capita fish consumption in Zimbabwe was estimated at about 2.2 kg in 2010, with 4 000 and 44 000 people being employed in aquaculture and inland fisheries respectively (FAO, 2017).

Aquaculture and capture fisheries

Although there has been an increase in aquaculture since early 2000, generally capture fisheries have been on the decline (Fig. 4.2).

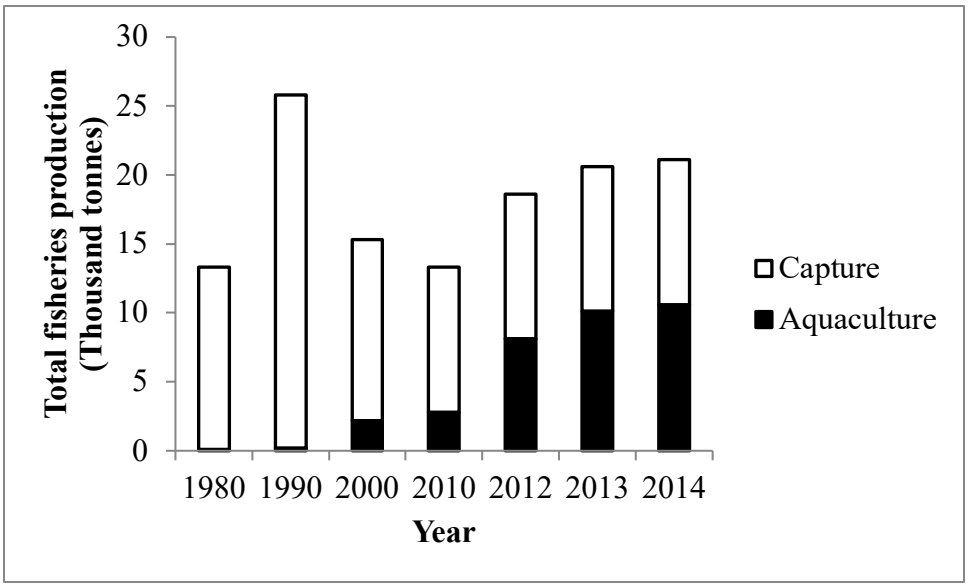

Fig. 4.2: Total fisheries production in Zimbabwe

The pelagic, semi-industrial (offshore) and artisanal (inshore) fisheries are mainly supported by the oligotrophic Lake Kariba (FAO, 2017). The highly reproductive clupeid sardine kapenta is the main species exploited within the pelagic zone. It reaches yields of up to 60 kg per hectare, spawning two times per annum and developing from egg to adult in 5-6 months. The kapenta accounts for more than 90%of the lake's total fish production. The relative importance in the total catch (expressed as index of relative importance) of Nile tilapia (*Oreochromis niloticus*) is 48% among the cichlids in Lake Kariba, while its proportion in the total catch is 37.1% (FAO, 2017). Average quantities of other by-catches such as Tiger fish (*Hydrocynus vittatus*), Squeaker (*Synodontis zambenzensis*), *Barbus marequensis*, Bottle fish, Cornish fish, Mudsuckers, Burble fish and recently, Red-claw crayfish (*Cherax quadricarinatus*) are 1-2 kg per rig per fished night (FAO, 2017). Additional species found in other water bodies such as Lake Chivero, Lake Mutirikwi, Lake Manyame and Mazvikadei Dam include cichlids (*Oreochromis mortimeri,* Nile Tilapia*, Oreochromis macroghir, Sargochromis codringtonii,* Red-breasted Tilapia, cyprinids Hunyani labeo (*Labeo altivelis*) and *Labeo congoro*), mormyridseastern bottlenose (*Mormyrus longirostris*) and cornish jack (*Mormyrops anguilloides*), and African catfish (*Clarias gariepinus*) - a clariid (FAO, 2017). Productivity in Lake Chivero is estimated at 250 kg h.-1 yr-1 with the Green-headed Tilapia and Nile Tilapia constituting more than 80% of the total catch, having a catch per unit effort of 1.03 and 2.76 respectively (Marshall, 2005 in FAO, 2017).

Commercial aquaculture is mainly based on the Nile Tilapia from floating cages in Lake Kariba, and rainbow trout (*Onchorynchus mykiss*) mostly from the Eastern Highlands (MENRM, 2010). There is also African catfish and Indian carp production, although at a much smaller scale. Table 4.2 summarises annual production and characteristics of the major lakes and dams of Zimbabwe.

Table 4.2. Annual production and characteristics of major lakes and dams

Name of Reservoir	Surface area	Length (m)	Depth (m)	Annual production (tonnes)
Lake Kariba	5 364 km^2	277	29	13 226 (3 400 from artisanal; 9826 from pelagic)
Lake Chivero	2 630 ha	-	9.4	160 – 412 (gillnets and seine nets)
Lake Mutirikwi	9 105 ha	-	57	14 – 20 (commercial fishery)
Lake Manyame	8 100 ha	-	23.6	100 – 400 (commercial fishery)
Mazvikadei Dam	2 300 ha	-	-	4 (commercial fishery)

Trade and markets

Generally, fish imports are higher than exports in Zimbabwe, and this creates trade deficits. The observed increase in exports since the early 1990s (Fig. 4.3), is due to production from Lake Harvest, a fish farm on Lake Kariba, and trout in the Eastern Highlands. On the other hand, imports have been decreasing since 2013. Fish exports and imports in 2014 amounted to US$ 15.3 and 27.9 million respectively (Fig. 4.3). Most of the imports consist of kapenta from Mozambique, canned pilchards and sardines from South Africa, canned tuna from Thailand, and horse mackerel and hake from Namibia, while the exports consisting of fresh, chilled and frozen fish are mainly from Lake Harvest to the SADC regional market (mostly Zambia) and, to a lesser extent, the European Union (FAO, 2017). On the local market, sun-dried kapenta is the most popular and affordable type of fish. Unsalted fresh kapenta may also be available in frozen state mainly in the urban centres. Apart from kapenta, other fish commonly sold as whole and frozen or fresh fish include the bream, which is often processed into frozen fillets that are readily available in butcheries, supermarkets, and some informal markets countrywide. Other fillet processing by-products, such as heads and belly flaps, are also easily affordable to low-end consumers (FAO, 2017). On the other hand, trout, which is less common, is thus more expensive than tilapia. It is available as frozen whole trout, trout fillets, smoked trout and trout pates (FAO, 2017). Crayfish is also sold fresh or processed into tails for urban and export markets. There is also a growing market for fingerlings and breeding stock due to the increase in fish farmers. In the livestock industry, fish meal is used to produce livestock feeds. For instance, kapenta is used as supplementary feed for crocodiles.

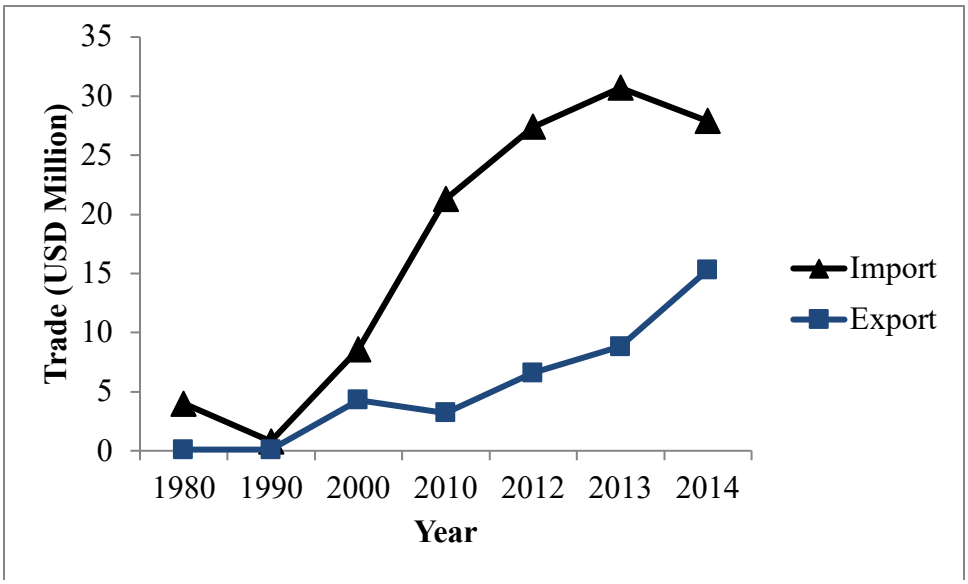

Fig. 4.3: Trend in fish imports and exports in Zimbabwe

Recreational fishery

Recreational fishing is the main sporting activity on large water bodies such as Lake Chivero and Lake Kariba, and on a few smaller dams too. For instance, recreational fishing for tiger fish is active in the Zambezi River and its tributaries, while for trout is common in Chimanimani Mountains and Nyanga National Park, and for large-mouth Bass is in dams such as Matopos, Mutirikwi and Manyuchi (FAO, 2017). Species on various other dams that have been converted to angling waters include Hunyani labeo, eastern bottlenose and cornish jack.

SWOT analysis of the fishery industry in Zimbabwe

An analysis of the strengths, weaknesses, opportunities, and threats (SWOT analysis) of the fisheries resource in Zimbabwe is summarised on Table 4.3.

Table 4.3: SWOT analysis of the fisheries industry in Zimbabwe

Strengths	More than 12 000 dams that have been built in different parts of Zimbabwe have a capacity to intensify both aquaculture and capture fisheries.
	There are approximately 132 fish types important in commercial and subsistence aquaculture, as well as for their esthetic value in the tourism industry.
	Zimbabwe has many fisheries training and research institutions for capacity building
	High technical expertise
	Good export market
Weaknesses	Lack of modern equipment for production and inadequate cooling chain, especially at marketing
	Heavy bureaucracy in government procedures
	Poor institutional capacity and ineffective law enforcement
	Insufficient production and management research
	Inefficient top-bottom approaches to management
	High turnover of technical manpower and expertise
	Inadequate infrastructure
	Poor fiscal support especially to small scale producers
	Incapacitation for value addition
	Inaccessibility of national fisheries information
	Lack of knowledge on production and marketing among the small-scale producers
Opportunities	Viable fisheries market locally and regionally
	Expanding global market
	Improvement in food nutrition and security
	Employment creation and source of income
	Economic development due to export market
	Increase in tourism opportunities
Threats	Mismanagement
	Overharvesting
	Increase in frequency of droughts due to climate change and variability
	Pollution from industrial waste and raw municipal discharges
	Aquatic invasive indigenous and alien species
	High price of fish compared to red meat and chicken
	Increase in rate of siltation

Roles of institutions in fisheries development in Zimbabwe

There are various major players in the fisheries industry in Zimbabwe. They include ZPWMA, DR&SS, DLPD and RDCs. Their roles are described on Table 4.4.

Table 4.4: Roles of institutions in fisheries development in Zimbabwe

Body	Role	Description
Zimbabwe Parks and Wildlife Management Authority (ZPWMA)	1. Fisheries development and production	The ZPWMA has responsibility for fisheries development in the whole country in state water bodies such as Lake Kariba, Lake Chivero, Lake Manyame and Lake Mutirikwi. The Parks and Wildlife Act (Chapter 20:14 of 2001, as amended) is the principal legislation and management act that governs the development, control, and management of fisheries throughout Zimbabwe.
	2. Fish research • Breeding • Nutrition • Health	The main mandate of the ZPWMA is fisheries research and management within the Parks Estate. There are fisheries research stations at Lake Kariba, Lake Chivero, Sebakwe, Mutirikwi, Nyanga and Matobo. Most of the research at these stations is on capture fisheries of the indigenous species. Aquaculture research is also conducted at Lake Chivero and Lake Mutirikwi. Nyanga Research Station is mainly involved in breeding trout for stocking in the dams within the Nyanga National Park and nearby rivers. In addition to breeding, fish nutrition and health research is also done specifically for trout production.
	3. Fish conservation	The ZPWMA is also responsible for fish conservation as covered in part XIV of the Zimbabwe Parks and Wildlife Act (Chapter 20:14 of 2001, as amended).
	4. Enforcement of regulations governing production and monitoring of aquatic resources outside the Parks Estate	Outside the Parks Estate, ZPWMA also enforces regulations that govern aquatic resources as well as monitoring of indigenous and exotic fish species. The fisheries management measures employed include control of fishing, granting of permission to fish, control of fishing methods, control of introduction to waters of fish and aquatic growth and importation of live fish and fish ova, control of fish and aquatic growth, control of business of catching and selling fish, control of fishing nets, registration as dealer in or manufacturer of fishing nets, authorization of fishing gear, offering of permits to carry on business of catching and selling fish, and dealing with possession of fish caught in contravention of the Parks and Wildlife Act. The ZPWMA is also responsible for licensing of commercial fishing operations.
Department of Research and Specialist	1. Fish research • Breeding • Nutrition • Health	DR&SS is mandated to carry out fisheries research. The institutes under the department that have this mandate are Henderson and Makoholi Research Institutes in Mazowe and Masvingo respectively. The Department`s

Services (DR&SS)		client driven research programme focuses on nutritional intervention for sustainable fish production, integration of fish production with other livestock and horticultural enterprises, physiological manipulation of fish for improved growth and production, breeding and provision of fry and fingerlings for stocking dams and ponds.
	2. Fish conservation	DR&SS is also mandated to conserve indigenous fish species.
	3. Training and capacity building	The Department works in conjunction with DLPD in training of fish farmers and other stakeholders as well as dissemination of research output.
Department of Livestock Production (DLPD)	1. Extension services	DLPD is mandated to carry out fisheries extension in small dams throughout Zimbabwe. The Department also trains fishermen on sustainable exploitation of fish from dams, and smallholder farmers on aquaculture. It recommends appropriate fishing gear including correct net sizes according to numbers of fish per given dam.
	2. Pond designing and construction	It also designs and constructs fishponds, as well as recommends suitable species for pond culture
	3. Monitoring and evaluation	DLPD carries out monitoring and evaluation exercises of fisheries projects.
	4. Dam stocking and restocking	The Department also carries out dam stocking and restocking, and dam surveys to determine fish populations, sizes and species composition.
	5. Fisheries development and production in small dams	DLPD works with RDCs that have appropriate authority status and assists communities to manage fisheries resources in small dams.
Rural District Councils	1. Management at local level	Rural District Councils have appropriate authority to manage fisheries in their areas of jurisdiction. When the ZPWMA issues fishing licenses, it does so in consultation with the relevant local authorities such as RDCs.

Production challenges in the small-scale fish farming sector

The socio-demographics of the respondents who participated in individual interviews are illustrated on Fig. 4.4.

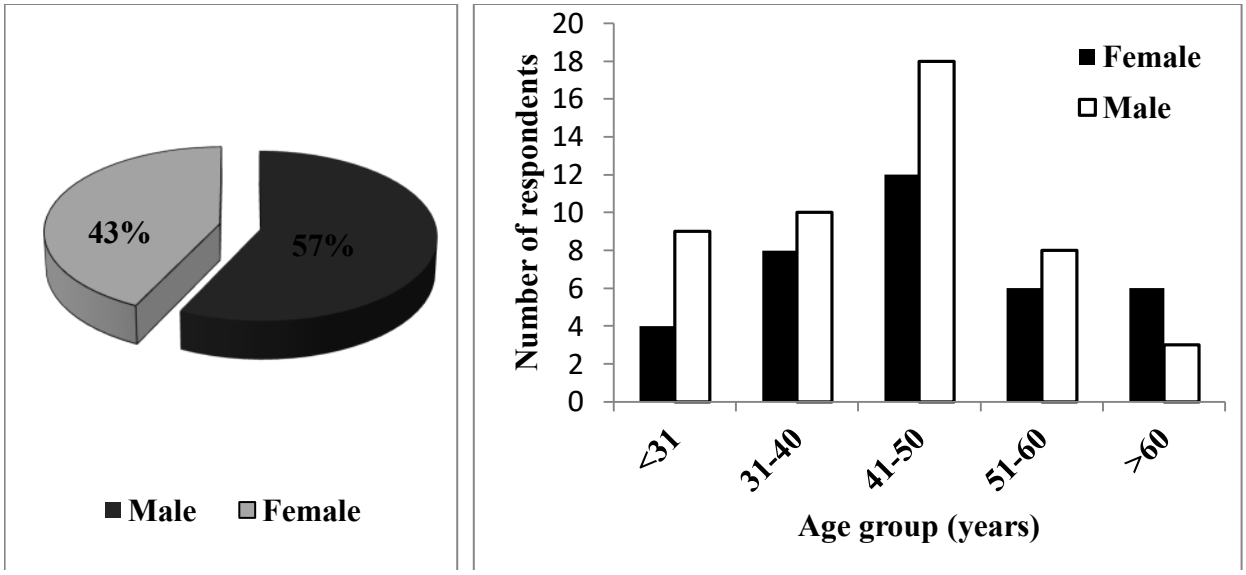

Fig. 4.4: Socio-demographics of respondents

Production constraints in the small-scale fish farming sector in the study areas (Fig. 4.5) were similar to challenges observed from interviews with key informants as well as from literature review (Table 4.5). The biggest was lack of technical expertise (78.6%; $n = 66$), followed by lack of breeding stock (73.8%; $n = 62$) then thirdly, lack of infrastructure (57.1%; $n = 48$). Only 35.7% ($n = 30$) of the respondents owned the land they were farming; hence it was not surprising that land shortage was one of the constraining factors. However, noting that 79.8% ($n = 67$) of the respondents were already into livestock production (cattle, small ruminants, pigs or poultry) means that integrating fish farming with other livestock enterprises is possible, and would address the constraint of supplementary feeding. 14.3% ($n = 12$) of the respondents had already received some training from the DR & SS, DLPD, non-governmental organisations and other farmers. Additionally, 95.2% ($n = 80$) of the respondents confirmed that they would take up fish farming if training was offered to them; while the remaining 4.8% ($n = 4$) were skeptical citing that lack of financial capital would probably be a hindrance.

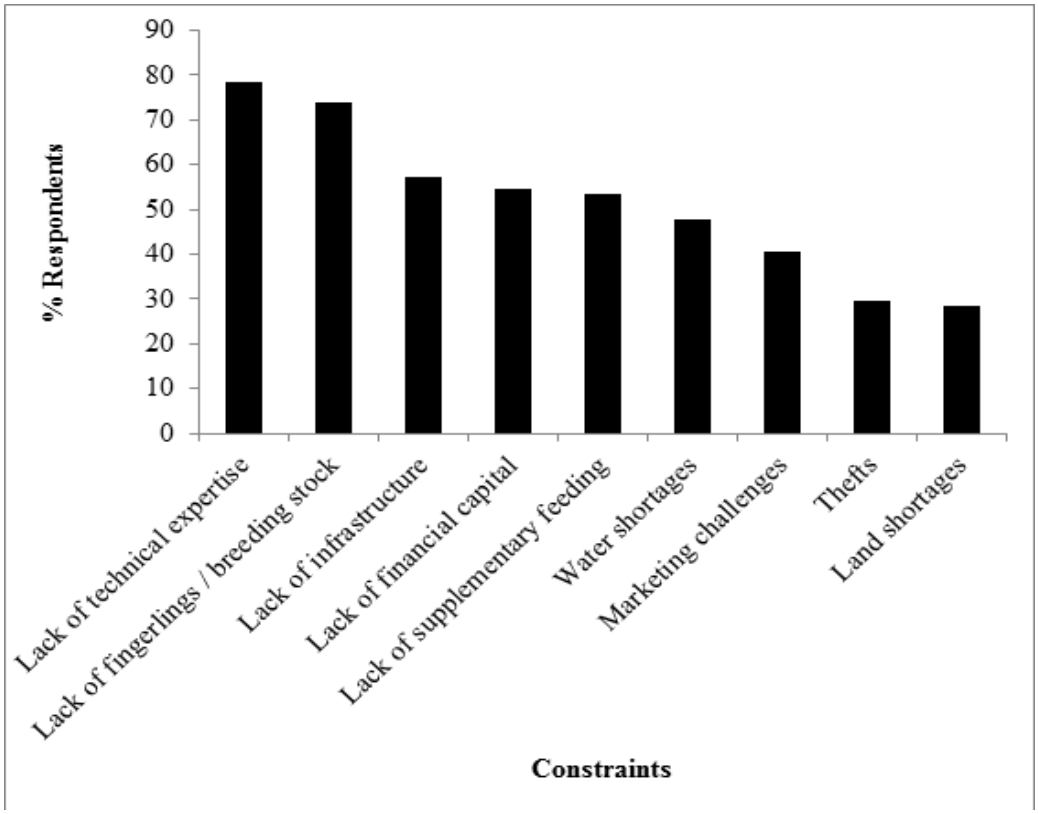

Fig. 4.5: Production constraints in the small-scale fish farming sector

Table 4.5: Recommendations to the production challenges in the fisheries industry

Challenge	Recommendation
Inadequate technical expertise Inadequacy in human capital can result in limited technical expertise in both production and management.	• Prioritize personnel involved with fisheries development in manpower development and capacity building programmes in workplaces. • Strengthen collaborations among all stakeholders to improve human capital and expertise • Equip extension staff for efficient and effective dissemination of research outputs. • Invest in training fish farmers
Lack of breeding stock and fingerlings Lack of breeding stock and fingerlings is one of the major constraints in production	• Subsidize cost of breeding stock at government institutions and research centers • Develop grow-out farms to capacitate farmers to breed, select, produce and supply breeding stock and fingerlings among themselves
Decline in government infrastructure Dilapidated government fisheries facilities affect fish research, and production. Additionally, limited use of modern and more efficient tools affects monitoring and evaluation programmes.	• Mainstream fisheries programmes into national development strategies and plans. • Increase efforts to source donor funding to subsidize government funds. • Encourage use of GIS, Remote Sensing and other tools of biodiversity conservation and management
Inadequate fiscal resources Inadequate financial support, especially to small scale fish fishing communities makes them fail to take care of the economic and ecological considerations in the fishery industry.	• Formulate policies that improve access by small-scale fish farmers and cooperatives to financial loans, sustainable technology, services and markets • Invest in training farmers in financial management and fish farming as a business
Lack of supplementary feeding Nutrition is one of the main factors that affect fish production	• Promote integrated fish farming especially among small scale farmers to produce home based feeds • Subsidize commercial feeds
Climate change Climate change is a reality in the 21st century. It is anticipated to influence biotic interactions in aquatic ecosystems (de Sanker & Magadza, 2001; Phoon *et al*., 2004; Komatsua *et al*., 2007; IPCC, 2007). As discussed for Lake Kariba below (Case	• Include fisheries in international strategies and frameworks that address climate change issues. • At national level, there is need to include fisheries in policies that deal with poverty

Study), the seasonal cycle of fish productivity in the lake demonstrates changes in the climate around Lake Kariba with an increase in temperatures in comparison to previous years.	to ensure food nutrition and security and adapt to climate change and variability. • Improve quality and timeliness in meteorological data availability to smallholders. • Support research and information dissemination of sustainable adaptive technologies and production systems in the light of climate change • Integrate scientific approaches with indigenous knowledge systems of fish production
Marketing Without proper markets, there is no incentive of taking up fish farming	• Develop policies that create an enabling environment and support international markets • Invest in institutions that offer technical expertise and capacity for processing, packaging and marketing of fish and fishery products • Enhance access to credit as an incentive to producers.
Insecure tenure Lack of secure tenure rights impedes sustainable intensification of production. It discourages investment in infrastructure such as ponds.	• Formulate relevant policies and laws to ensure land ownership and inheritance among both women and men

Effects of climate change on limnological ecosystems: Case of Lake Kariba

Fluctuations in temperature

There is a close relationship between climatic factors and fish production. Water levels influence catches, followed by temperature. The Annual Birgian Heat Budget values indicate an increase of almost 25% in the heat budget of Lake Kariba, and these have with ecological consequences (Ndebele-Murisa, 2011b). The IPCC has also projected temperature rises ranging from 1.4 to 5.8°C (IPCC, 2001) over the African continent whilst regional assessments for Southern Africa give a warming of 1.7 to 2.5°C by 2050 and 2 to 3°C by 2100 (Hulme *et al*., 2001; IPCC, 2001). More recent projections give estimates of 1 to 3.5°C by 2100 (IPCC, 2007). Hulme *et al*. (2001) show that areas over the Sahara and semi-arid parts of Southern Africa such as the Zambezi Valley, where Lake Kariba is located will warm up by as much as 2.5ºC by 2050 whilst the IPCC (IPCC, 2001) has shown how surface runoff will decrease in the Zambezi Basin. Temperature increases in the lake can also affect biotic communities such as phytoplankton (Magadza, 2008; Magadza, 2006; Ndebele-Murisa, 2011b), zooplankton and fish (Magadza, 2008). For instance, there has been a shift in phytoplankton species composition from Chlorophyta to Cyanophyta which are competitively superior at higher temperatures. Although total phytoplankton biomass may not necessarily be altered, the effects of this species shift are predicted to contribute towards a decrease in herbivorous zooplankton resulting in a decline in fisheries (Magadza, 2008).

Effect of thermal stratification on nutrient cycling

Temperature has a significant effect on nutrient cycling using the stratification cycle. Normally within lake ecosystems, the higher the temperatures, the more stable the stratification, and the more locked up nutrients are in the hypolimnion. This in turn, adversely impacts on phytoplankton production within the nutrient deprived epilimnion, thereby affecting trophic levels of zooplankton, kapenta and other fish (Ndebele-Murisa, 2011a). The symbiotic positive correlation connecting temperature and fish production is inevitable as enzyme-catalysed biochemical reactions positively amplify with increase in temperature according to the Q10 factor (Ndebele-Murisa, 2011b). Fish production peaks around September / October yearly, mainly due to effects of an overturn – when the lake would have undergone mixing, and during the latter months of the rainy season when strong winds and thundershowers tend to mix the lake (Ndebele-Murisa, 2011b). The increase in nutrients during these two periods has been documented as phosphorous increases: following overturn in winter, indicating the release of nutrients from the deeper waters and in the rainy season (Magadza, 2006).

Fluctuations in precipitation

Fish production largely depends on nutrient inflow from the river flow (Coche 1968; Coche, 1974). The nutrient levels within Lake Kariba are influenced by lake water levels, which in turn are influenced by rainfall (around Kariba and the catchment), and water inflow in addition to temperature (Marshall, 1988; Magadza, 2006). The decline in zooplankton and phytoplankton in Lake Kariba can be attributed to reduced nutrients, less mixing of the waters and warmed up waters. Consequently, when fewer nutrients enter the lake due to reduced river inflow and water levels, this cascades up the food chain to cause declines in the kapenta and other fish stocks which are largely zooplanktivorous (Masundire, 1991). The association between hydrological factors and fish parameters is a product of the link between rainfall, water inflow, water levels and nutrient fluxes in Lake Kariba (Coche 1968; Coche 1974). For instance, considering summer input of nutrients, biological production in the epilimnion increases, subsequently because of high quantities of nutrients introduced into Lake Kariba by the Zambezi and other inflowing rivers during the rainy season (November-April) (Marshall, 1992). The spatial distribution of fish is closely linked with areas of river inflow and the timing of the peaks in the phytoplankton biomass and zooplankton production, which coincides with the nutrient fluxes caused by river inflow, water levels and turnover. This trend in turn, is followed by peaks in fish production in the lake. However, due to the lake's high outflow rate of 50–65km^2 / year relative to its volume (160km^2), this implies that a significant amount of nutrients are lost each year thus affecting seasonality of phytoplankton production within the lake (Marshall, 1992).

