ZIMBABWE BIODIVERSITY ECONOMY

STATUS REPORT, INVESTMENT BLUEPRINT AND FRAMEWORK FOR NATURAL CAPITAL ACCOUNTING

MAY 2023

FOREWORD

Zimbabwe is rich in biodiversity, in its abundant plant and animal life and its varied landscapes and aquatic ecosystems. This biodiversity is the foundation for human well-being through the goods and services it provides, notably food, fresh water, wood, grass and fuel; climate regulation; water purification; disease regulation; recreational activities; spiritual practices; support for nutrient cycling and soil formation; and the provision of aesthetic value.

Biodiversity and ecosystem services are particularly important in supporting agriculture, industry, energy, tourism and manufacturing, which are the country's key economic pillars. As Zimbabwe positions itself for a decade of economic growth to achieve its vision of becoming a prosperous and empowered upper middle-income country by 2030, there is need to substantially harness development opportunities in the biodiversity economy. The Government of Zimbabwe has therefore prioritized four sectors that are important for the biodiversity economy, namely bioprospecting, fisheries, forestry and wildlife.

However, Zimbabwe's biodiversity is under severe pressure and degradation resulting from climate change and human activities such as deforestation, wildlife crime and illegal harvesting and trade in wildlife and forest products. The World Economic Forum Global Risk Report 2022 underscores loss of biodiversity and ecosystem services as being the third most severe global risk over the next 10 years. Therefore, Zimbabwe's utilization of nature has to be sustainable to ensure that it does not exceed the capacity of nature to regenerate itself.

This Zimbabwe Biodiversity Economy (ZBE) Report is the first of its kind in Zimbabwe. It seeks to address challenges underpinning biodiversity loss and to position the biodiversity economy as a key sector to invest in. The ZBE Report resonates with the National Development Strategy 1 (2021-2025) which seeks to promote environmental protection, climate resilience and natural resource management. The report is also in line with Sustainable Development Goals (SDGs) 11, 12, 13, 14 and 15, which speak to environmental protection, and with SDG 8, which speaks to economic growth. The findings and recommendations of the ZBE Report are important to Zimbabwe's contribution to national and international development frameworks.

An inclusive approach and wide consultations with stakeholders were taken in producing the report. I urge all stakeholders in the biodiversity economy to embrace the findings and to work collectively towards implementing the recommendations as we build our country to achieve an upper middle-income status.

Hon. N.M Ndhlovu (MP)

Minister of Environment, Climate, Tourism and Hospitality Industry

PREFACE

There is limited understanding of the value of biodiversity among policymakers, investors, civil society and private sector players, partly because Zimbabwe has not had comprehensive information about the contribution of nature to the country's economy. Zimbabwe has not developed natural capital accounting frameworks for capturing nature's contribution. The result has been undervaluation and under-investment in nature conservation. This in turn has led to unrealized potential and unsustainable use that erodes the country's biodiversity resource base.

This inaugural Zimbabwe Biodiversity Economy (ZBE) Report seeks to uncover the contribution of biodiversity and to ensure it is mainstreamed in development planning and national accounting frameworks. The report is in three parts: a status report giving a detailed description and analysis of the current state and potential of biodiversity economy; a high-level investment blueprint which identifies the key investment opportunities in the biodiversity economy and the business and investment models that can be used to leverage the opportunities; and a proposed natural capital accounting framework for mainstreaming biodiversity into development planning and decision making.

The ZBE study gives hope that the protected areas have the potential to realize and grow sustainable revenue for Zimbabwe. Zimbabwe boasts an extensive protected areas network comprising 28.2% of the country. This is an asset which can contribute significantly to the safeguarding of biodiversity while generating revenue through nature-based tourism and providing employment opportunities to the country's population. The protected areas have also contributed to global development frameworks such as the biodiversity Aichi targets of the UN Convention of Biological Diversity by increasing the area under protection, and the Paris Agreement through carbon sequestration.

The bioprospecting and biotrade sector is a very important part of the Zimbabwe biodiversity economy. The country's rural communities depend largely on biodiversity for their livelihoods through trading in biological resources. Biodiversity is also their source of food, medicine, and timber. There is potential for commercialization of some biological products, thus providing opportunities for enhancing rural livelihoods, creating green jobs and expanding the national economy. The exploitation of biological resources should, however, be sustainable.

This report is our commitment as the Ministry of Environment, Climate, Tourism, and Hospitality Industry and as the Government of Zimbabwe to ensure that the country achieves its 2030 vision and attains global targets under the SDGs. We will work with various sectors to ensure the successful implementation of the recommendations of this report.

Ambassador Raphael T. Faranisi

Secretary for Environment, Climate, Tourism and Hospitality Industry

ACKNOWLEDGEMENTS

The Ministry of Environment, Climate, Tourism and Hospitality Industry extends its profound gratitude to the Ministry of Finance and Economic Development, Reserve Bank of Zimbabwe and African Wildlife Foundation for the technical and financial support provided towards the production of the ZBE Study Report. The Ministry also greatly appreciates the technical guidance given by the ZBE Technical Committee for the production of the report and the consultancy services provided by Anchor Environmental Consultants and Zimbabwe Environmental Law Association in the compilation of this report.

Thanks also go to all the government agencies and departments and stakeholders that provided data and information that enabled the compilation of this report.

Ministry of Environment, Climate, Tourism and Hospitality Industry

11th Floor Kaguvi Building

Corner 4th Street and Central Avenue

Harare

Zimbabwe

Tel: +263 242 702054

Telegraphic address: "TOURISM"

Website: http://www.envirotourism.org.zw

Zimbabwe Biodiversity Economy: Status Report, Investment Blueprint and Framework for Natural Capital Accounting is published by the Government of Zimbabwe, Ministry of Environment, Climate, Tourism and Hospitality Industry.

Cover Artwork: Brandace Print Solutions

Terms of use and disclaimer

The Government of Zimbabwe does not claim to own all the material in this publication, whether text, tables, maps, graphs, photographs or other images. It does not warrant that the use, reproduction or unacknowledged citation of such material by a third party will not infringe on the rights of the authors of such material. The risk of claims resulting from such infringement and the responsibility to determine whether permission is needed for using or reproducing such material rest solely with the user.

The responsibility for facts and opinions in this publication rests exclusively with the authors and their interpretations do not necessarily reflect the views or the policies of the Government of Zimbabwe. Nor does the Government guarantee the accuracy of the data shown in tables and graphs. The boundaries, shading, legends and other information shown on any map in this publication do not imply any determination on the part of the Government of Zimbabwe concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

TABLE OF CONTENTS

FOREWORD I

PREFACE II

ACKNOWLEDGEMENTS III

EXECUTIVE SUMMARY IX

ABBREVIATIONS & ACRONYMS XV

1. INTRODUCTION 1

BACKGROUND 1

OBJECTIVES OF THE STUDY 5

2. THE NATURE, CONTEXT AND CURRENT STATUS OF BIODIVERSITY IN ZIMBABWE 6

ZIMBABWE'S NATURAL HERITAGE 6

Topography and drainage 6

Climate 7

Natural vegetation 9

Patterns of biodiversity 10

Population and land tenure 13

BIODIVERSITY CONSERVATION 15

Overview 15

State-Protected and Conservation Areas 16

Conservation in private land areas 17

Conservation in communal land areas 17

STATUS OF HABITATS, WILD POPULATIONS AND RESOURCES 21

Habitats 21

Wildlife Populations 25

3. THE BIODIVERSITY ECONOMY 30

THE WILDLIFE SUBSECTOR 30

Overview 30

Wildlife tourism 31

Trophy hunting 37

Wildlife (Crocodile) ranching....44
Trends in PWMA revenues and expenditure....44
Key challenges and opportunities....46
THE FISHERIES SUBSECTOR....49
Overview....49
Actors involved and their roles....51
Wild capture fisheries....53
Aquaculture....56
Recreational fisheries....54
Key challenges and opportunities....57
THE FORESTRY SUBSECTOR....59
Overview....59
Forest tenure system....59
Forestry Production and value....61
Trends in the Forestry Industry....65
Key challenges and opportunities....66
THE BIOPROSPECTING AND BIOTRADE SUBSECTOR....67
Overview....67
Household use and sale of NTFPs....67
Formal biotrade....73
Bioprospecting....78
Actors involved in Biotrade and Bioprospecting....82
Key challenges and opportunities....83
PAYMENT FOR ECOSYSTEM SERVICES....85
Overview....85
OPPORTUNITIES....91
4. INVESTMENT BLUEPRINT....92
UPGRADING STATE PROTECTED AREAS....92
Overview of the investment opportunity....92
The business model – Public-private partnerships....92

The investment model 94
The Government's role 94
REVITALISING WILDLIFE-BASED LAND USE 94
Overview of the investment opportunity 94
The business model – Biodiversity fund, Community Conservancies and PES 95
The investment model 96
The Government's role 96
DEVELOPING THE BIOTRADE INDUSTRY 97
Overview of the investment opportunity 97
The business model: Biotrade Fund and certification 97
Investment model 98
The Government's role 98
GOVERNMENT'S OVERARCHING ROLE 98
5. A FRAMEWORK FOR NATURAL CAPITAL ACCOUNTING 100
National context 101
Policy context 101
Application of NCA in Zimbabwe 102
Challenges for the adoption of NCA in Zimbabwe 103
PROPOSED FRAMEWORK FOR NCA IN ZIMBABWE 104
Institutional arrangements 105
Accounts 107
Data requirements for undertaking NCA 111
ROADMAP TO IMPLEMENTATION 113
1. Design of the NCA 114
2. Develop functioning institutional mechanisms to support implementation of NCA 114
3. Define the roles and responsibilities of key stakeholders and working groups 114
4. Strengthen data collection and develop spatial datasets 115
5. Secure support and resources to drive NCA forward 115
6. Join international and regional NCA declarations and partnerships 115
7. Pilot prioritized set of accounts 115

8. Develop a strategy for NCA, including a monitoring and evaluation plan 115

Work plan 115

6. REFERENCES 117

APPENDIX 1: GLOSSARY 132

APPENDIX 2: CONTRIBUTORS TO THE COMPILATION OF THIS REPORT 133

EXECUTIVE SUMMARY

INTRODUCTION

Zimbabwe is looking to develop its biodiversity economy as a means of contributing to its goals of achieving middle-income status by 2030 and following a greener growth path. The biodiversity economy encompasses the economic benefits derived from the sustainable use and/or conservation of indigenous species in their natural habitats. It includes business transactions related to wildlife, wild-capture fisheries, indigenous forestry, bioprospecting, wild-harvested non-timber products ("biotrade") and the supply of ecosystem services. It delivers economic gains that are not recorded in GDP, including subsistence livelihood benefits, health benefits and ecological functions that underpin economic production or save costs in other sectors.

In developing the biodiversity economy, the country needs to balance short- and long-term gains and national economic interests and the interests of the environment, communities and society as a whole. Biodiversity provides opportunities for commercial enterprise, but these opportunities need to be harnessed in a way that minimizes harm or that augments the full range of benefits that biodiversity contributes to human well-being. The trade-offs and synergies between different uses of biodiversity need to be understood in order to maximize the long-term benefits to society. To achieve this, it is necessary to take stock of biodiversity and the biodiversity economy and the relationships between them, and then to undertake investments that increase the value of ecosystems and increase inclusive wealth.

The overall aims of this report are to describe the current status of the biodiversity economy in Zimbabwe, to increase appreciation of the contribution of biodiversity to the economy and livelihoods, to foster investment in the conservation and responsible use of biodiversity, and to chart the way forward in raising the visibility of nature's contributions to people through natural capital accounting.

THE NATURE, CONTEXT AND CURRENT STATUS OF BIODIVERSITY

Zimbabwe is richly endowed with biodiversity and supports a number of iconic wildlife species such as elephant, buffalo, rhino, lion and cheetah. It also boasts a wide variety of vascular plant species, birds, reptiles, amphibians and micro-organisms. Its vegetation is dominated by savanna woodlands, particularly miombo woodlands, and it has significant areas of forest, grasslands and wetlands. Globally, biodiversity is being lost at unprecedented rates and Zimbabwe is no exception. Biodiversity in Zimbabwe is lost largely due to anthropogenic activities: fires, poaching, unsustainable harvesting practices, illegal wildlife trafficking and trade and deforestation, among others. Zimbabwe is home to 15.2 million people, most of whom depend on biodiversity resources and their derivatives for their livelihoods. This provides an opportunity for developing sustainable biodiversity economies which benefit both biodiversity and the human population.

Biodiversity in Zimbabwe is protected and conserved through various systems that include state protected areas (PAs), private conservancies, areas under the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) and traditionally protected areas. It is party to a number of international biodiversity-related multilateral environmental agreements (MEAs) such as the UN Convention on Biological Diversity and its protocols, the Convention on International Trade in Endangered Species of Wild Fauna and Flora and the Ramsar Convention. The country is committed to fulfilling its commitments under these MEAs and has therefore developed various laws to protect biodiversity. These include the Parks and Wildlife Management Act, the Forest Act and the Environmental Management Act.

THE BIODIVERSITY ECONOMY

Zimbabwe has identified four priority biodiversity economy sub-sectors, namely bioprospecting and biotrade, fisheries, forestry and wildlife.

Wildlife subsector

Nature-based tourism

Zimbabwe's wildlife is a key tourism drawcard. The country ranks in the top third globally on the World Economic Forum's Travel and Tourism Competitiveness Index natural resources pillar, while about a third of all foreign tourists visited national parks and other attractions in the Parks and Wildlife Management Authority (PWMA) estate in 2019. Total tourism receipts were around $1.25 billion in 2019, while tourism accounted for 6.3% of GDP and 3.7% of national employment. Tourism receipts declined by 71% to $360 million in 2020 during the COVID-19 pandemic.

Income from attraction-based tourism in protected areas was $351.9 million in 2019 or 40.1% of national attraction-based tourism. Tourism in protected areas thus accounted for 1.7% of GDP in 2019. This represents a conservative estimate of the value of nature-based tourism, as it does not account for nature-related attractions outside of formal protected areas. On average, attraction-based tourism income across all protected areas amounted to $5 469/km2 in 2019, more than double the national average value of $2 246/km2. Notably, national parks generated particularly high attraction-based tourism income per unit area ($10 113/km2), highlighting the importance of non-consumptive tourism in the country's flagship areas for wildlife and biodiversity.

Trophy hunting

Trophy hunting occurs in safari areas, CAMPFIRE areas and private wildlife ranches and conservancies, with quotas regulated by the Parks and Wildlife Management Authority across all these land tenure categories. Trophy hunting contributes to conservation in Zimbabwe, as the proceeds are channelled back into conservation. In 2019 hunting in Zimbabwe generated $19.1 million compared to $27.2 million in 2015. Elephant and buffalo have made the greatest overall contribution to hunting revenues, accounting for 74% of trophy fees. Lion, leopard and sable are other key species for hunting, which remains the dominant source of revenue for the CAMPFIRE programme, providing around $2 million annually prior to COVID-19.

Addressing barriers and leveraging opportunities for growth in the wildlife subsector

In the light of growing global resistance to trophy hunting, measures to combat negative perceptions of the industry will be key for the growth in hunting. Such measures could include increased research to demonstrate the benefits and value of trophy hunting, the formation of a regional certification scheme (at SADC level, for instance) which recognizes adherence with agreed ethical hunting practices, and the development of a professional hunters' council to regulate and enforce professional and ethical practices.

Visitor data suggest that Zimbabwe's PAs (excluding rainforests and the Zambezi National Park) remain under-visited, thus presenting opportunities for growth. This requires investment in visitor infrastructure in PAs as well as improved road, air, electricity supply and other key infrastructure across the country. Efforts to market the PAs should focus on their competitive advantage, namely their high wilderness value and their relatively unspoiled nature in comparison with more popular safari destinations.

Like other countries, Zimbabwe suffers from a PA funding gap. Partnerships with international conservation organizations can help to alleviate the PWMA's capacity constraints. This model has achieved success, most notably in Gonarezhou through a co-management arrangement with the Frankfurt Zoological Society.

Opportunities also exist in the ongoing review of the Wildlife Policy of 1992 and the Government's CAMPFIRE model which seeks to enhance wildlife conservation and its contribution to the economy. For instance, devolution of local authority to local communities allows would allow for greater financial inflows to communities.

The fisheries subsector

Production in Zimbabwe's fishery sector has been significantly increased by manmade lakes and introduced species. Production in the inshore fishery is based on 114 endemic and 30 exotic species. Production is dominated by bream or tilapia (*Oreochromis spp.*) (37.9% to 56.4%). The country has at least 12 000 dams with a combined surface area of more than 3 910 km2. The largest capture fishery is on Lake Kariba and contributes almost 90% of the country's capture fishery production. Lake Kariba has an open-water, semi-industrial fishery based on small pelagics (*Limnothrissa miodon* or kapenta) and an artisanal inshore gillnet fishery around the lakeshore. Other dams with significant fisheries are Chivero, Mutirikwi, Manyame and Mazvikadei, while fisheries in Tokwe Mukosi Dam are being developed. Recreational angling occurs in most reservoirs and along the Zambezi River. Subsistence fishing is a common activity in all reservoirs near urban centres, including Chivero, Manyame and Kariba.

The total value of fish production in 2019 was estimated to be $250 million and has been increasing. Capture fishery accounts for only a small portion of this, ranging from $60 million to $86 million between 2012 and 2019. Employment in the gillnet fishery has been increasing, with around 3 500 fishers and their employees holding PWMA fishing permits as of 2021. The number of informal fishers is far greater, however.

Addressing barriers and leveraging opportunities for growth in the fisheries subsector

Established capture fisheries in the larger waterbodies appear to be fully exploited. However, there are opportunities for growth in smaller water bodies outside of recreational parks, as well as in newly constructed dams. Given the potential for small-scale fish farming, there is a need to improve fingerling and feed supply, technology, extension services and market access. Data on the contribution of small water bodies outside recreational parks are lacking. The report recommends improvements in fisheries data collection systems, although the PWMA has recently made progress on data collection from water bodies in recreational parks.

The forestry subsector

Zimbabwe's forest and woodland resources cover a large portion of the country's land area, but most indigenous species are perceived to have low economic value in their natural state due to limited timber production potential and relatively slow growth rates. However, official estimates of the contribution of the forestry sector to GDP grossly misrepresent the full economic contribution of woody habitats, as the value of non-timber forest products (NTFPs) and crucial ecosystem services provided by natural woody habitats are not captured in the national accounting system. The development of national capital accounting would address this gap.

State forest areas in Zimbabwe cover around 860 000 ha, of which 800 000 ha are in the western parts of the country. These forests have several valuable indigenous hardwood timber species. There are also 108 000 ha of planted or exotic forests. Exotic plantations are the dominant source of formally harvested timber for construction and industrial purposes, accounting for 93% of timber produced in 2020. Forestry accounts for 3-4% of Zimbabwe's GDP and contributes approximately 15 000 jobs.

Addressing barriers and leveraging opportunities for growth in the indigenous forestry subsector

The potential for developing the indigenous hardwood timber industry is hampered by slow rates of growth of indigenous hardwood species. Better returns might be achieved by increasing revenue from hunting and wildlife tourism in suitable forest areas. Improved protection of the resource base, such as better control of illegal harvesting and fires, could yield production benefits. Additionally, the forestry sector could generate additional revenues through payment for ecosystem services (PES) schemes. Creating a central data repository of forestry information could overcome the challenge of lack of systematic data for the industry.

The Bioprospecting and Bio-Trade Subsector.

Subsistence harvesting of non-timber forest products (NTFPs)

Non-timber forest products are a major component of Zimbabwe's rich biodiversity resources, very little of which, if any, is accounted for in economic statistics. They encompass a broad range of goods, ranging from firewood to wild plant and animal foods, medicinal plants, thatching grass, various barks and fibres and other materials used in handcrafts and construction. Rural populations are highly dependent on NTFPs for their subsistence, while many households informally trade NTFPs to supplement their incomes. For example, 94% of rural households still depend on firewood as their main fuel source, while case studies have found that NTFPs account for 30% or more of household incomes in some parts of Zimbabwe.

Despite its importance, the value of subsistence harvesting of biodiversity-related resources is often missed in formal economic accounting studies. The report describes the value of selected key natural resources that are widely harvested. These include wood for fuel and hut construction, thatching grass, wild plant foods, mushrooms, honey and mopane worms. Their total subsistence value is estimated to be $500.3 million per year or an average value of $17.2/ha across all natural land covers. Per unit and overall, miombo woodland is the habitat type with the highest value for the selected NTFPs, with an estimated total subsistence value of $294.3 million/year and an average value of $33.4/ha.

Fuelwood and wood for hut construction are the most valuable NTFPs at $227.2 million/year. Wild plant foods are the next most valuable ($107 million/year), particularly in miombo areas with an abundance of several favoured fruit tree species. Harvesting of mushrooms is estimated to be worth $76.2 million/year; thatching grass, a popular roofing material in most parts of the country $48.3 million; honey harvesting $23.8 million; and mopane worms $17.9 million.

Commercialization of NTFPs and biological resources (bioprospecting and biotrade)

The commercialization of NTFPs enhances the livelihoods of people who harvest them. Some of the commercially valuable NTFPs in Zimbabwe are wild fruits such as baobab, marula and mazhanje. Zimbabwe is a key supplier in the growing global market chain for baobab, with potential for further growth given the abundance of baobab trees in the hot, dry regions. Baobab harvesters reportedly earn around $100 per season from selling baobab fruit to private companies which process and export the powder in the form of cream of tartar.

Addressing barriers and leveraging opportunities for growth in the bioprospecting and biotrade subsector

There is growing global demand for new natural products in the personal care and cosmetics, food and beverage and flavour and fragrance industries. Zimbabwe is well placed to capitalize on this growing demand.

However, there are significant risks and barriers to entry, such as the lengthy and costly process of acquiring regulatory approval for new natural products on the export market. Greater public support for the sector could help to overcome some of these barriers. For example, public and academic institutions could undertake market research and safety and efficiency studies for species of potential commercial benefit.

Revision of the legislation regarding access and benefit sharing (ABS) and the recognition of indigenous knowledge systems (IKS) are recommended in order to increase the benefits of NTFP commercialization for knowledge holders. The Government would do well to create an IKS database and enact domestic patent laws that protect indigenous knowledge. The Environmental Management Act makes provision for ABS arrangements only for products that are exported. Clearly the Act needs to be reformed to cover access and benefit sharing for products that are sold and consumed locally.

Payment for ecosystem services (PES)

While over 500 payment for ecosystem services schemes have been developed worldwide, Zimbabwe has not fully developed mechanisms to tap into PES (AfDB 2015; Bösch, Elsasser and Wunder 2019). The biggest barriers to adoption are limited institutional capacity and the absence

of the necessary framework. Zimbabwe has potential to realize significant income from its carbon sinks. It has an estimated 521 million tonnes of above-ground carbon, which is equivalent to 1.91 billion tonnes of CO_2 (du Preez 2013). The significant amounts of carbon stored in Zimbabwe's woodland habitats could be a substantial source of revenue in the form of carbon offset credits.

High rates of deforestation demand improved incentives for preserving forests and woodland habitats. Such incentives are provided by Reducing Emissions from Deforestation and Forest Degradation (REDD+) and similar schemes that offer an alternative means of promoting woodland conservation. The Kariba REDD+ project has reportedly generated $250 000 in income for local communities, generated about $60 000 in support for health clinics and schools, secured access to clean water for 37 000 people and trained over 18 000 community members in gardening, conservation farming and beekeeping.

Addressing barriers and leveraging opportunities for growth in the payment for ecosystem services

The potential for further REDD+ scheme development is being explored in Matabeleland, where the gazetted Ngamo and Sikumi forest reserves have been earmarked for REDD+ carbon trading (Forestry Commission 2019). Depending on what form the revenue sharing agreements take, this could present a significant source of income for the Forestry Commission and local communities. Zimbabwe needs to develop a national REDD+ strategy to guide certified emission reduction in the forestry sector in compliance with the Warsaw Framework for REDD+. The Government, in collaboration with relevant institutions, could facilitate and encourage further development of carbon forestry schemes by conducting more biomass assessments and identifying areas with potential for carbon financing schemes.

INVESTMENT BLUEPRINT

The investment blueprint aims to chart a way forward for capitalizing on major opportunities for securing and increasing economic benefits from biodiversity and for enhancing the conservation and restoration of ecosystems in Zimbabwe. It outlines ways to upgrade park estates, to generate funding for improved management of protected areas and biodiversity, to incentivize local actors to participate in wildlife-based land use and the delivery of ecosystem services, and to stimulate the development of sustainable business opportunities in biotrade. The blueprint provides a brief overview of each of these three areas of opportunity and describes the business and investment models to achieve this.

To increase tourism revenues from state PAs, it is proposed that Zimbabwe continues to pursue and expand the joint management of selected national parks. The Government's role will be to set the prerequisites needed to make the model work optimally. This will require it to address the economic and social challenges that discourage tourists, notably shortcomings in transport infrastructure, and to improve the management of other state lands and areas that buffer and connect the national parks.

The report recommends that the Government supports the establishment of community conservancies which would derive income from joint ventures with the private sector and PES. Also recommended are the establishment of a biotrade fund to finance research and development, provide concessionary loans to start-up businesses and establish a certification body for enhanced biotrade, and a biodiversity fund to support communities in creating conservancies and funding community equity in joint venture partners.

FRAMEWORK FOR NATURAL CAPITAL ACCOUNTING

The depletion of natural capital poses a significant challenge to achieving sustainable development objectives and poverty reduction. In response to this, some countries are starting to recognize the importance of keeping track of natural capital and the need for policies that promote a sustainable development path where natural capital is recognized as a critical economic asset (UN 2021). Natural capital accounting (NCA) provides a systematic way to account for changes in the stocks and flows of natural capital. It provides a standardized approach or framework for organizing and presenting statistics on the environment and its contribution to the economy

through a structured accounting approach. This helps to integrate natural capital into evidence-based socio-economic decision making and policy formulation, which in turn supports planning for land use and freshwater and marine resources (World Bank Group 2021a).

In Zimbabwe, only some aspects of the biodiversity economy are captured in the national accounts. Tourism, for example, contributes to the national accounts; how much of that contribution is provided by biodiversity and natural ecosystems in the form of nature-based tourism? The finalization of the Tourism Satellite Account is expected to improve accounting of the performance of the tourism sector, but ecosystem accounts are needed to determine the contribution of ecosystems and biodiversity to Gross Domestic Product. Developing key policy questions to frame each account is an important step in understanding the relevance and role of each account in achieving sustainable development. The Government undertakes to develop natural capital accounting in order to improve understanding and management of natural capital accounts for sustainable socio-economic development.

ABBREVIATIONS & ACRONYMS

ABS	Access and benefit-sharing
AfDB	African Development Bank
AfRSG	African Rhino Specialist Group
CAMPFIRE	Communal Areas Management Programme for Indigenous Resources
CBD	Convention on Biological Diversity
CBNRM	Community-based natural resources management
CCG	CAMPFIRE Collaborative Group
CGA	Carbon Green Africa
CIFOR	Centre for International Forestry Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COVID19	Coronavirus 2019
EA	Ecosystem approach
EMA	Environmental Management Agency
ESC	Environment Statistics Committee
FAO	Food and Agricultural Organisation
FBLRP	Forest-based land reform policy
FDES	Framework for the Development of Environment Statistics
FZS	Frankfort Zoological Society
GDP	Gross Domestic Product
GIS	Geographic information system
GPS	Global Program for Sustainability
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature
MEA	Multilateral environmental agreement
MECTHI	Ministry of Environment, Climate, Tourism and Hospitality Industry
MLAFWRD	Ministry of Lands, Agriculture, Fisheries, Water and Rural Development
MRV	Monitoring, reporting and verification
$MtCO_2e$	Million ton of carbon dioxide equivalent
NCAVES	Natural capital accounting and valuation of ecosystem services
NCCRS	National Climate Change Response Strategy
NDS1	National Development Strategy 1
NEP	National Environment Policy
NGO	Non-government organisation
NPO	Non-profit organisation
NTFPs	Non-timber forest products

PA	Protected area
PES	Payment for Ecosystem Services
PPP	Public-private partnership
PUDs	Photo-user density
PWA	Parks and Wildlife Act
PWMA	Parks and Wildlife Management Authority
RBZ	Reserve Bank of Zimbabwe
RDC	Rural district council
REDD+	Reduction of Emissions from Deforestation and Forest Degradation
SADC	Southern African Development Community
SAFA	Sub-area fishers association
SEEA CF	System of Environmental Economic Accounting Central Framework
SEEA	System of Environmental-Economic Accounting
TTCI	Travel and Tourism Competitiveness Index
TWG	Technical working group
UNCTAD	United Nations Conference on Trade and Development
UNFCCC	United Nations Framework Convention on Climate Change
WAVES	Wealth Accounting and the Valuation of Ecosystem Services
WEF	World Economic Forum
WWF	World Wide Fund for Nature
ZIDA	Zimbabwe Investment Development Agency
ZIMSTAT	Zimbabwe National Statistics Agency
ZIPO	Zimbabwe Intellectual Property Office
ZTA	Zimbabwe Tourism Authority

1. INTRODUCTION

Key points

- *The biodiversity economy encompasses the businesses and economic activities that depend on conservation and sustainable use of indigenous biological resources or that contribute to the conservation of biodiversity and ecosystem services.*
- *Biodiversity offers a range of economic opportunities, but there are important trade-offs that cannot be ignored in devising an investment strategy, such as those between managing for provisioning services and those regulating and cultural services.*
- *Zimbabwe needs to take stock of its biodiversity and its contribution to the economy and the well-being of its people, and devise strategies to maximize its long-term benefits.*
- *This report outlines the current state of the biodiversity economy, identifies important areas for investment and outlines a natural capital accounting framework to guide future decision making.*

BACKGROUND

Biodiversity can be defined as the variability among living organisms and the ecological complexes of which they are part. This includes variation within species, the diversity of species within ecosystems and the diversity of ecosystem types in nature. Biodiversity underlies the provision of ecosystem services that make a critical contribution to human well-being.

Zimbabwe's National Development Strategy 1 for 2021-2025 (NDS 1) recognizes the strategic importance of biodiversity to socio-economic development,[1] and the country is looking to develop its biodiversity economy as a means of contributing to its goals of achieving middle-income status by 2030 and following a greener growth path.

In developing the biodiversity economy, Zimbabwe needs to consider how to balance short- and long-term gains and national economic interests with the interests of the environment, communities and society as a whole. Biodiversity provides opportunities for commercial enterprise, but these opportunities need to be harnessed in a way that minimizes harmful impacts or augments the full range of benefits that biodiversity contributes to human well-being (see Box 1). These include economic benefits that are not recorded in GDP, such as the provision of subsistence livelihood benefits, health benefits and ecological functions that underpin economic production or save costs in other sectors.

Obtaining optimal value from biodiversity therefore requires an understanding of the trade-offs and synergies between alternative land and ecosystem uses. This means not only Sfinding ways to transform biological wealth into value-added goods and services, as encouraged in the Southern African Development Community's Regional Biodiversity Strategy (SADC 2008), but also investing in restoring and maintaining the capacity of ecosystems to provide valuable ecosystem services. It is widely asserted that policy makers and investors require improved understanding and information about the value of investing in and improving the conservation of biodiversity (GoZ 2014b; Mutasa and Ndebele-Murisa 2015; Snyman et al 2020). To sustain all these benefits and develop a viable and sustainable biodiversity economy, a country needs to mainstream biodiversity considerations in decision making across all its sectors, take measures to prevent the degradation and loss of biodiversity and ecosystems and invest in their restoration and management.

DEFINING THE BIODIVERSITY ECONOMY

The "biodiversity economy" encompasses the economic benefits derived from the sustainable use and conservation of indigenous species in their natural habitats. It includes business transactions related to wildlife, wild-capture fisheries, indigenous forestry, "bioprospecting", wild-harvested non-timber products ("biotrade") and the supply of ecosystem services. Bioprospecting involves the identification of genetic resources or chemical compounds used in the development of commercial products (for instance for food, cosmetics, medicines or horticulture), with research often building on traditional uses.

1 National Development Strategy 1 2021-25. Government of Zimbabwe

These are all elements of the subsectors of the Ministry of Environment, Climate, Tourism and Hospitality Industry (MECTHI) – wildlife, forestry, fisheries and bioprospecting, – although some are cross-cutting. However, these subsectors also include cultivated and other intensively managed systems that do not form an element of the biodiversity economy. Nevertheless, there are strong links between these and the biodiversity sector in that the biodiversity economy often leads to or supports intensive activities, and vice versa. For example, the successful marketing of wild resources sometimes leads to their cultivation, and the continued success of cultivation often depends on the genetic variability maintained in wild populations. The elements of the biodiversity economy are summarized in Table 1.

Table 1. Elements of the biodiversity economy in the context of sectoral activities

SUBSECTOR	BIODIVERSITY ECONOMY COMPONENT	OTHER COMPONENTS
Wildlife	Sport/trophy hunting	Intensive game production
	Photographic tourism and film	Zoos, gardens, sanctuaries
Forestry	Indigenous forestry	Plantation forestry
Fisheries	Indigenous capture fisheries	Aquaculture
Bioprospecting and biotrade	Bioprospecting	
	Terrestrial non-timber resources harvesting* and trade	Beekeeping
Cross-cutting	Trade in ecosystem services	

"Non-timber forest products" (NTFPS) is the term often used, but this is not confined to forest habitats.

The biodiversity economy has formal and informal elements. The former involves registered firms, state entities and registered individual proprietors. Their activities are formally recorded and generate tax revenue. Informal economic activities are not fully reflected in the national accounts and include uncontrolled and illegal practices. The size of the informal sector is determined by the scope and influence of the country's legal, institutional and governance systems.

The formal and informal sectors both contribute to societal well-being, but in different ways. The former's taxes provide services to society; the informal sector offers greater access to the poor and marginalized and greater opportunities for their subsistence. The informal sector is estimated to make up 64.1% of Zimbabwe's economy.[2] It is not always easily distinguished from the formal sector. Informal harvesting of certain wildlife products takes place not only at the subsistence level but is also often orchestrated by businessmen.

2 www.worldeconomics.com/National-Statistics/Informal-Economy/Zimbabwe.aspx

THE NEED FOR STRATEGIC INVESTMENT AND ACCOUNTING

Biodiversity has value beyond the biodiversity economy, notably the wide range of ecosystem services that are not marketed. While the activities that make up the biodiversity economy encompass the full value of provisioning services, less account is taken of the cultural values and the regulating services that nature offers. This report rightly focuses on the subsectors of the biodiversity economy and necessarily uses the language of economics, but a broader view is needed that takes account of intrinsic values stemming from the cultural and spiritual significance of biodiversity and the ecosystem services that indirectly support a range of economic activities (See Box 1).

While there are comprehensive international frameworks to address biodiversity loss, species have been disappearing at an unprecedented rate over the last two decades. Current rates of biodiversity loss show that global demand for ecosystem services exceeds the rate at which they can be sustainably supplied (Dasgupta 2021). People and their livestock now make up 96% of the mass of mammals on earth and 70% of all birds alive are poultry (ibid). A quarter of tropical forests have been lost since the Rio Summit in 1992. The rates of species extinctions are now 100 to 1 000 times higher than natural rates. Only 23% of the world's land area remains classified as wilderness, and according to the Living Planet Index, by 2021 the world had lost 68% of the wildlife populations that it had in 1970.

The global decline of biodiversity and ecosystem services is a development issue: developing economies such as Zimbabwe cannot afford the risk of collapse in the services provided by nature because of the disproportionately large impact it would have on their economies (Johnson et al 2021). Zimbabwe's biodiversity is also at grave risk from a range of pressures, but decisive and positive action could put the country at a comparative advantage for its biodiversity economy and the well-being of its people. Nature-smart policies that offer win-win solutions for biodiversity and economic outcomes could mesh well with the sustainable development of the biodiversity economy.

Well-planned biodiversity economy development could make a significant contribution to Zimbabwe's economic goals. That calls for an assessment of the current status of the biodiversity economy, for identifying potential areas of investment in the biodiversity-based business and for supporting ecosystem services that are critical for sustaining intergenerational well-being.

Ecosystems are a component of natural capital, which includes abiotic resources such as minerals. Natural capital is in turn a component of a country's inclusive wealth, which is the combined social value of produced, human and natural capital. It is critical to consider that development cannot be sustained if it involves undermining the value of natural capital (Dasgupta 2021). For this reason, countries have recognized the shortcomings of basing economic decisions on indicators such as Gross Domestic Product and are instead resorting to natural capital accounting to provide important supplementary information required for better policy making. NCA keeps track of environmental changes and goes a long way towards enabling countries to mainstream biodiversity in their policy making.

Box 1. Ecosystem services

Ecosystem services are broadly defined as "the benefits people obtain from ecosystems" (Millennium Ecosystem Assessment 2003, 2005). These benefits vary depending on the natural characteristics and condition of the ecosystem. An ecosystem can be defined in terms of the structure and organization of its biotic and abiotic components. These in turn determine its functioning, productivity and also the attributes that society values, such as the presence of charismatic species or suitability for recreational use. The attributes provide "cultural services", its productivity determines its value in terms of "provisioning services" and its functioning gives rise to a range of "regulating services".[3]

Provisioning services comprise the nutrition, material and energy contributions of ecosystems that people harvest. They include biotic goods such as foods and medicines, raw materials, fuel, ornamental resources like flowers, and genetic resources. Some descriptions include abiotic goods like sand, clay, minerals and water that are collected from ecosystems.

People derive benefits from the active or passive use of nature, be it for aesthetic, recreational, spiritual, scientific, or educational fulfilment, or a combination of them. An example of active use is to visit a nature reserve. An example of passive use is to enjoy a view of a mountain from one's window. People also derive satisfaction from knowing of the existence of healthy ecosystems and biodiversity and of their possible enjoyment by future generations. All of these benefits are classified as nature's cultural services.

Regulating services include the regulation of climate, hydrological and soil processes, services to agriculture and fisheries, and amelioration of environmental problems such as pollution and erosion. Some examples of regulating services are:

Global climate regulation: Ecosystems help to reduce climate change through the sequestration (uptake) of carbon dioxide from the atmosphere and through the accumulation and storage of this carbon in biomass and soil. Maintaining natural forests helps to prevent stored carbon from being released into the atmosphere.

Flow regulation: Ecosystems regulate timing of hydrological flows by facilitating infiltration of rainfall into groundwater and so ensuring river flows in the dry season.

Flood attenuation: Natural vegetation can slow down the movement of water in the landscape. Wetlands in particular offer protection from floods through temporary storage (Nedkov and Burkhard 2012).

Pollination: Ecosystems provide habitat for wild pollinators that fertilize crops in adjacent fields.

Critical habitat: Some ecosystems are critical for populations of species that occur over a wide area; for example, seasonal watering, grazing or breeding areas.

Soil retention: Maintaining vegetation cover helps to keep soils in place (Conte et al 2011).

Sediment trapping: Natural vegetation, especially in wetlands, can trap excess sediments generated by anthropogenic activities in the landscape, preventing them from causing problems in downstream aquatic ecosystems, reservoirs and hydropower installations (Ekka et al 2020).

Water quality amelioration: Wetlands and riparian vegetation can take up some of the excess nutrients and pollutants generated by anthropogenic activities in the landscape.

3 Note that the Millennium Ecosystem Assessment included "supporting services" as a category of ecosystem services. This refers to the ecosystem functionality that underpins the provisioning, regulating and cultural services, and has been dropped from more recent classifications.

OBJECTIVES OF THE STUDY

The overall aims of the report are to describe the current status of the biodiversity economy in Zimbabwe, to increase appreciation of the contribution of biodiversity to the economy and livelihoods, to foster investment in the conservation and responsible use of biodiversity, and to chart the way forward in raising the visibility of nature's contributions to people through natural capital accounting. The specific objectives are:

- Assess the current status of the biodiversity economy:
  - Provide a brief overview of the nature, context and current status of biodiversity in Zimbabwe
  - Provide an overview of the anthropocentric and intrinsic values of biodiversity, highlighting its benefits to society and communities in terms of health, food security, water security and energy
  - Describe Zimbabwe's biodiversity economy, providing facts and figures useful to the Government and potential investors, and noting gaps in available information
  - Provide an overview of the regulatory framework and institutional arrangements governing biodiversity-based economic activities in Zimbabwe, noting the shortcomings and how they can be addressed
  - Identify and analyse best practices through case studies illustrating how the biodiversity economy can contribute to green job creation, livelihood opportunities, conservation and sustainable use of biodiversity
- Provide guidance on stimulating responsible investment:
  - Assess the factors that pose risks to the sector or that present opportunities, and their trends
  - Identify potential barriers and incentives for growing the biodiversity economy and recommended actions by the Government to help encourage investment
  - Draft a high-level investment blueprint that explores opportunities for the biodiversity economy
- Produce a framework for natural capital accounting:
  - Identify what biodiversity data are currently reflected in national statistics and consider how data gaps might be addressed
  - Develop a framework for natural capital accounting in order to keep track of changes in biodiversity, ecosystem services and their benefits over time

2. THE NATURE, CONTEXT AND CURRENT STATUS OF BIODIVERSITY IN ZIMBABWE

Key points

- *As a subtropical country with a variety of natural habitats, Zimbabwe is richly endowed with biodiversity and supports a number of iconic wildlife species.*
- *It is home to 15.2 million people, the majority of whom live off the land and depend on the harvest of living resources.*
- *Land use changes and illegal settlements, unsustainable utilization of biodiversity and its components, a growing population and continued reliance on primary sector activities have all contributed to a major reduction in biodiversity over the last 20 years, particularly outside of state protected areas (PAs).*
- *Satellite data confirm that deforestation and habitat loss are a major problem in Zimbabwe that threatens the existing and future potential biodiversity economy.*
- *While changes in habitats and forest cover can be quantified from satellite data, changes in biodiversity are largely unmonitored, being limited to a few areas and species.*

Zimbabwe's natural heritage

According to Zimbabwe's most recent report to the Convention on Biological Diversity (CBD), the country is home to 6 398 plant species, 232 of which are endemic or near-endemic, as well as 627 bird species, 270 mammal species, 197 reptile species, 120 amphibian species and 145 species of fish (GoZ 2019).[4] This diversity of biological life is underpinned by the country's varied topographic and climatic landscape. These key determinants of Zimbabwe's biodiversity are briefly described in this chapter.

Topography and drainage

Zimbabwe is a landlocked country with its eastern boundary between 200 and 400 km inland of the Indian Ocean. Much of the country is on a relatively high elevation, including the major cities of Harare and Bulawayo in the central-northern and southwestern parts of the country. Both cities are situated on the prominent central watershed which bisects the country from the southwest to the northeast at an altitude of 1 200-1 600 m (Figure 1). These and other areas above 1 200 m are referred to as the highveld, which is largely flat and gently undulating with frequent rounded granite domes or dwalas that are a characteristic feature of the Zimbabwean landscape. The central watershed forms the major divide between the Zambezi drainage basin to the north and the Save and Limpopo drainage basins to the south, and is the source of a number of major rivers (Moore et al 2009).

The Great Dyke forms a ridge running north to south across central Zimbabwe and across different ecosystems. The dyke is most prominent to the northwest of Harare. Another notable feature is the mountainous Eastern Highlands, with Zimbabwe's highest point, Mount Nyangani, at 2 592 m.

In the north the Zambezi escarpment is a prominent relief feature that marks the sharp drop in elevation from the central watershed to the lower-lying Zambezi Valley. Elevation declines more gradually south of the central watershed towards the Save and Limpopo rivers. Zimbabwe's lowest point is found here at the confluence of the Save and Runde rivers on the south-eastern border, at an elevation of 160 m. The northwest of the country is largely flat and lies around 1 000 m with no prominent relief features away from the Zambezi River.

4 To put this in perspective, Africa has over 2 300 bird species, 1 100 mammal species and 3 000 fresh water fish species.

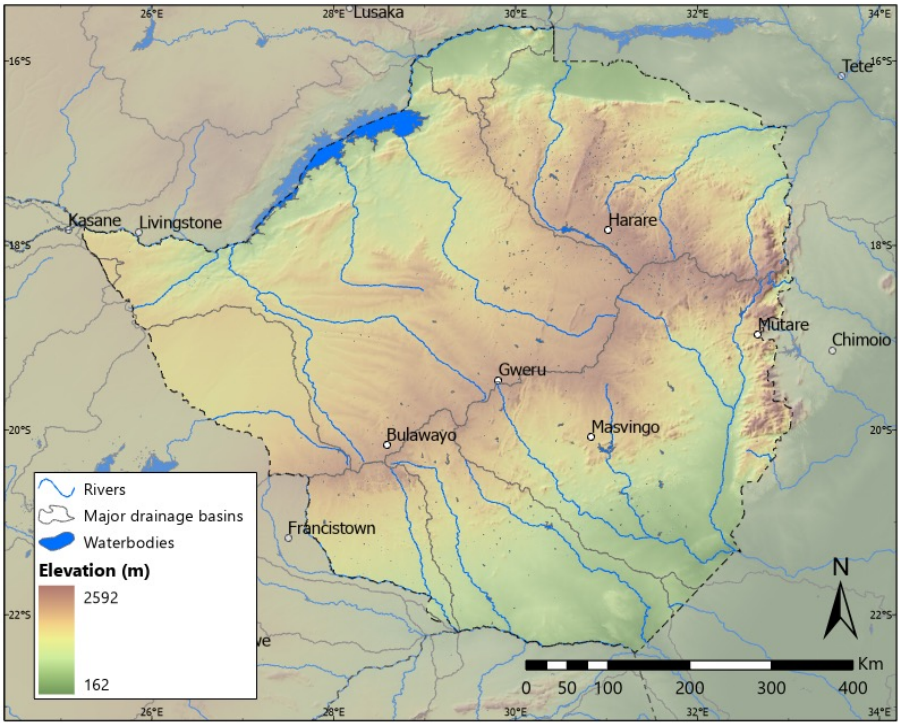


Figure 1. Topographic map of Zimbabwe with rivers and major drainage basins. Derived from 90 m Shuttle Radar Topography Mission Digital Elevation Model

Climate

Topography is a key determinant of Zimbabwe's climate. Despite its tropical location, much of the country experiences moderate temperatures due to its altitude. A correlation can be seen between the elevation (Figure 1) and mean annual temperatures across the country (Figure 2); cooler temperatures are associated with higher altitudes. The climate of the higher central and eastern parts of the country varies from subtropical to temperate (Mugandani et al 2012), with mean annual temperatures in the range of 16-20°C. Mean temperatures rise to 23°C or more in the lower-lying Zambezi, Limpopo and Save river basins.

Mean annual rainfall varies substantially across the country (Figure 3), from as low as 300 mm in the Limpopo Valley in the south to 3 000 mm in the wettest parts of the Eastern Highlands (ibid). Rainfall is generally higher in the north and east of the country (over 700 mm) and decreases towards the south and west. Higher rainfall in the north of the country is driven by its closer proximity to the Inter-Tropical-Convergence Zone, which brings warm, moist air from tropical Africa (Unganai and Mason 2001). Rainfall is relatively high around the Eastern Highlands as a result of orographic lifting and their relative proximity to the warm, moist Indian Ocean.

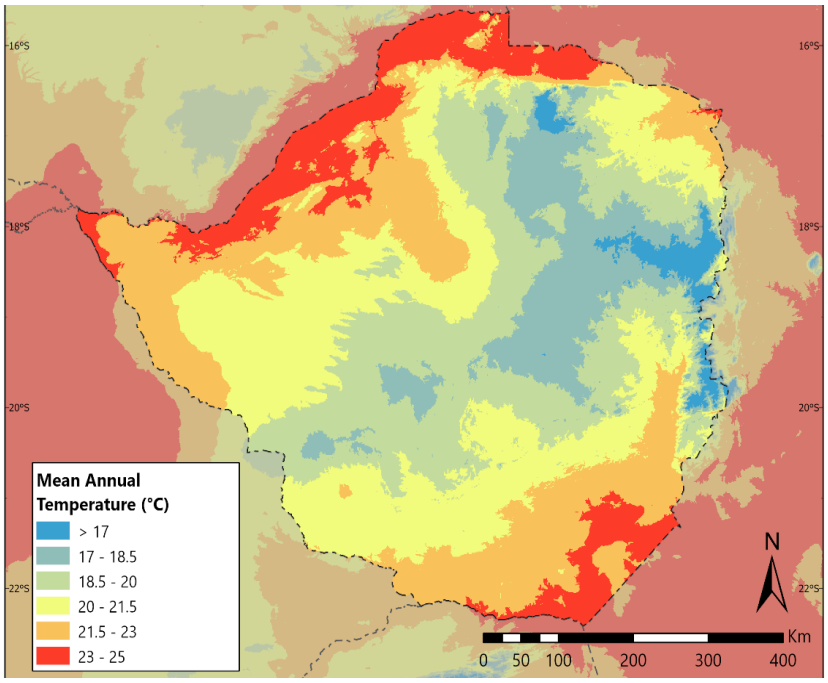


Figure 2. Map of mean annual temperatures across Zimbabwebased on WorldClim data (Fick and Hijmans 2017a)

Zimbabwe's climate is seasonal, with a wet season from November to March and a long dry season from April to October (Mugandani et al 2012). Temperatures are highest in October at the end of the dry season and lowest in the winter months of June and July (ibid). Rainfall and cloud cover moderate temperatures over the wet summer months. Beyond its seasonal rainfall, Zimbabwe experiences high inter-annual rainfall variability, with increasing unreliability of rainfall moving from north to south. Inter-annual rainfall variability is strongly linked to phase changes in the El Niño-Southern Oscillation phenomenon (Unganai and Mason 2001).

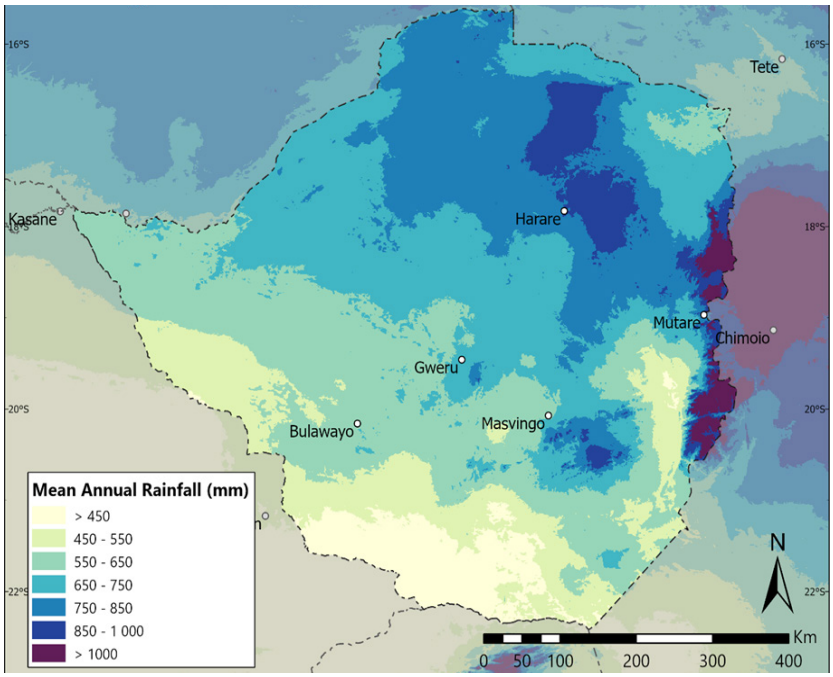


Figure 3. Map of mean annual rainfall across Zimbabwe based on WorldClim data (Fick and Hijmans 2017b)

Natural vegetation

Topography, soils and climate collectively give rise to the spatial pattern of vegetation and wildlife habitats in Zimbabwe and thus to the overall pattern of biodiversity. Most of the country is characterized by savanna woodland[5] and grassland. The higher rainfall (750-1 000 mm) central, northern and eastern parts of the country are dominated by miombo woodland (Figures 4 and 5). This woodland type extends over a large portion of southeast Africa and is at the southern edge of its range in Zimbabwe. Brachystegia spiciformis (musasa) and Julbernardia globiflora (munondo) are dominant tree species in miombo woodland, giving way to Brachystegia boehmii in the drier miombo woodland areas (Whitlow 1988). Woodland vegetation on the central watershed varies from open to closed canopy and is often interspersed with seasonally inundated grassland in lower-lying areas, known locally as vleis or dambos.

With rainfall increasing towards the Eastern Highlands, woodland gives way to a mosaic of forest and grassland. Indigenous forest fragments are small, ranging from less than a hectare to a few square kilometres and limited to areas with mean annual rainfall of at least 1 200 mm (Forestry Commission 2011). Forests typically occur on steep windward slopes and sheltered valley sites, while grassland occurs in areas subject to frost and fire (Whitlow 1988). Rainforests are estimated to cover just 10 700 ha, or 0.03% of Zimbabwe's land area (Müller 2006). Most remaining forests are montane and sub-montane forest, with very little lowland forest left. According to Müller (2006), remaining lowland forest in the Pungwe and Rusitu valleys is just a small fraction of the natural forest extent in these areas.

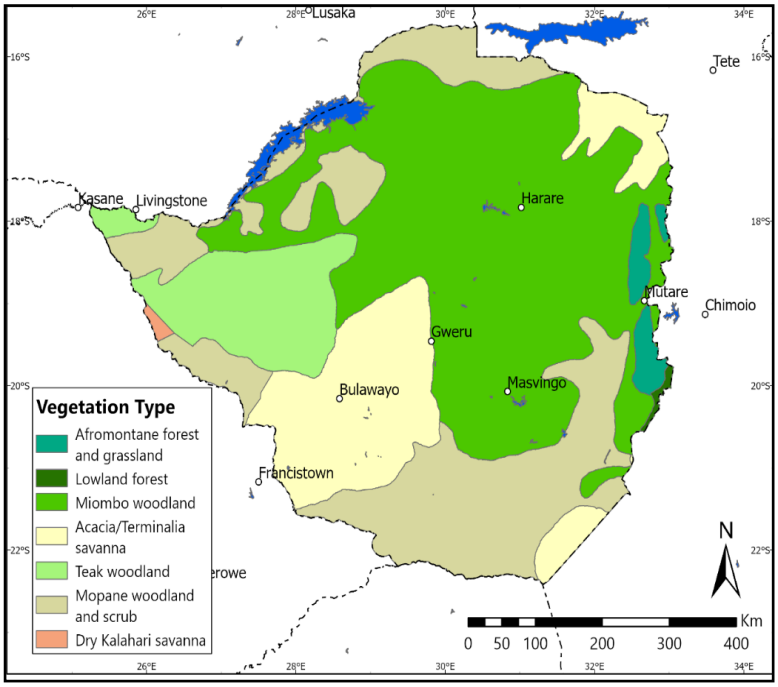


Figure 4. Simplified vegetation map for Zimbabwe derived from WWF Ecoregions (Olson et al 2001)

In the drier southwest parts of the central watershed (such as around Bulawayo), miombo woodland grades into tree and shrub savanna, which is characterized by more open canopy cover and shorter vegetation (generally 2-6 m high) with a mixture of Senegalia/Vachellia- and Terminalia-dominated communities (Whitlow 1988). Kalahari sands in the northwest are associated with Baikiaea (teak) woodland. This woodland type contains a number of valuable timber species, including Pterocarpus angolensis (mukwa) and Baikiaea plurijuga (Zambezi teak), the latter being the dominant tree species (Forestry Commission 2011; WWF 2016a). In the hot, low-lying southern parts and the Zambezi Valley, mopane (Colophospermum mopane) woodland and scrub become the

5 Most of the country's wodland areas would be classified as forest if certain global definitions are used. For example, the FAO defines forest as any area where tree cover exeeds 10%. In regional vegetation classification schemes, however, the term is generally reserved for woody communities with interlocking crowns and 100% canopy cover(sometimes reduced to 80% to account for degraded forest types)(white 1983: Kindt et al 2011)

dominant vegetation type. The iconic baobab tree (Adansonia digitata) is also a characteristic species in these areas. Throughout the country, riparian areas (i.e., those close to watercourses) are often associated with taller, denser woodland due to the enhanced availability of water and nutrients.

