UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

School of Geography, Archaeology & Environmental Sciences

RURAL WETLANDS USE AND SUSTAINABILITY:

A CASE STUDY OF ZINDI AREA IN HONDE VALLEY, ZIMBABWE

By

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A THESIS submitted to the **SCHOOL OF GEOGRAPHY, ARCHAEOLOGY & ENVIRONMENTAL STUDIES**, **FACULTY OF SCIENCE, UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG**, in fulfilment of the **DEGREE OF DOCTOR OF PHILOSOPHY** in **GEOGRAPHY AND ENVIRONMENTAL STUDIES**

Declaration

I, Emmah Mandishona, declare that this thesis is my own original work and is being submitted in fulfilment for the degree of Doctor of Philosophy to the Faculty of Science at the University of Witwatersrand, Johannesburg, South Africa. The data, figures, photos and tables are my original work. I have acknowledged within the text ideas and figures borrowed from other authors. It has not been submitted before for any degree or examination at any University.

Emmah Mandishona

Date: 28 June 2021

Abstract

Wetlands are crucial as they provide different ecosystem services that support livelihoods. However, uncontrolled use of wetlands globally has compromised wetland sustainability and negatively impacted on people and the natural environment. The thrust of this qualitative study is to understand how people in Zindi rural area, Honde Valley, Zimbabwe, use and interact with wetlands. The study also assessed the specific problems encountered by farmers in using wetlands for agriculture. Snowball and purposive sampling strategies were used to select participants for individual interviews and focus group discussions. Ethnographic techniques, such as participant observations and participatory action research, were also used to collect data. These were complemented with photos and direct observations of the physical characteristics of the six wetlands, and how people were using these wetlands. Semi-structured interviews and focus group discussions were conducted with farmers, the village heads, Agritex officers, seed companies and an Environmental Management Agency (EMA) official. Results show that wetland users depend on the valley bottom wetlands for provisioning and cultural services, and there are some changes between the ways in which wetlands have been used in the past compared to the present. Some of these changes included different types of crops grown on the wetlands and an increase in the amount of land used for wetland farming. As the wetlands were exploited mainly for provisioning services, some ecosystem supporting and regulatory services were affected. However, the changes reported by the farmers on different wetland elements such as the decrease in plant and animal species, loss of soil fertility and decrease in wetland water reflect how exploitation of some services has compromised other services. Therefore, the preservation of ecological characteristics and hydrological processes of the wetlands is threatened. The study also revealed that wetland farmers interacted with different stakeholders in different ways – with other wetland farmers when sharing ideas and seeds; village heads during wetland laws implementation; seed companies during seed breeding and seed selling; EMA officials during wetland restoration and implementation of wetland laws; and with Agritex officers when being shown good agronomy practises. In using wetlands for agriculture, farmers encountered challenges such as pests and diseases, stealing of crops, and water shortage in some parts of the wetlands. Although farmers were trying to employ sustainable methods of wetland exploitation, most of these methods were not correctly used. Training on conservation wetland farming was limited, hence farmers inappropriately employed dryland conservation farming techniques on wetland areas. Wetland users were not getting enough information from the EMA on wetland sustainable wetland use and management. Lack of collaboration amongst stakeholders involved in wetland use and management has compromised the sustainability of wetlands. The study contributes in advancing knowledge on how wetland use, methods of wetland exploitation, and different environmental attitudes by wetland users can affect the integrity and sustainability of the wetland ecosystem and sustainable development in a developing world context. This study recommends that the Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement in Zimbabwe, through the Department of Agricultural Technical and Extension Services and the EMA, should ensure wise use of wetlands by equipping wetland farmers with wetland conservation farming skills and ensuring effective monitoring and implementing of wetlands laws.

Keywords*: ecosystem services, wetlands, sustainability, management, user interactions, agricultural practices, wetland farmers, conservation*

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Dedication

I dedicate this PhD to my late parents, Mr Samson Rice Mandishona and Mrs Vongai Mugwadi Mandishona.

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Acronyms

AGRITEX- Agricultural Technical and Extension Services

ARDA- Agricultural and Rural Development Authority

CYMMTY- Centro Internacional de Mejoramiento de Maíz y Trigo (International Maize and Wheat Improvement Center)

EIA- Environmental Impact Assessment

EMA- Environmental Management Agency

FAO- Food and Agriculture Organisation

FEO- Field extension officers

GIS- Geographical Information Systems

GPS- Geographical Positioning System

IPCC- Intergovernmental Panel on Climate Change

ITCZ- Intertropical Convergence Zone

LEAP- Local Environmental Action Planning

SIP- Sustainable Intensification Programme

TSP- Transitional Stabilisation Programme

Zim-Asset- Zimbabwe Agenda for Sustainable Economic Transformation

ZINWA- Zimbabwe National Water Authority

Chapter 1: Introduction

1.1 Background to the study

The growth of the human population has increased the need for food and other resources, which has resulted in the increased exploitation of natural resources of different types (Jogo and Hassan, 2010; Kattumuri, 2018). Wetlands are amongst these widely used natural resources and have been directly used for different purposes and provide a variety of services to people (Cavendish, 2000; Rebelo *et al.*, 2010). Wetlands have been used globally to cater for human needs by providing a variety of goods and services because they are amongst the most productive ecosystems in the world (De Groot *et al.*, 2002; Thapa *et al.*, 2020; Dixon *et al.*, 2021). Extreme poverty in most developing countries has forced many people to depend on natural resources for their livelihoods (Cooper *et al.*, 2008; Kenton and Singha, 2018). The seasonal variability of rainfall amounts and distribution and extreme weather conditions has posed a threat to natural ecosystems and agriculture (Cooper *et al.*, 2008; Maco *et al.*, 2018). Many rural dwellers have turned to wetlands as a source of water. Agriculture on wetlands is mainly affected by extreme weather conditions since it is susceptible to climate variability (Kotir, 2011; Shiferaw *et al.*, 2014). The poor and vulnerable people in most developing world communities that rely on rain-fed agriculture for livelihoods sustenance are easily affected by climate variations (Cooper *et al.*, 2008; Kenton and Singha, 2018). Since 40% of people in Africa live in semi-arid or arid areas, the increase in temperature by 0.7°C over the past century has greatly affected them (Adenle *et al*., 2018). However, many people have moved to wetlands as a coping strategy against the dryland upland farming, which is no longer productive due to poor soil and unpredictable, erratic rainfall (Turyahabwe *et al.*, 2013).

The world is endowed with a variety of wetlands, and in most developing countries, they have become a source of income and food for both the urban and rural poor (Elegbede *et al*., 2014). Wetlands can be used for water purification and regulation of water flows, fishery and other resources for human and non-human uses, habitats for plants, animals and micro-organisms, and opportunities for recreation and tourism (Silvius *et al*., 2000). Wetlands contribute in different ways to the sustenance of people’s livelihoods since they can provide fruits to eat, reeds to thatch roof, timber for construction, peat and fuelwood for fire (Matlby, 2013; Marambanyika and Beckedahl, 2016a). In the past and in many places at present as well, wetlands in Africa were used for agriculture (variety of vegetables, cucurbits and cocoyam), fish, indigenous fruits, medicinal plants, grazing, and water and reed sources (Whitlow, 1983; Dixon and Wood, 2003). Wetland water can also be used for domestic purposes, and in many places, wetlands have been used for agriculture (cropping and livestock management systems) (Rebelo *et al*., 2010). In Tanzania, for example in Bumbwisudi and the Kilombero Valley wetlands, people relied on wetland water for domestic use during dry periods (Rebelo *et al*., 2010). Their inherent hydrological processes help mitigate extreme weather effects such as droughts and flooding (Silvius *et al*., 2000). Wetlands also perform essential environmental, economic and social functions (Tiner, 2017) due to the interactions between physical, chemical and biological elements of wetlands, such as soils, water, plants and animals (Smith *et al.*, 1995; Finlayson *et al.*, 1999). However, the use of wetlands in the past was generally of lower intensity than today, allowing wetlands to recover quickly. Recent activities have heavily impacted wetlands due to the increasing need for shelter, forage and food (Kairu, 2001; Bregoli *et al.*, 2019; Makopondo, Rotich and Kamau, 2020).

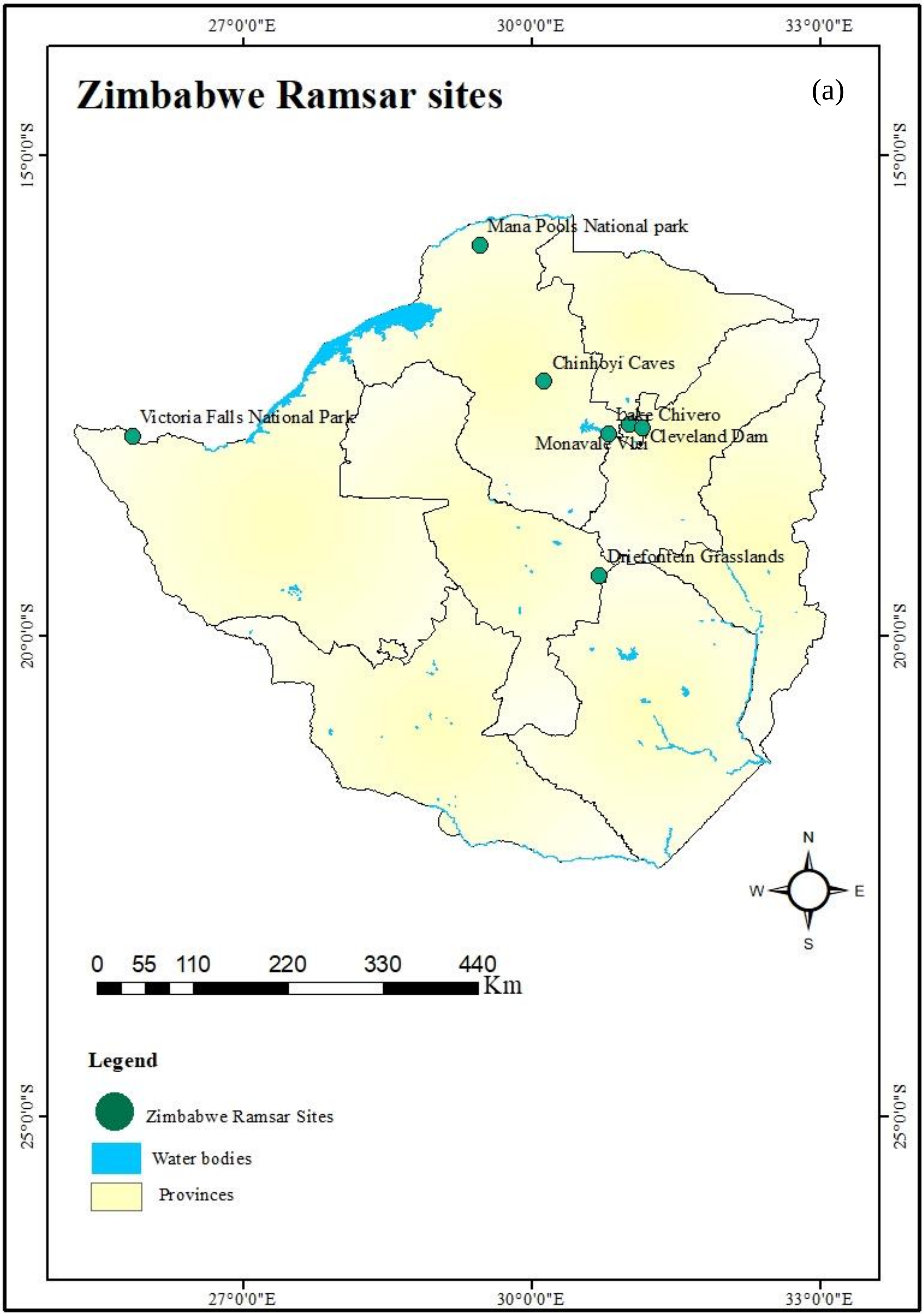
Although wetlands are valued for their benefits, in some areas, they have become territories of great concern because they are breeding places for mosquitoes causing malaria (Robarts *et al*., 2013). Pollution of wetlands due to waste dumping has contaminated wetland water and affected different plant and animal species. Wetlands have been used to treat acid mine drainage because they act as natural biological filters (Sheoran and Sheoran, 2006; Aguinaga *et al.*, 2018; Singh and Chakraborty, 2020). However, acid mine drainage treatment using wetlands has destroyed some wetland plants such as *Sphagnum* after failing to absorb toxic substances (Norton, 1992; Gazea *et al.*, 1996). The accumulation of heavy metals and acid in wetland water can be dangerous to the food web (Mays and Edwards, 2001; Ochieng *et al*., 2010; Aguinaga *et al.*, 2018). Acid mine drainage is toxic to wetlands aquatic life such as fish and frogs since they can die from the acid and toxic heavy metals (Ochieng *et al*., 2010).