Fluctuations in dissolved oxygen

The distribution pattern of dissolved oxygen throughout the year is closely related to temperature depth profiles. The dissolved oxygen fluctuations observed throughout the year can be attributed to the occurrence of turnover, and this has a negative implication on fish distribution (Ndebele-Murisa, 2011b). For instance, between April and June, mean dissolved oxygen concentrations along the water profile will be relatively low, and at depths of above 35 m, the waters will be virtually anaerobic. However, the dissolved oxygen concentration improves significantly even in the hypolimnion between July and September, facilitating the release of retained nutrients (Marshall, 1988). The nutrient release can be inferred from the higher densities of zooplankton

observed from July to August after turnover. The increased zooplankton densities influence fish abundance in the lake as relatively higher catches are observed from August.

Effect of reduced depths of light transparent epilimnion

Light availability and a variety of other factors such as grazing by zooplankton, water mixing regimes and basin morphometry influence the standing crop of phytoplankton (Gurung *et al*., 2006). As primary producers, phytoplankton is an important source of energy at the first trophic tier of the food web. Thus, a reduction in the depths of light transparent epilimnion, due to upward shifts in thermocline in response to elevated temperatures, could possibly have negative effects on primary production in Lake Kariba (Ndebele-Murisa, 2011b).

Management challenges of fisheries in Zimbabwe

In addition to the production challenges from interviews with key informants, we also established additional challenges pertaining to management of fisheries (Table 4.6). However, it is important to note that institutions and governance are central to the success of the fisheries industries as elaborated in Box 1.

Box 1: Significance of institutions and governance in fisheries management

Institutions are the (implicit or explicit) rules, norms, and strategies adopted by individuals operating within and across organizations (Ostrom,1999) while governance refers to 'processes of interaction and decision-making among the actors involved in a collective problem that led to the creation, reinforcement, or reproduction of social norms and institutions' (Hufty, 2011). Public management and administration have changed dramatically in many countries including Zimbabwe in recent decades (Muchapondwa & Stage, 2015). Traditionally, African wildlife conservation was carried out by state agencies in clearly demarcated state-owned protected areas. Wildlife elsewhere was nominally protected by legislation, which was, however, often poorly enforced, and the trade-offs and conflicts between wildlife and rural livelihoods were often ignored. This 'fortress' model of conservation became increasingly problematic as agricultural activity intensified outside the protected areas (Hulme & Murphree, 2001). To that effect, there has been an international shift from government to governance system of management involving a broader range of actors (NGOs, community organizations, private companies with an interest in the sector). Communities that have not traditionally worked with fisheries conservation now find themselves doing so. Ecological considerations require that, in addition to managing the water resources, communities now need to engage in proactive fisheries management to maintain sustainable fish stocks. Economic considerations require that communities now need to understand market demands and to supply fresh and dry fish, to achieve sustainable livelihoods from management and conservation. Thus, the modern approach adds extra responsibilities to community governance systems.

Picture: Courtesy of Henderson Research Institute, Mazowe, Zimbabwe.

Table 4.6. Challenges and recommendations in fisheries management

Challenge	Recommendation
Ineffective institutions Traditional authority represents the earliest and most resilient community-based natural resource management (CBNRM) (Mawere *et al.*, 2014). The colonial era shifted this arrangement of traditional management, which is a potential source of conflict in the present-day management. The role of traditional leaders is only on paper while the statutory boards (e.g., RDCs) are more involved with technical aspects of management.	• Governance is an important concept of fisheries management that is crucial in determination of how decision making and power can be shared among different components of a society, in terms of socio-economic and political arrangements. • A co-management approach with a more significant role in all aspects of fisheries management including resource monitoring, law enforcement, fisheries policy and strategy development and implementation is a viable option for artisanal fisheries. It allows sharing of the power and authority over the fishery resource among all relevant stakeholders. However, all types of co-management (instructive, consultative, informative, advisory, and cooperative) should be observed, learning from successes and failures in Malawi and other Southern African countries where co-management has been implemented (Njaya, 2007). • Decentralization allows transfer of some of the power and authority of a government to institutions at lower levels, hence representation of such institutions is attained in key decision-making processes. It is important to note that local leaders should be involved in the process of decision as they are a symbol of power and authority in their respective communities.
Poor institutional coordination The potential disunity between the structures involved in fisheries management is reducing effectiveness of fisheries management at local level (Mhlanga & Mhlanga, 2013). For instance, the ZPWMA focuses more on terrestrial than aquatic resources. Likewise, there is more research and focus on livestock enterprises such as beef, dairy and poultry compared to fish in government livestock research institutes. Additionally, stakeholders tend to push activities through those structures where they exert maximum influence. For instance, politically well-connected stakeholders push their agendas through	• Formulate ministerial and institutional management systems with clearly defined non-duplicative roles and responsibilities within the fisheries sector • Improve institutional coordination within government departments and across different ministries and parastatals by sharing information. • Equip government departments with necessary resources to fully execute their roles and responsibilities

political structures while those with influence in the traditional structures attempt to push their agendas there (Hasler, 1999).	
Overfishing As is the case in many inland fisheries, those of the Zambezi are economically overfished (Tweddle *et al*., 2015). Catch rates described as catch per unit effort (CPUE) are decreasing, fish communities are changing, and larger, more valuable, species are being replaced by smaller, much less valuable species (FAO, 1993). Fish productivity in the designated fishing areas is much lower than in the closed (non-fished) areas. As a result, impoverished rural fishing communities have become trapped in a cycle of declining individual catches resulting from increased effort, reduced mesh sizes and ultimately use of environmentally destructive active fishing gear like the seine nets. In Lake Kariba, fish is very popular and an important food item, but due to the increasing human population, the present fish catches may not be sufficient to satisfy the future demand (Berg *et al*., 1996).	• Strengthen national institutions to coordinate *in situ* and *ex situ* conservation programmes of fish genetic resources as overfishing can lead to extinction of some species. • Encourage small-scale intensification of fish farming • Support fishing cooperatives by equipping them with proper fishing equipment and other resources. • Regulate issuing of fishing licenses strictly, especially considering size of area and productivity levels • Improve monitoring and evaluation in lakes, dams and other water bodies • Improve access to fisheries information, especially to the public
Poaching Fish poaching is high across the country's lakes and reservoirs. In small areas such activities result in failure to regulate operations. Consequently, the breeding cycle will be disrupted, and breeding areas may also be disturbed leading to a decline in production.	• Strengthen inter-ministerial and inter-institutional relations to improve law enforcement. The anti-poaching unit of ZPWMA can be more operational working with the Zimbabwe Republic Police (ZRP) and the Zimbabwe Defence Forces (ZDF) for police and military support respectively to combat illegal, unregulated and unreported fishing. • Strengthen by-laws at lower authority levels, e.g., district level to be more legally binding to improve enforcement of rules and regulations governing fisheries management. • Incentivize local communities to ensure sustainable exploitation as this instills a sense of ownership and belonging; consequently, improving accountability.

Pollution Effluent from raw municipal sewerage, industrial chemical discharges and frequent sewer bursts are the major causes of water pollution. Water pollution adversely affects fish health and increases proliferation of invasive species such as *Eichhornia crassipes* (water hyacinth).	• Develop more effective policies regulating the use and discharge of chemicals to protect biodiversity • Strengthen links with other multilateral environment conventions. • Encourage environment friendly industrial production systems
Inaccessibility of information on fisheries Information on fisheries management in Zimbabwe (including indigenous knowledge systems) is not readily accessible by the public. Besides Lake Kariba which produces annual statistics of its fisheries, other dams do not provide such information freely (Mhlanga & Mhlanga, 2013). There is, therefore, lack of monitoring of fish populations in most dams other than Lake Kariba, Lake Chivero, Lake Mutirikwi and Lake Manyame.	• Establish an effective biodiversity monitoring and reporting system at local, national and regional level. • Strengthen data collection methods on biodiversity through the development of appropriate biodiversity indicators. • Strengthen collaboration and information sharing among all stakeholders such as research, extension service providers and farmers.

Conclusion

Despite being a landlocked country, the fishery resource can be a sustainable source of livelihoods for many Zimbabwean people. However, to achieve this would require more efficient production and management systems. This Chapter has shown the growth potential despite current low production levels of fisheries in Zimbabwe. We have also highlighted production constraints such as lack of infrastructure, breeding stock, fingerlings, financial capital and effect of climate change. Management challenges cited include ineffectiveness of institutions, overfishing and inaccessibility of information on fisheries in the country. Most of the recommendations suggested call for formulation of more effective and efficient policy systems, and devolution of power. For instance, a more participatory approach in which all stakeholders including local communities are represented would result in improved fish production for increased food nutrition and security.

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Chapter 5

Protected areas and society: exploring conservation history and the nature of relationships between communities and adjacent protected areas in Zimbabwe

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Abstract

This Chapter traces the history of conservation and relationships in Zimbabwe pre-1890 to the present and presents a framework for modelling protected area staff-community relationships based on previous similar studies. A literature review of 61 documents including peer-reviewed journal articles, books, edited book chapters, relevant unpublished articles and academic theses related to protected area staff-community relationships was conducted. Data were analysed inductively by making specific observations per each specified period, followed by detecting themes in the data. The Chapter starts by heralding the history of conservation relationships pre-1890 to present which saw communities moving from the era of collective resource access and sharing (pre-colonial period) to institutional fencing of wildlife during colonialism, and finally the evolution of community-based wildlife management (post colonialism). A model for modelling protected area staff-community relationships that is framed within the concepts of sustainability science and socio-ecological systems is also presented. The resultant outcomes include positive protected area staff-community relationships which are incremental in improving community livelihoods, increase community motivation to support wildlife conservation and promote a desirable wildlife-based tourism product.

Keywords: *biodiversity, CAMPFIRE, community livelihoods, human-wildlife conflicts, wildlife tourism*

Introduction

With the history of the creation of protected areas, especially that of forced removal of the local communities from their original areas of residency and prohibition of access to resources in the protected areas, the communities may harbour deep rooted memories which may negatively affect their relationships with adjacent protected areas (Mutanga et al., 2015). Protected area staff-community relationships are important for the success of wildlife conservation (Tessema et al., 2010, Hausser et al., 2009). Positive protected area staff-community relationships can enhance local support for protected area existence and wildlife conservation, whereas if the relationship between protected area staff and local communities is poor, local people do not support protected areas and they can refuse to cooperate with protected area authorities or participate in their plans (Holmes, 2007, 2013). For successful wildlife conservation, Holmes (2013) recommends for the move towards solutions which are beneficial to both the protected areas and the local people. Protected area staff-community relationship therefore refers to the interrelated interactions between protected area staff and the local communities in which these two are interdependent and where the behaviour of each influences responses from the other (Mutanga et al., 2015).

Many cases of conflict between wildlife and local communities living adjacent to protected areas have been documented (Hawkes, 1991, Mhlanga, 2001, Murphree, 1991, Muboko et al., 2014a). Human-wildlife conflict is still a major problem that has not been effectively resolved in Zimbabwe (Matema and Andersson, 2015). The result has been increasing conflict between people and animals, with people developing a hostile attitude towards wild animals and wildlife conservation authorities since they feel that exclusive preference is being given to wildlife conservation (Mombeshora and Le Bel, 2009, Shibia, 2010, Tessema et al., 2010, Snyman, 2012). These conflicts continue to influence the communities' perceptions of wildlife, protected areas and tourism. More often, even when the people in wildlife abundant areas are furnished with community development benefits from wildlife revenues, they still lose out in economic terms from the presence of wildlife (Emerton, 2001). Thus, the survival of wildlife in protected areas depends on whether it is an asset or liability to the communities living adjacent to the wildlife areas (Cetas and Yasué, 2017). According to Muchapondwa et al. (2009), the decline in African wildlife is linked to the displacement of poor rural communities who subsequently lost their traditional right to use wildlife resources, thus, have little/no incentive to conserve them. Wildlife is, thus, both a very important resource and a source of conflict between protected area staff and local communities.

In spite of genuine efforts in some cases to recruit members of the host communities as stakeholders to participate in the biodiversity conservation programmes, some members of these communities view the establishment of protected areas as insensitive to their needs (Wilshusen et al., 2002; Berkes, 2004 since the rights to most of their lands is not retained. Even though the local communities do enter into agreements with park authorities to promote biodiversity conservation by sustainable utilization of available natural resources in the protected areas, they usually back track on these agreements as they actively collaborate and participate in habitat destruction, game poaching, illegal tree logging and unsustainable exploitation of other wildlife products (Wood, 1993). It is therefore necessary to assess the relationships between protected area staff and surrounding communities to ensure sustainable wildlife conservation. The objectives of the study were to: (i) trace the history of conservation and relationships in Zimbabwe, pre-1890 to present, and (ii) present a model for modelling protected area staff-community relationships based on previous studies on protected area staff-community relationships.

Methods

Given the history of conservation in Zimbabwe, the country was considered an ideal case for studying conservation relationships. We approached this Chapter from using a case study from a historical angle which allowed us to retrace the history of conservation and relationships in Zimbabwe, pre-1890 to 2014. We conducted a documentary review of policy documents, peer-reviewed journal articles, books, edited book chapters, relevant unpublished articles and academic theses related to protected area staff-community relationships. About 88 documents focussing on PA-community relationships, wildlife conservation, community involvement and wildlife management systems in Zimbabwe over distinct time periods spanning from pre-colonial period (pre-1890), the colonial period (1890-1980), and the post-colonial period (post 1980) including the evolution of community-based natural resource management (CBNRM), fast track land reform (1999-2003), and the Wildlife-Based Land Reform (2004) were initially selected. After rigorous screening of these documents, we finally settled on 61 documents which were considered relevant and were finally used for this review. Data were analysed inductively by making specific observations per each specified time period, followed by detecting themes in the data (Soiferman, 2010). These themes then allowed us to systematically organise the data according to the main issues derived from the themes.

Results and Discussion

History of conservation and relationships in Zimbabwe, pre-1890 to 2015

The history of conservation relationships in Zimbabwe saw the communities moving from the era of collective resource access and sharing (pre-colonial period) to institutional fencing of wildlife during colonialism, and finally the evolution of different conservation models which include wildlife conservancies, Transfrontier Conservation Areas (TFCAs), and world heritage sites, community-based wildlife management and wildlife-based land reform (post colonialism).

Traditional management systems (pre1890)

In pre-colonial times, resource utilisation was controlled by local institutions and bound by tribal laws. Totems were often the basis for laws and regulations, hence they were described as a traditional environmental conservation method. The Zimbabwean communities survived on hunting and gathering and were dependent on wild animals and plants for their survival. During this time, there were no poaching, communities only killed only what they needed. All by-products were utilized and nothing was wasted (Muchapondwa et al., 2009).Communities exercised shared access to the resources through complex distribution and rotation schemes (Mhlanga, 2001). Resource utilisation was controlled by local institutions and bound by tribal laws and knowledge (Patel, 1998).

Colonial period, 1890-1979 (Institutional fencing of wildlife or 'fences and fines approach')

Colonialism replaced the traditional African wildlife management systems with European models in which large tracks of land were taken and designated as protected areas e.g. national parks and safari areas (Mhlanga, 2001). About 11 national parks, 16 botanical reserves and gardens, 6 sanctuaries, 14 recreational parks and 15 safari areas were established. The establishment of many of the protected areas was however associated with forced removal of the local communities from land that was originally theirs and their deprivation of access to resources in the protected areas like meat, grazing areas and firewood (Fischer et al., 2011, Risso, 2017, Clay, 1985). The communities now survived on small-scale subsistence and cash crop farming and livestock production. Antagonism grew between local communities and

wildlife in many areas where protected areas were created and this situation resulted in increased illegal harvesting of animals, and habitat encroachment and destruction (Mhlanga, 2001). Despite law enforcement, local communities continued to kill wildlife (Mhlanga, 2001, Gandiwa et al., 2013b, Muboko et al., 2014b). Wildlife managers were unable to cope with the problem and, as a result, pressure on the dwindling wildlife populations was increasing (Patel, 1998). Protected area staff-community relationships were bad and were mainly characterised by increasing conflicts. During this period, the tourism uses of protected areas developed and increased, and protected areas became powerful attractions for tourists.

Post-independence (1979-2015)

In order to resolve the wildlife problems, Conservation and Development Projects (ICDPs) were adopted (Dearden, 2016). The argument was that, unless local communities are able to benefit financially and materially from neighbouring wildlife resources, poaching of wildlife will continue (Madzudzo, 1998). Several conservation models were then adopted during this period and these include Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) and wildlife-based land reform.

The main objective of CAMPF1RE was to manage wildlife in co-operation with local people where poaching of wildlife was expected to decline as local communities benefited financially and materially from neighbouring wildlife resources (Madzudzo, 1998, Martin, 1986). However, genuine participation by rural communities in wildlife management has not been effectively addressed by CAMPFIRE (Mhlanga, 2001). This is because the programme is principally funded by external organisations and the private safari operating industry while business and operational agreements are mainly between Rural District Councils and the private safari industry (Muboko and Murindagomo, 2014, Murombedzi, 1990).

Wildlife-based land reform was introduced by Government of Zimbabwe to normalise the problems which had been brought about by the Fast-track land reform (2000 – 2004). Zimbabwe's fast track land reform resulted in a massive agrarian restructuring (Scoones et al., 2011). Some of the occupied land is in or surrounds protected areas, e.g., northern part of Gonarezhou National Park. Many game ranches were occupied in varying degrees by indigenous people. Many cases of severe poaching and deforestation were brought to the attention of the world's media (Gratwicke and Stapelkamp, 2006, Gandiwa et al., 2014). As a result of the land use changes that initially seemed to ignore wildlife issues, there are arguments that the country suffered losses of irreplaceable endangered species such as Black rhinos (*Diceros bicornis*) and African wild dogs (*Lycaon pictus*), as well as the destruction of commercially important herds of wildlife (Table 5.1). The Wildlife-Based Land Reform Policy of 2006 was therefore introduced to achieve greater equity in the ownership and management of conservancies and wildlife ranches (which were previously privately owned) for indigenous partners (Rukuni, 2012).

Other conservation models which were adopted during the post-independence period were the wildlife conservancies, Transfrontier Conservation Areas (TFCAs), and world heritage sites (UNESCO, 2016). These models and the other introduced in preceding paragraphs are summarised in Table 5.1.

Table 5.1: Conservation models in the post-independence (1979-2015) period

Conservation model	Key issues	Means of community livelihood	Tourism status	PA staff-community relationship status
Wildlife conservancies	-Privately owned ranches were amalgamated to allow for commercially managed wildlife which must be done on a land extensive basis to be viable. -The highly visible disparities between relatively empty ranches, stocked at low levels with wild animals separated by electric fences from overpopulated, poor communal areas are an obvious source of conflict. - Game ranches began to show acts of goodwill between to neighbouring communities such as borehole drilling, school fee handouts and permitting access to sacred areas. -Communities however felt the benefits were too few.	- Small-scale subsistence and cash crop farming -Small scale livestock production	- Tourism use of PAs developed and increased	- PA staff-community relationships still bad (characterised by increasing conflicts)
CAMPFIRE (introduced in the 1980s)	-The increase in illegal hunting led to a realisation that the 'fences and fines' approach was failing, which then led to the introduction of integrated conservation and development projects (ICDPs) - The concept of CAMPFIRE was then introduced in Zimbabwe. -Benefits to communities included social infrastructure, i.e., construction of schools, clinics, boreholes, grinding mills or cash payments to each household among others	- Small-scale subsistence and cash crop farming -Small scale livestock production-Revenue from CAMPFIRE	-Tourism increased especially hunting tourism	- Although communities are getting benefits from CAMPFIRE, PA staff-community relationships are still bad [1] - poaching significantly reduced in some areas but it temporary in other areas[2]

Wildlife-based land reform	-The Wildlife-based land reform prompted the conservancies to formally offer communities land inside the conservancy fence on the condition that much of the land remains under wildlife utilisation. -To members of communities with land claims on private and state land, the wildlife-based land reform discourse is a means by which the repossession of ancestral land can be justified in the language of community development.	- Small-scale subsistence and cash crop farming -Small scale livestock production - Safari hunting and tourism revenues that accrue to the local community as the concession holder. -Income generating schemes such as craft production and cultural tourism in the communal and resettlement areas outside the wildlife zone.	-Led to positive media reviews and possibly positive perceptions about the country (after the fast-track land[3]) which was good for tourism.	-There was a peaceful environment between PA staff and local communities and the relationship between the two parties was improved.
TFCAs	-Provide a potential financial incentive to states and the private sector to bring more land into the conservation estate.	- Small-scale subsistence and cash crop farming -Small scale livestock production	-Adventure nature-based tourism in remote destinations	-Still bad in some areas due to restrictions on land use options and the increased presence of wild animals in the area -Potential of improved conservation and relationships due to poverty alleviation (when communities begin to benefit)
World Heritage Sites	-Ensure the protection of the natural and cultural heritage as well as encourage participation of the local population in the preservation of their cultural and natural heritage	- Small-scale subsistence and cash crop farming -Small scale livestock production	-Improved tourism due to international recognition and improved conservation	-Still bad in some areas due to restrictions on land use options and the increased presence of wild animals in the area

Notes: PA = Protected Area; TFCA = Transfrontier Conservation Areas; ICDPs = Conservation and Development Projects; CAMPFIRE = Communal Areas Management Programme for Indigenous Resources. [1] Despite communities benefiting from CAMPFIRE, protected area staff-community relationships remain bad in some areas which shows that either people are not happy with the benefit-sharing mechanism or there are other factors that need to be resolved besides benefit-sharing, e.g., communication between protected area staff and local communities; [2] poaching considerably declined in some areas as the neighbouring communities started obtaining economic benefits from legal wildlife utilisation and began to assist in wildlife protection. However, in other areas, poaching subsided only temporarily with CAMPFIRE and then bounced back after a few years; [3] Many game ranches were occupied in varying degrees by indigenous people during the fast-track land reform of 2000 to 2004 which led to an increase in poaching and conflicts between protected areas and the communities, which was extensively reported in the media and consequently led to negative framing of Zimbabwe as a tourist destination. *Sources:* Hanks (2003), Gandiwa et al. (2014), Mutanga et al. (2016a), Spierenburg et al. (2008)

Protected area staff-community relationships in Zimbabwe

Protected area-community relationships moved from being bad or negative during the colonial period to state of being a mixed bag in the post independence era. In some cases like the wildlife-based land reform, relationships were improved as communities became concession holders to some land inside conservancies, and in other cases relationships improved as communities began to benefit from CAMPFIRE (Fischer et al., 2011). However, in other instances, where communities were not happy with benefit sharing mechanism in place or other factors like ways of communication between protected area staff and the communities, relationships were still bad. Harmonious protected area-community relationships are important for sustainable development (Fig. 5.1). The World Commission on Environment and Development defines sustainable development as development which meets the needs of the present without compromising the ability of future generations to meet their own needs (Martens, 2006). To achieve this, it is necessary to address sustainability challenges such as climate change, biodiversity loss, deforestation, land degradation, and water scarcity. These sustainability challenges have been identified as imminent or future problems that society as a collective is just starting to understand and grapple with (Jerneck et al., 2011). The rate of species extinction is rapidly increasing (Dirzo and Raven, 2003) and is expected to increase to as much as ten thousand times in coming decades (Chivian and Bernstein, 2008). Sustainability science seeks to be responsive to the needs of and values in society while preserving the life-support systems of the earth (Kates et al., 2000, Bäckstrand, 2003). In view of this, with the aim of enhancing sustainable development, Mutanga et al. (2015) proposed a model for understanding protected area staff-community relationships focusing on the determinants of protected area staff-community relationships. The model considers factors like history of protected area creation, benefits associated with living closer to protected areas versus costs, ccompensation for losses from wildlife, socio-demographic factors, communication between protected area staff and communities, community involvement in conservation, community perceptions on tourism, conservation, and protected area staff, ICDPs, and community attitudes and protected area staff attitudes. We build on to that model (Fig. 5.1) by adding on two more determinants which are problems caused by communities for protected areas and protected area staff perceptions on communities as well as intervening factors in the form of efforts that can be put in by both communities and protected area staff to improve their relationship (Mutanga et al., 2016a, Mutanga et al., 2016b).

We argue that determination from both protected area staff and communities is crucial for long-term natural resources conservation (Bruyere et al., 2009). Protected areas cannot coexist in the long term with communities that are hostile to them (Holmes, 2013). If protected area staff is able to maintain the balance between respecting community needs and imposing terms and processes on the community, provide incentives to communities like subsidised game meat or game meat during national events or celebrations, plan resource allocation efficiently, for example through investing in the establishment of effective communication mechanisms for the transparent information exchange, invest in capacity building for communities like training them in entrepreneurship activities (Fig. 5.1), then communities would be happy and may have positive attitudes towards protected area staff. This may imply reduction in problems like illegal hunting and encroachment. Similarly, if communities can engage in activities that are complementary to conservation like reducing fires, stop illegal hunting, desisting from harbouring poachers, reporting any poachers or suspects within the communities, and engage protected area staff whenever they do cultural activities related to nature; make initiatives to empower themselves through furthering their education and skills development so that they are

employable in better paying jobs in the protected areas; and engage in revenue-generating projects like poultry, as well as artefact and curio selling businesses, so as to reduce dependency on protected area resources, protected area staff may have positive attitudes towards them and may treat them like stakeholders and not poachers. This may enhance positive protected area staff-community relationships which in turn help to promote sustainable wildlife conservation, enhance improved sustainable community livelihoods and promote a desirable tourism product.

Frequently, communities living in and around protected areas have important and longstanding relationships with these protected areas that embrace subsistence practices essential to sustaining livelihoods, and often contribute to maintenance of biodiversity (see Table 5.1). Conservation policies that attempt to keep communities out of the decision-making process and/or out of the sharing of benefits are therefore unlikely to be sustainable for a long period (Tomicevic et al., 2011). Protected areas are increasingly being recognised as 'social spaces' (Ghimire and Pimbert, 1997) and as such, cannot be separated from their human context in terms of management regimes (Brechin et al., 2002). The model thus considers the connections between natural and social systems (socio-ecological systems). Social-ecological system indicates a commitment to adopt a holistic, systemic perspective towards human and non-human elements of a problem situation of interest (Halliday and Glaser, 2011). The determinants of PA-community relationships could be used to improve the interactions between natural and social systems. If PA-community relationships are good, communities can willingly participate in conservation and problems like illegal hunting can be reduced thereby enhancing the sustainability of wildlife resources.

Moreover, as denoted in the model (Fig. 5.1), local communities can be a direct threat to protected areas, especially where negative protected area staff-community relationships exist. Negativity may lead to boycotting and this can ruin the protected areas as well as the tourism industry. However, when carefully planned and effectively managed, tourism can provide significant benefits to protected areas and nearby communities (Sabuhoro et al., 2017, Eagles and Mccool, 2002), especially to rural communities in developing countries that are strongly dependent on natural resources (Tosun, 2000) and this develops a connection and support for the tourism sector and protected areas in general hence creating a positive relationship between protected area staff and communities. Facilitating community members to benefit from tourism can enhance their support for protected area staff (Pan, 2005) thereby moderating the conflicts and result in a win-win outcome (Sekhar, 2003). Wildlife tourism can be used as a development strategy for communities living adjacent protected areas (Margaryan and Fredman, 2017). Wildlife tourism is therefore important in improving socio-ecological benefits through improved conservation and local community livelihoods. The proposed model (Fig. 5.1) is thus framed within the concepts of sustainability science and socio-ecological systems.