Figure 5. An example of miombo woodland habitat in Zimbabwe

Patterns of biodiversity

Zimbabwe is richly endowed with biodiversity. Patterns in the diversity and distribution of species are linked to the underlying topographic and climate characteristics of different parts of the country, as outlined above. Notably, parts of the Eastern Highlands fall within the Eastern Afromontane Hotspot. This part of the country exhibits particularly high species richness and endemism, especially of plants and birds (Figure 6). This reflects the high variety of habitats and micro-climates found there. In recognition of the diversity and endemism of bird species in the Eastern Highlands, eight of the country's 20 important bird areas (IBAs) are found there.

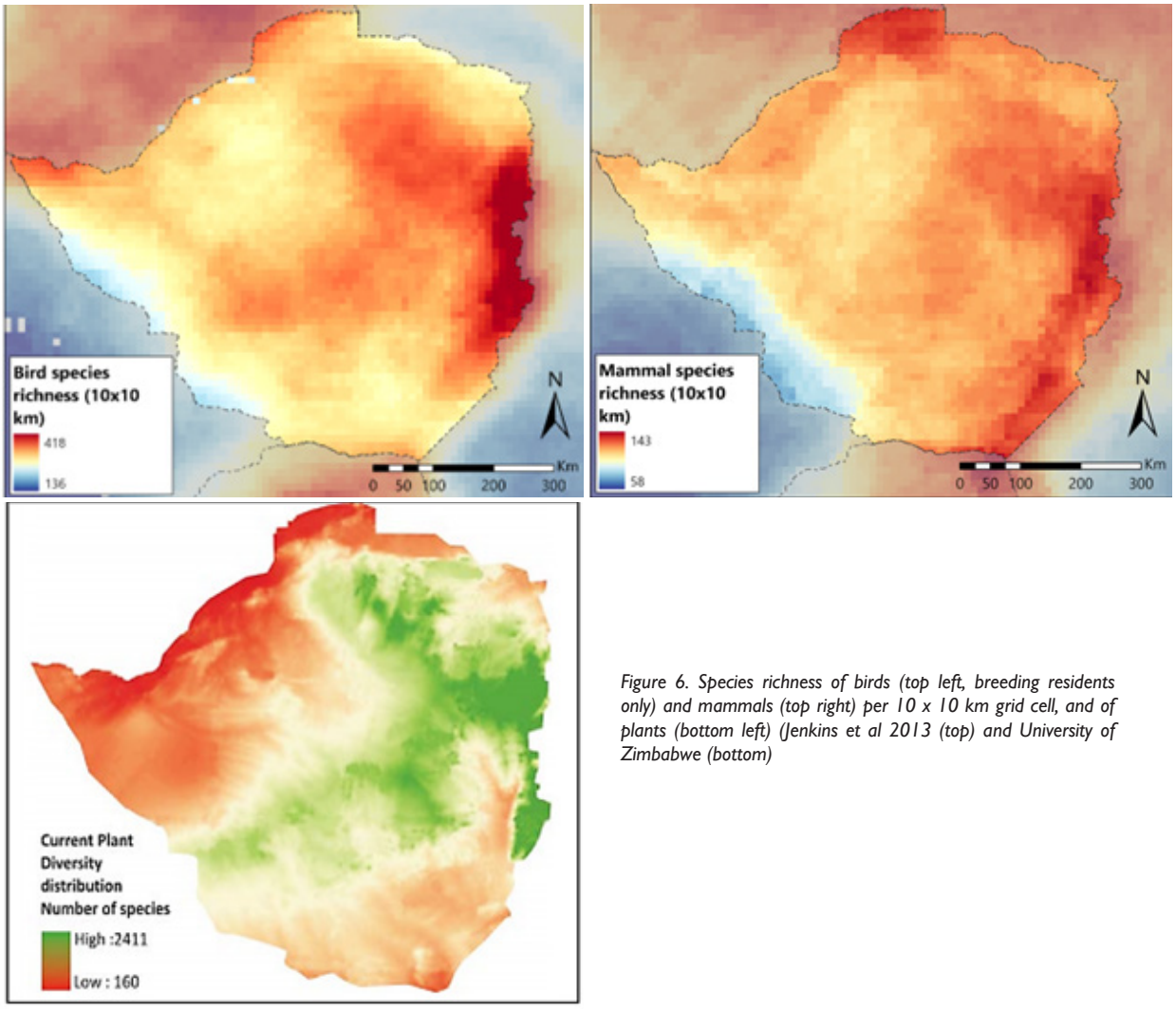


Figure 6. Species richness of birds (top left, breeding residents only) and mammals (top right) per 10 x 10 km grid cell, and of plants (bottom left) (Jenkins et al 2013 (top) and University of Zimbabwe (bottom)

Zimbabwe harbours 6 398 plant species, of which 174 are endemic, while a further 58 are near-endemic (Mapaura 2002; GoZ 2019). Plant diversity is highest in the varied montane habitats of the wet Eastern Highlands; the central watershed also has relatively high plant diversity. The diversity decreases in the drier, lower-lying areas, particularly the Zambezi Valley. Patterns of plant endemism generally follow those of plant diversity, with high numbers of endemic plant species occurring in the species-rich Eastern Highlands (Mapaura 2002). Most of these endemic species are associated with grasslands, particularly those in the Chimanimani Mountains which contain around 70 plant species. The Great Dyke is another notable centre of plant endemism, which has been attributed to the unusual serpentine soils associated with this geological formation. Twenty-eight endemic species have been recorded in this narrow range of hills (Mapaura 2002). Approximately 38 endemic species occur in the remainder of the central watershed, while 18 endemic species have been recorded in the Limpopo escarpment. There are also several species endemic to the Zambezi Valley, southern lowveld and the northwest of the country. Most of the endemic species are either vulnerable, threatened or endangered.

About 627 bird species have been recorded in Zimbabwe, of which around 450 breed in the country. As with plants, the Eastern Highlands have the highest bird diversity, followed by the central watershed (Figure 6). There are also some notable areas of high bird diversity in the Zambezi Valley. Zimbabwe has no endemic bird species. However, some species such as the Chirinda apalis *(Apalis chirindensis)* and Roberts's warbler *(Oreophilais robertsi)* share the same ecosystem which straddles Zimbabwe's Eastern Highlands and Mozambique.

Estimates of the number of mammal species

vary widely, between 175 and 270 (Mutasa and Ndebele-Murisa 2015; GoZ 2019). Mammal diversity shows a slightly different pattern to plant and bird diversity. It is similarly high in the Eastern Highlands, and also high in the low-lying south-east lowveld and the Zambezi Valley (Figure 6).

Large mammal populations are mainly confined to protected areas, most of which are located along the northern, north-western and southern borders of the country. This contributes to the high mammal diversity in the far north of the country around Mana Pools National Park and surrounding protected areas as well as the southeast where Gonarezhou National Park and the private Malilangwe and Save Valley conservancies are located. Zimbabwe still has significant populations of several of Africa's most charismatic mammal species, including all of the "Big Five: lion *(Panthera leo)*, leopard *(Panthera pardus)*, white and black rhinoceros *(Ceratotherium simum* and *Diceros bicornis),* African savanna elephant *(Loxodonta africana)* and African buffalo *(Syncerus caffer)*. Zimbabwe has the second largest elephant population in the world, as well as a sizeable black rhinoceros population (WWF 2016).

Reptiles and amphibians have received comparatively less attention (GoZ 2019). It is estimated that Zimbabwe has between 120 and 180 reptile species (Miller and Gwaze 2012; Mutasa & Ndebele-Murisa, 2015), along with 57 to 101 amphibian species (Mutasa and Ndebele-Murisa 2015). The discrepancy in these estimates calls for more detailed biodiversity inventories of these taxa, although it also partly reflects taxonomic disagreements around whether some taxa should be considered species or subspecies.

It is broadly accepted that Zimbabwe has two endemic reptile species, Tasman's house gecko *(Hemidactylus tasmani)* and *Zygaspis ferox,* a species of worm lizard (Mutasa Ndebele-Murisa 2015). The country has as many as five endemic amphibian species, with the exact number subject to disputes over their taxonomic status and uncertainty about whether they occur in neighbouring countries. Most of these possibly endemic amphibian species are restricted to the Eastern Highlands, although they may occur in adjacent parts of Mozambique. Zimbabwe has large populations of Nile crocodile and a significant crocodile farming industry.

Zimbabwe's freshwater ecosystems cover approximately 3 910 km^2, providing habitat for 144 fish species, of which 114 are endemic and 30 are exotic (FAO 2018). Lake Kariba is a key fisheries water body covering 5 364 km^2 on the border with Zambia.

POPULATION AND ECONOMY

Population and land tenure

According to the most recent census, Zimbabwe is home to around 15.2 million people (ZIMSTAT 2022). While urbanization is increasing, about 61.4% of Zimbabwe's people live in rural areas (ibid). Like most African countries, Zimbabwe has a broad-based population pyramid, with children under 15 years accounting for 40% of the population. The population continues to grow at estimated rate of natural increase of 1.5% (ibid).

Although Zimbabwe's overall population density of around 39 people/km2 is moderate, it varies significantly across the country (Figure 7), reflecting the influence of climate, land tenure and road infrastructure. Population densities are higher in the north and east than in the drier south and west.

Land tenure also has a significant influence on population densities (Figure 8). Large parts of the central watershed consist of large-scale commercial farmland, along with extensive private ranching areas in the south. Population densities are generally lower in commercial farming and resettlement areas, relative to surrounding communal lands. Densely populated communal lands, which exert significant pressure on land and natural resources, are a persistent legacy of colonial land tenure. This includes disproportionately high population densities in relatively dry areas, such as in communal lands south of Masvingo, communal areas southwest of Mutare and those in the far northeast (Figure 7).

Events since 2000 resulted in a radical change in agrarian structure. The Fast Track Land Reform Programme, which began in 2000, allocated over 4 500 farms to new farmers, covering 20% of the land area of the country. Two models were at the centre of the process – one focused on smallholder production (A1 schemes) and the other on commercial production at slightly larger scale (A2 farms). By 2009 there were over 145 000 households in A1 schemes (with average farm sizes of 37 ha) and 16 500 on A2 plots (with average farm sizes of 318 ha). As a result, large-scale commercial farming gave way to many more smaller farms focusing on mixed farming, usually with low levels of capitalization (Scoones et al 2011).

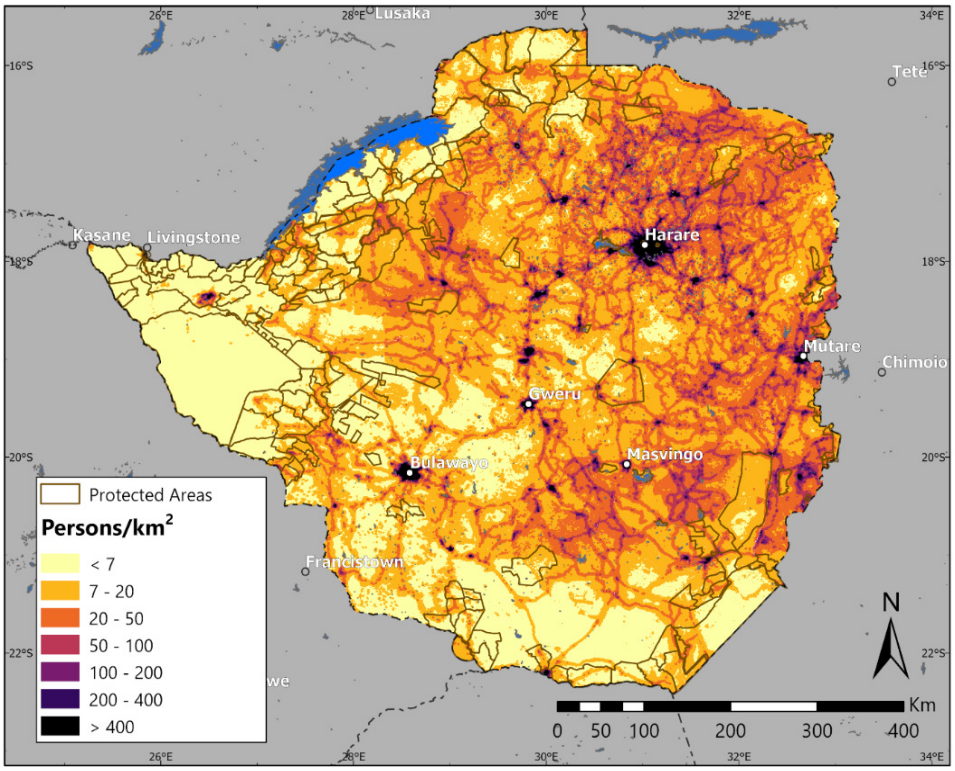


Figure 7. Population density map of Zimbabwe (Data derived from www.worldpop.org)

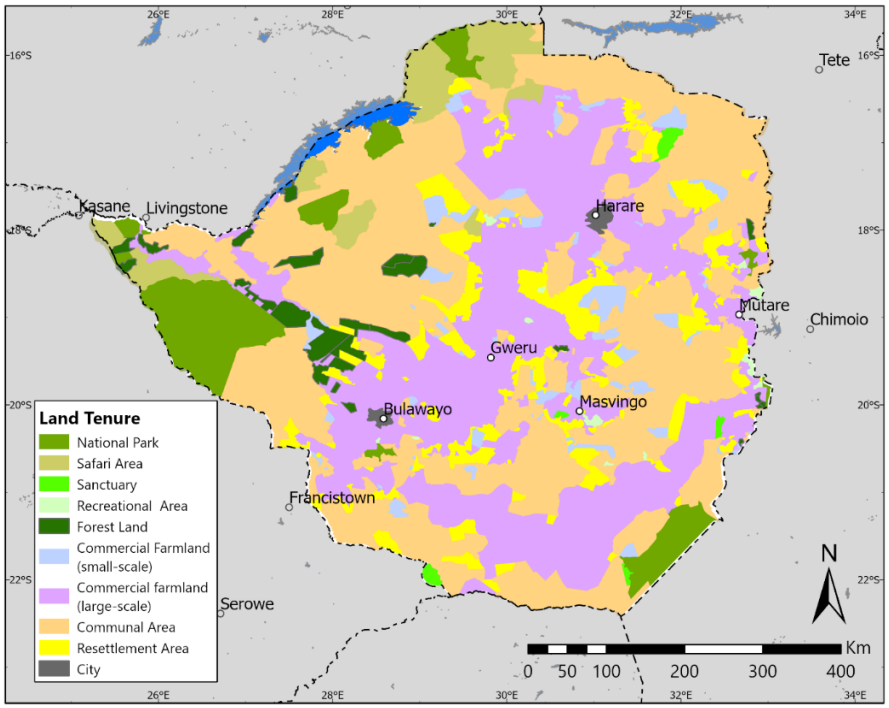


Figure 8. Map of land tenure across Zimbabwe Economy

Zimbabwe has abundant wildlife and agricultural and mineral resources, including significant reserves of platinum, coal, iron ore, gold and diamonds. GDP grew from $6.7 billion in 2000 to $21.8 billion in 2019, before shrinking to $21.5 billion in 2020 (World Bank 2022) due to the COVID-19 pandemic.

According to ZIMSTAT national accounting data for 2009-2017,[6] the formal agriculture, hunting, fishing and forestry sector contributed 7.9% to GDP in 2017, mining and quarrying 5.9% and manufacturing 11.6%. Wholesale and retail trade made the biggest contribution of 16.6%.

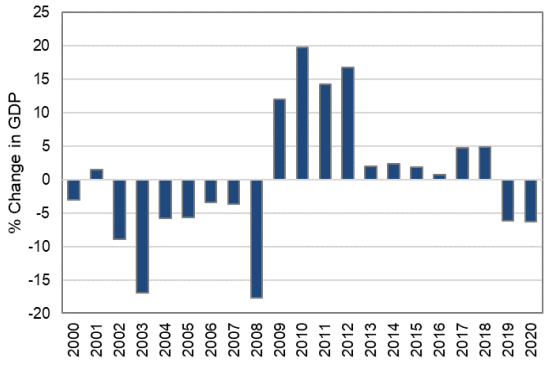


Figure 9. Percentage change in GDP from 2000 to 2020. (World Bank 2022).

The proportional contribution of different sectors has changed over time, with mining overtaking agriculture. The agricultural sector's contribution to GDP has decreased substantially, from 15.7% in 2000 to 7.6% in 2020. After a major decline in 2009, its contribution to GDP per capita remained relatively stable from 2009 to 2017 (Figure 10). Industry (including mining and construction) contributed 29.8% of GDP in 2000, and after a major reduction in the 2000s increased to 35.8% in 2020. The contribution of mining and quarrying to GDP per capita increased from 2009 to 2013 but has levelled off since.

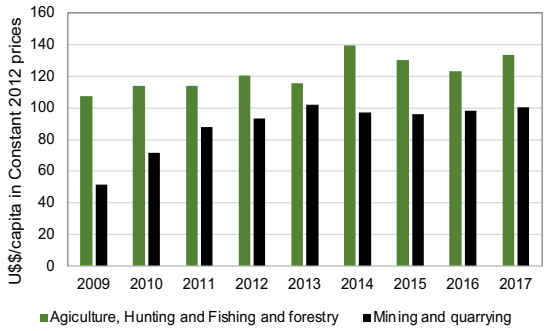


Figure 10. Contribution of the primary sectors to GDP per capita from 2009 to 2017, expressed in constant 2012 prices (ZIMSTAT and population data from World Bank 2022)

Tobacco was one of the worst hit industries during the 2000s. Production had declined by about 79% by 2008 (Scoones et al 2018).

6 National Accounts Statistics, ZIMSTATS.co.zw, accessed January 2022.

However, it had largely recovered by 2018 through the intensive support of international tobacco companies, particularly in China and especially through contract growers. By 2014 over 70% of A1 farmers were growing tobacco (ibid). However, tobacco requires firewood for curing, which has become one of the major drivers of deforestation and forest degradation (Gotore et al 2021)

Between 2000 and 2020 exports increased from 22.9% to 37.2% of GDP (possibly because exports remained buoyant at a time of decreasing domestic consumption), while imports increased dramatically from 22.8% before settling down to 38.8% in 2020. Foreign direct investment was negative in 1990 (reflecting disinvestment), but grew to $23 million by 2000 and $280 million by 2019. Net official development assistance grew from $334.3 million in 2010 to $974.9 million in 2019 (World Bank 2022).

Most of Zimbabwe's people are poor, with 61% of households nationally living in poverty and 22% in extreme poverty (ZIMSTAT 2019). Poverty is proportionally higher in rural areas, which account for the majority of the national population (68%). Approximately 77% of households are poor and 32% extremely poor. Most of the country's population is dependent on low-input subsistence and small-scale agriculture, the primary source of income for 67% of rural households (ZIMSTAT 2018). This is often combined with informal mining activities and/or supplementary use of harvested natural resources. Subsistence use of woody resources is particularly important, providing the main source of cooking fuel for 94% of rural households and 69% of households nationally (ZIMSTAT and UNICEF 2019), much of which is derived from indigenous woodlands and forests.

An estimated 3.9 million people worked in the informal sector in 2017 (ZIMSTAT 2018). This accounts for well over half of the economically active population, given that the population of people aged 15 and older (which includes many people who are too young or too old or otherwise unable to work) was estimated to be 8 million (ZIMSTAT 2017). The value of outputs from the non-farm informal sector alone was estimated to be $1.7 billion in 2017, or around 9% of 2017 GDP. However, other studies have reported the contribution of the informal sector to be far greater. For example, the International Monetary Fund estimates that the informal sector accounts for 61% of Zimbabwe's GDP, the second highest in the world after Bolivia (Medina and Schneider 2018).

The country is currently operating on a medium-term plan, the Zimbabwe National Development Strategy (NDS 1) for 2021-2025. This calls for the reform and harmonizing of national laws to create an enabling environment for quality service delivery and for the implementation of supportive policies and practices in key productive economic sectors. It also calls for value addition to and beneficiation of various natural resource-based products and services. The aims of the NDS 1 climate change adaptation strategy include promotion of conservation agriculture, drought-tolerant and high-yielding crop varieties and irrigation infrastructure development.

BIODIVERSITY CONSERVATION

Overview

A range of conservation measures have been implemented in Zimbabwe in response to human pressures on land and resources. The aim has been to achieve and maintain a balance between conventional development, which impacts on nature, and conserving the country's rich natural heritage and the benefits that it brings.

Area-based protection and/or conservation management occurs through the state-owned park estates, state forests, privately owned game reserves and conservancies and wildlife management areas (WMAs) in communal lands. The WMAs represent wards participating in the CAMPFIRE programme. While biodiversity is found throughout the country, designated protected areas increase the probability of occurrence of intact habitats and populations while enhancing the capacity of the landscape to supply ecosystem services. The PAs cover around 27% of the country according to official estimates from the World Database of Protected Areas (UNEP-WCMC 2022) (Figure 11; Table 2). At least 10.1% of this consists of WMAs, which function as multi-use landscapes rather than strictly protected areas.

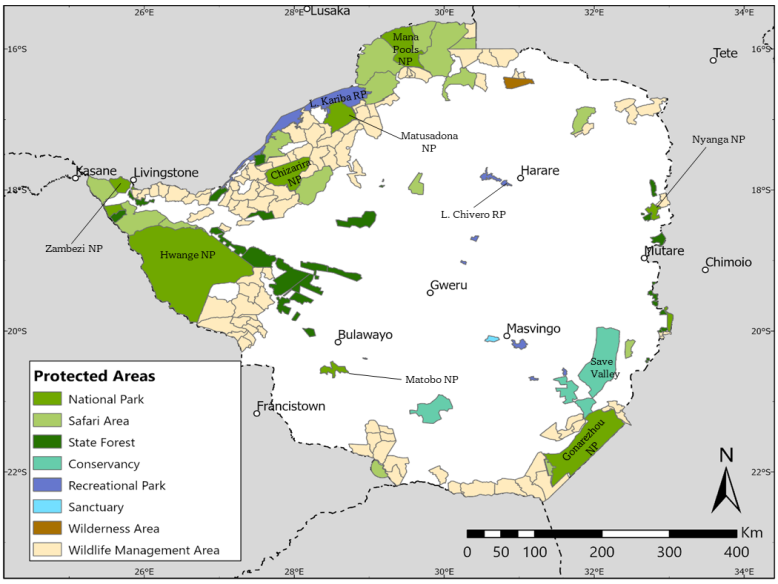


Figure 11. Location of the various protected area types across Zimbabwe, with names given for some of the key protected areas for tourism and wildlife

Table 2. Area and percentage cover of different types of protected and conservation areas in Zimbabwe (UNEP-WCMC 2022)

TYPE	AREA COVERAGE (KM^2)	% COVERAGE
National parks	27 039	6.9
Safari areas	19 071	4.9
Recreational parks	3 662	0.9
State forests	8 659	2.2
Wilderness areas	507	0.1
Private game reserves/ conservancies	6 020	1.5
Sanctuaries	126	<0.1
Wildlife management areas (CAMPFIRE wards)	39 582	10.1

State-Protected and Conservation Areas

The protected and conservation areas are administered among others by the Parks and Wildlife Management Authority (PWMA) responsible for the wildlife sector, the Forestry Commission and the rural district councils which are the appropriate authority for WMAs.

- **National parks** were established for the preservation and protection of the natural landscape, wildlife, plants and scenery. They are set aside as wildlife preserves where wildlife should be strictly protected. Commercial operations here are confined to the non-consumptive market. Zimbabwe currently has 11 national parks. They have played an important role in biodiversity preservation and tourism. Examples are Mana Pools, Hwange, Gonarezhou, Nyanga and Matusadona national parks.
- **Safari areas** are mostly found adjacent to national parks and are primarily for sustainable offtake of wildlife resources, contributing to the country's wildlife economy. They constitute a large proportion of the park estate and mainly support hunting safaris. There are 16 safari areas. Examples are the Hurungwe, Matetsi and Chewore safari areas. The five key species for hunting are buffalo, elephant, leopard, sable antelope and lion.
- **Recreational parks** were established for the preservation and protection of natural features and have been established around medium-to-large waterbodies. Examples are Lake Chivero, Lake Kyle and the recently established Tugwi Mkosi Recreational Park.
- **Sanctuaries** offer special protection for animals, allowing them to breed in a closed system. Zimbabwe has 11 sanctuaries. Examples are Tshabalala and Mushandike.
- The role of **botanical reserves** is to "preserve and protect rare or

endangered indigenous plants or representative plant communities in the wild" (Parks and Wildlife Act 1991). **Botanical gardens** are used for the propagation of exotic and indigenous plants such as cycads, which are exported (Parks and Wildlife Act 1991). Zimbabwe has three botanical gardens and 14 botanical reserves. Examples are Vumba and Ewanrig botanical gardens, Vumba Forest and Haroni botanical reserve. These areas are all small and are not included in the official protected area coverage estimates (UNEP-WCMC 2022).

- There are 43 **state forests**, managed by the Forestry Commission and Allied Timbers. In the west of the country these protected Kalahari woodland ecosystems allow for sustainable harvesting of indigenous hardwood timber species (FAO 2007). They also provide habitat to a variety of wildlife species. Forests such as Sikumi, adjacent to Hwange National Park, share wildlife populations and play a role in the preservation and protection of species. Several state forest areas are located in the country's Eastern Highlands, where they primarily consist of exotic tree plantations for timber production and do not contribute to biodiversity conservation as they are monocultures.

While historically the establishment of protected areas has been criticized for the "fortress conservation" philosophy which views people as agents of environmental degradation (Mutekwa and Gambiza 2017), the Government has taken steps to address these concerns. For instance, the CAMPFIRE and Wildlife Policy of 1992 are being reviewed to increase benefits for communities living around protected areas.

Conservation in private land areas

Conservation in private land still plays an important role in the conservation of wildlife populations and endangered species in Zimbabwe (GoZ 2019). The growth of wildlife-related land use on private land was stimulated by the 1975 Parks and Wildlife Act, which granted private landholders the right to use the wildlife on their land for their own benefit. This legislative change, in combination with challenging conditions for livestock and agriculture in many of the country's semi-arid regions, led to a change from private livestock rearing to a wildlife-dominated system after the mid-1980s (Child 2009). By the end of the 1990s Zimbabwe had a flourishing wildlife economy on private rangelands, with 669 registered game farms and conservancies in the country covering around 25 000 km2, which amounted to at least 20% of the country's commercial farmland and 5% of national area (Chigonda 2018). Rhinoceros populations, as one example, are thriving in conservancies.

However, private conservancies are not recognized in the Parks and Wildlife Act of 1991, although internationally they have recently been recognized as a PA category in the Convention on Biological Diversity, falling under the "other effective area-based conservation measures" category. The current wildlife policy review is set to make changes that will legally recognize private and communal conservancies as protected areas. Some of the larger conservancies which still retain significant wildlife populations, including endangered species like rhino and lion, are Save Valley, Bubye Valley and Malilangwe. A mixture of activities is undertaken in these private conservancies. Some, like Malilangwe, focus on photographic tourism, while others, like Save Valley, offer a mixture of photographic tourism and hunting.

Conservation in communal land areas

Communal conservation areas are registered under CAMPFIRE. There are 104 ward-level WMAs under the programme, making up 10.1% of Zimbabwe's surface area (UNEP-WCMC 2022). These areas are mostly in marginal, hot and arid regions that are unsuitable for crop production. They offer tourism and sport hunting and the proceeds go toward the development of the community (Gandiwa et al 2013). However, the significance of CAMPFIRE benefits for local communities has been diminished by the decline in hunting and wildlife tourism in the 2000s, a reduction in donor support and problems with the administrative structure and revenue sharing.

The CAMPFIRE programme was launched in the 1980s by the then Department of National Parks and Wildlife Management. The aim was to devolve rights to manage, use natural resources to benefit communities (Taylor 2009). It thus

sought to emulate the conservation successes that had occurred on private land following the shift in wildlife policy in the 1960s to allow private land owners to benefit economically from wildlife resources, as formalized in the 1975 Parks and Wildlife Act (Jones and Murphree 2001). By designating appropriate authority to land owners, they acquired *de facto* responsibility for wildlife (Taylor 2009). However, wildlife legally remained a state resource. Although CAMPFIRE was originally envisaged to focus on conservation and exploitation of wildlife as well as forest, grassland and water resources, the success of the programme has largely been premised on the use of large mammal wildlife resources, particularly through trophy hunting (Taylor 2009). Between 1980 and 2006 the lease of sport hunting rights accounted for 90% of total CAMPFIRE revenues, highlighting the importance of hunting to the programme. However, efforts have been made to diversify CAMPFIRE activities beyond hunting, to include non-consumptive ecotourism, timber and bamboo harvesting, production of honey and wild fruits, fishing and edible insects, particularly mopane worms.

Although the transfer of proprietorial rights over wildlife was highly successful on commercial farmland, replicating this on communal lands faced several legal and institutional barriers. Responsibility for devolved governance was initially granted to 12 rural district councils, although it was recognized that the long-term success of the programme depended on further devolution to the ward and village level (Taylor 2009; Tchakatumba et al 2019). However, this was impeded by the absence of any legal persona below RDC level, obliging administrative authority and legal rights to wildlife to be decentralized to RDCs on the condition that rights and benefits were to be further devolved to producer communities. In other words, there was a need for a communal property regime involving a defined group, collectively managing and exploiting common property resources, thus functioning as a defined proprietorship unit over land and resources (Jones and Murphree 2001). This led to the emergence of ward-level producer communities through the establishment of ward wildlife committees. The chairpersons of these committees would represent their wards on the district wildlife committee, a sub-committee of the district council (Murombedzi 2001). In 1991, the CAMPFIRE Association was formed to lobby for and promote the role of wildlife producers on communal land, enhancing the political legitimacy of CAMPFIRE and its ability to play a proactive advocacy role (Taylor 2009). However, membership of the association has remained limited to the RDCs rather than devolving to the true wildlife producer communities at sub-district level.

While there is some variability in the CAMPFIRE revenue generation and allocation model across different districts, a general typology can be described. In a typical arrangement an RDC leases hunting or ecotourism rights to wildlife and wild land use (Bond 2001). The conditions of these leases – the financial structure, location and duration, for instance- – are determined primarily by the RDC (Taylor 2009). Current CAMPFIRE revenue guidelines state that 55% of gross revenues should go to producer communities, 41% to the RDCs and 4% to the CAMPFIRE Association (Tchakatumba et al 2019) (Figure 12). Of the 41% allocated to RDCs, 26% is meant to be used for wildlife management, including fire control, habitat management, monitoring and hiring game scouts, while 15% goes towards administrative and management costs.

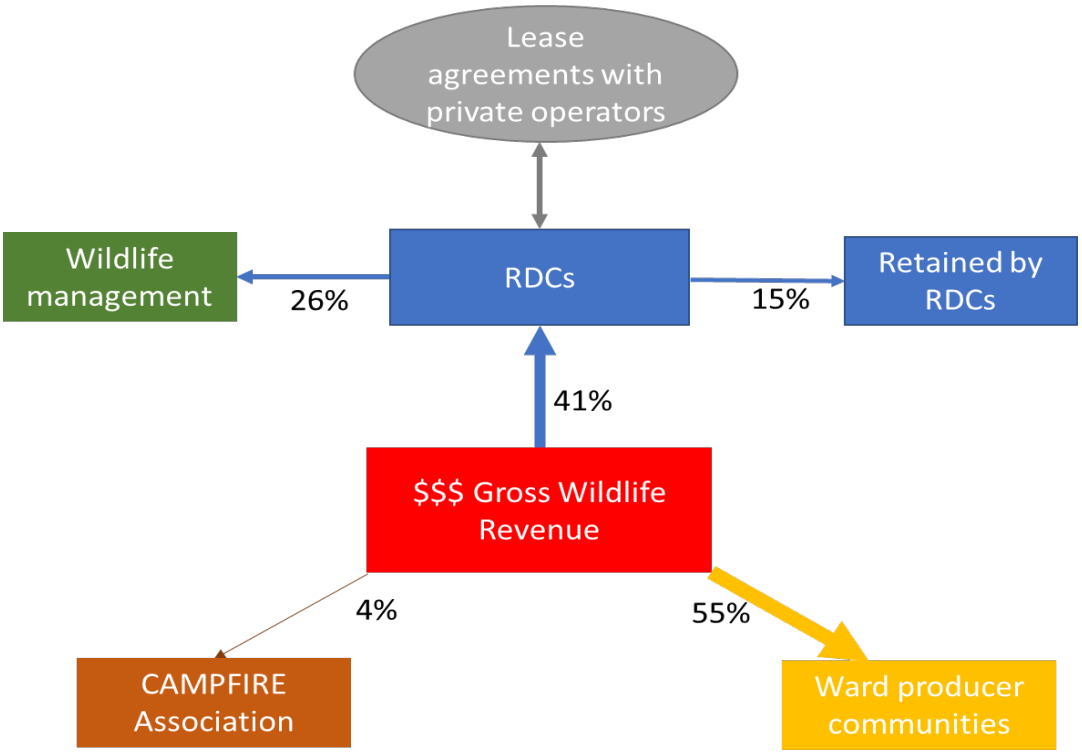


Figure 12. CAMPFIRE revenue sharing arrangements (Based on Bond 2001 and Tchakatumba et al 2019)

CAMPFIRE was initially funded by the Government and received technical and other support from various research organizations and NGOs. The CAMPFIRE Collaborative Group, a joint structure of government agencies, NGOs and academic institutions. played an important role in capacity building and acting as a third-party broker providing neutral arbitration where community disputes stalled progress (Rihoy et al 2010).

Government noted the strengths and weaknesses with CAMPFIRE and began to review the model with a view to improving revenue sharing and governance mechanisms. Other practical models of community governance structures are being piloted by the Government under the Global Environment Facility (GEF 6) project in the Zambezi Valley, which aims to establish six community conservancies. They are meant to ensure that communities are fully involved in the management of natural resources in their areas. The Government is using lessons learnt from Mahenye Community Conservancy (see Box 2).

Box 2. CAMPFIRE case study – Mahenye Ward, Chipinge District: Overall rationale, successes and challenges

Mahenye was one of the first wards to participate in the CAMPFIRE programme (Chigonda and Urmilla 2021a) and has been the subject of several previous studies. It thus provides a good case study for further demonstrating the successes, challenges and controversies around the CAMPFIRE programme, especially in the post-donor era since 2003. Mahenye is in Chipinge District in south-eastern Zimbabwe between 21.0°S-21.3°S and 32.3°E-32.5°E. Gonarezhou National Park is located along the ward's southern border. As of 2012, Mahenye was estimated to have a population of 3 671 in 707 households, with an average household size of 5.2 people (ZIMSTAT 2012). The CAMPFIRE programme in Mahenye officially started in 1990 when the Chipinge RDC was given appropriate authority by the central government to manage wildlife in the district on behalf of local communities (Chigonda and Urmilla 2021a). Responsibility for management at the local level was given to an elected CAMPFIRE committee, which also represented the community in dealing with the RDC and with hunting and lodge operators (Balint and Mashinya 2006). Of the 30 wards located in Chipinge District, only Mahenye and its neighbour, Mutandahwe, are actively involved in CAMPFIRE. Both wards fall within some of the most arid regions of the country (agro-ecological regions IV and V), making rain-fed subsistence agriculture challenging.

Successes

- Ability to diversify revenue streams from trophy hunting to incorporate ecotourism (Rihoy et al 2010). This involved the RDC entering into a joint venture agreement with a private tourism operator on behalf of the community. In return for the right to develop lodges on communal land, the development firm agreed to pay around 10% of the lodges' gross receipts to the RDC, which would in turn channel 75% of revenue back to the ward (Murphree 2001). By 1997, income from these lodges was twice the income generated from hunting, thus significantly boosting the overall annual CAMPFIRE income for Mahenye.
- Average annual disbursements to Mahenye Ward from 1991-2003 were around $36 500 (Tchakatumba et al 2019), derived from hunting and ecotourism in the ward.
- Disbursement's to Mahenye were higher than for any other ward in the south-east lowveld, reflecting its sizeable wildlife populations, attractive wilderness characteristics and diversity of revenue streams (Rihoy et al 2010; Mudzengi Iet al 2021). The Chipinge RDC retained an average of $44 500 a year over this period.
- Revenues disbursed to the ward were sufficient to pay household dividends to all community members, which averaged between $14 and $40 a year. This amounted to between 5% and 10% of average household income from crops and livestock, suggesting that while CAMPFIRE dividends were a significant source of income, they were not sufficient to lift local people out of poverty (Balint and Mashinya 2006)

Challenges

- The decline in ecotourism, leading to reduced average annual cash disbursements to the ward as a whole from $36 500 between 1993 and 2003 to $19 000 between 2004 and 2014, representing a decline in revenue of almost 50% (Tchakatumba et al 2019).
- Communities perceived that there was mismanagement of funds in the CAMPFIRE programme.
- Weak governance systems such as the lack of appropriate accounting systems and procedures leading to leakages of funds.

Conclusion

- Mahenye Community Conservancy demonstrates the potential of the CAMPFIRE model as a framework that could be strengthened and adopted for community-based natural resource management. The model will need to have strong governance and financial management to strengthen accountability and transparency.

STATUS OF HABITATS, WILD POPULATIONS AND RESOURCES

Habitats

Distribution and coverage of natural habitats across Zimbabwe

The forests and grasslands of the country have been transformed by cultivation, which covers 24% of the country's land surface (Figure 13), according to global land cover data (Buchhorn et al 2020). The current land cover reflects the impact of human activities on natural vegetation (Figure 13). Urban expansion is another increasingly important driver of land cover change. Natural vegetation cover is generally more intact in low agricultural potential areas, which coincides with areas where most of the country's protected areas are located. PAs such as national parks, safari areas, state forests and some private conservancies remain generally free of agriculture. Note that the PAs shown in Figure 13 include CAMPFIRE wards, where cultivation is permitted.

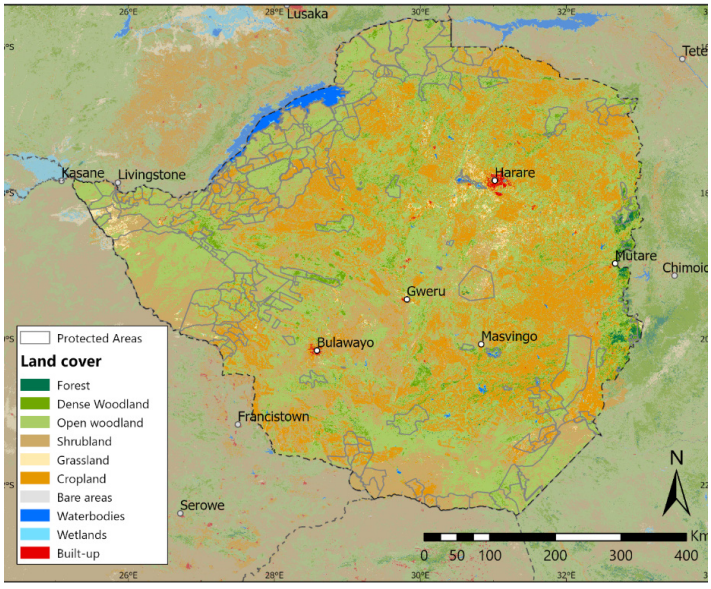


Figure 13. Zimbabwe land cover map for the year 2019 (Buchhorn et al 2020)

The land cover data (Buchhorn et al 2020) in different woody habitat types were combined with the map of World Wide Fund for Nature ecoregions (Olson et al 2001), which provides a broad depiction of natural vegetation types in the absence of human disturbance. Table 3 shows estimates of the extent of the habitats and land uses.

Table 3. Coverage of different habitat types across Zimbabwe obtained through combing land cover data (Buchhorn et al 2020) with WWF Ecoregions (Olson et al 2001)

BROAD HABITAT	HABITAT	AREA (KM^2)	% COVERAGE
Forest	Indigenous forest	975	0.2%
	Plantation forest	1 282	0.3%
	Forest total	2 257	0.5%
Woodland	Miombo woodland	88 068	22.5%
	Kalahari woodland	23 162	5.9%
	Mopane woodland	43 690	11.2%
	Acacia-terminalia woodland	28 379	7.3%
	Woodland total	183 300	46.9%
Other woody habitats	Miombo shrubland/wooded grassland	29 886	7.6%
	Mopane shrubland/wooded grassland	34 594	8.9%
	Kalahari shrubland/wooded grassland	10 846	2.8%
	Acacia-Terminalia shrubland/ wooded grassland	24 781	6.3%
	Other woody habitats total	100 107	25.6%
Grassland		5 761	1.49
Cropland		92 474	23.99
Bare areas		16	0.00
Water bodies		3 290	0.85
Wetlands		1 004	0.26
Built-up		937	0.24

Woodland as a whole was estimated to cover 46.9% of the country.[7] This accords with the most recent assessment by the FAO, which estimated Zimbabwe's forest and woodland resources to cover 45% of the country's total land area (FAO 2020a). Miombo woodland is the dominant woodland type, accounting for 22.5% of surface area and just under half of all woodland in the country. Miombo shrubland and wooded grassland were estimated to cover a further 7.6%. Miombo woodland generally has a low proportion of quality commercial timber species (Campbell et al 2007). There has thus been limited exploitation of this woodland type by the formal forestry sector. However, it does hold good stocks of wood for fuelwood and building materials, as well as an abundance of non-timber forest products (NTFPs) including prized fruit tree species such as muzhanje *(Uapaca kirkiana)* and mushrooms and honey.

Mopane woodland is the next most dominant woodland type, covering an estimated 11.2% of the land area; mopane shrubland accounts for a further 8.9%. Mopane *(Colophospermum mopane)* provides quality firewood and construction material for rural households (Makhado et al 2014). The trees are also renowned for hosting the larvae of the mopane worm *(Gonimbrasia belina)*. The value of mopane worm harvesting is discussed in the section on NTFPs. *Acacia-terminalia* woodland, which is a grouping of varied woodland communities in relatively dry parts of the country, accounts for 7.3% of national area.

Although it covers the smallest area of the major woodland types used in our classification scheme (5.9% of the country), Kalahari woodland is the major focus of indigenous timber exploitation, as reflected in the establishment of numerous state forest areas in this vegetation type. Zambezi teak *(Baikiaea plurijuga)* is the dominant tree species in this woodland and is a valuable timber species (FAO 2007). Other important indigenous timber species found in this woodland type are mukwa *(Pterocarpus angolensis)*, mchibi *(Guibourtia coleosperma)* and pod mahogany *(Afzelia quanzensis)*.

Shrubland areas in the four woodland types described above collectively account for another 25.6% of the country. Shorter shrubland vegetation becomes increasingly dominant in drier parts in the south and west (Figure 13). In moister regions (with miombo woodland, for instance), much of these areas likely represent woodland areas which have become degraded to shrubland or to fallow fields with short regenerating woody vegetation. However, in drier parts of the country shrubland may represent the climax natural vegetation type such as *Acacia-terminalia* and mopane shrubland).

Indigenous forests, whose canopy cover exceeds 70%, was estimated to cover just 0.2% of the country. The low forest coverage reflects both climate conditions and historical conversion by humans. Much of this area would not be classified as forest in stricter regional definitions (for instance, by White 1983), where the canopy cover threshold is 100%. This is likely why Müller (2006) gives a much lower estimate of the coverage of rainforest in the country – less than 0.04%. Furthermore, despite their very small overall extent, rainforests are estimated to account for around 740 of the 6 000 vascular plant species found in Zimbabwe, highlighting the need for their conservation.

Plantation forests consisting of exotic species were estimated to cover around 0.3% or 1 300 km^2. Plantations are systematically planted and comprise stands of young and mature trees harvested for commercial timber, research trials, firebreaks and woodlots. The dominant species are pines (69%), eucalyptus (16%) and wattle (15%). Although plantation forests tend to be monocultures with low biodiversity value, they are a more sustainable source of wood products than slower-growing indigenous species and can thus reduce harvesting of indigenous forests and woodlands (Shumba 2001).

The woody habitats described above collectively account for 73% of the country's land area, while grasslands make up 1.5%. Land cover categories such waterbodies, wetlands and bare areas cover less than 1%.

Aboveground biomass distribution

The map of aboveground biomass, derived from satellite imagery (Santoro et al 2018), is an indicator of the relative density of trees across the country (Figure 14) and reflects the combined effects of natural vegetation patterns and human impacts. Generally, areas with higher biomass will have a greater availability of harvestable resources, meaning biomass can provide a rough

7 For this study, woodland was defined as areas under tree cover where canopy cover ranges between 15% and 70%. The canopy cover threshold for forest was 70%.

indicator of the value of harvestable timber and non-timber products. Higher biomass is also associated with high carbon storage potential, contributing to climate change mitigation and therefore a potential contender for inclusion in international carbon trading schemes.

According to Bouvet et al 2018 and Santoro et al 2018, areas of high carbon biomass are patchily distributed across the Eastern Highlands, corresponding with indigenous forest and plantations. Carbon biomass is also relatively high across much of the Zambezi Valley, particularly to the north of Hwange. Conversely, carbon biomass has been significantly reduced by human activities over much of Zimbabwe, particularly in densely populated communal areas around Harare and in the southeast. Tree cover had already been reduced to less than 30% in some of the most densely populated rural districts by the turn of the century (Shumba 2001) and is likely to have declined further since then. Other areas of low biomass, between Gweru and Bulawayo for instance, are natural grasslands and wooded grasslands with sparse tree cover.

It is estimated that natural habitats in Zimbabwe store a total of 521 million tons of aboveground carbon, or an average of 17.7 tons per hectare (Table 4). Converting this to CO_2 using a 3.67 conversion factor indicates that retaining Zimbabwe's existing natural woody habitats would prevent the emission of some 1.91 billion tons of CO_2, which would be released if all of these habitats were destroyed. Table 4 also shows the breakdown of carbon storage across the different habitat classifications generated in the current study. As would be expected, values of average carbon storage per hectare increase as the density of woody plants increases – highest for forests, followed by the various woodland types, then shrublands and grassland. However, Miombo woodland stores the highest amount of carbon overall due to its extensive coverage in the country, followed by mopane woodland and then *Acacia-Terminalia* woodland and savanna.

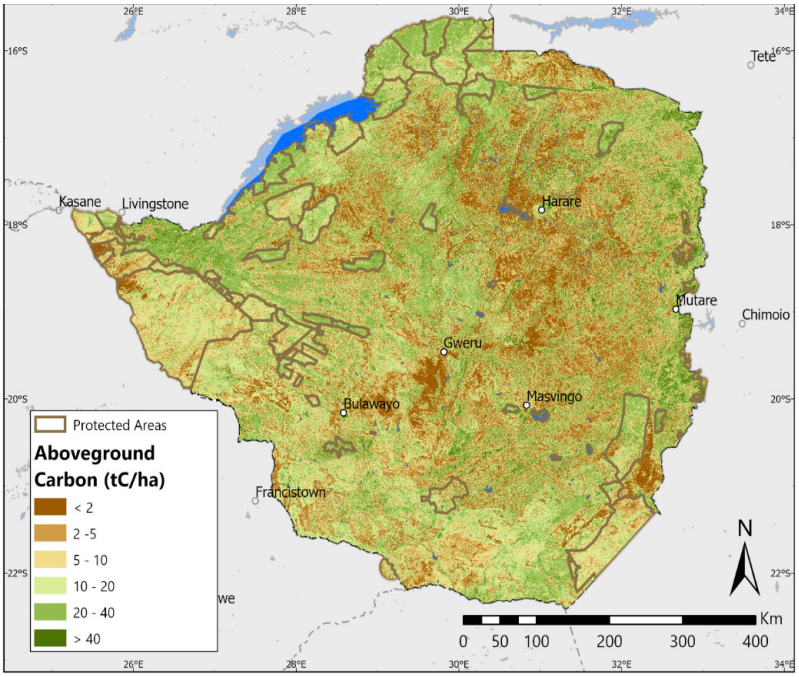


Figure 14. Map of aboveground carbon biomass (tons per hectare) across the country (Bouvet et al 2018; Santoro et al 2018)

Table 4.Total and average amounts of aboveground carbon stored across Zimbabwe's natural habitats, and equivalent amounts of CO2 (Bouvet et al 2018; Santoro et al 2018)

HABITAT	TOTAL CARBON BIOMASS (MILLION T)	AVERAGE CARBON BIOMASS (T/HA)	TOTAL CO_2 STORED (MILLION T)	AVERAGE CO_2 STORED (T/HA)
Indigenous forest	3.6	36.5	13.0	133.8
Miombo woodland	199.8	24.4	733.1	89.6
Mopane woodland	96.2	22.6	353.1	83.0
Baikiaea woodland	43.7	18.3	160.3	67.2
Acacia-Terminalia woodland	60.2	21.2	220.9	77.9
Miombo shrubland/ wooded grassland	33.3	11.1	122.2	40.9
Mopane shrubland/ wooded grassland	44.0	12.7	161.6	46.7
Baikiaea shrubland/ wooded grassland	11.2	10.3	40.9	37.8
Acacia-Terminalia shrubland/ wooded grassland	25.2	10.2	92.3	37.3
Grassland	3.7	6.3	13.5	46.8
TOTAL	520.8	17.7	1910.9	65.0

Status of terrestrial ecosystems

While Zimbabwe is rich in biodiversity, the country's forest and woodland habitats and resources are threatened by an array of factors – agricultural and settlement expansion, unsustainable exploitation of fuelwood, infrastructural development, illegal timber harvesting, uncontrolled burning, mining, invasive alien species, elephant damage in national parks and safari areas, and climate change. Fuelwood gathering for urban areas often involves cutting of entire stands in a given area to reduce transport costs. In addition, 1.4 million tons of firewood are gathered annually for tobacco curing, a major cause of deforestation that was identified a decade ago (Miller and Gwaze 2012). The trade in illegal timber is another prevalent threat to forests in Zimbabwe (USAID Tropical Forests and Biodiversity Analysis 2021).

Estimates of deforestation rates vary significantly. Zimbabwe has a natural forest area of 18.351 million hectares which is approximately 46% of the total land area. The area under forest plantations is estimated to be 187,531.42 ha, or about 0.48% of total land area. Zimbabwe lost 6 558 724.51 ha from 1992 to 2017, giving an annual deforestation rate of 262 348.98 ha each year (Forestry Commission 2017).

Wetland ecosystems

Zimbabwe is home to various wetlands – rivers, man-made lakes, dams, dambos and vleis. It has seven Ramsar sites, which are wetland habitats of international importance designated under the Ramsar Convention. Some of these fall within PAs. For example, the entirety of Mana Pools National Park is considered a Ramsar site, as are the Victoria Falls National Park and Lake Chivero and Darwendale recreation parks. The remaining Ramsar sites are Cleveland Dam and Monovale vlei in Harare, and the Driefontein Grasslands south of Chivhu. Ramsar is an international protected area designation, and the degree to which these sites are protected in practice varies greatly, being limited in Driefontein grasslands, for instance, and fully in Ramsar sites that occur in nationally designated PAs such as Mana Pools.

Zimbabwe has no large floodplains or swamps because of its topography and its drainage and surface features (Matiza 1994). Very small floodplain areas are found in the mid-Zambezi Valley around Mana Pools and around the Save-Runde confluence in the southeast. Several perennial pools are found in both of these regions (ibid). Palustrine wetlands, locally known as dambos or vleis, are the most widespread type of wetland in Zimbabwe. These are typically seasonally inundated grasslands that harbour unique wetland biodiversity.

Wetlands are a key source of water for people, livestock and wildlife, helping to regulate groundwater recharge, control floods and retain sediments, nutrients and toxic substances (Matiza 1994) as well as providing habitats, among other important ecosystem services. However, wetland habitats have come under increasingly severe pressure from livestock overgrazing and cultivation as well as infrastructure development. In the Driefontein grasslands the total wetland area declined by an alarming 45% between 1995 and 2010 (Fakarayi et al 2015). Research dating from the 1990s finds that wet dambos have become increasingly scarce, exacerbating the country's water shortages (Matiza 1994).

In urban areas wetlands are severely threatened by the expansion of agriculture and built settlements, most notably in Harare. Urban wetlands provide habitats for a variety of plant and animal species (Sharai, Tawanda and Gladman 2020). Harare's wetlands form the headwaters for a number of streams which eventually drain into its supply dams (Cleveland Dam and Lake Chivero and Lake Manyame). In the face of chronic water shortages and poor water quality in Harare, housing developments on wetlands have become an increasingly contentious topic (Mandishona and Knight 2019).

Wildlife Populations

Zimbabwe's state PAs support significant populations of wildlife, with the greatest diversity and biggest populations found in designated wildlife areas such as Hwange and Gonarezhou national parks. Other major wildlife populations are found in private conservancies, wildlife ranches and communal areas. Remarkably, it was estimated that by 2000 more wildlife was found outside state parks than within them (Child 2000). Zimbabwe has over the years successfully conserved its large mammal populations, with the "Big Five" thriving in most protected areas. The PWMA regularly monitors key species in the parks estates. In some areas – for instance in Mana Pools – data are collected by citizen scientists (see Dunham and du Toit 2013), but there is a lack of analysis of trends and the integrity status of these populations. Management plans have

been developed for keystone species such as elephant and rhino to enhance conservation and promote sustainable use.

Elephant population status

Thanks to the concerted efforts by the Government and support from development partners, Zimbabwe's elephant population increased steadily from the 1900s to 2020, as shown in Figure 16. The elephant population growth rate has been estimated at 5% per annum. As of 2014 the country had an estimated elephant population of 85 000, the largest after Botswana (Thouless et al 2016).

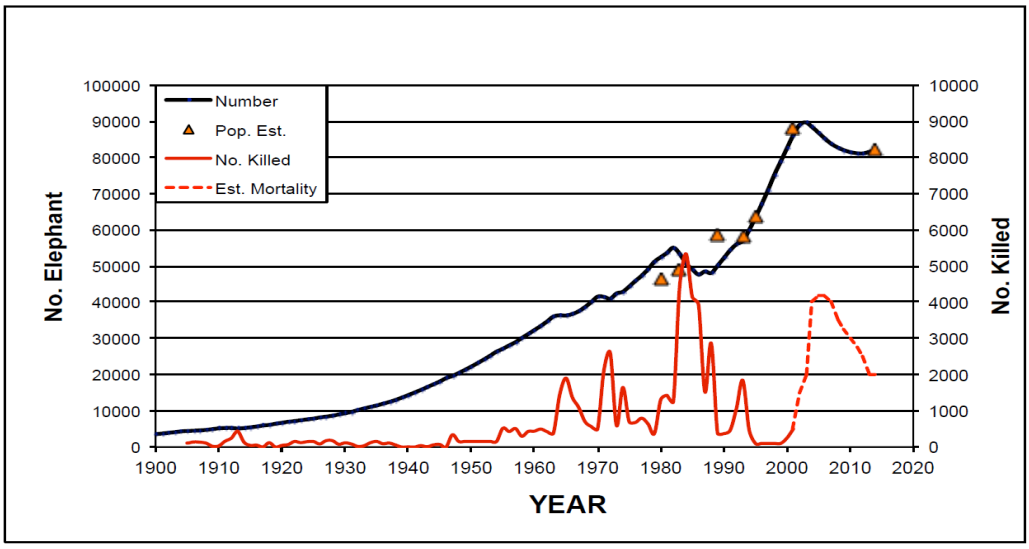


Figure 15. Trends in elephant populations in Zimbabwe (National Elephant Management Plan 2021)

Table 5. Trends in elephant populations in the four elephant regions of Zimbabwe (Aerial survey reports 2001 and 2014)

ELEPHANT REGION	2001	2014
Northwest Matabeleland	49 310	53 991
Mid Zambezi Valley	19 297	11 657
Southeast Lowveld	4 992	11 120
Sebungwe	13 988	3 407
TOTAL	88 123	80 175

Northwest Matabeleland has Zimbabwe's largest elephant population – 53 991 elephants at an average density of about three per square kilometre (Aerial survey report 2014). This region forms part of the Kavango Zambezi Trans-frontier Conservation Area, the largest TFCA globally. Decline in elephant populations in the Sebungwe and Mid-Zambezi Valley regions were seen between 2001 and 2014.