Although following the Ramsar Convention in 1971, signatories of the Convention were compelled to set national regulations in 1975 to guard against the use of wetlands (Turner *et al.*, 2000; Finlayson *et al*., 2011), most governments in Africa enact wetland policies and regulations, but enforcement of these policies and regulations has been met with many challenges. The Ramsar Convention further supported the 'wise use of wetlands' to prevent and reverse the wetland loss and degradation (Finlayson *et al*., 2011). However, management and preservation of biodiversity and ecosystem function by natural resource users have become a challenge (Lee and Miller-Rushing, 2014; Hanford *et al*., 2020), which has left fragile ecosystems at risk due to environmental laws that are not being enforced. Although the Ramsar Convention encouraged signatories of the Convention to make an inventory of all the wetlands within their countries, inventories for wetlands in Africa are incomplete, and in some cases, the distribution of small wetlands such as dambos or vleis is not known (Finlayson and Van der Valk, 1995; Schuyt, 2005). Although Zimbabwe joined the Ramsar Convention in 2013, it does not have a recent inventory of all the wetlands.

In most African rural areas, there has been intensive use of small wetlands (dambos or vleis) for livestock grazing and crop production, and the competition for grazing land and agricultural land has resulted in the ecological destruction of wetlands (Scoones, 1991). In Nigeria, the Fadama agricultural project resulted in farmers expanding the cultivation area and therefore reduced the land available for livestock grazing during the dry season (Scoones, 1991). In southern Brazil, most wetlands have been converted to croplands, and some have been destroyed by road construction (Maclean *et al.*, 2003). Most people who use wetlands are supposed to be conserving them but want to benefit from them without considering that they should be used sustainably (Pearce *et al*., 2013). Zimbabwe has concentrated more on protecting its seven Ramsar sites (Wetlands of International Importance identified by the Ramsar Convention) (Figure 1.1a) rather than small wetlands such as vleis or dambos, which are the most common type of wetlands in most rural areas of Zimbabwe used to sustain rural livelihoods. This is despite the fact that many wetlands in rural areas of Zimbabwe have been reduced in size due to uncontrolled continuous and unsustainable use.

Zimbabwe has a variety of wetlands (Matiza and Crafter, 1994). The most common wetlands are known as dambos or vleis, and in some areas, they are known as “matoro”, “mapani” (in Shona) (Whitlow, 1990; Silvius *et al*., 2000; Mbereko *et al*., 2007; Mandishona and Knight, 2019). Dambos, also known as vleis in South Africa and Zimbabwe, are shallow low-lying wetlands at the source of drainage systems that are usually seasonally waterlogged (Mäckel, 1973; McFarlane and Whitlow, 1990; Bullock, 1992; von der Heyden, 2004). Dambos are a unique type of African freshwater seasonal wetland characterized by headwater streams (Bullock, 1992). According to the recent study by the Environmental Management Agency (EMA) (2012), wetlands occupy approximately 3% (11 717.4 km^2) of Zimbabwe’s land area. Zimbabwe is, therefore, estimated to have 1271 wetlands in total (Taylor *et al.*, 1995; EMA, 2012). About 60% of these wetlands are found in rural areas (Musasa and Marambanyika, 2020). These wetlands have been exploited for different ecosystem services. Wetland use by rural dwellers in Zimbabwe dates back prior to European colonization when African farmers practised shifting cultivation and cattle raising throughout the region (Whitlow, 1983; Roberts and Bell, 1990). Cultivation on wetlands involved draining the wetlands by constructing raised beds or ridges and basins (Whitlow, 1990; McCauley *et al.*, 2015). Farmers used to grow crops such as rice in wetter troughs or basins, whilst maize, pumpkins and *tsenza* (*Plectranthus floribundus*, a tuber crop) were grown on the better-drained ridges or basin rims (Whitlow, 1990). Dambo gardening has become a widespread activity amongst most rural communities in Zimbabwe. The failure of dryland agriculture to provide enough yields has compelled rural farmers to turn to wetland agriculture. The dambos or vleis mostly found in the Highveld of Zimbabwe's rural wetlands are commonly used for agriculture, livestock grazing, and burying children (Scoones, 1991; Marambanyika and Beckedahl, 2016; Musasa and Marambanyika, 2020). However, in some areas, people collect wild fruits, medicine and building material from wetlands. Despite objections from EMA that wetlands should be preserved, some rural wetlands have been used uncontrollably for different purposes in Zimbabwe. This study concentrated on six different valley bottom wetlands vleis or dambos, which are Tawarara A, Tawarara B, Madimbo, Chiwira, Rutsate and Mareya in Mutasa district in Honde Valley, Zindi rural area (Eastern Highlands of Zimbabwe) (Figure 1.1b) as case studies to explore how people use rural wetlands. These valley bottom dambos are common in the Honde valley area because of the presence of surrounding mountain ranges. Most of these wetlands found in the Eastern Highlands of Zimbabwe are wet the more significant part of the year due to considerably high rainfall.

However, just like any other natural resource, wetlands in Zimbabwe are also affected by climate variability. Since temperature and rainfall are the main factors contributing to plant growth on wetlands, climate variability has affected the integrity and biodiversity of wetlands, thereby affecting their functions (Nyieku *et al.*, 2021). Thus, climate changes have also caused impacts on natural ecosystems such as wetlands (Wood *et al*., 2013). Wetland losses have, therefore, increased over the past few years due to climate-induced impacts on different activities on wetlands such as agriculture (Elegbede *et al*., 2014; Sandi *et al.*, 2020). Different stakeholders such as politicians, environmentalists, rural and urban dwellers have different interests in wetlands because of the variety of benefits they derive from them. Wetlands have, therefore, different meanings for different people depending on how they are benefiting from them. Therefore the thrust of this research was to explore the different ecosystem services provided by rural wetlands and establish different ways in which rural dwellers have been using wetlands to sustain their livelihoods and how people interact with wetlands through other uses such as cultural uses, and how they value them. Thus, the different ways people have been benefiting from wetlands were identified to make an inventory on different ecosystem services provided by rural wetlands.


Zimbabwe Ramsar sites
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Victoria Falls National Park
Lake Chivero
Monavale Vlei
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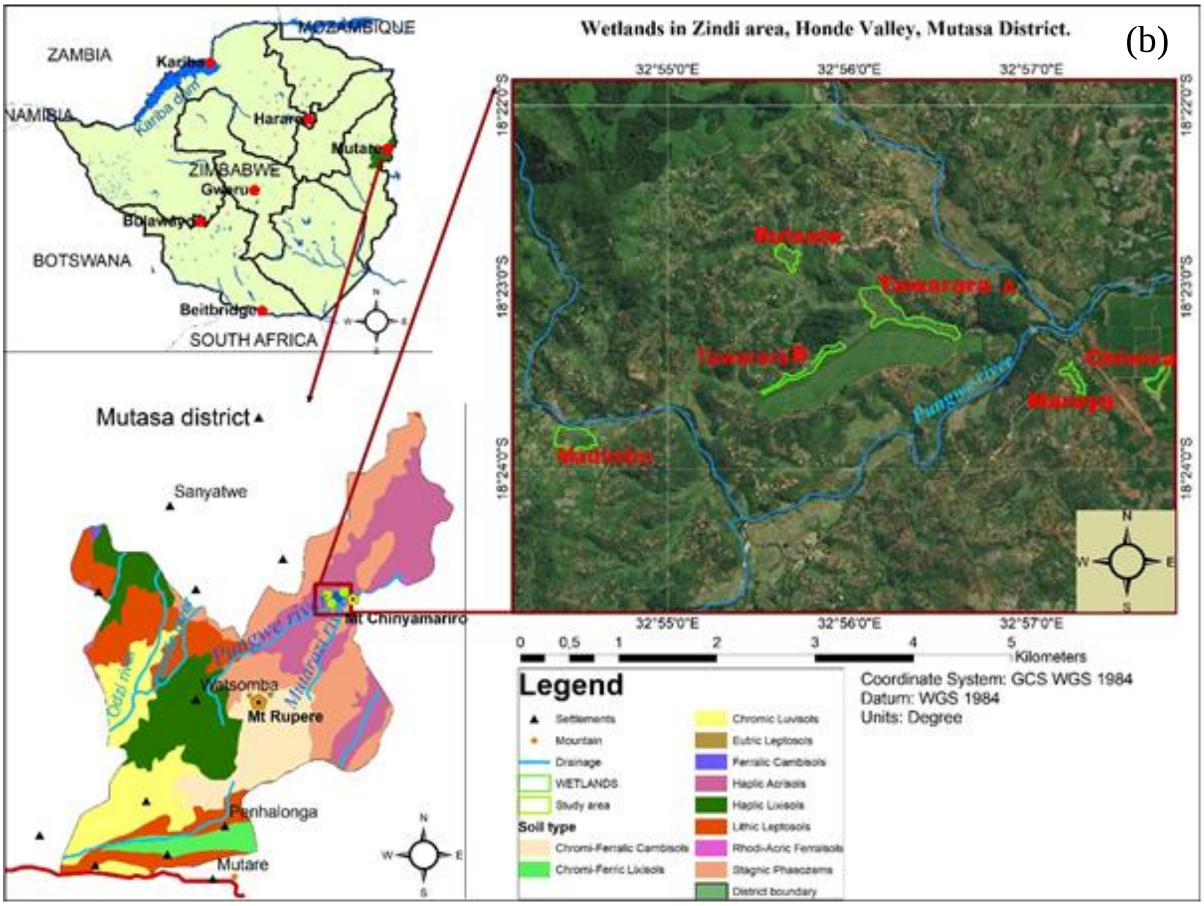

Figure 1.1: (a) Ramsar sites in Zimbabwe; (b) wetlands in Zindi rural area, Honde Valley, Mutasa District, Zimbabwe. Source: Map by Emmah Mandishona

Although wetlands play an essential role in livelihood sustenance, especially in developing countries such as Zimbabwe, few governments openly support their utilization and development (Dixon, 2005). Many smallholder farmers in rural areas in Zimbabwe have turned to wetlands for livelihoods sustenance as they produce a variety of crops for consumption and sale through wetland agriculture. However, in Zimbabwe the Environmental Management Agency Statutory Instrument 7 of 2007 section 20 (1) does not allow any person to reclaim or drain, drill or make a tunnel, introduce any exotic animal or plant species, cultivate, or licence the cultivation of or destroy any natural vegetation on, or dig up, break up, remove or alter in any way the soil or surface of wetlands without a licence issued by the Agency. Most rural dwellers do not apply for licences to use wetlands. As a result, rural wetlands in Zimbabwe continue to be exploited without control, and their sustainability is, therefore, questionable. Despite the EMA having a multi-sectoral national wetland committee (members include academics, government and the public sector) that monitors the use of wetlands, wetlands continue to be used uncontrollably.

Many environmental problems have also emanated from these wetlands' declining ecological qualities (Luan and Zhou, 2013), such as deforestation, peat oxidation, and fires on degraded peatland areas, unsustainable wetlands use and are responsible for greenhouse gas emissions. Overexploitation of rural wetlands has led to the destruction of these fragile ecosystems. Modification of wetlands by human activities has affected their ability to perform ecological functions (McCartney *et al*., 2005). There have been conflicts in Zimbabwe between different stakeholders on how wetlands should be used and managed (Marambanyika and Beckedahl, 2016a). Different institutions such as government, local leaders, non-governmental organizations and traditional institutions in rural areas have not reached a consensus on how wetlands should be used and managed (Mbereko *et al*., 2007). Since these institutions monitor access, utilisation, and wetlands management, hostile differences usually arise due to the conflicting roles and priorities of these different stakeholders (Marambanyika *et al*., 2012). Local communities who interact with these wetlands are usually excluded when decisions about these wetlands are being made. Hence, this study also explored the problems faced by wetland farmers and the role of different institutions and policymakers in assisting the rural population in ensuring sustainable use and management of wetlands.

1.2 Problem statement

The valley bottom wetlands have also been used as an adaptive strategy to unproductive dryland farming and providing different ecosystem services. However, the contribution of wetlands towards human wellbeing have frequently been unrecognised and overlooked by policymakers. Previous studies on valley bottom wetland established that they are used for food provision through agriculture (Scoones, 1991). However, besides sustaining livelihoods through agriculture, these small wetlands have provided many ecosystem and environmental services, yet there is little research about these. Human activities on wetlands have imposed considerable pressure on the wetland ecosystem services despite their contribution to societal wellbeing (Fenta *et al.*, 2020). Such pressure is attributed partly to the view that wetland ecosystem services have been considered infinite public resources (Fenta *et al.*, 2020). Whilst most research and the government has concentrated on the benefits of wetlands and increasing food output through agriculture, the essential wetland ecosystem services and the ecological processes that support agriculture or local communities seem to be ignored. Previous studies have focused on monitoring and assessing wetland use without fully understanding the sustainability of the different wetland land uses (Musasa and Marambanyika, 2020). Therefore, previous research in Zimbabwe has not paid attention to the sustainability of exploiting wetland ecosystem services. The interactions between people and these small valley bottom wetlands has not been explored. Hence, there are gaps in understanding the relationship between different exploited wetland resources and wetland ecosystem services. The current challenges in wetland management and conservation such as absence of wetland laws enforcement and management and conservation frameworks have compromised the integrity of wetlands in the region. Different institutions interested in exploiting the different wetland ecosystem services have not been able to collaborate to ensure sustainable use, management and conservation of wetlands. It is therefore crucial to study the nature of management and conservation of the small wetlands such as valley bottom wetlands since they support livelihoods and biodiversity.