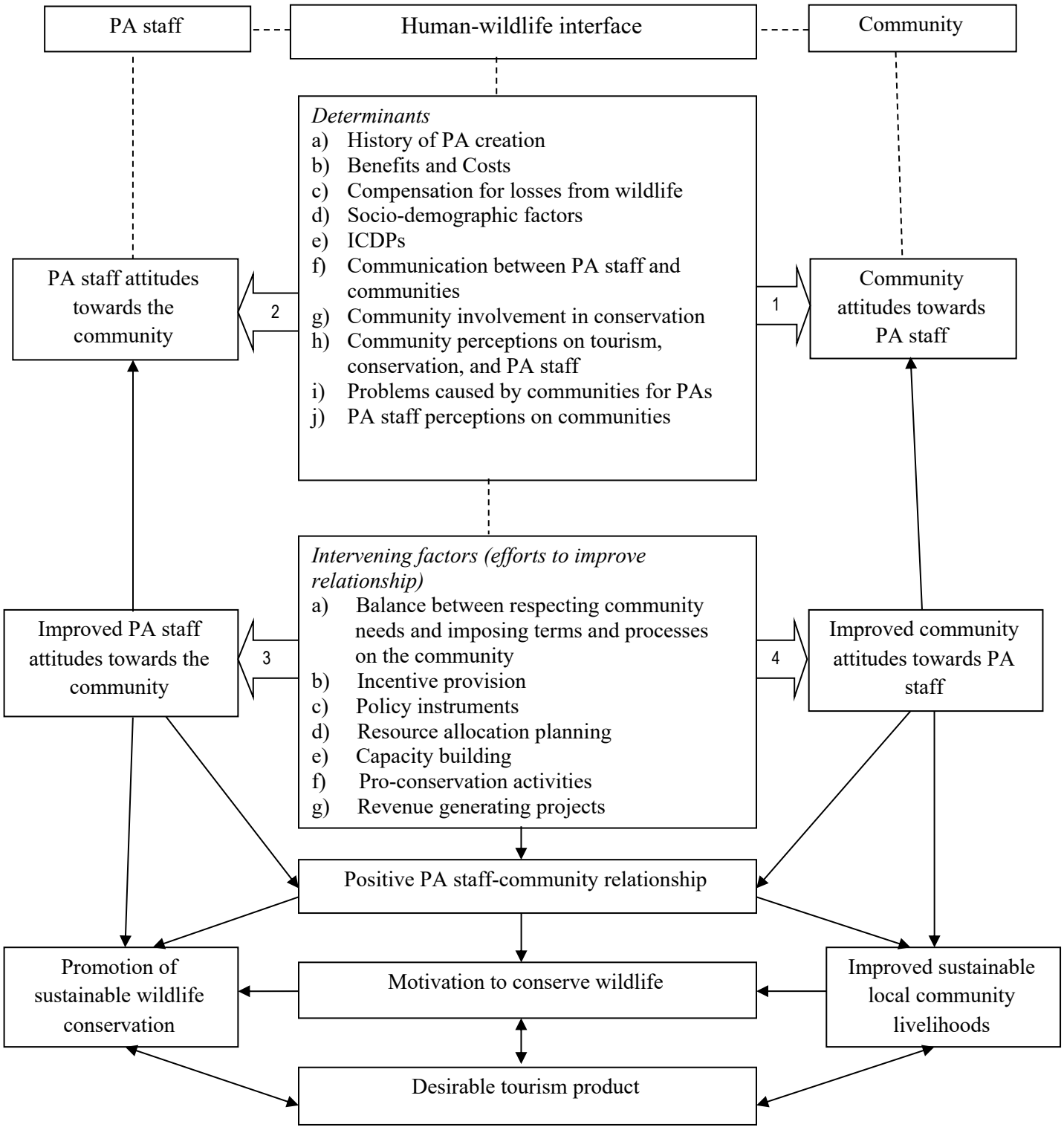

Fig. 5.1: Model for modelling protected area staff-community relationships. *Notes:* PA – Protected area; ICDP - Integrated Conservation and Development Project. The direction of lines indicates interconnectedness of the components. '1' indicates the direction of determinants a – h; '2' indicates the direction of determinants i and j; '3' indicates the direction of determinants a – e; and '4' indicates the direction of determinants e – g. Adapted and modified from Mutanga et al. (2015).

Modelling protected area staff-community relationships in Zimbabwe

Our model (Fig. 5.1) is important in the broad protected area management as they help in addressing important issues on the complexity of interactions between nature and society. However, we acknowledge that the model is applied differently on different scales. At the local level, issues such as human-wildlife conflict, community involvement in conservation and ICDPs are more pronounced and have to be handled at the local level too (Gandiwa et al., 2013a, Muboko et al., 2014a). Still at the local level, communities are heterogeneous and therefore have different needs and expectations. For each protected area, it is therefore necessary to understand the factors that influence its relationship with the adjacent community and the best possible intervention measures that can aid in achieving a win-win situation (Mutanga et al., 2016a).

At the national level, some policy instruments can be established, for example compensation policies for losses from wildlife depredation, capacity building training for communities or penalty schedules for illegal hunters. These policies can either be implemented at a local or national level. At the global or international level, wildlife conservation issues are debated and decided at conferences and conventions by scientists, researchers, scholars and practitioners. This is where global wildlife policies and issues are agreed on for example the development of protected area management categories by the International Union for Conservation of Nature (IUCN), which is followed by all nations.

The future of conservation and conservation relationships in Zimbabwe

To improve conservation relationships there is need for protected area agencies to provide incentives to communities that encourage the conservation and sustainable use of natural resources as well as develop alternative means of livelihood for local populations, especially from tourism. This could be done by enhancing community involvement and benefits from tourism through establishing links between community support and conservation. Moreover, protected area staff-community relationship strategy formulation should be based on an understanding of community expectations. Proper communication channels should also be established between protected area staff and adjacent communities. Furthermore, since perceptions are regarded as attitude-forming processes (Allendorf et al., 2012), it important that conservation agencies direct more effort to changing negative perceptions (Simelane et al., 2006) that easily become negative attitudes. Conservation agencies should also nurture positive perceptions and address the possible determinants of negative perceptions to improve community appreciation of conservation. Protected area agencies should continuously endeavour to determine factors that influence protected area staff-community relationships as well as their level of influence on their relationships. It will then be possible to pay more attention to those factors that influence protected area staff-community relationships to nurture positive relationships between protected area staff and local communities. While commonly identified factors are important, it could be more useful for conservation agencies and other stakeholders to consider community heterogeneity in their conservation planning and community relationship management initiatives. Finally, properly planned environmental and conservation awareness campaigns should be implemented.

Conclusion

Although very little is documented about conservation in pre-colonial times (e.g., Murombedzi, 2003), it is generally accepted that pre-colonial communities exercised shared access to the resources through complex distribution and rotation schemes controlled by local institutions

and bound by tribal laws and local ecological knowledge. The traditional African wildlife management systems were replaced with European models in which large tracks of land were taken and designated as protected areas and local people were prohibited from utilising the resources within protected areas. This period of institutional fencing of wildlife was associated with antagonism between local communities and wildlife in many areas where protected areas were created which resulted in increased illegal harvesting of animals, and habitat encroachment and destruction. However, the success of community-based wildlife management programmes like CAMPFIRE is a subject of current debate, with its opponents suggesting that in other areas, poaching subsided only temporarily with CAMPFIRE and then bounced back after a few years. The Zimbabwe fast track land reform programme which commenced in 2000 could have aided to the contraction of wildlife resources. Currently, communities generally perceive the relationship they have with the protected area staff to be negative while protected area staff perceives a positive relationship with the communities (Mutanga et al., 2016b).

Framed with the concepts of sustainability science and socio-ecological systems, a model for modelling protected area staff-community relationship is presented that depicts the interactions occurring at the human-wildlife interface of the protected areas (including their staff) and local communities. The model focuses on determinants of protected area staff-community relationships, for example benefits associated with living closer to protected areas versus costs, and communication between protected area staff and communities and the intervening factors that are meant to improve community or protected area staff attitudes towards each other like policy instruments and revenue-generating projects. This can lead to positive protected area staff-community relationships which are incremental in improving community livelihoods, increase community motivation to conserve wildlife and finally promote a desirable tourism product. Of importance is the understanding that relationships are dynamic and change over time and therefore should be continuously monitored to gain a better understanding of the nature of the relationship.

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Chapter 6

External and internal institutional issues affecting the Mahenye community from effectively benefitting from CAMPFIRE

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Abstract

The objective of the study is to examine the hindrances to the flow of livelihood benefits from the Mahenye community conservancy area in south-eastern Zimbabwe to the local community. A questionnaire targeting Mahenye residents; key-informant interviews; a focused group discussion; and document analysis were employed in gathering perceived hindrances to the flow of livelihood benefits. Among the key hindrances internal to the Mahenye community include alleged misappropriation of Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) funds by the Mahenye CAMPFIRE Committee leadership. External hindrances to the maximum enjoyment of livelihood benefits from the community-conserved area to Mahenye residents include lack of complete devolution of appropriate authority in natural resource management to sub-district structures, a low sport hunting quota, a sharp decline in international tourist flows to Zimbabwe, and the undue influence of the chieftaincy upon the community CAMPFIRE project. Considering the dwindling international ecotouristic market into the country, the need for Chilo Lodge to refocus attention towards the domestic tourist market is apparent. While complete devolution of appropriate authority to sub-district structures would be most appropriate, this should be preceded by comprehensive institutional capacity building. Multiple stakeholder engagement would ensure that the community project is transparently managed for the benefit of the whole community and not just a few local elites.

Keywords: *Biodiversity, CAMPFIRE, community-based conservation, livelihood benefits, hindrances*

Introduction

Biodiversity conservation and poverty alleviation are old and important policy objectives across the world, which have largely been pursued separately prior to the 1980s (Miller, 2014). The 1980s witnessed an international growth of interest in jointly pursuing conservation and development goals after the realisation that "environmentally destructive development imperils human well-being by threatening the stable functioning of the Earth's life support systems while conservation at the expense of the poorest is ethically, and likely practically, infeasible" (Miller, 2014: 342). Since then, various approaches have been attempted to reconcile the twin policy goals of biodiversity conservation and poverty elimination.

The involvement of local communities and populations in biodiversity protection strategies has become a major feature of conservation policy across the world (Adams and Hulme, 2001; Balint, 2006; Rawlins and Westby, 2013). The counter-narrative of community-based natural resource management represents a more inclusive and people-oriented approach to conservation and is a reaction to the failure of exclusionary conservation in a world in which social and economic factors are increasingly seen as key to conservation success (Murphree, 2002; Balint, 2006). Advocates of community-based conservation note that the approach will, especially in developing countries, result in increased support for conservation values and more prosperous and empowered people (Brockington et al., 2008; Rawlins and Westby, 2013). Empowerment of local people comes in the form of decentralised decision-making. This results in meaningful participation of rural populations in decisions that affect their lives, in addition to sustainable utilisation of local resources (Wilshusen et al., 2002).

Adams and Hulme (2001: 13) have defined community-based conservation as "those principles and practices that argue that conservation goals should be pursued by strategies that emphasise the role of local residents in decision-making about natural resources". It is increasingly being noted that a great deal of hope can be placed in the ability of rural communities to conserve nature, and conservation by local communities is often claimed to be a more equitable and effective alternative to many types of protected areas, particularly fortress conservation, due to several reasons (Brockington et al., 2008; Liu et al., 2010). Residents have evolved with their surrounding environment over several centuries and thus possess vast traditional ecological knowledge and activities crucial for facilitating effective biodiversity conservation (Liu et al., 2010). Such traditional ecological knowledge, especially as it relates to resource use, can complement modern conservation systems and aid biological research, while supporting a more equitable and culturally sensitive method of management (Liu et al., 2010; Cox et al., 2014). Community-based conservation areas are also widely perceived to be a means of expanding the conservation estate, ensuring land is managed for conservation purposes beyond the boundaries of formal protected areas (Brockington et al., 2008; Cox et al., 2014).

Despite the promise of delivering positive outcomes for both people and nature, the results of efforts to simultaneously tackle the twin objectives of biodiversity conservation and poverty alleviation have been mixed, mainly due to poor knowledge of the complex relationships between poverty and biodiversity (Miller, 2014). This study specifically focuses on hindrances to the flow of livelihood benefits from a community-based conservation area in south-eastern Zimbabwe, Mahenye, to the local community. Conservation literature identifies various factors impinging the livelihood benefits to local rural communities from community-conserved areas, and some of these challenges have succinctly been summarised by Fabricius (2004: 20-23):

- *Weak institutions:* Local institutions are often weak and unstable, or unacceptably flexible, and traditional institutions are disappearing and are being replaced by open-access systems and lawlessness. Furthermore, the amount of effort and resources required to sufficiently develop local institutions has been grossly underestimated. The extent and duration of facilitation and assistance to local communities that is required has equally been underestimated. Project managers now realise that project cycles should be measured in decades rather than years.
- *Poor local administrative capacity:* Local people's ability to manage and administer revenues from natural resources is primarily weak. Because of decades of poverty and experiences of being marginalised, the temptation to be corrupt is often too great. New elites, for example, often try their best to gain a disproportionate share of the benefits from biodiversity projects. The much-promoted partnerships between communities and the private sector are also not the panacea they were anticipated to be. Joint-venture partnerships often approach community-based enterprises with caution because of the high risks involved, the high potential for corruption and manipulation, and uncertainties about their rights and obligations.
- *Different definitions of participation:* Although the policy trend is towards increased participation and devolution of natural resource management to communities, the interpretation of 'participation' on the ground varies widely. The state will always have a role in natural resource management, and many natural resource professionals feel that the state should control access and decision-making over natural resources, and that communities should be passive participants.
- *Naïve assumptions about custodianship:* The assumption that local people, when given opportunities to participate and benefit from biodiversity, will automatically become custodians of the natural resource base is naïve. The engagement of local people in biodiversity conservation requires a range of critical ingredients that vary from one context to another. The lack of meaningful devolution of authority, and the lack of land ownership has contributed to apathy in many communities.
- *Elusive communities:* The expectation that local people should 'speak with one voice' and have a single vision that encompasses all the aspirations of the group often does not hold. It is becoming apparent that the term community is difficult to define, at least, because local groupings constantly redefine and realign themselves and reformulate their objectives. Moreover, 'indigenous peoples' refuse to subscribe to the stereotype assigned to them by donors and NGOs.
- *Globalisation:* These days local people are as keen as most other citizens to spend their money on modern conveniences and are much more mobile than before. Many rural villages consist of school children and old people, with everyone of working age either looking for a job in the urban areas or already working there. This has profound implications for capacity development in rural communities.

The above and other challenges have hindered the poverty-reducing capabilities of community-conserved areas across the globe. Whereas the livelihood benefits derived from community-conserved areas could have acted as an effective route out of poverty for many poverty-stricken rural communities in developing countries, such benefits will, due to the above-noted hindrances, now only either result in modest poverty reduction, or just act as a safety net to keep people from falling deeper into poverty, or at times become poverty traps that perpetuate rural poverty (Leisher et al., 2010).

This Chapter is guided by the political ecological framework. Robbins (2004) defines political ecology as explorations to explain linkages in the condition and change of social and environmental systems, with explicit considerations of relations of power. Political ecology seeks to understand the complex relations between nature and society through careful analysis of the forms of access and control over resources and their implications for environmental health and sustainable livelihoods (Watts, 2000). In the context of community-based conservation, political ecology focuses on the multiple interests and actors within communities and how this influence decision-making, and on the internal and external institutions that shape the decision-making process and benefit sharing (Agrawal and Gibson, 1999).

In Zimbabwe, community-based natural resource management comes in the context of the CAMPFIRE. CAMPFIRE aims at the sustainable utilisation of local resources by combining conservation, local resource management, community empowerment and development (Olthof, 1995). It aims to remove the conflict between environment and development through sustainable resource use, based on a safe minimum standard offtake, in order to ensure long-term satisfaction of basic human needs (Taylor, 2009). In contrast to colonial-style 'fortress conservation', the central tenet of CAMPFIRE is that there should be no conflict between the economic survival of rural agricultural communities and foraging needs of wildlife but rather these should complement each other (Wolmer et al., 2004).

While research on community-conserved areas in Zimbabwe has spanned the more than three and half decades since independence, most such studies were mainly carried out in the first two decades after independence. The year 2000 marked a turning point in Zimbabwe's socio-economic and political environment, which has affected almost every facet of the country's fabric, including biodiversity conservation. This study attempts to add new insights into the hindrances to the flow of livelihood benefits from the Mahenye community-based conservation project in light of the changing socio-economic environment in the country.

Study site

Mahenye ward is located in south-eastern Zimbabwe (Fig. 6.1). It lies in the extreme southern end of Chipinge District in Manicaland Province in Ndowuyu communal land. The ward consists of a narrow wedge of land lying between the Save River in the west and the Rupembi River in the east (Murphree 2001). To the south across the Save River is the northern boundary of Gonarezhou National Park in Chiredzi District (Murphree 2001; The Africa Resources Trust 2002). The northern boundary of Mahenye is Mutandahwe ward, also in Ndowuyu Communal Land. The estimated total population of Mahenye is 3671 from about 707 households, with an average household size of 5.2 people (Central Statistical Office, 2012).

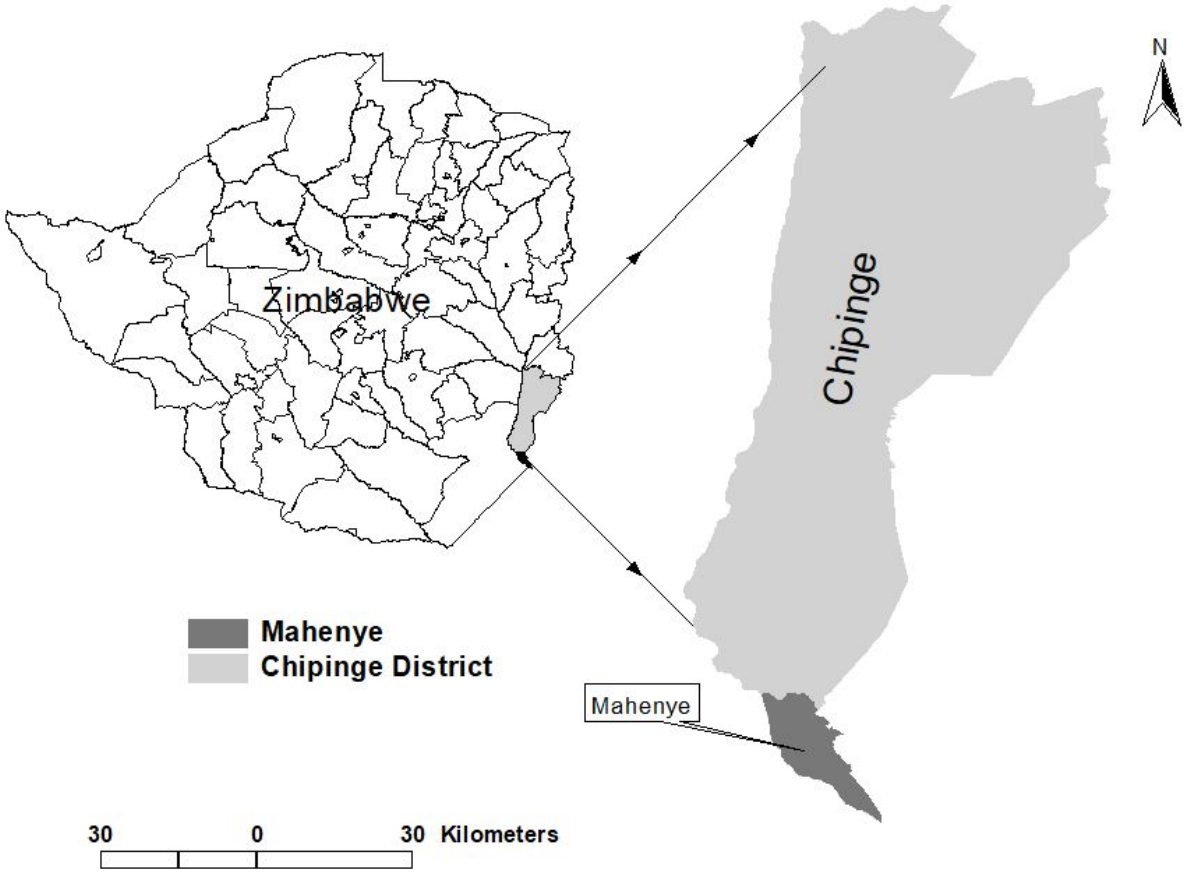

Fig. 6.1: Location of Mahenye ward in Chipinge District, south-eastern Zimbabwe

The Mahenye community originally settled in part of the area that is now under Gonarezhou National Park (Balint and Mashinya 2006). They were finally evicted in the 1960s during the colonial period to make way for the expansion of Gonarezhou National Park and were resettled to their current location. With hunting now prohibited, the people were forced to resort to subsistence pastoralism and cropping which, however, were unsuitable for the hot dry area (Balint and Mashinya 2006). The inevitable result was an increase in poaching activities by local communities in both Gonarezhou National Park and adjacent areas.

Mahenye is one of the first communities to be involved with CAMPFIRE, a nationwide community-based natural resource management initiative that started in the late 1980s to early 1990s in Zimbabwe to promote sustainable utilisation of natural resources in the wildlife-rich districts of the country bordering public protected areas. The Mahenye CAMPFIRE project officially started in 1990 when Chipinge Rural District Council was granted appropriate authority to manage wildlife in the district on behalf of local communities.

Materials and methods

The bulk of this Chapter draws from broader comparative research on biodiversity conservation and rural livelihoods that we conducted in south-eastern Zimbabwe between 2012 and 2014 involving a community-conserved area (Mahenye) and a private protected area (Malilangwe). This Chapter therefore draws on a narrow section of this data, focusing on the Mahenye case study and on hindrances to the flow of livelihood benefits from the community-conserved area.

Follow-up field visits were conducted in August 2017 so as to keep pace with latest developments in the study area.

A questionnaire was used for collecting quantitative data from the residents of Mahenye. The questionnaire solicited for information on perceived hindrances to the flow of livelihood benefits from the Mahenye community-conserved area to the local community.

Interviews with key informants were also conducted to gather in-depth information on hindrances to the flow of livelihood benefits from the community conservation area. Targeted key informants included the Mahenye CAMPFIRE Committee Chairperson and committee members, resource monitors and the accounts clerk. Former CAMPFIRE committee chairpersons and committee members were also interviewed. The Chipinge District CAMPFIRE Coordinator was also interviewed to solicit views on the CAMPFIRE project in Mahenye. Interviews were also held with the traditional leadership in Mahenye, including the Chief and selected village heads to solicit their view on issues affecting the Mahenye community from effectively benefiting from CAMPFIRE. Interviews were also held with a representative from Zambezi Hunters, the current hunter for the Mahenye CAMPFIRE project. A representative of the Chilo Lodge, which oversees ecotourism activities in Mahenye was also interviewed. Ecotourism, photographic hunting, and trophy hunting are the main sources of income for the Mahenye CAMPFIRE project. Interviews were also held with representatives from some of the organisations that played a pivotal role in the formative years of the national CAMPFIRE programme, namely, the University of Zimbabwe's Center for Applied Social Sciences (CASS), the CAMPFIRE Association, and the Zimbabwe Parks and Wildlife Management Authority (ZPWMA). The collection of in-depth information on hindrances to the flow of livelihood benefits from the Mahenye community conservation area to the local community was further enhanced through a focus group discussion that was held in the area.

Secondary data were also accessed, analysed and corroborated with the data obtained from primary sources. Unpublished secondary data were obtained from the Mahenye CAMPFIRE Committee in Mahenye and the District CAMPFIRE office in Chipinge. Published secondary data in the form of journal articles, books and academic theses were also accessed via various academic search engines such as Science Direct, Google Scholar and Scopus among others. The accessed published and unpublished secondary data were both qualitative and quantitative in form enabling easy corroboration with the collected primary data, thereby allowing for the generation of more information for addressing the objective of the research.

The sampling frame for questionnaire interviews comprised the 707 households (Central Statistical Office, 2012) of Mahenye ward. A total of 150 households, constituting 21% of the target population, were selected for questionnaire interviews. Simple random sampling was employed in drawing respondents into the sample. A register of Mahenye households was obtained from the Ward Councillor. The names were then written on pieces of paper and drawn from a hat. For the key informants, purposive sampling was employed. Purposive sampling is a particular technique that aids the researcher in identifying individuals for interviewing according to the research topic and objectives (de Vaus, 2002). The snowballing technique was further used for identifying additional participants through individuals already interviewed (Somekh and Lewin, 2005).

Responses from questionnaire respondents were computed into percentage frequencies using SPSS, with some of the responses presented in tabular form. The presentation and analysis of

quantitative data was thus accomplished using descriptive statistics. On the other hand, qualitative data from interviews and group discussions were analysed by means of thematic analysis. Thematic analysis is the process of identifying patterns or themes within a qualitative data set that are important or of interest in addressing the research questions (Maguire and Delahunt, 2017; Nowell et al., 2017). The advantage of thematic analysis lies in its theoretical and epistemological freedom, making it a highly flexible approach that can be modified for the needs of many studies to provide a rich, detailed and complex account of data (Maguire and Delahunt, 2017; Nowell et al., 2017).

Results and discussion

Various hindrances to the flow of livelihood benefits from the Mahenye community-based conservation area to the local community were identified. These have conveniently been divided into two categories, namely, external and internal hindrances.

External hindrances

The granting of appropriate authority to Rural District Councils (RDCs), instead of local sub-district structures, for the management of natural resources in communal areas is perhaps the main external hindrance to the flow of livelihood benefits to communities under the CAMPFIRE programme. CAMPFIRE originally aimed at granting communal-area residents territorial rights over defined tracts of land, custody and responsibility over natural resources and the right to benefit directly from the exploitation of the natural resources on their land (Martin, 1986). Compromises were however made during the implementation of the programme, with appropriate authority for the formal control over wildlife eventually being devolved to RDCs rather than to sub-district local communities as originally planned (Frost and Bond, 2008). The granting of appropriate authority to RDCs gives them, rather than local communities, the power to sign contracts with hunters and to accrue all the generated income. The issue of devolution has attracted the attention of many scholars worldwide. Most of them have, however, concluded that, despite enjoying wide publicity, devolution has rarely been tried (Ribot, 2008). In addition, in the few cases where it has been tried, it has often not been completed (Ribot, 2008). The devolution of appropriate authority for the management of wildlife in Mahenye to Chipinge RDC is a good example of incomplete devolution. This is because RDCs are an extension of central government. The political ecological framework directs attention to the struggles among diverse actors, both local and non-local, over natural resource access and control (Wilshusen, 2003) and, in the CAMPFIRE programme, such struggles are clearly reflected in the arguments surrounding the granting of appropriate authority to councils instead of grassroots structures at the sub-district level.