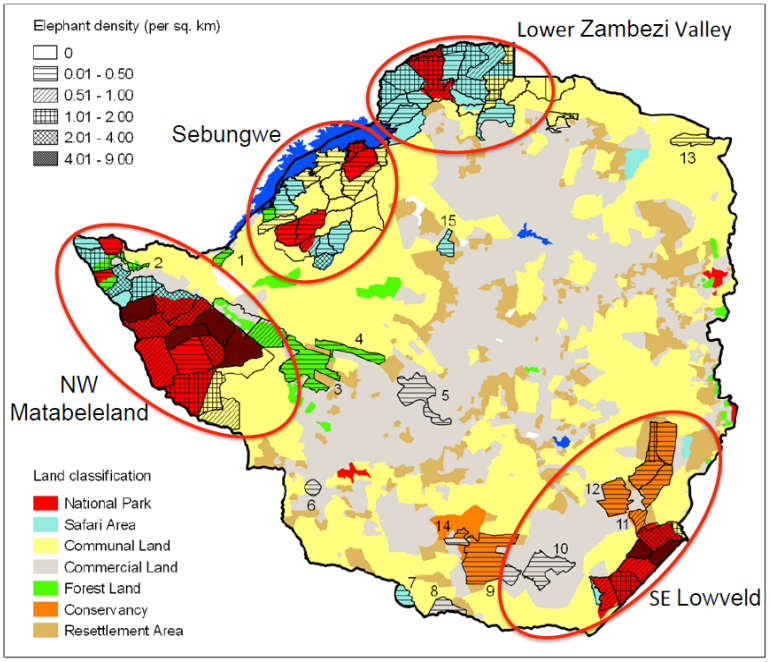


Figure 16. Elephant range areas and management regions in Zimbabwe, indicated by red circles. (National Elephant Management Plan 2021-2025)

Rhino population status

In the late 1980s Zimbabwe had the largest rhino populations in world (Cumming 1987). In 2021 it had the fourth largest rhino population in Africa – at least 971 black and white rhinos. South Africa the largest rhino population at 17 671, followed by Namibia (2 832) and Kenya (1 258) as of 2017 (Emslie et al 2019).

Hunting before 1980 took a heavy toll on rhino populations in the country, particularly white rhino, which is regarded as the only animal that has been hunted to extinction in Zimbabwe, the last individual having been shot in 1912 (Child 1995). White rhino were later reintroduced into the country. While sport hunting is no longer a major threat, poaching has resulted in a severe decline in rhino populations in more recent decades and their disappearance from most PWMA areas. Between 2006 and 2015, 6 062 rhinos were poached across Africa, according to the African Rhino Specialist Group (AfRSG 2016). Rhino poaching peaked around 2008, with over 10 000 rhinos poached across Africa – 635 of them in Zimbabwe – by 2020 (Knight 2020). While Zimbabwe's populations of both species remain heavily depressed (Standley and Emslie 2013), white rhino numbers increased from 299 in 2010 to 398 in 2020 and black rhino numbers from 423 to 573 (Figure 18), according to PWMA data. Nonetheless, annual population growth is slow and falls short of the target of 5% (GoZ 2018). This is because Zimbabwe has not been able to contain well-organized poaching of both species, with 130 black and 59 white rhinos killed between 2011 and 2016 (GoZ 2018). Rhino populations continue to benefit from PAs and intensive protection zones (IPZs), for example in Hwange and Matobo national parks. Efforts are being made to reintroduce rhinos in more secure PAs, with recent translocations to Gonarezhou National Park.

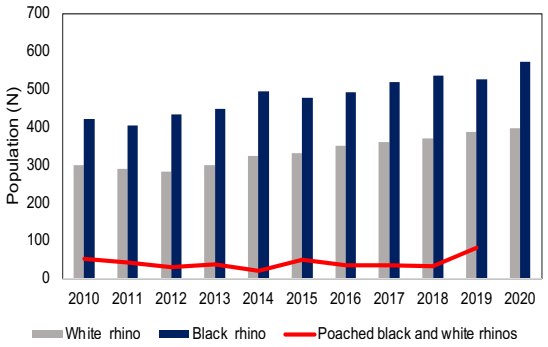


Figure 17. Trends in rhino populations in Zimbabwe (PWMA and Knight(2020)

Lion population status

A global database for lion populations is being developed (www.cms.int), but available data suggest that lions in Africa are in decline. Data from 2004 estimated the population of lion in southern Africa to be around 10 000 (Bauer, Chardonnet and Nowell 2005). Just over one

thousand lion were estimated to reside in Zimbabwe compared to 2 900 in Botswana and 2 700 in South Africa and 910 in Namibia.A more recent estimate puts Zimbabwe's lion population at 1 917 (PWMA 2020).

Lions occur in most PAs except recreational parks and a few areas in the high and central parts of the country, notably Matopos National Park, Sebakwe, Ngezi and Chegutu safari area (Figure 19, Table 4). Most of the national parks and safari areas on the borders support lion populations. International connectivity of lion range has been enhanced by the creation of TFCAs. Populations outside of protected areas are declining as a result of habitat fragmentation and increasing human population pressure.

A study conducted in Tuli Safari Area and Gonarezhou National Park found that lion numbers were significantly lower than would have been predicted by prey-availability models (Groom, Funston and Mandisodza 2014). Other factors limiting growth of lion populations in Zimbabwe are habitat fragmentation, shrinking the areas for lions to roam in and leading to reduced hunting niche, and a lack of resources to implement adequate conservation action.

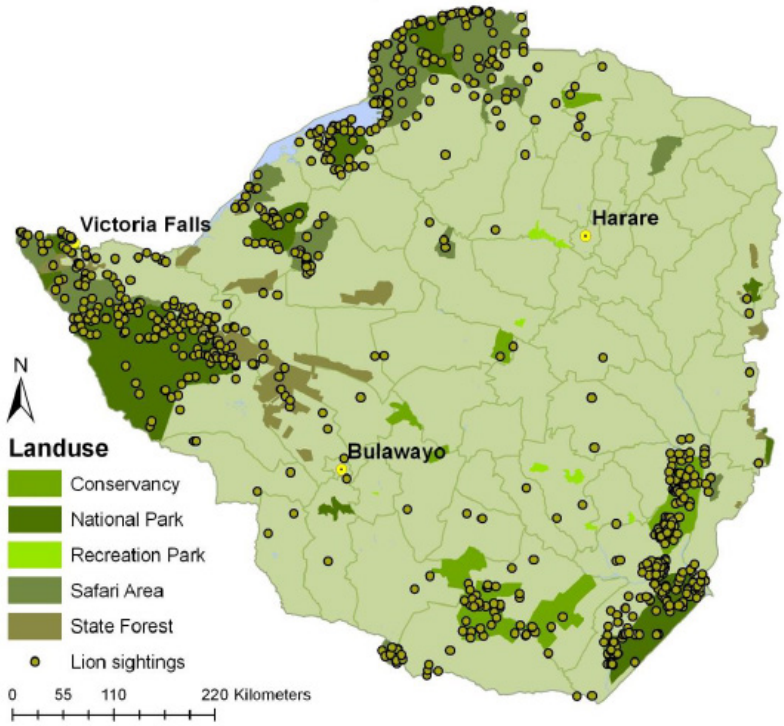


Figure 18. Distribution of lion populations in Zimbabwe (van der Meer, Cheetah Conservation Zimbabwe)left

Table 6. Estimated lion range extent, populations and densities in four key lion regions (PWMA 2020)(below)Am nem ingules tatuitimus

REGION	AREA (KM²)	ESTIMATED POPULATION	INDIVIDUALS PER 1 00KM²
Northwest Matabeleland	24 863	737	3.0
Sebungwe	6 953	72	1.0
Lower Zambezi Valley	7 491	212	2.8
Southeast lowveld	12 335	896	7.3
TOTAL	51 642	1 917	2.7

Leopard population status

Zimbabwe's leopard populations are thought to be healthy and stable (PWMA 2018). Populations are found inside and outside PAs (Figure 20) and leopard densities are higher inside PAs. It is vital that population surveys are carried out regularly

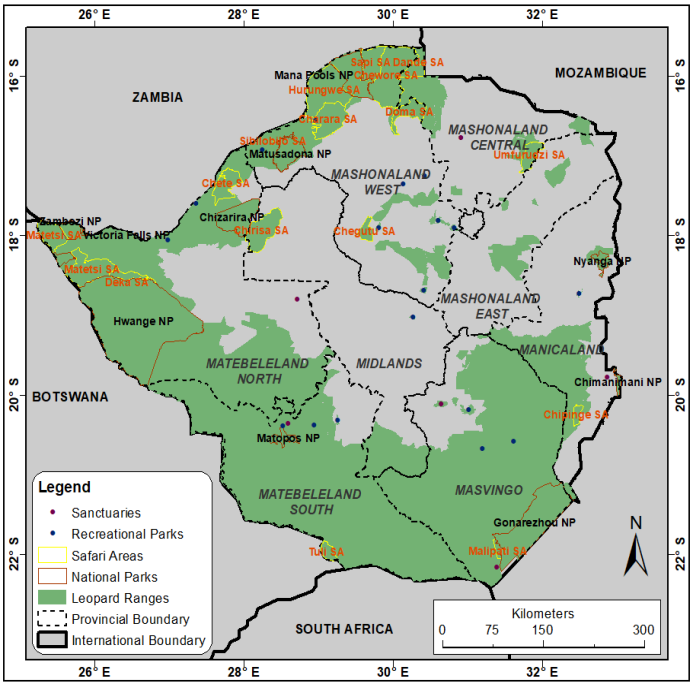


Figure 19. Distribution of leopard across Zimbabwe – green indicates areas where leopard are present (PWMA 2018)

to guide species management and decision making. Zimbabwe carried out nationwide camera trap and spoor surveys for leopard population densities and distribution estimates between 2018 and 2021. The data currently are being consolidated.

3. THE BIODIVERSITY ECONOMY

The biodiversity economy comprises business transactions related to wildlife, wild-capture fisheries, indigenous forestry, bioprospecting, wild-harvested non-timber products ("biotrade") and the supply of ecosystem services, all of which are described in the following sections. These activities fall in four of MECTHI's prioritized subsectors, namely wildlife, fisheries, forestry and bioprospecting and biotrade, or are cross-cutting, in the case of payments for ecosystem services. Note that in some cases, the subsistence and cultivation aspects of these subsectors, which are not considered part of the biodiversity economy, are also briefly described in this report to put the biodiversity economy activities in context.

THE WILDLIFE SUBSECTOR

Key points

- *Safari hunting and nature-based tourism are key aspects of Zimbabwe's biodiversity economy, whose current value and future potential rely on the size and quality of Zimbabwe's protected and conservation areas.*
- *It is estimated that protected areas (PAs) attracted about $351.9 million in photographic and hunting tourism in 2019, or 27% of total tourist expenditure and 1.7% of GDP.*
- *Tourism has been increasing since the 2010s (discounting the impact of COVID-19), which is attributed to a recovery from the economic collapse of the 2000s.*
- *Hunting generated about $19 million in fees paid to the Government in 2019.*
- *The major challenges in the wildlife subsector are poaching and limited financing for conservation initiatives.*
- *Even before COVID-19, the expenses of the Parks and Wildlife Management Authority (PWMA) generally exceeded its operational revenue, highlighting a PA financing gap.*
- *By strengthening and expanding its system of protected and conservation areas and with sensitive attention to development, Zimbabwe has the potential to provide a world-class tourism offering that delivers a number of co-benefits to its society.*
- *Legislative reform leading to the formation of authentic community conservancies could create new economic opportunities in rural areas and contribute significantly to maintaining the country's biodiversity.*

Overview

The wildlife subsector, sometimes called the "wildlife economy", generates income from nature-based tourism, the supply of film locations and production of wildlife documentaries, sport and trophy hunting and the sale of live game or game products such as meat, bones and skins. It includes the income generated from downstream enterprises such as travel and accommodation services, professional hunting outfitters,

taxidermy and research and monitoring. Zimbabwe is mainly known for wildlife tourism and trophy hunting, and this is mostly sustained by international visitors. With the exception of crocodile farming, wildlife ranching for live sales or wildlife products is limited.

The key actors in the wildlife economy are the PWMA and Forestry Commission. They manage the state PAs in which non-consumptive tourism and hunting take place and which provide the core conservation effort required to support the wildlife economy on private and communal land areas. On private land or land leased from the state, private actors (which include international companies) operate wildlife ranches or conservancies for game production, hunting or ecotourism. In communal lands this has been achieved through the CAMPFIRE programme. Hunting on private and communal land is closely regulated by the PWMA and trophy fees are collected by Treasury. Wildlife economy income generated in communal areas is collected by rural district councils. Some of it goes to benefit the communities that set aside land for wildlife and are involved in wildlife management.

Informal and illegal activities in the wildlife sector make trouble for the formal sector, increasing its costs and reducing its net benefits. Zimbabwe's expanding population and increasing poverty are bringing crushing pressures to bear on wildlife and other natural resources and creating opportunities for organized wildlife crime. These problems are exacerbated by dwindling resources for wildlife protection. The PWMA is expected to be self-supporting and it receives little direct financial support from the Government. Its budgets are stretched and it struggles to generate enough revenue to keep its activities going. Monitoring of wildlife populations is often dependent on donor interventions and is far from adequate.

Key elements of the wildlife sector are described below. The account is based on data supplied by PWMA and the Reserve Bank of Zimbabwe, on information from sectoral reports and on global data sets. It focuses on the years leading up to the COVID-19 and offers some insights into the factors limiting growth of the subsector and recommends measures to promote its sustainable development.

Wildlife tourism

Nature based tourism income and contibution of protected areas.

Wildlife is the single biggest driver of tourism growth on the African continent (Space for Giants 2019), which highlights the vital need to maintain attractive wildlife populations as part of the a country's comparative advantage. Zimbabwe's biodiversity is a key drawcard for tourism. In 2019, protected areas in PWMA estates alone received around 530 000 foreign visitors (ZTA 2020). Excluding visitors in transit, total visitor arrivals were around 1.7 million in 2019, which means that the PWMA estates attracted about a third of all visitors in 2019. This conservative estimate of the numbers of tourist arrivals who visit biodiversity attractions does not account for those who come to see wildlife that is not in the state PA network.

Zimbabwe ranks among the top third of countries globally on the natural resources pillar of the World Economic Forum's Travel And Tourism Competitiveness Index (WEF 2019), underscoring the competitive advantage afforded by its natural attractions. Zimbabwe's tourism marketing also makes much of its natural attractions (see https://zimbabwetourism.net/), further highlighting the importance of biodiversity to its tourism sector.

There are, however, no data on the value of biodiversity-based tourism in Zimbabwe. For this study, nature-based tourism value and the contribution of PAs were calculated from spatial data on tourism activity. This involved estimating the expenditure due to tourism involved in visiting attractions (as opposed to visiting on business or visiting friends and family), and then estimating how much of that expenditure was due to visiting natural attractions based on the density of photo user days (PUDs) calculated from geo-tagged photographs uploaded to the internet (www.flickr.com).[8] This method provides a reliable proxy for visitation rates (see Wood et al 2013) and maps the value to the attractions rather than to overnighting locations (Turpie et al 2021).

In 2019, tourism as a whole was estimated to have generated around $1.25 billion in receipts, or 6.3% of GDP, while directly accounting for

8 The average annual photo-user-days (PUDs) were obtained for each grid cell (5 km x 5 km) from 2005-2017 using the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) recreation model. One PUD translates into one unique photographer who took at least one photo in a specific location on a single day

3.7% of national employment (ZTA 2020).[9] A report by the Zimbabwe Tourism Association (ZTA) cites estimates from the World Travel and Tourism Council (WTCC) of the contribution of the tourism sector to national employment, underscoring the scarcity of information on the sector's contribution to employment. The WTTC itself reports that tourism directly and indirectly provided 178 000 jobs in Zimbabwe in 2019, accounting for 8.6% of total employment (WTTC 2021). Similarly, Zibanai (2018) estimated direct employment in the tourism industry to be at least 200 000 based on desktop research and interviews with key Government and tourism industry players.

Tourism receipts declined dramatically to $360 million in 2020 due to the slump in international travel and restrictions on movement in the country as a result of the COVID-19 pandemic, representing a 71% decline in tourism revenue (ZTA 2021). According to the WTTC, employment in the sector declined by 28% between 2019 and 2020, with a loss of 50 000 jobs (WTTC 2021). The analysis in the current report is based on the value of tourism in 2019 as this is more representative of the historical situation and the potential recovery of tourism following the decline in the pandemic and lifting of lockdown measures.

The contributions of business and leisure tourism to total tourist spending, sourced from WTTC data, were correlated to quantify the value of attraction-based tourism. Data from ZTA (2020), which differentiated leisure tourist numbers by purpose (visiting family and relatives, holidays, shopping and education), were used to refine the estimates. Data from ZTA reports that show the large numbers of visitors in transit.

They were excluded from the analysis because such travellers spend little or nothing on tourist attractions. Estimates based on data from South Africa assumed that the percentage of tourist spending on attractions varied as follows: 100% spending on attractions for holiday tourists, 4% for business visitors, 2% for those visiting family and relatives and 15% for other visitor categories.

The WTTC (2021) calculates that 92% of tourism expenditure in Zimbabwe was for leisure purposes in 2019, mainly for visiting friends and relatives (56%), followed by holiday tourists (33%) and other categories (11%) (ZTA, 2020). Based on the estimates of the different visitor categories, the authors of this report calculate that the total expenditure on attraction-based tourism in Zimbabwe to be $878 million in 2019, which is 65% of total tourism receipts. Applying the proportional contribution of attraction-based tourism to the figures reported by ZTA and WTTC, attraction-based tourism is calculated to account for 4.1% of national GDP and 5.6% of national employment in 2019.

A map showing the density of PUDs is shown in Figure 20. There is an obvious concentration of photographs around larger urban centres. However, there are also clear clusters of higher density around a number of protected areas and other biodiversity-related attractions. Away from urban centres and the more popular protected areas, the distribution of geotagged photographs is generally sparse, indicating the high value of PAs as focal points for tourism outside of major towns.

9 At the time this report was being written, Zimbabwe had no tourism satellite accounts. Thus, the figures for the percentage contribution of tourism to GDP and employment in ZTA's annual reports are in fact derived from the World Travel and Tourism Council (WTCC), as is acknowledged in the ZTA reports.

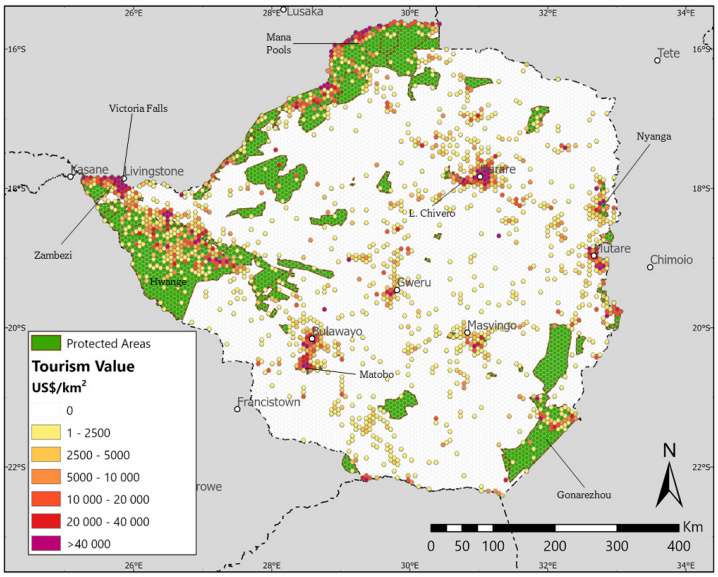


Figure 20. Estimated attraction-based tourism expenditure per km2 (Based on the density of geotagged photographs sourced from www.Flickr.com)

PUDs were particularly high in Zambezi National Park and neighbouring Matetsi Safari area. This reflects their prime location as a wildlife-viewing area near the country's premier tourist attraction, the Victoria Falls. PUDs were also high in Hwange National Park, particularly in the east, which is more accessible to visitors, and in Matobo National Park just south of Bulawayo which attracts visitors due to both its wildlife and unique hilly landscapes.

In the north of the country, Mana Pools National Park and neighbouring safari areas had high PUDs, particularly along the Zambezi River which is attractive for both wildlife and recreational fishing. The same can be said for Lake Kariba which also provides a mix of fishing and wildlife-viewing opportunities. Just southwest of Harare, Lake Chivero is a major biodiversity-related tourist attraction offering fishing and a game park with rhino. In the east, a concentration of PUDs is evident around Nyanga National Park which offers a mixture of wildlife and hiking with attractive mountain scenery. In the southeast, a notable cluster of PUDs is evident in Gonarezhou National Park, particularly in the northern section that is most accessible to visitors. Lower visitations in other national parks such as Chizarira is evident in the map. This can be attributed to lower accessibility and/or less developed visitor facilities relative to the more popular protected areas mentioned earlier. Few photographs were also evident from private protected areas such as the Save Valley and Bubye Valley conservancies.

Overall, 40.1% of PUDs in Zimbabwe were located in protected areas. The average attraction-based tourism expenditure per unit area was significantly higher in protected areas ($5 469/km2/year) than the national average ($2 246/km2/year). Overall, it is estimated that $351.9 million of tourist expenditure in 2019 was linked to visiting PAs (Table 7). This represents 27% of total tourist expenditure (both attraction and non-attraction-based) in the country. Given that tourism contributed 6.3% of GDP in 2019 (ZTA 2020), PA tourism was thus estimated to account for 1.7% of national GDP. This does not include the contribution of nature-based tourism outside PAs, for example in the Eastern Highlands, but is considerably higher than the previous estimate of total nature-based tourism in Zimbabwe of around $190 million in 2001 (Scholes and Biggs 2004, in Booth 2010).

Table 7. Gross income (tourist expenditure) from attraction-based tourism compared across major protected area categories (all figures based on 2019 tourism receipts)

	Total attraction-based tourism income ($-millions/year)	% of Total attraction-based tourism income	attraction-based tourism income per unit area (km²/year)
National-level	877.6	100%	2 246
All protected areas	351.9	40.1%	5 469
National parks	273.5	31.2%	10 113
Safari areas	44.7	5.1%	2 344
Recreational parks	20.9	2.4%	5 711
State forests	8.9	1.0%	1 031
Sanctuaries	3.8	0.4%	700

National parks are by far the most important areas in terms of both tourism income ($273.5 million/year) and average income per unit area ($10 113/km^2). Safari areas are the next most important category ($44.7 million/year), though their average value per unit area is relatively low ($2 344/km^2/year) and is similar to the national average. While safari areas are primarily for hunting, some are often used for non-consumptive wildlife tourism, as well as for angling, particularly along the Zambezi River. The relatively low value of tourism per unit area reflects the large land areas and remoteness of many safari areas, which are generally less accessible and have lower levels of development than national parks.

Recreational parks make a relatively small contribution to tourism income ($20.9 million) but have a high value per unit area ($5711/km^2). Most recreational parks are fairly small, concentrating visitors over a smaller area. This results in high values per unit area, particularly for more popular areas like Lake Chivero. State forests make a small contribution to tourism income ($8.9 million/year) and have a relatively low average income per unit area of the state PAs ($1 031/km^2/year). Apart from certain forest areas adjacent to Hwange National Park and in the Eastern Highlands, state forests generally have little to no tourist facility development. The same can be said for most sanctuaries, which also have a relatively low value compared with national parks ($700/km^2/year).

Victoria Falls National Park has the highest attraction-based tourism income of $116.6 million/year, followed by Hwange National Park at $54.3 million/year and Zambezi National Park at$46.9 million/year. Per unit, however, the relatively small Zambezi National Park has a much higher value ($90 526/km^2/year) than Hwange ($3 672/km^2/year), partly because much of Hwange's vast wilderness is inaccessible to visitors. Zambezi National Park also provides wildlife-viewing opportunities close to Victoria Falls, resulting in high visitor numbers. Other protected areas with notably high tourism income per unit area (above $10 000/km^2/year) are Lake Chivero Recreational Park, Matobo National Park, Fuller Forest and Mana Pools National Park. Figure 21 shows a view of some of the foremost nature-based tourism sites.

Table 8. Estimated contribution to tourism expenditure of the 15 protected areas with the highest number of PUDs (all figures based on 2019 tourism receipts)

PROTECTED AREA	TOURISM INCOME ($ MILLION/ YEAR)	TOURISM INCOME PER UNIT AREA ($/ KM^2/YEAR)
Victoria Falls National Park	116.6	3 836 152
Hwange National Park	54.3	3 672
Zambezi National Park	46.9	90 526
Mana Pools National Park	26.0	12 181
Matetsi Safari Area	16.9	5 619
Lake Kariba Recreation Park	13.8	4 560
Hurungwe Safari Area	13.5	4 649
Gonarezhou National Park	10.9	2 203
Matobo National Park	10.8	26 203
Sapi Safari Area	3.8	3 191
Lake Chivero Recreation Park	3.5	49 397
Fuller State Forest	3.5	14 069
Malilangwe Conservancy	3.2	6 749
Chewore Safari Area	3.2	929
Matusadona National Park	3.1	2 137

Figure 21. Some of Zimbabwe's foremost nature-based tourism sites: Matobo National Park (top) and the Chilojo Cliffs in Gonarezhou National Park (Photos: LJ Wilson)

Most of the country's premier nature-based tourism attractions are in national parks and other state PAs. Trends in the numbers of people visiting these areas thus provide a good indication of the attractiveness of the country's nature-based tourism hotspots.[10]

Based on datasets from ZTA and PWMA, visitor numbers were relatively high in 1999, but were generally depressed from 2000 to 2011. The decline in tourism over this period has been attributed to negative perceptions about Zimbabwe by the international community and the economic downturn (Karambakuwa et al 2011; Zibanai 2018).

Park visitor numbers increased from 2012, reaching a peak of around 960 000 in 2018 according to ZTA.[11] However, this conflicts with the data shared directly by PWMA, which rather suggest visitor numbers peaked at around 930 000 in 2019. Notwithstanding the discrepancies, both datasets indicate that park visitor numbers were on the rise through the 2010s, until the shock of the COVID-19 pandemic in 2020, when visitor numbers declined to around 230 000.

Various reasons have been given for the growth in tourism from 2010:

- Formation of the Government of National Unity and dollarization of the economy in 2009 brought relative political and economic stability to the country, which helped to gradually improve international perceptions and publicity (Moyo and Tichaawa 2017)
- Endorsements from key travel and international media organizations, which has helped to raise the profile of its nature-based and other tourism attractions (GoZ 2020a)
- The Government's economic development strategies and improved marketing and branding efforts by the ZTA and other key actors (Moyo and Tichaawa 2017; Zibanai 2018)
- Increased interest in tourism as an economic development strategy by the Government and improved marketing and branding efforts by the ZTA and other key actors (Moyo and Tichaawa 2017; GoZ 2020a). This includes greater efforts to market the country's tourist attractions in Asia, resulting in an upsurge in visitors from this region (Tichaawa and Mhlanga 2015)
- The expansion and upgrading of Victoria Falls International Airport, completed in 2016, provided a significant boost to the country's premier tourist attraction (Zibanai 2018). Indeed, there were notable increases in visitor numbers to Victoria Falls National Park and nearby Zambezi National Park after 2016.

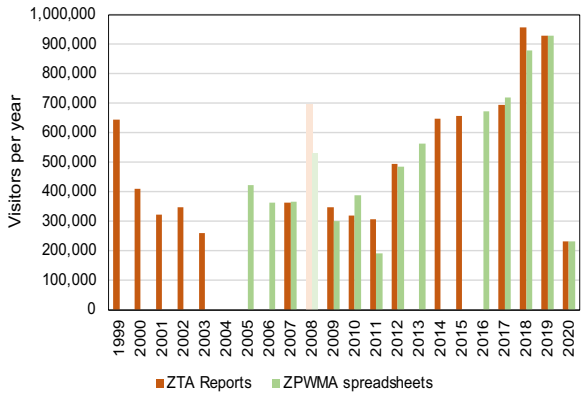


Figure 22. Annual visitor numbers to national parks and other state protected areas (ZTA annual tourism trends reports and PWMA spreadsheets; PWMA data were shared only for 2005-2020 while ZTA reports omit park visitor data for some years. Data for 2008 were erroneous}

10 Two sources of data on visitor numbers were available. These were statistics on visitor numbers to PWMA areas in annual reports released by the ZTA and spreadsheets shared directly by the PWMA. Even though the statistics quoted in the ZTA reports are derived from the PWMA, discrepancies between the two datasets were evident (Figure 23). Figures from both sources are thus quoted in this report. However, the data shared directly by PWMA went back only as far as 2005, whereas the ZTA reports accessed dated back to 1999. No ZTA annual report could be sourced for 2006, however.

11 The ZTA report for 2004 quoted a figure of 1.87 million visitors. However, this figure was omitted from our report as it was highly unprecedented and derived from what appeared to be an obvious error in the figure for visitor numbers to Nyanga National Park, which was given as 1.53 million.

Trophy hunting

Overview

Recreational or sport hunting is a major component of wildlife tourism in Zimbabwe, which generated $19 million from fees in 2019. This is mainly from trophy hunting by international clients, involving just over 1 000 trophy animals. A wide range of wildlife species, including over 30 mammal species, Nile crocodiles and a variety of game bird species, are available for sport hunting in Zimbabwe. The most valuable of these are elephant, buffalo, lion, leopard, sable and cheetah. Although cheetah are considered a key hunting species because of the value attached to the trophy, they are not commonly hunted. Trophy hunting is an important contributor to conservation in Zimbabwe, especially in remote hunting areas that are not well-suited for photographic tourism (Dickman et al 2019). Hunting areas often lack the topographic or ecological diversity to attract photographic tourists, but play a vital role in sustaining the overall size and connectivity of wildlife populations and ecosystem processes.

Hunting is carried out in safari areas managed by the PWMA, indigenous state forests managed by the Forestry Commission, communal areas under RDCs and private game farms and conservancies. In addition to the Government revenues generated directly through a range of fees associated with hunting, the sport generates a range of local benefits. Some of the meat from the hunts is given to neighbouring communities and sold as supplementary feed to crocodile farms and other wildlife breeders. Besides direct benefits such as cash and employment, indirect benefits arise from multiplier effects in downstream activities such as taxidermy, freight and leather processing.

Sport hunting attracts clients mainly from the United States, Germany, Russia, Spain and South Africa. In fact, more than 70% of hunters in Africa are from the U.S. (The Humane Society 2016). Trophy hunting is highly competitive, involving large and influential membership organizations, and the sport is therefore closely monitored on a global scale. The Convention on International Trade in Endangered Species of Fauna and Flora (CITES) conducts much of the monitoring since the majority of the most prized trophies are also endangered species. Zimbabwe was one of the top ten countries of origin of imported trophies to the U.S. in 2005-2014, accounting for 4%; South Africa accounts for 32%, Namibia 7% and Zambia and Botswana 1% each. Although South Africa and Namibia account for the most trophies hunted, for Africa's "Big Five" Zimbabwe was the top supplier of elephant, leopard and buffalo trophies, and third highest supplier of lion trophies to the U.S. during this period (The Humane Society 2016). This ranks Zimbabwe among the most important trophy hunting destinations in the world.

Hunting is regulated by the PWMA through a quota system based on the estimated sustainable offtakes of game in designated wildlife areas. The hunting quota follows the guidelines published by WWF (1997) and is based on wildlife population sizes, wildlife age, wildlife gender, property sizes, habitat status, trophy quality trends, recruitment and wildlife mortalities. The accuracy of the quota setting process is limited by a lack of data on wildlife populations {the last nationwide aerial surveys were conducted in 2014). Other methods of counting, such as spoor, transect, sightings by local communities and tourists' and water hole surveys, have been adopted for use in quota setting, though gaps still remain in area coverage. There are generally not enough funds to carry out quality wildlife surveys, resulting in data of variable quality. The approach to quota setting has therefore been adapted over the years (see Box 3 for details).

Box 3. The quota setting process

The following criteria and practices are upheld for scientific, objective and transparent quota allocations:

- Review and analysis of previous animal quota allocations and offtakes to ensure these are adaptive and responsive to population changes, trophy quality, levels of problem animal control and poaching in a defined timeframe
- Allocation of quotas at a scale that reflects wildlife ecological and biological functionality, which differs across land units, land sizes and land uses

Quota setting takes a participatory approach among stakeholders to ensure that offtake is not detrimental to the ecological and biological status of wildlife. Quota setting workshops are held annually and stakeholders involved in research, wildlife business and local communities are invited to participate. At the property level (parks estates, private farms, state forests, conservancies and RDCs), custodians make presentations on the conservation status of their properties that cover wildlife population estimates, security and poaching activities, diseases, mortality, translocations and management practices. Discussions and critiques from the workshop help to increase transparency and learning among practitioners, and derive objective policy directives for quota allocation.

The following factors are considered in setting quotas:

- Zimbabwe is a signatory to CITES and has set maximum off-take numbers for key CITES controlled wildlife species. Zimbabwe's off-take is thus predicated on and capped by the quota allocation set under CITES – 500 elephants (1 000 tusks) as part of the hunting trophies, 500 leopards, 200 crocodiles and 50 cheetahs.
- Wildlife population data from aerial and ground surveys form the basis for any quota allocation. Any change in wildlife population estimates results in the adaptive management of quotas.
- Given the sensitive nature relating to hunting of cheetah, leopard and lion, further consideration is given to input from research, including a compilation of credible repeated lion surveys.
- Consideration is given to all research and monitoring projects and publications for all hunted species; for example, a recent publication on trophy quality trends in the Chewore Safari Area (Muboko et al 2020) informed the quota setting process on the trophy quality status in the area from 2021.
- Historical quotas and hunting returns are a critical input, providing information on trends and quality of animals.
- Assumptions about populations can be made based on animal home range size and the size and land use of the properties.
- Management aspects such as artificial supplies of water for game, supplementation, fire prevention and fencing are considered when determining quota allocations.
- The level of security and probability of illegal hunting are considered. Where security is poor the premise for quota allocation is presumed doubtful and a precautionary quota is allocated factoring in poaching as a form of off-take.
- Community-based conservation programmes that establish an economic value for wildlife and provide incentives for sustainable use are a mechanism for restoring the responsibility of managing natural resources to local communities. Human-elephant conflict is rampant cropping seasons. A quota is issued in an effort to reduce losses to wildlife and improve local communities' tolerance to wildlife.

- during cropping seasons. A quota is issued in an effort to reduce losses to wildlife and improve local communities' tolerance to wildlife.
- Lion quotas are allocated using the age of harvested animals, following a system used in Mozambique and Tanzania. When an underage lion is shot the quota is reduced. The methodology of coming up with a sustainable quota for lions is shown below. Points are allocated for ages of lions hunted to discourage the hunting of young lions.

	≥6 YEARS	NO TROPHY	5 YEARS	4 YEARS	<4 YEARS	FAILURE TO SUBMIT HUNT RETURN OR INCOMPLETE HUNT RETURNS
For quotas of 3 or more	4	3	3	2	-3	0
For quotas of 2	4	3	3	2	0	0
For quotas of 1	6	3	3	2	0	0
Quota setting process	These points are added up and divided by 3 to yield the quota for next year					

- Trophy quality is one of the most significant determinants of the impact and the future of hunting in a population and is a good index of the status of animal population in an area. This is true mostly as the trends indicate the recruitment performance of the population (the repeated availability of the favoured trophy sizes over a period). The analysis of trophy quality therefore provides a representation of hunting impacts and can be used to inform appropriate adaptive measures such as reduction in the allocated quota if the trend shows a reduction in quality (for example trophy size). It should be noted that trophy quality is one of the few absolute (as opposed to approximate) measures used in quota setting.

Hunting offtakes

Hunting is monitored in terms of offtake and direct revenues from fees only. There are no recent studies or data on numbers of hunters, average expenditure, value chains or employment. The offtake of key trophy species from 2014 to 2019 is summarized in Figure 23. In general, offtakes of most species declined over this period, with some exceptions.

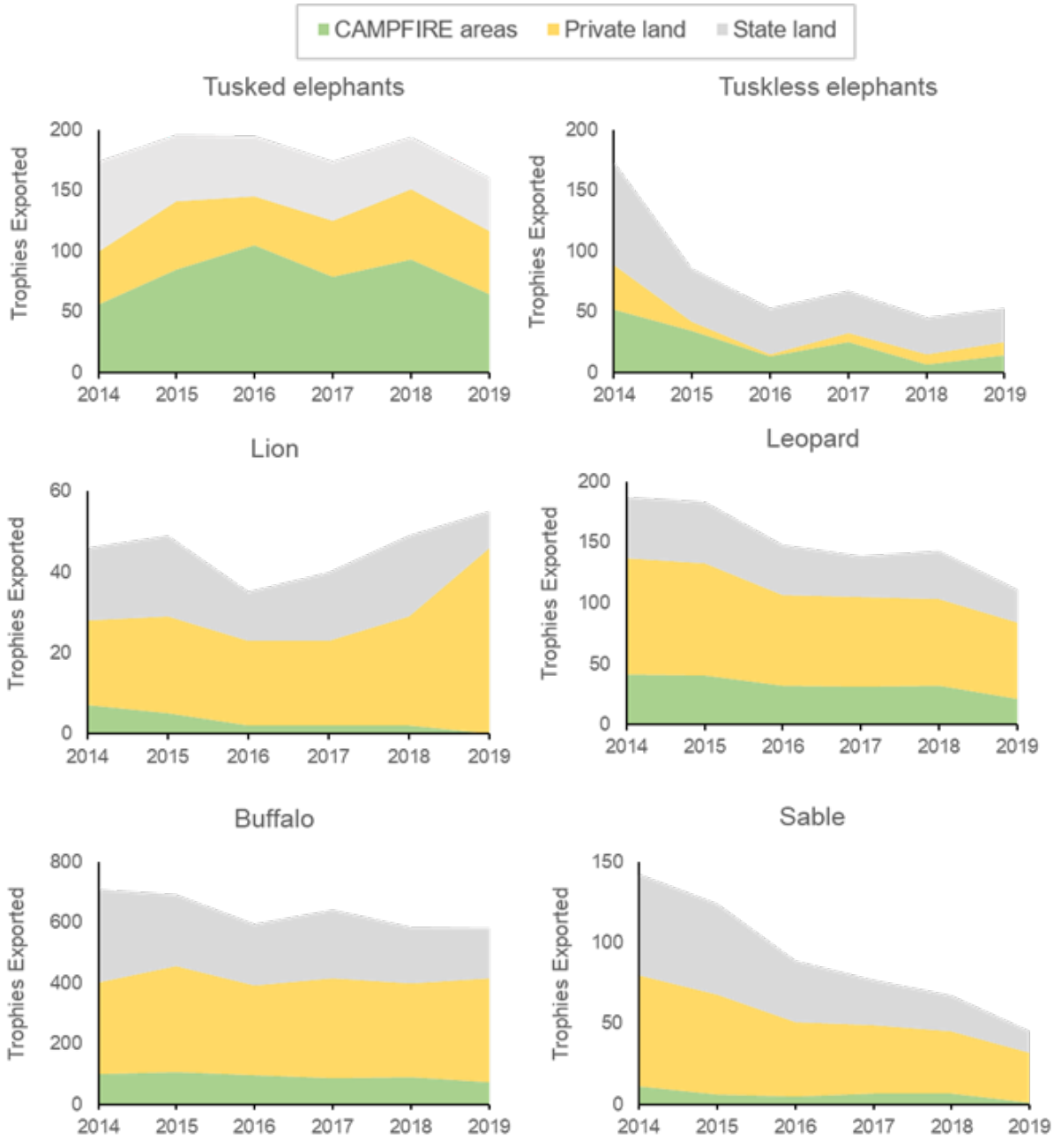


Figure 23. Trends in numbers of trophy exports from state land and private and communal land (Reserve Bank of Zimbabwe)

Buffalo, an abundant species in Zimbabwe, make up over half of the numbers of trophy species hunted, with an average of 638 hunted from 2014 to 2019 compared with the average of 838 hunted around 2000 (Booth 2002). While the PWMA allocates 500 elephants under the sport hunting quota each year, actual offtake averaged 182 tusked elephants from 2014 to 2019. This is less than the average number of 243 hunted during the period around 2000 under the same quota size (Booth 2002). Nyamayedenga et al (2021) found a significant reduction in the demand for elephant hunting in northwest Zimbabwe after the U.S. banned the importation of elephant trophies from Zimbabwe in 2014. A ban on ivory went into effect in China at the end of 2017 and could also have significant impact on elephant hunting in Zimbabwe, according to Jia Qiao, external relations manager, China, with the African Wildlife Society.

An average of 46 lions were hunted from 2014 to 2019 compared to 89 around 2000 (Lindsey et al 2007). Leopard are another key high-value carnivore species hunted in Zimbabwe. From 2014 to 2019 an annual average of 152 leopards were hunted and exported. During the reporting period, the average number of leopard hunted was around half of the 303 hunted around 2000 (Booth 2002). While sable antelope are the most important trophy antelope species, the numbers hunted declined over the reporting period from 145 to 45. Very few cheetahs are hunted, which has always been the case because of their low population; only six cheetahs were hunted around 2000 (Booth 2002).

The relative contribution of state PAs, private ranches and conservancies and CAMPFIRE areas to hunting offtake is shown in Figure 24. CAMPFIRE areas and particularly private land account for a larger share than state PAs, showing the importance of hunting outside of the state PA network. Indeed, apart from elephant, private land accounts for the highest offtake of all other species. It is notable that trophy hunting on private land has remained resilient despite the resettlement of many private conservancies and wildlife ranches under the Fast Track Land Resettlement Programme. The increasing dominance of private land in lion hunting offtake is noteworthy. This suggests improved protection of lions on private land relative to state PAs and CAMPFIRE areas and/or an increase in investment in private lion breeding, as has been the trend in South Africa.

To uncover historical trends in hunting offtakes, Figure 24 presents the total numbers of trophy imports to the U.S. from Zimbabwe between 2005 and 2014. Since the U.S. has the largest number of foreign hunters, trends in the importation of trophies there should be a reliable indication of trends in hunting overall. The data suggest trophy hunting has been declining in Zimbabwe since the early 2000s, even before the U.S. ban on the importation of trophies in 2014. These trends are not echoed elsewhere in southern Africa; they were comparatively stable over the same period and some countries, like Mozambique, experienced an increasing trend (The Humane Society 2016).

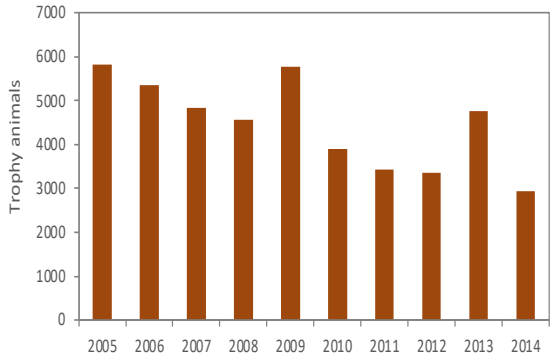


Figure 24. Trend in the number of trophy animals imported into the U.S. from Zimbabwe (The Humane Society 2016, based on U.S. Fish and Wildlife Service data)

Trophy hunting has been impacted by increased restrictions on the importation of wildlife trophies and worsening global public sentiment around trophy hunting, particularly following the highly publicized baiting incident in 2016 involving Cecil the lion (Lindsey et al 2016). China banned the import of ivory products in 2010. The U.S. banned trophy imports in 2014. Several European countries introduced bans on lion and a range of trophy animals in 2015-16.

In 2014 and 2015, the U.S. Fish and Wildlife Service suspended imports of elephant trophies from Zimbabwe for the following reasons: unclear progress toward goals and objectives of elephant management plans; inadequate information to confirm population status; inability to implement and enforce existing laws and regulations; questionable hunting quotas; failure to prove that revenue from trophy hunting incentivizes elephant conservation; and

lack of Government support for conservation. This brought Zimbabwe's entire trophy hunting industry into disrepute.

Hunting revenues

Trophy fees generally declined for all species of large herbivores from 2014 to 2019 (Table 9), in line with the decline in offtakes of most species. Similarly, revenues decreased for big cats except for lions, probably because of the notable increases in lion offtake from private land shown in Figure 25.

Trophy revenues were dominated by elephant (average $2.9 million) and buffalo (average $2.6 million), with the average overall revenue from trophy fees for the top six species amounting to some $7.35 million between 2014 and 2019 (Table 9). The average proportional contribution of the key trophy hunting species to overall trophy hunting revenues between 2014 and 2019 is shown in Figure 26, which highlights the dominant contribution of elephant and buffalo to trophy fee revenues, collectively accounting for 74% of revenues.

For all species annual trophy fees amounted to $10.8 million on average (Table 10). Including the other charges associated with hunting (daily rates, guest rates and other fees), total revenues from trophy hunting in all areas amounted to some $23.5 million per year on average, peaking at $27.3 million in 2015. This does not count additional travel expenditure by hunters while visiting the country and the value of other downstream multiplier industries such as taxidermy. Accounting for such expenditure could more than double the overall contribution of hunting to the economy. For example, it was estimated that hunters in Zimbabwe spent an average of $39.3 million per year during 2012-14 taking this additional expenditure into account (Southwick Associates 2015). Given that revenues declined between 2014 and 2019, a more up-to-date estimate might be somewhat lower. Previous estimates of the value of hunting tourism in Zimbabwe have been $18.5 million in 2000 (Booth 2002), and $15.8 million in 2007 (RBZ 2007, in Booth 2010), both of which are lower than the estimates given in the current study.

Table 9. Trophy fees from 2014-2019, in $ '000s (Reserve Bank of Zimbabwe).

SPECIES	2014	2015	2016	2017	2018	2019	MEAN
Buffalo	2 577.3	2 753.5	2 419.4	2 562.3	2 454.7	2 589.5	2 559.5
Elephant with tusks	2 157.9	2 663.6	3 128.8	2 468.2	2 603.2	1 844.6	2 477.7
Elephant tusk-less	1 396.6	310.3	197.0	267.8	168.0	219.6	426.5
Lion	648.0	947.0	780.3	737.3	912.5	931.5	826.1
Leopard	748.6	806.4	721.8	679.6	783.0	634.0	728.9
Sable antelope	482.2	474.0	330.9	276.4	250.5	166.1	330.0
Cheetah	2.6	-	6.0	-	-	-	1.4
TOTAL	**8 013.1**	**7 954.9**	**7 584.0**	**6 991.5**	**7 171.8**	**6 393.8**	**7 351.5**

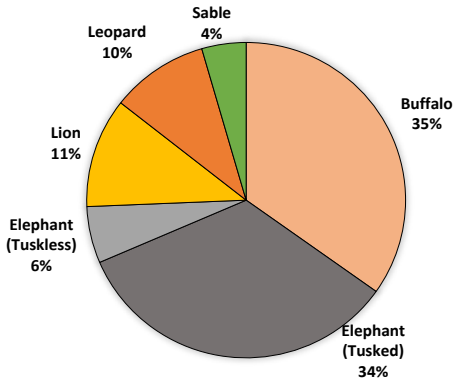


Figure 25. Average proportional contribution of the five most valuable trophy species to trophy fee revenue between 2014 and 2019(left)

Trophy hunting revenues declined consistently from 2015 ($27.2 million) to 2019 ($19.1 million). As was the case with offtakes, this likely reflects the impact of trophy import bans and international anti-hunting lobbying.

Table 10. Total hunting revenues from 2014-2019, in $ '000s (Reserve Bank of Zimbabwe)

	2014	2015	2016	2017	2018	2019
Total Daily Rates	13 495.2	12 978.5	10 180.5	9 970.8	9 890.3	8 208.0
Total Other Fees	840.9	1 427.7	1 234.2	1 359.8	1 012.7	1 077.6
Total Trophy Fees	11 858.1	11 901.9	10 865.9	10 296.5	10 516.4	9 340.8
Total Guest Rate	872.5	974.6	804.8	849.5	659.1	463.1
TOTAL	**27 066.7**	**27 282.6**	**23 085.3**	**22 476.5**	**22 078.4**	**19 089.6**

The wildlife industry has adapted to trophy import bans to some extent by offering "non-exportable" hunts. For example, one safari operator quotes a high-end 10-day elephant hunt, including trophy fee, of between $20 000 and $30 000 depending on the size of the animal. However, it is also possible to do a five-day non-exportable elephant hunt for about $11 000.[12] By comparison, a 10-day lion hunt, including trophy, costs about $50 000, confirming that lion remain the most valuable species at the individual trophy level, even though the overall contribution of buffalo and elephant to total revenues is greater (Figure 26) due to their higher offtake. A significant domestic ivory trade also exists in Zimbabwe, but information about its size is very scarce; data available for the current study was from the RBZ and thus focuses on revenues gained from exported trophies.

Contribution of hunting to CAMPFIRE Revenues

Sport hunting through the CAMPFIRE Programme generates an annual $2 million on average. Trends in total income generated from trophy hunting across twelve CAMPFIRE districts are shown in Figure 26, while Figure 27 shows the breakdown of CAMPFIRE income among different districts. The drastic impact of the COVID-19 pandemic on revenues in 2020 is clearly evident, as revenues ranged between $1.5 million and $2.5 million from 2010 to 2019, before slumping to just $230 000 by 2020. Variations in income generated across different districts can be ascribed to differences in sizes of wildlife area, the value of species available for hunting and wildlife population sizes. Matobo, for example, has no lions and elephants, which fetch significant income in trophy hunting.

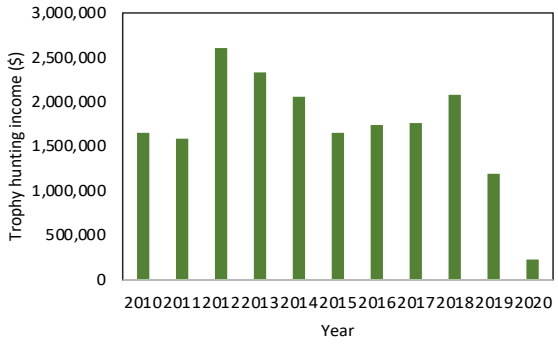


Figure 26. Trends in annual income generated from trophy hunting in 12 CAMPFIRE districts in Zimbabwe (CAMPFIRE Association)

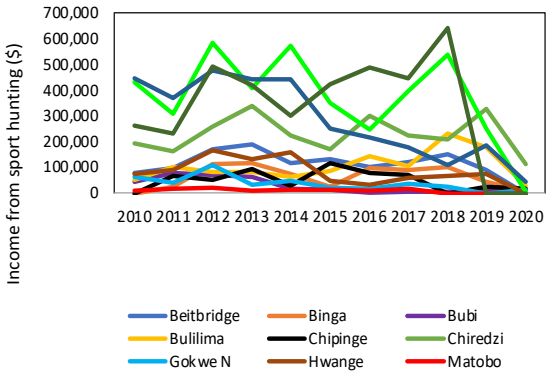


Figure 27. Trends in income generated from sport hunting in 12 CAMPFIRE districts in Zimbabwe, in $ (CAMPFIRE Association)(right)

12 Zimbabwe hunting safaris, luxuryhunts.com

Wildlife (Crocodile) ranching

Wildlife ranching is the breeding of animals for live sales, meat, ecotourism or hunting. In South Africa such ranches are the main suppliers of trophy hunting. In Zimbabwe there is little wildlife ranching for game meat or hunting, but there is a substantial crocodile ranching industry. Zimbabwe is a top exporter of crocodile products in the SADC region and one of the leading exporters globally. Since 2012 total annual crocodile exports have been just over 100 000 skins. Zimbabwe ranks as the second largest exporter of reptile products globally, after the U.S.[13] The annual value of Zimbabwe's crocodile exports was reportedly almost $30 million in 2014.[14] Data on the numbers of crocodile ranches and their production are difficult to obtain from the Crocodile Farming Association of Zimbabwe and from the wildlife authorities (Utete 2021). Farmed populations are estimated to be between 180 000 and 250 000.

During the 1950s and 60s Nile crocodiles *(Crocodylus niloticus)* were heavily exploited for their skins in uncontrolled trade throughout Africa. The first ranch was established in 1965 and in 20 years there were about 46 farms in Zimbabwe. In 1978 the former Department of National Parks and Wildlife Management organized the formation of the Crocodile Farmers' Association of Zimbabwe. The association has been important in the development of crocodile farming as a mainstream agro-wildlife industry. In its early years it contributed significantly to Zimbabwe's campaign to move its crocodile population from CITES Appendix I to Appendix II. While farmed crocodiles cannot be added to wild populations, they act as a reserve for wild stocks. The farms rely on eggs collected from the wild and farmers are required to remit 5% of the number of eggs back to the wild as hatchlings (PWMA 2015; Utete 2021).

There are currently between 18 and 26 farms, mostly in the hot regions of the country. Most farms operate well below capacity. Crocodile farming is capital intensive; it attracts few locals and it is difficult to establish community-based crocodile farming initiatives. Moreover, the number of farms and overall production have declined because of the economic downturn and a growing global movement against crocodile ranching. Since the PWMA became a self-funded authority, investment in wildlife management, including crocodiles, has shrunk.

The bulk of the producer farms are located on the shores of Lake Kariba and along the upper and middle Zambezi River. Padenga Holdings

Limited owns three crocodile farms – Kariba, Nyanyana and Ume – on the shores of Lake Kariba and an abattoir. The first was established in 1965, the others in 1973 and 2005. Two are on land leased from PWMA and the third leases land from an RDC. The farms produce about 47 000 skins and over 240 tons of meat. They generated revenues of $27 million in 2020 and employ over 320 staff. There are two large producers in the lowveld at Chiredzi and Mwenezi and several small producers on the highveld around Chinhoyi and Harare (Childes 2019). Development of the industry in communal areas could benefit local communities through harvesting of eggs for crocodile farmers and engaging in partnerships for crocodile ranching, particularly in drier regions where agriculture is challenging, especially in the face of climate change.

Trends in PWMA revenues and expenditure

The PWMA derives revenues from a range of sources – daily conservation fees charged for all park visitors, fishing permits and hunting fees, earnings from PWMA accommodation, leases for private concessions on PWMA land, sales of products derived from PWMA areas and annual registration and special permit fees. Its expenses have to cover the management of all of these activities and to protect and monitor the ecosystems and wildlife that make up the resource base for the wildlife subsector.

Information on revenue generated by the PWMA, as well as the authority's expenses, was obtained for the years 2016 to 2021. However, the data are not directly comparable through time, since there was a change in functional currency from U.S. dollars to Zimbabwe dollars in 2019.[15] The currencies were initially on a par but the Zimbabwe dollar quickly lost value, creating accounting challenges for the PWMA. The data before and after the currency change are presented in Figures 28 and 29 below.