Although it is well known that agriculture is the predominant activity in most wetlands in rural Zimbabwe, no previous research has explored the challenges that wetland farmers face. Understanding the ecosystem services provided by small valley wetlands and how these are exploited is critical for assessing wetland sustainability and for policymakers and management institutions to propose management frameworks and policies that ensure wetland wise use and management according to the Ramsar Convention and the EMA statutory instrument. Wetland ecosystem integrity has always been ignored as people prioritise food security, resulting in wetland loss. However, management institutions and policymakers seem to underestimate the value of wetland ecosystem services to nature and people (Rieprich and Schnegg, 2015). Understanding the ways in which wetlands have contributed to livelihood sustenance is, therefore, crucial in directing decisions that reduce the adverse effects and increase the benefits communities derive from wetlands (Turyahabwe *et al.*, 2013; Thapa *et al.*, 2020; Dixon et al., 2021). Intensive use of rural dambos or vleis in Zimbabwe provides a suitable context for analysing how people interact with wetlands and the different stakeholders in wetland use. Thus, the study seeks to understand human livelihoods and how they exploit different wetland ecosystem services is essential for understanding how livelihoods depending on wetlands affect their sustainable use and management. Therefore, this study explores how human exploitation of wetland ecosystem services affect the wetland ecosystem services and the interaction between wetland users and different institutions in sustainable use and management of wetlands.

1.3 Research questions

In the view of the above observations, the following research questions guided this study:

(i) What are the physical characteristics of valley bottom wetlands in Zindi rural area?

(ii) How are people using wetlands and how have they used them in the past in particular reference to culture, beliefs, agriculture and ecosystem services?

(iii) How do wetland farmers interact with other actors such as the wetland users traditional leaders, seed companies, Agritex officers, the Zimbabwe National Water Authority (ZINWA) and the EMA in wetland use?

(iv) What is the role of institutions and policymakers in assisting rural populations in wetland sustainable use and management?

(v) What are the different agricultural practices employed by farmers and what impacts do they have on the environment?

(vi) What challenges are faced by farmers in in using wetlands for agriculture and what are the proposed solutions?

1.4 Research aims and objectives

The use of wetlands has increased in rural areas in Zimbabwe. The uncontrolled use of wetlands have increased the rate at which wetlands are lost in Zimbabwe. Given the rate at which wetlands are being lost, the study sought to investigate how people in Zindi rural area of Honde valley interact with wetlands and the challenges they encounter in using wetlands for agriculture.

In light of the abovementioned aims of this study, the objectives of the study were to;

(i) Identify and describe the physical features of the six valley bottom wetlands in Zindi rural area

(ii) Evaluate how people are using rural wetlands and how they have used them in the past in particular reference to culture, beliefs, agriculture and ecosystem services;

(iii) Examine how wetland farmers interact with other actors such as the wetland users traditional leaders, seed companies, Agritex officers, the Zimbabwe National Water Authority (ZINWA) and the EMA in wetland use;

(iv) Assess the role of institutions and policymakers in assisting rural populations in wetland sustainable use and management;

(v) Explore the different agricultural practices and their environmental impacts; and

(vi) Analyse the challenges encountered by farmers in using wetlands for agriculture and the proposed solutions.

1.5 Thematic consideration and literature review

This section gives a brief summary of the different themes that exist in the literature on wetland use. The different themes will be explored in detail in Chapter 2.

Many wetlands in Africa have come under pressure due to human exploitation (Dixon and Wood, 2003). Available literature also explores how wetland ecosystem services have contributed to human well being in Africa. However, there has been confusion on what constitutes a wetland. This study will explore themes such as wetland definition and types and human use of wetlands, in line with different wetland definitions used globally (discussed in Chapter 2). Although wetlands cover only about 5–8 % of the terrestrial landscape globally, they are currently estimated to store about 830 Tg/year of carbon with an average of 118 g C m^{-2} $year^{-1}$ of net carbon retention (Mitsch *et al.*, 2013). Besides their importance in carbon sequestration, wetlands have also been affected by climate change. Global climate change is seen as a threat to species survival and the health of natural ecosystems such as wetlands (Erwin, 2009). Since the loss of wetlands has increased over the recent years, a balance should be ensured between wetland management, sustainable utilisation and conservation (Turner, 1991). Thus, literature on the management strategies of these ecosystems will further be discussed in Chapter 2.

1.6 Methodological approach

The study used a qualitative approach to collect information about how people in Zindi, Honde Valley rural area of Zimbabwe, use wetlands and interact with different stakeholders towards the sustainable use and management of wetlands. Ethnographic techniques which include semi-structured individual interviews, focus group discussions, participant observation, direct observation, and participatory action research supported by photographs allowed the researcher to solicit information about how people have used wetlands in the past and present and how seed companies the EMA work with the local community in ensuring sustainable use and management of wetlands. Data were also analysed using qualitative methods such as content analysis for individual interviews and focus group interviews and direct observation was analysed through descriptive analysis.

1.7 Scope of the study

This study focused on understanding how the six valley bottom wetlands (Tawarara A, Tawarara B, Madimbo, Chiwira, Rutsate and Mareya) in the Mutasa district in Honde Valley, Zindi rural area (Eastern Highlands of Zimbabwe) (Figure 1.1b), have been used in the past and present. The study also used ethnographic techniques and participatory action research to understand how people interact with the wetlands, with each other and with the external actors such as the institutions in wetlands use. The study participants were the residents of Zindi, village heads, the Agritex officers, the EMA and seed companies' officials. Methods used, such as semi-structured individual interviews, focus group discussions, participant observation, direct observation, and participatory action research supported by photographs, allowed the researcher to capture what people said and were doing in the wetlands. Since wetland farming is not openly encouraged, problems that wetland farmers face are usually neglected. Hence, this study assesses the problems farmers face in using wetlands for agriculture. This study further assesses the different ecosystem services provided by these wetlands and their interrelationships. How wetlands were exploited of their different ecosystem services as the wetland users interacted with the wetlands, the farmers, and the different institutions helped evaluate sustainable development of wetland agricultural ecosystems.

1.8 Spatial context of the study

This study was limited to six valley bottom wetlands in Zindi rural area, developed through a case study approach. The study did not cover all the valley bottom wetlands in Zindi because of limited resources and time. The agriculture referred to in this study is limited to growing a variety of crops in wetlands. Although the study identified respondents who were involved in livestock rearing, this was not explored in detail.

1.9 Structure of the thesis

This thesis has seven chapters. **Chapter 1** is the introductory chapter which highlights the aims, objectives, key research questions, and study structure. **Chapter 2** presents and reviews the different literature reflecting the topic under study. **Chapter 3** describes the study area's physical characteristics of Honde Valley, such as geology, topography, and climate. Chapter 3 also describes the economic activities done in the area. **Chapter 4** presents research approaches, procedures and methods used to collect data in this study. It focuses on the research strategy used, the researcher's position, the research design, the sampling techniques, data collection instruments, data collection process, data analysis, limitations of the study and ethical considerations. **Chapter 5** presents the empirical findings on how people exploit the ecosystem services and interact with different internal and external actors on wetland use and management. **Chapter 6** presents the discussion and analysis of the empirical evidence presented in Chapter 5. **Chapter 7** concludes the key findings by giving the summary, contributions of the study to the broader literature on wetland use in sub-Saharan Africa, and recommendations for future research.

Chapter 2: Literature Review

2.1 Introduction

This chapter establishes the conceptual framework for the study that is vital to explain the findings. This is done by highlighting the main themes and reviewing literature from different scholars to unpack the historical, integrated and dynamic issues surrounding the human use of rural wetlands and sustainability. This chapter will therefore discuss themes such as wetlands and wetland types, the human use of wetlands, history of wetland use in Zimbabwe, challenges faced by present-day smallholder farmers, sustainability and wetlands, wetlands and climate change, wetland ecosystem services and human well being, wetland cultural services and the role of institutions in wetland management.

2.2 Wetlands and wetland types

Although different scholars have tried to define wetlands in different ways, there is no single definition of wetlands (William, 1995). Therefore, it is challenging to define wetlands since they are complex and dynamic hydrological and ecological systems (Turner, 1991). Although a lot of wetland definitions and classifications have been devised for different needs, regions and functions (Hammer, 1989; Roggeri, 1995; Finlayson and Rea, 1999), wetland definitions should include at least one of the following: wetland hydrology, wetland soil, and vegetation structure (Roggeri, 1995; Lee, 1999). Over 50 definitions of wetlands exist (Adebe and Geheb, 2003). Some of these definitions are listed in Table 1.

The Ramsar Convention defines wetlands as "areas of marsh, fen, peatland or water whether natural or artificial, permanent or temporary with water that is static, flowing, fresh, blackish or salt including areas of marine water, the depth at which at low tide does not exceed six metres" (Dugan, 1990; Silvius *et al*., 2000). This definition focuses on two main features, which are hydrology and ecosystems (Ellery *et al.*, 2016). The Ramsar Convention's definition of wetlands has been widely used because it is more comprehensive as it broadly identifies the dynamic nature of wetlands and their place within the landscape (Silvius *et al*., 2000). This definition was the first attempt by the Ramsar Convention signatories to develop an integrated idea for the most productive ecosystems and provides the most critical starting point for identifying and managing wetlands (Shine and de Klemm, 1999). The Ramsar definition of wetlands was therefore coined to differentiate between inland coastal and marine wetlands to avoid including all surface water such as oceans and seas (Shine and de Klemm, 1999). In

1979, the US Fish and Wildlife Services broadly defined wetlands as a "transition between terrestrial and aquatic systems where water is the dominant factor determining the development of soil associated biological communities and where at least periodically the water table is at or near the surface, or land is covered by shallow water" (Cowardin *et al.*, 1979; Hammer, 1989). Although sources of deep waters such as lakes and dams were omitted in this definition, small wetlands such as marshes have been taken into consideration. The Ramsar Convention definition focuses more on water and soils and that of the US Fish and Wildlife Service covers water, soil, and vegetation and there are therefore minor differences between these definitions (Lee, 1999).

Table 2.1: Wetland definitions

Definition	**References**
"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or land that is periodically covered with shallow water and usually inhabited by hydrophilic vegetation."	Cowardin *et al*. (1979) Hammer (1989) Shinea (1999) Ndlazi *et a*l. (2016)
"An ecosystem that arises when inundation by water produces soils dominated by anaerobic processes and forces the biota, particularly rooted plants, to exhibit adaptations to tolerate flooding."	Keddy (2000)
"A wetland is an ecosystem that depends on constant or recurrent, shallow inundation or saturation at or near the surface of the substrate. The minimum essential characteristics of a wetland are recurrent, sustained inundation or saturation at or near the surface and the presence of physical, chemical, and biological features reflective of recurrent, sustained inundation or saturation. Common diagnostic features of wetlands are hydric soils and hydrophytic vegetation. These features will be present except where specific physicochemical, biotic, or anthropogenic factors have removed them. or prevented their development."	National Research Council (1995) Department of Environment and Resource Management (2011)
"Lowlands covered with shallow and sometimes temporary or intermittent waters"	Tiner (1988)
"Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."	US Soil Conservation Service (1988) in Tiner (1988)
''Wetlands are heterogeneous but distinctive ecosystems in which special ecological, biogeochemical, and hydrological functions arise from the dominance and particular sources, chemistry, and periodicity of inundation or saturation by water."	Merot *et al*. (2006)

Some countries have classified wetlands in different ways and created national wetland inventories which have concentrated on the characteristics and status of the wetlands within their countries, and some cannot, therefore, be used for international classification (Taylor *et al*., 1995). According to the Ramsar Convention, wetlands are grouped into five main groups which are marine (coastal wetlands), estuarine (deltas, tidal marshes and mangroves), lacustrine (lakes and associated wetlands), riverine (rivers, streams and associated wetlands), and palustrine (marshes swamps and bogs) (Dugan, 1990; Adebe and Geheb, 2003). Therefore, it is important to consider the geomorphological and hydrological characteristics in classifying these wetlands (van der Valk, 2012). Roggeri (1995) classified wetlands according to geomorphological (water and nutrients) and ecological units (vegetation). He therefore grouped them into four main groups, which are alluvial lowlands (floodplains and deltas), small valleys (headwater lowlands), lakeshores (deep or shallow lakes), and depressions (rivers and lake systems).