CAMPFIRE Revenue Guidelines stipulate that the RDCs should take a 15% levy of gross sport hunting revenue, plus another 26% to be spent on wildlife management activities while the CAMPFIRE Association, an umbrella body for all CAMPFIRE participating districts, receives 4% of gross revenue as a levy from councils. This leaves producer communities with only 55% of gross hunting revenue. Residents of Mahenye expressed displeasure over the current CAMPFIRE revenue allocation model which leaves the community with very little (55%) while council remained with a total of 41% of CAMPFIRE hunting revenue. What further angered Mahenye residents was the fact that the 26% retained by the Chipinge RDC for wildlife management activities is not being used for its intended purpose. The money has been diverted to other uses by the Chipinge RDC, leaving the Mahenye community with no option but to pay

for wildlife management activities such as problem animal control and the payment of resource monitors, which are supposed to be paid for from the 26% being retained by the RDC.

The retention of 41% of gross CAMPFIRE hunting revenue is in fact a tax on wildlife activities in the communal areas, which makes wildlife less profitable compared with agricultural produce and livestock which are not subject to taxation (Duffy, 2000; Murombedzi, 2001; Nelson, 2010). This in turn reduces the incentive for investing in wildlife production and conservation among communal area residents (Murombedzi, 2001; Nelson, 2010). However, Rihoy and Maguranyanga (2007) have noted that, while responsibility for the provision of various services has been decentralised to RDCs from central government, there has not been commensurate financial decentralisation to enable RDCs to perform these new responsibilities. After decentralisation, central government grants to RDCs now accounted for only 35% of total revenue, with 65% generated locally by RDCs (Bond 2001; Rihoy and Maguranyanga, 2007). The income generated locally by RDCs has increasingly come from wildlife management activities and given the deteriorating financial situation of most RDCs due to reduced funding from central government and increased responsibilities, dependence on CAMPFIRE has only increased over the years (Rihoy and Maguranyanga, 2007). Under the above circumstances, RDCs are likely to resist any attempts to devolve appropriate authority to sub-district levels as this will result in loss of much-needed revenue.

Interviews in Mahenye further revealed that the 55% of gross CAMPFIRE hunting revenue received is further shared with Mutandahwe, a neighbouring ward with which Mahenye shares the same safari hunting concession. The revenue was initially shared equally between the two wards. However, following complaints by the Mahenye CAMPFIRE Committee, Mahenye now gets 80% of the revenue while Mutandahwe gets 20%. The current arrangement was necessitated by the fact that Mutandahwe ward is not endowed with as much wildlife as Mahenye. While the former's quota is just one elephant per year, Mahenye's hunting quota consists of 4-6 elephants annually. At the time of fieldwork, consultations were on-going for Mutandahwe to have its own separate hunting concession. With council retaining 41% of gross CAMPFIRE revenue while Mahenye shares the other 55% with Mutandahwe, residents of Mahenye lamented that it was Chipinge RDC which was now benefiting more from the natural resource management programme than the communities originally targeted. One group discussant succinctly described the situation by stating that: "*The Communal Area Management Programme for Indigenous Resources (CAMPFIRE) should change its name to Council Management Programme for Indigenous Resources as it is council which is the main beneficiary of the programme*". A popular sentiment among interviewees in Mahenye was that the CAMPFIRE project should completely be devolved to the ward level so as to allow for all benefits to directly accrue to the community without the costly intermediary role of Chipinge RDC. CAMPFIRE literature indicates that this was the original plan of the programme, which was however changed during implementation (Martin, 1986). At the time of fieldwork, the Mahenye CAMPFIRE Committee was in the process of preparing a Trust Deed as a first step in a quest for the full control of the natural resources in the area by the residents of the community. However, other interviewees preferred a continued but limited role by the Chipinge RDC in CAMPFIRE, especially through a reduction in the council levy on the community natural resource management project, with many indicating that Mahenye should accrue at least 85% of gross CAMPFIRE hunting revenue.

Another external hindrance to the flow of conservation benefits identified by most residents in Mahenye surrounded the issue of the hunting quota, particularly the elephant quota. Many

people felt that the quota being set for Mahenye was consistently too low considering the huge endowment of elephants and other wildlife in the area and the adjacent Gonarezhou National Park. The elephant quota for Mahenye was about four elephants per year throughout the 1990s, reaching a maximum of six in 2013. In addition, the Mahenye community has no say over the setting of the quota. While they are asked to submit some suggestions on the quota for each year, the final tell lies with the ZPWMA, in consultation with the Chipinge RDC. The community has consistently suggested a quota of between 8-10 elephants annually which has always been reduced to between 4 to 6 elephants by the ZPWMA.

Closely related to the issue of a low hunting quota is the fact that the quota in Mahenye is rarely filled by the hunter. Interviews revealed that out of a quota of 6 elephants set for 2013, only 4 elephants were hunted. The unfilled quota translates into loss of revenue for Mahenye residents. While negotiations are made to provide some compensation for the unfilled quota, the negotiated amount is usually lower than the amount that could have accrued to the community had the quota been filled. A study by Mashinya (2007) in the same area noted that the safari hunters usually have many hunting commitments in other areas around the country which makes them fail to fill their quotas in some of the areas.

In addition to the low hunting quota, residents of Mahenye also indicated that the community had no say over the selection of the safari hunting operator. The prerogative to select the hunter rests with the Chipinge RDC through a tendering process. However, an inquiry conducted in 2005 to review the tendering procedures and processes in Mahenye revealed that a competitive bidding process was not being followed, with money from safari hunting not reflecting the true value of wildlife resources in Mahenye (Rihoy et al., 2010). Many interviewees in Mahenye strongly suspected that council was accepting bribes for the awarding of the hunting concession. Of all the hunters that had operated in Mahenye, most people interviewed preferred Tshabezi Hunters as they consistently paid their quarterly hunting fees on time. In 2003, Tshabezi Hunters made a once-off payment of their hunting fees for the whole year amounting to Z$1 590 000. In addition, Tshabezi Hunters donated a Mazda B 2500 truck to the Mahenye community in 2004 for use as an ambulance for transporting critically ill patients to hospitals in Chipinge or Chiredzi. In 2002, Tshabezi Hunters also donated a short gun, a riffle and uniforms for use in problem animal control by resource monitors. In contrast, the current hunting operator in the Mahenye wilderness area, Zambezi Hunters, had a habit of not paying quarterly hunting fees on time. At the time of fieldwork, there were confirmed reports that Zambezi Hunters had not yet paid hunting fees for the previous quarter. In addition, unlike Tshabezi Hunters, many people noted that Zambezi Hunters had not done anything else for the community besides the payment of hunting fees. Zambezi Hunters promised to build Jamanda Bridge in Mahenye in 2003. However, the hunter only laid the foundation and never returned to finish the project. Other unfulfilled promises by Zambezi Hunters to the people of Mahenye included: the purchase of a grinding mill to be run from Mutandahwe Business Centre, restocking of the Mahenye wilderness area with plains game, assistance with transport and buying of guns and uniforms for use by resource monitors. The result of the total control over the safari hunting tendering process by council has been an outright imposition of the hunter on the Mahenye community.

The political and economic crisis currently affecting the country, which started in 2000, has negatively affected the performance of CAMPFIRE projects throughout the country. This has mainly been felt through a decline in tourist arrivals into the country owing to increased negative international publicity (Clover and Eriksen, 2009), with travel warnings against

Zimbabwe issued in most of the major tourist source markets such as German, United States of America (USA), France, Australia and the United Kingdom (Mutana et al., 2013). In Mahenye, the decline in tourist arrivals has mainly affected ecotourism. By 2003, the occupancy rate at Chilo Lodge had declined to 20% from 73% in early 2000 with foreign tourists accounting for only 2% of the visitors (Mashinya, 2007). A key informant at Chilo Lodge indicated during an interview that the lodge had a 35% occupancy rate in 2013 while it needed an occupancy of 45% to make profit. Mahenye Ward did not receive any money from the lodge in 2013 as management claimed that no profit had been made. Under the current agreement, the lodge gives 10% of annual profits to the Mahenye community.

Concerning sport hunting, previous research in the same area by Mashinya (2007) revealed that sport hunters were not affected as much by negative political developments as conventional tourists. Similar observations were made in the current research concerning sport hunting trends as there were no reports of declining trophy hunting due to a shortage of hunters. However, the recent announcement of the suspension of the import of sport-hunted African elephant trophies from Zimbabwe by the United States Fish and Wildlife Services (USFWS) is likely to change the situation soon as some of the trophy hunting clients for the country also come from the USA. In support of its decision, the USFWS has cited ineffective law enforcement and weak governance in the parks estates that have resulted in uncontrolled elephant poaching. The ban will result in a further decline in livelihood benefits from the community conservation initiative.

The decline in tourist arrivals has also affected other income generating activities in Mahenye such as the selling of crafts. It was revealed through a group discussion, and confirmed by observation, that craft-making was one of the income generating activities that had been stimulated by CAMPFIRE, with talented individuals producing mates, hats, bags, clay pots, wood carvings among other craft ware. One interviewee indicated that the clients for his crafts, who were mainly foreign tourists, had drastically declined in numbers thereby negatively impacting on his sales. The declining craft sales in Mahenye due to dwindling tourist arrivals were further echoed by one group discussant who noted that: *I used to pay school fees for my children with income from craft sales, but now I get very little from my craft ware due to reduced tourist visits.*

The political and economic crisis also resulted in hyperinflation which reached 1 700% by 2005, rendering worthless the Zimbabwean dollar (Rihoy et al., 2010). The inflation resulted in massive losses of CAMPFIRE cash benefits which undermined community investment projects and rendered as worthless household cash dividends (Rihoy et al., 2010). In Mahenye, the last household cash dividend of Z$100 given out in 2004 was worth only a mere US$0.03 and was thus virtually useless (Rihoy et al., 2010).

One of the impacts of the political crisis in the country has been the side-lining of civic organisations by government, particularly NGOs, from participating in the development arena (Child et al., 2003; Rihoy and Maguranyanga, 2007; Rihoy et al., 2010). The impact of the marginalisation of the civic society on CAMPFIRE has been profound, as members of the CAMPFIRE Coordinating Group, consisting of governmental agencies and NGOs formed to coordinate the national CAMPFIRE programme, had played a key role in capacity-building at grassroots level (Child et al., 2003; Rihoy and Maguranyanga, 2007). The CAMPFIRE Coordinating Group also performed a crucial role in CAMPFIRE of providing neutral arbitration when misunderstandings arose among community members (Rihoy and

Maguranyanga, 2007). The marginalisation of civic organisations has thus resulted in the loss of critical programme partners for CAMPFIRE. The institutional implications of the marginalisation of civic organisations to the CAMPFIRE project in Mahenye are discussed in the next section on internal hindrances.

Another external hindrance to the flow of conservation-related benefits in Mahenye emanated from the undue influence on the CAMPFIRE project by the chieftaincy. It is important to note that the first CAMPFIRE chairman in Mahenye was a chief, who is now late. The second CAMPFIRE chairman, who is brother to the late chief, has served in that capacity for about four times now, and was the sitting chairperson during the time of fieldwork. Another nephew of the late chief has also previously served as acting CAMPFIRE chairman. Information gathered through group discussions and interviews in Mahenye indicated that most people who had served as chairmen or committee members in the Mahenye CAMPFIRE Committee were either related to the chieftaincy or were close acquaintances. The CAMPFIRE Chairperson for 2005 was never elected but was imposed by the chief after the duly elected chairperson had stepped down due to alleged misappropriation of CAMPFIRE funds (Rihoy et al., 2010). Under such circumstances, CAMPFIRE in Mahenye is now synonymous with the chief, which has compromised the integrity of the community project. It emerged through interviews and group discussions that the power monopoly and hegemony of the chieftaincy over the Mahenye community CAMPFIRE project was being legitimised through political patronage. The ruling Zimbabwe African National Union Patriotic Front (ZANU PF) party has a stronghold in Mahenye and is heavily patronised by the traditional leadership, hence the immense influence of the chieftaincy over the community-based conservation project.

It was also interesting to discover that the chief, who was not a committee member, was getting a monthly allowance of US$40 from CAMPFIRE. Interviews also revealed that sometimes the chief asks for CAMPFIRE money to cover his personal travelling costs or for beer drinking. It was also revealed through group discussions and interviews that, at times, the chieftaincy asks for money from CAMPFIRE for sponsoring ZANU PF meetings in the ward, with any dissenters accused of being opposition supporters. In this case, the chief is now additionally abusing politics and promoting corruption to unfairly gain from the community CAMPFIRE project.

The stranglehold of the chieftaincy on CAMPFIRE was also evident in the filling of the employment opportunities being generated by the community-based conservation project in Mahenye. For example, the Mahenye CAMPFIRE Committee secretary was also employed as the head of the bar at Chilo Lodge. A study by Mashinya (2007) in the same area also revealed that most of the jobs allocated for locals at Chilo Lodge and the now-closed Mahenye Lodge were being taken by the ruling clan and its allies, particularly since 2000. She cited cases of the then CAMPFIRE chairman (who is also the current chairman) and the then deputy chairman closely related to the chief, who were employed by Chilo Lodge as community tourism officer and head chef, respectively.

The external hindrances to the flow of livelihood benefits from the community conservation area to the Mahenye community have some important implications on biodiversity conservation and livelihoods. Political ecology provides a useful theoretical framework in analysing society-environment relationships and articulates the motives, interests and actions of various actors vying for access to and control of resources (Bixter et al., 2015). The poor are often marginalised, forcing them to overexploit the natural environment to survive and

accumulate livelihoods capital. The hindrances are limiting the effectiveness of the conservation-related livelihood benefits in reducing poverty in the study area, which in turn has resulted in continued over-reliance on natural resources by residents. It is important to note that the livelihood benefits from the community conservation area are an important incentive among residents for supporting conservation activities.

Internal hindrances

Hindrances to the flow of conservation-related livelihood benefits internal to the Mahenye community were also identified. The political ecology framework notes that the struggles for the control of natural resources or the benefits emanating from these resources, can involve various local actors with horizontal linkages among actors (Wilshusen, 2003), which may result in the exclusion of others, often the weaker, from benefiting. Various scenarios fitting the above framework were identified in Mahenye.

Audit reports by Chipinge RDC, responses from group discussants and interviews with various key informants provided evidence indicating that the Mahenye CAMPFIRE Committee was not properly managing the community project. There was evidence of lack of proper accounting systems and procedures for the Mahenye CAMPFIRE project which has led to some financial leakages. Audit reports revealed that the Mahenye CAMPFIRE Committee was giving out loans to several people, particularly staff and committee members, and to individuals and institutions such as schools. However, the loan scheme was not sanctioned by the Mahenye community. In addition, there was no proper register to control these loans, with hardly any evidence of recovery of funds from most debtors. There was also evidence indicating that some debtors were getting new loans before paying back previous ones. Another problem revealed in the audit reports was that the giving out of loans was being done by the Mahenye CAMPFIRE Committee chairman, who appeared to be directly responsible for the management of project finances. The chairman also used his own discretion in selecting loan recipients, by-passing the Mahenye CAMPFIRE Committee which is the sole decision-making body for the CAMPFIRE project. It was also not clear whether, or what amount of, interest was being charged for the loans. In addition, key-informant interviews revealed that some of the loan recipients were either related to the elites such as the traditional leadership or closely acquainted with them. Under the above circumstances CAMPFIRE funds, which are supposed to benefit the whole community, are now benefitting the 'privileged' few.

The Mahenye CAMPFIRE Committee accounting system has also allowed for the use of funds without demanding proof of payment. This has resulted in payments with no proof that such payments were bona fide. The absence of proof of payment is cause for serious concern as misuse of funds can certainly not be ruled out. Audit reports also indicated that receipts were not properly being posted to the cash book. Several receipts were either not correctly posted to the cash book or were simply not posted at all. For example, the 2004 audit report noted a receipt for Z$90 000 which was posted to the cash book as Z$9 000, resulting in an understatement of Z$81 000. In other cases, some receipts could not be traced to the cash book at all.

Another weakness that was uncovered by the 2001 and 2004 audit reports for the Mahenye CAMPFIRE project involved the banking of cash which was usually done by the chairman. There were several occasions where cash was vouched out for banking and entered into the cash book bank column as banked yet no such amounts could be traced to deposit slips or bank statements. This was a clear indication that cash, which was supposed to have been taken for

banking, would have been used for other purposes without authorisation by the Mahenye CAMPFIRE Committee. In addition, there was evidence that the Mahenye CAMPFIRE Committee was in the habit of not preparing a bank reconciliation statement. This could be a deliberate move aimed at hiding evidence of misuse of funds. The absence of this vital record further increases the opportunities for the misuse of CAMPFIRE funds. In June 2004 Z$7 million was withdrawn for the payment of household dividends to the community. However, the actual payment totalled Z$5 415 500, leaving a balance of Z$ 1 584 500. When asked by auditors about the outstanding balance, the then chairman, who was in charge of the payments, said that the money had been used for hiring transport to ferry the cash from Chiredzi Town to Mahenye. There was, however, no documentary evidence to prove this. In any case, it was not possible for the car hire to cost that much, which is another proof of misuse of funds by the Mahenye CAMPFIRE Committee.

The above discrepancies in the accounting system run by the Mahenye CAMPFIRE Committee is proof that several leakages are occurring, resulting in the loss of CAMPFIRE revenue which is supposed to benefit all the residents of the area. This highlights the need for training committee members and project staff in basic accounting procedures and expectations. There is also a need to define areas of responsibilities between policymakers and implementers and ensuring that the CAMPFIRE chairperson is not mixed up in everything from chairing meetings to the handling of cash, which ends up leading to the abuse of project funds.

In addition to a poor accounting system, there is also evidence of poor management of CAMPFIRE projects by the Mahenye CAMPFIRE Committee. A particular case in point is the shop. At the time of fieldwork, the shop had been divided into two sections: one for CAMPFIRE and the other for the chief. The chief was renting out his section and getting monthly rentals, yet the shop is supposed to be a community project. Many residents interviewed expressed dismay in the way the shop was being run as it was now the chief's cash cow. However, those interviewed also said that they could not openly criticise the chief for fear of victimisation. Other issues of concern with the shop included:

- absence of adequate stock levels most of the time
- poor stock control practices
- poor security with doors and windows that cannot properly lock
- everyone in the CAMPFIRE Committee wanting to supervise, with responsibility not placed on a specific person, thereby confusing the shopkeeper

The grinding mill was the main source of income for the Mahenye CAMPFIRE Committee for the payment of wages to its employees. However, just as with the shop, there were also poor cash-flow records at the grinding mill. Reports from various interviewees indicated that at times the grinding mill can go for weeks or even months without operating due to lack of funds for repairs or for settling electricity bills.

The mismanagement of projects by the Mahenye CAMPFIRE Committee was also evident in the running of the vehicles under the Mahenye CAMPFIRE project. For example, the Mazda T35 truck generates revenue by ferrying people and goods. However, reports from interviews and group discussions were that the revenue generated by the truck was not fully benefitting the community as most of it was not properly accounted for. As a way of reducing the misuse of funds, the truck driver was now being accompanied by three committee members when ferrying people to and from Chiredzi Town. This measure is, however, not fool proof as these

people can still connive to misuse the money. The Mazda B2500 truck that was donated by Tshabezi Hunters for use as an ambulance at the clinic ended up being used by the then CAMPFIRE chairman for offering hiring services, with the money generated not benefiting the community. The vehicle has since broken down.

Sitting allowances for CAMPFIRE committee members, which according to the clerk currently totalled about US$6 500 per year (about US$500 per committee member per year), were one of the major expenditures of the Mahenye CAMPFIRE project. In addition, there was also a high frequency of travelling by committee members requiring subsistence allowances. The allowances were draining project resources. Most residents interviewed said that the CAMPFIRE project does not afford to pay out such huge allowances. People felt that it was unfair for committee members to continue enjoying huge allowances while other community members were no longer receiving household cash dividends. They further argued that, after all, it was the CAMPFIRE Committee which called for the stoppage of the payment of household dividends citing cash shortages. Most community members felt that, by continuing to give themselves huge allowances, the committee members were being hypocritical.

Lack of community involvement in decision-making was also identified as another important internal hindrance to the flow of conservation-related livelihoods benefits in Mahenye. When asked to rate the nature of community involvement in terms of decision-making in conservation-related livelihoods activities by the Mahenye CAMPFIRE Committee (Table 6.1), only 2.7% of questionnaire respondents in Mahenye rated community involvement as being interactive, involving joint analysis and action between the community and the Mahenye CAMPFIRE Committee. Most of the respondents (97.3%) indicated various levels of a more passive community involvement in decision-making.

Table 6.1: Respondents' rating of community involvement in conservation decision-making in Mahenye (Participation typologies adapted from Gustavsson et al., 2014)

Respondents rating of community involvement in conservation decision-making	**% Frequency (n = 150)**
Passive participation: People are being told what has already been decided. The decisions are announced without listening to people's responses	41.3
Participation by consultation: People are consulted by answering questions. People do not define the problems and do not participate in decision-making	48.7
Functional participation: Participation is seen to achieve project goals. People meet predetermined objectives. Participation may involve shared decision making but usually only after major decisions have already been made	7.3
Interactive participation: Participation is seen as a right, not just the means to achieve project goals and people participate in joint analysis and learning processes, thus incorporating multiple perspectives. Groups take control over local decisions and can determine how available resources are used; therefore, they have a stake in maintaining structures or practices)	2.7
Self-mobilisation: People participate by taking initiatives independently to change systems.	-
Total	100

The first three response categories in Table 6.1 cannot be considered as falling under the rubric of community-based conservation as they do not involve local collective action (Barrow and Murphree, 2001). Only in the last two category is the concept of community-based natural

resource management embraced. A case in point was the construction of new CAMPFIRE offices for resource monitors and the accounts clerk in 2012 where the Mahenye CAMPFIRE Committee did not consult the community. The Mahenye CAMPFIRE Committee bought 30 bags of cement for the construction project with CAMPFIRE money without informing the community. In another case, a newly elected Mahenye CAMPFIRE Committee demolished a school block at Mahenye Secondary School that was being constructed by CAMPFIRE. It later emerged that this was due to infighting within the newly elected committee through political partisanship. At the time of fieldwork, the sitting CAMPFIRE committee had three ZANU PF members, including the chairperson, while the Movement for Democratic Change (MDC) had four members, including the vice-chairperson. To this day, only the slab has been left of the school block which had reached window level. The interaction between residents and CAMPFIRE committees was also being hampered by the fact that there is only one general meeting held at the end of the year.

When asked to rate the relations between the Mahenye community and the community conservation area authority (the Mahenye CAMPFIRE Committee), 45.3% of questionnaire respondents rated them between very good (2%), good (40%) and satisfactory (3.3%). The remaining 54.7% of the respondents rated community-conservation area authority relations as either poor (12.7%) or very poor (42%). The results were indicative of not very good relations between the Mahenye community and the Mahenye CAMPFIRE Committee. When further asked to identify reasons for the poor relations between the Mahenye CAMPFIRE Committee and the Mahenye residents, most of the questionnaire respondents (53.3%), noted limited interaction as the major reason. This further highlight lack of community involvement in decision-making by the Mahenye CAMPFIRE Committee as a major internal hindrances to the flow of CAMPFIRE benefits.

Female respondents interviewed indicated that women were being marginalised from benefitting from the CAMPFIRE project in Mahenye. Of particular concern among most interviewed women was the fact that most jobs that were being generated by the CAMPFIRE project had been taken up by men. This is cause for serious concern particularly for female-headed households struggling to make ends meet. Income from conservation employment could make a significant impact on the livelihoods of these households. Some married women, however, indicated that even if they were to get the jobs, their husbands, who were hard-core traditionalists, were unlikely to let them go and work. The above cases indicate that patriarchy is also a major internal hindrance to the flow of conservation-related livelihood benefits in Mahenye. Feminist political ecology sees a gendered experience of environment, with gender shaping access to and control over natural resources (Sundberg, 2015), with the patriarchal system acting as a stumbling block to the struggle of women to join productive sectors of the economy.

The above external and internal hindrances are adversely affecting the flow of conservation-related livelihood benefits to the Mahenye community. While the external forces are more important in blocking full devolution of the CAMPFIRE project to the local community from Chipinge RDC the internal factors are negatively affecting efficiency in the CAMPFIRE project through misappropriation and mismanagement of project resources by a few individuals (which further increases scepticism on full devolution). An irate participant at the group discussion held in Mahenye lamented that "*our community used to benefit very much from CAMPFIRE when the project started but now some greedy individuals are taking most of the benefits to themselves and they are just getting away with it*". Several issues must be taken into

consideration before complete devolution can be entertained. Literature on community-based natural resource management indicates that local people's ability to manage and administer revenues from natural resources is primarily weak, partly because, due to decades of poverty and experiences of being marginalised, the temptation to be corrupt is often too great (Fabricius, 2004). The community elites often try their best to gain a disproportionate share of the benefits from biodiversity conservation projects.

Just as with external hindrances above, the internal hindrances to the flow of livelihood benefits from conservation are also limiting the effectiveness of these benefits in reducing poverty in the study area, thereby perpetuating the dependence of the residents on natural resources for livelihoods. As these hindrances are emanating from within the community itself, their impact as disincentives for supporting the community conservation initiative among residents is likely to be greater compared to the external hindrances. Measures should therefore be adopted so as to reduce or eliminate both the internal and external hindrances to ensure the flow of livelihood benefits from the community conservation area to the local community.

Conclusions and recommendations

The Chapter has identified various internal and external hindrances to the flow of livelihood benefits from the Mahenye community conservation area to the local community. One of the main external hindrances was the decline in international tourist arrivals into the country due to the negative political developments since 2000. This has negatively impacted ecotourism activities upon which the Mahenye CAMPFIRE project depends for income generation. Chilo Lodge, which oversees ecotourism activities in Mahenye, could take measures to promote domestic tourist visits to fill the gap that has been created by the decline in international tourist arrivals. One such measure could be the setting up of a competitive pricing regime that would attract visitors from within the country, which would improve occupancy rates at the ecotouristic lodge.

Another identified major external hindrance to the flow of livelihood benefits in the Mahenye CAMPFIRE project, and other similar projects across the country, has been the lack of complete devolution of appropriate authority to manage natural resources and accrue benefits at the grassroots level. This has seen RDCs retaining 41% of gross CAMPFIRE hunting revenue. This arrangement has acted as a major disincentive for natural resource management among the residents in Mahenye, leading some to poach for resources from the community-managed protected area. There is therefore a need to change the institutional framework of CAMPFIRE to allow the Mahenye community to fully benefit from local resources without the costly intermediary role of Chipinge RDC. This is, however, easier said than done considering the collapse of institutional capacity in Mahenye. The Chapter has revealed evidence of the lack of accountability in the handling of project funds by successive CAMPFIRE Committees and chairpersons in Mahenye, and complete devolution under the current conditions would thus only translate into the misappropriation of more community funds by a few individuals. There is thus a need to re-establish institutional capacity in the Mahenye CAMPFIRE project through multiple stakeholder engagement, which will ensure that the community project is transparently managed for the benefit of the whole community.