The PWMA's revenues increased from just under $25 million in 2016 to $34.3 million in 2018

13 www.aljazeera.com/features/2018/5/21/zimbabwes-crocodile-industry-rises-against-the-tide

14 www.bbc.com/news/av/business-29849211

15 Statutory Instruments 133 and 142

(Figure 28). Total expenses exceeded revenues in all three years, with the widest gap in 2018. The growth in income was mainly due to an increase in revenue from conservation fees, as evident from the increases in visitor numbers over this period (see Figure 22). Not included in the graphs are income from grants, donations and other sources. While modest, the $1.2 million received in grants and donations in 2017 resulted in a net surplus for the PWMA in that year.

Revenues and expenses dropped sharply in dollar terms following the switch to the mono-currency regime in 2019. Nevertheless, 2019 appeared to be a particularly successful year financially for the PWMA, being the only recent year when revenues exceeded expenses. At $12 million, revenue was about 50% greater than expenses, resulting in an operating surplus of $4 million. The situation was reversed in 2020 and 2021 when the COVID-19 pandemic drastically reduced visitor numbers and resulted in a 14% drop in revenue between 2019 and 2020. A drastic decline in revenue from conservation fees is evident, concomitant with a 75% drop in visitor numbers. Over the same period expenses increased by 71%, resulting in a $3.3 million operating deficit in 2020. Analysis of the expense breakdown indicates this was driven by marked increases in staff costs and administration expenses. The situation improved in 2021, when an increase in revenues narrowed the operating deficit to $2.8 million, despite ongoing increases in expenses that were driven by rising staff costs. The net deficit was reduced by sizeable donations and grants totalling $1.7 million and exchange rate gains of $400 000, which resulted in a net deficit of $700 000 million in 2021.

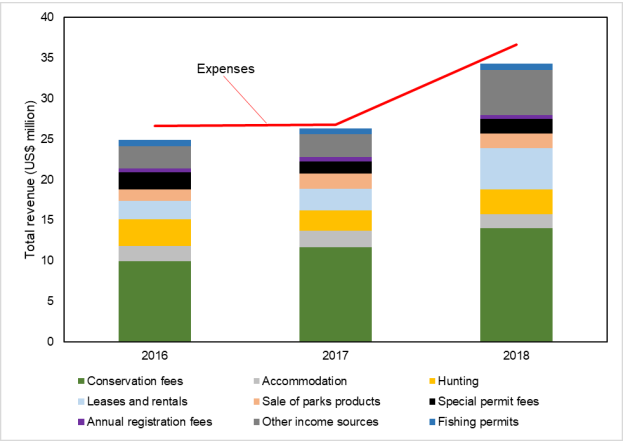


Figure 28. Total annual revenue from different sources (shown in stacked columns) and expenses (red line) of the PWMA from 2016-2018 (PWMA).

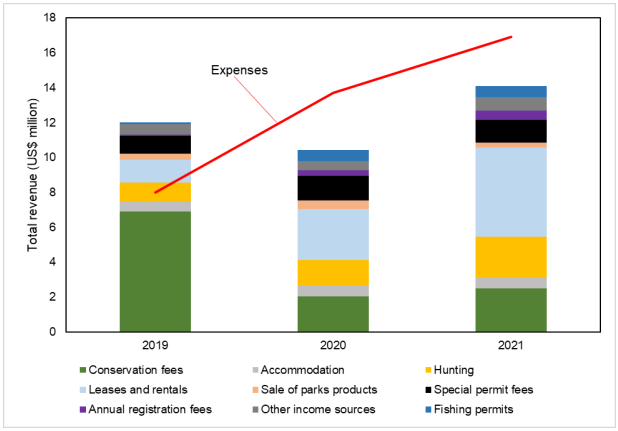


Figure 29. Total annual revenue from different sources (shown in stacked columns) and expenses (red line) of the PWMA from 2019-2021 in $ million equivalent, following reintroduction of the ZW$ (PWMA)

Despite the drop in revenues due to the COVID-19 pandemic, the PWMA continued to generate revenue from diversified biodiversity products. It increased revenues from other sources through leases and rentals, special permit fees, annual registration fees, fishing permits and hunting.

It is also noteworthy that revenue from hunting in 2021 ($2.34 million) was slightly less than total revenue from conservation fees ($2.51 million), highlighting the importance of hunting in the context of the pandemic and supressed tourism. Furthermore, hunting revenue in 2021 was only slightly lower than it was before 2019, when it ranged from $2.5 million to $3.25 million between 2016 and 2018, suggesting a notable recovery of hunting in that year.

Data on the PWMA's revenues and expenses show the authority struggles to generate enough money to support its activities, with the exception of 2019 when the PWMA was able to clear its debts and significantly improve its financial position (PWMA 2019). Whether 2019 was an anomalous year or if the PWMA would have been able to maintain its improved financial position is impossible to determine given the advent of COVID-19. These financing gaps are not unique to Zimbabwe. For example, the IUCN estimates that available financial resources for conservation across southern Africa are only 34% of the amount required to adequatel y manage the region's protected areas (IUCN 2020). Unlike many other national conservation authorities, which receive direct financial support from their governments, the PWMA is almost wholly dependent on its own revenue sources for its operational budget (Snyman et al 2020). This makes it even more challenging for the authority

to adequately fund its conservation mandate, although its performance in 2019 suggests that it has the potential to be self-supporting and even profitable with sound financial management and a recovery of the tourism industry. The authority's return to profitability will be necessary if the Ministry of Environment, Climate, Tourism an hieve its ambitious aim for Zimbabwe's tourism economy to be worth $5 billion by 2025 (GoZ 2020a).

Key challenges and opportunities

Improving the reputation of trophy hunting

Trophy hunting tourism generally proved more resilient than nature-based tourism. However, increased international restrictions on imports of wildlife trophies and worsening global public sentiment around trophy hunting, particularly following a highly-publicized lion baiting incident in 2016 (Lindsey et al 2016), have impacted hunting revenues. There is growing scepticism about the rigour of the country's quota setting system. Indeed, it was suggested that these factors contributed to a general decline in hunting revenues in the years preceding COVID-19. While some of these factors are beyond Zimbabwe's direct control, the recommendations in this section largely relate to measures the country could take to counter these trends and improve perceptions of its hunting industry. Such efforts could be essential to securing the industry's growth.

Convincing reports detailing the ecological, economic and social benefits of hunting by the PWMA, conservation NGOs and research institutions, in both the academic literature and mass media, could help to counter growing resistance to hunting. Such a campaign would encourage further research to demonstrate the comparative advantage of hunting over less controversial non-consumptive tourism alternatives. An eco-labelling and certification scheme, which grants recognition to safari operators and other players who conduct ethical hunting, would also help to improve perceptions of hunting, especially in the light of the adverse publicity around hunting practices such as the breeding of lions in captive or semi-captive conditions for canned hunting in other countries. Such measures could take social sustainability into consideration, by recognizing hunting operations which make a significant contribution to the livelihoods of people living in or around hunting areas. The campaign should ideally be tackled at the regional level to achieve international credibility and recognition. For example, Southern African Development Community (SADC) countries could create a certification scheme among member states that recognize strict adherence to ethical hunting practices.

Another important measure would be the creation of a professional hunters' council, akin to the institutions that regulate professions such as medical and legal practitioners, accountants and engineers. Such a council would specify and enforce standards for ethical and professional practices for any person wishing to register as a professional hunter in Zimbabwe. This would provide an opportunity for the country to stamp out and distance itself from unethical practices which have contributed to the increasing condemnation of hunting in global public opinion. To have legal recognition and force, the measure would require either amendment of current legislation or the introduction of new legislation which provides for its recognition as an official professional council. Regulations for a proposed professional hunters and guides council have been drafted by the Zimbabwe Professional Hunters and Guides Association and the Safari Operators Association of Zimbabwe, and the PWMA has received the proposal positively. Advancing the legal recognition of the proposed council should be a priority for hunting industry players, MECTHI and the Attorney General's Office.

Realising potential tourism revenues from the state protected area system

There is still scope for growth in the wildlife tourism subsector, in and outside of state parks, especially as tourism recovers from historical and recent setbacks, as long as this is done in a way that does not undermine the integrity of Zimbabwe's biodiversity or ecosystems, their connectivity and wilderness appeal. For example, in 2019, the Victoria Falls rainforest accounted for 43% of park visitors to the PWMA estate, while the nearby Zambezi National Park accounted for 26%. These parks thus accounted for 69% of visitors, despite accounting for less than 1% of national PA coverage. These statistics suggest that other PAs are highly under-utilized relative to their size and are not reaching their full visitor potential. The Government has identified tourism as a sector with good growth potential. The National Tourism Strategy has

set an ambitious goal of increasing the sector's contribution to GDP to $5 billion by 2025 (GoZ 2020a). Continued investment in protecting the country's wildlife and other natural resources will be essential for the recovery of the sector and the achievement of this target, particularly as the nation's wildlife remains a key tourism drawcard.

With the decline in biodiversity and wilderness areas globally and in Africa, coupled with growing global demand for nature-based tourism, investing in strengthening of the PA system is likely to provide one of the greatest opportunities for tangible economic development. Indeed, Zimbabwe ranked 44th out of 140 countries globally for the natural resources pillar of the World Economic Forum's Travel and Tourism Competitiveness Index (TTCI) (WEF 2019), underscoring the competitive advantage of its natural resource endowment. Protecting the system from growing threats would strengthen the core of a broader wildlife economy while securing a range of co-benefits to Zimbabweans from regulating ecosystem services. In addition, investments in nature-based tourism have the potential to contribute significantly to reducing unemployment. For example, investments in tourism are estimated to generate 40% more jobs than equivalent investments in agriculture (WEF, WB and AfDB, 2011) and to have twice the job creation potential of investments in the automotive, telecommunications and financial industries (WTTC 2017).

To maximize their tourism value, Zimbabwe's national parks need to maintain the capacity to benefit from high-end, exclusive tourism while accommodating mid-range experiences in different areas. State-owned safari and forestry areas need to attract hunters looking for high-end, authentic and ethical big-game hunting experiences in a well-managed and sustainable system. These require improved biodiversity protection, facilities and marketing, underpinned by investments in management and science.

While direct investment in the sector is likely to yield some returns, greater benefits could be achieved if problems that continue to deter international visitors were to be addressed. Improving Zimbabwe's global image remains a long-standing challenge for the tourism industry. While acknowledging that these challenges lie beyond the scope of the biodiversity sector, the ZTA and other players will need to conduct a sustained international marketing and branding campaign. The country's attractive biodiversity assets can be a key component of these strategies. Despite its competitive natural resource endowment, Zimbabwe is ranked just 118 out of 140 on the overall Travel and Tourism Competitiveness Index once all other pillars are considered. This reflects poor performances across metrics like policy, rules and regulations, transport and tourism infrastructure and information communication technology (WEF 2019), underscoring the problems which continue to undermine the country's tourism potential. Indeed, ZTA reports noted that issues such as high prices, inflation, cash shortages and power cuts continue to contribute to negative perceptions persisting among leisure tourists, compromising the growth potential of the sector even before COVID-19 (ZTA 2020, 2021). Maintenance and improvement of key infrastructure such as roads and electricity supply are crucial to enhancing the viability of nature-based tourism, particularly for increasing revenues generated by less visited, remote protected areas like Chizarira National Park, whose relative inaccessibility deter all but the most adventurous tourists.

Zimbabwe's sizeable wilderness areas and wildlife populations offer a comparative advantage over many African countries. However, wildlife alone might not be enough to attract sufficient tourist growth. Zimbabwe must therefore try to emphasize its unique selling points. For example, its PAs are larger and more remote, with arguably greater wilderness value. Its competitiveness and distinctiveness as a tourist destination could also be enhanced by developing and marketing its cultural tourism attractions, a form of tourism which is in growing demand on the global tourist market (Mutana and Zinyemba 2013). There are opportunities to integrate cultural and wildlife tourism attractions in marketing strategies and visitor itineraries.

Overcoming the funding gap for state protected areas

One solution to funding shortages has been public-private partnership (PPP) co-management arrangements between local national parks authorities and international conservation organizations or private agencies. This model has been adopted in Gonarezhou National Park which is co-managed by the PWMA and the Frankfurt Zoological Society (FZS). The partnership resulted in foreign direct investment of $3 million in 2019 (PWMA 2019). Funding

from the FZS has also contributed significantly to improving accommodation facilities and other park infrastructure, leading to a significant increase in park visitor numbers. Similarly, a recent partnership with African Parks will result in the investment of $11.5 million in the rehabilitation of Matusadona National Park over the first five years of the co-management arrangement (PWMA 2019). These partnership arrangements thus provide a promising way of reducing the PA financing gap, particularly while visitor numbers remain supressed after COVID-19.

Increasing the flow of benefits from wildlife to communities and reform of the CAMPFIRE model

CAMPFIRE has gone some way towards increasing community involvement and benefits from conservation. However, by recognizing RDCs as the appropriate authorities, CAMPFIRE has fallen short of fully devolving rights of wildlife to communities. If Zimbabwe's wildlife and natural resource regulations can be amended to allow for full ownership rights of communities over wildlife, this could open up new opportunities for wildlife enterprise development on communal land. The fact that lease agreements are signed by RDCs on behalf of communities reduces the communities' autonomy over decisions affecting the benefits they derive from wildlife. Allowing communities to form authentic community-owned conservancies – as has been done successfully in Namibia – has the potential to increase the attractiveness of wildlife-based land use for communal land users. This way communities would gain more direct benefits from wildlife than from the current CAMPFIRE model, which forfeits a large portion of its revenue to the RDC.

The proposed community conservancy model offers enhanced opportunities for joint venture enterprises and agreements to be made directly with private investors. For example, private investors can reach agreements directly with communities to lease a portion of conservancy land for nature-based tourism or hunting and to develop lodges. This way the community would receive a share of revenues and offer its members employment. Community conservancies also provide opportunities to draw on growing demand for cultural and ethical tourism attractions. For example, combining wildlife and cultural tourism offers greater potential than state PAs, which generally involve a strict separation between people and wildlife. Since tourism revenues will go directly to communities, the model should also be attractive to tourists seeking socially responsible attractions.

Leveraging economic imperatives for wildlife-based land use in semi-arid rangelands

Growth opportunities for the wildlife sector exist in the development of wildlife-based land uses outside state PAs, particularly in communal areas and on private land, and potentially in resettlement areas. The main barriers are land tenure, lack of devolved appropriate authority, and high start-up costs.

An important advantage of wildlife ranching is the potential for multiple sources of income compared to rearing livestock. For example, consumptive use of wildlife – in the form of hunting and producing meat and hides – can be combined with nature-based tourism. Particularly in the face of climate change, wildlife could be an increasingly appropriate and resilient land use option in drier parts of the country where conditions are less suited to agriculture and where even rearing livestock can be challenging. Indeed, ecological conditions on most ranches which switched from livestock to wildlife in the 1980s and 1990s improved significantly (Child 2009). Additionally, the switch to wildlife-based land uses often represents a transition from a simple, extractive commodity economy to a more complex economy with more horizontal and vertical linkages (ibid). This can yield a greater number and diversity of employment opportunities. Evidence from South Africa supports this finding, with a fivefold increase in employment resulting from switching to wildlife and nature-based tourism on private land, accompanied by a thirty-fold increase in the total wage bill, doubling of land values and the creation of numerous economic multipliers (Langholz and Kerley 2006). Furthermore, as wildlife-based land use generally maintains habitats in a relatively natural state, it provides enhanced ecosystem services relative to livestock and cultivation. These co-benefits can be leveraged to generate additional revenue through PES schemes, such as carbon credit financing.

Economic analyses have revealed the comparative financial efficiency of wildlife relative to livestock in semi-arid Zimbabwean rangelands. For example, ranches in the southeast lowveld which practised a mix of cattle and wildlife earned a net profit of Z$4.47/ha in 1985, compared to just

Z$1.23/ha from cattle (Child 1988). Even though many wildlife enterprises were still new and understocked by the early 1990s, almost half were found to be profitable and the average return on investment was 9% (Bond 1993). Conversely, most of the comparatively well-established cattle ranching enterprises were struggling, with only 5% managing to achieve a return of 10% or more.

The above discussion highlights the potential profitability of wildlife as a land use option, particularly in semi-arid areas. However, unlocking growth opportunities in this sector requires a review of lease conditions for A1 and A2 farms to recognize wildlife-based activities as a permissible land use option.

Additionally, the Government could consider subsidizing wildlife-based land uses, potentially accompanied by a reduction of subsidies to agriculture and livestock in areas identified as optimal for wildlife and marginal for agriculture. The relevant legislation could also be reformed to encourage wildlife-based land uses. The Parks and Wildlife Act does not expressly provide for wildlife ownership because wildlife is regarded as res *nullius* – no one owns it. This system of wildlife tenure does not fully encourage the establishment of private production systems, which offer a key opportunity for growth through wildlife ranching and farming. Tenure for wildlife should therefore be reviewed to encourage private production systems.

THE FISHERIES SUBSECTOR

Key points

- *Wild-capture fisheries productivity has been significantly boosted in dams and by introduced species, but most established fisheries are already fully exploited, if not overexploited*
- *Lake Kariba accounts for almost 90% of the country's capture fishery production*
- *Assuming a domestic retail price of $5/kg, it was estimated that the total value of fish production in the country was around $250 million in 2019. However, the value of capture fishery production accounts for only small portion of this, ranging from $60 to $86 million between 2012 and 2019 according to PWMA catch data.*
- *Increases in overall fishery production in recent years have been driven largely by aquaculture rather than capture fisheries. Apparent increases in capture fishery production in recent years can be attributed to improved fishery data collection systems*
- *There is limited opportunity for growth in the fisheries*
- *There is a clear need for improved fisheries monitoring to improve management*

Overview

The fisheries sector, which comprises wild-capture, aquaculture and recreational fisheries, provides opportunities for generating income and contributing to economic growth (Machena and Moinuddin 1993; Machena 2021). Most fisheries production and value in Zimbabwe is based on man-made waterbodies and much involves introduced species. Only the indigenous capture fisheries are considered part of the biodiversity economy. However, fisheries reporting data do not easily allow for the disaggregation of indigenous wild-capture component of the fisheries sector. This section therefore provides an overview of the subsector as a whole, highlighting what is understood about the biodiversity economy component.

Fishing is carried out in rivers and man-made

reservoirs as Zimbabwe does not have natural lakes. The country has perennial rivers that provide a valuable source of protein for rural populations and sport angling (Sugunan 1997). However, fishing opportunities have increased significantly over time though the construction of dams, ranging from the many small earthen dams across seasonal streams to Kariba Dam on the Zambezi. Although they were built for other purposes, these reservoirs are now the main source of fish in Zimbabwe. The country has at least 12 000 dams with a combined surface area of over 3 910 km2. The large dams include Kariba (510 000 ha), Mutirikwi (9 105 ha), Manyame (8 100 ha), Tokwe Mukosi (9 640 ha), Mazvikadei (2 300 ha) and Chivero (2 630 ha), as shown in Figure 30. Another large dam, Gwayi-Shangani, is under construction. Medium-sized water bodies include Zhowe, Osborne, Muzhwi, Manyuchi and Manjirenji. The rest are small water bodies of which nearly half are less than 5 ha in size (FAO 2016). Sixty-one percent of small dams are on privately owned commercial lands and are used for cattle ranching, irrigation and aquaculture. The remaining 39% are in communal and resettlement areas and are used for domestic and livestock purposes and artisanal fishing. Small dams are concentrated in the farming areas on the central watershed.

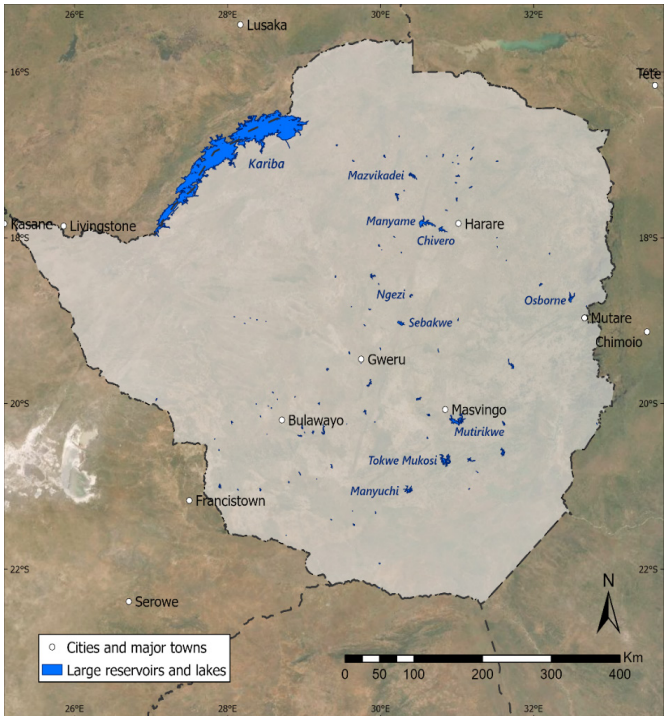


Figure 30. Location of some of the larger dams mentioned in the text

Lake Kariba contributes almost 90% of the country's capture fisheries production (FAO 2022). It has an open-water, semi-industrial fishery based on small pelagics, notably kapenta (Limnothrissa miodon) and an artisanal inshore gillnet fishery around the lakeshore. Chivero, Mutirikwi, Manyame and Mazvikadei also support significant inshore fisheries. Zhowe, Osborne, Muzhwi, Manyuchi and Manjirenji dams support fisheries on a much smaller scale. Fisheries on Tokwe Mukosi Dam, which was built in 2016, are still developing. The only river with significant fishery activity is the Lower Zambezi River, which is shared between Zambia and Zimbabwe.

Recreational angling is carried-out in most of the reservoirs and the Zambezi River. This is largely based on rod-and-line fishing. Trout were introduced for recreational fishing in the Eastern Highlands from Europe in the early 1900s (FAO 2016). Subsistence fishing is a common activity in all reservoirs near urban centres, including Chivero, Manyame and Kariba.

The aquaculture sector comprises a small number of private commercial farms, including the largest tilapia farm in sub-Saharan Africa, which uses floating cages on Lake Kariba.

A number of dams are managed as recreational parks. They encompass the whole waterbody and

Actors involved and their roles

land immediately surrounding it. Recreational parks include Lake Kariba and Lake Chivero and Darwendale, Mutirikwe, Sebakwe, and Ngezi dams. Plans to designate the newly built Tokwe Mukosi as a recreational park are advanced. The three types of fisheries – capture, aquaculture and recreational fisheries – take place in these recreational parks (Table 11), along with the actors involved.

Table 11. Some of the fisheries under the recreational parks

FISHERY	DAMS AND LOCATION	PWMA AND RDC	PRIVATE SECTOR
Capture fishery	Lake Kariba (Mashonaland West)	Lake Kariba Fisheries Research Institute (PWMA) Binga District Council Nyaminyami District Council	Fishing companies and cooperatives: Kapenta Producers Association Fishers: 8 sub area fishers associations
	Chivero (Mashonaland West)	Lake Chivero (National Parks)	Fishers
	Manyame (Mashonaland West)	Falls under Lake Chivero National Park	Fishers
	Mutirikwe (Masvingo)	Mutirikwe National Park	Fishers
	Mazvikadei (Mashonaland Central)	PWMA headquarters	Fishers
	Tokwe Mukosi (Masvingo)	MECTHI in the process of gazetting recreational park; PWMA yet to set up presence	Some fishers have been allocated fishing areas and commercial fishing has started
	Gwayi Shangani	Under construction	No commercial fishing yet
River (flood plain)	Lower Zambezi River	Mbire National Park Mbire RDC	Fishers
Sport fishing	Matobo (Matebeleland South)	Matobo National Park	Angling clubs
	Sebakwe (Midlands) Ngezi (Midlands)	Sebakwe National Park National parks (Midlands)	Angling clubs
	Lake Kariba (Mashonaland West)	Lake Kariba Fisheries Research Institute	Angling clubs
	Chivero (Mashonaland West)	Lake Chivero (National Parks)	Angling clubs
	Darwendale dam	Lake Chivero (National Parks)	Angling clubs
	Mutirikwe (Masvingo)	Mutirikwe (National Parks)	Angling clubs
	Nyanga (Manicaland)	Nyanga (National Parks)	Angling clubs
	Osborne Dam (Manicaland)	National Parks (Mutare)	Angling clubs
	Mazvikadei (Mashonaland central)	National Parks (Harare)	Angling clubs
	Lower Zambezi	National Parks	Angling clubs
Aquaculture	Lake Kariba		Lake Harvest Kariba bream farm
	Tokwe Mukosi	MECTHI in the process of gazetting recreational park; PWMA yet to set up presence	Private sector
	Mutirikwe		Private sector
	Chivero		Private sector
	Mazvikadei		Private sector

The key actors involved in fisheries activities in the recreational parks are the PWMA, the University of Zimbabwe's University Lake Kariba Research Station and the fishers themselves. The PWMA is responsible for managing and regulating the capture, angling and aquaculture fisheries. It also conducts fingerling production in a few dams, namely Tokwe Mukosi, Mutirikwe, Mushandike and dams in Nyanga National Park. Each recreational park has resident staff responsible for fisheries and wildlife research and management, regulation and enforcement. Each recreational park has a fisheries research ecologist and Lake Kariba has a fisheries research institute staffed by three ecologists. The PWMA also has a trout hatchery in Nyanga in the Eastern Highlands.

Outside the recreational parks, the main stakeholders in the fisheries subsector are the Ministry of Lands, Agriculture, Fisheries, Water and Rural Development (MLAFWRD), rural district councils and the Food and Agriculture Organization (FAO).

- The MLAFWRD had a small unit responsible for aquaculture and capture fisheries development, but with its new mandate to take up fisheries management outside recreational parks it is setting up a department for fisheries management.
- The State devolves the power to local communities to manage and benefit from fisheries through section 83 of the Parks and Wildlife Act, which appoints a riparian RDC to be the appropriate authority for waters. Thus, Nyaminyami and Binga RDCs, which share part of the Lake Kariba shoreline, can regulate fishing activities on their sections of the shoreline. Under the District Councils Act RDCs also have powers to generate revenue from the land and natural resources under their control, establish and maintain undertakings for the benefit of the people in the district, and assume powers of an environment committee for establishing proper management and control of the use of natural resources.
- The FAO supports the MLAFWRD through its technical cooperation project, which is assessing the potential for fisheries and aquaculture production systems in small water bodies. Its focus is on the aquaculture value chain with the aim of investing in the chain and stimulating inclusive growth. Its tilapia farming development programme is taking Oreochromis mortimeri as the preferred fish farming species in small-to-medium sized water bodies.

The fishers comprise small-scale and recreational anglers, commercial companies and co-operatives. The companies and cooperatives on Lake Kariba are members of the Kapenta Producers Association which lobbies for their interests. Anglers are organized in angling clubs. These players are described in detail in the following sections.

Wild capture fisheries

There are no data on river or floodplain fisheries in Zimbabwe, nor on subsistence angling. However, data are collected on artisanal gillnet fishing and on the industrial kapenta fisheries.

Gillnet fisheries

Small-scale gillnet fisheries operate on most waterbodies, keeping to inshore areas of larger waterbodies. Some 114 endemic species and over 30 exotic fish species are caught in Zimbabwe (FAO 2016). The species compositions vary between the water bodies. Some of the key species are cichlids *(Oreochromis mortimeri, O. niloticus, O. macroghir, Sargochromis codringtonii, Tilapia rendalli); cyprinids (Labeo altivelis, L.. congoro); mormyrids (Mormyrus longirostris, M. anguilloides); a clariid (Clarias gariepinus)*; and tiger fish (Hydrocynus vittatus). The small-scale fishers use gillnets and small metal or fibreglass boats. Some boats have motors, but most fishers use oars, which makes fishing physically demanding. This is why few women take part in gillnet fishing (Machena 2021). On Lake Kariba only 7% of the gillnet fishers are women and they tend to hire labour. The boats need to be registered with the Ministry of Transport and Infrastructure Development. Safety is a challenge for fishers in boats in windy conditions, particularly in the large open waters of Lake Kariba, where there is usually one fisher per boat. Lake Kariba has the biggest inshore fishery in the country with over 800 registered fishers. Equipment costs in

gillnet fishery are relatively small and this is a key driver for unregistered fishers carrying out illegal fishing who outnumber registered fishers (Machena 2021).

Employment figures in the inshore fisheries are based on the number of players who hold fishing permits from the PWMA and their employees (Table 12). A player typically has one or two employees who are paid on a share basis. This level of employment is significant as most of these water bodies are in rural areas and are a popular local source of income and protein. The average monthly income for a Lake Kariba gillnet fisher varies from $50 to $160 (Machena 2021). Fishers in the Lower Zambezi River have an average monthly income of $400 to $500 (Machena 2018). This level of income is significant for a rural setting and high even compared to some urban settings. It is worth noting that the incomes are earned in an industry based on natural resources. Most of the fishers are full-time anglers and sell to buyers who market the fish in various parts of the country. The downstream industry provides jobs; how many is not known, but it is a significant source of employment. There is every justification for setting up a system of national accounting for this aspect of the economy driven by biodiversity.

Table 12. Employment and investment in the gillnet fishery in 2021. Values in $ (PWMA database)

GILLNET FISHERY 2021	FISHERS	EMPLOYEES	BOATS	BOATS VALUE
Kariba	452	226	340	181 000
Other dams	1704	2055	460	502 000
Total	2156	2281	800	683 000

Each boat costs about $400. The total value of boats in gillnet fishery is estimated to be $683 000 and there were an estimated 2 281 fishers and their employees in 2021 (Table 12). Some of the fishers had lost their jobs in urban centres and found their way to Lake Kariba, they told Mr N. Ndhlovu, of the fisheries research institute, in interviews. The cost of entering gillnet fishery is low, making it an occupation of last resort. There are easily twice as many illegal fishers on Lake Kariba than those with permits, which is symptomatic of the deteriorating economy (Machena, 2021). Illegal fishers are not included in Table 12.

Total annual production in the inshore fishery varied from 3 550 tons to 17 150 tons over the eight-year period shown in Table 13. Mostly bream or tilapia are caught (37.86% and 56.4% respectively). Nile tilapia *(O. niloticus)* now dominates production in Lake Kariba. The total value of production in gillnet fisheries was about $55 million in 2019, based on a domestic retail price of $5/kg.[16]

16 This is the general retail price of fish in supermarket chains

Table 13. Total gillnet fish production from all waterbodies in tonnes (PWMA database)

	OREOCHROMIS SPP.	% CONTRIBUTION OF OREOCHROMIS SPP.	OTHER SPECIES	TOTAL CATCH (TONS)	APPROX. VALUE ($ MILLION)
2012	1 800	50.70	1 750	3 550	17.8
2013	2 100	53.85	1 800	3 900	19.5
2014	2 400	56.47	1 850	4 250	21.3
2015	7 896	46.04	9 254	17 150	85.8
2016	6 373	37.86	10 458	16 831	84.2
2017	6 253	44.82	7 699	13 952	69.8
2018	5 552	46.77	6 319	11 871	59.4
2019	5 256	48.09	5 673	10 929	54.6

An apparent increase in gillnet fishery production, particularly in 2015, was due to improved data collection on the various waterbodies rather than increased activity, according to Mr T. Matokwe, Principal Fisheries and Aquaculture Ecologist, PWMA (2022). The authority is setting up a centralized fisheries database in Harare and data collection systems at the various waterbodies have improved, according to Mr I. Tendaupenyu, Chief Aquatic Ecologist, PWMA (2022). Data collection remains a challenge on Lake Kariba. In the past the fisheries research institute deployed scouts monthly to collect data from fishing villages along the lengthy lakeshore. The system is defunct, however, due to limited resources. The research institute then trained fishers to record data instead. Registered fishers are given booklets to record catches which they hand to rangers on patrol. It is likely that the data gathered this way are underestimates because fishers pay fees based on volumes caught, thus incentivizing them to under-declare.

Kapenta fishery

Lake Kariba has a semi-industrial fishery based on the pelagic kapenta which was introduced from Lake Tanganyika between 1967 and 1968. The production potential for this resource is high, enabling the fishery to support yields of up to 60 kg per hectare (FAO 2016). The species spawns twice a year and develops from egg to adult in 5 to 6 months. This remarkable reproductive characteristic helps to maintain the stock viability in the lake. Fishing is done at night using a circular dip net with lights to attract the fish. The dip nets, which are operated by a winch, are 6 to 8 metres in diameter. Fish-finding devices are used to locate schools and to define the lake bottoms for smooth fishing operations. Kapenta catches are seasonal, being lowest in September and March. Kapenta is salted, dried, packaged and marketed mainly through food supply chains such as supermarkets in the urban areas. Local demand is high as it provides an alternative to other protein sources.

Kapenta is the major fishery on Lake Kariba, accounting for about 90% of the lake's total fish landings (FAO 2016). It is a pelagic species, so the fishery has little interaction with the gillnet fisheries. From 2012 to 2019 kapenta production ranged between 5 801 and 10 366 tons per year (Table 14). There are concerns that kapenta are overfished, as there is little control on either side of the lake, and informal trade on the lake shore typically goes unrecorded (I. Tendaupenyu, pers. com., of PWMA 2022).

According to the PWMA database, the number of kapenta fishing boats increased from 396 in 2012 to 436 in 2021. The total value of the fleet is estimated to be almost $3.5 million. The total value of production is thought to have ranged between $29 million and $50 million in the past few years, and the most recent estimates are the lowest (Table 14).

Table14. Production (tons) and approximate value ($ millions) of kapenta fisheries (PWMA database)

YEAR	BOATS	Total kapenta production (tons)	Total kapenta value ($ millions)
2012	396	9 100	45.5
2013	388	9 500	47.5
2014	386	9 900	49.5
2015	337	6 752	33.8
2016	431	8 035	40.2
2017	530	10 366	51.8
2018	558	9 475	47.4
2019	408	5 801	29.0

Aquaculture

Aquaculture in Zimbabwe is dominated by a private company, Lake Harvest, which raises Nile tilapia in floating cages in Lake Kariba. This species makes up virtually all aquaculture production in the country (99.6%), the remainder being rainbow trout, redbreast tilapia (Tilapia rendalli) and sharptooth catfish (Clarias gariepinus), the last two being indigenous to Zimbabwe. Aquaculture has led to the escape of Nile tilapia into the wild and the species is now found in most water catchment systems where it is a threat to some indigenous species. In Lake Kariba it is reported to be displacing the Kariba tilapia and redbreast tilapia, whose populations are declining. Aquaculture production increased from 20 417 tons in 2012 to 37 753 tons in 2019, with a steady increase in production over this period (Table 15). Notwithstanding the environmental risks, the potential for aquaculture expansion is considered to be high. The total value of aquaculture production is also shown in Table 15, at an average value of $5/kg. Total value of production increased from $102 million to $189 million from 2012 to 2019.

Table 15. Zimbabwe fish exports in 2019 based on whole gutted frozen fish quantities (PWMA database)

YEAR	Total aquaculture production (tons)	Total aquaculture value ($ millions)
2012	20 417	102.1
2013	25 419	122.1
2014	26 696	144.5
2015	26 792	134.0
2016	25 503	122.5
2017	26 015	133.1
2018	33 187	165.9
2019	37 752	188.7

In 2019 Zimbabwe exported 6 382 tons of whole gutted frozen fish with an export value of $11.7 million (Table 16). About 50% of frozen fish were exported overseas and the rest to Botswana, Malawi, Mozambique, South Africa and Zambia, which took 84% of the regional export share.

Table 16. Zimbabwe fish exports in 2019 based on whole gutted frozen fish quantities[17]

IMPORTING COUNTRY	EXPORTS (KG)	VALUE ($)
Rest of the world	3 190 750	5 864 940
Zambia	2 684 900	4 726 790
Malawi	321 080	667 110
South Africa	111 994	267 130
Botswana	51 000	153 830
Mozambique	21 780	50 050
TOTAL	**6 381 595**	**11 729 850**

Recreational fisheries

Recreational fishing in Zimbabwe is widespread among locals and tourists and takes place in rivers and man-made reservoirs. Lake Kariba and the Zambezi River are popular for tiger fish *(Hydrocynus vittatus)*. Mutirikwi, Manyuchi, Manjirenji, Matopos, Ncema and Mayfair dams are popular for angling largemouth bass *(Micropterus salmoides)*, chessa *(Distichodus schenga)*, nkupe *(D. mossambicus)*, Cornish jack *(Mormyrops anguilloides)*, eastern bottlenose *(M. longirostris)*, and Hunyani labeo, or "Pink Lady" *(Labeo altivelis)*

17 https://wits.worldbank.org/trade/comtrade/en/country/ZWE/year/2019/tradeflow/Exports/partner/ALL/product/030379

(FAO 2016). Largemouth black bass *(Micropterus salmoides)* is exotic and was introduced to support recreational fishing in these dams.

Fly fishing for rainbow trout *(Onchorynchus mykiss)* is a major attraction in reservoirs and rivers in Nyanga National Park as well as the rivers of the Chimanimani Mountains in the cool Eastern Highlands. Data on the performance of fly fishing are poor.

Angling in recreational parks requires permits. Angling safaris and fishing charters are well organized with fishing guides and are common on the Zambezi River. There are several angling clubs and associations. Three main angling competitions are held annually – the international tiger fishing tournament on Lake Kariba, the bass masters tournament on Lake Manyame and the fly-fishing tournament in Nyanga National Park.

Recreational fishing is a key component of the tourism industry and is promoted. The international tiger fishing tournament is a big drawcard for international tourists (Table 17) which could help to boost Kariba's appeal as a tourist destination. Most recreational resorts derive an income from lodges and camping facilities. Angling safaris and fishing charters have potential for growth as more dams are built.

Table 17. International tiger fishing tournament and other anglers on Lake Kariba. Data covers only Basin 5 (Parks and Wildlife Management Authority field station in Kariba, PWMA database)

ACTIVITY	2019	2020	2021	COMMENTS
Tiger fish tournament (residents)	320	145	207	Event
Tiger fish tournament (non-residents, mostly South Africans)	30	0	12	Event
Bream tournaments (residents)	42	53	62	Event
Bream tournaments (non-residents, mostly South Africans)	24	0	81	Event
Other anglers (residents). Anglers on houseboats, speedboats and those angling from the lakeshore	7 172	4 669	5 753	All anglers on houseboats are recorded once and no return of number of fishing days is collected, while anglers on speedboats and the lakeshore are recorded daily
Other anglers (non-residents)	2 070	679	94	
TOTAL NUMBER OF ANGLERS	**9 658**	**5 546**	**6 209**	

Key challenges and opportunities

Expanding fisheries to new dams and small waterbodies.

Gillnet fisheries in the recreational park water bodies have reached their production limits. There is potential to develop kapenta fisheries in some of the other larger dams, but attempts to introduce them in other waterbodies have so far not been successful.

Prospects for economic growth through increased fishery production can be explored in water bodies outside recreational parks under the MLAFWRD. There is also potential for increased production through the development of fisheries in new dams, as is happening in Tokwe Mukosi, which has a surface area of 9 660 ha, and Gwayi Shangani Dam.

Zimbabwe's estimated annual aquaculture production of 37 752 tons (based on 2019 figures) is high and the contribution of Lake Harvest operation on Lake Kariba is significant.

The company has similar cage aquaculture operations on Lake Victoria and the Zambian side of Lake Kariba. More cage fisheries could be established on Lake Kariba and other internal waterbodies. There is considerable potential for small-scale pond fish farming of tilapia and African catfish in Zimbabwe's many small waterbodies, with improving fingerling and feed supply and technology as well as extension services and market access, through joint efforts of public and private sectors (FAO 2016). Most of this potential for creating rural jobs and contributing to food security and increasing protein availability in rural areas remains unrealized.

Improving fisheries data collection systems

There is little information about the contribution to fisheries or aquaculture by small water bodies outside recreational parks. The MLAFWRD has a mandate to establish a department for fisheries and aquaculture development that could create opportunities for such enterprises and develop facilities for research, data collection and monitoring. The ministry is receiving FAO technical support with funding from the European Union and Germany's Ministry for Economic Cooperation and Development to assess the aquaculture value chain in small waterbodies. The study is identifying actors, their technical levels of operation and their challenges and needs; inclusivity; and prospects and shortfalls in aquaculture development. It is important that the ministry and the PWMA collaborate in data collection so that both data sets can be easily aggregated.

The PWMA is focusing on Improved data collection in the large waterbodies in recreational parks. For Lake Kariba this is being developed under the FAO technical cooperation project in the context of a fisheries co-management system that the fisheries research institute is setting up.

There is also a lack of data about recreational angling, although it is an important component of the tourism industry. The PWMA is setting up a data collection system that will cover catch records and economic impacts of downstream enterprises such as accommodation in the recreational parks and fishing safaris on the Zambezi River. Angling clubs will have a role in the data collection given that all anglers are required to pay a daily fee. Subsistence fishers, for instance, pay $1 for a bag limit of five fish.

Integrating fisheries policy and legislation for coordinated growth of the sector

Fisheries have vast potential for growth, particularly through aquaculture, and a key challenge in the absence of a dedicated policy and legislation to provide a clear framework for development of the sector.

Integrating aquaculture and subsistence farming

As the Government implements community-based natural resources management, indigenous capture fisheries should be promoted to diversify the income base and protein sources under the community conservancies programme. Strategies for integrating aquaculture and subsistence farming should be developed for communities living around small waterbodies in rural areas. This would involve animal husbandry and crop cultivation alongside fish farming (CNFA 2014). The system involves waste recycling, for instance with manure from livestock being used as inputs in crop and fish farming and crop residue being used as feed for livestock. Households would benefit from better nutrition, increased incomes and reduced costs of inputs such as stock feeds and fertilizer. Malawi offers an example of integrated aquaculture systems at the household level (CNFA 2014) which the World Fish Centre is promoting as a strategy for other countries to emulate.

Improving fisheries management through co-management approaches

The capacity for sustainable fisheries management based on the conservation of biodiversity and maintenance of the ecological capacity of aquatic ecosystems needs to be strengthened and developed from the community to the national level. The fisheries co-management approach being introduced on Lake Kariba is a promising development. The aim is to engage fishers in co-management arrangements in the form of sub-areas fishers' associations that are registered as trusts. This would lead to ecosystem and adaptive management practices regulated by the fishers themselves. The co-management approach is similar to the CAMPFIRE concept that puts local communities at the centre of natural resources management and is based on the ecosystem approach of the Convention on Biological Diversity. The approach promotes participatory decision making with the fishing community taking responsibility for managing and regulating the fishery under a communal resource rights regime. The objective would be to transform the fishery into a productive small-scale commercial fishery with positive impacts on livelihoods.

THE FORESTRY SUBSECTOR

Key points

- *Production in Zimbabwe's formal forestry sub-sector is dominated by exotic species. Indigenous timber species accounted for just 7% of national timber production in 2018.*
- *Forestry as a whole is cited by some sources as accounting for 3% to 4% of GDP. However, ZIMSTAT's supply and use tables suggest the contribution of forestry and related services is just 0.6% of GDP. Indigenous timber production is just a small portion of this overall contribution.*
- *Timber harvesting in state forest areas in the country's Kalahari woodlands generated between $164 000 and $275 000 from 2014 to 2018. Additional revenue, between $190 000 and $445 000, was raised from timber processing at the Gwaai Sawmill.*
- *There is limited opportunity for sustained growth in indigenous timber revenues because of the low growth rates of indigenous hardwoods and a declining resource base in some areas.*
- *Demand for timber products on the local market is depressed because of the economic downturn and Zimbabwe's timber products are not competitive on the export market partly because the use of antiquated equipment makes them too expensive.*
- *Some indigenous state forests generate higher revenues by offering services such as hunting. Other potential revenue streams are payments for ecosystem services (PES), including carbon capture and storage.*

Overview

The forestry sub-sector generates revenue mainly from the extraction of commercial timber from indigenous forests and exotic plantations, which contributes 3% to 4% of GDP (Mutasa and Ndebele-Murisa 2015). The total value of exported wood products was $26.5 million in 2019 (FAO 2021), mostly in the form of industrial roundwood ($8.5 million), sawn timber ($5.8 million), paper ($5.5 million) and fibreboard ($4.9 million). The formal forestry sector is a notable employer, supporting around 15 000 individuals (Timber Producers Federation 2018). The sector contributes to livelihood improvement through cross-sectoral benefits, including health facilities and schools for employees and communities (ibid).

While formal forestry is dominated by plantation timber production, it is the indigenous, non-plantation sub-sector that is part of the biodiversity economy. Forests and woodlands cover large expanses of Zimbabwe's total land area, but most indigenous species are perceived to have low economic value in their natural state due to limited timber production potential and relatively slow growth rates. Nonetheless, official estimates of the contribution of forestry to GDP grossly misrepresent the social and economic significance of woody habitats because the value of non-timber forest products (NTFPs) and crucial ecosystem services provided by natural woody habitats are not captured in the national accounts (FAO 2007). Forest and woodland habitats are important for the following: food and nutrition security; soil nutrient recycling; energy provision; climate change mitigation and adaptation; biodiversity conservation; and combating land degradation. None of these benefits are captured when calculating the contribution of forestry to GDP. This report seeks to address this anomaly by examining the current and potential commercial value of selected NTFPs and of subsistence harvesting of NTFPs.

Forest tenure system

The main types of forest tenure are state, communal and private. The state's protected forests and woodlands and their resources are managed and regulated by the Forestry Commission and the PWMA under the provisions of the Forest Act (Chapter 19: 05) or the Parks and Wildlife Act (Chapter 20: 14).

State-owned forests.

State-owned forest resources are managed as private, co-management or common pool arrangements in which local communities have rights and responsibilities in cooperation with the state. An example is the 82 000 ha Mafungautsi Forest in Gokwe district that has been co-managed since 1994.

State forests cover around 860 000 ha. Of that,

800 000 ha is in Kalahari woodland in the west of the country (Forestry Commission 2021) where state forests were gazetted to control the harvesting of indigenous timber species for mine props, railway sleepers, parquet flooring and furniture.

The forests are also important for watershed and soil protection, nutrient recycling, biodiversity conservation and the provision of wildlife habitats. However, the integrity of gazetted forests is under threat from illegal settlers who earn a living from them, by farming, for instance, leading to deforestation and land degradation.[18] Gazetted forests also under threat from timber and game poaching and forest fires. Although the Forest Act prohibits buffer communities from accessing goods and services from gazetted forests, the Forestry Commission allows controlled access to collect thatching grass and other NTFPs and to graze livestock.

The state also owns around 80 000 ha of forest plantations in the Eastern Highlands and smaller plantations on the central plateau. State-owned plantations are more susceptible than privately owned plantations to encroachment by neighbouring communities.

The state exercises indirect ownership of forests and woodlands in resettlement areas where there are leasehold systems for the occupiers of former commercial farms under the older resettlement schemes (1980 to 1999) and the more recent A1 model (from 2000). Other state-owned woodlands and forests are controlled by local authorities, such as rural district councils and urban municipalities. Examples are Nyatana woodlands in Mudzi district in the northeast, blocks of protected forests in Matebeleland, such as Pumula block in Tsholotsho, and undeveloped land on the periphery of urban centres that provides sources of fuelwood for urban residents. The degree of management by local authorities varies according to the perceived value and utility of the forest or woodland. Where the forest has commercial value, such as hardwood timber in Matebeleland North, RDCs exercise greater control and keep local communities out or seek collaborative arrangements. An example is Nyatana woodland scheme in Mudzi (Mukwekwerere 1996), where the RDC provides safari hunting concessions under a collaborative scheme that gives local communities access to forest products.

Communal forests.

State owned woodlands and forests in communal areas are managed by traditional and local authority structures. The woodland resources are managed through a variety of mechanisms, including customary controls and practices such as the designation of sacred forests, village control systems under the authority of traditional leaders or elected officials, and individual household control over arable patches and around homesteads. Land degradation caused by unsustainable agricultural practices and illegal cutting of firewood are a major concern in communal forests (Chauma 2006; Mapedza and Bond 2006; Manganga 2007).

Private forests

Privately owned forests and woodlands are plantations owned by companies, remnants of indigenous forests on company-owned property, individually owned forests on commercial farmland, and trees and woodlands on residential and farm land in communal and resettlement areas to which individuals have rights of use. Privately owned forests can be:

- Plantations of exotic trees
- Large-scale commercial farm-type woodlands
- Small-scale commercial farms
- Individual trees on farms and around homesteads in communal and resettlement areas.

Privately owned plantation estates are the forestry sector's main source of jobs. They provide the bulk of Zimbabwe's industrial wood and timber needs. Forestry sector jobs as a proportion of total labour force declined from 0.3% in 1990 to 0.1% in 2011 (FAO 2014). The Timber Producers Association (2018) estimates employment at 15 000 for both the formal and informal employment categories. Most forest plantations are owned by private corporations and operated commercially. Management systems follow business models and provide grazing rights to neighbouring communities when trees are a certain size. Access rights are not assured in these forms of co-management because they depend on the phase of the plantation management cycle. Plantation owners formed the Timber Producers' Federation (TPF) to monitor members'

18 www.sundaynews.co.zw/gazetted-forests-under-threat-40k-illegal-settlers-invade-forests/

performance of sustainable forest management (SFM). Standards of SFM have improved since most plantation owners have sought certification under the Forest Stewardship Council as a means of obtaining access to lucrative European markets. TPF members regularly monitor one another's sustainable management performances against environmental, social and productivity parameters. Harvesting of timber on private land is authorized by the Forest Commission.

Forestry Production and value

Timber exploitation started in the early 20th century when hardwoods in the Kalahari woodlands in western Matabeleland were harvested for railway sleepers, construction, mining, furniture and other uses (Nyakudanga 2021). Indigenous species are slow growing, however, and demand was fast exceeding supply, leading to efforts to introduce fast-growing exotic timber species in the early 1900s. The Forestry Commission pioneered large-scale pine tree plantings at Stapleford Forest in 1926 (ibid). Plantation forests continued to expand through the 1930s and 1940s, with wattle being introduced into the Eastern Highlands during this period.

Today Zimbabwe has 108 000 hectares of planted or exotic forests (FAO 2020a). The plantation estates are mainly in the Eastern Highlands (90%) (Mabugu and Chitiga 2002; Forestry Commission 2011). A number of smaller plantations are scattered across the central watershed. In 1996 plantations were estimated to cover around 156 000 ha (Mabugu and Chitiga 2002). FAO data show a decline in plantation area since the 1990s to around 108 000 ha today (FAO 2020a). Fifty-six percent of plantations are privately owned, the rest being owned by the state. The proportion of area planted under different exotic tree species is shown in Figure 31.

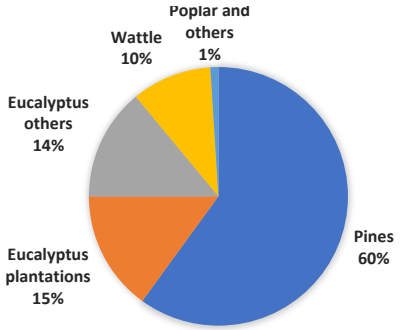


Figure 31. Proportional coverage of different exotic timber species across exotic forests in Zimbabwe (Mujuru and Oeba 2019)

Major role players in the plantation industry are Allied Timbers, Border Timbers, Wattle Company, Hunyani Forests and Mutare Board and Paper Mills (Nyakudanga, 2021). Mujuru and Oeba (2019) identify primary, secondary, and tertiary production players in the forestry sector. The first undertake management of natural forests, logging, harvesting poles, growing and managing woodlots, and agroforestry activities. The secondary and tertiary forest actors are business operations producing furniture, firewood and coffins and trading in NTFPs. Four big private and two Government organizations dominate the primary forest production; secondary and tertiary production is dominated by small and medium enterprises (Mujuru and Oeba 2019).

Table 18 lists the key players in primary forest production. The small and medium size enterprises account for 80 to 90% of forest and wood-based enterprises and more than 50% of jobs. The SMEs sector is dominated by producers of furniture (81%), firewood (7%), coffins (4%), timber sales (4%) and wild fruits (4%) (Mujuru and Oeba 2019).

Table 18. Key actors in primary forest production (Mujuru and Oeba 2019)

	AREA (HA)	FOREST TYPE	ROTATION AGE (YEARS)	PRODUCT
Allied Timbers	25 000	Plantation	22 to 25	Logs, poles
Boarder Timbers	27 648	Plantation	Pine 15, 20 & 22 Eucalyptus 6–11	Logs, poles
Wattle Company	25 445	Plantation	Pine 20–25 Wattle 9–10 Eucalyptus 5–11	Logs, poles, woodfuel
Manica Boards and Doors - Outgrowers scheme	4 572	Plantation	12–15	Logs
Mutare Board and Paper Mill	3 400	Plantation	12–15	Logs
Sustainable Afforestation Association	> 15 000	Plantation	7/8	Wood fuel
Forestry Commission Matabeleland	821 038	Natural	40–60	Fuelwood, Logs
Forestry Commission Midlands	82 433	Natural	40–60	Fuelwood, Logs
Forestry Commission	5 642**	Woodlots	7–10	Fuelwood and poles
Tobacco Industry Marketing Board (TIMB)	100	Woodlots	7/8	Fuelwood

** *only for 2015 rural afforestation*

As noted in Table 18, the Forestry Commission mainly manages natural forests in Matabeleland North and one in Midlands Province. Unlike exotic timber plantations, these biodiverse, indigenous forest and woodland areas fall in the ambit of the biodiversity economy. There are 18 natural forest management units in 903 471 ha extracting hardwood timber in the two provinces. As shown in Table 18, the rotation times are much longer for indigenous forest and woodland areas (40-60 years) compared to those for plantation forests. Productivity in indigenous forestry is inherently more limited than in plantations with faster-growing exotic species.

Production trends

Data on wood production in Zimbabwe are limited. The data used in this report were obtained from FAOSTAT and the Forestry Commission.[19] Estimated production over time of all roundwood harvested for commercial purposes (excluding firewood) is shown in Figure 32. It is important to note that the harvesting data are limited to gazetted forest areas and certain plantation areas the TPF and others report on timber production on behalf of the Forestry Commission.

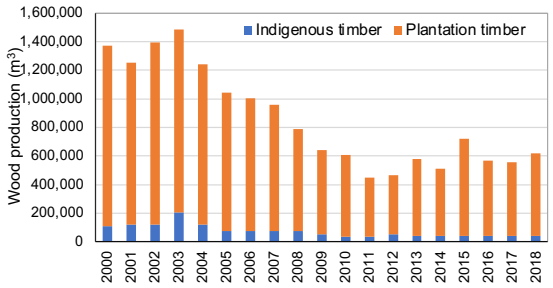


Figure 32. Production volumes of all wood harvested for commercial purposes (excluding firewood) split by plantations and indigenous forests and woodlands (Forestry Commission and FAO 2021)

The volumes of wood harvested nationally (excluding firewood) were estimated to be

19 While FAOSTAT estimates are based on figures submitted by the Government, they do not differentiate between production from indigenous and exotic species, with forest production split only into coniferous and non-coniferous species. In Zimbabwe the former captures production from exotic pines, the dominant plantation species in the country. All indigenous wood products would fall in the non-coniferous category. However, this also includes production from non-coniferous exotic species such as Eucalyptus and wattle. Hence only a portion of non-coniferous forestry production is from indigenous species. However, the Forestry Commission provided an estimated breakdown of timber production split by plantation forests and indigenous or natural forests and woodlands. The TPF captures data on forestry production from its members only, which does not encompass all forestry companies in the country, according to comments made by D. Duwa CEO of the TPF during the report validation workshop. These figures do not therefore represent total timber production in the country.