A variety of all these wetlands, however they are defined, are present in Africa. Coastal wetlands, deltas, marshes, lakes, rivers, streams, swamps and bogs stretch from the Senegal River to the Inner Niger Deltas in the West, the Sudan floodplains and the Ethiopian Wetlands in the East (Adebe and Geheb, 2003). Other important wetlands are found to the south including the Zaire Basin Swamps, the Okavango Inland Delta, the Kafue flats, the African Great Lakes, and the extensive Malagarasi-Moyovosi wetlands in Tanzania (Adebe and Geheb, 2003). Although these wetlands are the major wetlands found around Africa, they are commonly inaccessible and are being exploited by local people (Adebe and Geheb, 2003).

Marshes or Dambos (Chichewa name used in Malawi and Zambia) commonly known as *mapani* or *matoro* (Shona) Zimbabwe, fadama in Nigeria, inland valleys or bolis in Sierra Lione, vleis in South Africa, malapo in Namibia, Lesotho and Botswana, naka in Angola and bas fonds in Burkina Faso (Scoones, 1991; Matiza and Chabwela, 1992; Mbereko *et al*., 2007) are the most common type of wetlands in Africa (Mäckel, 1973; Roberts, 1988; von der Heyden, 2004). These are seasonally waterlogged wetlands and are part of the drainage network located close to headwater streams covering the low lying areas of uplands (Mäckel, 1973; Roberts, 1988; Turner, 1986; McFarlane and Whitlow, 1990; Bullock, 1992; von der Heyden, 2004). Zimbabwe is estimated to have 1271 wetlands (Taylor *et al*., 1995), of which 21% are considered to be stable (no evidence of degradation), 18% are extremely degraded, and 61% are moderately degraded (EMA, 2012). Zimbabwe is endowed with a variety of wetland such as riverine (inland rivers and international rivers), lakes, artificial impoundments (dams), floodplains, swamps, marshes and pans (Mharapara *et al*., 1998; Svotwa *et al*., 2008). Zimbabwe has small flood plains, swamps and marshes (dambos), but they are unique and diverse in nature (Matiza and Crafter, 1994). Marshes (dambos or vleis) are common wetlands in Zimbabwe, and they occupy 3.6% of the whole country (Frenken and Mharapara, 2002). The highest concentration of dambos in Zimbabwe is found in high altitude areas such as natural agro-ecological regions 1, 2 and 3 and this includes the area of this study (Mharapara *et al*., 1998; Musasa and Marambanyika, 2020).

Reaching consensus on what a wetland is made up of is essential for planning of wetland conservation at national and regional levels (Finlayson *et al*., 1999). The EMA adopted the Ramsar Convention's definition in defining wetlands in Zimbabwe (Environmental Management Agency Act, 2007). According to this Act, wetlands in Zimbabwe are defined as any area of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is flowing or static, fresh, peatland or brackish or salt, and includes riparian land adjacent to the wetland (EMA Act, 2007). Likewise, the EMA definition covers wetlands such as dambos, swamps, flood plains, riverine wetlands and artificial impoundments. Tooth and McCarthy (2007) define wetlands as areas that are regularly or continuously wet and have saturated soils and shallow water where a variety of plants and numerous biological activities are adapted to the wet soils and hydrophytic plants within the wetlands. Therefore, this study will adopt Tooth and McCarthy's (2007) definition since it concentrated on these shallow-water wetlands with saturated soils. Since dambos are seasonally or permanently saturated with water, and are readily available to be exploited for different purposes by most rural dwellers in Zimbabwe, they are to be considered as use case study areas for this research.

2.3 Human uses of wetlands

Wetlands have contributed to the advancement of human social and cultural development in the past and have historically been a source of water (Adebe and Geheb, 2003). Evidence showing that people once resided in these wetlands about 46 000 years ago (Ambrose, 1998) was discovered in the Ethiopian rift, Great Rift Valley and Omo in Southern Ethiopia (Adebe and Geheb, 2003). In Africa, wetlands have been used for cattle grazing, crop production and wetland water for domestic purposes, fishing, hunting and reed harvesting to sustain the local economies and individual livelihoods (Roberts, 1988; Scoones, 1991; Leauthaud *et al*., 2013). However, some human activities, such as drainage, unplanned and unregulated agriculture and settlement development have affected wetland biodiversity (Macharia *et al*., 2010; Thompson *et al*., 2010; Dixon *et al*., 2021). Wetlands have provided a wide variety of benefits for people and societies (Turner and Jones, 2013; Bregoli *et al.*, 2019). They have been referred to as the "kidneys of the landscape" as a result of their hydrological and chemical functions, and "biological supermarkets" because of the rich fauna and flora species they do support (Mitsch and Gosselink, 1993). Because of their dynamic and productive nature, wetlands have been under pressure from human use (Hartter and Ryan, 2010; Ayanlade and Proske, 2016; Chatanga *et al.*, 2020). Despite being fragile ecosystems, wetlands have historically been the key of livelihood sustenance due to their biodiversity, water availability and fertile soils fertile (Matiza and Chabwela, 1992; Mitsch and Gosselink, 1993; Mapedza *et al.*, 2012; Dixon *et al*., 2021).

The ecological condition and the size of wetland areas have changed due to destruction and conversion to other uses so that large areas have been lost globally (Junk *et al.*, 2013; Tan *et al*., 2021). According to Davidson (2014), 50% of both inland and coastal world wetlands have been lost since 1900 AD. Wetland activities such as land reclamation and drainage due to increased population densities have resulted in the loss of wetland biodiversity and drying up of some wetlands (Junk *et al.*, 2013; Wood *et al*., 2013; Musasa and Marambanyika, 2020). In some countries such as the USA and China, human-made wetlands have been on the increase through restoration (Wood *et al*., 2013). About 80 to 90% of the wetlands have disappeared in Southern Ontario, one of Canada's most populated regions, and Europe has also lost about 60% of its wetlands (Junk *et al.*, 2013). In the USA, vast wetlands such as the Great Dismal Swamp, Great Kankakee Marsh and the Great Black Swamp have been drained for agriculture, and the drainage of large wetlands in Russia began in the 17th and 18th centuries (Junk *et al.*, 2013).

Seasonally flooded wetlands such as dambos or vleis are used in arid and semi-arid regions to grow a variety of crops (Scoones, 1991; Scoones and Cousins 1994; Gopal, 2002; Sandi *et al.*, 2020). Rice, sedges, grasses, cucurbits, chillies and tomatoes are grown in Asia's seasonal wetlands (Gopal, 2002). In Africa, wetlands have been used to support livelihoods, and people have obtained food, water, firewood and fibre from these valuable ecosystems (Scoones, 1991; Wood *et al*., 2013; Marambanyika and Beckedahl, 2016a, 2016b; Dixon *et al*., 2021). In many arid and semi-arid regions, the capacity of dambos to allow for multiple cropping and their capacity to retain moisture for long periods has resulted in their widespread use for cultivation (Nyamadzawo *et al*., 2014a, 2014b). Cultivation of seasonal wetlands is common in Malawi, Zambia, Uganda, Angola, Kenya, Mozambique, Rwanda, South Africa and Zimbabwe (Mbereko *et al.*, 2007; Nyamadzawo *et al.*, 2014a, 2014b; Chatanga *et al.*, 2020). Dambo cultivation in Southern and East Africa is also similar to the cultivation of inland valleys known as fadamas in Nigeria and bolis in Sierra Leone (Mbereko *et al*., 2007; Nyamadzawo *et al*., 2015). Drainage and diversion of the water system within the wetlands through agriculture have affected the availability of water within these wetlands in some rural areas such as Zvishavane, Chiota, Mutasa and Matebeleland in Zimbabwe (Mbereko *et al*., 2007; Svotwa *et al*., 2008; Ndlovu and Manjeru, 2014; Nyamadzawo *et al*., 2015). Wetland cultivation in Zimbabwe continued after independence in 1980 though successive governments before and after independence prohibited their cultivation (Bell and Hotchkiss, 1991). Besides agriculture, wetlands have commonly been used for livestock grazing in dry regions such as Matabeleland in Zimbabwe (Ndlovu and Manjeru, 2014). Wetlands in rural areas in Zimbabwe are considered common property, although access and use of these wetlands are usually different (Mbereko *et al*., 2007).

The conversion of wetlands in urban areas for industrial and infrastructural development and farming has threatened their existence (Murungweni, 2013; Peng *et al*., 2018; Mandishona and Knight, 2019). Urbanisation has led to the increased use of wetlands for various purposes, and this has impacted on the quality of wetland water and soil and has led to the loss of biodiversity (Murungweni, 2013; Peng *et al*., 2018; Mandishona and Knight, 2019). Increasing population demands have posed a lot of pressure on wetlands (An *et al.*, 2007; Matamanda *et al.*, 2018; Matenga, 2019). The increase of poverty-stricken people living in informal settlements in many developing cities has posed a threat to wetlands (Dadaser-Celik *et al*., 2007; Douglas, 2018). People clustered in these informal settlements have been overexploiting the natural resources, and pollution from such settlements have affected wetland integrity (Douglas, 2018). Pollutants from industrial waste, household sewage and agricultural effluents have disturbed the aesthetic and functional value of wetlands, thereby rendering them less attractive for recreational and tourism activities (Xu *et al.*, 2019). An increase in population densities in urban areas has altered the land use of urban areas, which has also affected natural ecosystems such as wetlands (Dadaser-Celik *et al*., 2007; Douglas, 2018). Dadaser-Celik *et al*. (2007) on the Sultan marshes in Turkey revealed a reduction of forest-covered land area by 8.7% and agricultural land by 4.4%. Settlement area increased by 361% between 1989 and 2016, and this affected wetland ecology. These results corroborated with Song *et al.*'s (2012) study, which indicates that economic activities and environmental changes have increased wetland fragmentation and loss in northeastern China on the Mulenge Xingkai Plain. Here, these wetlands decreased in size by

64% due to anthropogenic activities such as agriculture. China's wetlands have also been threatened by dam construction (An *et al.*, 2007).

A study by Wasswa *et al*. (2019) revealed the loss of Kampala–Mukono Corridor wetlands in Uganda as they were converted to settlements, industries and agriculture. These wetlands were reduced in size by 47% from 1974 to 2013, and 56% of wetland loss was caused by development projects (construction of industries and residential houses) and agricultural activities. The development of Kampala into an industrial town attracted the construction of different structures on wetlands. The conversion of these wetlands in Uganda destroyed the habitats for warthogs, antelopes, geese and red-tailed monkeys, and many of these animals and birds migrated to the nearby Mukono district. Anthropogenic activities have, therefore, caused the degradation and loss of wetlands within the urban space (McCartney *et al.*, 2008; Mushamba, 2010; Wasswa *et al.*, 2019). Wetlands in urban areas continue to shrink, reducing the services they provide to people, such as water (Matamanda *et al.*, 2018). Some of the wetlands in Harare, Zimbabwe, such as Monavale, Borrowdale and Belvedere vleis, have also been affected by infrastructural development and crop production (Murungweni, 2013; Matamanda *et al.*, 2018; Mandishona and Knight, 2019). A study by Matamanda *et al*. (2018) reveals that the area of Monavale vlei in Zimbabwe decreased by 7% between 2010 and 2014 due to the development of residential houses, farming and waste dumping.

In the developed world, the destruction of wetlands due to agricultural activities occurred often hundreds of years ago, whilst in developing countries, it is continuing since the governments and the rural dwellers prefer short-term economic benefits of extensive agricultural production at the expense of the sustainability of the natural resources (Dadaser-Celik *et al.*, 2007). Marambanyika and Beckedahl (2016b) showed the shrinkage and dissection of Dufuya and Madigane, Guruguru, Tugwi, Chebvuterambatemwe and Zungwi wetlands in Midlands province, Zimbabwe, due to illegal wetland use. Although the EMA Statutory Instrument of 2007 reveals cultivation as one of the activities that should not be done without a permit, people continued to cultivate the wetlands uncontrollably on these six wetlands. This was mainly because most respondents (61.8%) indicated that they were not aware of the laws protecting the utilisation of wetlands. Similarly, Mbereko *et al*. (2007) revealed that increased population increased the use of wetlands for agriculture. Thus, the increased use of the Zungwi wetland led to the decline in the amount of water found in the wetland and deterioration in pastures and trees.