The non-involvement of community residents by the conservation area authority in decision-making has also been identified as another internal hindrance to the flow of livelihood benefits. There should thus be more regular general meetings between the Mahenye CAMPFIRE

Committee and the Mahenye residents to promote collective decision-making in the CAMPFIRE project. It would be best for the meetings to coincide with the quarterly release of hunting fees by the hunter so that the whole community decides on how the money should best be used. This will result in demand-driven community development projects capable of addressing the developmental aspirations of the people, in addition to enhancing relations between the community conservation area authority and the community.

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Chapter 7

A comparative study of rural livelihood benefits from a community-based and a private protected area in Zimbabwe

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Abstract

This Chapter compared livelihood benefits from a community-based and a private protected area in south-eastern Zimbabwe to local communities and employed mixed methods research in gathering primary data. A questionnaire was used to collect quantitative data on livelihood benefits to study communities from the protected areas. One hundred and fifty (150) respondents were selected for questionnaire interviews from each of the targeted communities through simple random sampling. Key-informant interviews and focus group discussions were also conducted for the collection of in-depth qualitative data. With some noted similarities and differences, the main livelihood contributions from the two conservation areas to the target communities included household and community income enhancement, and health and educational services provision. While the livelihood benefits from the protected areas were important, most of the respondents in both study sites noted that these were not adequate in meeting the developmental needs and aspirations of their communities. This calls on the protected areas to bring more meaningful livelihood benefits to the study areas. Community-based conservation has dominated conservation-development rhetoric in Zimbabwe since the 1980s. The importance of the results of this Chapter therefore lies in the fact that they highlighted private protected areas as an equally significant platform, just as community-conserved areas, on which to simultaneously pursue conservation and livelihoods goals.

Keywords: *Chizvirizvi, community-conserved area, livelihood benefits, private-protected area, Mahenye, Malilangwe*

Introduction

During the late 19th century and much of the 20th century, the dominant conservation strategy in the world was the establishment of protected areas through state action in the form of national parks (Carter et al., 2008; Kreuter et al., 2010; Massey et al., 2014; Romero et al., 2012; Sloan et al., 2014). Since the establishment of Yellowstone National Park in the United States of America (USA) in 1872, national parks and other government-protected areas have long served as the conventional tool for biodiversity conservation (Langholz, 2009). Since then, governments worldwide have set aside protected areas covering over 30 million km^2 of land, with many countries having reached the international requirement of formally protecting at least 10% of their territorial surface area (Langholz, 2009).

It, however, became apparent in the second half of the 20th century that national parks were not adequate as a tool to effectively protect the world's biodiversity from decline and species from extinction as was originally hoped (Kreuter et al., 2010; Langholz, 2003, 2009; Nelson, 2010; Romero et al., 2012). A diverse array of factors increasingly challenged the prevailing state-centric natural resource policies and management practices across much of the world (Nelson, 2010), with many governments, particularly in developing countries, increasingly lacking financial and other resources needed for the effective conservation of biodiversity (Horwich and Lyon, 2007; Holmes, 2013). It also became apparent that islands of protection were inadequate for maintaining spatially heterogeneous biodiversity (Kreuter et al., 2010). Additionally, state-led conservation, mainly characterised by strict protection, was increasingly resented by the often poor natural-resource dependent communities bordering most protected areas especially in developing countries, as evidenced by illegal encroachments (Adams and Hutton, 2007; Bennett and Dearden, 2014; Buta et al., 2014).

The struggle for solutions has led to new approaches, with most of this new conservation effort being directed on communal and private lands outside the formal protected national parks (Langholz, 2003; Bond, 2004; Romero et al., 2012). Community-based and private protected areas have been hailed as the preferred models of participation and devolution in natural resource management by extending resource use, management and control to individuals and communities (Langholz, 2003). A general trend in protected area governance approach, since the second half of the 20th century, has thus been a shift towards decentralisation and sustainable use. Such an approach has been hatched out of the sustainable development thinking that emerged roughly around the same period. This thinking has since set in motion an ongoing paradigm shift from the traditional sense of a protected area, with an increasingly vocal proportion of the conservation community now supporting the view that allocating land for biodiversity conservation needs to be reconciled with sustainable use at the local level, so as to enhance the livelihoods and opportunities of the poor (Scherl et al., 2004; Miller, 2014). These trends have spurred an emergence in the conservation literature of terms such as 'pro-poor conservation', 'conservation with a human face', 'parks for people', 'conservation and development', 'community conservation', among other associated terms (Wilshusen et al., 2003; Roe and Elliot, 2006; Miller, 2014).

This study took a comparative analysis of two of the main biodiversity conservation approaches in Zimbabwe, namely, a privately-owned protected area, Malilangwe Private Wildlife Reserve, and a community-based protected area, the Mahenye Community Conservation Area, in terms of their livelihood benefits to local communities, and sought to answer the following research questions:

(i) What livelihood benefits were being derived from the protected areas by the study communities?
(ii) What were the similarities and differences in the livelihood benefits being derived from the protected areas?
(iii) What were the views of the study respondents on the contributions of the protected areas to the socio-economic development of their communities?

There is an apparent dearth of a comparative perspective in the literature on the livelihood impacts of the various conservation approaches in the country. The few comparative studies that have been conducted, for example Bond (1999) and Mashinya (2007), have all focused on comparing community-based conservation cases, with none comparing cases from different conservation approaches. This paucity in comparative research into the conservation-development nexus in Zimbabwe has hampered meaningful policy debate. The comparative perspective on two different conservation approaches that this study adopts therefore attempts to close a research and knowledge gap, and thus has potential to bring out new insights to the discourse on conservation and development in Zimbabwe, since it adopts an approach that has not been embarked upon by previous researchers. The study draws some of its data from two earlier papers on the same study sites (Chigonda, 2017a; Chigonda, 2017b), with the comparative perspective in the current study bringing out insights that the independently produced previous works did not, and could not, bring out.

The Sustainable Livelihoods Framework (SLF) provided a frame of reference for this research and has become a popular framework for the analysis of livelihoods. The SLF posits that households make a living by using five types of assets (natural, physical, human, social and financial) in an environment influenced by several macro-level and micro-level institutional and structural factors (Carney, 1998; Chimhowu and Scoones, 1998; Hulme, 2006; Bennet and Dearden, 2014). While the framework has been criticised, it is especially relevant for studying protected areas in their interaction with adjacent communities. In the context of this study, the SLF is useful as a tool for analysing the livelihood impacts of protected areas on livelihood outcomes and assets in local communities.

Various socio-economic impacts of protected areas have been identified. These impacts can either be positive or negative depending on the nature of the laws, policies, institutions and processes operating within the protected areas. Table 7.1 shows some of the potential socio-economic impacts of protected areas on local communities. This study focused on the positive livelihood impacts of two conservation areas on local communities.

Table 7.1: Potential socio-economic impacts of protected areas on local communities

Benefits	Costs
• Increased food security • Increased wealth • More household assets • Higher levels of employment • Diversified livelihood options • Greater access to health and social infrastructure • Revitalized cultural institutions • Improved governance • Greater community organization • More participation in natural resource management • Increased empowerment of women • Reinvigorated common property regimes • Increased resilience	• Decreased food security • Increased restrictions • Decreased power and alienation from natural resource management • Forced migration • Loss of assets • Increased poverty • Loss of social and educational facilities • Inequitable distribution of benefits • Loss of tenure • Increased social tension • Increased conflict and political struggles • Exacerbated vulnerabilities • Negative socio-cultural changes • Reduced adaptive capacity

Source: Adapted from Bennett and Dearden (2014)

Materials and methods

Study sites

The two case study sites, the Mahenye Community Conservation Area and Malilangwe Private Wildlife Reserve, represent a community-based conservation area and a privately owned protected area respectively, and these were selected as cases for comparing their livelihood benefits to local communities.

Mahenye (S 21° 7' 0", E 32° 22' 60") lies in south-eastern Zimbabwe in the southern tip of Chipinge District in Manicaland Province, measuring 210 km^2 in extend (Fig. 7.1). The Mahenye community is situated between the Save River in the west; the Rupembi River in the east, also demarcating the international border with Mozambique; with the Mutandahwe community forming the northern boundary (Murphree, 2001; The Africa Resources Trust, 2002). Across the Save River in the south is the northern boundary of Gonarezhou National Park and also the Sangwe Communal Land in Chiredzi District (Murphree, 2001; The Africa Resources Trust, 2002).

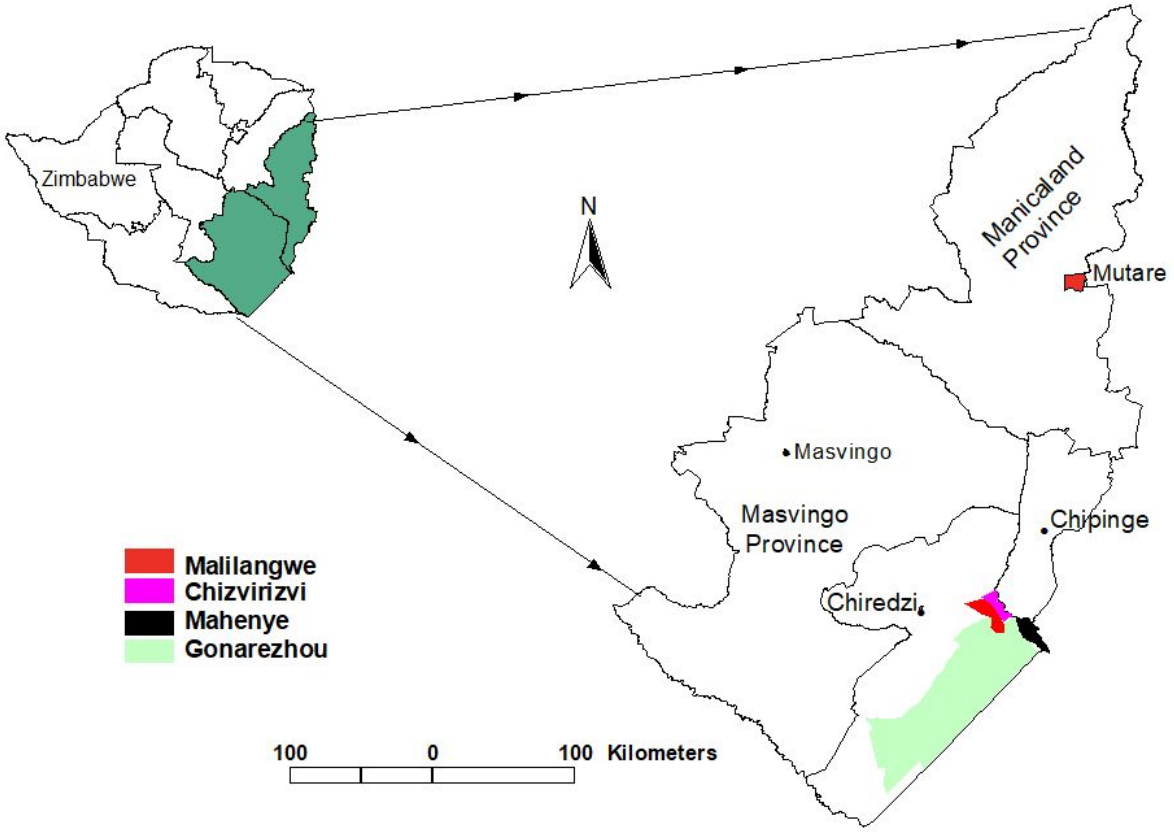

Fig. 7.1: Location of Malilangwe, Chizvirizvi and Mahenye in the south-east lowveld, Zimbabwe

Mahenye is one of the first communities to be involved in the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE), a national community-based natural resources management programme that seeks to promote sustainable natural resource utilisation in communities bordering public protected areas in Zimbabwe which started in the late 1980s and early 1990s (Murphree, 2001; Balint and Mashinya, 2006). The Mahenye CAMPFIRE project started in 1990 following the granting of appropriate authority to Chipinge RDC to manage wildlife in the district on behalf of local communities.

Like the Mahenye Community Conservation Area, Malilangwe Private Wildlife Reserve (20°58'–21°15'S, 31°47'– 32°01'E) is also situated in south-eastern Zimbabwe but in a different district and province, that is, Chiredzi District in Masvingo Province (Fig. 7.1). The private protected area is bordered by Gonarezhou National Park to the south, Hippo Valley Game Reserve to the west, the Chiredzi River to the west, while the Chizvirizvi resettlement area marks the eastern boundary of the protected area (Capon et al., 2013). In addition, the Runde River divides Malilangwe Private Wildlife Reserve from Matibi II communal land in the southwestern corner, while a resettlement area forms the northern boundary. Malilangwe Private Wildlife Reserve came into existence in 1994 following the merging of two properties, forming one of the largest private protected areas in Zimbabwe.

In addition to their proximity, the Mahenye Community Conservation Area and Malilangwe Private Wildlife Reserve came into existence around approximately the same time period, 1990 and 1994 respectively. Their experiences with conservation-development initiatives have thus occurred within a similar time frame thereby further enhancing their comparability.

The Chizvirizvi resettlement area on the eastern border of Malilangwe Private Wildlife Reserve was chosen as a case for assessing the livelihood benefits of the private protected area to surrounding communities. On the other hand, since Mahenye is a community-based conservation area, the investigation of its livelihood benefits was therefore confined to the same area.

Research design, data collection and analysis

This Chapter, which compares two conservation cases, namely, a community-based conservation area and a private protected area, in terms of their livelihood benefits to local communities, employed the comparative case study approach as a research design. One strength of the case study approach is that it allows for the examination of a particular instance in a greater deal of depth (Rule and John, 2011). The singularity of focus of a case study also makes it more manageable than a large-scale survey or wide-ranging policy review, especially in a research situation facing constraints of time and resources (Rule and John, 2011; Thomas, 2011). Another strength of the case study approach is that it can use a very wide variety of methods, both for data collection and analysis, depending on what is appropriate to the case (Bryman, 2008; Rule and John, 2011; Thomas, 2011). The in-depth study of the two cases was thus conducted using mixed methods. Both quantitative (questionnaire) and qualitative (interviews, group discussions and observation) approaches were thus employed in carrying out primary research in the case study areas. Such a mixture of data collection techniques enables the case study approach to obtain a rich output of data which helps in achieving data convergence (Yin, 1994; Biggam, 2011). The data collection instruments used in the two cases were similar in terms of content and administration procedure so as to legitimise comparison of information gathered.

For the questionnaire, 150 household surveys apiece were conducted in Mahenye and Chizvirizvi. The questionnaire solicited for information on perceived livelihood benefits from the conservation areas to the case study communities, with households for questionnaire interviews selected through simple random sampling. Names of all the household heads in Mahenye and Chizvirizvi were written on small pieces of paper and then drawn from hats. The lists of households were obtained from the councillors of the two study areas.
Key-informant interviews were held with various individuals in Mahenye, Malilangwe and Chizvirizvi. The key informants were identified through purposive sampling. A focus group discussion was held in Mahenye and another in Chizvirizvi, with each of the two groups having a total of 15 discussants. Key-informant interviews and focussed discussions enabled the gathering of in-depth information on the livelihood benefits from the conservation areas to the respective local communities. Observation was also employed both as a data gathering instrument and as a means of verifying information gathered through the other primary sources of data.

Descriptive statistics were used to describe and analyse quantitative data obtained through the questionnaire, with the responses from study respondents computed into percentage frequencies. The responses were then presented either as frequency tables or were simply incorporated in the text as individual figures to aid in the description, analysis and discussion of the results. On the other hand, qualitative data gathered through interviews, focused discussions and observation were processed through narrative analysis in line with the research

objective and research questions. The collected and processed mixed data were then used corroboratively in addressing the research objective.

Results and discussion

A comparative summary of the livelihood benefits from the Mahenye Community Conservation Area and Malilangwe Private Wildlife Reserve to the Mahenye and Chizvirizvi communities respectively is presented in Table 7.2. The Mahenye Community Conservation Area has generated income in Mahenye at the community level, while Malilangwe Private Wildlife Reserve has not contributed any income at the community level in Chizvirizvi. Community-level income generation from the Mahenye CAMPFIRE project has come about because of ecotourism and sport hunting activities in the area. The CAMPFIRE programme granted Rural District Councils appropriate authority to manage wildlife on behalf of local communities, with all revenue generated through ecotourism, sport hunting and other wildlife management activities accruing into respective Rural District Council accounts instead of central treasury. Rural District Councils are then required to disburse 55% of the accrued revenue to the wildlife producing communities. Between 1990 and 2000, the Mahenye community received a total of US$96 631 from Chipinge RDC out of ecotourism, trophy hunting and other wildlife management activities conducted in the community conservation area (The Africa Resources Trust, 2002). However, receipts from ecotourism and trophy hunting in Zimbabwe have drastically declined following the general international isolation of the country, particularly from the west, due to some negative political developments since 2000. The Mahenye community has further generated more income by investing some of the money received from Chipinge RDC into other income generating projects, including a grinding mill, a shop, and a truck which is hired by various clients, among other investments. A key informant for the Mahenye CAMPFIRE project noted that the grinding mill and shop generate an average monthly income of about US$1300.

Table 7.2: Comparison of livelihood benefits from Mahenye community conservation

area and Malilangwe private wildlife reserve

Livelihood benefits	Mahenye	Chizvirizvi
Household-level income enhancement	- Employment creation - Selling of crafts - Cash dividends	- Employment creation - Selling of crafts - Gardening projects - Self-contained pots
Community-level income enhancement	- Accrued revenue from trophy hunting and ecotourism - Investment of CAMPFIRE revenue in projects such as: -grinding mills -shops - truck for hire	
Education enhancement	- Construction of two classrooms Blocks at Mahenye primary school - Construction of classroom block, toilet and teachers' house at Mahenye secondary school - Bursary scheme	- Refurbishment of Benzi and Mwenje primary schools - Bursary scheme - Electrification of Mwenje primary and Dumisani secondary schools - Donation of computers, stationery, textbooks, sporting equipment - Availing of cash and book prizes on prize-giving days - Facilitated an exchange programme between Dumisani secondary school and a sister school in the USA
Health promotion	- Construction of toilets at Mahenye Clinic - Electrification of Mahenye clinic - Connection of Mahenye clinic to water and telephone lines - Regular supply of game meat from sport hunting	- Construction of waiting mothers' shelter at Chizvirizvi clinic - Construction of the new Chizvirizvi clinic - Conversion of old clinic into nurses' house - Child supplementary Feeding scheme - Sponsoring the control of malaria and human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS)

Both the Mahenye Community Conservation Area and Malilangwe Private Wildlife Reserve have, however, contributed towards household-level income enhancement in the Mahenye and Chizvirizvi communities respectively. 16.7% (n = 25) and 10% (n = 15) of study respondents in Mahenye and Chizvirizvi, respectively, indicated that they, or a household member or members, had a conservation-related job. Chilo Lodge, which oversees ecotourism activities in the Mahenye community-conserved area, employed a total of 33 local residents, while Zambezi Hunters, currently holding the hunting concession in Mahenye, employed 5 locals. The Mahenye community itself, under the leadership of the Mahenye CAMPFIRE Committee, has further created more job opportunities out of the various earlier-noted income generating projects it operates. Furthermore, the Committee employs some locals as resource monitors, for protecting and monitoring the community conservation area upon which CAMPFIRE is based. Similarly, Malilangwe Private Wildlife Reserve has also created employment opportunities for the residents of Chizvirizvi. However, while Malilangwe employed a total of 320 employees, the actual number of Chizvirizvi residents employed by the private protected area could not be established.

A striking similarity with the conservation-related jobs being offered by both conservation areas to the target communities was the low-skilled nature of the jobs. Residents of both Mahenye and Chizvirizvi were being employed as game scouts, cooks, cleaners, gardeners, security guards, tour guides, shop keepers, grinding mill operators and resource monitors, among other occupations requiring no specialised skills. This comes as an advantage to the lowly educated residents of these communities.

Table 7.3 shows the monthly salaries that study respondents in Mahenye and Chizvirizvi, or members of their households in conservation-related employment, were earning. The average monthly salary from conservation-related employment in Mahenye and Chizvirizvi was US$191 and US$258 respectively. The average salary in Chizvirizvi was higher than in Mahenye, with 13% (n = 2) of study respondents earning above US$400 in the former, while there was none in this salary category in the latter, hence the bigger salary range (r) in Chizvirizvi (US$375) than in Mahenye (US$300). It was reported that eight employees had left Chilo Ecotourism Lodge in Mahenye for Malilangwe Private Wildlife Reserve in search of improved salaries. The study revealed that Malilangwe Private Wildlife Reserve attracts more international high-spending eco-tourists and safari hunting clients than the Mahenye Community Conservation Area and is therefore more likely to afford higher salaries than the community-conserved area and its partners.

Table 7.3: Monthly household income from conservation employment (US$) (in %)

Monthly income from conservation employment	Mahenye (n = 25)	Chizvirizvi (n = 15)	Total (n = 40)
50-100	24.0	6.7	17.5
151-200	32.0	-	20.0
201-250	28.0	53.3	37.5
251-300	-	26.7	10.0
301-350	12.0	-	7.5
351-400	4.0	-	2.5
>400	-	13.3	5.0
Total	**100** *x = 191* *r = 300*	**100** *x = 258.3* *r = 375*	**100** *x = 216.3* *r = 375*

The Mahenye Community Conservation Area and its partners and Malilangwe Private Wildlife Reserve have also enhanced household incomes in Chizvirizvi and Mahenye through the stimulation of local craft-making activities. The conservation areas regularly host international and local tourists which have boosted the local crafts-making market. The stimulation of the craft-making business was confirmed by 71% (*n* = 107) and 52% (*n* = 78) of study respondents in Mahenye and Chizvirizvi respectively, and also through interviews with key informants and group discussants in both target communities. The Kambako Cultural Centre in Chizvirizvi and the Mahenye Traditional Home Centre have been constructed with help from Malilangwe Private Wildlife Reserve and Chilo Lodge respectively and have since turned out to be vibrant craft-making-and-selling centres for the residents of the two communities.

The Mahenye Community Conservation Area has further boosted household incomes in Mahenye by regularly disbursing household cash dividends out of some of the money received from Chipinge RDC for sport hunting and ecotourism activities. The household dividends averaged between US$10 and US$30 per annum between 1990 and 2000 (Balint and Mashinya, 2006). However, the last dividends were paid out in 2004 because of declining international tourist flows into the country, which has negatively affected revenue generation for the Mahenye CAMPFIRE project. On the other hand, Malilangwe Private Wildlife Reserve has not provided any household cash dividends to the residents of Chizvirizvi.

The residents of Chizvirizvi now occupy large landholdings averaging approximately 75 hectares each, which came because of Malilangwe Private Wildlife Reserve's availing of funds to government for the surveying and demarcation of the plots. The large plots have made it possible for most households in the resettlement area to produce surplus maize, sorghum and millet for sale, something they were not able to do on the small landholdings initially allocated to them by government. This has enhanced the incomes of many households in the area. Additionally, Malilangwe has also sponsored the setting up of community gardens in some parts of Chizvirizvi to produce various horticultural products. Surplus produce from the gardens is often sold for cash income, thereby further boosting the incomes of the beneficiaries to the project. On the other hand, the Mahenye Community Conservation Area and its partners have not undertaken any agrarian interventions in Mahenye.

The two conservation areas have also supported educational activities in the target communities, with some similarities and differences in the educational interventions by the two protected areas noted. The Mahenye Community Conservation Area has channelled some of the CAMPFIRE-generated revenue towards the construction of two classroom blocks at Mahenye Primary School; one classroom block, a toilet and a teachers' house at Mahenye Secondary School, while another CAMPFIRE-funded classroom block was still at slab level at the secondary school. Unlike the community conservation area which has embarked on constructing new structures at the two schools in Mahenye, Malilangwe Private Wildlife Reserve has renovated already existing structures at Benzi and Mwenje Primary Schools in Chizvirizvi. All classroom and toilet blocks at the two primary schools have been refurbished and repainted. In addition, the private protected area has connected Mwenje Primary and Dhumisani Secondary Schools in Chizvirizvi to the national electricity grid, something which the community-conserved area has not done for the schools in Mahenye.

Both protected areas have also bankrolled some bursary schemes for underprivileged but academically gifted students in Mahenye and Chizvirizvi, with the private protected area going a step further by funding the education of some students from Chizvirizvi at various tertiary institutions across the country. The bursaries by both conservation areas have however been scaled down since 2000 due to the prevailing economic challenges facing the country.

One other way in which Malilangwe Private Wildlife Reserve has enhanced education in Chizvirizvi has been through the occasional donation of stationery, textbooks and sporting equipment and uniforms to the schools in Chizvirizvi and beyond, in addition to the donation of computers and a printer to Dhumisani Secondary School. Malilangwe also regularly avails cash and book prizes for excelling students on prize giving days to the schools in Chizvirizvi and surrounding areas. An exchange programme between Dhumisani Secondary School and a sister school in the USA was facilitated by Malilangwe in 1999, though it never took off following negative political developments in Zimbabwe since 2000.

The two conservation areas have also contributed towards health enhancement in the target communities. Malilangwe's involvement in efforts to improve community health in Chizvirizvi started with the fencing of the old Chizvirizvi Clinic in 1997. In 1999, Malilangwe went a step further through the construction of a waiting-mothers' shelter at the clinic. The construction of the new Chizvirizvi Clinic by Malilangwe Private Wildlife Reserve in 2001, coupled with the sourcing and donation of some medical equipment and supplies to the new clinic, has been hailed as the biggest undertaking by the private protected area, so far, in its efforts to improve health in the resettlement area. Another notable contribution by Malilangwe to health improvement in Chizvirizvi is the ongoing child supplementary feeding scheme to mitigate malnutrition. Unlike in Chizvirizvi where Malilangwe has constructed a new clinic, the Mahenye Community Conservation Area has only financed the construction of toilets at Mahenye Clinic. The community-conserved area has also connected Mahenye Clinic to the national electricity grid, telephone and water supply, while sport hunting activities have improved the diets of the residents of Mahenye through community access to the regular supply of game meat from animals killed during sport-hunting.

The SLF identifies five assets necessary for the successful pursuit of livelihoods namely, human, financial, natural, social and physical capital (Scoones, 1998). The protected areas have contributed to these assets within the study communities in various ways. For example, enhancement of human capital has occurred through the promotion of education and health.

Additionally, the construction and refurbishment of educational infrastructure by the protected areas was a form of physical capital development. Employment creation, household cash dividends, and the stimulation of the craft-making business were some of the ways through which the protected areas have enhanced financial capital in the study areas. Most of the study respondents in Mahenye (77.3%) (n = 115) and Chizvirizvi (89.3%) (n = 134) regarded the livelihood benefits from the Mahenye Community Conservation Area and Malilangwe Private Wildlife Reserve, respectively, as important forms of community development. However, 80.1% (n = 92) and 73.1% (n = 98) of the study respondents viewing the livelihood benefits as a form of community development in Mahenye and Chizvirizvi, respectively further indicated that the livelihood benefits had not brought adequate development to their communities. This calls for more efforts from the community-conserved and private-protected areas to bring adequate, and hence more meaningful, development in the target communities.