618 000 m^3 in 2018. Exotic plantations are evidently the dominant source of wood for construction and industrial purposes, accounting for 93% of wood produced in 2020, or 577 000 m^3 compared to just 40 000 m^3 from indigenous species. Wood production peaked in 2003, almost reaching 1.5 million cubic metres before declining to a low of 447 000 m^3 in 2011. The TPF ascribes the decline in wood production to a myriad of challenges facing the forestry sector, including the economic downturn. Despite variability from year to year, plantation wood production appears to have been increasing gradually since 2011. However, wood production from indigenous species has reportedly remained steady at 40 400 m3 since 2013. The value of timber production from indigenous woodlands and forests thus appears to be relatively modest. This reflects the paucity of high-value timber species in most of the country's woody habitats and the slow growth rates of indigenous timber species.

Exports of wood products

According to FAO data, the total value of exported wood products from Zimbabwe was $16.8 million in 2020 (FAO, 2021a). However, there is no available breakdown of timber export value between exotic and indigenous species. The major constituents of Zimbabwe's timber exports in 2020 were sawn wood ($5.3 million), industrial roundwood ($4.4 million) and fibreboard ($4.3 million). Of these, industrial roundwood is wood that has undergone the least processing and is still relatively close to its natural state as felled. It may be used directly as poles in its round form or processed into sawn wood, pulp and other products. Sawn wood includes various products such as planks, beams and railway sleepers produced from roundwood (FAO 2021), thus representing a more advanced stage of processing and value addition. Similarly, fibreboard represents a group of products constructed from wood that has been reduced to a fibrous state. Other significant wood exports in 2020 included paper and paperboards ($1.6 million) and recovered paper ($600 00) (FAO 2021). The proportional breakdown of various wood products to the total value of wood exports in 2020 is shown in Figure 34.

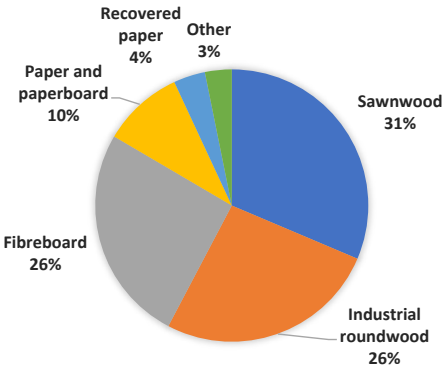


Figure 33. Proportional contribution of different products to the $16.7 million total export value of wood products in 2020 (FAO, 2021a)

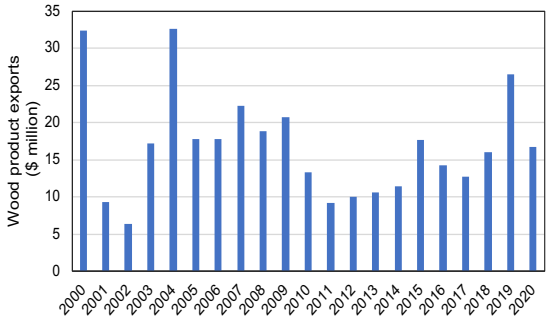


Figure 34: Annual value of wood products exported from Zimbabwe expressed in $ million (FAO 2021)

The value of Zimbabwe's wood exports has varied significantly since 2000, ranging from a high of $32.6 million in 2004 to as low as $6.3 million in 2002 (Figure 34). The direct contribution of the commercial forestry sector to Zimbabwe's exports thus appears to be rather volatile from year to year. Notably, the FAO export value estimates differ markedly from figures quoted by the TPF, who report that $130 million was earned from timber exports in 2011 (TPF 2018).

Overall contribution of forestry to GDP

Formal forestry accounted for around 3% of GDP and 8% of employment in the manufacturing sector (Mabugu and Chitiga 2002). The World Bank and OECD national accounts data give the contribution of agriculture, forestry and fishing to GDP as 7.6%. The World Bank data cover agriculture and fisheries and it can be assumed therefore that the contribution of forestry to GDP is below 3%. The data also describe a wide range of timber and non-timber products and services directly and indirectly benefiting

the population – fuelwood, wood for charcoal, sawn timber, pulpwood, building materials, wood for small artisanal crafts, fodder, fruits, honey, mushrooms, insects, bark for rope, medicines, leaf litter and gum. Valuable ecosystem services provided by forests and woodlands are watershed conservation; carbon fixing; microclimatic stabilization; and the provision of windbreaks, shade, soil stability and wildlife habitat.

Trends in the overall value and contribution to GDP of the forestry sector between 1995 and 2006 were obtained from an FAO report on forestry finance (Figure 35). The proportional contribution of forestry to GDP generally increased over the 2000s even though the value of the sector declined in absolute terms, in line with the overall decline in other sectors. The contribution of the forestry sector ranged from 3 to 5% between 1995 and 2006. However, data from the supply and use tables for Zimbabwe (ZIMSTAT 2012) indicate that forestry, logging, and related services contributed only 0.6% to GDP in 2012. This significant decline could be related to differences in the methods used for estimating the contribution of forestry between the FAO and ZIMSTAT. The large variations in estimates suggest a need for greater cooperation between the Forestry Commission, ZIMSTAT and other institutions in the collection, storage and dissemination of forestry data.

The same FAO data source (FAO 2006) breaks down the economic contribution of forestry into sub-sectors, including the furniture industry. The sectoral breakdown is shown for selected years between 1996 and 2006 in Figure 36. These data highlight that roundwood production has consistently been the major contributor to forestry revenues. The contributions of other forestry sub-sectors appeared to generally increase over the 2000s, indicating a higher level of value addition.

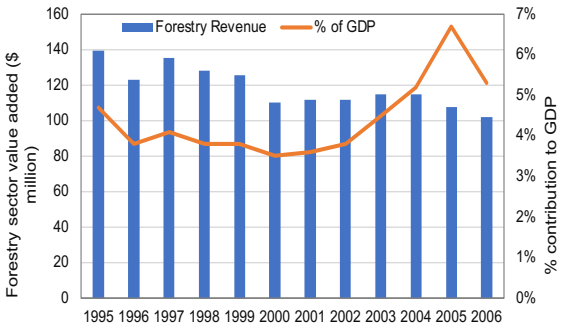


Figure 35. Overall value added by the forestry sector (converted to current prices) in Zimbabwe and its contribution to GDP between 1995 and 2006 (FAO 2006)

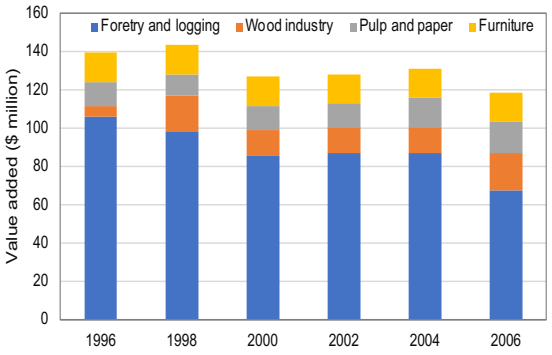


Figure 36. Contribution of the different forestry sub-sectors to total value added (FAO 2006)

According to FAO (2006) total employment in Zimbabwe's forestry sector ranged from 10 000 to 15 000 between 1996 and 2006, accounting for about 0.2% of the country's total labour force. This accords with more recent estimates that employment in forestry is around 15 000 (TPF 2018). The breakdown of employment in the different forestry sub-sectors as at 2006 is shown in Figure 37. Despite their smaller contribution to overall forestry revenues, the value-addition industries account for the bulk of employment, suggesting that they have good potential for job creation with further investment and development. In 2006 employment was relatively evenly split across the production in sawn wood, wood-based panels and other processed wood products; pulp and paper; and furniture.

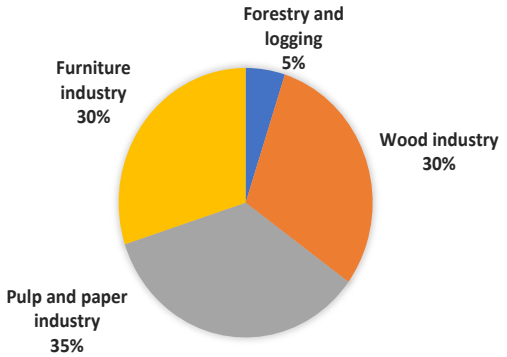


Figure 37. Breakdown of employment in the forestry industry in 2006 by subsector (FAO 2006)

The contribution of indigenous forestry production

As noted earlier, forestry production from indigenous species accounted for just 7% of timber production in 2018 (Forestry Commission and FAO 2021). Using the estimate that forestry overall accounts for 3-4% of GDP (Forestry Commission 2011; Mutasa and Ndebele-Murisa 2015), this suggests timber production from indigenous species accounts for just around 0.25% of GDP. This value would be slightly higher if indigenous hardwood timber was worth more per cubic metre than exotic timber, as is reportedly the case (Forestry Commission 2019).

Income from timber harvesting across gazetted forests in the Kalahari woodlands ecosystem was between $164 000 and $275 000 between 2014 and 2018, with a notable drop in revenues in 2018 (Figure 38). Combined revenue from timber harvesting and the Gwaai Sawmill was between $190 000 in 2018 and $445 000 in 2014; no sawmill revenue was reported for 2017. Although the time interval is short, these data indicate a declining trend in total revenues from timber harvesting and sawmill activities in state forest areas in the Kalahari woodlands.

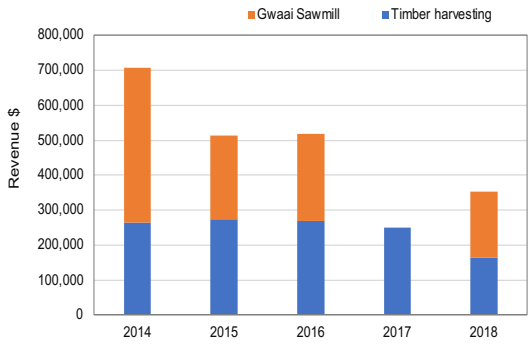


Figure 38. Revenues generated by indigenous hardwood timber harvesting in state forest areas and processing at the Gwaai Sawmill (Forestry Commission database, accessed 2022)

Analysis of the revenue data from state forests in the Kalahari woodlands shows that they serve multiple purposes. For example, significant income is generated from trophy hunting (Figure 39) which in some years exceeded the combined revenues from timber harvesting and sawmill activities between 2014 and 2018. Trophy hunting revenue declines over the short analysis period. Lease fees from hunting and photographic tourism camps in state forest areas also generated significant revenue, exceeding the value of timber harvesting in all years. Unlike timber harvesting, sawmilling and trophy hunting, this revenue stream increased in more recent years (Figure 40). Such activities are not possible in exotic plantations as they do not provide suitable habitat for wildlife, and plantation forests offer only limited NTFP value.

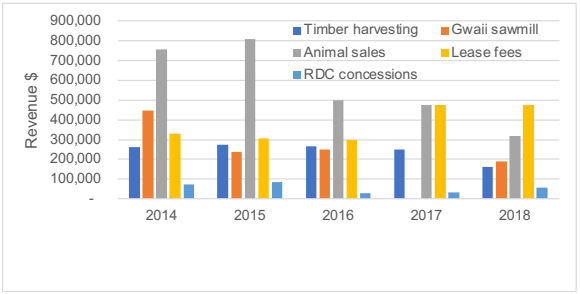


Figure 39. Revenues generated from various activities in state forest areas in the Kalahari woodlands (Forestry Commission database, accessed 2022)

Trends in the Forestry Industry

The indigenous forestry industry faces economic and resource challenges that adversely affect its economic performance and sustainability. For example, the allowable diameter for harvesting commercial indigenous timber has been reduced from 35 to 31 cm due to unsustainable harvesting and timber poaching (Mudekwe 2007) – a seemingly short-sighted measure that will afford even less protection to trees. Moreover, the illegal export of unprocessed timber continues despite the ban provided by Statutory Instrument (SI) 112 of 2001, a measure that is intended to promote local level value addition, create downstream industries and reduce overexploitation (Ibid). RDCs and the Forestry Commission, as the landowners on behalf of the state, grant timber concessions through a competitive bidding process adjudicated by the Forestry Commission. This is done on the strength of a forest inventory and timber cutting and environmental management plans submitted by the concession holder. Nine indigenous hardwood timber concessions are currently operating – two under the Forestry Commission, six under RDCs and one on private land. The Forestry Commission used to insist on a winning bidder ceding a 20% stake to local communities, but the communities lacked finance and technical capacity to acquire the 20% stake (Ibid).

The indigenous commercial timber industry

in Zimbabwe is shrinking. Half the companies involved in timber processing closed down between 2016 and 2022. Some of the major challenges are illegal settlements in forest areas resulting in land use change from forestry to agriculture, plantation area reduction, uncontrolled fires, illegal harvesting of timber and stray livestock destroying young trees (TPF 2018). Illegal mining is also a problem in some forestry areas (D. Duwa, CEO of TPF, pers. com during the project validation workshop).

Utilization of installed timber processing capacity is estimated at between 15 and 30%. Major timber products are furniture, flooring and decking, whose demand on the local market is depressed due to the economic squeeze and availability of more affordable ceramics for flooring. Moreover, other SADC countries export wet off-sawn timber to established traditional markets such as South Africa at low prices. Zimbabwe's timber products are too expensive because antiquated processing equipment increases production costs. Statutory Instrument 112 of 2001 that banned the export of unprocessed timber was introduced to promote local value addition and create downstream employment but its effectiveness is blunted because Zimbabwe's sawn timber is uncompetitively priced.

Key challenges and opportunities

The above discussion confirms that revenues from indigenous timber production are modest. The slow growth rates of indigenous hardwood species and fragile nature of the Kalahari woodland ecosystems limit the potential for long-term growth in the sector. Improved protection of the resource base, such as better control of illegal harvesting and fires, could yield production benefits. However, better returns might be generated from alternative revenue streams, such as hunting and wildlife tourism in suitable forest areas. Data shared by the Forestry Commission indicate that the former already has generated more revenue than timber production in recent years.

Additionally, the forestry sector could generate additional revenues through PES schemes, particularly those tied to the global carbon market due to limited local willingness and ability to pay for PES. These opportunities are discussed in a later chapter on the trade in ecosystem services.

One of the key challenges in the forestry sector is the lack of systematic collection of forestry data. The formation of a central data repository could be highly beneficial for achieving more complete and relevant forestry data.

The Communal Land Forest Produce Act (1987) needs to be reviewed in the light of new developments in sustainable forest management which put people at the centre of forest management and encourage the participation of communities. The Act should also embrace the need for communities to benefit sustainably from the commercialization of non-timber forest products.

THE BIOPROSPECTING AND BIOTRADE SUBSECTOR

Key points

- *Subsistence harvesting of selected NTFPs – fuelwood, poles, thatching grass, wild plant foods, mushrooms, honey and mopane worms – at the national level is estimated to be worth about $500 million/year, but its sustainability is unknown.*
- *Biotrade (trade in natural products) has been developed to a small extent, with products like baobab achieving some success. However, when they are still sourced from the wild, the risks to biodiversity are high.*
- *While there is little active bioprospecting, there is some potential for product development due to growing interest in novel natural products in botanical medicine, cosmetics and food and beverages.*
- *Growth of the subsector is hampered by high risks, uncertainty around requirements for access and benefit sharing (ABS), and costs of regulatory approval in export markets.*
- *There is a lack of systematically collected information.*

Overview

The bioprospecting and biotrade subsector involves economic transactions associated with the development of and trade in biological products sourced from nature. Bioprospecting is defined as the systematic search for genetic material, biochemical compounds and structural designs from microorganisms, plants and animals to develop commercially viable products for use in pharmaceuticals, farming, cosmetics, food and other industries (Melgarejo 2013; Wynberg et al 2015). Biotrade is the commercial trade arising from bioprospecting or commercialization of a natural product that is already in use on a small scale. These products are often harvested from the wild and then cultivated to improve efficiency. Existing indigenous uses and knowledge systems are pivotal in the commercialization of products.

Many wild resources are used widely in Zimbabwe for fuel, foods, medicines, as raw materials and for ornamental purposes, and are designated non-timber forest products (NTFPs).[20] Rural households sell some of these resources for cash. In some cases, especially where equipment or special skills are required, small business have been started – mainly in rural communities, but also serving urban communities – to develop fuel and medicinal products, for example. There is already a considerable informal biotrade subsector in Zimbabwe, but the development and marketing of products for formal domestic and international markets is still in its infancy. Neither the informal nor formal aspects of biotrade have ever been quantified in Zimbabwe. This section therefore attempts to address this shortcoming by estimating the potential extent of use and value of selected NTFPs based on existing studies and spatial modelling, and by collating existing information on bioprospecting and biotrade.

Household use and sale of NTFPs

Most poor rural households in developing countries depend on NTFPs for their livelihoods (Sills et al 2011; Chou 2018) and as safety nets in times of crisis (Golden et al 2011; Robledo et al 2012) because they tend to be cheap and easy to access, often being subject to open access (Vedeld et al 2007; Ludvig et al 2016). Indeed, NTFPs provide income and nutrition for over two-thirds of Africa's population (CIFOR 2005). In some areas of Zimbabwe forest-based resources contribute up to 35% of rural incomes (Feresu 2010 in Miller 2012).

Millions of Zimbabweans, particularly those living in rural areas, harvest wild plant and animal resources for nutrition, health, energy and construction and crafting materials (Campbell et al 1997; Cavendish 2000; Woittiez et al 2013). This is not captured in the national accounts (Shumba 2001). NTFPs such as firewood, thatching grass, construction poles and wild fruits are harvested for domestic use. Commercially important products are honey, crafts, mopane worm, wild fruits processed for cosmetic oils and pulp for jams and snacks (Madzara 2013).

20 In this report, NTFPs include fuelwood, poles and withies, wild fruits and nuts, vegetables, bush meat, medicinal plants, resins, essences and a range of barks and fibres such as bamboo, rattans, and a host of other palms and grasses. They do not include formally hunted game, timber or any fisheries, which are described under the subsectors above.

Ecological and socio-economic studies in Africa show that it is possible to arrive at approximate estimates of the volumes of natural resources harvested nationally and regionally (Turpie et al 2017, 2021). This is done using estimates of geographic variation in the supply and demand of different types of resources. For this report the quantities and values of harvests were estimated for selected groups of resources based on available data – a combination of land cover and ecoregion data (Olson et al 2001; Buchhorn et al 2020), population data and published studies on resource abundance, household use and prices. All prices were expressed in dollars at current rates. The detailed modelling methods and data sources are outlined in Turpie, Weiss and Letley (2022). Descriptions of the use of fuelwood and poles, thatch, plant foods, mushrooms, honey and mopane worms and their value are given below, followed by a summary.

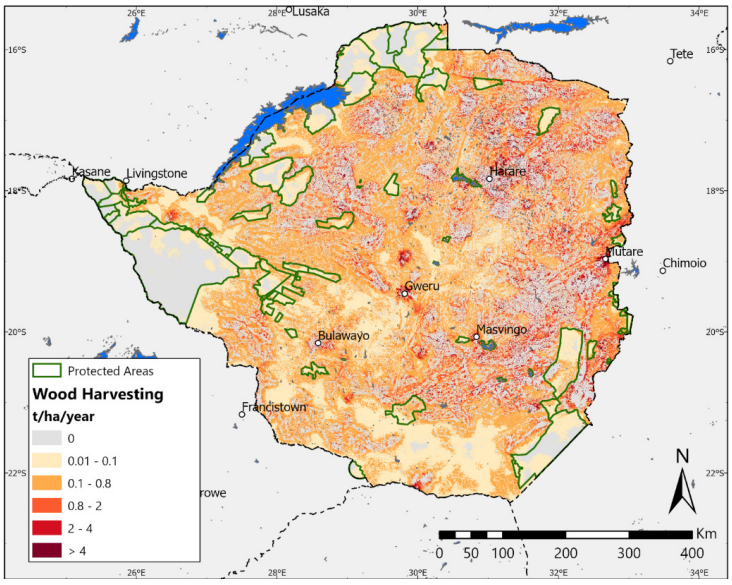


Figure 40. Quantities of wood harvested for local firewood consumption and hut construction (Source: Anchor Environmental Consultants, this study)

Woody resources

Firewood is the primary source of cooking fuel for 94% of rural households and 16% of urban households (ZIMSTAT and UNICEF 2019). Other woody resources are poles, withies and timber for construction and crafting. Harvesting of wood is lowest in the south and east where population densities are lower (Figure 40). High volumes of wood harvesting are associated with densely populated rural areas in the north and east and peri-urban settlements. Areas with negligible wood harvesting (shown in grey) are either those where natural habitats have been converted to cultivation and settlement (i.e., no wood stocks), or more remote parts of protected areas which have no nearby populations (i.e., no demand).

Subsistence or small-scale harvesting of woody resources is estimated to be around 9.1 million tons per year valued at $227 million. Harvesting in miombo woodlands accounts for about half of the national value (4.5 million tons per year valued at $113 million). The volume and value of wood harvesting from indigenous forests is estimated to be $14.80 per hectare per year compared to that from miombo woodlands ($12.8/ha/year).

Thatching grass

Thatching grass is widely used for roofing in rural areas (ZIMSTAT 2017) and harvesting by local communities in state PAs is conducted by agreement with state authorities. The trade in thatching grass is growing as rural communities living around state forests in Matabeleland North supply safari camps, hotels and lodges in Victoria Falls and other parts of the province, (Mutekwa and Gambiza 2017; V. Dzingirai, Senior Lecturer at University of Zimbabwe, pers. com., 2022). Most harvesting of thatching grass is associated with densely populated rural areas and peri-urban areas around cities and large towns (Figure 41).

Subsistence harvesting of thatching grass is estimated to be worth $48.3 million/year or $1.24/ha of natural land cover. It is estimated in this report that rural households harvest 120 700 tons per year for roofing (3.09 kg/year/ha) from natural land cover. Harvesting was highest in miombo woodlands (50 300 t/ha/year) with a relatively high value per unit area of $2.29/ha/year. Values are higher for mesic grassland ($10.01/ha/year), dry grassland ($3.09/ha/year) and miombo shrubland ($3.06/ha/year), reflecting the greater grass productivity in these more open habitats (Frost 1996).

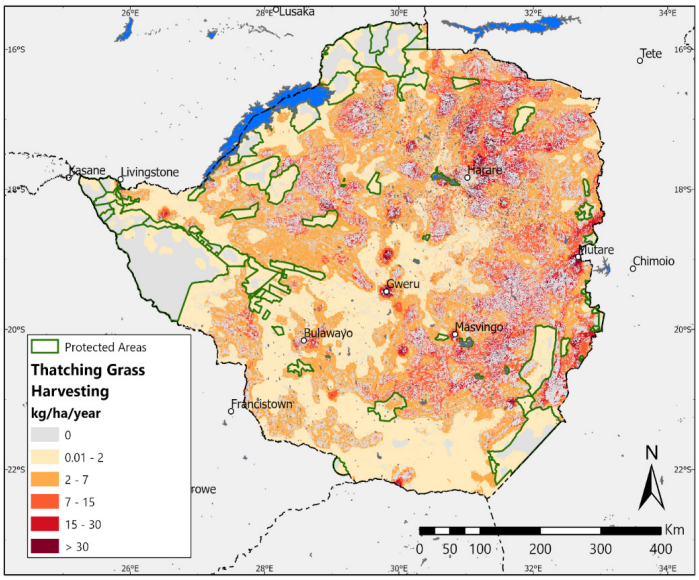


Figure 41. Estimated harvested quantities of thatching grass for roofing of rural households (Source: Anchor Environmental Consultants, this study

Wild plant foods

Spatial variation in estimates of household harvesting of wild plant foods is shown in Figure 42. While the spatial pattern follows population density, it is also influenced by the higher densities of valuable fruit trees in miombo woodlands (Campbell 1987). These include muzhanje/mahobohobo (Uapaca kirkiana) and mobola plum (Parinari curatellifolia) which local communities harvest in large quantities for consumption and sale locally and in urban markets (Karaan et al 2006; Woittiez et al 2013; Chagumaira et al 2016)is increasingly forcing rural households in Zimbabwe and other parts of Southern Africa to rely on common natural resource pools (CNRPs). The highest levels of wild plant food harvesting per unit area are associated with densely populated miombo woodlands in the central, eastern and north-eastern parts of the country.

Wild plant foods (wild fruits and vegetables) are the second most valuable of the selected NTFPs ($107.0 million/year) and thus the most valuable non-woody NTFPs. It is estimated in this report that around 306 000 t/year of wild plant foods are harvested across all natural habitats (7.82 kg/ha/year), with an average value of $2.74/ha/year. The value of wild plant foods is particularly high in miombo woodlands ($26.3/ha/year), which accounts for around 80% of total value.

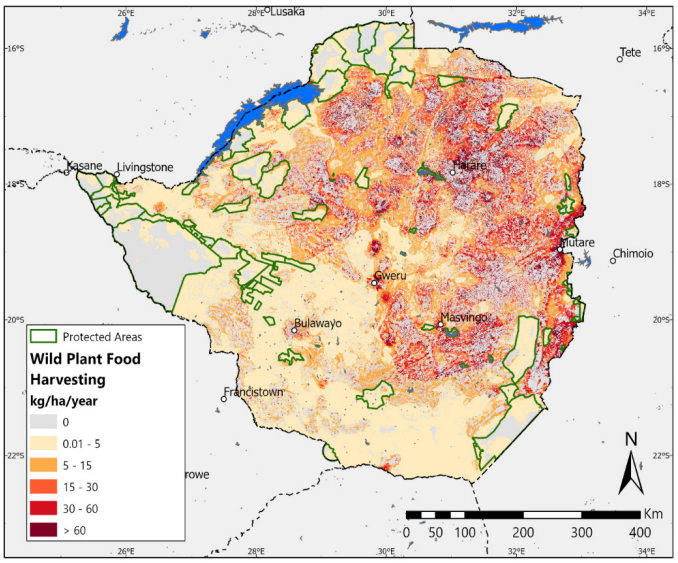


Figure 42. Estimated harvested quantities of wild plant foods Source: Anchor Environmental Consultants, this study)

Mushrooms

Mushroom harvesting is strongly seasonal in Zimbabwe, from December to April, and varies significantly in and between years in response to rainfall (Mlambo and Maphosa 2017, 2021). Mushroom flushes following good rainfall events may last for only a few weeks. Communities then collect mushrooms for sale along roadsides or in village and town stalls (Mlambo and Maphosa 2017; Dube and Tapfumaneyi 2021). Wild mushrooms are a rich source of protein which is often lacking in diets of rural communities (Chittaragi, Naika and Vinayaka 2014; Mlambo and Maphosa 2017).

Spatial variation in the household harvesting of mushrooms is shown in Figure 43. Compared to other woodland types, miombo woodlands have particularly high values for mushroom harvesting due to the high prevalence of tree genera *(Brachystegia, Jubelnardia and Uapaca)* associated with ectomycorrhizal fungi, resulting in an abundance of edible fungi (Degreef et al 2020; Mlambo and Maphosa 2021). The diversity of edible fungi in miombo woodlands is high – harvesting of at least 45 mushroom species has been documented – although only some of them are attractive enough for commercial sale along roadsides and in town stalls (Mlambo and Maphosa 2017).

Mushroom volumes are estimated in this report to be 63 500 t/year, or 1.62 kg/ha/year, worth $76.2 million/year or $1.95/ha/year, across all natural land cover. Around 55 500 t/year, worth $66.7 million, is thought to be harvested from miombo woodlands alone, accounting for 88% of total wild mushroom harvesting in the country.

Given the strongly seasonal nature of wild mushroom growth and the health risks arising from misidentification of poisonous species, controlled cultivation of indigenous mushrooms could provide a more reliable, safe and environmentally sustainable alternative to wild harvesting. There has been little scientific research,[21] but a recent joint project between Korean Programmes on International Agriculture and Zimbabwe's Scientific and Industrial Research and Development Centre aims to develop knowledge and technology for indigenous mushroom cultivation as part of a plan to enhance sustainable agriculture practices. Among other things, the project seeks to produce a training manual for safe mushroom collection and identification, development of good quality spawn and sustainable production methods

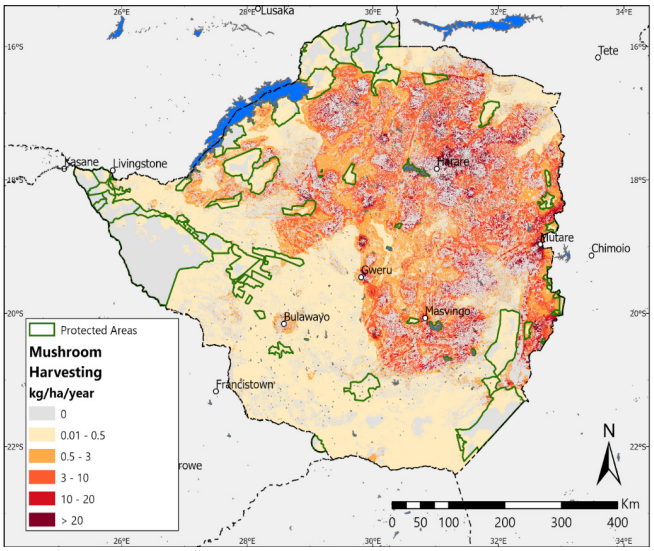


Figure 43. Estimated harvested quantities of wild mushrooms (Source: Anchor Environmental Consultants, this study)

Honey

Harvesting of wild honey was estimated to be worth $23.8 million or $0.61/ha. The dominance of wooded habitats across the country offers great potential for honey production (Campbell et al 2007). An estimated 6.8 million litres of honey are harvested nationally, with an average harvest of 0.17 l/ha of natural habitat. Miombo woodlands account for most honey harvesting.

The greatest volumes of honey harvesting occur where woodland and forest habitats are close to densely populated rural and peri-urban areas (Figure 44). The FAO's Forest Forces Project cites technological limitations as a major cause of low honey production among rural communities. The limitations are identified as traditional practices of harvesting and production, poor post-harvest handling and storage and low availability of beekeeping kits (FAO 2020b). The FAO, Practical Action and SAFIRE, among others, have attempted to overcome these technological limitations to increase the value of honey harvesting in the country's woodlands. For example, SAFIRE helped community members in Buhera to develop a modern honey processing facility with funding from Oxfam-UNDP and GEF, which has significantly enhanced incomes from honey sales.[22]

21 https://agrinews.co.zw/news/2021/08/2617technology-development-and-dissemination-of-indigenous-mushroom-cultivation-in-zimbabwe/

22 https://www.zw.undp.org/content/zimbabwe/en/home/stories/busy-bee-s---the-chapanduka-honey-processing-plant-.html

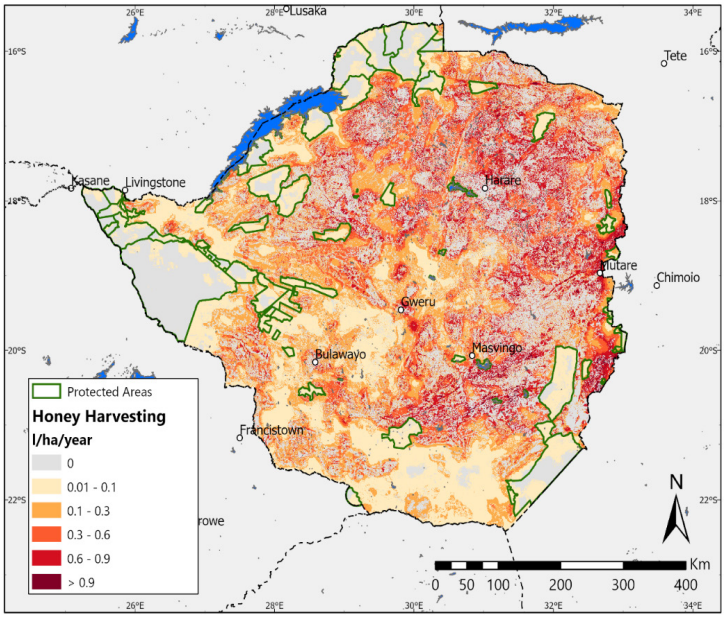


Figure44. Estimated harvested quantities of honey
Source: Anchor Environmental Consultants, this study)

Mopane worms

Mopane worm harvesting is estimated in this report to be worth $17.9 million/year. Harvesting is narrowly limited to wooded areas in the mopane woodland ecoregion. While the value of mopane worm harvesting is smaller than the other resources nationally, it has a relatively high value per unit area of $2.29/ha/year. It is noteworthy that mopane worms have the highest value of any of the selected NTFPs except wood.

Total volumes harvested is estimated to be 16 300 t/year, or 2.08 kg/year/ha.

The spatial map of mopane worm harvesting (Figure 45) differs markedly from any of the previous NTFPs, being confined to the mopane ecoregion, which is associated with lower-lying areas away from the central watershed. In this zone harvesting is generally highest in the southeast of Zimbabwe where densely populated communal lands overlap with mopane habitats.

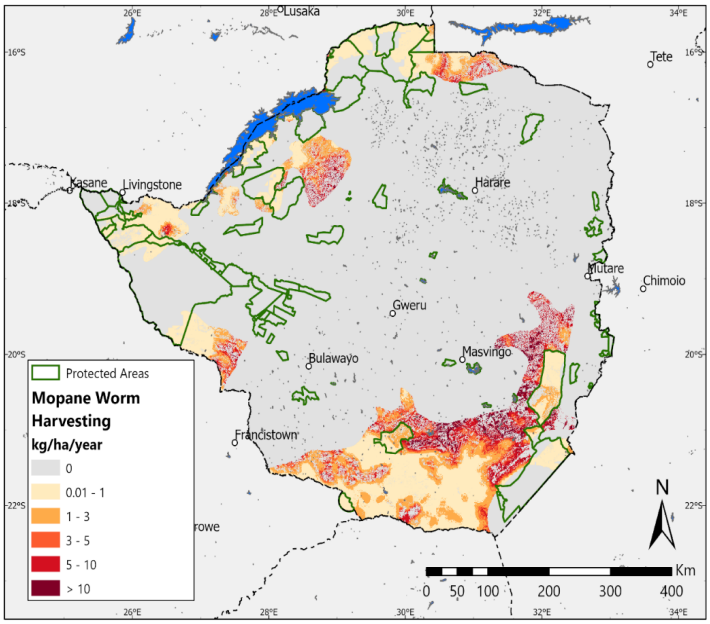


Figure 45. Estimated harvested quantities of mopane worms
Source: Anchor Environmental Consultants, this study)

Overall value

The total subsistence value of the selected NTFPs is estimated in this report to be $500 million/year, with an average value of $17.2/ha across all natural land cover except waterbodies (Table 19). Notably, this excludes the value of medicinal plants. Considering that about 80% of Zimbabweans use traditional medicines derived from indigenous biodiversity, their inclusion would add significantly to the total value of the resources considered here (Maroyi 2013).

On a per unit area and overall, miombo woodlands are the habitat type with the highest value for the selected NTFPs, with an estimated total subsistence value of $294 million/year and an average value of $33/ha. This is partly because population densities are higher in this woodland zone associated with the wetter and more productive highveld regions, which also accounts for greater aggregate demand for NTFPs. Miombo woodlands also have a greater incidence of several varieties of NTFPs than other vegetation types in the country, notably fruit trees and mushrooms. Other habitat types with relatively high values per unit area for the selected NTFPs are gazetted indigenous forests, mesic grasslands and miombo shrublands. Kalahari woodlands and shrublands have the lowest NTFP values per unit area because of low population densities and thus demand and because large parts of these habitats fall in protected areas, reducing the availability of resources for harvesting

Table 19. Estimated monetary value of selected NTFPs across major habitat types in $ millions and the estimated average contribution in terms of $ per ha of each habitat type

HABITAT	WOOD	THATCH GRASS	WILD PLANT FOODS	MUSHROOMS	HONEY	MOPANE WORMS	TOTAL ($ MILLIONS)	TOTAL ($ /HA)
Gazetted indigenous forest	1.44	0.00	0.57	0.20	0.16	0.00	2.37	24.29
Plantation forest	1.23	0.00	0.00	0.21	0.13	0.00	1.57	12.25
Miombo woodland	112.57	20.13	81.12	66.66	13.85	0.00	294.33	33.42
Miombo shrubland	21.18	9.15	7.96	6.06	1.59	0.00	45.94	15.37
Mopane woodland	29.46	3.52	5.36	0.96	3.01	12.10	54.41	12.45
Mopane shrubland	14.32	3.64	3.16	0.48	0.85	5.81	28.27	8.17
Kalahari woodland	7.94	1.14	1.56	0.38	0.84	0.00	11.86	5.12
Kalahari shrubland	3.53	0.89	0.32	0.08	0.21	0.00	5.03	4.64
Acacia-terminalia savanna	20.74	2.52	4.82	0.72	2.31	0.00	31.11	10.96
Acacia-terminalia shrubland	12.68	2.78	1.46	0.42	0.83	0.00	18.18	7.33
Mesic grassland	1.71	3.91	0.59	0.00	0.00	0.00	6.21	15.91
Dry grassland	0.42	0.60	0.04	0.00	0.00	0.00	1.06	5.43
TOTAL	227.22	48.28	106.95	76.17	23.79	17.91	500.32	17.16

Formal biotrade

Biotrade refers to the trade in NTFPs and biological resources in domestic and international markets. While the informal trade in NTFPs is large in Zimbabwe (see previous section), formal biotrade is not well developed. The commercialization of NTFPs is expected to increase their trade value and income and employment opportunities for poor people and marginalized communities (Belcher and Schreckenberg 2007; Galloway 2014). The sustainability of these benefits depends on a range of factors including access to the resources, resource production rates and levels of resource dependence in source areas.

The United Nations Conference on Trade and Development (UNACTD) describes biotrade activities as the collection, production, transformation and commercialization of goods and services derived from biodiversity (genetic resources, species, and ecosystems) under environmental, social, and economic sustainability criteria. At the local or small-scale level the value chain consists of harvesters who sell their products directly to consumers. At larger scales trade involves more complex value chains of processing, storage and distribution and formalized contracts (Belcher and Schreckenberg 2007). The estimated global value of biotrade is $11 billion per year (Vantomme 2001 in Phounvisouk 2013). The range of products is vast – from shea oil and gum arabic, rosewood oil (Dalbergia nigra) and chicle (Manilkara zapota) to Brazil nuts (Bertholletia excelsa) and are traded widely in international markets (Laird, 1995).

Table 21 lists some of the commercially traded NTFP products in Zimbabwe and where they are found. Two case study examples are given for two of the most commercially important and well-known NTFPs in Zimbabwe – baobab (Box 4) and marula (Box 5). These case studies illustrate the value chains and commercial potential of biotrade products.

Table 20: Major biotrade NTFPs in Zimbabwe (SAFIRE, 2007 and 2008).

NTFP	LOCATION (DISTRICTS)	PRODUCTS MARKETED	MAIN PLAYERS IN THE VALUE CHAIN
Masawu	Mbire, Muzarabani	Jams, masau strips	Speciality Foods Africa, Tulimara
Baobab	Chipinge, Rushinga, Binga, Chimanimani, Hwange, Zaka	Pulp, seed oil, baobab, tea, flavoured, yoghurt	Speciality Foods Africa, Tulimara, Bio Innovation Zimbabwe
Nyii	Maunganidze	Berchemia jam and drink	SAFIRE
Mazhanje	Masvingo wards 13 And 14, Zaka	Mazhanje jam, mazhanje juice	Speciality Foods Africa, Tulimara, SAFIRE
Marula	Muzarabani, Rushinga, Mwenezi, Binga, Chimanimani, Chipinge, Hwange, Zaka	Marula oil, jelly, and butter	Speciality Foods Africa, Tulimara, Bio Innovation Zimbabwe
Macimbi (mopane worms)	Matopo, Gwanda, Mwenezi	Dried macimbi, fortified porridge	Speciality Foods Africa, Tulimara, SAFIRE, Dried Foods Distributors
Honey	Across the country	Honey and wax	Tulimara, Environment Africa, Nyahari, Bumba, Mutoko Beekeepers, many players
Medicinal plants	Matobo, Bulilima, Mangwe, Chimanimani	Traditional remedies for various ailments	Ministry of Environment, SAFIRE
Crafts	Binga, Lupane, Masvingo, Victoria Falls, Kariba, Honde, Chimanimani, Chipinge	Wood craft, grass crafts, ilala palm, bamboo	Individuals or organized groups operating on their own

Box 4. Case study: baobab production a value chain

Baobab is a unique NTFP which grows in arid and semi-arid regions. The tree is valued by local communities for its edible fruit pulp, leaves and seeds, and it provides fibre, fodder and medicine (Gebauer et al 2016). Growing global demand for healthy organic foods and supplements has made baobab highly valuable. It is regarded as the highest earning NTFP in southern Africa (Wynberg et al 2015). Baobab pulp or powder is highly nutritious. It has been processed in yoghurt, juice and cereals. Moreover, at a time when consumer demand for antioxidant products is increasing, baobab fruit pulp has a significant comparative advantage as its antioxidant content is higher than that of berries, cranberries and pomegranate. The global antioxidant market was valued at $3.5 billion in 2019 and the market is expected to grow at an annual growth rate (CAGR) of 6.3% to reach $5.7 billion by 2027.[23]

Baobab oil, extracted from the seeds, has become an important commodity in the cosmetic industry. The market for oil for cosmetic and personal care has witnessed significant growth in the past few years owing to its health properties and increasing demand for organic personal care products.[24]

While the global market for baobab products is growing, so is the value chain. The 2021 Baobab Powder Report: Global Market Trajectory and Analytics shows that the U.S. accounts for over 27.1% of the global market, which includes China, Germany, Japan and Canada. In 2020 the global market for baobab powder was estimated at $6 billion and it is projected to reach $8.5 billion by 2027, growing at an estimated 5.1% from 2020 to 2027.[25] In 2020 the baobab powder market in the U.S. was estimated at $1.6 billion. As of 2020 some of the competitors in the global baobab market were fair trade firms in the UK and U.S. and West Africa and at least two companies in Zimbabwe, B'Ayoba and Organic Africa.

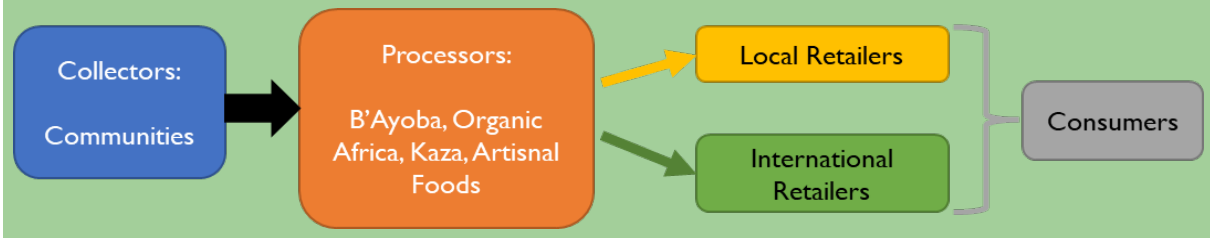
Zimbabwe has an important stake in this growing global market. Bio Innovation Zimbabwe (BIZ) estimates that there are about 5 million baobab trees in Zimbabwe, of which 3.8 million are found in communal and resettled areas. They grow at altitudes below 900 m, exclusively in Natural Regions 4 and 5. The value chain involves collectors, processors, retailers and consumers. At least 5 000 rural producers are thought to be involved in the commercial export trade. Many more sell the fruit and other baobab products on the local market (Wynberg et al 2015). Most of the harvesters are women who have few other sources of income

23 https://www.verifiedmarketresearch.com/product/antioxidant-market/

24 https://www.mordorintelligence.com/industry-reports/baobab-market

25 https://www.researchandmarkets.com/reports/5029822/baobab-powder-global-market-trajectory-and

Regulation has been a significant barrier to the trade on the global market, a challenge that is not unique to baobab but relevant to any attempts to market novel NTFPs internationally, particularly to industrialized nations. Registration of baobab as a "novel food" in the European Union, closely followed by certification as a "generally recognized as safe" ingredient in the U.S., has been vital to promote baobab on the export market and to pave the way for regulatory approval in other countries. The process took seven years for the first regulatory approval to be granted by the EU and cost $650 000 (ABioSA, 2021). The application for regulatory approval was undertaken by Phytotrade Africa, a regional trade association that carries out product research and development and helps to facilitate trade in natural products from the southern Africa. It also facilitated donor-funded safety testing of baobab oil as a cosmetic ingredient, preparing the documentation that enabled it to be sold on the international market.



Rural communities in Zimbabwe are often involved at the collection stage and they work with private sector companies such as Organic Africa and B'Ayoba. BIZ data show that an average harvester or collector earns around $100 each season from the sale of the baobab fruit. Baobab powder produced by Zimbabwean companies is sold in the U.S. and Europe for around $11 per kg and moisturizing seed oils for around $25 per kg. Artisanal Foods' 500 ml baobab juice sells in Zimbabwe for 50c retail and 35c wholesale. It targets the mass market and said in an interview that it can meet local demand.

Some rural producers sell baobab fibre products such as mats, bags and hats. Household income from the production and sale of these baobab products in the low-lying regions of Chimanimani District was found to be around $350 per year or around $140 per person (Luckert et al 2014). Respondents often ranked baobab as the second most important source of income after farming. However, harvesting of baobab bark is potentially much more destructive than the harvesting of baobab fruit, making measures to ensure its sustainability even more crucial.

Box 5. Cas study: marula production and value chain

Marula is a drought-resistant tree of the Anacardiaceous family, growing in the warm, frost-free regions of sub-equatorial Africa. Marula is a rich natural transboundary resource in Southern Africa with ecological, economic and social significance. The tree produces plum-sized fruits with a thick yellow peel, whitish translucent pulp and highly aromatic sweet-sour flavour. The kernels of this multipurpose species are eaten or expressed for oil which can be used for cooking or cosmetics (du Plessis et al 2002; Mojeremane and Tshwenyane 2004).

Marula oil has been used in cosmetic formulations in the international beauty market for more than 10 years. From 2016-2020, sales of marula oil increased at a rate of 4.4%. Marula is also a primary ingredient in the popular cream liqueur, Amarula, which is said by Drinks International to be one of the fastest growing spirit brands; 1.3 million 9 litre cases were sold in 2011.

Utilization in Zimbabwe has been growing. In 2014 a marula resource assessment conducted by BIZ in Binga, Hwange and Beitbridge found there were about 530 000, 510 000 and 1 760 000 marula trees in the three districts respectively (excluding national parks), giving a potential yield of 150 000 tons of fruits per year (BIZ 2014). Fruit yields range from 270-570 kg per tree per year.

The Development and Finance Institute for Rural Women Trust encourages women in the Chivi District in southern Zimbabwe, grouped as Marula Zimbabwe, to generate additional household income by processing traditional marula tree products. Besides receiving advice on production and processing, the women entrepreneurs are trained in finance, business management and savings and credit. Marula Zimbabwe in collaboration with the Zvishavane Water Project has successfully acquired two hydraulic oil-pressing machines and ensures consistent product quality through sampling and other measures. Such quality monitoring is essential to achieve a high quality, especially of the oils, and thus to market marula products effectively. The initiative also works with Phytotrade Africa, which carries out product research and development and provides links to markets for the finished products. In Mwenezi District 11 258 households were trained to produce the jelly for household consumption from 2007-2013, as were 11 643 households in Muzarabani District.

In 2022 the National Biotechnology Authority of Zimbabwe commissioned a $50 million marula processing plant in Rutenga, Mwenezi.

Bioprospecting

Bioprospecting has the potential to provide significant economic benefits for biodiversity-rich developing countries, with pharmaceutical and cosmetic industries companies potentially investing billions in research and development. The level of bioprospecting in most developing countries is still very low (Kursar et al 2006), but there are some examples of the successful development of novel products in Zimbabwe, including products from the resurrection bush *(Myrothamnus flabellifolius)* (see Box 6).

Box 6. Case study: resurrection bush (Myrothamnus flabellifolius)

Resurrection bush can dehydrate its vegetative tissue, endure more than 95% water loss and exist for months or years in an air-dried, dormant state (Integrated Rural Development and Nature Conservation 2016). Once water reaches the roots, the plant rehydrates its desiccated tissue and resumes its original state in a few hours (Moore et al 2007). Through research and development it was found that a mixture of essential oils extracted from the bush can be used for medicinal and cosmetic purposes (Integrated Rural Development and Nature Conservation 2016). An extract of is commercially sold as a protective agent against skin ageing (ibid).

The bush has many medicinal uses among African communities (Setshogo and Mbereki 2011) – infusions for colds and respiratory ailments, decoctions taken to alleviate backache, kidney problems, haemorrhoids and painful menstruation, a lotion of the leaves to treat abrasions and dried powdered leaves to dress burns and wounds (van Wyk et al 2009).

The following local companies involved in the production of food beverages, cosmetics and pharmaceuticals have been commercializing the plant:

- BIZ buy the resurrection plant mainly from organized farmers groups in Chivi and Nyanga whose chairpersons receive orders from BIZ. They harvest and package the bushes in 50 kg bags and send them to Harare by public transport. Each bag bears the name of the farmer, place of harvest and weight. The two companies produce the commercial blends of resurrection tea in Zimbabwe. Although Indigenous communities have traditionally consumed the tea, the companies have no access and benefit sharing (ABS) arrangements with the communities that supply them the raw materials
- Kaza Natural Oils, established in 2016, is involved in producing lipid oils. The oils are extracted from indigenous plants found in the Kavango and Zambezi regions. The company supplies the raw materials to an internationally recognized skin care company based in the UK that extracts and produces the lipid oil. Neither Kaza nor the UK firm have ABS arrangements with the communities that supply them with raw materials
- Thrive Zimbabwe, a beverage manufacturer established in 2016, specializes in the production of fermented products it sells locally. It has no ABS arrangements with the communities that supply it the resurrection bush and is not aware of such legal requirements
- Wild Health produces pharmaceuticals from indigenous plant species and makes flu mix capsules from resurrection tea. The preparation draws on traditional indigenous knowledge about using resurrection bush tea to treat flue and other ailments. Again, the company has no ABS arrangements with the communities that supply it the resurrection bush and is not aware of such legal requirements
- African Apothecary, a small company that produces aromatherapy and body care products from indigenous plant species, sells the resurrection bush capsules produced by Wild Health and intends to extract oils from the resurrection bush
- Specialty Foods specializes in the commercial extraction of under-utilized plant species. It sells resurrection bush tea, marketed locally under the Tulimara label. The company has no ABS arrangements with the communities that supply it with raw materials.

Photo: BIZ

Zimbabwe's traditional herbal medicines have commercial value in providing leads and products for pharmaceuticals. Globally the herbal medicines industry is estimated to be worth $60 billion (Eddouks et al 2012). The industry is also commended for providing leads for the discovery of life-saving drugs such as quinine. Throughout the world herbal medicines are developed from local indigenous knowledge systems (IKS). An estimated 80% of the world's people rely on traditional medicines for health care. A similar level of dependence is observed for Zimbabwe (Nkatazo 2010).

Indigenous communities have developed customary laws, values and practices based on traditional knowledge which guide how genetic resources are accessed, used and conserved to meet community needs (Swiderska 2009). Developers of products from genetic resources draw mostly on the same beneficial properties that were recognized by indigenous and local communities (Convention on Biological Diversity 2010; Laird and Wynberg 2012). Since bioprospecting companies often obtain their ideas from indigenous use and knowledge, one of the main international concerns around bioprospecting is the fair compensation of intellectual property rights. Signatories to the Convention on Biological Diversity (CBD) are obliged to follow the Nagoya Protocol on access and benefit sharing (ABS), which is designed to ensure the fair and equitable sharing of benefits arising out of the utilization of genetic resources. This is linked to various legal instruments around intellectual property rights relating to biological resources and traditional knowledge.

The ABS provisions require the provider of genetic resources to grant prior informed consent to a user of the genetic resources and negotiations between the parties to develop mutually agreed terms to ensure the fair and equitable sharing of benefits (Nott 2019; MET 2012), including those from research and development. One of the major challenges is that investors are not willing to accede to the terms before a product is developed and distributed in the market (Richerzhagen 2011).

Bioprospecting companies engage in research and development that yield new products for commercial use that benefit society. The developers ensure a return on their investments

by securing their intellectual property rights (IPRs) which take varying forms, including patents, copyrights, trademarks, geographic indications, trade secrets and registered (industrial) designs. Efficient administration of IPR ensures that there is a balance of benefits between the interests of innovators (extractors and users) and genetic resources providers (WIPO 2012). Despite the issuance of IPRs, the CBD observed that there are no meaningful benefits that flow to the providers of genetic resources (Chitsike 1998). This led to the development of traditional resources rights to augment the IPR system.

Property rights are also an international issue. The Trade Related Intellectual Property Rights on traditional medicine treaty (TRIPS), established by the World Trade Organization, outlines minimum standards for countries to abide by in the protection of IPRs. Article 27.3(b) of the TRIPS agreement urges member states to provide patent protection for plant varieties by formulating and implementing a system that is best aligned with national interests while considering the protection demands of informal and local communities. The article adds that there must be some form of intellectual property protection that best suits the interests of such communities, but those who do not wish to introduce patent rights can choose an alternative protection protocol. Under TRIPS the formulation of tailor-made legislation to protect traditional herbal medicines is of paramount importance because it gives governments the opportunity to draft national policies on IPRs that have international recognition. This affords effective protection for IKS at national level as well as conferring protection to the indigenous communities who generate this knowledge.

There are several cases that show that developing countries are not benefitting from bioprospecting. "Biopiracy" is the term for the unauthorized commercial use of biological resources without compensation for the developing country from which the resources were sourced (Mgbeoji 2006). For instance, in 1999 a research professor from the University of Lausanne, Switzerland, was granted a patent for the roots of the snake bean, or mucherekese (Swartzia madagascariens) (Mutandwa and Moyse 2003). Based on traditional knowledge in Zimbabwe, the leaves are used to cure scabies, the bark to soothe toothache and the flowers for insecticides. The value of the plant was estimated at over $1 billion. A U.S. pharmaceutical company, Phytera, and the University of Lausanne signed an addendum agreeing confidentiality and the transfer of material, with 1.5% royalty of the net sales value. The Government of Zimbabwe was given only 0.75%. The patent was in breach of the principle of informed consent provided for in the Convention on Biological Diversity. A collaborative campaign by the University of Zimbabwe, the Government and NGOs led to the cancellation of the patent.

The example illustrates that in most cases the state and its people do not benefit from bioprospecting in the traditional medicine sector in the absence of a robust legislative and policy framework that upholds the principles of ABS for the biological and genetic resources found in a country. Zimbabwe has Statutory Instrument 61 of 2009 on access to genetic resources and indigenous genetic-resource based knowledge, but it has yet to be aligned to international trend, particularly the Nagoya protocol on access to genetic resources and fair and equitable sharing of benefits from indigenous genetic resources of 2010. Developed countries are freely benefiting from biological and genetic resources from developing countries, a trend that is perpetuated by poor implementation of necessary instruments that protect the biological and genetic resources in developing countries. Brazil, India and China have enacted legislation to arrest the trend by regulating commercial exploitation of indigenous traditional medicines. India has established traditional knowledge digital libraries through a collaborative project between the council for Scientific and Industrial Research and the Ministry of Agriculture Food and Public Health (Gaudillière 2014)(2. The purpose of the library is to ensure that patent offices around the world do not issue patents for applications based on India's ancient traditional knowledge (Fredriksson 2021). India developed the database because of a huge public outcry following the granting of a patent by the U.S. Patent and Trademark Office for wound healing properties of turmeric *(Curcuma longa)*. The outcry led to legal fights that ended with the patents being revoked because there was existing Indian traditional medical knowledge on the plant (Sharma 2017). However, the development of the libraries has created problems for ABS with source communities because they can no longer benefit from their IKS.