The intensity and use of wetlands for agriculture in rural areas of Zimbabwe have increased over the past few years due to high land pressure and recurring droughts, which render upland farming unproductive (Kangalawe and Liwenga, 2005; Mbereko *et al*., 2007; Svotwa *et al*., 2008; Marambanyika and Beckedahl, 2016c). Thus, the poor performance of rain-fed agriculture in upland fields has resulted in mounting pressure to cultivate dambos where both organic and inorganic amendments are used to sustain crop yields (Nyamadzawo *et al*., 2015; Bregoli *et al.*, 2019). The change in climate and climate variability resulted in crop failure on dryland farms causing food insecurity and compelling small scale farmers in Zimbabwe to turn to vleis or dambos which have water and are fertile (Nyamadzawo *et al*., 2015). In many smallholder farming areas in southern Africa, the cultivation of seasonal wetlands (dambos) represents an essential adaptation to climate change (Nyamadzawo *et al*., 2015; Marambanyika and Beckedahl, 2016c; Murdiyarso *et al*., 2019; Chatanga *et al.*, 2020). Wetland cultivation, therefore, remains a predominant activity on most wetlands in rural areas of Zimbabwe (Marambanyika and Beckedahl, 2016c; Musasa and Marambanyika, 2020).

Nyamadzawo *et al*. (2015) revealed that people in Chiota rural community in Zimbabwe grew many different crops on their wetland gardens, such as sweet potatoes, peas, beans, cucumbers, *tsenza* and Irish potatoes. Farmers in Chiota were using different methods of cultivation such as the ox-drawn plough, zero tillage and hoes. Some farmers used sickles to cut the grass and weeds, and some would burn the vegetation, and others would clear the land using the hoe, herbicides, zero tillage and grazing animals to clear their gardens before ploughing. By contrast, Mbereko *et al.*'s (2007) study on Zungwi wetland in Zimbabwe revealed that the farmers were using the broad ridge and furrow scheme to grow their crops. Indigenous knowledge on different agricultural methods, which have been passed from one generation to another, show the methods that rural dwellers use to cope up with issues of food shortage and environmental stress (Madebwe and Madebwe, 2005). The need to reduce poverty, food insecurity and malnutrition has forced many rural farmers to increase their crop production (Devereux, 2016; Dixon *et al*., 2021) and also grow a variety of crops (Madebwe and Madebwe, 2005; Marambanyika and Beckedahl, 2016c). However, extensive wetland use and some of the poor methods of land preparation and cultivation can lead to the loss of soil fertility (Thompson *et al*., 2010; Nyamadzawo *et al*., 2015; Tan *et al*., 2021).

Since wetlands are used for different purposes, it is therefore important to identify the activities and factors affecting wetland integrity for planning and implementing an efficient and holistic strategy to reduce and stop further wetland loss and degradation (Muangthong *et al*., 2012).

Ga-Mampa wetland in South Africa has also been used for fishing, hunting collection of medicinal plants, fuelwood, water for domestic use and livestock grazing (Adekola *et al.*, 2012). However, the size of this wetland shrunk due to agricultural activities. Similarly, a study by Marambanyika and Beckedahl (2016c) on wetland use in Vungu, Tongogara and Runde districts in Zimbabwe revealed that the areas that were under cultivation on the wetlands increased from 49.6 ha in 1985 to 53.4 ha in 2013. The predominant crop grown by these farmers was maize since it is a staple crop. However, the increase in the land used for cultivation resulted in the loss of vegetation on the wetlands. People also collected wild fruits, harvested reeds, hunted wildlife, collected medicinal plants, traditional vegetables and practised fishing in Dufuya, Madigane, Guruguru, Tugwi, Chebvuterambatemwa and Zugwi wetlands in Zimbabwe (Marambanyika and Beckedahl, 2016c). Marambanyika *et al.* (2012) in Midlands province of Zimbabwe showed that wetlands remain the key source of food and income for children’s school fees in the rural areas of this province. Similarly, Marambanyika and Beckedahl (2016c) indicate that farmers growing crops on Chebvuterambatemwa, Dufuya, and Madigane wetlands intensified horticultural activities due to the presence of a viable urban market (Gweru town). Since people grow crops in wetlands for consumption and income generation, farmers have seen wetlands as “pots of gold” (McElwee and Wood, 2018).

Unlike in urban areas, most wetlands in rural areas in Zimbabwe wetlands are considered a community asset where ownership of these valuable resources is communal and local residents can have access to these wetlands (Svotwa *et al*., 2008; Nyamadzawo *et al.*, 2015; Marambanyika and Beckedahl, 2016a). Although these dambos are fertile relative to upland areas, there is an increase use of both organic and artificial fertilisers to boost production (Nyamadzawo *et al*., 2014a). However, the drainage of wetlands and the increased use of organic manure can lead to the production and emission of more carbon within these wetlands (Knops and Tilman, 2000; Hendricks *et al*., 2007; Murdiyarso *et al*., 2019). More so, the use of large quantities of artificial fertilizers in wetland agriculture results in increased nitrogen emission into the atmosphere resulting in greenhouse gas imbalance (Schrier-Uijl, 2010; Cardenas *et al*., 2010). Globally, agriculture contributes approximately 58% to total anthropogenic emissions of nitrous oxide (Smith *et al.*, 2007), and the magnitude of these emissions depends on several factors, including nitrogen fertilization (Mosier *et al*., 1998), tillage, soil moisture and crop residue management (Mutegi *et al*., 2010). Although applying large quantities of organic fertilisers or manure in wetlands can lead to the high rate of emissions of carbon dioxide, methane and nitrous oxide, choosing and applying reasonable amounts of organic manure over inorganic fertilisers in wetlands will therefore reduce the emissions of these greenhouse gases (Sampanpanish, 2012). Drainage of wetlands for agriculture alters the carbon sequestration role of wetlands by increasing carbon emission and increase in nitrous oxide emission, mostly in wetlands that get their water supply from streams and springs (IPCC, 2006).

Wetlands (both natural and constructed) have been used to treat acid mine drainage. Research by Lupankwa *et al.* (2004) revealed the contamination of surface and groundwater with different metals such as iron, nickel and sulphate from Madziva mine in Zimbabwe. However, there were fewer metals where the acid was drained into the wetlands since the wetlands were neutralising the metal-filled polluted water (Lupankwa *et al.*, 2004). However, concentrations of metals such as iron, nickel and sulphate is less when the acidic water from the mines has passed through the natural wetlands (Lupankwa *et al.*, 2004). Thus, the diversion of acid mine drainage into the wetlands meant that these wetlands were used as natural pollution controllers. Research done on the treatment of acid mine drainage by natural wetlands in Tennessee Valley (USA) indicated that plants were absorbing some metals, but this accounted for only a small percentage of the total metal load supplied to the wetlands each year (Mays and Edwards, 2001). Although wetlands function as sinks for mine waste, building up of these dangerous metals into the wetlands can disturb the natural food web within wetland ecosystems (Mays and Edwards, 2001). Although wetlands were the first significant ecosystem to be protected by an international treaty (Ramsar Convention on Wetlands, 1971), they are still at risk from human use (Macharia *et al*., 2010; Thompson *et al*., 2010). As the interaction between people and wetlands continues, wetlands are increasingly facing challenges from the ever-growing population (Ayanlade and Proske, 2016). Therefore, it is crucial to ensure that wetlands are used and managed in a sustainable way that does not compromise the integrity of these fragile ecosystems (Wood *et al*., 2013).

2.4 History of wetland use in Zimbabwe

Most of the small wetlands, which include marshes, swamps and valley bottom wetlands commonly known as dambos or vleis, have been exploited by human activity in Zimbabwe (Roberts and Bell, 1990; Bell and Hotchkiss, 1991). Past and present-day analysis of wetland use reveals that wetlands were seen as essential pieces of land where water was available for garden cultivation, livestock grazing, irrigation and livestock watering (Whitlow, 1983; Bell and Hotchkiss, 1989; Whitlow, 1990). Wetlands were commonly exploited for these purposes before colonialism, during colonialism and after independence in Zimbabwe (Whitlow, 1990; Bell and Hotchkiss, 1991). Prior to independence in 1980, the colonial government prohibited wetland cultivation in Zimbabwe although this was a traditional practice (Bell and Hotchkiss, 1989; McFarlane and Whitlow, 1990; Roberts and Bell, 1990; Whitlow, 1990; Bell and Hotchkiss, 1991; Mbereko *et al*., 2007). Despite this ban, people continued to grow crops on these seasonal wetlands (Whitlow, 1990; Bell and Roberts, 1991; Wood *et al*., 2013). The government was therefore responsible for the management of wetland resources through the Land Development Officers (LDO), who assisted in enforcing wetland laws and policies (Marambanyika *et al*., 2012). European farmers also preferred growing their crops on wetlands because the soils were easy to plough, and the moisture retention capacity permitted them to grow crops in dry winter seasons (Whitlow, 1990; Wood *et al*., 2013). Regardless of their importance to rural farmers, there were some irregularities and inconsistencies in the way wetlands were being used (Roberts, 1988; McFarlane and Whitlow, 1990; Bell and Roberts, 1991). The land segregation on racial terms and the environmental legislation which affected the African rural dwellers during the colonial times also affected traditional natural resource use practices (Bell and Hotchkiss, 1989).

The enactment of the Land Apportionment Act of 1930 by the then Rhodesian colonial government attracted the creation of marginalised reserve areas or tribal trust lands which were of lower fertility and where most Africans were concentrated (Roberts, 1988; McFarlane and Whitlow, 1990; Bell and Roberts, 1991). As a result, African rural farmers in those marginalised areas turned to wetlands for food production (Roberts, 1988). Despite the laws that prohibited the use of wetlands, wetland agriculture became common for livelihood sustenance as a vital cushion during drought periods and periods of early rains (Roberts, 1988; Bell and Roberts, 1991). Thus, to solve food insecurity problems, people turned to wetlands, although their use was prohibited by the conservation laws (Bell and Hotchkiss, 1989; Bell and Roberts, 1991). The 1930 Water Act regulated the various uses of water within the wetlands (Bell and Hotchkiss, 1991). Although people were allowed to use wetland water for primary use such as livestock watering, drinking and cooking, permission was supposed to be sought to use water for irrigation since it was considered a secondary use (Bell and Hotchkiss, 1991). Successful food production within the wetlands had been equated to the ability of the farmer to adjust and control the changing soil moisture requirements (Bell and Hotchkiss, 1989). By carefully acclimatising to the conditions within the wetlands farmers could produce enough food for their households (Bell and Hotchkiss, 1989).

In these wetlands, a variety of crops such as rice and green leafy vegetables were grown (McFarlane and Whitlow, 1990; Whitlow, 1990). Wetland crop production was, therefore, essential for augmenting their staple diet and would also boost income from dryland farming (Bell and Roberts, 1991). The Water Act of 1927 and 1976 and the Public Stream Bank Protection Regulation of 1952, which originated from the Natural Resources Act of 1941, were meant to stop activities that would cause erosion, affect rivers and stream banks on the wetlands (Bell and Hotchkiss, 1989; Bell and Hotchkiss, 1991; Wood *et al*., 2013). Thus, cultivation of crops in areas within a 30-metre distance of a stream and on wetlands was not allowed (Bell and Hotchkiss, 1989; 1991; Marambanyika *et al*., 2012). Although these laws were enacted on the use of the wetlands, it was impossible to effectively implement these laws throughout the country (Bell and Hotchkiss, 1989; Bell and Roberts, 1991). As a result of deviating from these conservation measures and variations in the implementation of these wetland management measures between rural areas, wetland cultivation continued in other areas (Roberts, 1988). Thus, ineffective monitoring and implementation of these laws in other areas failed to completely restrict people from utilising wetlands, especially for agriculture (Bell and Hotchkiss, 1989; Bell and Roberts, 1991).

However, in those areas where there was strict implementation of the wetland laws, there was constant conflict between resource conservation and the welfare of the local people (McFarlane and Whitlow, 1990). The successful restriction of wetland cultivation within rural areas such as Zvimba in Zimbabwe increased deforestation on upland areas as people were cutting trees to create more land for dryland agriculture (Whitlow, 1983). However, in 1985 and 1986, after independence in 1980, there was an increase in garden cultivation in wetlands in districts such as Gutu, Chihota and Zvimba (Bell and Hotchkiss, 1991). Wetland users in these districts never expressed fear of the fact that the dambo water they were using to irrigate their gardens and for domestic purposes would dry up (Bell and Hotchkiss, 1991). Besides, priority was not given to leaving some land within the wetland for livestock grazing as the wetland users were mainly concerned about food production (Bell and Hotchkiss, 1989). However, some farmers in Gutu were moved from wetlands and stopped from growing crops there by the land inspectors soon after independence, after they had failed to observe the 30 m rule from the streams (after failing to abide by the Stream Bank Protection Regulation) to avoid streambank cultivation (Bell and Hotchkiss, 1991).