When asked what they wanted the protected areas to do to bring adequate development to their areas, all study respondents in Chizvirizvi (n = 98) and 73,7% (n = 68) of study respondents in Mahenye, who had indicated that the protected areas had not brought adequate development to their areas, cited the development of irrigation. All study respondents in the target communities also indicated that the protected areas could fund the production of drought-resistant crop varieties and livestock rearing for meaningful development across the study areas. This further highlighted the importance of farming to local livelihoods, and the challenge posed by climate induced aridity to agricultural development.

Conclusions

Various livelihood benefits from the Mahenye Community Conservation Area and Malilangwe Private Wildlife Reserve to the Mahenye and Chizvirizvi communities respectively were identified. With some similarities and differences noted, the livelihood benefits included income generation opportunities and service provision enhancement in health and education.

While conservation-livelihoods discourse in Zimbabwe has inarguably become synonymous with community-based conservation since 1980 as evidenced by the now universally acclaimed CAMPFIRE catch-phrase, the results of this Chapter are important in the sense that they show that other conservation approaches, such as private protected areas, are apparently, and increasingly, becoming important to the conservation-development milieu in the country. The Chapter has shown that, comparatively, while the Mahenye Community Conservation Area fared much better than Malilangwe Private Wildlife Reserve in terms of income enhancement both at community and household levels, on the other hand, the private protected area seemed to fare much better than the community-conserved area in the provision of health and education services in the target communities. This highlighted the fact that, other conservation approaches should now increasingly be factored in debates on conservation and development in the country, the results of which should eventually be incorporated into policy frameworks informing the conservation-livelihoods nexus in Zimbabwe.

The Chapter therefore recommends that more comparative studies of all the major conservation approaches in the country should be carried out so as to come up with a robust, all-inclusive and well informed framework. This will ensure a more sustainable marriage of the ever-elusive twin goals of conservation and development.

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CHAPTER 8

Threats to non-timber forest products: the case of mopane worm harvesting and utilisation in Matebeleland South Province, Zimbabwe

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Abstract

We investigated socio-economic drivers of Mopane worm harvesting in Matobo District of Zimbabwe in April 2015. The snowball technique and purposive sampling were used to collect data through questionnaire interviews of 80 households involved in mopane worm harvesting. Key informants and interviewees provided information on how harvesting techniques and regulation of harvesting of mopane worms is affecting perceptions about mopane worm availability and utilisation. The harsh economic environment drives unsustainable harvesting practices and users perceived mopane worms to have declined over the past decade as evidenced by reduced harvests and no mopane worm outbreaks in some seasons. The decline was attributed to increased temperatures, unreliable rainfall, overharvesting and discarding indigenous knowledge in the harvesting of mopane worms. There were significant associations between employment status, level of education, religious affiliation and mopane worm utilisation (χ^2test, $P < 0.05$) and non-significant associations between gender, household head, marital status, location and the utilisation of mopane worms (χ^2test, $P > 0.05$). Harvesting of mopane worms was primarily for subsistence, but commercialisation has increased over the years. This potentially threatens livelihoods and requires an active engagement of all stakeholders in crafting and enforcement of sustainable methods of harvesting mopane worms.

Keywords*: Perceptions; natural resource managers; sustainable*

Introduction

Mopane worm (*Imbrasia belina)* has been confirmed as the most popular and lucrative caterpillar on the African continent (FAO, 2013). The mopane worm feeds primarily on the leaves of mopane trees (*Colophospermum mopane)* which are mainly found in the hot and low-lying areas of south tropical Africa including the northern parts of South Africa and Namibia, Botswana, Zambia, Mozambique, Malawi, Angola and Zimbabwe (Timberlake, 1995). The invertebrate consumes and produces more dry matter than elephants (Styles, 1996). Non-timber forest products (NTFPs) such as mopane worms are gradually being recognised as a key component of rural livelihood systems (Gondo *et al*., 2010; Makhado *et al.,* 2014; Taru and Chazovachii, 2015). According to Heubach (2012), the contribution of NTFPs to total household income was approximately 15 % in Malawi, 27 % in Northern Ethiopia and 35 % in Zimbabwe.

Neumann and Hirsch (2000) define NTFPs as the biological materials (other than industrial round wood and derived sawn timber, wood chips, wood-based panels and pulp) that may be extracted from natural ecosystems and be utilized within the household, be marketed, or have socio-cultural or religious significance. Jimoh (2006) extended this definition by including ecosystem services such as water purification and prevention of soil erosion. In this Chapter, such services are not considered. Mopane worm harvesting was mainly for subsistence use by rural households in many parts of Zimbabwe and it contributed significantly to rural diets (Ghazoul, 2006; Kwiri*et al*., 2014), but in recent years it has become an important resource for improved household income as mopane worms are sold in urban markets (Hobane, 1994; Stack *et al*., 2003; Gondo *et al*., 2010; Thomas, 2013). Harvesting of mopane worms is mainly based on beliefs, local knowledge and local-level institutional frameworks of control (Maviya and Gumbo, 2005; Mufandaedza *et al*., 2015; Ndeindoma and Weirsum, 2016). Despite the importance of mopane worms to rural livelihoods, there is currently no information on the management of the worm in formal extension systems. The same observation was made in Namibia (Thomas, 2013), South Africa (Shackleton, 2009) and Botswana (Lucas, 2010).

The population of the mopane worms are on the decline due to minimal barriers to entry into the collection areas and an increase in trading of the worm which has resulted in their exploitation, declining selective harvesting (Hobane, 1995; Mutopo, 2014) and general decrease of the mopane woodlands due to use as firewood and timber (Makhado *et al.,*2014). The commercialisation of the mopane worm in Southern Africa has also led to overharvesting, coupled with the indifference of local people and increased demand which have all accelerated the degradation of many valuable NTFPs (Mutenje *et al*., 2011). The harvesting of mopane worms for commercial purposes started in the 1990s in Southern Africa (Hobane, 1995; Kozanayi and Frost 2002). People started using motorised transport, moving away from their own communities and travelling to faraway places to harvest mopane worms (Ashipala *et al*., 1996; Rebe, 1999). The commercialisation of mopane worm harvesting, and increased harvesting pressures make resource use, access and control increasingly difficult (Lucas, 2010). Mopane worms are being sold for cash and in some regions, they are bartered for food, clothes, household utensils, cigarettes, alcohol, or machetes (Stack *et al*., 2003; Thomas, 2013). In Zimbabwe, mopane worms can be sold for cash or bartered for goods such as toiletries, kitchen utensils, mealie meal and second-hand clothes especially in the remote areas where food and household suppliers are in short supply (Kozanayi and Frost, 2002).

Resource availability influences harvesting decisions that people make pertaining to harvesting techniques and amounts harvested (Hobane, 1994). Mopane worm outbreak sizes vary within and between seasons and they interact with various human factors (economic status, level of

education, religious beliefs etc.) (Thomas, 2013). The outbreaks are associated with drivers of decision making around where, how much, what and how to harvest and possibly how this may have changed over time (Rebe, 1999). Reports of the disappearance of the mopane worm have been recorded in some parts of Botswana following heavy harvesting (Bartlett, 1996). In Zimbabwe, declines in the Matebeleland area have been attributed to excessive harvesting (Roberts, 1998). Human harvesting is considered as a type of predation of the last instar phase and this ecological driver of predation is driven by social and economic drivers of demand (Heubach, 2012).

Many rural communities in Zimbabwe face uncontrolled harvesting of NTFPs especially by people who are not resident in the area (Hobane, 1994; Roberts, 1998).There is very limited attention which has been given to the management of NTFPs in most communal lands (Shackleton, 2002).The harvesting of mopane worms has not been placed within formally regulated and controlled resources; as it is largely based on local knowledge, and local-level institutional frameworks of control (Thomas, 2013).Utilisation of mopane worms has not been based on scientific research, which is a potential threat to communal people's livelihoods as well as the natural resource base (Roberts, 1998).

Resource users of mopane worms have their own understanding about availability of mopane worms, as well as the abiotic and biotic factors affecting mopane worm outbreaks within and between seasons (Ghazoul, 2006). The impacts of harvesting on subsequent populations and perceived trends in mopane worm availability were studied in the Matobo area of Matebeleland South Province. The aim of the study was to assess how current utilisation and harvesting of mopane worms under the traditional management has affected the sustainability of the resource. The study objectives were to establish the socio-economic drivers of mopane worm harvesting and the perceptions that resource users have about mopane worm availability.

Materials and Methods

Study Area

The data collection for this Chapter was done in Matobo District of Matebeleland South Province of Zimbabwe, located between latitude 21°00′00″S and longitude 28°30′00″E. Matobo District is one of the seven districts in Matabeleland South Province. It is bounded to the west by Bulilima and Mangwe districts, to the east by Gwanda and Umzingwane districts, to the north by Bulawayo City and Umguza district and to the south by Shashe River which serves as a natural border between Zimbabwe and Botswana. Matobo District covers an area of 7 220 km^2 consisting of Commercial farms, Communal Lands; Resettlement areas; National Park and Self-Contained Plots (Moyo & Dube, 2014). It largely lies in agro-ecological region V, with a small portion to the north in region IV. Agro-ecological region IV is characterized by rainfall amounts ranging between 450-650mm per year and frequent and long dry spells during the rainy season. Agro-ecological region V is characterized by rainfall amounts that are below 450mm per year. The two agro-ecological regions are also characterized by high temperatures ranging from 18-25^{o}C (Mugandani *et al*., 2012).

Matobo District has a population of 93 991 people in 20749 households (ZimStat, 2012). The area is occupied by the Ndebele and Kalanga tribal groups and some other immigrants that may have moved into the area. English is the national official language, including Ndebele, Shona and Kalanga, some of the languages spoken in the area. Out of a total of 25 wards in the district, 15 wards harvest mopane worms.

Sample selection and data collection

The communal lands of Beula ward in Kapeni and Beula villages; and Madwaleni ward in Ndiweni and Mangala villages were selected for the study (Fig. 8.1). These wards were selected as they are prime producers of mopane worms in the district. Beula ward is dominated by Kalanga people and has a population of 4668 in 930 households while Madwaleni ward is dominated by Ndebele speaking people and has a population of 4326 in 980 households (Zimstat, 2012).

Two wards which were previously studied by Ghazoul (2006) were selected to compare and explain any observed changes. Two villages were randomly selected from each ward, Beula and Kapeni villages in Beula ward and Mangala and Ndiweni villages in Madwaleni ward of Matobo RDC. Purposive sampling and the snowball technique were used in the selection of participants. Key informants were identified for in-depth interviews and they comprised a member from the community leadership and Matobo RDC, the CAMPFIRE manager and a Forestry Commission (FC) officer.

The natural vegetation in the selected wards is mainly savanna composed of drought resistant trees (*Colophospermum mopane* and *Acacia* species). Mopane woodland occurs in varying densities across the District. The area is dominated by colluvium soils that support mopane savanna and is high in arenosols (ar), with sandy or loamy sand texture. Beula Ward is characterised as a high mopane woodland zone and Madwaleni Ward as a low to medium woodland zone.

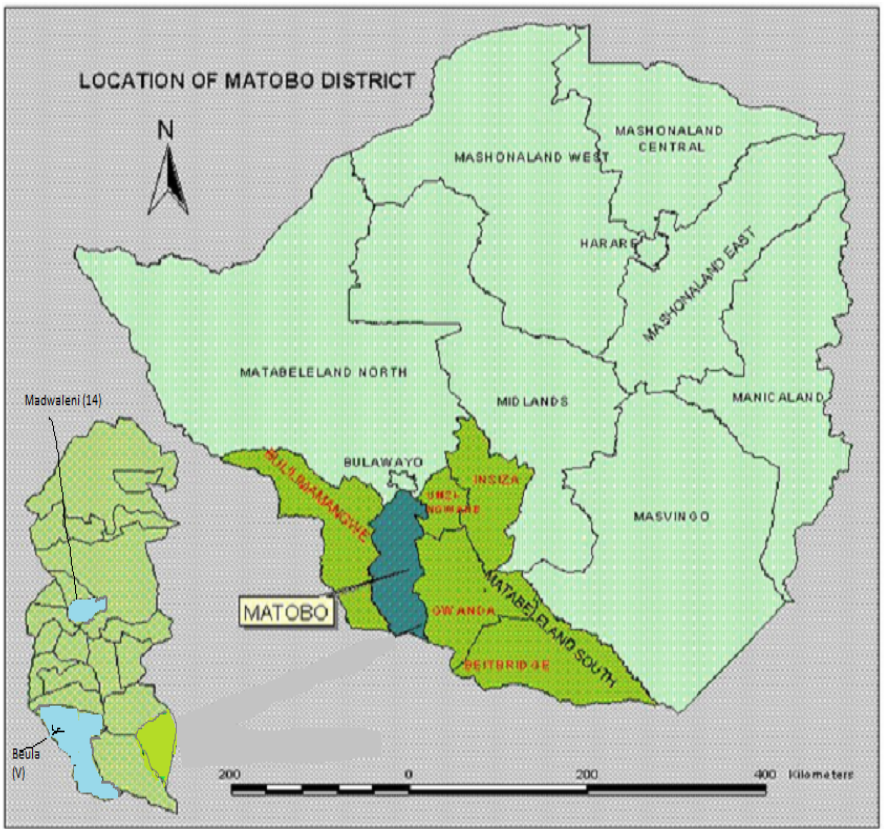

Fig. 8.1: The position of Madwalani Ward in Matobo District. *Source: Department of Surveyor General (2012).*

The data consisted of primary and secondary data. Secondary data was from the previous work conducted in Matobo Rural District Council (RDC). Primary data was from the research study

which was carried out in April 2015 and used qualitative techniques to assess the socio-economic factors affecting mopane worm utilization, harvesting and perceptions on mopane worm availability.

Questionnaires were administered targeting mopane worm harvesters who have been harvesting mopane worms for more than 5 years to capture historical information. Interviews were conducted in the local languages. A total of 80 questionnaires were administered to households in Beula and Madwaleni Ward with 40 participants from each ward. The questionnaire had both open ended and close ended questions and it was administered to one member of the household who had been in the business of harvesting mopane worms for more than five years. The respondents comprised of 16 males and 64 females. They ranged in ages from below 30 to above 70 and the majority had received primary and secondary education with only one respondent having a diploma qualification. Of the respondents, 65% were unemployed, 30% self-employed and 5% formally employed which constituted 32.5% female-headed households and 67.5% male-headed households. Regarding religion, 74% of the respondents had a Christian background and 26% believed in the African tradition.

Data analysis

Data set from questionnaire response were summarized using descriptive statistics. The Statistical Package for Social Sciences (IBM SPSS Version 20, Mrmonk, New York) was used to analyze the data. Data was presented as frequencies where several responses were possible. Chi-square ($\chi 2$) tests for independence were used to analyse association between the various socio-economic factors and mopane worm utilisation. Differences were significance at $P \leq 0.05$. Data from key informants was used to gain insight on the regulation of mopane worm harvesting.

Results

Socio-economic drivers of mopane worm utilization

The study revealed that 5% of respondents harvested mopane worms for the sole purpose of consumption whilst others combined household consumption with cash sales, barter trade and other combinations of use as shown in Fig. 8.2. The diversity of resource users' socio-economic backgrounds affected the way they utilised mopane worms. Among the Christian respondents, members of the Zimbabwe Christian Church (ZCC), Seventh Day Adventist (SDA), Apostolic sect and Zion did not eat mopane worms. The probability value obtained from the Chi-test results of <0.001 (df = 18)showed that there is a strong association between mopane worm utilisation and diffent religious groups.

Other socio-economic drivers that had very low p-values which indicated a strong association between the factor and mopane worm utilization were the employment status of the respondent ($P < 0.001$; DF = 6) and level of education ($P = 0.003$; df = 6).However, there was no association between mopane worm utilization and gender ($P = 0.464$; df = 3); marital status of respondent ($P = 0.339$; df = 3), sex of the household head ($P = 0.707$; df = 3) and also the ward from which the respondent came from ($P = 0.607$; df = 3).

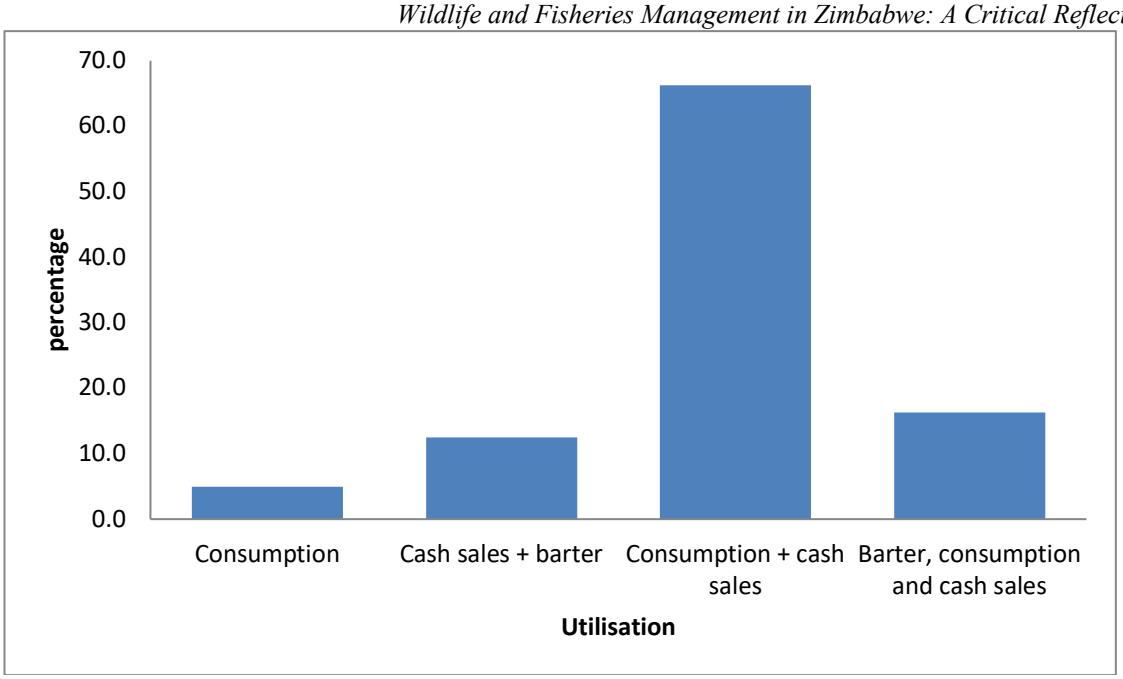

Fig. 8.2: Utilisation of mopane worms

Perceptions about trends in mopane worm availability

The results showed that 96% of the harvesters felt that mopane worm populations have decreased, 3% thought that they have remained the same and 1% did not have an opinion about how mopane worm availability has been changing over the years. Harvesters displayed varied perceptions on the causes of decline in mopane worms' population as depicted in Fig. 8.3. Respondents constituting 61% felt that the noticed trends in the mopane worms were due to climatic influences such as unreliable rainfall and high temperatures. 9% of respondents attributed the decline in mopane worm availability to failure to obey taboos. The common taboos that are no longer being adhered to were "*Do not roast mopane worms on charcoal, boil them"* and "*Do not cook mopane worms with the pot-cover on*".

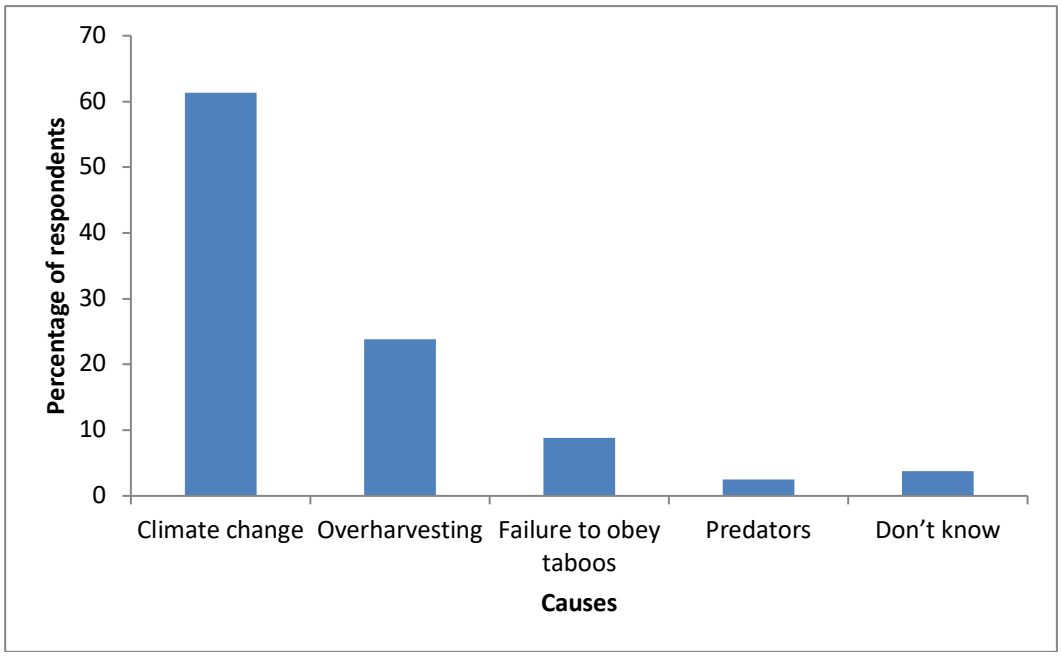

Fig. 8.3: Possible causes of mopane worm decline

Twenty four percent (24%) of household respondents indicated that changes in mopane worm availability were due to overharvesting of the resource due to increase in commercialisation of the resource and increase in the number of harvesters, 2% identified predators like birds as causing declines in mopane worm availability and 4% of respondents could not identify possible causes of the declining populations. Mopane worm harvesters employ various strategies in harvesting the resource as shown in Table 8.1.

Table 8.1: Harvesting practices used

Harvesting practice	Frequency (n = 80)	Percentage
Collecting mopane worms from the ground	6	7
Hand picking from trees (4^{th} and 5^{th} instars)	71	89
Cutting down of trees for easy collection	3	4

Addressing Sustainability

The key informants indicated that Matobo Redowas not issuing resource users with permits to control and give them access to harvest mopane worms. Permits are only given to the buyers of mopane worms as a way of restricting harvesting, but some buyers operate informally without permits. The Forestry Commission (FC) administers the Forest Produce Act but does not effectively implement the laws restricting the harvesting of mopane worms. The Matobo RDC uses by laws developed under CAMPFIRE but there are challenges in enforcing them. The FC safeguards the host tree (*Colophospermum mopane*) by giving permits for cutting down timber. Traditional leaders are not involved in monitoring the harvesting of mopane worms and villagers make their own decisions on the starting and ending dates of harvesting.

Discussion

Socio-economic drivers of mopane worm utilization

Most rural people depend on NTFPs as sources of livelihoods as they have limited sources of income, making trading the most common reason for utilization (Akpala *et al*., 2009).This prompted the harvesting of mopane worms dominantly for consumption and cash sales in order for the people to make a living.There were more female than male harvesters as has been postulated that the harvesting and utilisation of mopane worms is women's task (Kozanayi and Frost, 2002; Mufandaedza *et al*., 2015)Some studies showed no gender effects and the differences can be attributed to changes in gender duties and responsibilities in society(Lucas, 2010; Martin and Villareal, 1997; Stack *et al*., 2003). The economic situation in the country affects both female or male headed households. This situation creates an overlap of household duties and responsibilities between males and females (Oppong*et al.,* 2009; Stack *et al*., 2003).In the face of economic hardships, roles interchange (Lucas, 2010) and may cause no association between mopane worm utilisation and marital status and gender.

According to Gondo and Frost (2002), some religious groups regard mopane worms as being unclean and unfit for consumption and thus limiting the involvement of their households in mopane worm utilisation (Stack *et al*., 2003). The results are in agreement with the findings of Zhou (2003) who observed that members of the Apostolic sect participated in harvesting of mopane worms for the sole purpose of selling unlike the non-apostolics who have no restrictive religious laws.

Highly educated people do not usually get involved in the harvesting of mopane worms (Lucas, 2010). This clarifies the strong association between mopane worm utilisation and level of education. Generally, the employed individuals hardly harvest mopane worms because of good income earning opportunities (Stack *et al*., 2003) thus explaining the association between employment status and mopane worm harvesting. The formally employed may have little time to spend on harvesting mopane except for consumption. Stack *et al.,* (2003) observed that most harvesters who harvested for trading purposes and consumption were the unemployed.

Perceptions about mopane worm availability

Rainfall amounts in Matobo district have been decreasing over the last four decades and temperatures have been increasing steadily (UNDP, 2007; Stern, 2007). The decline and unreliability in rainfall affects the development of mopane worms (Heubach, 2012) and death usually occurs. Disappearance of mopane worms have been recorded in some parts of Zimbabwe and Botswana (Barlett, 1996) and similar observations have been made in Kruger National Park, South Africa, where very high day temperatures and lack of rainfall caused drying of mopane worms which were seen dead under mopane trees and shrubs, (Toms and Thangwana, 2005). Thus, climatic factors may play a significant role in the availability of mopane worms.

The negative effects of overharvesting due to commercialisation and increase in the number of harvesters were highlighted and other studies indicated that mopane worms are facing threats of overexploitation (Toms and Thangwana, 2005; Yen, 2009). Overharvesting has been attributed to commercialisation of the worm (Rebe, 1999; Mutanga, 2009; Stack *et al*., 2003; Gondo *et al*., 2010; Lucas, 2010) whilst in the past, harvesting of mopane worms used to be for subsistence only (Ashipala *et al*., 1996). According to Ghazoul (2006), the best time for collecting mopane worm larvae is when they are coming down the tree for pupation as this leads to their sustainable utilisation. Poverty, low income and the quest for survival result in local people over-harvesting mopane worms to the detriment of environmental sustainability (Mufandaedza *et al.,* 2015). Harvesting practises of cutting down trees contribute to the low density of mopane woodlands (Gullan *et al*., 2005). Commercial harvesters employ unsustainable practices like climbing trees, cutting branches and whole trees to get mopane worms (Thomas, 2013).

Conclusion

The utilisation of mopane worms is affected by diverse socio-economic factors such as employment status, level of education and religious affiliation. Most people in Matobo District depend on NTFPs as sources of livelihoods as they have no other source of income making trading the most common reason for utilization. The governance structures for mopane worm harvesting are mainly based on trust and kinship ties, where rules and regulations are not strictly enforced. The resource managers in Matobo do not give permits for the harvesting of mopane worms resulting in outsiders "illegally harvesting" the resource. It would be prudent to employ mopane worm farming technologies in the same manner that captive breeding has been used to address wildlife species threatened by extinction.

Combinations of natural and anthropogenic factors are having serious implications on the availability of mopane worms. Resource managers should adopt adaptive harvesting technologies and integrate indigenous knowledge concerning mopane worm utilisation and harvesting into formal management systems. Sustainable harvesting practises should be enforced as the harvesting practices which are widely used in Matobo district are unsustainable.