Zimbabwe is in the same predicament. It has made limited progress in protecting IKS and to date has no established database on IKS relevant

for bioprospecting. It therefore means that there is a need for the Government to expedite the development of an IKS database and enact patent laws that recognize IKS and ABS arrangements with source communities.

Actors involved in Biotrade and Bioprospecting

There is a high degree of overlap in the institutions involved in bioprospecting and biotrade. For example, a company which develops a new commercial product from an indigenous species (bioprospecting) will then become a key actor in the biotrade of that species. Actors in biotrade and bioprospecting are presented below.

State institutions

National Biotechnology Authority

The National Biotechnology Authority (NBA) is an autonomous research and development institution with a mandate to contribute to national development through the application of both conventional and cutting-edge biotechnologies.[26] It was established through the National Biotechnology Authority Act of 2006 (Chap. 14: 31]. According to the Act, its role is to transform Zimbabwe from a raw material-based economy into one that is into a knowledge-based through the judicious application of biotechnology in agriculture, medicine, energy and the environment. In compliance with the Statutory Instrument 61 of 2009, the NBA and the Research Council of Zimbabwe should be consulted by actors involved in the commercialization of NTFPs and biological resources. The NBA also collaborates with the Standards Association of Zimbabwe in setting standards of quality for products of biotechnology.

Zimbabwe Intellectual Property Office (ZIPO)

The issuing of patents in Zimbabwe, including those relating to the development of novel products from biological resources, is done by the Zimbabwe Intellectual Property Office (ZIPO), which falls under the Ministry of Justice, Legal and Parliamentary Affairs. Patent registration fees go to ZIPO to fund its activities. ZIPO is not a highly visible or prominent institution, however, leading to a recent Cabinet proposal that it becomes a semi-autonomous organization, according to comments made by C. Chimombe , Head of Section at ZIPO, during the project validation workshop.

Rural district councils

The RDC chief executive officer and the district development coordinator coordinate all bio trade and bioprospecting extraction activities in Zimbabwe's districts. The RDC ensures that any person or company involved in commercial harvesting of plant species has prior permission. The RDC informs the community of the approach of a company and its intended activities.

Ministry of Agriculture, Lands, Fisheries, Water and Rural Development

The ministry issues export permits and phytosanitary certificates for the export of plant and animal genetics, including all materials from bioprospecting that are exported as raw materials.

Ministry of Environment, Climate, Tourism and Hospitality Industry (MECTHI) and the Environmental Management Agency (EMA)

The MECTHI oversees the implementation of the CBD and the Nagoya Protocol. The genetic resources and indigenous genetic resource-based knowledge protection committee established through the Environmental Management Act is chaired by the Department of Environment and Natural Resources. The role of the committee is to provide advice to the Environmental Management Agency board on all issues pertaining the protection of indigenous communities' rights over the knowledge they have of genetic resources, covering how they have managed, maintained, conserved, reproduced and enhanced their knowledge, culture and other traditional practices on genetic resources they hold in common.

NON-GOVERNMENTAL ORGANISATIONS

Bio Innovation Zimbabwe

BIZ is a non-profit organization that undertakes research and knowledge-sharing around existing and potential commercial applications for

26 https://www.mordorintelligence.com/industry-reports/baobab-market

underutilized indigenous plants.[27] Its goal is to find locally available plant species that could be used by smallholder farmers, especially in the drier parts of Zimbabwe, and develop them into marketable products that generate revenues for communities.[28] BIZ works in collaboration with a range of actors that include the Government, academia, private companies, smallholder farmers, entrepreneurs, individual researchers, and other NGOs. Its work on bioprospecting involves detailed feasibility studies (how the plant has been used elsewhere, market opportunities and commercial relevance), mapping the distribution and density of the plant species, implementing propagation and field trials and undertaking toxicology and efficacy trials. The organization is then able to design commercial food, medicine and cosmetic products that are safe for use by humans. When the resurrection bush was identified as one of the top 20 underutilized species in the country in 2011, BIZ researched potential markets and began commercializing the species (Nott 2019).

Southern Alliance for Indigenous Resources (SAFIRE)

SAFIRE is a local NGO established in 1994 to assist rural communities in economic development through sustainable utilization of their natural resources. By promoting community-based natural resources management, SAFIRE has enabled communities to cope with and adapt to the adverse effects of climate change and achieve food and income security. It has helped communities to strengthen institutions in forest management, human-wildlife conflict management, disaster risk management, biodiversity assessments and sustainable agriculture to support rural livelihoods.

NTFP associations

Various NTFP associations have been established in different parts of in Zimbabwe for example, Marula Zimbabwe in Chivi and the Indigenous Tea Company Zimbabwe in Nyanga. The establishment of community organizations or associations provides an effective approach to consulting harvesters and developing necessary agreements. It also makes it easier for companies to negotiate and remunerate harvesters for the raw materials.

These state and non-state organizations mentioned above work with private companies such as Kaza Natural Oils, Africa Apothecary and Wild Health.

Key challenges and opportunities

The foregoing discussion shows that Zimbabwe has a wealth of indigenous plant species that have traditional uses as food, cosmetics or medicines. There is growing global demand for new natural products in the personal care and cosmetics, food and beverage and flavour and fragrance industries (Laird and Wynberg 2012b). Companies in these sectors draw heavily on wild resources in product development and marketing, actively seeking out new natural ingredients and often drawing on traditional knowledge. With its wealth of potentially useful plant species and traditional knowledge associated with their use, Zimbabwe is well placed to capitalize on this trend. Furthermore, since many of these valuable species grow in remote, semi-arid rural regions, commercialization has the potential to bring meaningful socioeconomic benefits to these areas.

Increasing public support in product research and acquiring regulatory approval

While the commercialization of products like baobab have been successful, barriers to greater commercialization of indigenous plant species in Zimbabwe remain. Greater public support for the sector could be instrumental in overcoming several of these barriers. For example, the costs associated with gaining regulatory approval for novel food and cosmetic products from export markets present a challenge and deterrent to venture capital investment in new natural products. Increased public sector support could help mitigate these costs and risks of entry in the sector. As another example the Government could provide start-up capital or technical assistance to ease the burden of gaining regulatory approval for indigenous species with potential commercial value. Public finance could also fund primary research to demonstrate the safety properties of target species, as well as to validate health benefits. Such research would provide useful baseline data that could increase the speed of regulatory approval. Compelling scientific evidence for the safety and efficacy of novel products could also contribute significantly to raising consumer awareness and acceptance

27 https://www.bio-innovation.org/about/

28 ibid

(ABioSA 2021). This could in turn increase the willingness of private investors to put money into developing products with demonstrated safety and health potential. To date, much of the research into the safety and efficacy of indigenous plant products has been conducted by the private sector and academia which results in privately owned intellectual property (ABioSA 2021). Such research should ideally be publicly funded by the Government and NGOs to benefit the entire industry.

Ultimately, increasing public recognition and support for biotrade and bioprospecting would require the formation of a dedicated Government institution, according to comments made during the project validation workshop by G. Le Breton, founder of BIZ. This would be akin to the way that the wildlife, forestry and fisheries subsectors all have dedicated institutions the PWMA, Forestry Commission and new Department for Fisheries Management – that seek to promote the growth of the sector. Such an institution with a dedicated budget could be instrumental in driving the growth of biotrade and bioprospecting.

Increasing demand through marketing and certification

The public and private sectors should conduct solid market research to avoid investing in products for which there is not significant consumer demand. The research should be accompanied by sophisticated marketing and awareness-raising campaigns for commercially valuable plant products, both on the domestic market and internationally at trade fairs and similar events. This way the Government would have an opportunity to build a distinctive national brand on the export market for novel products that are distinctively Zimbabwean. Effective marketing could also leverage growing interest by consumers in the environmental footprint and social sustainability of the goods they purchase (Laird and Wynberg 2012b). Products like baobab fruit are harvested only in the wild because cultivation is not feasible (ABioSA 2021) and they can therefore be promoted for their positive, non-destructive environmental impact while providing an income to rural harvesters.

Certification schemes would assure consumers of the environmental and social sustainability of these products (Laird and Wynberg 2012b) and should therefore be promoted by the Government and the private sector. For example, B'Ayoba, the major supplier of baobab products in Zimbabwe, has achieved Fairwild Certification to assure consumers that its products are sustainably and ethically harvested.

Leveraging donor funding and NGO support

The promise of livelihood benefits in rural areas and the prospects for improved conservation outcomes when rural people come to recognize the commercial value of particular plant species suggest there is potential for Zimbabwe to attract donor funding from agencies with social development and nature conservation objectives. Such funding could support market research and scientific studies of safety and efficacy and provide start-up capital, training and other capacity-building initiatives to help grow small and medium enterprises seeking to develop commercial products from indigenous species. Recent donor interest in commercializing Zimbabwe's plant products is shown, for example, in the request by the U.S. Agency for International Development inviting applications for a grant to support the commercialization of Zimbabwe's NTFPs, which as at 2022 is worth an estimated $13 million.

Regional and local NGOs have an important role in supporting value addition for indigenous plant products. For example, BIZ has taken the lead in conducting market and ecological research and promoting the use of potentially valuable indigenous plant species in Zimbabwe, as well as training rural people in sustainable harvesting strategies and business management skills. Such organizations should be supported in their efforts to foster the commercialization of indigenous plant products; they are a valuable link between rural producers and private sector organizations looking to profit from natural products.

Ensuring ecological sustainability

Commercialization of indigenous products comes with significant risk to biodiversity. If communities harvest the product in the wild under conditions of open access, increasing their value is likely to lead to overexploitation; the value added by the venture will quickly be lost, possibly with other biodiversity species in the area. It is therefore vital for mechanisms for sustainable harvesting of resources to be put in place, possibly leading to cultivation of successful products. Under the right circumstances the development of commercially valuable products from indigenous plant species could also encourage communities to better conserve forest and woodland resources. For example, the Manketti farmers group in Lupane

District produces a range of skincare products from manketti *(Schinziophyton rautanenii)* seed. The realization of these commercial benefits has encouraged the group to plant trees and raise awareness among local communities about sustainable forest management as a way of ensuring the sustainable supply of manketti seeds (Tembani et al 2021).

Addressing legal barriers to the commercial harvesting of NTFPs by rural communities

The Communal Land Forest Produce Act regulates the exploitation and protection of forest produce in communal lands. It restricts access to forest produce to "own use" and prohibits commercial use except with a permit. This means that forest produce harvested by the inhabitants of the communal area cannot be sold without a permit or given to an outsider. These regulations could therefore prevent local communities from taking part in NTFP commercialization and limit the growth of the sector. There is therefore a need to make allowance for rural communities to self-organize and sustainably harvest NTFPs for sale to companies that process and add value to these products. Once again, granting communities appropriate authority over natural resources could be helpful in this regard. However, any review of the legislation should be accompanied by guidelines and monitoring mechanisms that ensure that harvesting remains sustainable and overexploitation is avoided. Certification schemes that incorporate the ecological sustainability of harvesting practices are a possible solution.

Simplifying ABS arrangements and the recognition of traditional knowledge

The concentration of access and benefit sharing measures exclusively in exported products is one of the shortcomings of the ABS legislation. Section 117 of the EMA Act provides for equitable sharing of benefits arising from biological exploitation of genetic resources originating from Zimbabwe. The Act stresses that the arrangements are between the owner of technology and the Government of Zimbabwe, thus excluding communities who are the custodians of the indigenous resources. The Act also provides for ABS arrangements involving products that are exported, to the exclusion of those that are consumed locally. The Act should be amended to make provision for communities to benefit from ABS arrangements and to include products traded in the domestic market under those arrangements.

The legal framework for access and benefit sharing (i.e., the Environmental Management Act, Plant Breeders Act and Statutory Instrument 61 of 2009 on Access to Genetic Resources and Indigenous Genetic Resource-based Knowledge) focuses solely on the utilization of genetic resources as envisioned by the CBD and excludes biotrade activities from its scope. There is therefore a need to develop a clear framework regulating biotrade.

PAYMENT FOR ECOSYSTEM SERVICES

Key points

- *Payments for ecosystem services (PES) schemes have not yet generated much revenue, but there is potential, particularly from the restoration and maintenance of woody cover for carbon credits*
- *The Kariba REDD+ scheme is the most notable PES project in Zimbabwe to date. While the scheme appears to have achieved a level of success in reducing deforestation, there are concerns about the lack of transparency and the failure to bring enough benefits to local communities to compensate for the loss of livelihood options*
- *Devolution of appropriate authority over natural resources to communities would allow for full proprietorship and autonomy over decisions regarding the use of revenue generated through carbon trading and other PES schemes*
- *Further development of carbon forestry schemes could be encouraged through national biomass assessments hosted on an online portal that is accessible to potential investors*

Overview

PES can be described as a voluntary transaction whereby a well-defined ecosystem service is bought by one or more ecosystem service buyers from one or more service providers on the condition that the ecosystem service

provider secures the provision of the service (Wunder 2005). It is a mechanism to incentivize landowners and other resource stewards to adopt conservation-friendly practices or to undertake ecosystem restoration, thereby securing or enhancing the flow of ecosystem services (Wunder et al 2020). The provision of these services, such as water flow regulation, carbon sequestration and pasture, can be harmed or enhanced by the land use and resource use activities of those who own or live on the land that provides the ecosystem services. Often, the benefits of these services flow offsite to other users, as is the case where flow regulation services benefit downstream consumers, or where the world at large benefits from carbon sequestration, which helps to mitigate climate change. Paying land users for these services helps to incentivize them to change their behaviour to maintain or increase ecosystem service provision (Salzman et al 2018).

Payments for hydrological service schemes could secure sustained ecological functioning mediated by healthy vegetation in catchment areas, including infiltration, flood attenuation and water quality amelioration. Water utilities can pay for such services and benefit from infrastructure and savings in water treatment costs. Urban authorities and/or water service providers would pay for the active protection of wetlands, for instance, which could yield benefits in the form of flood attenuation and water quality amelioration. Reducing Emissions from Deforestation and Forest Degradation (REDD+) is another form of PES. REDD+ schemes aim to reduce forest degradation and loss to reduce carbon emissions and increase carbon sequestration, thus contributing to climate change mitigation.

While over 500 PES schemes have been developed worldwide, uptake remains limited in Africa (AfDB 2015; Bösch et al 2019). Among the biggest barriers to adoption are limited awareness of PES and the lack of national frameworks in the following areas for implementing PES: national carbon registries; monitoring, reporting and verification systems; national forestry emission reference levels; a REDD+ strategy; and a national carbon credit framework. Many countries rely too heavily on natural resources for meeting subsistence needs in the service provision areas. They have limited institutional capacity; limited ability to pay for ecosystem services; a lack of coordination among public agencies; and a lack of technical skills (Gross-Camp et al 2012; Lopa et al 2012; AfDB, 2015; Emerton, 2018; Mbopha, 2019; Zimbabwe REDD+ Country Readiness Report, 2015).

Zimbabwe's development of PES is very limited. However, its woodland habitats store significant amounts of carbon, indicating its potential to tap into international carbon financing schemes that seek to secure climate regulation services. Zimbabwe's natural habitats store around 521 million tons of aboveground carbon, equivalent to 1.91 billion tons of CO_2. The capacity of forests and woodlands to store and remove carbon from the atmosphere has made them a global public good, promoting the uptake of international carbon financing schemes (du Preez 2013). By relying on global finance streams, these forms of PES can help to overcome the challenges of limited local ability or lack of willingness to pay for ecosystem services. PES schemes which aim to secure climate regulation services have been the most successful form of PES in Africa to date. For instance, a PES mechanism has been implemented in the Congo Basin with the operationalization of a REDD+ initiative aimed at achieving sustainable forest management and the enhancement of forest carbon stocks (Kengoum et al 2020), and Uganda has received PES for carbon sequestration (Bond et al 2008). Although the global carbon market remains relatively volatile, it has grown significantly in recent years, particularly for projects relating to forestry and land use (Ecosystem Marketplace 2021).

Zimbabwe's forest and woodland resources face severe pressure from competing land uses, notably agriculture and mining, as well as from fuelwood harvesting to meet domestic energy requirements and tobacco curing. More recently charcoal production has become rampant in mopane woodlands (L. Mujuru, Lecturer at BUSE, pers. com, 2022), driven by high demand for affordable sources of energy and the challenging economic circumstances in the country. Besides the harm to biodiversity, the loss and degradation of these habitats results in a loss of the ecosystem services they provide, including control of soil erosion control, base flow regulation, habitats for wild crop pollinators and the provision of wild foods and medicines, building materials and other important products for rural communities. In the face of high deforestation rates and the need to improve incentives for preserving forest and woodland habitats, REDD+ schemes provide an alternative means of promoting woodland conservation in Zimbabwe. The potential for

REDD+ has been recognized in Zimbabwe's National Climate Change Response Strategy (NCCRS), which identified REDD+ as one of the mitigation options for reducing the country's greenhouse gas emissions (GoZ 2014a). The need to strengthen the framework for REDD+ and other carbon financing mechanisms is also noted in the National Climate Policy of 2017, which provides the implementation framework for the NCCRS (GoZ 2019).

Experience with the implementation of REDD+ so far has revealed that much work still needs to be done to facilitate the successful implementation of sustainable forest management in Zimbabwe, as is illustrated in the case study of the Kariba REDD+ project, the first such scheme to be established in the country (Box 7).

Box 7. PES case study: the Kariba REDD+ project

Project rationale and history

The Kariba REDD+ project was established in 2011, the first such scheme in Zimbabwe. It is in northern Zimbabwe, stretching from the southern shores of Lake Kariba around Binga, to Mbire District in the far north (Figure 46). The project encompasses around 785 000 ha of mopane and miombo woodlands and aims to prevent the emission of about 5.6 million tons of carbon dioxide over its 30-year timespan by halting deforestation. It also seeks to benefit conservation since the area connects several national parks and safari areas in the Zambezi Valley and serves as a wildlife movement corridor (South Pole Group 2020). As seen in Figure 46, CAMPFIRE wards make up most of the project area, indicating that the areas involved in the scheme already have a history of conservation-related land uses.

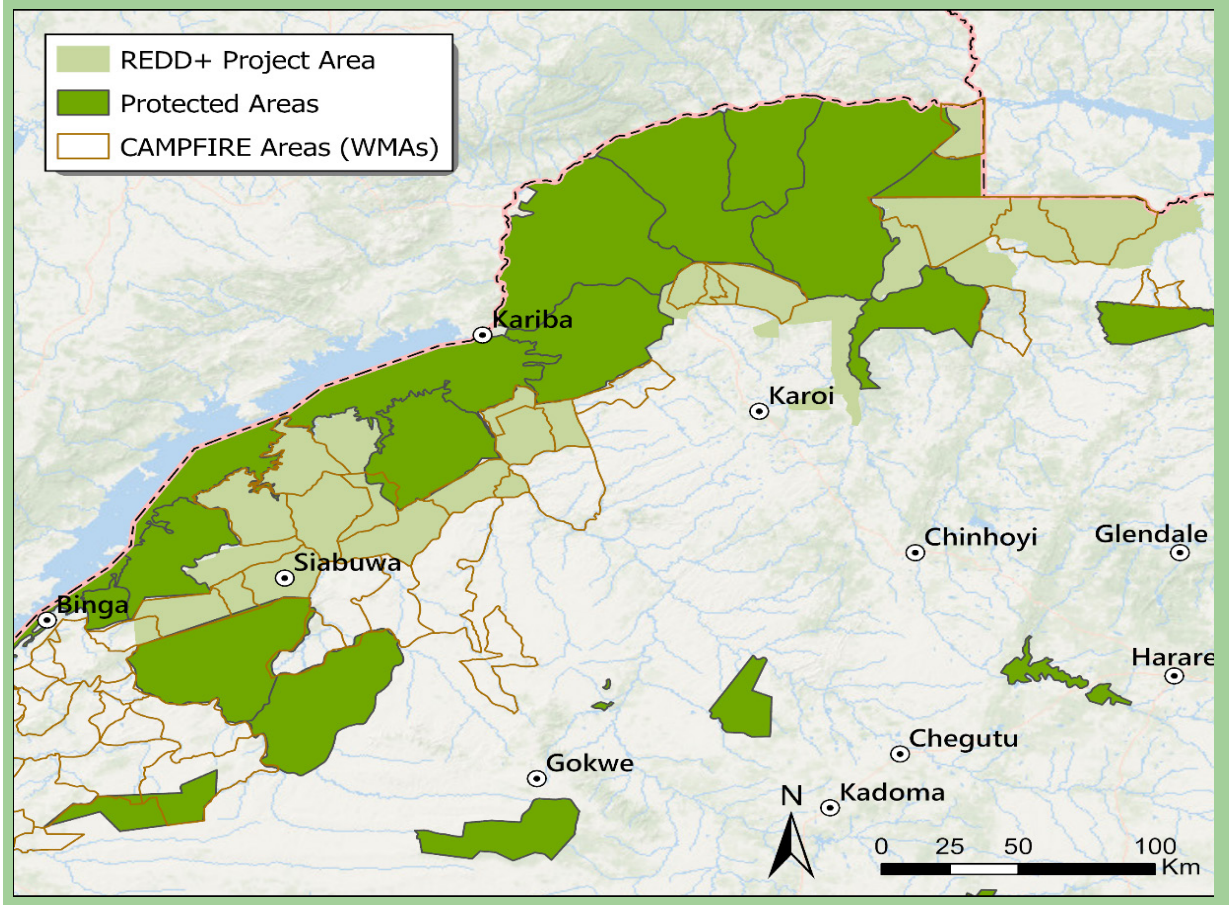


Figure 46. Location of the Kariba REDD+ project area (Source: based on South Pole Group 2020)

Carbon Green Investments (CGI) is the promoter of the Kariba REDD+ project, which is implemented and managed by its local subsidiary, Carbon Green Africa (CGA). The private sector made an initial investment of $1.25 million (Dzingirai and Mangwanya 2015). Socio-economic feasibility studies to inform the project design were conducted by Environment Africa, a regional NGO. Other stakeholders were the EMA, RDCs, safari operators, Agritex and the Forestry Commission (Dzingirai and Mangwanya 2015; South Pole Group 2020).

Forest protection was secured through a lease of 30 years or more of these vast areas of communal forest land. Activities that compromise the capacity of the forest ecosystems to sequester carbon from the atmosphere are restricted (Tembani et al 2021). The aim is for the income generated from

carbon credit sales and the enhanced socio-ecological benefits from the forests to compensate for losses incurred from the restrictions on harvesting and forest clearance. The scheme seeks to use the income to reduce deforestation by supporting and improving local livelihoods through improved agriculture and beekeeping, developing fuelwood plantations and improving fire management (South Pole Group 2020). Tobacco farmers will be encouraged to use alternative sources of fuel for tobacco curing (Kupika et al 2019). The project has also contributed to the repair and resuscitation of boreholes and supported local schools and clinics.

Revenues generated

According to an interview with CGA's chief executive, 80% of revenues raised from selling carbon credits is used for community development and the remaining 20% retained to support CGA's operation. However, by 2014, the project had reportedly not generated any tangible compensation in Binga District. This was attributed to low prices on the international carbon market, particularly during the early years of the scheme. For example, a 2016 interview with CGA's chief executive revealed that while the scheme had generated up to 5 million carbon credits[29] since its inception, it had sold only around 1.5 million due to poor global prices, and was holding back the remaining 3.5 million in the hope of improved prices at a later date.[30] Some of these credits were sold for as little as $50c per million tons of carbon dioxide equivalent ($MtCO_2e$), well below the peak price of $7 $MtCO_2e$ on the 2013 global carbon market. By 2019 the managing director of CGA reported that Mbire District had realized around $255 000 from carbon credit sales over the previous five years.[31] While the project could have benefited from increased carbon prices since 2020, it is still struggling to sell all of its carbon credits due to limited interest from buyers in industrialized countries.[32] By 2021 the average value of CO_2 per tonne increased to $3.13 on the international market (Ecosystem Marketplace 2021). Given that verification reports estimate that the scheme sequesters around 3.6 million tons of CO_2 per year, the project could have generated around $11.3 million in revenue if it had managed to sell all the credits it generated in 2021.

Socio-economic benefits

Although the Kariba REDD+ has not realized its full financial potential, it has still delivered some notable benefits to the area:

- Generating income of about $250 000 for the community through beekeeping, plantation forestry and community garden sales, among other projects
- Spending approximately $60 000 on supporting health clinics and schools
- Securing access to clean water for 37 000 people through borehole maintenance and resuscitation
- Training over 18 000 community members in community gardening, conservation farming and beekeeping (South Pole Group 2020)

Ecological benefits

An analysis was conducted to evaluate whether the scheme is meeting its ecological goal of reducing deforestation. This involved Global Forest Watch assessing trends in tree canopy cover loss across line roughly indicating the point at which the scheme should start having an impact on tree cover loss (given that it was established in mid-2011, a slight lag time would be expected). The estimates on the right of the dotted line suggest that tree cover loss has declined since the scheme began. Tree cover loss across the project area. In particular, the aim was to evaluate whether any change in deforestation

29 One carbon credit is equivalent to an offset of one million tons of carbon dioxide emitted

30 https://www.herald.co.zw/kariba-redd-changes-lives-but-poor-carbon-prices-threaten-viability

31 https://www.herald.co.zw/carbon-credits-boon-for-mbire-community/

32 https://www.herald.co.zw/zim-struggles-to-sell-carbon-credits/

levels was evident before and after the inception of the project in mid-2011. To account for short-term inter-annual variability, the tree cover loss data were averaged across three year time periodsfrom 2003 to 2020.

Estimated tree cover across the Kariba REDD+ project area is shown in Figure 47, with the red dotted line roughly indicating the point at which the scheme should start having an impact on tree cover loss (given that it was established in mid-2011, a slight lag time would be expected). The estimates on the right of the dotted line suggest that tree cover loss has declined since the scheme began. Tree cover loss across all three-year time intervals between 2012 and 2020 was lower than in all three-year time intervals between 2003 and 2011. Overall, average annual tree cover loss between 2012 and 2020 was 32% lower than it was between 2003 and 2011. This suggests the Kariba REDD+ scheme has succeeded significantly in reducing deforestation. However, it has evidently not prevented all tree cover loss in the area as losses have continued since 2012, albeit at lower rates. Nevertheless, not all tree cover loss is caused by anthropogenic factors; some were due to natural events, such as fires arising from lightning strikes and thinning of woodlands by elephants. Further study would be needed to uncover what proportion of deforestation in the area is due to natural causes. However, given the dominance of anthropogenic causes in driving deforestation today, the fact that tree cover loss has been reduced by 32% since 2012 suggests the REDD+ scheme has partially reduced human-induced deforestation in the area.

Figure 47. Mean tree cover loss in the Kariba REDD+ project area across three-year time intervals from 2003-2020. Values to the left of the red dotted line pre-date the REDD+ scheme, while those to the right reflect tree cover loss since establishment of the scheme (Global Forest Watch data).

OPPORTUNITIES

Carbon trading schemes like REDD+ have the potential to increase funding and incentives for the conservation of the country's forest and woodland ecosystems in the face of strong conversion pressures. The concept has achieved a measure of success in the Zambezi Valley, where the Kariba REDD+ project has reduced deforestation while generating livelihood benefits for communities.

The potential for further REDD+ scheme development in the country is being explored in Matabeleland, where the gazetted Ngamo and Sikumi Forest Reserves have been earmarked for REDD+ carbon trading (Forestry Commission 2019). As part of the pilot project phase a biomass assessment has been conducted in the forests, which cover a combined area of 157 000 ha with a total carbon stock of 2.6 million tons, or 9.54 million tons of CO2 based on the 3.67 conversion factor. If successfully implemented, the scheme could become an additional source of revenue for these state forests, supplementing income generated by hunting and photographic tourism. The total amount of carbon stored in the Ngamo and Sikumi forests is worth an estimated $29.9 million per year. Depending on what form the revenue sharing agreements take, this could present a significant source of income for the Forestry Commission and local communities.

For Zimbabwe to comply with the Warsaw Framework for REDD+, it needs to develop a national REDD+ strategy to guide certified emission reduction in the forestry sector, forest reference emission levels, a forest monitoring system and safeguard information system. The Government, through the Forestry Commission and other agencies, could facilitate and encourage further development of carbon forestry schemes by conducting more biomass assessments and identifying areas with potential for carbon financing schemes. This data should ideally be made readily available in an online portal.

4. INVESTMENT BLUEPRINT

Drawing on the analysis of the current status and trajectory of key subsectors in Zimbabwe's biodiversity economy, the aim of the investment blueprint is to chart a way forward for capitalizing on some of the main opportunities for securing and economic benefits from the country's biodiversity.The blueprint guides the conservation and restoration of ecosystems in Zimbabwe. It outlines a means to upgrade national parks, generating funding for improved management of protected areas and biodiversity. The aim is to incentivize local actors to participate in wildlife-based land use and the delivery of ecosystem services, and to stimulate the development of sustainable business opportunities in biotrade. The blueprint provides a brief overview of each of these areas of opportunity and describes the business and investment models to achieve this.

It is recommended that for the biodiversity economy to thrive, the country needs to invest in a number of key fundamentals, notably large-scale integrated development and conservation planning and increased macroeconomic stability, and to create an enabling environment for investors.

UPGRADING STATE PROTECTED AREAS

Overview of the investment opportunity

Tourist expenditure in Zimbabwe's protected areas amounted to $351.9 million in 2019, or 27% of total tourism receipts nationally. In the same year the PWMA estates received around 530 000 visitors, almost a third of the 1.7 million visitors to Zimbabwe in 2019. Nevertheless, and notwithstanding necessary limits on tourist density in protected areas, the full potential of tourism in protected areas has yet to be realized. For example, hotel bed occupancy nationally in 2019 was estimated to be just 32% of capacity, which declined to 15% as a result of the COVID-19 pandemic (ZTA 2020, 2021). Visitors to PWMA estates are disproportionately concentrated in the rainforest and Zambezi National Park, which account for 69% of visitors despite covering less than 1% of the area of the PWMA estates. This suggests that other protected areas in the country are underutilized.

There is scope to generate further revenues for the parks and for businesses from non-consumptive tourism in national parks, by strengthening the product offering (biodiversity) and by developing well-planned tourism facilities and services. Investment in these areas has lagged for lack of state funding (IUCN 2020). Indeed, the PWMA, which receives little to no Government funding, has failed to generate enough revenue to meet its operational budget in recent years, even before the pandemic. This constrains the ability of the PWMA to achieve its conservation mandate as well as to maintain visitor facilities in its parks.

Investing in the protected areas system will help to secure their biodiversity both by increasing the revenue streams and through improved management efficiency. It will also secure ecosystem services that benefit neighbouring communities, the economy of the broader region and society worldwide. Since strict protection forms the core of any biodiversity conservation strategy, investments in the protected areas system will support the other areas of investment outlined here, as well as the broader economy.

The business model – Public-private partnerships

The proposed business model aims to improve the quality and offerings of the national parks so that they generate higher revenues through low-impact, non-consumptive tourism that does not undermine the biodiversity or wilderness character of the parks. To this end it is proposed that Zimbabwe continues to pursue and expand the joint management of selected national parks. In this model a non-profit organization works with the state (the PWMA in this case) in a public-private partnership. A PPP can significantly increase funds and institutional capacity for protected area management. Such partnerships are often able to attract greater donor funding due to the capacity and expertise of the private partner, while many non-profit conservation organizations themselves have a successful track record of attracting funding and implementing the accounting systems required to satisfy donor requirements (IUCN 2020). PPPs have injected millions of dollars into parks – with the Frankfurt Zoological Society (FZS) in Gonarezhou and with African Parks in Matusadona (PWMA 2019). To attract finance the state needs to partner with credible international organizations which have

a proven track record and objectives and values that align with its conservation philosophy.

Four main types of PPP arrangements are recognized:

Delegated management: full management authority is handed to the non-profit entity (IUCN 2020). Akagera National Park in Rwanda is an example, with full management authority delegated to African Parks.

Integrated-co management: the NPO shares governance and management responsibility with the state in a 50-50 power sharing arrangement. This was the model adopted in Gonarezhou National Park in 2017, the first protected area PPP with a major international NPO to be established in Zimbabwe. Co-management arrangements between the PWMA and FZS culminated in the formation of the Gonarezhou Conservation Trust. This partnership has been credited with improving the conservation status of the park and increasing tourism, highlighting the potential of innovative conservation partnerships to improve the status of biodiversity and increase tourism revenue (Musakwa, Mpofu and Nyathi 2020). FZS has invested $13 million to improve conservation work in the park and has committed to provide $1 million of support annually for the next 15 years.

Bilateral co-management: the NPO similarly shares governance and management responsibility with the state, but without the creation of a separate entity such as a trust.

Financial-technical support partnership: in this traditional arrangement the NPO assists the state with aspects of management without having formal decision-making authority (IUCN 2020).

The proposed PPP model for national parks is shown in Figure 48. Under this model the NPO assumes at least partial responsibility for the park's finances and management. The degree of responsibility depends on the exact form of the partnership arrangement adopted and the partnership remains accountable to the Government. The Government is the owner of the park, determines policy and provides support functions such as law enforcement through the PWMA. Except in cases of delegated management, the PWMA will be responsible for co-management. The additional funds raised by the NPO can pay for necessary infrastructure upgrades, situation assessments, management planning and other preparatory activities, as well as to support park operations in the longer term (Figure 48). The investments are expected to increase demand for the parks' offerings, leading to increased revenues from visitor fees, concessions and other user fees. These revenues would contribute to increasing the management effectiveness in achieving the conservation mandate of the park.

Figure 48. Business model for increasing tourism revenues and ecosystem services from protected areas (Source: this study).

Lodge management and new lodge development in parks would typically be outsourced to operators specializing in the level of service required through concession arrangements in a competitive tender process. This offers the opportunity to provide high-end services as well as more affordable domestic tourism products that would generate greater profits and park revenues and more job opportunities. The PWMA has experience in co-management of accommodation sites with private operators. For instance, Robins Camp in Hwange National Park was upgraded through private investment at a cost of $3 million (Begg 2021). Similar private investments have been made elsewhere in the national park – $1.5 million for Verney's Camp and $3 million for Deteema Springs. Such arrangements have resulted in a significant improvement of visitor facilities in some areas and increased opportunities for revenue generation. While similar developments in other PAs would require investments in this range, it is important that the level of development allowed in national parks should be strictly capped, allowing

surrounding communities to contribute to the improvement of the quality of the protected area through participation in sustainable management that translates to an attractive product to tourists and other services.

The investment model

The choice of an internationally reputable NPO is key to leveraging funding for investing in parks. Such funds would be raised from donors and impact investors. Both types usually require metrics of success to ensure continued support. A review of PPP models by IUCN (2020) states that delegated or integrated co-management models are usually able to attract higher funding than bilateral co-management and financial-technical support partnerships. This is because these models lead to the formation of a special purpose vehicle – for example the Gonarezhou Conservation Trust – with greater independence and responsibilities. This reportedly increases donor confidence that funds will be correctly managed and targets achieved without the challenges associated with the bilateral co-management and financial-technical support partnership models.

African Parks' average operational budget across the PAs it comanages was around $1000/km2/year[33] in 2013 (Lindsey et al 2016). In comparison, the PWMA's operational budget in 2021 was $16 million. This amounts to around $320/km2/year when averaged across all PWMA PAs. The actual amount available for PA management is likely to be much lower, however, as the PWMA's total annual budget includes costs that go beyond direct PA management.

Contributions could also come from Zimbabwe's Environmental Fund if its role is expanded to support state conservation areas. There is potential to bolster this fund by raising income from levies or offset payments from other sectors that harm the environment. For example, the Government could introduce a levy for new infrastructure developments that cause deforestation or other types of environmental degradation. Revenues can also be raised to support the biodiversity sector through "no net loss" or more ambitious "net biodiversity gain" policies in other sectors. These would require the implementation of biodiversity offsets designed to internalise the external costs of biodiversity losses arising from development projects. Such policies could be implemented as part of a deal for approving new mining or property developments, commercial forestry plantations, commercial agriculture, water supply infrastructure or other developments that impact the environment, including the expansion of human settlements. Offsets are not used in place of impact mitigation (which is determined in the environmental impact assessment process); they are used only to offset residual impacts, i.e., those impacts that are unavoidable.

The Government's role

In addition to policy formulation and legal support and law enforcement governing protected areas and their buffer zones, the Government would need to put in place the prerequisites needed to make this model work optimally – tackling the broader economic and social issues that discourage tourists, such as improving roads and transport infrastructure and the management of other state lands and areas that buffer and connect the national parks.

Promoting the growth of Zimbabwe's tourism sector will require continued marketing to keep improving the country's global image and to emphasize the distinctiveness and comparative advantage of its tourism assets. Institutions such as the Zimbabwe Tourism Authority and the PWMA have a key role in this regard, promoting nature-based tourism attractions with the high wilderness value, the pristine charms and the uncongested appeal of many of its national parks.

REVITALISING WILDLIFE-BASED LAND USE

Overview of the investment opportunity

The full potential of wildlife and biodiversity-related land use on private and communal lands is not being realized in Zimbabwe today. In the 1980s and 1990s rapid voluntary transition to wildlife farming in the semi-arid rangelands was driven by the comparative economic and ecological advantage of keeping wild animals in these challenging regions. Profits from farms in the southeast lowveld with a mix of cattle and wildlife were 3.6 times greater than those from cattle ranches (Child 1988). Even though many wildlife enterprises were still new and

33 The original value quoted by Lindsey et al (2016) has been inflated to the equivalent 2021-dollar value, to ensure comparability with the 2021 PWMA budget figure.

understocked by the early 1990s, almost half were found to be profitable, with an average ROI of 9%, while only 5% of established cattle ranches were managing to achieve a comparable ROI (Bond 1993). Since then, the balance has been tipped to some extent by strong support for the agricultural sector, particularly through subsidies. Without these distortions it is likely that there are opportunities to raise revenue by stimulating wildlife-based land use in rural areas. Since wildlife has been shown to generate greater returns than livestock in certain parts of the country (Child 2009; Child et al 2012), subsidies for wildlife could be more financially effective than those for agriculture, including livestock, in unsuitable areas.

Wildlife ranching generally leads to a more complex commodity economy, with more horizontal and vertical linkages relative to livestock, increasing the number and diversity of employment opportunities (Child 2009). In parts of South Africa a fivefold increase in jobs resulted from switching to wildlife and nature-based tourism on private land, accompanied by a thirty-fold increase in the total wage bill, doubling of land values and the creation of numerous economic multipliers (Langholz and Kerley 2006).

Additionally, wildlife-based land use is compatible with payment for ecosystem services (PES), as it generally maintains habitats in a natural state with appropriate carrying capacities. This would allow for even greater financial returns from wildlife. Key complementary opportunities are:

- Trade in carbon credits or biodiversity credits which are purchased by the international community, involving transfers to local communities in payment for the retention or restoration of indigenous forest woody biomass or ecosystem integrity. The global carbon market has grown significantly in recent years, particularly for projects relating to forestry and land use such as REDD+ (Ecosystem Marketplace 2021)
- Trade in hydrological ecosystem services, where local or regional water utilities pay local land managers to retain vegetation cover and reduce loss of nutrients and sediment exports in order to avoid higher infrastructure and water treatment costs

Prospects for developing wildlife-related land use on communal land continues to be hampered by Zimbabwe's legal framework which has not fully devolved rights over wildlife and natural resources to the community level. Review of legislation to allow for the development of community conservancies, as has been successfully achieved in countries such as Namibia and Kenya, will create new opportunities for wildlife-based tourism, including the development of novel products that combine wildlife and cultural tourism. Moreover, an approach revised in this way could increase the flow of conservation benefits to communities and give them greater autonomy over decisions regarding the management and use of wildlife and other natural resources in the areas in which they live. Optimal sites for community conservancies are communal areas that retain notable wildlife populations and natural habitat, notably CAMPFIRE areas bordering state protected areas, and communal lands bordering private wildlife ranches and conservancies. In such cases the protected areas could provide a source of wildlife population to disperse into the new conservancies, which would themselves provide a buffer and improved connectivity with the existing protected area network.

The business model – Biodiversity fund, Community Conservancies and PES

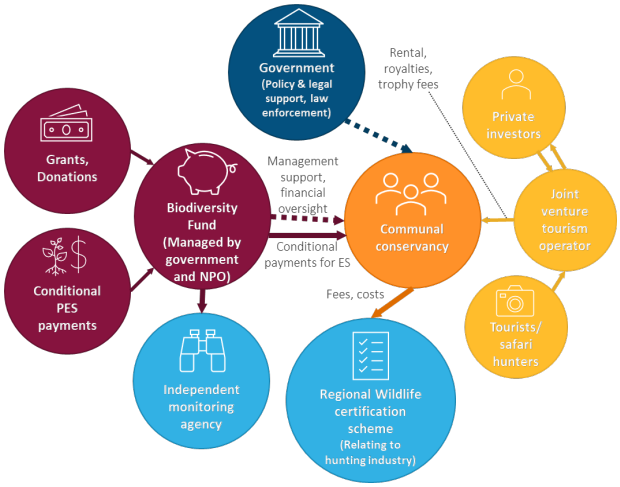


Figure 49. Business model for increasing tourism revenues and ecosystem services from communal land areas (Source: this study).

The proposed model is a community conservancy

generating income from wildlife-based land use. The model has two main funding streams which can be applied jointly or separately (Figure 49):

- Income from hunting or photographic tourism through a joint venture operation under an agreed management plan in which the JV partner pays a fixed rental and part of its revenue to the community running the conservancy
- A PES scheme that generates income for the conservancy from global, national or downstream beneficiaries of ecosystem services such as carbon sequestration, water purification or sediment retention.

PES payments vary considerably, depending on the service being traded and the extent to which the management action increases the supply of that service relative to a without-conservancy baseline.

A biodiversity fund should be set up to support communities in establishing conservancies, funding JV partners and channelling payments for ecosystem services to the conservancies. This could be co-managed by the Government and partner NPO and provide financial oversight of the revenues earmarked for investment in conservation and for distribution to the communities.

JV arrangements can be highly profitable. In Namibia a typical 16-bed community conservancy lodge charging $250 per night would have a total turnover of $750 000 at an average occupancy rate of 50% through the year (Schnegg and Kiaka 2018) indicating the level of revenue that similar developments might generate in Zimbabwe. Successful community conservancies would ideally become self-sufficient over time without needing support from external partners. In Namibia for example, 34 out of 50 conservancies for which detailed management cost data were available were found to be profitable; in other words, their income from hunting and/or tourism exceeded operating costs (Naidoo et al 2016). This demonstrates that community conservancies could similarly become a profitable land use option in Zimbabwe.

Conservancy operations that depend on safari hunting for revenue would benefit from a certification scheme which recognizes sustainable and ethical hunting operations. To achieve international recognition a hunting certification scheme would ideally need to operate at the regional or global level.

The investment model

The main investors are private sector actors involved in safari hunting and tourism. While the community conservancy model in Zimbabwe is not yet fully developed, a biodiversity fund capitalised by the Government, donors and private sector could provide ongoing support and oversight to help to secure the conservation of areas set aside in conservancies and provide concessionary loans to investors to reduce their risk.

The Government's role

The Government would put in place the prerequisites needed to make this model work. Firstly, the Parks and Wildlife Act would need to be amended to allow for full devolution of wildlife use rights to communities that establish conservancies. This would allow communities to enter into agreements directly with private sector tourism and hunting operators wishing to build lodges or conduct tourism and hunting in the conservancy. The Ministry of Lands, Agriculture, Fisheries, Water and Rural Development would need to review the lease conditions for A2 farming areas so that wildlife is included as a permissible lease activity, particularly in areas where conditions for agriculture are unsuitable. A spatial zoning exercise to identify areas better suited to wildlife production would be helpful in this regard.

The Government should also consider levelling the playing field for land use by extending subsidies to wildlife conservancies. In this regard, again, a spatial zoning exercise would identify areas where wildlife faming offers a more profitable and resilient land use option than cattle ranching or agriculture generally. In such areas the Government could divert subsidies for agriculture to wildlife-based land uses. Likewise, economic incentives to attract investment for industries that prove harmful to biodiversity or that damage the environment could be diverted to the biodiversity economy to encourage the growth of the sector. As a variation on the above in areas where there is a strong potential for PES that delivers hydrological services in important water supply areas, communities could receive payments from a water fund, rather than a

biodiversity fund. An example is the Upper Tana Nairobi Water Fund in Kenya.[34]

DEVELOPING THE BIOTRADE INDUSTRY

Overview of the investment opportunity

Zimbabwe has diverse plant and animal species suitable for commercial production and marketing of medicinal, food and cosmetic products. Opportunities for growth in bioprospecting and biotrade abound in the personal care and cosmetics, food and beverage and flavour and fragrance industries. The sector is growing as global demand increases for new natural products and it draws heavily on wild resources for product development and marketing. Investors seeking novel natural ingredients for their products often exploit traditional knowledge (Laird and Wynberg 2012b). In addition to opportunities in export markets, there is potential to grow and formalize the domestic market for natural products in Zimbabwe. The rise in popularity of products such as zumbani tea (Lipia javanica) during the COVID-19 pandemic points to the potential demand for these products locally. Integrating a product like baobab powder[35] with popular breakfast cereals could bring significant nutritional benefits to domestic consumers while substantially increasing the market for biotrade ingredients, a point made by G. Le Breton, founder of BIZ, during the project validation workshop.

Commercialization of certain indigenous plant products has the potential to bring socioeconomic benefits to rural areas, including semi-arid regions where conditions are unfavourable for farming. Zimbabwe has achieved some success in this sector through the commercialization of products such as baobab. However, the sector receives very limited public support

The business model: Biotrade Fund and certification

It is proposed that a biotrade fund be established and managed jointly by the Government and an NPO to raise funds to support the development of biotrade (Figure 50). The fund would contribute to research and development, provide concessionary loans for start-up businesses and set up a certification body. The business model involves both bioprospecting and biotrade. The Government would be responsible for policy and law enforcement, particularly to ensure compliance with the Nagoya Protocol.

Figure 50. Business model for increasing revenues from the harvest and domestication of wild natural resources (Source: this study).

The biodiversity products need to meet environmental and social sustainability standards. The business model would need to subscribe to an independent certification scheme that sets and monitors standards and markets the scheme and its products. Labels and certification are commonly used to show adherence to sustainability standards and often display fair trade metrics about environmental impact, human rights and labour laws. With growing global interest in the environmental and social sustainability of goods, such labels and certification schemes increase the attractiveness of products to ethically minded consumers. Additionally, certification schemes can encourage players in the biotrade sector to adhere to production processes that do not harm the environment and affirm that producers and harvesters receive adequate benefits. Zimbabwe's indigenous plant products should be eligible for certification under schemes like FairWild, which recognizes wild plant products that are harvested in an environmentally sustainable manner while providing meaningful livelihood benefits to rural

34 https://www.nature.org/en-us/about-us/where-we-work/africa/stories-in-africa/nairobi-water-fund/

35 Baobab powder is rich in vitamins and antioxidants and thus has a significant nutritional advantage over maize, soya beans, sugar and other ingredients commonly used in these products

communities, thus providing reassurance to ethical consumers.

Investment model

Private companies, the Government and NGOs can all become involved in bioprospecting and biotrade. High risk currently discourages venture capital investment in novel natural products. Concessionary loans[36] would reduce the risk for entrepreneurs and investors and make the enterprises more attractive. The loans would be supplied from grants or donations to the proposed biotrade fund. It is worth considering that bioprospecting and biotrade companies may be attractive to impact investors because they have the potential to generate returns while providing livelihood benefits to poor and marginalized rural communities. And if harvesting proves sustainable, there is potential to improve the conservation status of target species as communities realize their value as a source of income.

The Government's role

The Government role would encompass law enforcement, streamlining of regulatory processes and support for marketing and monitoring. The costs involved in launching a new product on the export market can be prohibitive. For example, gaining regulatory approval for the export of baobab cost $650,000 and took seven years. Public institutions such as the Research Council of Zimbabwe and the National Biotechnology Authority could provide technical support. Ideally there should be a dedicated Government institution tasked with overseeing and promoting the subsector, just as there are Government agencies for the wildlife, fisheries and forestry subsectors.

International marketing at events like global trade fairs will be important for informing consumers in potential export markets about novel products from Zimbabwe. Entities like ZimTrade could build the national brand by marketing novel indigenous products that are distinctively Zimbabwean in origin.

Resource and stock assessments of commercially valuable plant species have been largely undertaken by non-state actors such as Bio Innovation Zimbabwe. Additionally, greater public baseline research by agencies like the Research Council of Zimbabwe and the Forestry Commission could identify parts of the country with good potential for investment in biotrade and bioprospecting development.

Where bioprospecting results in the development of new products and patents drawing on traditional knowledge, companies are required to compensate traditional knowledge holders under the access and benefit sharing (ABS) provisions of the Nagoya Protocol. The Government should encourage companies to use the services of intellectual property consultants to advise whether a product should be registered under a patent or under the provisions of the Nagoya Protocol. Companies should agree mutually acceptable terms with knowledge holders about integrating compensation in the product offering.

GOVERNMENT'S OVERARCHING ROLE

A thriving biodiversity economy needs a stable policy environment for doing business, a well-functioning financial system and a government that responds effectively to technological changes, social and demographic trends and economic challenges.

In 2019, Zimbabwe ranked 140 out of 190 countries on the World Bank's "ease of doing business" indicator (World Bank 2019). It ranked low among 141 other countries in terms of trade openness according to the Global Competitiveness Report in 2019 (Schwab 2019) and its financial system is positioned at 120th out of 141 countries. Financing for SMEs is comparatively scarce (123rd out of 141) and venture capital availability is ranked at 130th out of 141 (ibid). Banks are said to have unsound balance sheets and may require recapitalization (ibid). As of 2022, Zimbabwe has the world's highest interest rate at 200% while the local currency continues to devalue. Given the lack of access to affordable capital, business growth is often funded through internal cash flows, which limits growth opportunities. It is clear that Zimbabwe needs to implement policies that increase macroeconomic stability, address corruption and create a less volatile and risky environment for investors.

Another crucial requirement for a thriving

36 A concessionary loan is a loan provided on more favourable terms than the borrower could obtain in the marketplace, such as a lower interest rate

business environment is sustainable investment in infrastructure, including transport, electricity, water supply and communications. While substantial investment in the roads network is necessary to improve access to areas with nature-based tourism, it needs to be carefully planned to avoid the severe impacts on biodiversity that road infrastructure expansion has made in other countries in Africa. Electricity networks need to be extended and power deficits and outages reduced significantly as they make it difficult for businesses to plan their production and to continue to operate. Zimbabwe's current efforts to upgrade its road network, increase electricity generation capacity, improve water supply and extend access to communication technologies are commendable but they require sustained effort to ensure a thriving business environment.

The Zimbabwe Investment Development Agency (ZIDA) has an important role in promoting and facilitating investment. It can support value-chain development of NTFPs and facilitate investment in protected areas, including PPPs. The agency operates a one-stop investment service centre that aims to streamline the investment process, including assistance with legal aspects such as company and tax registration. Such services should be extended to the biodiversity economy

5. A FRAMEWORK FOR NATURAL CAPITAL ACCOUNTING

Natural capital accounting (NCA) provides a systematic way to account for changes in the stocks and flows of natural capital, as illustrated in Box 8 below. It provides a standardized approach or framework for organizing and presenting statistics on the environment and its contribution to the economy through a structured accounting approach.[37] This helps to integrate natural capital into evidence-based socio-economic decision making and policy formulation which in turn supports planning for land use and freshwater and marine resources (World Bank Group 2021a). It provides an indication of the level of sustainable use and the trade-offs between resource use and economic production (European Commission 2019; Stats SA 2021a). Ultimately, NCA is used to inform the development needs of a region or country by guiding policy on the environment and the economy and how to manage them sustainably. This is especially important for countries rich in biodiversity or those whose economy is strongly resource-based – often both apply – and where economic growth could be severely impacted by the depletion of natural capital (World Bank Group 2021a).

Box 8. Defining natural capital

There are many definitions of the term "natural capital". Here we present the definition developed by the Natural Capital Coalition and used by the UN System of Environmental Economic Accounting: "Natural capital is the stock of renewable and non-renewable resources (e.g., plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people."

The concept of natural capital includes the role of the environment and ecosystems in supporting human well-being through the supply of important goods and services, including renewable and non-renewable resources, sinks that absorb or neutralize waste, and processes such as climate regulation.

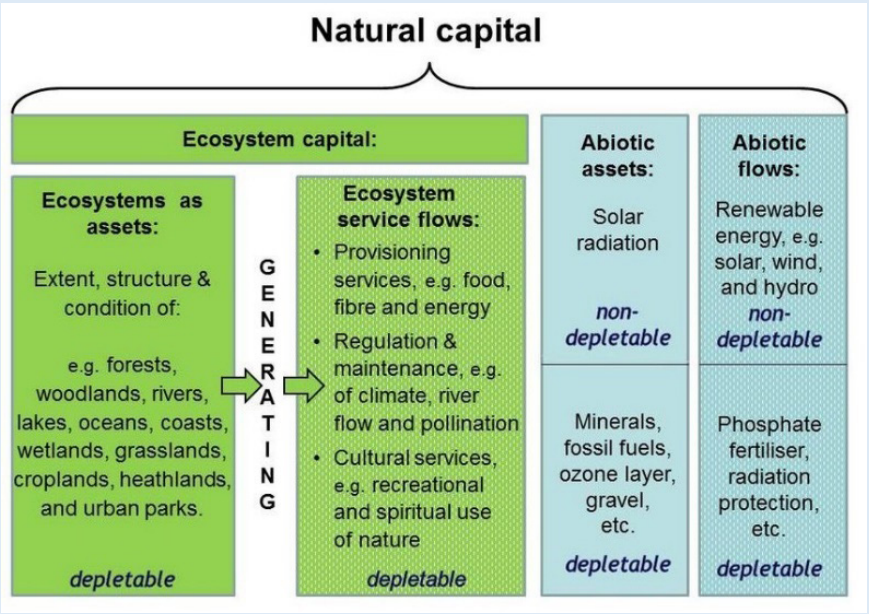


Figure 51. Components of natural capital (Based on Maes et al 2013)

37 NCA is not the same as natural capital assessment or natural capital inventory/audit. NCA is based on methodology and processes that are regular and repeatable rather than ad-hoc. Unlike assessments and inventories or audits, NCA outputs are intended to be official statistical products led by a statistical authority.

National context

Zimbabwe's ecosystems are vital for its well-being and there is immense potential for suitably harnessing its biodiversity and natural resources for sustainable growth (GoZ 2019). The population relies heavily on the direct benefits of ecosystems, with nearly 70% of people deriving their livelihoods directly or indirectly from agriculture and biodiversity (ZIMSTAT 2018). Environmental policy is therefore strongly linked to the overall development agenda. Zimbabwe has a proud record of biodiversity conservation and is regarded as one of the leading countries in Africa in terms of biodiversity protection: currently around 17% of the country falls under strict protection (GoZ 2019; UNEP-WCMC 2022).[38] However, Zimbabwe is ranked only 123rd out of 180 countries in the 2020 Environmental Performance Index with a score of 37 out of 100 (Wendling et al 2020). While it is ranked higher than most countries with a similar GDP per capita, and scores highly for most biodiversity indices, it ranks especially low for water and sanitation, waste management, air quality and agriculture indices. Land use changes, primarily due to agricultural expansion, rangeland degradation (particularly in communal areas), overexploitation and climate change are the primary threats to biodiversity and ecosystem health (GoZ 2019).