Despite the formulation of legislation that made cultivation of dambos illegal, and the determination to continue implementing these laws after independence in 1980, dambo cultivation continued and has increased today (McFarlane and Whitlow, 1990; Mbereko *et al*., 2015; Marambanyika and Beckedahl, 2016c). Furthermore, national political concerns such as the need to increase food production affected the interpretation and effective implementation of the colonial wetland legislation (Roberts, 1988; Bell and Hotchkiss, 1989; Bell and Roberts, 1991). The colonial legislation in Zimbabwe provided the conditions around the present-day agricultural management policy and practices on wetlands (Bell and Hotchkiss, 1989). The post-colonial government implemented these colonial wetland laws until 2002, when the Environmental Management Agency was set up (Marambanyika *et al*., 2012). The colonial legislation has affected the historical use of wetlands, changed the rights people had over water and land, and the different ways in which the wetlands are managed (Bell and Hotchkiss, 1989). It is important to investigate "how far do current patterns of dambo use reflect a sensitivity to conservation needs as reflected in government legislation and what strategies are employed to use dambo gardens in different physical and social settings?" (Bell and Hotchkiss, 1991:204-205). Taking into consideration how wetlands have been of great importance to rural dwellers in Zimbabwe, it is, therefore, the thrust of this study to evaluate how people are using rural wetlands and how they have used them in the past.

2.5 Challenges faced by present-day smallholder farmers

Agriculture is often practiced in rural areas as an economic plan for rural households to get out of poverty (Singh-Peterson and Iranacolaivalu, 2018). However, these small scale farmers encounter many challenges in growing their crops (Svotwa *et al*., 2008b). These challenges vary from socioeconomic to environmental challenges (Dhar *et al*., 2018). Lack of income to buy inputs is one common challenge faced by most smallholder farmers (Svotwa *et al*., 2008b; (Brown *et al*., 2018; Dhar *et al*., 2018). Many smallholder farmers are excluded from financial services that assist in increasing their productivity, and they fail to secure inputs such as hybrid seeds, fertilisers, machinery and land (Fan *et al*., 2013). Most of these farmers lack services that enable them to save their finances informal accounts, and this contributes to the low saving rates (Brown *et al*., 2018; Ratan *et al*., 2018). There are also limited loans to support rural farmers, especially from commercial banks (Fan *et al*., 2013). This is because there is limited demand in some rural areas and therefore, services are expensive in areas with few people, and property rights which can act as surety for loans are absent amongst such farmers (Fan *et al.*, 2013).

Evidence from a study by Dhar *et al*. (2018) shows that a majority of smallholder farmers in Bangladesh (Jamalpur and Bogra districts) could not afford to buy high-quality inputs such as fertilisers and seeds because of their cost. These smallholder farmers faced challenges such as shortage of transport to the market because of the poorly developed transport system, lack of understanding and skills on conservation farming practices, reduced production due to minimum tillage since the soil in Bangladesh does not require minimum tillage (a lot of weeds grew when minimum tillage was used), different types of diseases caused by fungus and pests, inadequate formal credit systems which forced the farmers to rely on the informal form of credits such as money lenders, inadequate agricultural extension services, problems in maintaining conservation agriculture, unstable market prices, and poor and unpredictable sporadic rainfall. They would sometimes receive the rainfall late, or it would stop raining before their crops were ready for harvest (Dhar *et al.*, 2018). These results corroborate recent studies in Fiji that show that subsistence farmers lacked support and help from the government to deal with transport issues and the availability of viable and secure markets (Singh-Peterson and Iranacolaivalu, 2018). Dhar *et al.*'s (2018) results are also consistent with Brown *et al.*'s (2018) study on six African countries (Zambia, Malawi, Ethiopia, Mozambique, Kenya and Uganda) which revealed that without enough income, the financial burden of conservation agriculture was too much on the farmers such that they saw it as impractical to implement. This study finds similarities across the six countries on the problems associated with conservation agriculture by small scale farmers. In addition to limited information from extension officers, there was confusion and lack of institutional support on conservation agriculture. It is therefore important that conservation agriculture is implemented with an understanding of the realities and experiences of the smallholder farmers to ensure its success (Brown *et al*., 2018; Holden *et al*., 2018).

Similarly, conservation agriculture proved to be a problem to smallholder farmers in Juru district in Zimbabwe (Svotwa *et al*., 2008b). Svotwa *et al*. (2008) argue that though artificial fertilisers are expensive, organic farming is not that simple because organic manure is not readily available, and there is less information about the proper use of this organic manure in dryland areas. Thus, small scale farmers also lack education on what could assist them in building the skills they require to manage their crops effectively and adopt innovative and profitable technologies (Dhar *et al.*, 2018). Studies by Hill (2000, 2004) revealed loss of crops by African farmers to wild animals (especially baboons) as one of the major problems faced by subsistence farmers. Hill (2000) argued that crop-raiding by wild baboons in Masindi district in Uganda impacted negatively on the subsistence farmers' lives since it resulted in other costs such as the increased need for labour to guard the fields, creation of labour shortages in certain seasons, school children being disrupted from going to school as their labour was required to guard family fields, increased risk of being hurt by wild animals and increased danger of getting diseases such as malaria. Although the loss of crops to wild animals is difficult to quantify, most farmers in Africa with small farms do not tolerate such loss, whereas those with large farms sometimes are not bothered about the quantity of loss to wild animals (Hill, 2004).

Climate change has made many rural farmers vulnerable to an increase in temperatures, sporadic rainfall and extreme weather conditions (Fan *et al.*, 2013). Thus natural hazards such as droughts, floods, heatwaves and wildfires will increase financial distress to farmers (Fan *et al.*, 2013). In recent years, poor rains have led to severe droughts in most parts of Africa, which has resulted in crop failure and livestock losses (Fan *et al*., 2013; Brown *et al*., 2018). Most of these challenges seem to be familiar to most of these farmers, especially in developing countries (Svotwa *et al*., 2008b; Brown *et al*., 2018; Dhar *et al*., 2018). In light of the above discussion, this study seeks to unpack solutions proposed by farmers to the different challenges encountered in using wetlands for agriculture since there is less information on solutions to the problems encountered by wetland smallholder farmers.

2.6 Sustainability and wetlands

The term sustainability was coined to deal with the continual existence and wellbeing of humanity's future as they live in harmony in nature (Benessia *et al.*, 2012). Wetland sustainability, therefore, refers to the maintenance of the ecological characteristics and hydrological processes of wetlands for them to continue functioning (Dixon, 2005; Finlayson *et al*., 2011). Recently attention has been given to the 'wise use' of wetlands due to the overexploitation of wetland resources caused by the changing socio-economic and political environment (Dixon and Wood, 2007). The 'wise use' of wetlands was coined by the Ramsar Convention in agreement with the concept of sustainable development, and it means the preservation of the ecological characteristics of wetland ecosystem through the implementation of ecosystem approaches to enhance long term conservation of wetland biodiversity and human wellbeing to reduce poverty (Millenium Ecosystem Assessment, 2005; Ramsar Convention Secretariat, 2010c; Finlayson *et al*., 2011). This implies that the Ramsar Convention encourages the use of wetlands as long as the integrity and health of the wetland continue to remain intact (Verhoeven and Setter, 2010). Wetland ecosystem services should therefore be exploited in a manner that will enhance maintenance of the physical ecosystem and hydrological function (Ramsar Convention Secretariat, 2010b). However, the development of agriculture at the expense of the integrity of the natural wetlands is a historical and global issue (Yu *et al*., 2018; Tomas *et al*., 2019). Drainage of wetlands for agriculture and soil improvement to boost crop production have often led to the destruction of the ecological character of wetlands, hydrological processes and different wetland ecosystem services (Finlayson *et al*., 2011). The conflicts between conservation and exploitation of wetlands make it difficult for the two to co-exist, hence the sustainability of wetlands is constantly threatened (Yu *et al.*, 2018). The wise use of wetlands can, directly and indirectly, help in reducing poverty (Kumar *et al*., 2011). Directly, sustainable use of wetlands is important in supporting livelihoods and reduce poverty, and indirectly it can help in mitigating climate change which can improve human wellbeing (Kumar *et al*., 2011).

Ensuring wetland sustainability means that people will get maximum benefits from the wetlands and continue enhancing livelihood sustenance (Tomas *et al.*, 2019). Thus, methods used to exploit the wetland should therefore be sustainable. For example, sustainable agricultural methods should be employed in those wetlands being used for agriculture. When different stakeholders met in 2018 to discuss how different efforts can be used for sustainable development of the Pantanal wetlands in Brazil, they came up with many different agenda points (Tomas *et al.*, 2019). These different stakeholders agreed that there was a need to employ a bottom-up approach in wetland conservation and remove the gap between different stakeholders so that they unite and follow steps necessary for wetland sustainability (Tomas *et al.*, 2019). The stakeholders identified the following agenda points for sustainable development of the wetland: increase the protected areas of the wetland; stopping conversion of the wetland to other uses to maintain wetland ecosystem services; introduce policies to stop overfishing and poaching to prevent biodiversity loss; encourage sustainable use and assisting ecological sound developments; support green infrastructure and the use of renewable energy on the wetlands; and protect against water pollution by avoiding point source contamination (Tomas *et al.*, 2019). Although these were listed as future possible achievements for wetland sustainability (Tomas *et al.*, 2019), implementation of what was proposed can be challenging and hence they remain more theoretical than practical. It is also possible that some of the above mentioned objectives can be achieved only at the expense of others, hence different elements of wetland sustainability cannot always be compatible or achieved at the same time.

Conservation practices on most of these wetlands are complicated by the limited availability of resources such as knowledge on appropriate sustainable exploitation methods and management technology (Sarkar and Das, 2016). As a result, there is livelihood sustenance at the expense of wetland sustainability (Tomas *et al.*, 2019). A study by Nyamadzawo *et al*. (2015) on dambo cultivation in Chiota rural area in Zimbabwe revealed that farmers were using both unsustainable and sustainable methods to grow crops on the wetlands. The use of inorganic fertilisers such as ammonium nitrate and compound D by some farmers could lead to pollution of both surface and groundwater and affect soil organic content. Clearing land by burning plant residue was also a common method used by farmers for land preparation. Burning can affect species diversity by destroying some plant species, thereby affecting the wetland ecological processes (Matayaya *et al*., 2017). Burning can also increase greenhouse gas emissions. Although burning of biomass can be exploited to produce biochar (produced by heating the plant residue under limited oxygen) which is crucial in maintaining soil fertility and increasing the carbon sequestration function of wetlands and soil quality, knowledge about biochar is still limited in Zimbabwe (Nyamadzawo *et al*., 2015). Sustainable farming methods used by wetland farmers in Chiota included organic manure such as cow dung and leaf litter, and compost manure. Such methods enhanced the soil structure by improving the water holding capacity of wetland soils. Some farmers also used different methods of conserving wetland water such as pipe irrigation and engine water pumps, ridges, mulching and deep planting to reduce loss of water. Although farmers were using conservation agriculture and mulching, increased cultivation of the wetland led to the reduction in water availability, hence some parts were reported to be drying up due to overexploitation of water resources.

Although wetland cultivation has improved the livelihoods of many subsistence farmers in Zimbabwe, Malawi, Zambia and Tanzania (Nyamadzawo *et al*., 2015), cultivation of wetlands releases greenhouse gases (Sarkar and Das, 2016) and some wetland ecosystem services such as carbon sequestration are depleted due to cultivation (Nyamadzawo *et al*., 2015; Matayaya *et al*., 2017). Climate-smart agricultural methods such as intercropping, agroforestry, and improved manure management can enhance sustainable food production and wetland sustainability (Nyamadzawo *et al*., 2015). Since the farmers in Chiota were using both sustainable and unstainable methods of farming, it is difficult to conclude that wetland sustainability was guaranteed. Conservation agriculture and climate-smart agriculture can reduce the destruction of wetland elements such as water and soil (Nyamadzawo *et al*., 2015). Sustainability can be achieved if the scientific knowledge of the complex nature of systems within the earth is integrated with suitable management plans compatible with the resource being managed (Knight, 2015). Therefore, it is important to have a scientific understanding of the dynamic nature of wetlands and engage the wetland users in wetland management with appropriate management frameworks to ensure wetland sustainability.

Marambanyika *et al*. (2012) indicated that empowering communities as conservators and prime users of wetlands, integrated with scientific, technical support from the EMA and Agritex officers, ensured the sustainable use of Chebvute wetland in Zvishavane rural district, Zimbabwe. Conservation methods such as guarding the wetland against intruders, fence maintenance, setting up sand traps and sustainable methods of cultivation such as crop rotation, minimal cultivation and maintenance of the natural groundcover assisted in ensuring maintenance of the wetland's ecological and hydrological processes. These methods also assisted in restoring the wetland ecosystem, as was evidenced by the increase in plant and animal species. The local farmers' understanding and expertise on conservation and dedication to wetland management are influential in preserving wetland ecological quality and its sustainability (Svotwa *et al*., 2008a). Despite the development of sustainable methods of wetland use, lack of collaboration between stakeholders compromises the practical implementation of policies to ensure wetland sustainability (Matamanda *et al*., 2018; Mandishona and Knight, 2019). By contrast, Kangalawe and Liwenga (2005) on Kilombero Valley wetlands in Tanzania indicated increased use of the wetland due to population increase and unsustainable methods of wetland cultivation. Some of these unsustainable methods of cultivation included the use of inorganic fertilisers, which compromised wetland integrity and the benefits derived by wetland users.