Acknowledgements

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Chapter 9

Quenching the Thirst for Zimbabweans: Anthropogenic Activities and Their Impacts on Freshwater Ecosystems

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Abstract

This Chapter aims to provide an awareness of the impacts of human activities on water and stimulate respect for the aquatic environments. Most human activities are primarily directed towards achieving some specific purposes (e.g., industrial production), though they have indirect and unintended effects on ecosystems (e.g., siltation) which affects freshwater ecosystem integrity and valuable ecosystem services. In Zimbabwe, freshwater ecosystems are being altered and degraded by intense anthropogenic activities such as water abstraction, discharge of untreated sewage, mining etc., leading to water-shortage, and a water-supply crisis that threatens the country's development. Although statutory bodies- such as Environmental Management Agency and Zimbabwe National Water Authority (ZINWA); and legislation- such as the Water Act and Environmental Management Act, responsible for ensuring sustainable management and protection of freshwater resources have been developed, the possibilities of lessening ecological impacts of anthropogenic activities in Zimbabwe remain uncertain at best. This Chapter demonstrates that maintaining healthy aquatic ecosystems while meeting other demands on freshwater will require improvements in the planning and management of freshwater resources.

Keywords: *biodiversity conservation, inland water systems, pollution, water management*

Introduction

Freshwater ecosystem services are vital to human life and economic wellbeing (Connor, 2015; Harrison et al., 2016). Societies rely heavily on rivers, lakes, wetlands, and underground aquifers to supply water for irrigating crops, municipal and industrial processes (Harrison et al., 2016).The success of human civilization is largely attributed to their skills as ecosystem engineers(Tanner, 2001). Although human activities are primarily directed towards achieving some specific noble purposes (e.g. agricultural and industrial production), most have major indirect and unintended effects on freshwater ecosystems (e.g. siltation, eutrophication and water pollution) which affects biotic integrity of aquatic ecosystems (Allan, 2004). The benefits of the extractive uses of freshwater usually overshadow the equally vital element of ecosystem integrity (Revenga et al., 2000; Baron et al., 2003; Kohler et al., 2015). Two-thirds of the world's largest rivers are moderately to severely fragmented by dams and reservoirs and in some regions 95 per cent of wetlands have been lost (Armenteras and Finlayson, 2012a; Pastor et al., 2014; Grill et al., 2015; Hennig and Magee, 2017).

Available scientific evidence suggests that freshwater biodiversity is progressively declining, with substantial and ongoing losses of populations, species and habitats (Armenteras and Finlayson, 2012a; McLarney et al., 2016; Ding et al., 2017; Macdonald et al., 2017). Biodiversity declines are reportedly much faster in the tropical freshwater ecosystems utilized by humans (Armenteras and Finlayson, 2012b). Freshwater fishes are vulnerable, and constitute one of the most threatened animal groups whose biodiversity is decreasing faster than any other group (Timberlake, 2000). Degradation of freshwater species and ecosystems leads to loss of a wealth of ecosystem services provided by healthy freshwater ecosystems to human society worldwide (De Groot et al., 2012; Beier et al., 2017; Yi et al., 2017).

The continued human population increase, and water demand for agriculture, industry and domestic uses, is increasingly straining water resources in some parts of Zimbabwe (Ministry of Mines Environment and Tourism, 1998). The total human population in Zimbabwe was last recorded at 13.1 million people in 2012 from 3.8 million recorded in 1960, a 289 % change during the last 50 years (ZimStat, 2013). Between 2015 and 2032, the population of Zimbabwe is projected to increase from 13.1 million to 19.3 million (Zimstat, 2015). This population growth has serious implications for food security (agriculture), industrial production and urban expansion, all of which exert increasing pressure on the already constrained freshwater resources thus, posing a significant challenge to water resources management.

The seriousness of the water management challenges being faced by Zimbabwe is underscored by the fact that many dams have been reported to be eutrophic, due to reduced river inflows, elevated fertilizer runoff and effluent discharges resulting from increased anthropogenic activity in catchments (Moyo, 1997; Magadza, 2003b; Nhapi and Tirivarombo, 2004).Streams passing through urban areas are polluted by direct incessant discharge of raw municipal sewerage due to frequent sewer bursts and uploading of untreated effluent from industries (Magadza, 2003a; Magadza, 2008; Ndebele-Murisa, 2012; Bere and Nyamupingidza, 2014). Worsening these challenges is the reality of climate change in the country. The climate change situation in Zimbabwe is regarded an extreme scenario (Davis, 2011), with predictions of lesser rainfall and increased temperatures.

This Chapter focusses on the ecological impacts associated with anthropogenic activities on freshwater resources in Zimbabwe. The aim of this Chapter is to critically analyse the current threats to freshwater resources in the country and discuss their implications on the sustainability of such a critical life component. The Chapter also gives science-based solutions to minimize or prevent the ecological damage caused by these threats.

Freshwater Ecosystem Integrity

Karr and Chu (2000) described five dynamic environmental factors that regulate the structure and functioning of aquatic ecosystems (Fig. 9.1). These factors comprise, flow pattern, energy source, biotic interactions, physical habitat structure and water quality. Evaluating freshwater ecosystem integrity requires that all five of these dynamic environmental factors be integrated and considered jointly.

The flow regime is a major determinant of physical habitat in streams, which in turn is a major determinant of biotic composition (Armanini et al., 2012). Water allocated for freshwater ecosystems (environmental flows) must therefore be in the context of the natural variability of the flow regime (Mathews and Richter, 2007). Resilience within these ecosystems is maintained by a range of natural variation or disturbances e.g. occasional flooding and seasonal droughts (Baron et al., 2003; Peters et al., 2016).

The structure and functioning of freshwater ecosystems are also determined by catchment or water shed characteristics and their dynamics (Baron et al., 2002; Mwedzi et al., 2016a). Materials generated across the landscape ultimately make their way into rivers, lakes, and other freshwater ecosystems. Thus, these systems are greatly influenced by what happens on the catchment, including human activities. Periodic and episodic water flow patterns also influence water quality, physical habitat conditions and lateral and longitudinal connections, and energy transfer in aquatic ecosystems(Gasith and Resh, 1999). Freshwater ecosystems have therefore evolved and adapted to a specific range of environmental conditions favourable for their survival.

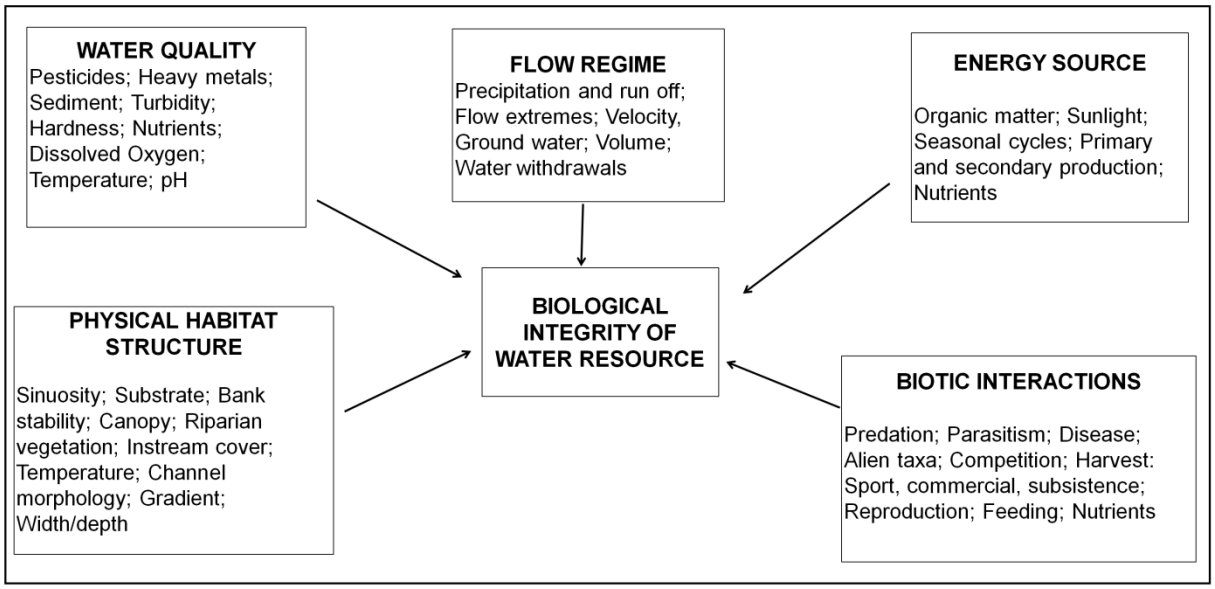

Fig. 9.1: Schematic representation of the five dynamic environmental factors that regulate the structure and functioning of any aquatic ecosystem (Karr and Chu, 2000).

Threats to Freshwater ecosystems in Zimbabwe

Habitat loss

Habitat loss is a process of environmental change in which a natural habitat is rendered functionally unable to support the species present (Reza and Abdullah, 2011; Estavillo et al., 2013). This process may be natural or anthropogenic, and may be caused by fragmentation,

destruction, or degradation of habitat (Reza and Abdullah, 2011; Estavillo et al., 2013). It results in habitat conversion or isolation of elements that were once connected, thereby reducing population viability and ecosystem resilience (Nilsson et al., 2005; Lawler et al., 2006).

Anthropogenic and natural factors (including damming, rechanneling, dredging, pollution, siltation, flooding, underground leakage) are responsible for habitat loss in aquatic systems in Zimbabwe (Minshull, 1993). However, natural factors are responsible for a small percentage of the total habitat lost globally over the past 10,000 years causing minor destructions compared to the systematic destruction of habitat by human activities(Redman, 1999; McKee, 2005; McKee and Chambers, 2011). Habitat loss is considered the greatest threat to species across the globe being the greatest threat to 85% of all species described in the IUCN's Red List of Threatened Species(Armenteras and Finlayson, 2012b).

It has been noted that land use change influences both species richness and abundance of fish, diatoms and macroinvertebrate communities (Mangadze et al., 2015; Mwedzi et al., 2016a; Siziba et al., 2017). Gratwicke and Marshall (2001) reported that *Barbus* fish species were threatened throughout southern Africa by dam construction, pollution and other factors. Gratwicke et al. (2003) observed that species richness and abundance of fish were lower on commercial farms in Manyame Catchment (Zimbabwe) where most streams were regulated by dams and where exotic predators were present compared to communal lands where subsistence farmers had not built dams, leaving the streams unregulated, and where exotic predators were generally absent. Butler and Du Toit (1994) described the Cape clawless otter (*Aonyx capensis)* population in Zimbabwe's Eastern highlands rivers as fragile owing to habitat loss more than any other reason. They noted that the habitat was being destroyed by deforestation, logging, and agricultural land expansion which is escalating in the unprotected areas of the communal lands.

Water Pollution

Point and non-point water pollution impacts water quality, dramatically altering the survival of hydrobionts (Wetzel, 2001). The main sources of water pollution in Zimbabwe are agricultural runoff, mining, sewage and solid waste disposal, domestic and industrial effluents (Moyo, 1997; Magadza, 2003a; Magadza, 2008; Mangadze et al., 2015; Mwedzi et al., 2016a). Water pollution emanating from inadequate processing of sewage, leakage of pipes and breakdown of equipment is typical of all cities and towns in the country (Mhlanga et al., 2013; Mwedzi et al., 2016a) (Fig. 9.2).

Fig. 9.2: Water pollution in Zimbabwe, A-C tributaries of the Manyame River in Chinhoyi and D -Mazai River- a tributary of Umguza River in Bulawayo. Photos by Tongayi Mwedzi (year).

Mhlanga et al. (2013) reported that Victoria Falls discharges inadequately treated sewer and industrial waste into the Zambezi River upstream of Lake Kariba. However, Lake Kariba has so far had a diluting effect due to its huge capacity. This diluting effect has not been reported in other lakes in the country where pollution continues to increase at an alarming rate and the natural purification systems are overburdened (Mhlanga et al., 2006; Ndebele and Magadza, 2006; Ndebele, 2009). The general breaks down in service delivery by most municipalities in the country leads to pollution of surrounding water resources which manifested itself in such events as the outbreak of cholera, at the peak of economic meltdown (2008-2009) in the country (Fig. 9.3).

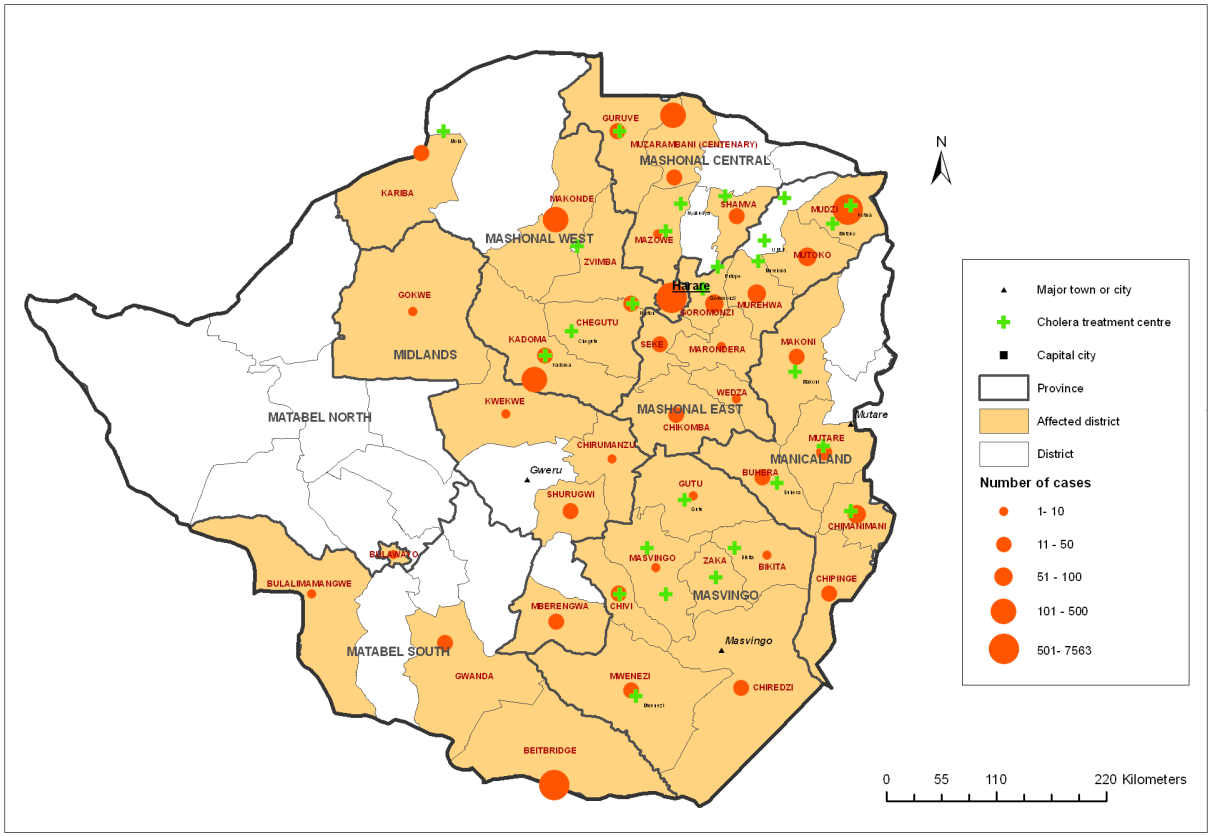

Fig. 9.3: The number of cholera cases reported in 2008 in Zimbabwe. Source: World Health Organisation (2008).

There are records of dichlorodiphenyltrichloroethane (DDT) accumulation in crocodile fat and crocodile eggs following the use of DDT in controlling tsetse fly and mosquitoes in Kariba and the Zambezi Valley (Timberlake, 2000). Intensive fish farming also has its own consequences, leading to the excretion of high concentrations of nutrients in the water (Timberlake, 2000). Increased nitrate and phosphate levels (from faeces or uneaten food) can cause algal blooms (including some toxic species) and mass fish mortality events (Ndebele and Magadza, 2006; Tendaupenyu, 2012). Another source of pollution which may be present in effluent from *Oreochromis niloticus* farms is artificial hormones. Tilapia farms use 17-methyl testosterone to create all male populations, which have larger body sizes and are thus more profitable. The long-term effects of this hormone to health and the environment are yet to be determined.

Eutrophication – A special type of water pollution

Eutrophication is a process by which lakes, rivers, and coastal waters become increasingly rich in plant biomass as a result of the enhanced input of nutrients (mainly nitrogen and phosphorus) (Corcoran et al., 2010; Nyenje et al., 2010). Eutrophication leads to increased species mortality and changes in species assemblages, and is a current problematic issue in Zimbabwe (Marshall, 2005; Nyenje et al., 2010; Thornton, 2012).Various town councils in the country do not meet the technical standards for sewage treatment, garbage collection and urban drainage following the economic downturn (Nhapi, 2009). Raw sewage is being dumped into the waterways turning freshwater into acrid anoxic bodies which can only be tolerated by few specialized species (Magadza, 2003a; Magadza, 2008).

Lakes Chivero is a classic example of a hyper eutrophic lake in the country. The lake first showed signs of eutrophication in the mid-1960s and 1970s (Magadza, 2003a), became mesotrophic in the early 1980s (Thornton, 1982) following the enactment of the 1975

Rhodesian Water Act, and tragically reverted to the eutrophic state which has morphed into the current hyper eutrophic state (Magadza, 2008). This trend can easily be followed by looking at records of Phosphorus regime and conductivity over the years (Table 9.1). The current phosphorus loads are the same as those of the 1960's in which the lake was considered to be hyper eutrophic.

Table 9.1: Historical changes in conductivity and phosphorus regime in Lake Chivero (Thornton, 1982; Magadza, 1997; Magadza, 2003a; Ndebele and Magadza, 2006)

Parameter	1967	1978	1996	2006
P load (tonnes per annum)	685(27.4 gm^{-2})	39.6 (1.5gm^{-2})	350 (14gm^{-2})	
Mean P concentration (mgL^{-})	2.8	0.13	1.8	2.67 (2.42-3.18)
Conductivity (scm^{-1})	160	120	800	2124.5

Eutrophication enhances plant growth capacity leading to an increase in rooted or floating macrophytes, or phytoplankton (giving water a green colour). Ndebele and Magadza (2006) reported a tenfold increase in Lake Chivero's primary productivity from its previously reported range of 1.64- 6.03 g C m^{-2} h^{-1} in 1979 to a new range of 18.5- 140 g C m^{-2} h^{-1} in 2005. The resultant high primary productivity increases fish production in the early stages of eutrophication but as the process continues, conditions worsen and lead to a decrease in fish species diversity (Timberlake, 2000).

Eutrophication is undesirable because of water quality deterioration, interference with water use, and corresponding economic losses. Eutrophication can change the recreational value of water bodies and impair related activities such as swimming and fishing. Perhaps, the most important consequence of the eutrophication of Lake Chivero is the dense blooms of blue-green algae and the presence of water hyacinth *(Eichhornia crassipes*, Fig.9.4 (Ndebele and Magadza, 2006)). Blooms of blue-green algae cause problems with water purification, and concerns have been raised about the toxins produced by the *Microcystis* species. Furthermore, when stratification is disrupted by overturn, oxygen depletion and release of toxins caused by algal bloom die-off during this period leads to massive fish mortalities, as has been observed in Lake Chivero (Moyo, 1997; Mhlanga et al., 2006). Eutrophication changes in Lake Chivero has also resulted in a progressive decrease in phytoplankton species diversity with the Cyanobacterial species (*Microcystis aeruginosa)* dominating and *Aulacoseira* species (*Melosira*) co-dominating the phytoplankton community (Mhlanga et al., 2006; Ndebele and Magadza, 2006).

Introduction of alien invasive hydrobionts

Introduction of alien species has been cited as the greatest driver of biodiversity loss, posing a threat to freshwater ecosystem integrity and function and therefore, to human well-being in Zimbabwe (Ministry of Environment & Natural Resources Management, 2010; Mhlanga et al., 2013; Marufu et al., 2014). The altered range of environmental variation resulting from climate change, pollution and altered flows further exacerbates this problem. Some non-native species that can thrive better under these new conditions, severely modify food webs, alter ecological processes (such as nutrient cycling) and contribute to the extinction of native species (Mhlanga et al., 2013). The major problematic aquatic alien species in Zimbabwe are: Water hyacinth (*Eichhornia crassipes*) and the Nile tilapia (*Oreochromis niloticus)* (Fig. 9.4). The potential threats presented by the Australian Red Claw Crayfish (*Cherax quadricarinatus)* has also received attention of late (Marufu et al., 2014).

Fig. 9.4: The two major problematic aquatic alien species in Zimbabwe; Water hyacinth (A) (Photo by Colin Wilson); Nile tilapia (B) (Photo by Pam Fuller - United States Geological Survey); and the new potentially aquatic environment threatening species Australian Red Claw Crayfish (C) (Source: Belle and Yeo (2010))

Water hyacinth (Eichhornia crassipes)

Water hyacinth has been recognized as one of the top 10 worst weeds in the world and has attracted international attention as an aggressive invasive species (Shanab et al., 2010; Zhang et al., 2010; Gichuki et al., 2012). The weed is efficient in utilizing aquatic nutrients and solar energy for profuse biomass production and thus tends to invade water bodies where hydrological or nutrient conditions have been altered by human activities (Brendonck et al., 2003). Water hyacinth has been a constant problem in the Manyame river basin inland lakes and rivers which are contaminated with sewage effluent mainly from Harare and Chitungwiza (Chikwenhere and Phiri, 1999; Moyo and Phiri, 2002). Other large infestations are found in rivers and dams around the small towns of Masvingo, Chinhoyi and Rusape and in Lake Kariba (Chikwenhere and Phiri, 1999). The rapid increase and spread of the plant in the country is due to its reproductive output, absence of natural predators and due to favourable environmental conditions, particularly eutrophication (Chikwenhere and Phiri, 1999; Moyo and Phiri, 2002)

Water hyacinth is an invasive habitat modifier with most of its problems arising from its tendency to form a structurally complex canopy forming a dense vegetative mat. These thick mats result in enormous water losses through evapotranspiration and impede water flow thereby increasing sedimentation and causing flooding. The mats suppress the growth of native plants and submerged macrophytes e.g. submerged and rooted floating-leaved macrophytes which were common in shallow parts of Lake Chivero became scarce following water hyacinth expansion (Brendonck et al., 2003).

Due to shading and the low transparency induced by the hyacinth mats, light penetration into the aquatic ecosystem is radically inhibited (Brendonck et al., 2003). This results in net respiration of phytoplankton and in the stimulation of bacterial decay processes thereby affecting the physicochemical conditions of the water body (Brendonck et al., 2003). The mats also affect the physicochemical conditions by preventing oxygen transfer from the air to the water surface, or decreasing oxygen production by other plants and algae (Villamagna and Murphy, 2010). In addition, when the plant dies and sinks to the bottom the decomposing biomass depletes dissolved oxygen in the water (EEA, 2012). Dissolved oxygen under water hyacinth mats can reach critically low concentrations for fish that are sensitive to such changes. Low dissolved oxygen conditions promote the release of phosphorus from the sediment which in turn accelerates eutrophication and leads to a further increase in water hyacinth or algal blooms (Bicudo et al., 2007).

There are three common control methods that have been used to suppress water hyacinth infestations, i.e., physical, chemical, and biological controls in Zimbabwe. However, these methods have often been insufficient to contain the aggressive weed due to lack of continued policy and management support by governments (Villamagna and Murphy, 2010; Gichuki et

al., 2012). This is the case with Lake Chivero where the weed was controlled and declined from 42% in 1976 to 22% in 2000. However, re-invasion began to emerge in 2005 (UNEP, 2008) and by 2012 the weed had taken over the lack again (Fig. 9.5). The most effective control method therefore remains the control of excessive nutrients and prevention of the spread of this species.

Chemical control of water hyacinth is the least recommended, because of its long-term effects on the environment and human health. Physical control is performed by land-based machines such as bucket cranes, draglines or by water-based machinery such as aquatic weed harvester, dredges, or vegetation shredder. This method is costly and time intensive and is only considered a short-term solution to a long-term problem.

As chemical and mechanical removal is often too expensive and ineffective, researchers have turned to biological control agents where the natural predators of water hyacinth are introduced into the system (Villamagna and Murphy, 2010; Dagno et al., 2012). In this regard, two South American weevil beetles (*Neochetina eichhorniae* and *Neochetina bruchi*) and two water hyacinth moth species (*Niphograptaalbig uttalis* and *Xubida infusella*) have had tremendous success in the long-term control of water hyacinth in many countries, notably at Lake Victoria (Kenya) and Louisiana (USA) (Williams et al., 2007; Dagno et al., 2012; Gichuki et al., 2012; Venter et al., 2013). Biological control methods (weevils) followed by chemical control (Roundup, a glyphosate herbicide) were used at Lake Kariba in 1996 and 1997 following an outbreak (Mhlanga et al., 2013). However, the weed continued to proliferate until a decision to control the weed using aerial spraying of 2,4Dichlorophenoxyacetic acid (2,4D) was made. This was done in the Gache gache and Nyaodza Rivers on the Zimbabwean side of Lake Kariba (Mhlanga et al., 2013)

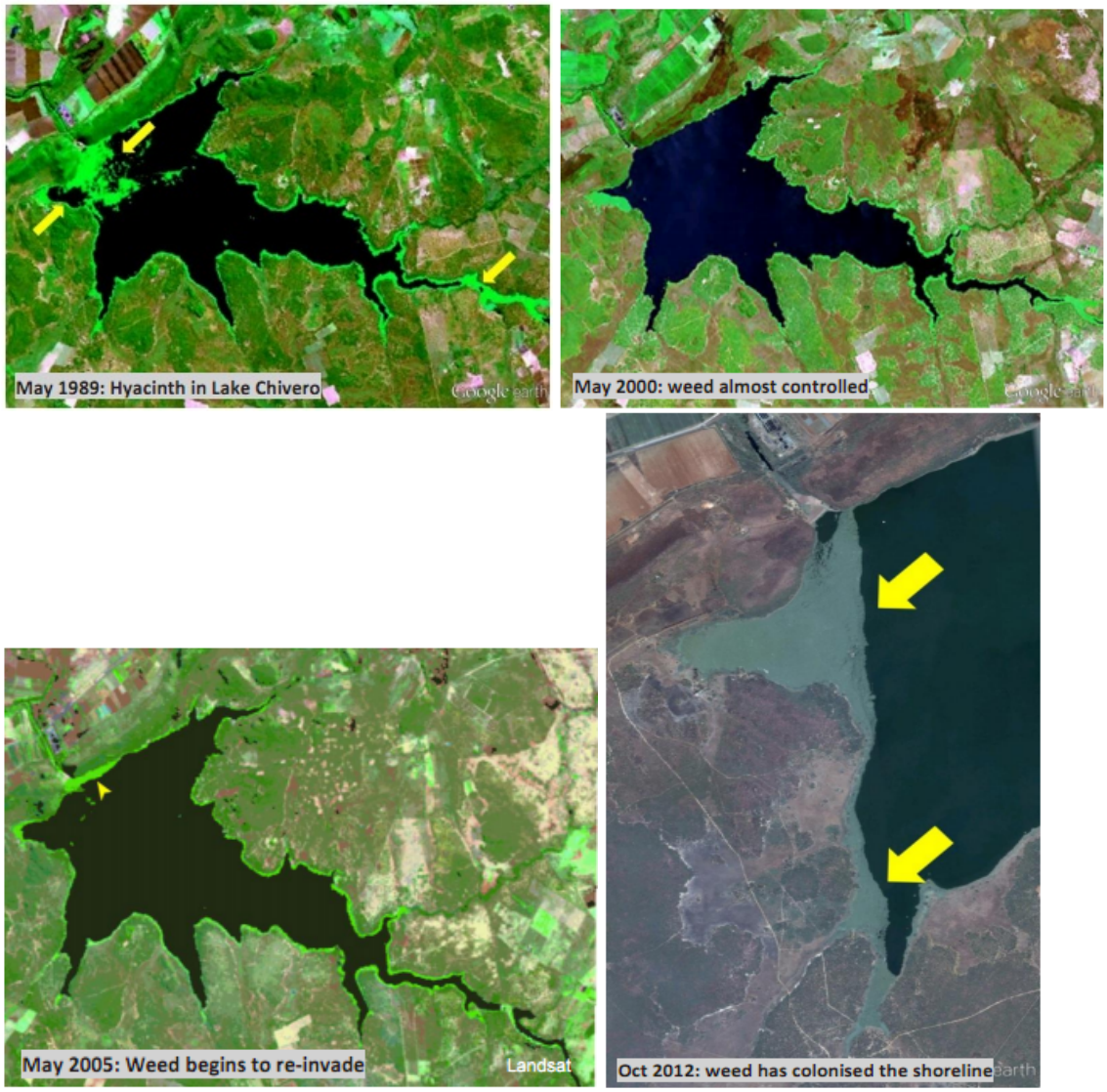

Fig. 9.5: Satellite images showing progressive invasion, control and re-invasion of water hyacinth on Lake Chivero, Zimbabwe (shown by the yellow arrows) Source: UNEP (2013).