Zimbabwe has experienced a decline in per capita wealth over a number of decades (World Bank Group 2021b). The United Nations Development Programme's Human Development Index[39] ranks Zimbabwe 150th out of 189 countries with an HDI of 0.571 (out of 1), although this has increased since 2010 (UNDP 2020). In order to make improvements and revive the country's well-being, a green and resilient recovery that places natural capital at the forefront of economic development is needed. Furthermore, the COVID-19 pandemic has exacerbated economic challenges, highlighting the need for a recovery that emphasizes the value of biodiversity to the country's economy and well-being. In order to realize the potential of the biodiversity economy, Zimbabwe needs to take stock of and account for its natural resources in its balance sheets systematically through NCA. This can highlight the need to improve, restore or protect resources in natural ecosystems and agricultural land.

Policy context

Zimbabwe has a number of policy documents and commitments in place that aim to improve the management and conservation of its natural capital base by ensuring sustainable environmental protection and resilience. The policy context for NCA is constantly evolving, with the most recent policy documents, such as the National Development Strategy I (NDS 1), recognizing the importance of NCA and promoting strategies to encourage its implementation (GoZ 2020b). In the context of NCA, relevant policies, strategies, plans and commitments include but are not limited to the following:

Vision 2030 was developed to chart Zimbabwe's new development trajectory "to achieve an upper middle-income society by 2030, for an empowered and prosperous Zimbabwe". Vision 2030 is "focused on promoting innovation, entrepreneurship, equitable development and prosperity for all, under a market economy that leverages on Zimbabwe's natural resources and abundant human skills".

Zimbabwe's National Development Strategy I for 2021-2025(NDS I) is the country's first five-year medium-term plan aimed at realizing Vision 2030 while addressing the Sustainable Development Goals (SDGs) and the African Union's Africa Agenda 2063. NDS 1 outlines the strategies, policies, legal and institutional reforms and the programmes and projects that the Government aims to implement from 2021-2025 to "achieve accelerated, high, inclusive, broad-based and sustainable economic growth as well as socio-economic transformation and development". In NDS 1 "environmental protection, climate resilience and natural resource management" have been identified as national priorities.

The Sustainable Development Goals (United Nations 2015) identify NCA as a way of mainstreaming environmental concerns into decision making (SDG Target 15.9). The UN has determined that 40 indicators for nine SDGs can be informed by the System of Environmental-Economic Accounting (SEEA).

SADC Regional Indicative Strategic Development Plan(RISDP) 2020-2030 highlights the importance of an integrated green economy for achieving sustainable development goals.

38 Excluding wildlife management areas which account for 10.1% of the surface area function as multi-use landscapes rather than strictly protected areas

39 HDI provides a composite index measuring three basic dimensions of human development: life expectancy, education and per capita income.

The Environmental Management Act (Act 13 of 2002) guides all environmental management decision making and applies to the actions of all state agencies that may significantly affect the environment.

National Biodiversity Strategy and Action Plan (NBSAP) 2013-2020 in which i) incorporating economic valuations of ecosystems and associated biodiversity in the implementation of the strategy and action plan, and ii) mainstreaming and incorporating biodiversity into national accounting and reporting systems are priority activities (Objective 1 Target 2, Objective 5, Target 17).

Application of NCA in Zimbabwe

Zimbabwe has comprehensive environmental legislation and recognized institutions which sets a solid foundation for formally rolling out NCA. Its National Biodiversity Strategy and Action Plan (NBSAP, 2013-2020) emphasizes the need to adopt an ecosystem-based adaptation approach to climate change to promote the green economy transition agenda (GoZ 2014b). Furthermore, there is an explicit recognition of the benefit of the environment to human well-being and the importance of linking various sectors to ecosystems and the benefits that they supply to ensure cross-sectoral cooperation and coherent policy outcomes. It further emphasizes the need for a strategy to build resilient ecosystems and enhance biodiversity value through "research, innovations and best practice" among others, and to adopt an ecosystem approach to environmental planning (GoZ 2014b). While there is no explicit mention of NCA, the NBSAP does state that "economic valuations of ecosystems and associated biodiversity be incorporated in the implementation of the strategy and action plan". The application of NCA is fast becoming best practice in the pursuit of sustainable development trajectories.

In the mid-1990s Crowards (1996) used Zimbabwe as a case study for natural resource accounting and found that degradation of resources was resulting in an approximate loss of 2% of annual GDP. In 2013 the Environmental Statistics Committee[40] embarked on developing a Framework for the Development of Environment Statistics (FDES), with a final report published three years later (ZIMSTAT 2016). The report describes physical characteristics, including details of climate, soil, land cover, ecosystems, biodiversity, hydrology and natural resources, including minerals, energy, fish, agricultural production and water. Residuals, in the form of materials and energy that are discarded, discharged or emitted as waste are also described. However, a framework in the broad sense is not portrayed or described in the FDES. ZIMSTAT (2016) details a National Land Classification System produced by the Forestry Commission's mapping and inventory unit which comprises ten broad land cover classes. These were compared, as would be done in a land account, between 1992 and 2008. The results showed significant declines in natural/semi-natural land cover classes (except bushland) and increases in settlements, cultivation, rock outcrops (presumably due to erosion and degradation), waterbodies and plantations.

Changes in gazetted forests (indigenous) and forested areas (plantations) were also recorded. Wood stocks from natural forests and woodland and timber volume from plantations were compiled, but at irregular intervals. While the report presents useful data and statistics overall, it does not have the formal structure and format that is required of the SEEA framework, reading rather like a compendium of annually aggregated environmental data or resource accounts that feed into the national accounts. The FDES notes in its conclusions and recommendations that greater and more consistent funding is required for continuous updating of environmental statistics, while improving collaboration and co-ordination among partners.

Furthermore, economic valuation of biodiversity and ecosystems was applied, albeit to a limited extent, in the NBSAP for wildlife, forestry and agrobiodiversity.

A coherent integrated system such as NCA through the SEEA provides a structured means to mainstream ecosystem valuation. It was hoped that these would facilitate effective mainstreaming of biodiversity and make a business case for biodiversity (GoZ 2014b; GoZ 2019).

In NDS 1 the following strategies related to biodiversity, ecosystem services valuation and natural capital accounting were identified:

- To improve growth in the tourism sector, the Tourism Satellite Account will be finalized to improve the accounting of

40 The Environmental Statistics Committee is co-chaired by the Ministry of Environment, Climate, Tourism and Hospitality Industry and the Institute of Environmental Studies, University of Zimbabwe.

the performance of the tourism sector

- To achieve increased forest production and processing, environmental valuation and satellite accounting will be implemented
- To achieve improved status of protected areas, NCA will be implemented
- To achieve improved accountability and transparency, the Government will prioritize the implementation of public accounting systems, compliance and reporting

Steps have been taken to familiarize Government professionals with valuation of ecosystem services and how it can be used for policy analysis. Over three weeks in November and December 2021, nine officials from the Zimbabwe National Statistics Agency (ZIMSTAT), the Ministry of Environment, Climate, Tourism and Hospitality Industry (MECTHI), the Parks and Wildlife Management Authority (PWMA), the Environmental Management Agency and the Forestry Commission attended a short course titled "Measuring and valuing ecosystem services in the context of NCA" through the World Bank WAVES programme. The objectives of the online training were: to recognize and describe methods which can be used to value ecosystem services and what type of questions they can answer; interpret results from valuation studies and apply them appropriately in policy analyses; recognize and describe the prerequisites for using benefit transfer; and describe and exemplify how ecosystem services can be integrated into natural capital accounts. While this is a step in the right direction, more needs to be done in terms of preparation and implementation of NCA.

Challenges for the adoption of NCA in Zimbabwe

Although Zimbabwe has the necessary legislation and institutions related to environmental governance and management in place, it faces some institutional challenges for the adoption of NCA. For a start, there is limited coordination among stakeholders which has hindered full policy implementation (GoZ 2014b). This is also reflected in the discrepancies in measuring production and the economic contribution of the biodiversity economy noted in earlier chapters of this report, most notably in forestry and tourism.

It was noted from discussions with a range of stakeholders that while mainstreaming of biodiversity in other sectors has been satisfactory, the legal framework on biodiversity and the environment is inadequate (GoZ 2019). Limited mainstreaming has led to information and metrics becoming outdated, inaccessible and disorganized, with no central repository in any single institution. It was also noted that there was limited capacity for undertaking ecosystem services valuation and environmental accounting.

Limited financial resources and low national budget allocations to the relevant ministries involved as a result of the economic downturn the country has been experienced over the last two decades. Limited expertise has also been cited as an obstacle (GoZ 2019). A key step in this regard would be to identify the key institutions that should be involved in NCA and ensure systematic and regular monitoring and reporting on key environmental indicators so that they can be sufficiently resourced. Capacity and funding are two challenges that are relatively straightforward to overcome if there is high-level political will and commitment to prioritize NCA and improve institutional systems, as has been the case in Uganda (Box 9).

Box 9. NCA in Uganda (World Bank 2020)

While Uganda had made progress in promoting and developing NCA through a number of pilot studies, the country lacked sufficient capacity and resources to fully execute an NCA system. A partnership with the World Bank's WAVES programme built on previous work concentrating on the ecosystems and natural resources that are critical to Uganda's development. In two years this had led to the creation of land accounts, forest accounts and experimental ecosystem accounts. The WAVES partnership helped to build capacity and provided guidance by deploying key experts and technical coordinators to work alongside staff in the relevant agencies and departments. In addition to the hands-on training provided by the key experts, formal training on SEEA and InVEST modelling suite was provided. A national plan for advancing environmental economic accounting which includes a strategy and roadmap was developed with assistance from the United Nations Statistics Division.

Furthermore, Uganda has undertaken integrated accounting for agriculture, land and soils (King et al 2021). Fisheries resources (NEMA 2021a) and water, biodiversity and tourism (NEMA 2021b) have been compiled following SEEA EA guidelines and formats. These were deemed particularly important aspects of natural capital given the high contribution of agriculture to the Ugandan GDP (23.7%) and employment (73%), as well as the number of people living in rural areas (85%) that rely on the natural environment to meet their daily needs. Species accounts have also been produced which demonstrate the economic importance of the indigenous shea tree *(Vitellaria paradoxa)*, which is under threat in several parts of Africa.

PROPOSED FRAMEWORK FOR NCA IN ZIMBABWE

Natural capital accounting is a complex undertaking that requires a wide range of technical skills, data and expertise from numerous government and non-government entities and agencies. Adopting and compiling natural capital accounts requires successful collaboration between entities so that expertise, data and resources can be mobilized and effectively utilized. The NCA community is expanding and updates and recommendations to advance and harmonize NCA are becoming more regular and easily accessible.

However, the data, technical knowledge, financial and institutional capacity that are required to undertake NCA are significant and remain a challenge for Zimbabwe. Gaps and inconsistencies in national datasets are a concern, but this is diminishing with the increasing availability of harmonized global and regional datasets. This is particularly the case with spatial datasets, that are sufficiently downscaled to allow for use at national level. The increasing use of machine learning and automation to produce consistent accounts is reducing the need for technical knowledge required to embark on NCA. The efforts to create a standardized global ecosystem classification (see Keith et al 2020) have also helped to reduce inconsistencies in information required for ecosystem accounting.

Training in gathering and analysing data, followed by compiling accounts, is important to enhance capacity to undertake NCA successfully and efficiently. This, too, is improving with a growing community of practice, such as the Africa Natural Capital Accounting Community of Practice,[41] that shares country experiences, while various published country reports appear to be widely available. The rise of automated approaches to ecosystems accounting, such as the Artificial Intelligence for Environment and Sustainability software, also helps to reduce the need for technical skills and in-depth knowledge. The growing network involved in NCA and willingness to share skills and knowledge should encourage those wishing to further their involvement with NCA. Given sufficient willingness to address the in-country gaps, there is enough external material and support to assist Zimbabwe in undertaking this important endeavour to enhance environmental policy and realize sustainable development and growth.

This framework provides some practical steps that the country can take to start the process of NCA. It aims to provide a structured and coordinated approach to piloting and developing NCA through a step-by-step roadmap to implementation. Ideally, the framework

41 The Africa Natural Capital Accounting Community of Practice (NCA-CoP) is a regional learning and knowledge platform comprising professionals, institutions including governments, private entities, NGOs and academics that are interested in or working on NCA throughout Africa. The aim of the African NCA-CoP is to mainstream NCA into statistical compilation and policy in African countries through best practices, sharing knowledge and building capacity.

should make way for the development of a comprehensive NCA strategy through which the key natural capital accounts and the systems that are needed to undertake these are identified by way of an extensive and inclusive stakeholder consultation process.

Institutional arrangements

NCA is usually led by the national statistical agency. The lead institution should be credible and sufficiently capacitated to lead on environmental statistics. Therefore, it should house an environmental division. This could be an expansion of an existing division that deals with natural capital and resource accounts – fish, water, timber etc. Alternatively, a technical working group that comprises key individuals or champions from different organizations, including government ministries, (such as MECTHI and Ministry of Lands, Agriculture, Fisheries, Water and Rural Development), conservation authorities (such as the PWMA and Forestry Commission), key NGOs and private entities, could also be formed.

MECTHI should lead the development of NCA through an NCA unit, with technical support from ZIMSTAT and the Environment Statistics Committee (ESC), which is composed of key environment stakeholder institutions (Figure 52).

ZIMSTAT can constitute a technical working group (TWG) composed of members from relevant departments and some members from the ESC to lead technical NCA preparation and implementation. The TWG would comprise statistical officers and data and policy experts who provide guidance, overarching data quality assessment and technical reviews of NCA systems and outputs. Specialist entities under the TWG and a strategic advisory group (SAG) should be established to work on specific accounts. The participants in these specialist groups would be from the relevant government departments and agencies as well as civic organizations aligned with each account.

The ESC and associated working groups should be responsible for advising on the current institutional arrangements and their applicability to NCA. The ESC would need to know if existing institutions are able to undertake NCA effectively and successfully or whether new institutions need to be developed or existing ones reformed to better accommodate NCA systems. The ESC should also be responsible for developing an NCA strategy guided by the NCA technical working group/SAG.

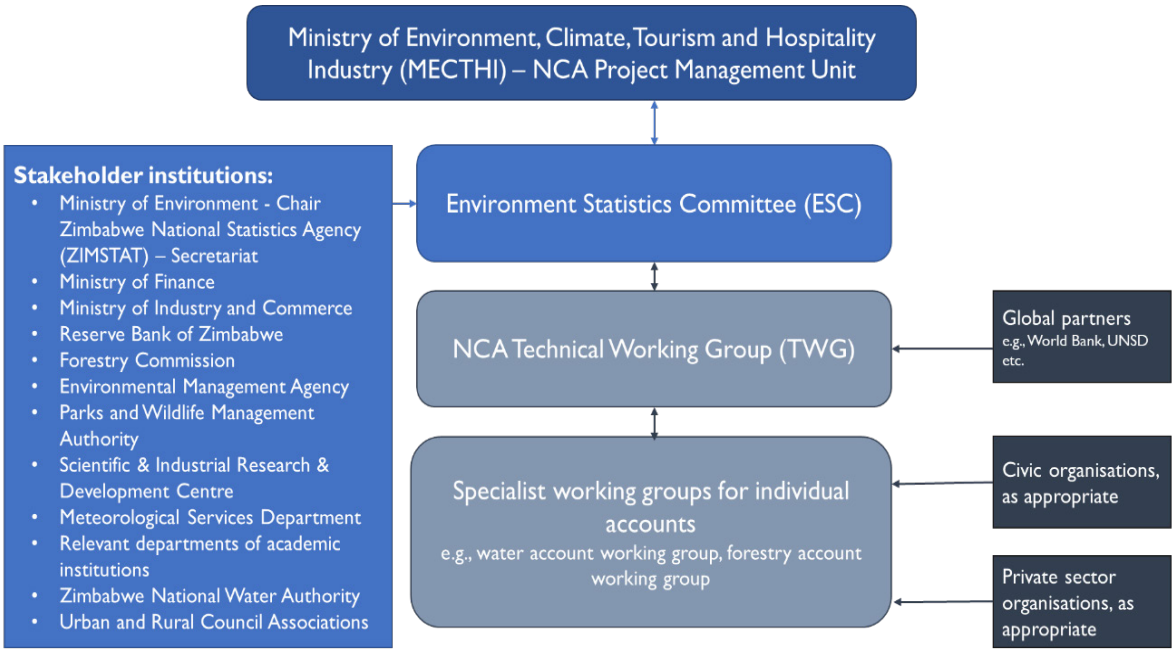


Figure 52. Potential institutional arrangements for NCA in Zimbabwe

Table 21. A brief summary of the accounts that can be produced through NCA and their policy relevance

ACCOUNT	BRIEF DESCRIPTION	POLICY RELEVANCE
Land accounts	Land accounts are based on the physical extent of land units, by land cover class. The accounts assess changes in the spatial extent of land cover classes, with a particular focus on modified land cover (e.g., agriculture, built-up areas) as well as changes in natural land cover classes.	• How has physical land cover and land use changed over time and what are the implications of this? • Contribution of land to the economy and the impact of the economy on terrestrial resources • The results can be used for future management of land cover and land use in Zimbabwe.
Forest accounts	Forest accounts provide an assessment of forested land, wood assets and supply and use tables for wood and other forest products.	• How much have forest stocks reduced or increased by over the accounting period? • How much wood is available for supply from different land tenure types? • What are the main causes of forest stock reductions and how can they be addressed? • What is the impact of afforestation programmes? • What is the value of wood products and non-wood products from forests?
Water accounts	Water accounts provide an assessment of water assets and resources, in terms of water stocks and flows (use and supply) from and by the environment to the economy and within the economy (i.e., how much water is there, where is water coming from and who is using it?)	• How much water flows from the environment to the economy? • How much water flows from the economy to the environment? • How much water flows within the economy? • Able to analyse impact of changes of water availability on the economy. • Able to analyse impact of economic changes on the environment.
Mineral and energy accounts	Mineral and energy accounts provide the stocks and flows of mineral and energy over time. Increases in stocks include discoveries and decreases include extractions (i.e., what quantities have been produced and what recoverable quantities remain?)	• What are the quantity and value of the stocks of minerals and energy? • How has this changed over time? • How are the changes in stocks over time a result of extraction, discoveries, changes in economic conditions etc.?

ACCOUNT	BRIEF DESCRIPTION	POLICY RELEVANCE
Ecosystem accounts	Linked to the land accounts but focus on measuring changes in the spatial ecosystem of terrestrial ecosystem types. By assessing the changes in natural or semi-natural and modified land cover, the remaining extent of each ecosystem type can be determined against a reference condition. Ecosystem accounts are made up of five core accounts: ecosystem extent accounts; ecosystem condition accounts; ecosystem services flow accounts (in physical terms and in monetary terms), and ecosystem monetary asset accounts.	• These accounts highlight the impacts on natural ecosystems and can in many instances highlight links to socioeconomic drivers of landscape change. This helps to identify areas of conservation importance where ecosystem types are threatened by habitat loss. • Highlight the contribution of biodiversity and ecosystems to the economy. • The results can be used for future management of land cover and land use in Zimbabwe
Species accounts	Developed to reflect the status and trends in biodiversity. Very difficult to do comprehensively. These accounts should focus on species that are important in terms of ecosystem services or ecosystem condition, or species of conservation concern.	• What are the population numbers over time? • What is the species diversity? Does it change? How and why?
Protected area account	Status and change in protected area extent over time.	• Useful for assessing progress against national and international targets and assessing shortcomings in terms of ecosystem protection that can be included in protected area expansion strategies. • Assessing management effectiveness can be undertaken once initial extent accounts are produced.

Accounts

NCA can measure Zimbabwe's wealth of land, water, minerals, ecosystems, biodiversity and ecological infrastructure. The information generated by NCA will increase understanding of the contribution of biodiversity to Zimbabwe's economy and the NCA process will provide valuable input in the development of the biodiversity satellite account. Only some aspects of the biodiversity economy are currently captured in the national accounts, for example through the tourism satellite accounts. However, the specific contribution of biodiversity and natural ecosystems in the form of nature-based tourism remains unknown. Finalization of the Tourism Satellite Account is expected to improve the accounting of the performance of the tourism sector. However, to accurately determine the contribution of ecosystems and biodiversity to tourism value, ecosystem accounts are needed, followed by a biodiversity tourism account. Forests are another example: their full value in terms of the goods and services they provide is not fully captured in the national accounts. Forest accounts would capture the total extent of forest land, wood assets and the supply and use of woody resources and other non-woody forest products.

Developing key policy questions to frame each account is an important step in understanding the relevance and role of each account to achieving sustainable development. Table 22 provides a brief summary of the accounts that can be produced for Zimbabwe and their policy relevance.

Table 22. A summary of data needed to undertake NCA. Note that this list may not be exhaustive

CATEGORY	FORM	TYPE	DETAILS
Ecosystem accounting framework grid	Basic spatial unit	Geospatial raster and vector	Expert-driven through national statistics and geographical bodies. One hectare grid recommended for simplicity in account compilation, but a smaller unit may be necessary for small area accounts (e.g., urban areas).
Administrative Land tenure and management	Administrative boundaries	Geospatial vector	National statistics office or geographical body or several open-source datasets available online.
	Land ownership and/or tenure	Geospatial vector	Usually sourced in-country and may require compilation from historical records. Such data often have limited public accessibility, but efforts should be made to increase availability.
SDG Indicators	Indicators	Data spreadsheets	Data available at UNStats or FAOStat.
Land use/ land cover (LULC) – land and condition accounts	Land cover	Geospatial raster	A variety of open-source LULC datasets are available online. These vary in nominal and temporal resolution, number of classes and quality. For accounting between two time periods, a dataset that is directly comparable (i.e. produced in the same way, likely by the same entity) is required. Useful to explore different products to see which is most applicable to the EAA. Production of an in-country LULC product can be very useful for several applications beyond NCA and is thus a highly recommended undertaking. See Box 10 for more information on this.
	Ecosystem/ vegetation types	Geospatial vector or raster	A number of open-source ecosystem type/ biome datasets are available. A localized dataset produced in-country is recommended. Should be able to be aligned to the IUCN Global Ecosystem Typology.
	Ecosystem/ land condition	Geospatial vector or raster	Trends.Earth provides a useful tool for gathering globally consistent data that aligns to NCA reporting. More localised data is recommended but it is very challenging to accurately compile.
Topography	Digital elevation model (DEM)	Geospatial raster	Open-source DEM data are available online. Recommended resolution ranges from 30 m to 250 m depending on the scale of accounts, with a larger resolution suitable for a larger EAA. 90 m DEM suitable for most applications. 30 m available from SERVIR Global.

CATEGORY	FORM	TYPE	DETAILS
Wastes, pollution and environmental management	GHG Emissions data	Data spreadsheets	FAOStat or the World Bank data repository compile national emissions data if unavailable in-country.
	Pollution statistics	Data spreadsheets	Details of emissions and effluents from different economic actors (industry, households etc.).
	Environmental management expenditures		National expenditures on pollution abatement, wastewater management, environmental restoration and protection.
Minerals	Physical stock, production and sales data	Data spreadsheets	Stocks, production (extraction) and discoveries of prominent minerals, as well as output (sales), intermediate consumption, compensation of employees, unit rent ($/kg) data from national statistics.
Energy	Energy production and consumption	Data spreadsheets	Energy production by source and consumption by different economic actors
Water and hydrology	Water use and supply data	Data spreadsheets, integrated models	Production (water source), abstraction, intermediate consumption, return flows.
	River data	Geospatial vector	Rive mapping (perennial) and volumes measured in hydro volumes (start with all irrigation schemes).
	Waterbody extent	Geospatial raster	Consistent dataset for integration into land cover map or for reporting SDGs available from the Global Surface Water Explorer.
	Catchments	Geospatial vector or raster	Several open-source online datasets available or can be created using GIS software with a DEM.
	Historical metrological data	Data spreadsheets	Gathered from in-country weather service provider. Also available online (e.g., WorldClim) but should be used only in the absence of local data.
Demographic and social statistics	Population statistics / census	Data spreadsheets or geospatial	In-country census data recommended. Time-series gridded population spatial data can be sourced from WorldPop.
	Natural resource use / harvested resources / household surveys	Literature and data spreadsheets	Sourced from relevant literature and national census data.

CATEGORY	FORM	TYPE	DETAILS
Biodiversity	Species counts and distribution	Spreadsheets	Various online resources with species richness data including IUCN and the Global Biodiversity Information Facility (GBIF).
	Protected area boundaries	Geospatial vector	Usually compiled in-country by relevant ministry. Date of declaration attribute is important for compiling time series within protected area accounts.
	Hunting and game sales statistics	Data spreadsheets	Should be compiled by the PWMA and relevant ministry.
Tourism, cultural ecosystem services	Tourism statistics	Data spreadsheets	Satellite account data from ZTA/MECTHI and using InVEST recreation model.
	International tourist arrivals	Data spreadsheets	Data gathered from ports of entry statistics and can be compared to tourist attractions of various types to determine the number of tourists undertaking different types of tourism. Data can be requested from World Travel & Tourism Council (WTTC).
	Cultural values and places of cultural importance	Literature and archive materials	
Forestry and carbon	Forestry statistics/ inventories (stocks, extent and growth)	Data spreadsheets and geospatial vector or raster	National satellite accounts, Forestry Commission. Spatial data also available from Global Forest Watch. FAOStat provides national production and trade statistics.
	Deforestation and afforestation (legal and illegal)	Data spreadsheets and geospatial raster data	Available from year 2000 at Global Forest Watch.
	Net primary productivity, soil organic carbon and above and below-ground biomass	Geospatial raster data	Various global datasets available online.

CATEGORY	FORM	TYPE	DETAILS
Agriculture and fisheries	Agricultural production statistics, crop areas and food security	Data spreadsheets and geospatial datasets	National accounts, relevant department (Agritex, MLAFWRD).
	Livestock numbers	Data spreadsheets and geospatial raster data	May be available as part of national satellite accounts and from relevant government departments (Agritex, MLAFWRD). Spatially aggregated data at low resolution available through the FAO.
	Fisheries statistics	Data spreadsheets	National accounts, relevant department (PWMA, MLAFWRD) or Agritex, as well as online resources such as FAO and World Bank who collate fisheries data.
Macroeconomic data	GDP indices and data from different sectors	Data spreadsheets	National statistics (ZIMSTAT).

Data requirements for undertaking NCA

Substantial amounts of geospatial and non-geospatial data are needed to enable the production of accounts. This requires public sector investment in data collection on ecosystems, water and land cover. Zimbabwe should develop a structured framework for organizing, collecting and disseminating geospatial data and tools before embarking on the accounts. This is a key foundation to developing NCA, particularly ecosystem accounting, which allows for a consistent approach and spatial setup from the outset and is strongly recommended; Stats SA 2021a).

Table 22 provides a summary of data requirements for undertaking NCA. The data are summarized by category and a brief description is provided on data availability and the quality and extent of existing data, if known. From this a more detailed data collection and monitoring plan specific to each account should be developed by the ESC and technical working group. This plan should describe what data are collected by whom and cover any data gaps.

Box 10. Land use land cover (LULC):a fundamental dataset for undertakine NCA

A high-quality LULC dataset is essential for compiling land and ecosystem accounts as well as various thematic accounts. Zimbabwe does not have a high-resolution land cover dataset and should endeavour to create such a product using repeatable methods for later comparison. However, this is a relatively costly exercise. In the interim there are numerous global LULC products available that are constantly improving. For example, the ARIES platform uses the European Space Agency Climate Change Initiative land cover data. However, the authors have found that this often misclassifies woodland, grassland and small-scale agriculture in rural African settings. The Regional Centre for Mapping of Resources for Development based in Kenya uses Sentinel-2 satellite imagery to create land cover products for different years. There is currently only a 2016 land cover product available for Zimbabwe, but other years may become available. For the natural capital assessment as part of this study, the Copernicus Global Land Service LULC data (Buchhorn et al 2020) was found to be the most accurate for Zimbabwe's current land cover.

The choice of land cover dataset is challenging, with pros and cons associated with each option. An evaluation will need to be made that balances the accuracy, age and resolution of the data as well as the key outcomes of the exercise. For example, a dataset may be relatively new (produced in the last two years) and thus reflect a more accurate representation of the current physical landscape, but have a low (coarse) nominal resolution, say of 100 m or more, reducing the detail at which accounts can be produced. This is especially problematic for small areas and cities where the issue of resolution is amplified. A spatial resolution of 100 m (1 ha) is appropriate for national- and provincial-scale accounts and makes calculations relatively simple. This resolution also reduces computational demands of finer resolution data. However, for smaller geographical areas such as protected areas and city region/metropolitan accounts, a finer resolution of about 20 m would be preferable to better account for areas smaller than a hectare or linear/narrow features (Anchor Environmental Consultants 2020). Best practice is to standardize the selection of LULC data for all accounts such that they are directly comparable, even if not entirely accurate, to the real situation on the ground in all areas.

Deciding on the accounting area extent, a robust tiered classification (e.g., broad land cover classes at one level followed by ecosystem types or finer land use classes – see RDLR 2017; Dayaram et al 2021), naming and numbering of land cover classes is another important step in setting up the spatial architecture for NCA.

Where a better dataset for certain ecosystem features exists, the integration of this into the land cover should be investigated. For example, because LULC datasets are usually collected over a sub-annual period, they often reflect conditions that are ephemeral, which is particularly problematic for waterbodies and wetlands which may not be as widely detected as water by satellites in droughts or dry years (such was the case for South Africa's land accounts – Stats SA 2020). The global surface water datasets produced by Pekel et al (2016) are a prime example of a high-quality dataset that can be integrated into a LULC product.

With regard to ecosystem extent accounts, the IUCN has finalized the classification of its global ecosystem typology (Keith et al 2020) which provides a useful hierarchy at which to report results and is likely to become the standard for the SEEA EA framework. In addition to LULC, a finely mapped vegetation map indicating the historical cover of different ecosystem types is useful, and production of such a map should be prioritized with the assistance of regional vegetation mapping experts.

ROADMAP TO IMPLEMENTATION

The proposed roadmap to implementation for NCA in Zimbabwe is outlined in Figure 53. The roadmap includes eight broad tasks of implementation with a number of actions or recommendations to be considered or undertaken in each. These steps are discussed in more detail below.

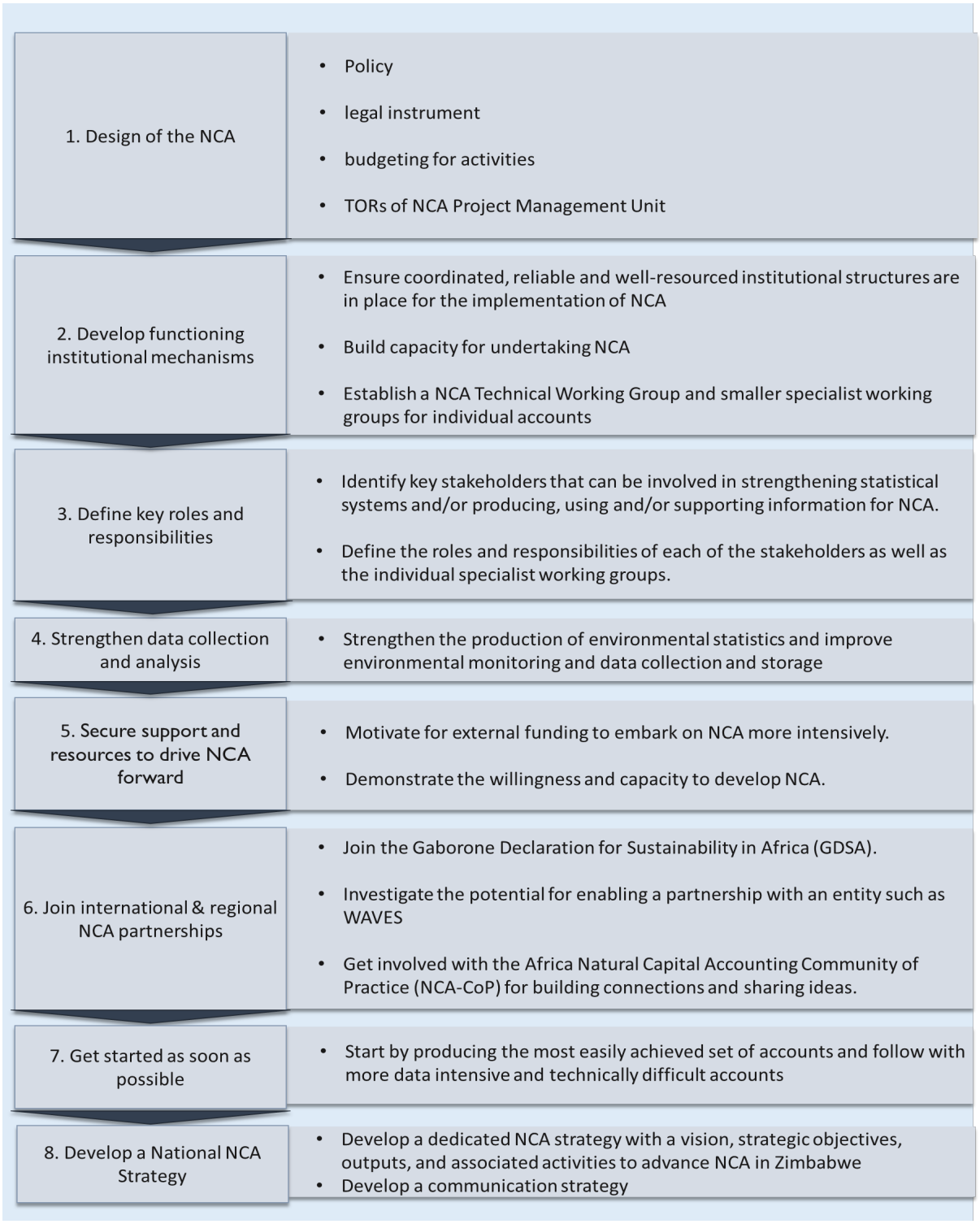


Figure 53. Roadmap to the implementation of NCA in Zimbabwe

1. Design of the NCA

MECTHI will establish the NCA project management unit headed by a deputy director. The terms of reference of the unit are as follows:

- Improving inter-ministerial cooperation to ensure holistic cross-sectoral planning and implementation
- Assessing current institutional arrangements and their applicability to NCA to fully understand if existing institutions are able to effectively and successfully undertake NCA or whether new institutions need to be developed or existing ones reformed to better accommodate the NCA system
- Building expertise in key environmental sectors through training and retaining skills, particularly in the natural resources management sector in terms of resource economics, ecosystem services assessment, modelling and valuation, and spatial analyses
- Improving monitoring and enforcement of environmental planning and management legislation through, for example, the development of a national biodiversity monitoring framework to ensure systematic and regular monitoring and reporting on key environmental indicators
- Improving the legal framework on biodiversity and the environment as a whole to ensure that biodiversity considerations are incorporated directly into the policies and planning of business or industry and organs of state; for example, to ensure that priority biodiversity areas in Zimbabwe are fully protected and their degradation or loss is avoided through appropriate legal approaches such as stewardship and offsets
- Reviewing legislation to reduce conflicting legislation across different sectors. For example, there is a need to incorporate biodiversity issues into the decision-making processes for other sectors, such as new mining and housing and infrastructural development projects
- Improving capacity for undertaking ecosystem services valuation and environmental accounting

All of the above are underpinned by the need to adhere to sound policies and economic reforms, which will unlock finances and restore capacity to some degree.

2. Develop functioning institutional mechanisms to support implementation of NCA

Undertaking NCA effectively and successfully in Zimbabwe will require that coordinated, reliable and well-resourced institutional structures are in place. It is recommended that the institutional arrangements as presented under "Proposed Framework for Zimbabwe: Institutional Arrangements" be adopted and implemented. The institutions in the proposed framework will produce NCA accounts.

3. Define the roles and responsibilities of key stakeholders and working groups

In addition to the ESC that has already been formed, it will be important to identify key stakeholders to drive NCA forward, in collaboration with ZIMSTAT and MECTHI, that could be involved in strengthening statistical systems and/or producing, using or supporting information for NCA. This will require close collaboration between partners and a mutual understanding of the objectives and goals of NCA implementation. Furthermore, it is important that non-governmental entities are included as partners or as part of reference and advisory groups.

Defining the roles and responsibilities of each of the stakeholders and individual specialist working groups and how they can contribute is important. This should ideally form part of the NCA strategy (item 5 below) or could be a separate environmental statistics sector plan which outlines all role players listed with their responsibility.

4. Strengthen data collection and develop spatial datasets

Zimbabwe could benefit from strengthening the production of environmental statistics and improving environmental monitoring and data collection, storage and availability. There is also a need to improve the collection and development of spatial data, which is critical for compiling several natural capital accounts. In the medium to long term, a comprehensive, accurate and accessible spatial data repository will be needed. Developing standardized, fit-for-purpose spatial architecture, including a suitable basic spatial unit, will be a valuable and useful undertaking.

5. Secure support and resources to drive NCA forward

The new development thrust under NDS1 presents an opportunity for facilitating the adoption of NCA. Stakeholders will need to motivate for internal and external funding to embark on NCA more intensively. Existing global and regional partnerships should be able to support Zimbabwe if they are able to demonstrate the willingness and capacity to develop NCA, and to be accountable for the support received.

6. Join international and regional NCA declarations and partnerships

In order to assist in the process of developing a framework and subsequently undertaking NCA, it is recommended that Zimbabwe joins the Gaborone Declaration for Sustainability in Africa. An expression of interest to join automatically renders a country an associate member. The declaration aims to promote three key actions for sustainability and a transition to a green economy: incorporating the value of natural capital into policies and decision making; pursuing inclusive sustainable production in natural resource-based sectors; and generating data and building capacity to support policy networks (Reuter et al 2016). Furthermore, enabling a partnership with an entity such as WAVES would streamline natural capital accounting in Zimbabwe. WAVES assists countries in identifying and adopting policy-relevant accounts and compiling data and information to support the compilation of such accounts (WAVES 2015). Its work to date has assisted countries set up dedicated units in key agencies and departments to undertake NCA. The work done adds to a growing body of evidence and experience used to refine and expand ecosystem accounting as part of the SEEA. It is also recommended that Zimbabwe joins the Africa Natural Capital Accounting Community of Practice.

The Government of Zimbabwe will join such declarations and partnerships to undertake NCA, and by having NCA champions, further funding and technical assistance will be offered to Zimbabwe.

7. Pilot prioritized set of accounts

MECTHI will commence development of a set of natural capital accounts that are not data-intensive. NCA is an iterative process and initial exploration can be experimental in its development to be used as building blocks for future iterations.

8. Develop a strategy for NCA, including a monitoring and evaluation plan

An integrated and well-structured approach will advance NCA in Zimbabwe. A dedicated NCA strategy will support the coordination and collaboration of institutions to strengthen their commitment and involvement in producing natural capital accounts. The creation of a NCA strategy should be followed by an indicative Implementation plan and draft monitoring and evaluation framework.

Work plan

The implementation of the roadmap is divided into five steps, each of which have specific objectives, reflecting the phased approach that is needed for NCA implementation in Zimbabwe (Figure 54).

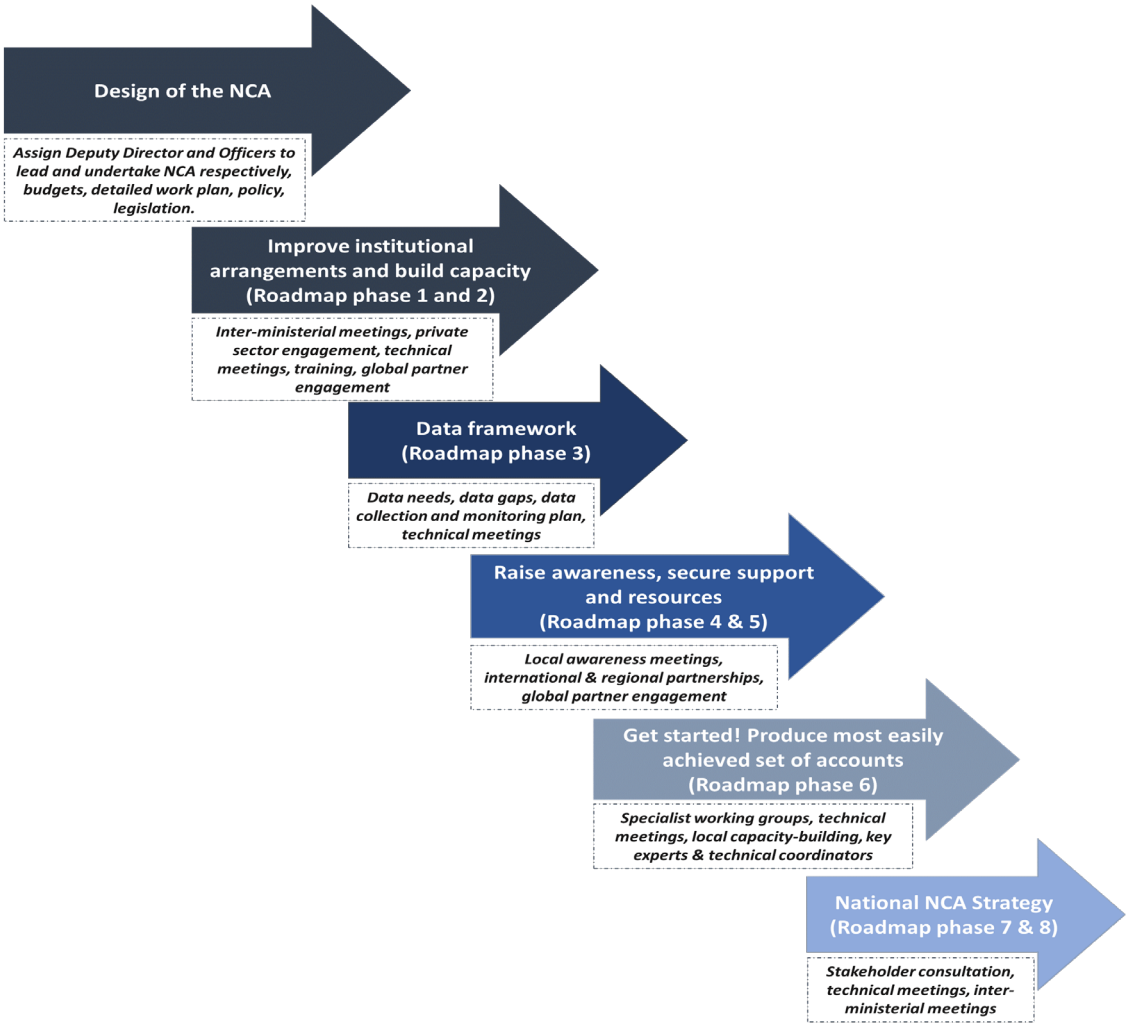


Figure 54. Work plan for implementation of the NCA roadmap

6. REFERENCES

ABioSA 2021. "How the baobab industry developed: From emerging to maturing sector."ABioSA case study.

Addicott, E.T., Fenichel, E.P. and Kotchen, M.J. 2020. "Even the representative agent must die: Using demographics to inform long-term social discount rates". Association of Environmental and Resource Economists 7: 379-415.

AfDB. 2015. "Payment for Environmental Services: A Promising Tool for Natural Resources Management in Africa". African Development Bank Group, Abidjan.

Africa Progress Panel APP 2014. "Grain Fish Money Financing Africa's Green and Blue Revolutions". https://www.tralac.org/images/docs/5693/africa-progress-report-2014-grain-fish-money.pdf

AfRSG 2016. "African rhino range states' African rhino conservation plan". www.readkong.com/page/african-rhino-range-states-african-rhino-conservation-plan-7576490

Anchor Environmental Consultants 2020. "Compilation of South Africa's natural capital accounts: lessons learned, way forward and recommendations". Unpublished report. Statistics South Africa, Pretoria.

Anderson, R. 2019. "Basic Spatial Unit". Version 2019_01. ZAF_BSU_100. Unpublished technical note.

Anderson, R. and Parry, R. 2019. "Natural capital accounting and valuation of ecosystems services: basic spatial unit for ecosystem accounting". https://seea.un.org/sites/seea.un.org/files/ncaves-ver4-small_0.pdf

Badura, T., Ferrini, S., Agarwala, M. and Turner, R.K. 2017. "Valuation for natural capital and ecosystem accounting". Synthesis report for the European Commission. Centre for Social and Economic Research on the Global Environment, University of East Anglia, Norwich.

Bagstad, K.J., Ingram, J.C., Lange, G.M., Masozera, M., Ancona, Z.H., Bana, M., Kagabo, D., Musana, B., Nabahungu, N.L., Rukundo, E., Rutebuka, E., Polasky, S., Rugege, D. and Uwera, C. 2020. "Towards ecosystem accounts for Rwanda: Tracking 25 years of change in flows and potential supply of ecosystem services". https://doi.org/10.1002/pan3.10062

Balint, P.J. and Mashinya, J. 2006. "The decline of a model community-based conservation project: Governance, capacity, and devolution in Mahenye, Zimbabwe". Geoforum 37: 805-815.

Bauer, H., Chardonnet, P. and Nowell, K. 2005. "Status and distribution of the lion in east and southern Africa". Background paper East and southern African lion conservation workshop. Johannesburg.

Begg, A. 2021. "Private investment is good news on several levels for Zimbabwe's conservation efforts". Daily Maverick. www.dailymaverick.co.za/article/2021-11-09-private-investment-is-good-news-on-several-levels-for-zimbabwes-conservation-efforts/

Belcher, B. and Schreckenberg, K. 2007. "Commercialisation of non-timber forest products: A reality check". Development Policy Review 25: 355-377.

Biggs, D., Ban, N.C., Castilla, J.C., Gelcich, S., Mills, M., Gandiwa, E., Etienne, M., Knight, A.T., Marquet, P.A. and Possingham, H.P. 2019. "Insights on fostering the emergence of robust conservation actions from Zimbabwe's CAMPFIRE program". Global Ecology and Conservation 17: 355-377.

BIZ 2014. "An assessment of the marula (Sclerocarya birrea) resource in the Binga, Hwange and Beitbridge districts of Zimbabwe". Bio-Innovation Zimbabwe Report, Harare.

Bojö, J. 1996. "The Economics of Wildlife: Case Studies from Ghana, Kenya, Namibia and Zimbabwe". Africa Technical Department Environmentally Sustainable Development Division (AFTES) Working Paper 19. World Bank Group. http://documents.worldbank.org/curated/en/449801468285058882/The-economics-of-wildlife-case-studies-from-Ghana-Kenya-Nambia-and-Zimbabwe

Bond, I. 1993. "The economics of wildlife and land use in Zimbabwe: An examination of current knowledge and issues". Multispecies project paper 36. WWF-SARPO Report, Harare

– 2001. "African wildlife, livelihoods. The promise, performance of community conservation". In African Wildlife and Livelihoods. Hulme, D. and Murphree, M. eds. Oxford: James Currey.

Bond, I., Chambwera, M., Jones, B., Chundama, M. and Nhantumbo, I. 2010. "REDD+ in dryland forests: Issues and prospects for pro-poor REDD in the miombo woodlands of southern Africa". International Institute for Environment and Development, London. https://www.iied.org/redd-protecting-climate-forests-livelihoods

Bond I., Wage S., Ruweza A. 2008. "Payment for ecosystem services PES in East and Southern Africa:Assessing prospects and pathways forward". http://www.katoombagroup.org/regions/africa/documents/2009 scoping report.pdf

Booth, V., 2002. "Analysis of wildlife markets (sport hunting and tourism)". WWF-SARPO Report, Harare.

Booth, V.R. 2010. "Contribution of wildlife to national economies". International Council for Game and Wildlife Conservation and Food and Agriculture Organisation.

Bösch, M., Elsasser, P. and Wunder, S. 2019. "Why do payments for watershed services emerge? A cross-country analysis of adoption contexts". World Development 119: 111-119.

Bouvet, A., Mermoz, S., Le Toan, T., Villard, L., Mathieu, R., Naidoo, L. and Asner, G.P. 2018. "An above-ground biomass map of African savannahs and woodlands at 25 m resolution derived from ALOS PALSAR". Remote Sensing of Environment 206: 156-173.

Boyle, J. 1997. "A politics of intellectual property: environmentalism for the net?". Duke Law Journal: 87-116.

Buchhorn, M., Smets, B., Bertels, L., De Roo, B., Lesiv, M., Tsendbazar, N., Herold, M. and Fritz, S. 2020. "Copernicus Global Land Service: Land Cover 100m": Collection 3: epoch 2019.

Campbell, B.M. 1987. "The use of wild fruits in Zimbabwe". Economic Botany 41:375–385.

Campbell, B.M., Angelsen, A., Cunningham, A., Katerere, Y., Sitoe, A. and Wunder, S. 2007. "Miombo woodlands – opportunities and barriers to sustainable forest management". ISRN Biodiversity Center for International Forestry Research, Bogor, Indonesia.

Campbell, B.M., Luckert, M. and Scoones, I. 1997. "Local-level valuation of savanna resources: A case study from Zimbabwe". Economic Botany 51: 59-77.

Campbell, B.M., Vermeulen, S.J. and Lynam, T. 1991. "Value of trees in the small-scale farming sector of Zimbabwe". International Development Research Centre. https://idl-bnc-idrc.dspacedirect.org/handle/10625/10855

Cavendish, W. 2000. "Empirical regularities in the poverty-environment relationship of rural households: Evidence from Zimbabwe". World Development 28: 1979-2003.

Chagumaira, C., Rurinda, J., Nezomba, H., Mtambanengwe, F. and Mapfumo, P. 2016. "Use patterns of natural resources supporting livelihoods of smallholder communities and implications for climate change adaptation in Zimbabwe". Environment, Development and Sustainability 18: 237-255.

Chambwera, M. and Folmer, H. 2007. "Fuel switching in Harare: An almost ideal demand system approach". Energy Policy 35: 2538-2548.

Chaumba, J. 2006. "Opportunities for and constraints on crop production within Zimbabwe's fast-track resettlement programme: A case study of Fair Range Estate, Chiredzi District, South Eastern Zimbabwe". University of Western Cape. http://hdl.handle.net/11394/1807

Chibememe, G., Muboko, N., Gandiwa, E., Kupika, O.L., Muposhi, V.K. and Pwiti, G. 2014. "Embracing indigenous knowledge systems in the management of dryland ecosystems in the Great Limpopo Transfrontier Conservation Area: The case of Chibememe and Tshovani communities, Chiredzi, Zimbabwe". Biodiversity 15: 192-202.

Chigonda, T. 2018. "More than just story telling: A review of biodiversity conservation and utilisation from precolonial to postcolonial Zimbabwe". Scientifica. https://doi.org/10.1155/2018/6214318" \t "_blank

Chigonda, T. and Urmilla, B. 2021a. "External and internal institutional issues affecting the Mahenye community from effectively benefitting from CAMPFIRE". In Wildlife and Fisheries Management in Zimbabwe: A Critical Reflection. Gandiwa, E., Mashapa, C. and Muboko, N. eds. Chinhoyi University of Technology, Zimbabwe.

Chigonda, T. and Urmilla, B. 2021b. "A comparative study of rural livelihood benefits from a community-based and a private protected area in Zimbabwe". In Wildlife and Fisheries Management in Zimbabwe: A Critical Reflection. Gandiwa, E., Mashapa, C. and Muboko, N. eds. Chinhoyi University of Technology, Zimbabwe.

Child, B. 1988. "The role of wildlife utilization in the sustainable economic development of

semi-arid rangelands in Zimbabwe". Biodiversity Conservation 5: 355–367

– 1995. "Wildlife and people: The Zimbabwean success". Wisdom Foundation. Harare

– 2000. "Making Wildlife Pay: Converting wildlife's comparative advantage into real incentives for having wildlife in African savannas: Case studies from Zimbabwe and Zambia". In Wildlife Conservation by Sustainable Use 18: 335-387.

– 2004. "Elephant culling in Zimbabwe". http://www.zimconservation.com/opinion.htm

– 2009. "Game ranching in Zimbabwe. in evolution and innovation in wildlife conservation". In Parks and Game Ranches to Transfrontier Conservation Areas. Suich, H., Child, B. and Anna, S. eds. London. Routledge.

Child, B.A., Musengezi, J., Parent, G.D. and Child, G.F.T. 2012. "The economics and institutional economics of wildlife on private land in Africa". Pastoralism 2: 1-32.

Chitsike, L.T. 1998. "Indigenous knowledge, intellectual rights and development". Sui-generis Legislation series. Community Technology Development Trust:2-8.

Chittaragi, A., Naika, R. and Vinayaka, K.S. 2014. "Nutritive value of few wild mushrooms from the western ghats of Shivamogga district, Karnataka, India". Asian Journal of Pharmaceutical and Clinical Research 7: 50-53.

Chou, P. 2018. "The role of non-timber forest products in creating incentives for forest conservation: A case study of Phnom Prich wildlife sanctuary, Cambodia". Resources 7. https://doi.org/10.3390/resources7030041

CNFA. 2014. "Fish farming in Malawi: An integrated approach to improving food security". www.cnfa.org/blog/fish-farming-in-malawi-an-integrated-approach-to-improving-food-security/

Crowards, T.M. 1996. "Natural resource accounting: A case study of Zimbabwe". Environmental & Resource Economics 7: 213-241.

Cumming, D. 1987. "Zimbabwe and the conservation of black rhino". Zimbabwe Science News 21: 59-62.

Dasgupta, P. 2009. "The Welfare Economic Theory of Green National Accounts". Environmental & Resource Economics 42: 3-38.

– 2021. "The Economics of Biodiversity: The Dasgupta Review". Her Majesty's Treasury.

Dayaram, A., Skowno, A.L., Driver, A., Sink, K., Van Deventer, H., Smith-Adao, L., van Niekerk, L., Harris, L.R., Job, N. and Nel, J.L. 2021. The South African National Ecosystem Classification System Handbook. Pretoria. South African National Biodiversity Institute.

Degreef, J., Kasongo, B., Niyongabo, E. and de Kesel, A. 2020. "Edible mushrooms, a vulnerable ecosystem service from African miombo woodlands". Biotechnology, Agronomy and Society and Environment 24: 70-80.

Dewees, P.A., Campbell, B.M., Katerere, Y., Sitoe, A., Cunningham, A.B., Angelsen, A. and Wunder, S. 2010. "Managing the miombo woodlands of southern Africa: Policies, incentives and options for the rural poor". Journal of Natural Resources Policy Research 2: 57-73.

Dickman, A., Cooney, R., Johnson, P.J., Louise, M.P., Roe, D. 2019. "Trophy hunting bans imperil biodiversity". Science 80: 365, 874.

Dowo, G.M., Kativu, S. and de Garine-Wichatitsky, M. 2018. "Local perceptions of tree diversity, resource utilisation and ecosystem services provision at the periphery of Gonarezhou National Park, Zimbabwe". Forests, Trees and Livelihoods 27: 1-21.

Dube, P. and Tapfumaneyi, L. 2021. "Collection and consumption of wild edible mushrooms in three villages of Binga , Zimbabwe". ResearchGate 10.21203/rs.3.rs-998341/v1

Dunham, K.M. and du Toit, A.J. 2013. "Using citizen-based survey data to determine densities of large mammals: A case study from Mana Pools National Park, Zimbabwe". African Journal of Ecology 51: 431-440.

du Plessis, P., Lombard, C. and den Adel, S. 2002. "Marula in Namibia: Commercial chain analysis". National Biological Research Institute, Windhoek, Namibia. https://www.nbri.org.na/marula-namibia-commercial-chain-analysis https://www.nbri.org.na/marula-namibia-commercial-chain-analysis

Dzingirai, V. 2003. 'CAMPFIRE is not for Ndebele migrants': The impact of excluding outsiders from CAMPFIRE in the Zambezi Valley, Zimbabwe". Journal of Southern African Studies 29: 1-14.