Unsustainable methods of wetland exploitation have led to the destruction of many wetlands in Africa through over-drainage and erosion, which lead to downdraw of the water table (Roggeri, 1995b; Schuyt, 2005). However, draining wetlands for intensive agricultural activities should be discouraged since it disturbs ecological processes and hydrological functioning of wetlands, thereby threatening wetland sustainability (Verhoeven and Setter, 2010). Wetland policy and planning strategies must merge the main principles of sustainability (Wood *et al*., 2013), which are environmental sustainability, which refers to the promotion of wetland use methods and management plans and developments (such as agriculture) that does not destroy the wetland; economic sustainability, which refers to the promotion of wetland utilisation with distinctly economic developments that remain beneficial in the long term; and social sustainability, meaning that wetland use and management plans are embedded within the local community (benefiting the local community). These principles call for wetland management to be socially and economically impartial to desist from the conflict that compromises sustainable use (Wood *et al*., 2013). Sustainable livelihood frameworks should also be a key to wetland use and sustainability (Kumar *et al.*, 2011; Wood *et al*., 2013). Thus, a sustainable livelihoods framework explains how rural peoples' livelihoods are directly linked to natural resources and that the use of these resources is influenced by outside forces such as government laws, market demands and institutional arrangements (Wood *et al*., 2013). Therefore, sustainable livelihoods result in material and capital benefits by ensuring human wellbeing, food security and resilience that critically support environmental sustainability (Kumar *et al.*, 2011; Wood *et al.*, 2013). Figure 2.1 summarises important components of a people-centred approach to sustainable wetland and livelihoods (Wood *et al.*, 2013). According to the diagram, if the interaction between people and wetlands is conducted by appropriate management frameworks, wetland ecosystem services will remain balanced to ensure sustainability and the ability to support livelihoods.

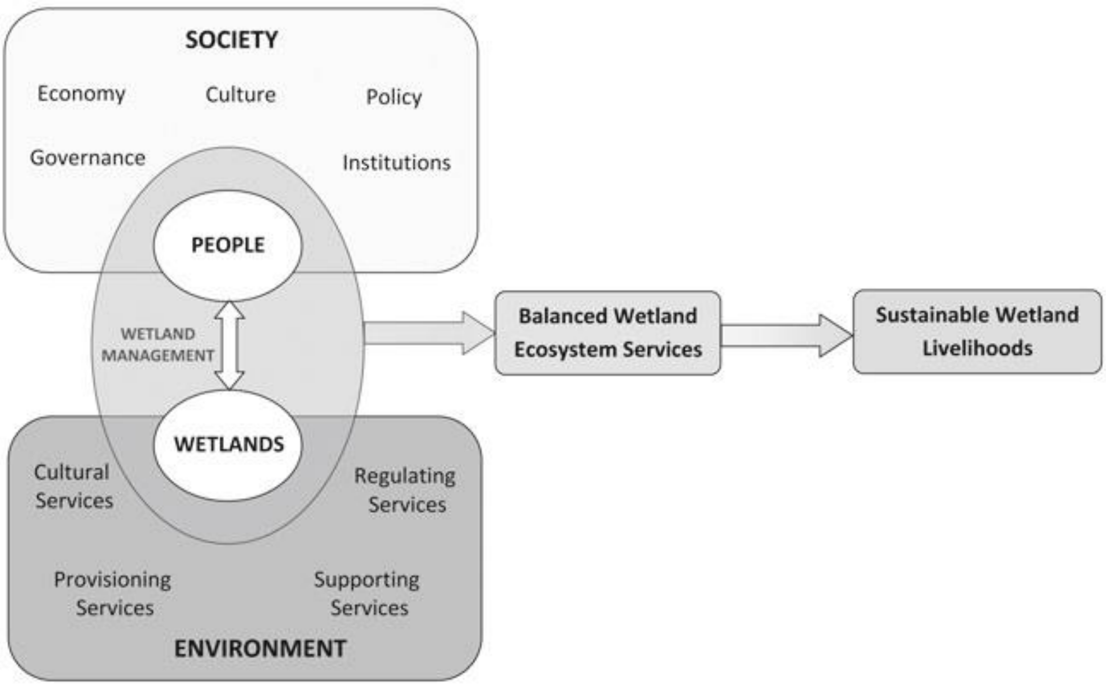

Figure 2.1: Interactions between people and wetlands (from Wood *et al.*, 2013)

Sustainable wetlands and livelihoods can also be achieved if the following components are considered: peoples' contributions are included in institutional wetland management; peoples' actions are guided by societal frameworks; economic and social incentives are taken into consideration; evaluating how socioeconomic and environmental aspects influence interactions between people and wetlands; and how these interactions influence ecological, economic and institutional sustainability (institutional policies and organisation) (Macharia *et al*., 2010; Wood *et al*., 2013). It is also important that the wetland users understand wetland processes (Rebelo *et al*., 2010; Matamanda *et al*., 2018). The high rate of wetland loss and degradation worldwide, especially in developing countries, has also been caused by the absence of public and political appreciation of wetland values and lack of political will to preserve and use these wetlands sustainably (Finlayson *et al*., 2005). Destruction of these wetlands threatens the livelihoods of many communities in developing countries since they directly depend on wetlands for survival (Deepak, 2016). However, given the rate at which the wetlands have been threatened, lost, and environmentally degraded, sustainable use of wetlands cannot be ignored and valuing, conserving and managing wetlands remains the primary objective of the national and international community (Turner *et al*., 2000). Although the ecological characteristics of some wetlands are not fully known (Finlayson *et al*., 2005), it is important to make people appreciate the importance of wetlands as a priority (Finlayson *et al.*, 2011) to enhance their controlled and sustainable use (Macharia *et al*., 2010). Thus, sustainable use of wetlands should be encouraged to preserve the health of wetland ecosystems (Kumar *et al*., 2011).

As people continue to benefit from wetlands, maintaining the ecological character of the wetlands should be a priority, yet at the same time, should meet the needs of future generations (Finlayson *et al.*, 2011). Wetlands should therefore continue to be used like any other natural resource, conserving their unique, diverse nature for the present and future (Kuhlman and Farrington, 2010). Thus, different land uses on wetlands should be environmentally sound to maintain the ecological status of wetlands so that the ability of the wetlands to meet future needs is not compromised (Kuhlman and Farrington, 2010; Finlayson *et al.*, 2011). This will enhance the continuous exploitation of wetland resources and enhance peoples' health and wellbeing through the services rendered by wetlands (Finlayson *et al.*, 2011). Policymakers should also not ignore the changing conditions of the Anthropocene characterised by complexity and unpredictable changes with human activities having diverse impacts on different ecosystems (Benson and Craig, 2014; Hirvilammi and Helne, 2014).

2.7 Wetlands and climate change

Wetlands play an essential role in regulating climate and supporting climate change adaptation and resilience (Millenium Ecosystem Assessment, 2005; Ramsar Convention Secretariat, 2010a; Moomaw *et al.*, 2018), but are also affected by climate change (Moomaw *et al.*, 2018). Although wetlands can sequestrate and store large quantities of carbon (this function is important in regulating climate) (Millenium Ecosystem Assessment, 2005; Nahlik and Fennessy, 2016; Moomaw *et al.*, 2018), they usually produce large quantities of greenhouse gases such as methane, nitrous oxide and carbon dioxide when their ecological and hydrological functioning are disturbed (Ramsar Convention Secretariat, 2010a, 2010b, 2010c Moomaw *et al*., 2018; Oviedo and Kenza-Ali, 2018). Increased emission of greenhouse gases from disturbed wetlands can contribute to global warming, thereby facilitating the rate at which climate change occurs, leaving people and wetlands exposed to floods and droughts and other effects of climate change (Ramsar Convention Secretariat, 2010a; Junk *et al.*, 2013). Thus, reclamation and draining of wetlands can contribute to climate change, and in turn, wetlands can be affected by these impacts (Ramsar Convention Secretariat, 2010a; Junk *et al*., 2013). Poor implementation of climate change policies on water-related issues can become detrimental to the existence of wetlands (Ramsar Convention Secretariat, 2010d). Governments and policymakers should therefore appreciate the existence of wetlands in their natural state as a major asset in mitigating against climate change (Ramsar Convention Secretariat, 2010d). It is also crucial that climate impact prediction studies are done in advance to assess how climate change affects wetlands (Oviedo and Kenza-Ali, 2018).

Changes in rainfall and temperature patterns have affected the ecological character of many wetlands in most countries (Lamsal *et al*., 2019). It is most likely that global climatic change will further threaten wetland biodiversity and compromise the existence of some species (Ramsar Convention Secretariat, 2010d). Lamsal *et al*. (2019) showed that a change in temperatures led to an increase in other species such as snails and water hyacinth on the Ghodaghodi wetland in Nepal. Climate change therefore affects the hydrology of wetlands, chemical processes and the nutrient balance, and can lead to increased invasive species (Ramsar Convention on Wetlands, 2018). The way future climate will affect wetland soil carbon will depend on the factors that cause the build-up of carbon in these systems (Moomaw *et al.*, 2018). These include wetland conversion as a result of changes in land use, rainfall variability, and wetland water balance which significantly affect carbon sequestration potential (Moomaw *et al.*, 2018). International studies such as the IPCC (IPCC Wetland Supplement,

2014) and the United Nations Framework Convention on Climate Change (UNFCCC, 2017) have started to include wetlands in their climate change management strategies and policies (Ramsar Convention Secretariat, 2010a). Management strategies for diverse ecosystems such as wetlands should critically consider the maintenance of the ecological properties of wetlands for climate resilience (Petrescu *et al.,* 2015; Finlayson *et al*., 2019).

2.8 Wetland ecosystem services and human wellbeing

Communities in most developing countries depend on different ecosystem services provided by wetlands to sustain their livelihoods (Lamsal *et al*., 2019; Chatanga *et al.,* 2020; Dixon *et al*., 2021). Ecosystem services refer to the benefits people derive from ecosystems in different ways (Millenium Ecosystem Assessment, 2005b; Ramsar Convention Secretariat, 2010a, 2010b, 2010c, 2010e). Human wellbeing incorporates human health, security, provision of essential materials for a good life, ethical, social relations, and privilege of choices and actions (Millenium Ecosystem Assessment, 2005b) (Figure 2.2). Ecosystem services have contributed to human wellbeing, and people have benefited directly and indirectly from them (Millenium Ecosystem Assessment, 2005b; Maltby and Acreman, 2011; Müller and Burkhard, 2012). Human societies are therefore connected to wetlands since their ecosystems services link to human livelihoods and wellbeing (Kumar *et al.*, 2011; Leauthaud *et al.*, 2013; Dixon and Carrie, 2016). Although the concept of ecosystem services has developed over recent years (Abson *et al.*, 2014), questions remain on how ecosystem services such as provided by wetlands have contributed to human wellbeing, especially in rural areas (Maltby and Acreman, 2011b).

According to the Millenium Ecosystem Assessment (2005b), the ecosystem services provided by wetlands include provisioning (food, fresh water, fibre and fuel), regulatory (water purification, water regulation, climate regulation, cultural (spiritual, recreational, aesthetic and educational), and supporting services (soil formation and nutrient cycling). Wetlands in both urban and rural areas are valuable ecologically, socially and economically since they provide a variety of ecosystem services for human wellbeing such as animal habitat provision, conservation of a variety of biodiversity, flood reduction, recreation, groundwater recharge, food through agriculture, wild roots and fruits and spiritual/aesthetic values (Maltby and Acreman, 2011; Isopescu *et al*., 2012). However, not all wetlands provide all of these services (Horwitz and Finlayson, 2011); wetlands may provide ecosystem services that are restricted to their size and hydrology (Sellamuttu *et al*., 2011). Wetlands have played a vital role in reducing poverty through their provisional services, especially food production (Millenium Ecosystem Assessment, 2005a; 2005b; Sarkar and Das, 2016) which has contributed to people's nutrition, income generation and lower exposure to illnesses (Sarkar and Das, 2016). Thus, an increase in population and the changes in economies have increased the demand for provisioning services (Millenium Ecosystem Assessment, 2005b). Therefore, the deterioration of wetland uses is not equal with respect to the different ecosystem services available.