The Nile tilapia (Oreochromis niloticus)

The Nile tilapia, *O. niloticus* is the major invasive alien fish species in Zimbabwean dams and rivers (Mhlanga et al., 2013). A major problem with *O. niloticus* is that it hybridises superbly with indigenous species such as the *Oreochromis mortimeri* which has implications on the conservation of pure strains of indigenous species(Mhlanga et al., 2013). For instance, its introduction in Lake Kariba was followed by a reduction in the catches of the native *O. mortimeri (*Kariba bream)(Chifamba et al., 2006). This is the only endemic species in the middle Zambezi- ranging from Victoria Falls to Cabbora Bassa Gorge (Chifamba and Videler, 2014). *Oreochromis mortimeri* has declined rapidly (at a rate of 80% in 10 years) in Lake Kariba and the Zambezi River being replaced by the exotic *O. niloticus (Marshall and Tweddle, 2007)*. As a result the once abundant *O. mortimeri* has been classified as critically Endangered in the IUCN Red list of threatened species (Marshall and Tweddle, 2007).

High stocking densities commonly found in aquaculture farms can also be problematic as they can lead to outbreaks of parasites and diseases if the hatchery design and management is not optimal. Some of the parasites which affect tilapia may also affect other freshwater fish. If unknown diseases are introduced, indigenous species may not have an adequate immune system to cope with them, and as a result it can lead to their demise. There is only one example

(the nation state of Palau) globally of an *O. niloticus* established population being successfully eradicated (Global Invasive Species Database – Oreochromis niloticus, 2012). The nation state of Palau used Rotenone to successfully eradicate tilapia from five invaded locations on the island (Global Invasive Species Database – Oreochromis niloticus, 2012).

Australian red claw crayfish (Cherax quadricarinatus)

The Australian red claw crayfish (*Cherax quadricarinatus*) is native to freshwater water bodies in Australia and south-eastern Papua New Guinea (Ahyong, 2014). It was accidentally introduced into the Zimbabwean side of Lake Kariba from Zambia where it is being intensively farmed for ornamental and export purposes having been introduced in 2001 (Macdonald et al., 2003; FAO-DIAS, 2011). Red claw crayfish impacts on native fauna through direct competition and predation (Bortolini et al., 2007). Concerns have therefore been raised about its potential to outcompete indigenous crustaceans and other components of the invaded communities (FAO-DIAS, 2011).

Cherax quadricarinatus is known to be omnivorous and hence it places the lake's entire aquatic ecosystem at risk as it devours the food sources of other fish (Bortolini et al., 2007). Its tendency to feed on fish eggs also places the eggs of Zambezi species like Tiger fish and others at high risk. *Cherax quadricarinatus* also has the potential to transmit new parasites (Bowater et al., 2002). It has been reported to carry a number of pathogens, including viruses, bacteria and fungi as well as protozoan and metazoan parasites (Edgerton et al., 2000; Kent Hauck et al., 2001; Romero and Jimenez, 2002).

The biggest challenge with the control of *C. quadricarinatus* is that it has no natural predators in Lake Kariba. Furthermore, the species is robust and hardy and cannot be poisoned without killing other natural species. Commercial exploitation might be the only viable solution and thus Zimbabwe Parks and Wildlife Authority is issuing *C. quadricarinatus* fishing permits and encouraging fisherman to apply for them. *Cherax quadricarinatus* is high in protein and is a delicacy reaching prices of up to US$12.00 per kg in Harare shops and restaurants (Nyamukondiwa, 2014).

Siltation

The increasing rate of riverine deforestation and land clearance in Zimbabwe and Africa as a whole, combined with poor agricultural practices and the unrelenting growth of the human populations contribute immensely to habitat loss as they subsequently lead to erosion and finally siltation (Kasangaki et al., 2008). Whitlow (1983) reported that soil losses through erosion were more than 20 times greater from cleared plots compared to secluded ones at a sand veld area in Zimbabwe. Previous studies have shown that estimates for average soil losses in communal lands are around 30-50 tonnes/km^2/annum (Chikwanha and Ward, 1979). The situation is feared to have potentially worsened since the land reform program of 2000 (Moyo et al., 2014).

Siltation is a more visible and probably the most pervasive and devastating force on aquatic biota in the short term (Chakona et al., 2008; Kasangaki et al., 2008). This habitat degradation is considered the most important threat to aquatic biodiversity in Africa (Chakona et al., 2008). So severe is the extent of siltation in Zimbabwe that some of the rivers have been severely clogged (Fig. 9.6). Hence, some streams that used to store dry season water in pools no longer do so (Timberlake, 2000).

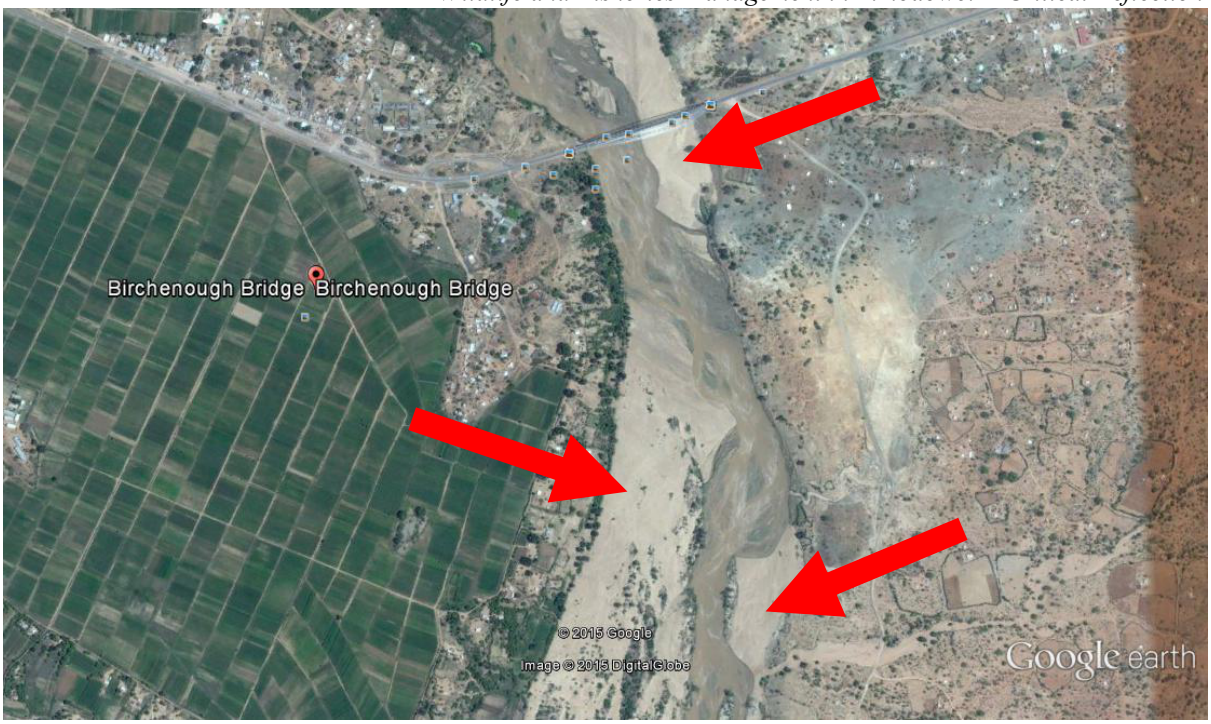

Fig. 9.6: Siltation along the Save river and its tributaries (red arrows showing areas of sediment deposition (Source: Google Earth)

The effect of sediments is to a great extent more detrimental in small water bodies, which, in a number of areas, have lost significant quantities of their storage capacities (Timberlake, 2000). For instance, in some parts of Zimbabwe a number of small dams lost, on average, 39% of their capacity in 20 years (Magadza, 1984; Magadza, 1992). Habitat destruction on this scale will have an obviously severe impact on fish populations. There have been reports that Lake Chivero's total storage capacity has already been reduced by an estimated 20 percent due to siltation mainly emanating from rampant urban agriculture in the lake's entire catchment area.

Mining

Ministry of Environment & Natural Resources Management (2010) reported that mining activities have become a major biodiversity threat in Zimbabwe. Due to the economic crisis faced by Zimbabwe in the past ten or more years, small scale gold and chrome mining have become more prevalent. The number of panners and the mined area has increased resulting in serious damage to aquatic, fauna and riverine ecosystems (Ministry of Environment & Natural Resources Management, 2010). Thousands of poor Zimbabweans have turned to illegal panning for precious minerals (Fig. 9.7A). Illegal gold mining is common along rivers that run close to the Great Dyke, a hilly mineral-rich belt which cuts across most of the country, and is concentrated in Mashonaland Central, West, East and Midlands provinces. Diamond panning is associated with the Chiadzwa District of Manicaland.

The impact of mining activities on water and biota has been recorded on Lake Kariba. Mining activities that drain into Lake Kariba include the glitter stone quarry near Kariba, coal mines in Hwange, gold, platinum and nickel mines in the Kwekwe and Kadoma area and several other iron, chromium, copper and antimony mines spread out in the Zambezi catchment in Zimbabwe (Timberlake, 2000). Legget (1994) observed that affluent rivers brought into Lake Kariba metals absorbed on large quantities of particulate matter. Mercury levels have already been reported to be higher than the World Health Organisation's (WHO) acceptable levels (Mhlanga et al., 2013). These metals have an impact on biota and entire ecosystems. Mercury has already been observed to be bioaccumulating along the fish food chain with the highest

concentration being in the top predator, *Hydrocynus vittatus* (Mhlanga, 2000). Legget (1994) reported an increase in other trace metals such as zinc, nickel, lead, molybdenum, and vanadium on Lake Kariba. The concentrations of lead and cadmium in aquatic plants (e.g., *Lagarosiphon ilicifolius* and *Vallisnieria aethiopica*) and fish (e.g. *Tilapia rendalli, Oreochromis mortimeri* and *Labeo altivelis*) have also been seen to be higher on Lake Kariba compared to other unimpacted aquatic systems (Berg et al., 1995). Nakayama et al. (2010) also found that the concentrations of lead, chromium and nickel in fish (*Oreochromis niloticus* and *Serranochromis thumbergi*) and crayfish (*Cherax quadricarinatus*) from Lake Kariba were higher than those from Lake Itezhi-tezhi in neighbouring Zambia.

Mining is also contributing to the siltation of rivers and reservoirs (Ministry of Environment & Natural Resources Management, 2010). Digging within riverbeds and banks is resulting in the siltation of rivers downstream of the mining operations. Typical examples of heavily silted rivers because of mining in the country are Save and Mazowe Rivers (Fig. 9.7B). Gold panning along the Mazowe River has negatively impacted on water availability with some parts of the river drying up. Sections of the Mazowe River has totally shifted from a fast-flowing waterway which was too deep to cross during the rainy season, to a muddy trickle without any fish in it. Zimbabwe's largest river: the Save River, also became a victim to illegal mining following the discovery of alluvial diamonds in Chiadzwa in 2005.

A **B**

Fig. 9.7: A-Poverty has pushed many Zimbabweans into illegal gold panning (Source: Rutsate (2010)) and B- Silted Mazowe river reduced to a trickle (Source: http://www.herald.co.zw/gold-panning-destroys-mazowe-river/)

Damming and infrastructural development

Dams create new wetland habitats. However, the ecosystem impacts of dams (particularly large ones) are more negative than positive. Dams impose a lentic habitat within a lotic system and aquatic communities must adjust suddenly to the changes in physical, chemical and biological attributes of riverine systems to those of lacustrine systems and this may be accompanied by some taxa decreasing or even disappearing while some others may increase (Sharma and Sharma, 2013). Dams have in many cases led to significant and irreversible loss of species in the portions of the river drowned by them (Timberlake, 2000). For instance, before Lake Kariba was constructed, the Zambezi River was dominated by rheophilic fish species like cyprinids and distichodids (Timberlake, 2000). These species have declined rapidly following dam construction with some specialised riverine forms like *Opsaridium zambezense, Barbus marequensis* and *Chilo glanisneumanni*, disappearing completely from the lake (Timberlake, 2000). Labeo and Distichodus species reductions were evident in the larger, more lacustrine sections and they are now restricted to the riverine western basin of the lake where they survive in large numbers (Timberlake, 2000).

Dam construction alters important characteristics of the flow regime i.e. magnitude, frequency, duration, timing, and the rate of change (Allan et al., 1997; Dudgeon, 2000; Jiang et al., 2014). This results in hydrological fragmentation (Jiang et al., 2014), habitat fragmentation, degraded

water quality, altered sediment transport processes, and changes in timing and duration of floodplain inundation (Pringle et al., 2000). Dam induced hydrological fragmentation has been reported in the Manyame catchment (Mwedzi et al., 2016c).

Damming significantly reduces dissolved oxygen and temperatures immediately downstream of the dam wall (Poff and Zimmerman, 2010; Benítez-Mora and Camargo, 2014) as has been reported on Manyame dams (Mwedzi et al., 2016b). This is a usual consequence of hypolimnial (deep) release (Poff and Zimmerman, 2010). Minimal water mixing, chemical oxidation and bacterial decomposition of organic matter collectively reduces dissolved oxygen levels within the hypolimnial layer (Sullivan et al., 2001; March et al., 2003; Benítez-Mora and Camargo, 2014). Shifts in macroinvertebrate composition and structure as a consequence of dam imposed changes in water quality have been recorded in Zimbabwe (Mwedzi et al., 2016b) and elsewhere (Rehn, 2009; Benítez-Mora and Camargo, 2014). Stretches downstream of dams are dominated by macroinvertebrate taxa known to survive in areas with low DO levels e.g. chironomids (Chakona et al., 2008; Mwedzi et al., 2016b).

Water abstraction

Water allocated for fresh water ecosystems (environmental flows) must be in the context of the natural variability of the flow regime(Mathews and Richter, 2007). This is important as different components of the hydrological regime have an ecological significance; determining the composition, diversity, productivity, and resilience of ecosystems (Smakhtin et al., 2004). The Water Act (1998) of Zimbabwe requires that a catchment outline plan be developed for each of the river systems in the country. Among other things, this outline plan should contain information on the major water uses, maximum permissible levels of water pollution as well as the proportion of water that should be reserved for the environment**.** However, increased domestic abstraction, irrigation and unregulated upstream activities exert pressure on the limited water resources (Nhapi, 2009) leading to reductions in stream flow. Water demand therefore outstrips supply in most of the cities (Ministry of Mines Environment and Tourism, 1998). This situation makes it increasingly difficult for water to be reserved for the environment. Reductions in flow lead to habitat restriction in a stream. For many fish species, adequate flows are necessary to stimulate breeding. High flow breeders are likely to decline with reduction in flow being replaced by those with a more flexible breeding pattern, which are often exotic or alien invasive species (Timberlake, 2000). For instance cyprinids would be replaced by cichlids in the Zambezi basin (Timberlake, 2000). Reduction of river flows also lead to increased fluctuations in the water levels of reservoirs, and decrease the extent of flooding on floodplains (Siziba et al., 2011). Severe fluctuations of water levels would in turn impede development of submerged vegetation communities, important substrates for invertebrates and refuges for small fish (Timberlake, 2000).

Climate change

Increasing temperatures and droughts also play a part in the drying up of Zimbabwean rivers (Ministry of Mines Environment and Tourism, 1998; Mugandani et al., 2012). Climate change is projected to accelerate aquatic species population losses and extinctions (Ndebele-Murisa, 2014). The Zambezi River Basin has been shown to be exhibiting the "worst" potential effects of climate change among eleven major African river basins (IPCC, 2001). Zimbabwe's climate change situation is on the extreme because of its continental interior location (Davis, 2011; Lotz-Sisitka and Urquhart, 2014).

Zimbabwe is currently experiencing increases in temperature, recurrent droughts and unpredictable rainfall patterns (Ministry of Environment and Natural Resources Management, 2013a). A temperature increase of 0.4°C has already been recorded in the period 1900 to 2000,with the most rapid warming occurring post 1970 (Davis, 2011; Ministry of Environment

and Natural Resources Management, 2013a; Lotz-Sisitka and Urquhart, 2014). The 20th century recorded close to a 5% decrease in rainfall across Zimbabwe (Ministry of Environment and Natural Resources Management, 2013a). There is increasing uncertainty on timing and amount of rainfall as inter annual rainfall variability has increased since the 1960s with droughts becoming more intense and wide spread (Fauchereau et al., 2003; Davis, 2011).

Zimbabwe's climate change projections (using 1961-1990 as the base period) indicate a 5-18% decrease in rainfall by 2080 (Ministry of Environment and Natural Resources Management, 2013a; Lotz-Sisitka and Urquhart, 2014).Temperature increases in the range 0.15 – 0.55°C per decade are also expected with higher temperature changes in the dry seasons compared to the wet seasons (Lotz-Sisitka and Urquhart, 2014). The most important and pressing effects of climate change on freshwater resources is decreasing water availability (Kusangaya et al., 2014). Ministry of Mines Environment and Tourism (1998) reported that a doubling of CO_2 (imminent soon) will lead to a 15%-19% decrease in rainfall and a 7.5%-13% increase in potential evapotranspiration. This will result in potentially a 50% decrease in runoff. This implies that a climate induced reduction in precipitation will lead to a sharp decline in drainage density and many smaller rivers or their tributaries will permanently dry up. Perennial rivers will also shift to seasonal rivers (Ministry of Mines Environment and Tourism, 1998). Such changes to the natural flow will temper with the historical disturbance regime, thereby impacting on life history processes, rendering some biotic adaptations to these regimes obsolete while potentially favouring others (Naiman et al., 2008; Strayer, 2010; Rolls and Arthington, 2014).

Water governance in Zimbabwe

Globally, it is widely accepted that the water crisis is largely a governance crisis (UNDP, 2004; Connor, 2015). Effective water governance requires an enabling environment and appropriate institutional structures that allow different stakeholders to work together (UNDP, 2004; Lenton et al., 2005). Water legislation in Zimbabwe is severely fragmented and the ministries and statutory bodies meant to implement it are continually troubled by lack of coordination in areas of responsibility (Chinamora, 2002; Musingafi, 2013).

The major pieces of legislation addressing the sustainable management and protection of freshwater ecosystems are; the Water Act [Chapter 20:24], Environmental Management Act [Chapter 20:27] and the Zimbabwe National Water Authority Act [Chapter 20:25]. The Parks and Wildlife Act [Chapter 20:14] only addresses issues to do with the aquatic species in the water and not necessarily the water body itself. Other ministries responsible for water management (although at a consumer level) include the Ministry of Agriculture, Mechanization and Irrigation, Ministry of Energy and Power Development, Ministry of Mines and Mining Development, and the Ministry of Local Government, Public works and National Housing.

The ACTS regulating water resource governance themselves have short comings. For instance, while the Environmental Management Act addresses pollution in general, it is inadequate to ensure correction and prevention. Additionally, penalties and fines are not linked to better performance and corrective action. The Water Act also has its shortfalls as it is not adequately linked to the ZINWA Act, Urban Councils Act and Public Health Act.

While the framework for a water management system exists, the biggest challenge has had to do with enforcement. The regulations, penalties and enforcement practices have generally been ineffective. For example, allocation of environmental flows; a vital section of the Water Act has not been fully enforced (Ministry of Water Resources Development and Management, 2012). Environment Pollution from point and non-point sources continues to increase at an

alarming rate, despite the existence of regulations and penalties for offences. Thus, Zimbabwe, has a lot of well-crafted blue prints and theoretical frameworks for protection of freshwater resources, which has been difficult to follow in practice owing to a combination of factors ranging from conflicting policies and weak institutional linkages, to insufficient funding (Manzungu and Kujinga, 2002; Ministry of Water Resources Development and Management, 2012). In acknowledgement of this fact, a new National Water Policy (NWP- launched on 22 March 2013) has been crafted to provide solutions to the challenges of the water sector in Zimbabwe.

The NWP acknowledges that recovery of the water sector will take many years and there is need for a clear framework that accelerates this process. It also acknowledges that legislation needs to be updated. Additionally, all the Acts underpinning the water sector will have to be synchronized with the NWP as a matter of priority. Further to this, institutions must have clear and unique mandates which are not duplicated by other institutions or levels of government.

In redressing issues of water pollution, the NWP states that "the polluter pays principle" will be strengthened to include real deterrents and real incentives not to pollute. The polluter is not only expected to pay (punitive sanctions), but they are also required to restore the environment and pay for consequential damages such as health impacts due to pollution. Repeat offenders (or their representatives in the case of corporate bodies) should be prosecuted and risk having their operating licenses withdrawn. Additionally, concerted efforts will be put in place to control non-point sources of pollution (e.g., mercury used in artisanal mining) and control of agrochemicals used in agriculture. Furthermore, the policy advocates for granting protected status to water sources like wildlife protection. The policy states that there will be establishment of a Water and Wastewater Services Regulatory Unit to ensure that Water Services Authorities are monitored and kept accountable for the services they are responsible for.

The NWP also addresses the issue of the environment as a legitimate water user acknowledging that there have not been specific releases of environmental water based on scientific assessment. As such, environmental flows will be determined scientifically, reserved and included in all water plans, permit applications and permit approvals. Measures that protect high-value ecosystems such as wetlands will be introduced together with the management and control of erosion and high-risk flood areas. The NWP also recognizes the potential impact of climate change on planning for future investments and ensuring the resilience of existing investments. As such, ZINWA and Catchment Councils will integrate climate change into all water resource planning and design activities.

A future perspective on management of Zimbabwe's freshwater ecosystems

The outlook for freshwater conservation does not seem favourable in our generation (Ministry of Environment and Natural Resources Management, 2013b). The rapid expansion of the global human population is increasing the world's food requirement substantially. This is a more serious problem in Zimbabwe which already has substantial deficiencies in food production (Sadza et al., 2015; United Nations World Food Program, 2017). The future will be faced with enormous pressure as the population is still being expected to expand (Zimstat, 2015). Farmers are going to become desperate to produce more food from the same amount of land, so they will use more fertilizers with less concern for the environment to meet the market demand. Other land uses will be converted to agriculture. Agricultural intensification with more dams and irrigation will become widespread at the cost of the environment and its inhabitants. There is also a growing demand for hydropower, which may lead to an increase in the number of dams in the country. Species will be pushed out of their habitat either directly by habitat destruction or indirectly by fragmentation or degradation. Any efforts to protect the

remaining natural habitat and biodiversity will have to compete directly with humans' growing demand for natural resources, especially new agricultural lands.

Bioaccumulation of metals in fish and crabs may also become a health problem in the future as uncontrolled effluent discharges and intensive agriculture increases. Aquatic ecosystems will therefore continue to be stressed and the need to balance the demand for water against the need to conserve biodiversity will become a mammoth task (Timberlake, 2000). In addition, the unpredictable consequences of climate change coupled with other emerging contaminants makes the future gloomier. Aquatic ecosystems will therefore keep on degrading unless we take appropriate policy measures for restorative and preventive strategies to achieve ecosystems integrity (Rio Declaration, 1992; Reza and Abdullah, 2011).

The Zimbabwean government needs to act by addressing the underlying driving forces, rather than merely regulating the proximate causes. This includes reducing human population and expansion (by developing family planning programs in areas of rapid population growth) and finding ways to increase water use efficiency in all the water consuming sectors. Furthermore, there is need to find innovative ways of producing more agricultural output without increasing the land in production and the number of fertilisers. Setting aside protected areas is less likely to be effective in conserving aquatic ecosystems because rivers are linear systems that can be influenced by other events in the catchment, often far from the area to be protected (Timberlake, 2000). A better strategy is to use ecological methods for runoff water quality control e.g., wetland construction. A study on the Mukuvisi River, one of the major nutrient contributors to lake Chivero, has shown that Mukuvisi woodlands wetlands associated with this river have considerable water quality restoration capacity (Ndebele-Murisa, 2012). A series of well landscaped constructed wetlands could be important in tertiary treatment of processed waste water, as well as the interception of urban run-off (Ndebele-Murisa, 2012).

Microcystins and other toxins in lakes can be eliminated by controlling algal blooms, through reduction of nutrient supply. This requires a major capital investment in sewage treatment works and in the disposal of sewage effluent. Phosphorus removal from sewage might also be an effective strategy as algal bloom have been shown to respond to reductions in phosphorus loading. This can be achieved by chemical or biological methods. The banning of phosphorus detergents can also be considered but may not have a noticeable impact in places like Lake Chivero. This is because only 6% of the phosphorus originates from domestic sewage in Harare and a 20% phosphorus inflow reduction is required to make a noticeable impact in Lake Chivero (Nhapi et al., 2004). A more realistic approach given the country's economic situation would be to recycle sewage to agricultural land. This approach combined with pollution prevention and water re-use, could yield savings on chemicals, energy and costs.

Emerging science and technologies should generally be harnessed to tackle the present and future water resources problems. Habitat restoration has become topical in developed countries. Zimbabwe can also follow suite and start restoring habitat while it can still be saved. This includes embarking on a massive desiltation programme to remove silt from the country's major rivers and dams.

There is a need for educating the public and stakeholders about the importance of natural habitat and biodiversity and their impact on water resources. Local communities and all stakeholders can be mobilized towards controlling alien species. One possible approach is involving communities/ or other stakeholders in manual and biological control activities (e.g., rearing weevils). Invasive plants control methods should also include reduction of nutrient load in the water bodies. One of the most sustainable long term management actions involves close monitoring and a change in land use practices by riparian communities. This will help reduce

agricultural and mining runoff as a mechanism for controlling the propagation of water hyacinth and siltation. Communities that have been heavily dependent on rivers for their livelihoods need to be helped to look for other sources of income away from the river courses. This can be done through the provision of communal water points such as boreholes which can be effective in communal or smallholder market gardening while also providing water for livestock and other uses.

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