Dzingirai, V. and Mangwanya, L. 2015. "Struggles over carbon in the Zambezi Valley: The case

of Kariba REDD in Hurungwe, Zimbabwe". In Carbon Conflicts and Forest Landscapes in Africa. Leach, M. and Scoones, I. eds. Abingdon. Routledge: 142-162.

Ecosystem Marketplace. 2021. "Markets in motion: State of the voluntary carbon markets 2021". http://www.indiaenvironmentportal.org.in/content/471579/state-of-the-voluntary-carbon-markets-2021-market-in-motion/

Eddouks, M., Chattopadhyay, D., De Feo, V., Cho W.C. 2012. "Medicinal plants in the prevention and treatment of chronic diseases". Evidence-based complementary and alternative medicine. eCAM, 2012, 458274.

Egoh, B., Reyers, B., Rouget, M., Bode, M. and Richardson, D.M. 2009. "Spatial congruence between biodiversity and ecosystem services in South Africa". Conservation Biology 142: 553-562.

Eigenraam, M. 2019. "Basic Spatial Unit: Sources and Methods Report". Unpublished.

Ekka, A., Pande, S., Jiang, Y. and van der Zaag, P. 2020. "Anthropogenic modifications and river ecosystem services: A landscape perspective". Water Switzerland 12: 1-21.

Emerton, L. 2018. "Experiences and lessons learned in payments for ecosystem services PES in East Africa". U.S Agency for International Development. https://www.climatelinks.org/resources/experiences-and-lessons-learned-payments-ecosystem-services-pes-east-africa

Emslie, R., Services, E.C., Talukdar, B.K., Burgess, G. and Adcock, K. 2019. "African and Asian Rhinoceroses – Status , Conservation and Trade: A report from the IUCN Species Survival Commission" IUCN SSC.

European Commission 2018. "Natural capital accounting in support of policymaking in Europe: A review based on EEA ecosystem accounting work". EEA Report 26/2018. EEA, Luxembourg.

– 2019. "Natural Capital Accounting: Overview and Progress in the European Union: 6th Report". Publications Office of the European Union, Luxembourg.

– 2021. Accounting for Ecosystems and Their Services in the European Union. INCA. Publications Office of the European Union, Luxembourg.

Fairbrass, A., Mace, G., Ekins, P. and Milligan, B. 2020. "The natural capital indicator framework NCIF for improved national natural capital reporting". Ecosystem Services 46: 101-198.

Fakarayi, T., Mashapa, C., Gandiwa, E. and Kativu, S. 2015. "Pattern of land-use and land cover changes in Driefontein Grassland Important Bird Area, Zimbabwe". Tropical Conservation Science 8: 274-283.

FAO 2006. "Forest finance: Contribution of the forestry sector to national economies, 1990-2006". Working paper: FSFM/ACC/08. Food and Agriculture Organization.

– 2007. "Management practices for the protection of forest reserves: The case of Kalahari sand teak forest reserves in western Zimbabwe". Based on the work of John Mudekwe. Forest Management Working Paper FM/31 8-10.

– 2016. Fishery and Aquaculture Country Profiles. Republic of Zimbabwe. Food and Agriculture Organization.

– 2018. "Part 1 Overview and main indicators: Country briefing Fish and Aquaculture Country profile – Zimbabwe": 1-15.

– 2020a. Global forest resources assessment 2020 Report: Zimbabwe. Food and Agriculture Organization. https://www.fao.org/3/cb0093en/cb0093en.pdf

– 2020b. A cross-sector approach supporting the mainstreaming of sustainable forest and land management to enhance ecosystem resilience for improved livelihoods in the Save and Runde catchments of Zimbabwe https://www.thegef.org/projects-operations/projects/10257

– 2021. FAO Yearbook of Forest Products, Global Forest Products Facts and Figures. https://www.fao.org/forestry/statistics/80570/en/

– 2022. Fishery and Aquaculture Country Profile – Zimbabwe. https://www.fao.org/africa/news/detail-news/en/c/1618198/

Forestry Commission 2011. The State of the World's Forest Genetic Resources. Country Report. Zimbabwe. Ministry of Lands and Natural Resources.

– 2017. "Forestry information system landcover map 2017". http://www.forestry.co.zw/research-training-introduction/forestinformationsystem/

– 2019. "Hwange Sanyati biological corridor project wood drying kiln activity: Environmental and social management plan". http://www.forestry.co.zw/2019/12/17/hwange-sanyati-

biological-corridor-project-wood-drying-kiln-activity-environmental-and-social-management-plan-esmp/

Fredriksson, M. 2021. "India's Traditional Knowledge Digital Library and the Politics of Patent Classifications". Law Critique. https://doi.org/10.1007/s10978-021-09299-7

Frost, P. 1996. "The ecology of miombo woodlands". In The Miombo in Transition: Woodlands and Welfare in Africa". Campbell, B.M. ed. Bogor, Indonesia. Center for International Forestry Research: 11-57.

Galloway, F.B. 2014. "The Impacts of commercialising Commiphora wildii in two conservancies in north-western Namibia". University of Cape Town. https://open.uct.ac.za/handle/11427/9105

Gandiwa, E., Heitkönig, I.M.A., Lokhorst, A.M., Prins, H.H.T. and Leeuwis, C. 2013. "CAMPFIRE and human-wildlife conflicts in local communities bordering northern Gonarezhou National Park, Zimbabwe". Ecology and Society 18. https://www.ecologyandsociety.org/vol18/iss4/art7/

Garcia, R.C., de Oliveira, N.T.E., Camargo, S.C., Pires, B.G., de Oliveira, C.A.L., Teixeira, R. de A. and Pickler, M.A. 2013. "Honey and propolis production, hygiene and defense behaviors of two generations of Africanized honey bees". Scienta Agriola 70: 74-81.

Gaudillière, J.P. 2014. "An indian path to biocapital? The traditional knowledge digital library, drug patents, and the reformulation regime of contemporary ayurveda". East Asian Science, Technology and Society 8: 391-415.

Gebauer, J., Adam, Y.O., Sanchez, A.C., Darr, D., Eltahir, M.E.S., Fadl, K.E.M., Fernsebner, G., Frei, M., Habte, T.Y., Hammer, K., Hunsche, M., Johnson, H., Kordofani, M., Krawinkel, M., Kugler, F., Luedeling, E., Mahmoud, T.E., Maina, A., Mithöfer, D., Munthali, C.R.Y., Noga, G., North, R., Owino, W.O., Prinz, K., Rimberia, F.K., Saied, A., Schüring, M., Sennhenn, A., Späth, M.A., Taha, M.E.N., Triebel, A., Wichern, F., Wiehle, M., Wrage-Mönnig, N. and Kehlenbeck, K. 2016. "Africa's wooden elephant: the baobab tree Adansonia digitata L. in Sudan and Kenya: A review". Genetic Resources and Crop Evolution 63: 377-399.

Golden, C.D., Fernald, L.C.H., Brashares, J.S., Rasolofoniaina, B.J.R. and Kremen, C. 2011. "Benefits of wildlife consumption to child nutrition in a biodiversity hotspot". Proceedings of the National Academy of Sciences 108: 19653-19656.

Gotore, T., Ndagurwa, H.G.T., Kativu, S., Gautier, D. and Gazull, L. 2021. "Woody plant assemblage and the structure of miombo woodland along a disturbance gradient in Hurungwe, Zambezi Valley, Zimbabwe". Journal of Forestry Research 32: 1867-1877.

GoZ 2010. Zimbabwe Environment Outlook: Our Environment, Everybody's Responsibility, Zimbabwe's Third State of the Environment Report. Ministry of Environment and Natural Resources Management.

– 2013. Zimbabwe Agenda for Sustainable Socio-Economic Transformation ZimAsset. Harare: Government of Zimbabwe.

– 2014a. Zimbabwe's National Climate Change Response Strategy NCCRS. Ministry of Environment, Water and Climate.

– 2014b. National Biodiversity Strategy and Action Plan 2014. Government of Zimbabwe Ministry of Environment, Water and Climate, Harare.

– 2018. Rhino Management Strategy for Zimbabwe 2018-2022. Ministry of Environment, Water and Climate.

– 2019. Zimbabwe's Sixth National Report to the Convention on Biodiversity. Ministry of Environment, Water and Climate.

– 2020a. National Tourism Recovery and Growth Strategy. Ministry of Environment, Water, Climate, Tourism and Hopsitality Industry.

– 2020b. Zimbabwe's National Development Strategy 1 for 2021-2025 NDS 1. Government of Zimbabwe.

Greiber, T. et al 2012. "An explanatory guide to the Nagoya Protocol on access and benefit sharing". Gland, Switzerland: International Union for Conservation of Nature Environmental Law Centre.

Groom, R.J., Funston, P.J. and Mandisodza, R. 2014. "Surveys of lions Panthera leo in protected areas in Zimbabwe yield disturbing results: What is driving the population collapse?" Oryx 48: 385-393.

Gross-Camp, N.D., Martin, A., McGuire, S., Kebede, B. and Munyarukaza, J. 2012. "Payments for ecosystem services in an African protected area: Exploring issues of legitimacy, fairness,

equity and effectiveness". Oryx 46: 24-33.

Grundy, I., Turpie, J., Jagger, P., Witkowski, E., Guambe, I., Semwayo, D. and Solomon, A. 2000. "Implications of co-management for benefits from natural resources for rural households in north-western Zimbabwe". Ecological Economics 33: 369-381.

Grundy, I.M., Campbell, B.M., Balebereho, S., Cunliffe, R., Tafangenyasha, C., Fergusson, R. and Parry, D. 1993. "Availability and use of trees in Mutanda Resettlement Area, Zimbabwe". Forest Ecology and Management 56: 243-266.

Hansen, M.C.C., P.V., P., Moore, R., Hancher, M., Turubanova, S.A.A., Tyukavina, A., Thau, D., Stehman, S. V., Goetz, S.J., Loveland, T.R.R., Kommareddy, A., Egorov, A., Chini, L., Justice, C.O.O., Townshend, J.R.G.R.G., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S.A.A., Tyukavina, A., Thau, D., Stehman, S. V., Goetz, S.J., Loveland, T.R.R., Kommareddy, A., Egorov, A., Chini, L., Justice, C.O.O. and Townshend, J.R.G.R.G. 2013. "High-resolution global maps of 21st-century forest cover change". Science 342, 6160: 850-853.

Hove, M. and Chenzi, V. 2020. "Social media, civil unrest and government responses: the Zimbabwean experience". Journal of Contemporary African Studies 38: 121-137.

Illgner, P. and Nel, E. 2000. "The geography of edible insects in Sub-Saharan Africa: A study of the mopane caterpillar". The Geographical Journal 166, 4: 336-351.

IPBES 2018. "Summary for policymakers of the regional assessment report on biodiversity and ecosystem services for Africa of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services". Bonn: IPBES secretariat.

IRDNC (Integrated Rural Development and Nature Conservation) 2016. "The search to safeguard Zimbabwe's genetic heritage". Community Technology Development Trust.

IUCN (International Union for Conservation of Nature) 2017. "Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria. Version 1.1". https://portals.iucn.org/library/sites/library/files/documents/2016-010-v1.1.pdf

– 2020. "Closing the gap: Financing and resourcing of protected and conserved areas in Eastern and Southern Africa". https://biopama.org/event/closing-the-gap-financing-and-resourcing-of-protected-and-conserved-areas-in-eastern-and-southern-africa/

Jaffé, R., Dietemann, V., Allsopp, M.H., Costa, C., Crewe, R.M., Dall'olio, R., De La Rúa, P., El-Niweiri, M.A.A., Fries, I., Kezic, N., Meusel, M.S., Paxton, R.J., Shaibi, T., Stolle, E. and Moritz, R.F.A. 2010. "Estimating the density of honeybee colonies across their natural range to fill the gap in pollinator decline censuses". Conservation Biology 24: 583-593.

Jenkins, C.N., Pimm, S.L. and Joppa, L.N. 2013. "Global patterns of terrestrial vertebrate diversity and conservation". Proceedings of the National Academy of Sciences 110: E2603-E2610.

Johnson, J.A., Ruta, G., Baldos, U., Cervigni, R., Chonabayashi, S., Corong, E., Gavryliuk, O., Gerber, J., Hertel, T., Nootenboom, C. and Polasky, S. 2021. "The Economic Case for Nature: A global Earth-economy model". World Bank. https://openknowledge.worldbank.org/handle/10986/35882

Jones, B. and Murphree, M. 2001. "The evolution of policy on community conservation in Namibia and Zimbabwe". In African Wildlife and Livelihoods: The Promise and Performance of Community Conservation. Hulme, D. and Murphree, M. eds. Oxford: James Currey: 38-58.

Kanyenze, K. 2004. "Economic Structural Adjustment Programme: Precursor to the fast track resettlement?" In Post-independence Land Reform in Zimbabwe: Controversies and Impact on the Economy. Masiiwa, M. ed. Friedrich Ebert Stiftung and Institute of Development Studies, University of Zimbabwe: 90-124.

Karaan, M., Ham, C., Akinnifesi, F., Moombe, K., Jordaan, D., Franzel, S. and Aithal January, A. 2006. "Baseline marketing surveys and supply chain studies for indigenous fruit markets in Tanzania, Zimbabwe and Zambia". World Agroforestry Centre and CPWild Research Alliance. http://hdl.handle.net/20.500.12018/7406

Karambakuwa, R.T., Shonhiwa, T., Murombo, L., Mauchi, F.N., Gopo, N.R., Denhere, W., Chingarande, A. and Mudavanhu, V. 2011. "The Impact of Zimbabwe Tourism Authority Initiatives on Tourist Arrivals in Zimbabwe 2008". Journal of Sustainable Development in Africa 13: 68-77.

Keith, D.A., Ferrer-Paris, J.R., Nicholson, E. and Kingsford, R.T. 2020. "IUCN Global Ecosystem Typology 2.0: descriptive profiles

for biomes and ecosystem functional groups". https://portals.iucn.org/library/node/49250.

Kengoum, F., Thuy, P.T. and Sonwa, D.J. 2020. "A decade of REDD+ in a changing political environment in the Democratic Republic of Congo". CIFOR Infobrief No. 318.

Kindt, R., Breugel, P.Van, Demissew, S., Dudley, C., Friis, I., Gachathi, F., Kalema, J., Mbago, F., Minani, V., Moshi, H.N., Mulumba, J., Namaganda, M., Ndangalasi, H.J., Ruffo, C.K., Jamnadass, R. and Graudal, L. 2011. "Potential natural vegetation of eastern Africa Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia. Volume 2: Description and tree species composition for forest potential natural vegetation types". https://www.worldagroforestry.org/publication/potential-natural-vegetation-eastern-africa-ethiopia-kenya-malawi-rwanda-tanzania

King, S., Masiga, M., Eigenramm, M. and Obst, C. 2021. "Integrated accounting for land, soils and agriculture in Uganda". Paper for 27th London Group Meeting. https://seea.un.org/sites/seea.un.org/files/king_integrated-accounting-for-land-soils-and-agriculture-in-uganda_paper.pdf

Knight, M. 2020 "African Rhino Specialist Group Chair report /Rapport du Groupe de Spécialistes du Rhinocéros d ' Afrique". Pachyderm 61: 23-42.

Koech, J. 2011. "Hyperinflation in Zimbabwe". Annual Report, Globalization and Monetary Policy Institute. Federal Reserve Bank of Dallas: 2-12.

Kozanayi, W. and Frost, P. 2002. "Marketing of Mopane Worm in Southern Zimbabwe". Institute of Environmental Studies. Harare.

Kupika, O.L., Gandiwa, E. and Nhamo, G. 2019. "Green economy initiatives in the face of climate change: experiences from the Middle Zambezi biosphere reserve, Zimbabwe". Environment, Development and Sustainability 21: 2507-2533.

Kupurai, P., Kugedera, A.T. and Sakadzo, N. 2021. "Evaluating the potential contribution of non-timber forest products to smallholder farmers in semi-arid and arid regions: A case of Chivi, Zimbabwe". Ecological Research 3: 22-30.

Laird, S. 1995. "The natural management of tropical forests for timber and non-timber products". Oxford Forestry Institute Occasional Paper Series, No. 49 Oxford University

Laird, S. and Wynberg, R. 2012a. "Bioscience at a crossroads: implementing the Nagoya Protocol in a time of scientific, technological and industry changes Convention on Biological Diversity. https://www.cbd.int/abs/policy-brief/default.shtml/

– 2012b. "Diversity and change in the commercial use of genetic resources: implications for access and benefit sharing policy". http://ceser.in/ceserp/index.php/ijees/article/view/1963

Langholz, J.A. and Kerley, G.I.H. 2006. "Combining conservation and development on private lands: an assessment of ecotourism-based private game reserves in the Eastern Cape". Centre for African Conservation Ecology, Port Elizabeth.

Lin, Q. and Lian, Z. 2018. "On protection of intangible cultural heritage in China from the intellectual property rights perspective". Sustainability 10, 12. https://doi.org/10.3390/su10124369

Lindsey, P.A., Balme, G.A., Funston, P.J., Henschel, P.H. and Hunter, L.T.B. 2016. "Life after Cecil: channelling global outrage into funding for conservation in Africa". Conservation Letters 9: 296-301.

Lindsey, P.A., Roulet, P.A. and Romañach, S.S. 2007. "Economic and conservation significance of the trophy hunting industry in sub-Saharan Africa". Biological Conservation 134, 4.

Lindsey, P.A., Romañach, S.S., Tambling, C.J., Chartier, K. and Groom, R. 2011. "Ecological and financial impacts of illegal bushmeat trade in Zimbabwe". Oryx 45: 96-111.

Lopa, D., Mwanyoka, I., Jambiya, G., Massoud, T., Harrison, P., Ellis-Jones, M., Blomley, T., Leimona, B., van Noordwijk, M. and Burgess, N.D. 2012. "Towards operational payments for water ecosystem services in Tanzania: A case study from the Uluguru Mountains". Oryx 46: 34-44.

Loveridge, A.J., Valeix, M., Chapron, G., Davidson, Z., Mtare, G. and Macdonald, D.W. 2016. "Conservation of large predator populations : Demographic and spatial responses of African lions to the intensity of trophy hunting". Biological Conservation 204, Part B: 247-254.

Luckert, M.K., Nemarundwe, N., Gibbs, L., Grundy, I., Grant, K., Maruzane, D., Shackleton, S., Sithole, J., Lückert, M.K., Nemarundwe, N., Gibbs, L., Grundy, I., Hauer, G.K., Maruzane, D., Shackleton, S. and Sithole, J. 2014. "Contribution of baobab

production activities to household livelihoods: A case study in Zimbabwe" Advances in Economic Botany 17: 255–70.

Ludvig, A., Tahvanainen, V., Dickson, A., Evard, C., Kurttila, M., Cosovic, M., Chapman, E., Wilding, M. and Weiss, G. 2016. The practice of entrepreneurship in the non-wood forest products sector: Support for innovation on private forest land". Forest Policy and Economics: 66: 31-37.

Mabugu, R. and Chitiga, M. 2002. "Accounting for forest resources in Zimbabwe". CEEPA. University of Pretoria.

Machena, C. 2018. "Partnership for improved anti-poaching and compatible land use in community lands of the Lower Zambezi- Mana Pools Transboundary Conservation Area". Baseline report prepared for Zimbabwe Environmental Law Association. African Wildlife Foundation. https://tfcaportal.org/partnership-improved-anti-poaching-and-compatible-land-use-community-lands-lower-zambezi%E2%80%93mana-pools

– 2021. "Enhancing community resilience and sustainability of small scale fisheries of Lake Kariba and the Zambezi River: A Baseline Survey of the Lake Kariba inshore gillnet fishery." Report submitted to FAO, Zimbabwe.

Machena, C. and Moinuddin, H. 1993. "Management of the Lake Kariba inshore fisheries Zimbabwe". Proposal prepared for the Zambia/Zimbabwe SADC Fisheries Project.

Madzara A. 2013. "Monetary Quantification of the Ecosystem Products and Services in Protected Areas". Ministry of Environment, Water and Climate, Zimbabwe.

Maes, J., Teller, A., Erhard, M., Liquete, C., Braat, L., Berry, P., Egoh, B., Puydarrieus, P., Fiorina, C., Santos, F., Paracchini, M.L., Keune, H., Wittmer, H. and Hauck, J. 2013. "An analytical framework for ecosystem assessments under Action 5 of the EU biodiversity strategy to 2020. Publications office of the European Union, Luxembourg.

Mahlatini, P., Hove, A., Maguma, L.F. and Chemura, A. 2020. "Using direct use values for economic valuation of wetland ecosystem services: a case of Songore wetland, Zimbabwe". GeoJournal 85: 41-51.

Makhado, R., Potgieter, M., Timberlake, J. and Gumbo, D. 2014." A review of the significance of mopane products to rural people's livelihoods in southern Africa". Transactions of the Royal Society of South Africa 69: 117-122.

Malinga, W. 2018. "From an agro-based to a mineral resources-dependent economy': A critical review of the contribution of mineral resources to the economic development of Zimbabwe". Forum for Development Studies 45: 71-95.

Mandishona, E. and Knight, J. 2019. "Users' perceptions and understanding of two urban wetlands in Harare, Zimbabwe". South African Geographical Journal 101: 326-348.

Mandondo, A. 2000. "Situating Zimbabwe's natural resource governance systems in history". CIFOR occasional paper 3.2

Manganga, K. 2007. "An agrarian history of the Mwenezi District, Zimbabwe, 1980-2004". M. Phil thesis, Programme for Land and Agrarian Studies, University of the Western Cape.

Mapaura, A. 2002. "Endemic plant species of Zimbabwe". Kirkia 18: 117-148.

Mapedza, E. and Bond, I. 2006. "Political deadlock and devolved wildlife management in Zimbabwe: The case of Nenyunga Ward". Journal of Environment & Development 15: 407-427.

Maroyi, A. 2013. "Traditional use of medicinal plants in south-central Zimbabwe: Review and perspectives". Journal of Ethnobiology and Ethnomedicine 9.

Martin, R., Craig, G.. and Booth, V.R. 1989. "Elephant management in Zimbabwe". IUCN. https://portals.iucn.org/library/node/20697

Martin, R.B. 1986. "Communal Areas Management Programme for Indigenous Resources" CAMPFIRE Working Document No. 1/86. Department of National Parks and Wild Life Management, Harare.

Mashapa, C., Gandiwa, E., Mhuriro-Mashapa, P. and Zisadza-Gandiwa, P. 2014. "Increasing demand on natural forest products in urban and peri-urban areas of Mutare, eastern Zimbabwe: Implications for sustainable natural resources management". Nature & Faune Journal 28: 42-48.

Mashapa, C., Gandiwa, E., Muboko, N. and Mhuriro-Mashapa, P. 2021. "Land use and land cover changes in a human-wildlife mediated landscape of Save Valley Conservancy, south-eastern lowveld of Zimbabwe". J. Anim. Plant Science 31: 583-595.

Mashingaidze, N., Chirisa, I., Mutambisi, T. and Matamanda, A.R. 2021. "Paradoxes surrounding

carbon credits and local area development: the case of Mbire District, Zimbabwe". Local Environment 26: 1175-1185.

Matiza, T. 1994. "Wetlands in Zimbabwe: an overview". Proceedings of a Seminar on Wetlands Ecology and Priorities for Conservation in Zimbabwe, Harare Kentucky Airport Hotel, 13-15 January, 1992.

Mbopha, M.S. 2019. "Unlocking and securing ecological infrastructure investments: A review of EI investment models". South African Journal of Science.117, 9-10.

McGregor, J. 1991. "Woodland resources: ecology, policy and ideology an historical case study of communal area, Zimbabwe". Thesis, Loughborough University. https://hdl.handle.net/2134/7211

Medina, L. and Schneider, F. 2018. "Shadow economies around the world: What did we learn over the last 20 years?" IMF Working Paper 2018/017.

Melgarejo, L.M. 2013. "Bioprospecting as a possible development mechanism for Colombia". Acta Biológica Colombiana. 18: 19-30.

Mgbeoji, I. 2006. "Global biopiracy: Patents, plants, and indigenous knowledge". Vancouver. University of British Columbia Press.

Mihigo, B.P. and Cliquet, A. 2020. "Payment for Ecosystem Services in the Congo Basin: Filling the Gap Between Law and Sustainability for an Optimal Preservation of Ecosystem Services".

Millennium Ecosystem Assessment 2003. "Ecosystems and human well-being: A framework for assessment". Washington. Island Press.

– 2005. "Ecosystems and Human Well-being: Synthesis". Island Washington. Island Press.

Miller, D. and Gwaze, D. 2012. "Zimbabwe biodiversity and tropical forest assessment 118/119". USAID. https://usaidgems.org/Documents/FAA&Regs/FAA118119/Zimbabwe2012.pdf

Milligan, B., Terama, E., Jimenez-Aybar, R. and Ekins, P. 2014. GLOBE Natural Capital Accounting Study. GLOBE International and University College London.

Mlambo, A. and Maphosa, M. 2017. "Miombo woodland mushrooms of commercial food value: A survey of central districts of Zimbabwe. Journal of Food Security 5: 51-57.

– 2021. "Ectomycorrhizal mushroom yield association with woody species and leaf litter in a miombo woodland, central Zimbabwe. African Journal of Ecology and Ecosystems 8: 1-10.

Mojeremane, W. and Tshwenyane, S.O. 2004. "The Resource Role of Morula Sclerocarya birrea: A multipurpose indigenous fruit tree of Botswana". Journal of Biological Sciences 4, 6: 771-775.

Moore, A.E., Cotterill, F.P.D., Broderick, T. and Plowes, D. 2009. "Landscape evolution in Zimbabwe from the Permian to present, with implications for kimberlite prospecting". South African Journal of Geology.112: 65-88.

Moore, J.P., Lindsey, G.G., Farrant, J.M. and Brandt, W.F. 2007. "An overview of the biology of the desiccation-tolerant resurrection plant Myrothamnus flabellifolia". Annals of Botany 99: 211-217.

Morgera, E. and Geelhoed, M. 2016. "Consultancy on the Notion of 'Utilisation' in the Nagoya Protocol and the EU ABS Regulation for the Upstream Actors". University of Edinburgh. 10.13140/RG.2.1.1748.7604.

Moyo, S. 2011. "Three decades of agrarian reform in Zimbabwe". Journal of Peasant Studies 38: 493-531.

Moyo, S. and Tichaawa, T.M. 2017. "Community involvement and participation in tourism development: A Zimbabwe study". African Journal of Hospitality, Tourism and Leisure 6: 1-15.

Muboko, N., Dube, P., Mashapa, C., Ngosi, E. and Gandiwa, E. 2020. "Trophy quality trends and hunting effort of selected big game in Chewore South Safari Area, northern Zimbabwe, 2009-2012". Tropical Ecology 62: 52-60.

Mudekwe, J. 2007. "The Impact of subsistence use of forest products and the dynamics of harvested woody species populations in a protected forest reserve in western Zimbabwe". PhD thesis. University of Stellenbosch.

Mudombi-Rusinamhodzi, G. and Thiel, A. 2020. "Property rights and the conservation of forests in communal areas in Zimbabwe". Forest Policy and Economics 121.

Mudzengi, B.K., Gandiwa, E., Muboko, N., Mutanga, C.N. and Chiutsi, S. 2021. "Ecotourism resilience: The case of Mahenye community project, Chipinge District, Zimbabwe". African Journal of Hospitality, Tourism and Leisure 10: 459-471.

Mugandani, R., Wuta, M., Makarau, A. and Chipindu,

B. 2012. "Re-classification of agro-ecological regions of Zimbabwe in conformity with climate variability and change". African Crop Science Journal 20: 361-369.

Mujuru, L. and Oeba, V.O. 2019. "Forestry sector engagement in climate change action: the role of public and private sectors in Zimbabwe." International Forestry Review 21, Supplement 1: 87-101.

Mukamuri, B.B., Campbell, B.M. and Kowero, G. 2003. "Local organisations and natural resource management in the face of economic hardships: A case study from Zimbabwe". CIFOR-ICRAF. https://www.cifor.org/knowledge/publication/1414/

Mukwekwerere, M.C. 1996. "Non-timber forest products: their role in subsistence economies in Zimbabwe". Zimbabwe Science News: 30: 65-67.

Müller, T. 2006. "The distribution, classification and conservation of rainforests in eastern Zimbabwe". Occasional Publications in Biodiversity 19.

Murombedzi, J. 2001. "Committees, rights, costs and benefits: natural resource stewardship and community benefits in Zimbabwe's CAMPFIRE programme". In African Wildlife and Livelihoods: The Promise and Performance of Community Conservation: Hulme, D. and Murphree, M. eds. Oxford: James Currey: 244-255.

Musakwa, W., Mpofu, E. and Nyathi, N.A. 2020. "Local community perceptions on landscape change, ecosystem services, climate change, and livelihoods in Gonarezhou National Park, Zimbabwe". Sustainability 12.

Mutana, S. and Zinyemba, A.Z. 2013. "Rebranding the Zimbabwe tourism product: A case for Innovative packaging". International Journal of Advanced Research in Management and Social Sciences 2: 95-105.

Mutandwa, G. and Moyse, A. 2003. "The search to safeguard Zimbabwe's genetic heritage". Community Technology Development Trust.

Mutasa, M. and Ndebele-Murisa, M.R. 2015. "Biodiversity and Human Development in Zimbabwe". In Beyond the Crises : Zimbabwe's Prospects for Transformation. Murisa, T. and Chikweche, T. eds. Harare: Trust Africa.

Mutekwa, V.T. and Gambiza, J. 2017. "Forest protected areas governance in Zimbabwe: Shift needed away from a long history of local community exclusion". Journal of Environmental Management 198: 330-339.

Naidoo, R., Weaver, L.C., Diggle, R.W., Matongo, G., Stuart-Hill, G. and Thouless, C. 2016. "Complementary benefits of tourism and hunting to communal conservancies in Namibia". Conservation Biology 30: 628-638.

Nedkov, S. and Burkhard, B. 2012. "Flood regulating ecosystem services: Mapping supply and demand, in the Etropole municipality, Bulgaria". Ecological Indicators 21: 67-79.

NEMA 2021a. "Fisheries resources accounts for Uganda". National Environment Management Authority, Kampala.

– 2021b. "Biodiversity and tourism accounts for Uganda". National Environment Management Authority, Kampala.

Ngadze, R.T., Linnemann, A.R., Nyanga, L.K., Fogliano, V. and Verkerk, R. 2017. "Local processing and nutritional composition of indigenous fruits: The case of monkey orange Strychnos spp. from Southern Africa". Food Reviews International, 33: 123-142.

Ngulube, M.R., Hall, J.B. and Maghembe, J.A. 1996. "A review of the silviculture and resource potential of a miombo fruit tree Uapaca kirkiana Euphorbiaceae". Journal of Tropical Forest Science 8, 3: 395-411.

NISR (National Institute of Statistics of Rwanda) 2018. Rwanda Natural Capital Accounts – Land. Ministry of Environment and Ministry of Lands and Forestry, Kigali.

– 2019a. Natural Capital Accounts or Water. Ministry of Environment and Ministry of Lands and Forestry, Kigali.

– 2019b. Natural Capital Accounts or Mineral Resource Flows. Ministry of Environment and Ministry of Lands and Forestry, Kigali.

Nkatazo, L. 2010. "80% of Zimbabwe uses traditional medicine". Newspaper, The Zimbabwean, 5 March.

Nott, M. 2019. "Benefit sharing and environmental sustainability in policy and practice: the commercialisation of the resurrection bush Myrothamnus flabellifolius in Southern Africa". University of Cape Town. https://absch.cbd.int/en/database/record/251190

Ntirumenyerwa Mihigo, BP., Cliquet, A. (2020). Payment for Ecosystem Services in the Congo Basin: Filling the Gap between Law and

Sustainability for an Optimal Preservation of Ecosystem Services. In: Mauerhofer, V., Rupo, D., Tarquinio, L. (eds) Sustainability and Law. Springer, Cham. https://doi.org/10.1007/978-3-030-42630-9_32

Nyakudanga, J. 2021. "Zimbabwe forestry industry: The past, present and future". https://www.zimbabweforestrymagazine.com/article/zimbabwe-forestry-industry-the-past-present-and-future

Nyamayedenga, S., Mashapa, C., Chateya, R.J. and Gandiwa, E. 2021. "An assessment of the impact of the 2014 U.S. elephant trophy importation ban on the hunting patterns in Matetsi hunting complex, north-west Zimbabwe". Global Ecology and Conservation 30: e01758.

OECD (Organization for Economic Cooperation and Development) 2019. "Biodiversity: Finance and the Economic and Business Case for Action". Report prepared for the G7 Environment Ministers' Meeting, 5-6 May 2019.

Olson, D.M., Dinerstein, E., Wikramanayake, E.D., Burgess, N.D., Powell, G.V.N., Underwood, E.C., D'Amico, J.A., Itoua, I., Strand, H.E., Morrison, J.C., Loucks, C.J., Allnutt, T.F., Ricketts, T.H., Kura, Y., Lamoreux, J.F., Wettengel, W.W., Hedao, P. and Kassem, K.R. 2001. "Terrestrial Ecoregions of the World: A New Map of Life on Earth". Bioscience 51: 933-938.

Pekel, J.F., Cottam, A., Gorelick, N. and Belward, A.S. 2016. "High-resolution mapping of global surface water and its long-term changes". Nature 540: 418-422.

Phounvisouk, L. 2013. "Non-timber forest products marketing: trading network of trader and market chain in Luang Namtha Province, Lao PDR". IOSR Journal of Humanities and Social Science 18 4:48-57.

Poilecot, P. and Gaidet, N. 2011. "A quantitative study of the grass and woody layers of a Mopane Colophospermum mopane savannah in the mid-Zambezi Valley, Zimbabwe". African Journal of Ecology 49: 150-164.

Posey, D.A. 1985. "Native and indigenous guidelines for new Amazonian development strategies: understanding biological diversity through ethnoecology". In Change in the Amazon Basin. Vol. 1. Symposium at 44th international congress of Americanists, Manchester, 1982: 156-181.

Pritchard, R., Ryan, C.M., Grundy, I. and van der Horst, D. 2018. "Human appropriation of net primary productivity and rural livelihoods: Findings from six villages in Zimbabwe". Ecological Economics 146: 115-124.

PWMA 2018. "Zimbabwe's Review of the Convention on International Trade in Endangered Species CITES Leopard Panthera pardus Quota". Parks and Wildlife Management Authority.

– 2019. Zimparks Sustainability Report. Parks and Wildlife Management Authority.

– 2020. Zimbabwe National Lion Conservation Strategy and Action Plan 2020-2025. Parks and Wildlife Management Authority.

Reuter, K.E., Juhn, D., Portela, R. and Venter, J. 2016. "Natural capital accounting across the Gaborone Declaration for Sustainability in Africa: A desktop scoping".

Richerzhagen, C. 2011. "Effective governance of access and benefit-sharing under the Convention on Biological Diversity". Biodiversity and Conservation 20: 2243-2261.

Rihoy, L., Chirozva, C. and Anstey, S. 2010. "'People are not happy': Crisis, adaptation and resilience in Zimbabwe's CAMPFIRE programme". In Community Rights, Conservation and Contested Land: The Politics of Natural Resource Governance in Africa Nelson, F. ed. Routledge: 174-201.

Robinson, B.E., Holland, M.B. and Naughton-Treves, L. 2014. "Does secure land tenure save forests? A meta-analysis of the relationship between land tenure and tropical deforestation". Global Environmental Change 29: 281-293.

Robledo, C., Clot, N., Hammill, A. and Riché, B. 2012. "The role of forest ecosystems in community-based coping strategies to climate hazards: Three examples from rural areas in Africa". Forest Policy and Economics 24: 20-28.

Rousseau, K., Gautier, D. and Wardell, D.A. 2017. "Renegotiating access to shea trees in Burkina Faso: Challenging power relationships associated with demographic shifts and globalized trade". Journal of Agrarian Change 17: 497-517.

SADC 2008. Regional Biodiversity Strategy. Southern African Development Community.

Salzman, J., Bennett, G., Carroll, N., Goldstein, A. and Jenkins, M. 2018. "The global status and trends of payments for ecosystem services". Nature Sustainability 1: 136-144.

SANBI and Stats SA. 2021. Ecosystem Accounts for South Africa. Report of the NCAVES Project developed in partnership with United Nations Statistical Division and United Nations Environment Programme. South African National Biodiversity Institute, Pretoria.

Santoro, M., Cartus, O., Mermoz, S., Bouvet, A., Le Toan, T., Carvalhais, N., Rozendaal, D., Herold, M., Avitabile, V., Quegan, S., Carreiras, J., Rauste, Y., Balzter, H., Schmullius, C. and Seifert, F.M. 2018. "GlobBiomass global above-ground biomass and growing stock volume datasets". http://globbiomass.org/products/global-mapping

Schnegg, M. and Kiaka, R.D. 2018. "Subsidized elephants: Community-based resource governance and environmental injustice in Namibia". Geoforum 93: 105-115.

Schwab, K. 2019. The Global Competitiveness Report. World Economic Forum.

Scoones, I., Marongwe, N., Mavedzenge, B., Murimbarimba, F., Mahenehene, J. and Sukume, C. 2011. "Zimbabwe's land reform: A summary of findings". Institute of Development Studies, Brighton.

– 2012. "Livelihoods after land reform in Zimbabwe: Understanding processes of rural differentiation". Journal of Agrarian Change 12: 503-527.

Scoones, I., Mavedzenge, B., Murimbarimba, F. and Sukume, C. 2018. "Tobacco, contract farming, and agrarian change in Zimbabwe". Journal of Agrarian Change 18: 22-42.

Setshogo, M.P. and Mbereki, C.M. 2011. "Floristic diversity and uses of medicinal plants sold by street vendors in Gaborone, Botswana". African Journal of Plant Science and Biotechnology.

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

Sharai, S., Tawanda, T. and Gladman, C. 2020. "Threats and conservation strategies on urban wetlands: A case of Monavale and surrounding areas in Harare, Zimbabwe". American Journal of Environmental Protection 9 2: 31-38.

Sharma, S. 2017. "Traditional knowledge digital library: A silver bullet in the war against biopiracy". The John Marshall Review of Intellectual Property Law 17.

Sharp, R., Douglass, J., Wolny, S., Arkema, K., Bernhardt, J., Bierbower, W., Chaumont, N., Denu, D., Fisher, D., Glowinski, K., Griffin, R., Guannel, G., Guerry, A., Johnson, J., Hamel, P., Kennedy, C., Kim, C.K., Lacayo, M., Lonsdorf, E., Mandle, L., Rogers, L., Silver, J., Toft, J., Verutes, G., Vogl, A.L., Wood, S. and Wyatt, K. 2020. "InVEST 3.10.2.post28+ug.ga4e401c.d20220324 User's Guide". The Natural Capital Project, Stanford University, University of Minnesota, The Nature Conservancy, and World Wildlife Fund. https://invest-userguide.readthedocs.io/en/latest/index.html

Shumba, E.M. 2001. "Forestry outlook studies in Africa FOSA country report: Zimbabwe". Forestry Outlook Studies in Africa. https://www.fao.org/3/ac429e/ac429e.pdf

Sills, E., Shanley, P., Paumgarten, F., de Beer, J. and Pierce, A. 2011. "Evolving Perspectives on Non-timber Forest Products". In Non-Timber Forest Products In The Global Context: 23-51. Berlin Heidelberg: Springer.

Slingenberg, A., Braat, L., Windt, H. van der, Rademaekers, K., Eichler, L. and Turner, K. 2009. "Study on understanding the causes of biodiversity loss and the policy assessment framework". Report for the European Commission Directorate-General for Environment.

Snyman, S., Sumba, D., Vorhies, F., Gitari, E., Enders, C., Ahenkan, A., Pambo, A.F.K. and Bengone, N. 2020. "State of the wildlife economy in Africa". Kigali, Rwanda: African Leadership University, School of Wildlife Conservation.

South Pole Group 2020. The Kariba Forest Protection Project 2020. https://www.southpole.com/public/projects/0990.pdf

Space for Giants. 2019. "Building a wildlife economy: Developing nature-based tourism in Africa's state protected areas.. Working Paper 1. https://www.biofund.org.mz/biblioteca_virtual/building-a-wildlife-economy-working-paper-1-developing-nature-based-tourism-in-africas-state-protected-areas/

Stack, J., Dorward, A., Gondo, T., Frost, P., Taylor, F., Kurebgaseka, N., Gwavuya, S., Tawedzegwa, M., Rutamaba, W., Tlotlego, S. and Zhou, R. 2003. "Mopane worm utilisation and rural livelihoods in Southern Africa". In The International Conference on Rural Livelihoods, Forests and Biodiversity: 1-38.

Standley, S. and Emslie, R.H. 2013. "Population and poaching of African rhinos across African

range states". Evidence on Demand. http://www.stoprhinopoaching.com/wp-content/uploads/2021/08/Population-and-Poaching-of-African-Rhinos-across-African-Range-States.pdf

Stats SA 2020. Natural Capital 1: Land and Terrestrial Ecosystem Accounts, 1990 to 2014. Statistics South Africa, Pretoria.

– 2021a. National Natural Capital Accounting Strategy. A Ten-Year Strategy for Advancing Natural Capital Accounting in South Africa. Statistics South Africa, Pretoria.

– 2021b. Natural Capital 2: Accounts for Protected Areas, 1900 to 2020. Statistics South Africa, Pretoria.

Stern, N. 2007. The Economics of Climate Change: The Stern Review. London, Cambridge University Press.

Sugunan, V. V. 1997. Fisheries Management of Small Water Bodies in Seven Countries in Africa, Asia and Latin America. Food and Agriculture Organization.

Swiderska, K. 2009. Protecting Community Rights over Traditional Knowledge Implications of Customary Laws and Practices. International Institute for Environment and Development.

Taylor, R. 2009. "Community based natural resource Management in Zimbabwe: The experience of CAMPFIRE". Biodiversity and Conservation 18: 2563-2583.

Tchakatumba, P.K., Gandiwa, E., Mwakiwa, E., Clegg, B. and Nyasha, S. 2019. "Does the CAMPFIRE programme ensure economic benefits from wildlife to households in Zimbabwe?" Ecosystems and People 15: 119-135.

Tembani, M., Mujuru, L., Mureva, A., Mutete, P., Gotore, T., Muchawona, A., Makumbe, P. and Murepa, R. 2021. "Institutional arrangements and collective action: evidence from forest management in Zimbabwe". Forests, Trees and Livelihoods 30: 258-274.

The Humane Society. 2016. "Trophy hunting by the numbers: The United States' role in global trophy hunting". https://www.hsi.org/wp-content/uploads/assets/pdfs/report_trophy_hunting_by_the.pdf

Thouless, C.R., Dublin, H.T., Blanc, J.J., Skinner, D.P., Daniel, T.E., Taylor, R.D., Maisels, F., Frederick, H.L. and Bouché, P. 2016. "An update from the African Elephant Database African Elephant Status Report". Occasional Paper IUCN Species Survival Commission.

Tichaawa, T.M. and Mhlanga, O. 2015. "Residents' perceptions towards the impacts of tourism development: The case of Victoria Falls, Zimbabwe". African Journal of Hospitality, Tourism and Leisure 4.

TPF 2018. "Timber Producers' Federation's Presentation at the National Consultative Dialogue Workshop on land tenure and land policy in Zimbabwe". 15-16 February, Harare

Turpie, J.K., Forsythe, K.J., Knowles, A., Blignaut, J. and Letley, G. 2017. "Mapping and valuation of South Africa's ecosystem services: A local perspective". Ecosystem Services 27 Part B: 179-192:

Turpie, J.K., Letley, G., Schmidt, K., Weiss, J., O'Farrell, P.J. and Jewitt, D. 2021. "Towards a method for accounting for ecosystem services and asset value: Pilot accounts for KwaZulu-Natal, South Africa , 2005-2011". NCAVES project report: https://seea.un.org/content/knowledge-base

Turpie, J.K., Weiss, J. & Letley, G.L. 2022. Novel spatial modelling method for quantifying and assessing the sustainability of wild harvested resource use for physical and monetary ecosystem services and asset accounting. In review.

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

UN. 2010. System of National Accounts 2008. New York: United Nations.

– 2014. System of Environmental-Economic Accounting 2012. Central Framework. New York: United Nations.

– 2017. SEEA Experimental Ecosystem Accounting: Technical Recommendations. Prepared as part of the joint UNEP / UNSD / CBD project on advancing natural capital accounting funded by NORAD.

– 2021. "System of Environmental-Economic Accounting— Ecosystem Accounting SEEA EA". White cover publication final draft.

UNDP 2020. Human Development Report 2020. New York: United Nations Development Programme.

UNEP-WCMC 2022. "Protected area profile for Zimbabwe from the World Database of Protected Areas". Protected Planet.

UNFPA 2021. World Population Dashboard Zimbabwe. United Nations Population Fund.

Unganai, L.S. and Mason, S.J. 2001. "Spatial characterization of Zimbabwe summer rainfall during the period 1920-1996". South African Journal of Science 97: 425-431.

Utete, B. 2021. "A review of the conservation status of the Nile crocodile Crocodylus niloticus Laurenti, 1768 in aquatic systems of Zimbabwe". Global Ecology and Conservation 29: e01743.

Vallecillo, S., La Notte, A., Zulian, G., Ferrini, S. and Maes, J. 2019. "Ecosystem services accounts: Valuing the actual flow of nature-based recreation from ecosystems to people". Ecological Modelling 392: 196-211.

van der Meer, E. 2018. "Carnivore conservation under land use change: The status of Zimbabwe's cheetah population after land reform". Biodiversity and Conservation 27: 647-663.

van Uhm D. 2016. "The Illegal Wildlife Trade: Inside the World of Poachers, Smugglers And Traders". Berlin: Springer.

van Wyk, B.E., van Oudshoorn, B. and Gericke, N. 2009. Medicinal Plants of South Africa. Pretoria: Briza.

Vedeld, P., Angelsen, A., Bojö, J., Sjaastad, E. and Kobugabe Berg, G. 2007. Forest environmental incomes and the rural poor. Forest Policy and Economics 9, 7: 869-879.

WAVES 2016. "Natural Capital Accounting in Brief. Wealth Accounting and the Valuation of Ecosystem Services". Washington D.C. https://www.wavespartnership.org/sites/waves/files/images/NCA%20in%20Brief.pdf

WEF 2019. The Travel and Tourism Competitiveness Report 2019. Geneva: World Economic Forum.

World Economic Forum, World Bank and African Development Bank. 2011. The Africa Competitiveness Report 2011. World Economic Forum, Geneva.

Wendling, Z.A., Emerson, J.W., de Sherbinin, A. and Esty, D.C. 2020. "2020 Environmental Performance Results". New Haven: Yale Center for Environmental Law and Policy.

White, F. 1983. "The Vegetation of Africa, A descriptive memoir to accompany the UNESCO/AETFAT/UNSO Vegetation Map of Africa". https://portals.iucn.org/library/node/25459

WHO. 2012. Traditional Medicine and Intellectual Property Rights. World Health Organisation.

Woittiez, L.S., Rufino, M.C., Giller, K.E. and Mapfumo, P. 2013. "The use of woodland products to cope with climate variability in communal areas in Zimbabwe". Ecology and Society 18 4.

Wood, S.A., Guerry, A.D., Silver, J.M. and Lacayo, M. 2013. "Using social media to quantify nature-based tourism and recreation". Scientific Reports 3.

World Bank. 2019. Ease of doing business rank [WWW Document]. https://data.worldbank.org/indicator/IC.BUS.EASE.XQ?

– 2020. Natural Capital Accounting: Informing Policy Decisions and Management of Uganda's Natural Resources. World Bank.

– 2022. World Development Indicators. https://databank.worldbank.org/source/world-development-indicators

World Bank Group. 2021a. Unlocking Nature-Smart Development: An Approach Paper on Biodiversity and Ecosystem Services. World Bank Group, Washington D.C.

– 2021b. Changing Wealth of Nations 2021: Summary for Policy-makers. World Bank. World Bank Group, Washington D.C.

World Travel & Tourism Council (WTTC). 2017. Global Benchmarking Report 2017. World Travel and Tourism Council.

– 2021. Zimbabwe 2021 Annual Research: Key Highlights. World Travel and Tourism Council.

Wunder, S. 2005. "Payments for environmental services: Some nuts and bolts". CIFOR. https://www.cifor.org/knowledge/publication/1765/.

Wunder, S., Börner, J., Ezzine-De-Blas, D., Feder, S. and Pagiola, S. 2020. "Payments for environmental services: Past performance and pending potentials". Annual Review of Resource Economics 12: 209-234.

WWF. 1997. Quota Setting Manual. World Wide Fund for Nature, Zimbabwe Trust, Safari Club International.

– 2016. WWF Zimbabwe Conservation Strategy: 2015-2020. World Wildlife Fund For Nature, Harare.

Wynberg, R., Laird, S., Van Niekerk, J. and Kozanayi, W. 2015. "Formalization of the natural product trade in Southern Africa: Unintended Consequences and policy blurring in biotrade and bioprospecting". Society & Natural Resources 28: 559-574.

Zibanai, Z. 2018. "The tourism sector: A bright light in Zimbabwe's depressed economic environment". African Journal of Hospitality, Tourism and Leisure 7: 1-15.

ZIMSTAT 2012. Zimbabwe Population Cesnus 2012. Zimbabwe National Statistics Agency.

– 2016. Framework for the Development of Environment Statistics FDES in Zimbabwe. Zimbabwe National Satistics Agency.

– 2017. Inter-censal Demographic Survey 2017. Zimbabwe National Statistics Agency.

– 2018. Poverty, Income, Consumption and Expenditure Survey 2017 Report. Zimbabwe National Statistics Agency.

– 2019. Zimbabwe Poverty Report 2017. Zimbabwe National Statistics Agency.

ZIMSTAT and UNICEF 2019. MICS 2019 Survey Findings Report. Zimbabwe National Statistics Agency and the United Nations Children's Fund.

ZTA 2009. Tourism Trends and Statistics Report 2008. Zimbabwe Tourism Authority.

– 2020. Tourism Trends and Statistics Report 2019. Zimbabwe Tourism Authority.

– 2021. Tourism Trends and Statistics Report 2020. Zimbabwe Tourism Authority.

APPENDIX 1: GLOSSARY

Biodiversity: the variability among living organisms and the ecological complexes of which they are part. This includes variation in species, the diversity of species in ecosystems and the diversity of ecosystem types in nature.

Biodiversity economy: the businesses and economic activities that depend on conservation and sustainable use of indigenous biological resources, or that contribute to the conservation of biodiversity and ecosystem services.

Biodiversity sector: the sector that focuses on the conservation and use of a country's biological diversity, thereby effectively enabling its contribution to socio-economic development.

Biodiversity mainstreaming: the integration or inclusion of actions related to conservation and sustainable use of biodiversity with policies and planning of the state or business or industry.

Bioprospecting: the search for animal and plant species from which medicinal drugs, biochemicals and other commercially valuable material can be developed.

Biotrade: the collection, production, transformation and commercialization of goods and services derived from biodiversity.

Carbon sequestration: the process of capturing and storing atmospheric carbon dioxide. Natural carbon sequestration processes can be supported through changes in land use and agricultural practices, including forest restoration and the conversion of annual cropping systems and livestock grazing land into agroforestry systems.

Catchment: an area where water is collected by the natural landscape. Precipitation that falls in a catchment runs downhill into creeks, rivers, lakes, oceans or into built infrastructure such as reservoirs. In this report the terms "catchment" and "watershed" are used interchangeably.

Certification: a procedure by which a third party gives written assurance that a product, process or service is in conformity with certain standards.

Cost benefit analysis: a conceptual framework and tool used to evaluate the viability and desirability of projects or policies based on their costs and benefits over time. It involves the adjustment of future values to their present value equivalent by discounting at a rate which reflects the potential rate of return on alternative investments or the rate of time preference.

Discount rate: the interest rate used in discounted cash flow analysis to determine the present value of future cash flows.

Ecological infrastructure: nature's equivalent of grey or engineered infrastructure. It forms and supports a network of interconnected structural elements such as catchments, rivers, riparian areas and natural corridors supporting habitats and movement of animals and plants.

Ecosystem services: the benefits people obtain from the Earth's many life-support systems. The Millennium Ecosystem Assessment defines four categories of ecosystem services: provisioning, regulating, cultural and supporting services.

Natural capital: the stock of renewable and non-renewable resources (e.g., plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people.

Natural capital accounting (NCA): the process of measuring the total stocks and flows of natural resources and services in a given ecosystem or region. Accounting for such goods may occur in physical or monetary terms.

Payments for Ecosystem Services (PES): a system in which beneficiaries of ecosystem services compensate ecosystem managers (landowners or resource stewards) to change their practices in order to secure those ecosystem services. This may involve desisting from damaging activities or adopting more expensive practices that are less damaging to the environment.

Return on investment: a simple ratio of the gain from an investment relative to the amount invested. ROI is calculated by dividing net profit (current value of investment minus cost of investment) by the cost of investment.

Sustainable: managing the use and protection of natural resources in a way (or at a rate) that delivers social, economic and cultural well-being while ensuring that these resources are sustained for future generations and any adverse effects on the environment are minimized.

Tipping point: a point or critical threshold that, when exceeded, can lead to a large shift or irreversible change in the state of a system.

Trophy hunting: Also known as safari hunting or sport hunting. A trophy is any part of a wild animal or exotic animal that is hunted by a hunting client and that is retained as a token or memento of the hunt.

Value addition: the increase in the value of a good at each successive stage of production. It is the difference between the total value of output and the total value of intermediate consumption.

APPENDIX 2: CONTRIBUTORS TO THE COMPILATION OF THIS REPORT

The Ministry of Environment, Climate, Tourism and Hospitality Industry (MECTHI) thanks the following persons for their contributions in the compilation and review of the Zimbabwe Biodiversity Economy Report:

Zimbabwe Biodiversity Economy technical committee members: Munesushe Munodawafa, Edward Samuriwo, Tanyaradzwa Mundoga, Venrandah Munyoro (all of MECTHI), Innocent Madziva (Ministry of Finance and Economic Development), Lizzie Mujuru (head of delegation GBIF Zimbabwe, Department of Natural Resources, Bindura University), Constantine Nyanzero (youth entrepreneur), Cuthbert Kambanje (Food and Agriculture Organisation, Swaziland), Rose Mukogo (Green Tourism Services), Vupenyu Dzingirai (University of Zimbabwe Centre of Applied Sciences), Olivia Mufute (African Wildlife Foundation – AWF), Yemi Katerere (independent consultant) and Wellington Matsika (AWF).

Authors: Jane Turpie (Anchor), Luke Wilson (Anchor), Gwyn Letley (Anchor), Farai Mutondoro (Zimbabwe Environmental Law Association – ZELA), Nobesuthu Ngwenya (Parks and Wildlife Management Authority), Nqobizitha Ndlovu (ZELA), Cecil Machena (ZELA) and Byron Zamasiya (ZELA).

Reviewers: Alexis Wilkman (AWF), Andrea Athanas (AWF), Angela Kabira (MECTHI), Brett Stevenson (AWF), David Williams (AWF), Edwin Tambara (AWF), Eric Coppenger (AWF), Jia Quiao (AWF), Kundishora Mpandaguta (MECTHI), Munashe Mukonoweshuro (MECTHI), Natsai Kushata (AWF) and Prosper Matondi (MECTHI).

Editor: Alwyn Francis