Figure 2.2: Relationships between ecosystems and human wellbeing (Millenium Ecosystem Assessment, 2005a)

Ecosystems contribute to maintaining human wellbeing directly through the provision of goods and indirectly through the provision of services that support clean water, clean air, flood protection and atmospheric stability (McCartney *et al*., 2010; Teague *et al.*, 2016). Indirect ecosystem services such as supporting (sediment formation, nutrient retention) and regulatory services (flood attenuation, climate regulation and water purification, waste treatment) are often neglected for direct services even if communities are aware of these indirect benefits (Costanza *et al.*, 2011; Pantshwa and Buschke, 2019). Private benefits of wetlands are often compromised as they are modified for agriculture and infrastructure such as residential areas, industries, roads and tourism facilities (Millenium Ecosystem Assessment, 2005b). In most cases, some ecosystem services are degraded as people exploit other services (Christie *et al.*, 2012; Bailey and Buck, 2016). There are also interlinkages between these services since support and regulatory services ensure the continuation of provisioning and cultural services. However, supporting services are key processes (Millenium Ecosystem Assessment, 2005a) (Figure 2.2), and once they are disturbed, then all the other services will be adversely affected (FAO, 2008; Bengochea Paz et *al*., 2020). For example, the disruption of the supporting services can negatively affect the provisional services provided by wetlands through agriculture hence reducing the crop yields (FAO, 2008; Bengochea Paz *et al*., 2020). Although regulatory services ensure that people continue to secure goods from wetlands (Figure 2.2), availability and quality of these services are commonly neglected (Millenium Ecosystem Assessment, 2005b). Provisioning services are normally considered the most important for food security and their contribution to human health (Millennium Ecosystem Assessment, 2005a) (Figure 2.2). Despite the deterioration of other ecosystem services as people benefit through other services, not all services are depleted equally (FAO, 2008). Although it is challenging to exploit one ecosystem services whilst maintaining other services, all different types of ecosystem services are needed to preserve security, health and human wellbeing (Millenium Ecosystem Assessment, 2005a).

Some studies done on rural wetlands in Zimbabwe reveal that most communities exploit wetlands for their direct benefits, such as provisioning and cultural services, and in the process, supporting and regulatory services are often overlooked (Bell and Hotchkiss, 1989, 1991; Whitlow, 1989, 1990; McFarlane and Whitlow, 1990; Roberts and Bell, 1990; Bell and Roberts, 1991; Madebwe and Madebwe, 2005; Hardlife *et al*., 2014; Marambanyika and Beckedahl, 2016b, 2016c; Matayaya *et al*., 2017). Hardlife *et al*. (2014) revealed that Chingombe community in Zimbabwe valued Mutubuki wetland mainly for its provisioning and cultural services, and supporting and regulatory services were viewed as less important. The Millennium Ecosystem Assessment (2005a) acknowledges the connections between ecosystems services provided by wetlands and human health and wellbeing (Horwitz and Finlayson, 2011) (Figures 2.2, 2.3). The Ramsar Convention's definition of wetlands ecological character also includes human wellbeing (Horwitz and Finlayson, 2011). According to Figure 2.3, the ecological character of a wetland incorporates its different ecosystem elements, processes and benefits (ecosystem services) (Horwitz and Finlayson, 2011). More so, as people benefit from different wetland ecosystem services, it is their duty to acknowledge and preserve them (Horwitz and Finlayson, 2011).

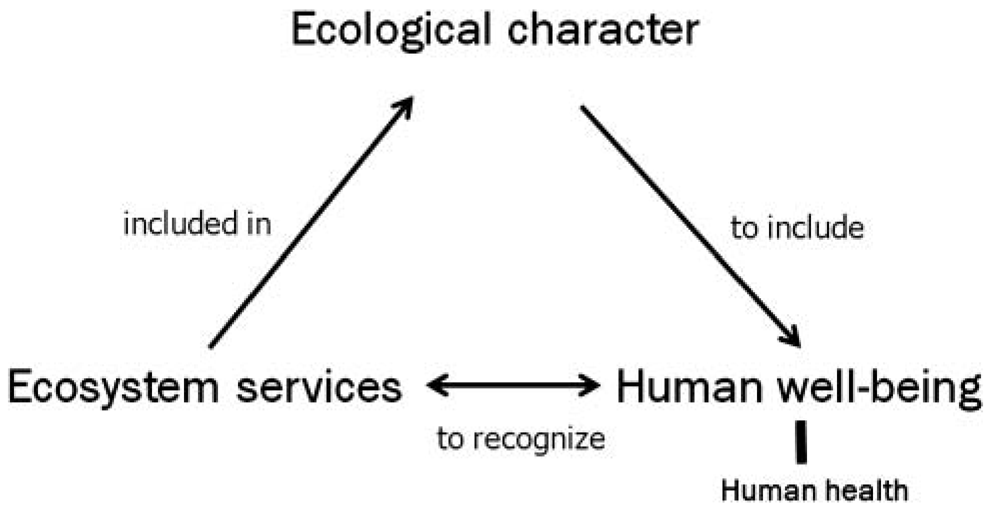

Figure 2.3: The link between ecosystem services and human wellbeing (Horwitz and Finlayson, 2011)

The term healthy ecosystems recognise that human beings are an inherent part of the ecosystems (Horwitz and Finlayson, 2011; Isopescu *et al*., 2012). Although people are involved in activities that destroy wetland ecosystems, they are also facilitators for their management, conservation and restoration (Horwitz and Finlayson, 2011; Maltby and Acreman, 2011). Understanding the most significant factors impacting negatively on wetland health is therefore important in the planning and execution of an integrated strategy to stop further wetland degradation that can lead to loss of ecosystem services (Muangthong *et al.*, 2012). Addressing the United Nations Sustainable Development Goals relies on maintaining, managing and improving wetland ecosystems services (Albaladejo *et al*., 2021). Thus, maintenance and restoration (where appropriate) of wetland ecosystem services should be a priority when making decisions about wetland management (Ramsar Convention Secretariat, 2010d).

Maltby and Acreman (2011) argued that the economic development of most wetlands in developed countries had threatened their existence. Thus, remaining wetlands have been managed for recreational services, and funding is directed towards restoration and conservation. For example, the U.S. government funded the restoration of the Florida marshes for waterfowl and herbaceous species conservation (Rey *et al*., 2012). This is in contrast to developing countries where human populations still depend directly on wetland ecosystem services for livelihood sustenance (Maltby and Acreman, 2011). Mahlatini *et al*. (2020) on

Songore wetland in Zimbabwe revealed that people were directly benefiting from wetlands through provisioning services such as food (from agriculture and wild fruits), fish and raw materials. A variety of goods harvested from this wetland has contributed to income generation, with each household generating US$463 annually. Although the income they generated was not a lot, they could buy basic goods and pay school fees for their children. Songore wetland users grew a variety of crops such as maize, vegetables, sweet potatoes and bananas. The provision of basic human needs such as food from wetlands can therefore improve their health and social relations, enhance their freedom of choice to improve livelihoods, and strengthen mutual respect (societal integration and human wellbeing) (Maltby and Acreman, 2011).

Although agriculture is important for provisioning ecosystem services, it normally changes the status and function of many wetland processes, thereby potentially compromising regulatory and cultural services (Gordon *et al*., 2010; Rebelo *et al*., 2010). Some of the changes include reducing flora and fauna species populations, altering nutrient and biomass chemical processes, and changing landscape processes such as pollination (Gordon *et al*., 2010; Rebelo *et al*., 2010). Changing natural wetlands to agricultural use with practices such as wetland drainage, application of pesticides, herbicides and fertilisers, and livestock grazing can adversely affect the regulatory functions of wetlands (FAO, 2008). Thus, water can be polluted with inorganic fertilisers used during cultivation, and this can affect the health of people as the polluted water recharges the water table, and in turn, people draw water from the wetland to drink (Gordon *et al.*, 2010). However, in cases where appropriate agricultural practices are performed, such as growing crops suitable for the wetland environment and using environmentally sensitive methods such as zero tillage, preservation of other ecosystem services can be ensured (Horwitz and Finlayson, 2011). Although ecosystem services play an important role in reducing poverty (Silvius *et al.*, 2000), increasing poverty can heighten pressure on ecosystem services where vulnerable rural dwellers may have no other option but to overuse the available natural resource base (Gordon *et al*., 2010).

Besides agriculture, other ecosystem services can be very valuable during crop failure. Enfors and Gordon (2008) observed that small scale farmers in Tanzania (Pare Mountains) benefited from the other ecosystem service such as handcrafts, livestock selling and charcoal selling, which were obtained from the wetlands after experiencing two seasons of recurring droughts. However, wetlands need to be preserved for the continuous provision of these services. In light of the above discussion, this study, through ethnographic methods, therefore seeks to understand how rural farmers in Honde Valley rural area of Zimbabwe are exploiting different wetland ecosystem services for livelihood sustenance.

2.9 Wetland cultural services

Cultural and traditional beliefs and taboos of indigenous people can be of importance in controlling the use of wetlands (Svotwa *et al*., 2008; Oviedo and Kenza-Ali, 2018). These beliefs and taboos can influence peoples' behaviour in exploiting wetland resources which, in turn, assists in conserving wetlands (Svotwa *et al*., 2008). The cultural values assigned to wetlands are important to local communities, and their loss may isolate them from engagement with wetland services and also cause detrimental social and ecological impacts (Ramsar Convention Secretariat, 2010b; Chunhabunyatip *et al*., 2018). The use of wetlands in rural areas can be controlled by customary laws, and in some communities these customary laws still exist (as further discussed in this section) (Mbereko *et al*., 2007). Wetland elements such as water, soil, fauna and flora may be influenced through customary laws (Oviedo and Kenza-Ali, 2018). At the centre of the discussion on this theme are studies by Svotwa *et al*. (2008), Marambanyika *et al*. (2012), Ramírez and Fennell (2014) and Chunhabunyatip *et al.* (2018) that consider how traditional customs and beliefs control the use of wetland resources.

Chunhabunyatip *et al*. (2018) indicated how people in Ban Don Daeng, southern Thailand, believed in the spirits of their ancestors (Buddhism) and the different animal spirits (animism) which assisted them in managing Nongchaiwan wetland. They worshipped the common Pu Ta spirit, and they believed that after breaching some indigenous practices, one was punished by these gods. Some of the taboos which protected the wetland include the killing of rat snakes, birds and turtles, which was prohibited as killing was considered sinning since they were a symbol of holiness. Entering sacred places in the wetland was prohibited as it would anger the Pu Ta spirit and bring mental sickness. The indigenous people were supposed to seek permission to fish from the guardian at the beginning of the rain season, and failure to do so would bring bad luck. Some communities associated the origins of their cultures with wetlands (Ramírez and Fennell, 2014). Ramírez and Fennell (2014) showed that in Colombia indigenous people of the Muiscas and Chibchas' cultures who lived near the wetlands flourished in the Bogota wetlands. Some grew a variety of crops such as potatoes and beans. Historically it was believed that the Bachue goddess of the Muiscas people originated from the waters of the Bogota wetlands, and as such, monuments and symbols representing the Muiscas culture are usually found in the wetlands, and this in turn has led to the conservation of wetland water. In some African societies, the wetland soil has been considered as sacred, and some people cover their bodies with this wetland clay soil during initiation ceremonies (Denny, 1994).

Similarly, Mbereko *et al*. (2007) on Zungwi wetland in Zimbabwe showed how the use of wetland resources was controlled by customary rules which the community was compelled to adhere to. There were strict regulations that controlled the use of wetland wells, trees, land and grass. Some wells, such as Chikamhe well on Zungwi wetland, were seen as sacred and therefore gourds were the only items to be used to fetch water and metal, and dirty utensils with ash were not allowed. Perfumed items such as lotion and soap were also not allowed near sacred wells and washing clothes near such wells was prohibited. Some of the rules which regulated the use of trees were that fruit trees were not allowed to be cut; everyone had access to wild fruits in the wetland unless the tree was in someone's field; permission was to be sought from the village head if one wanted to cut a tree; and wild fruits were not allowed to be sold. Metal and wire fencing materials were also not allowed to be used to protect the fields, and field owners had control over their crops, not the wetland resources. Although there was no specified distance from the waterways, fields and gardens were not allowed close to these waterways. Men who were not married were not allocated fields in the wetlands but everyone from the community had access to graze their animals and cut grass for thatching from Zungwi wetland. At the boundary of Zungwi wetland was the burial area for the ruling family, and this was a sacred area controlled by the traditional leaders, and only a few people had access to it. Sacred wells were also associated with myths which the community believed were important in preserving wetland resources.

Studies by Svotwa *et al*. (2008a) and Marambanyika *et al*. (2012) showed similar results. Svotwa *et al*. (2008a) argued that areas on the Mwaonazvawo wetland in Mutasa district in Zimbabwe, which had a lot of water, were seen as sacred such that traditional leaders allowed people to use these areas moderately to guard against overexploitation of the resource as it would assault the ancestors. According to Marambanyika *et al.* (2012), Chebvute wetland in Zimbabwe was also partly conserved through the traditional beliefs and customs of the society. Chebvute wetland was believed to be the habitat of mermaids, which mysteriously cause disappearances of those who were not respecting the traditional customs. It was prohibited to wear black clothes when working in the wetlands, and indecent language was also not allowed near the wetland. At times the grumbling sounds from cattle and people who had disappeared were heard in the wetland. Similar to that described by Mbereko *et al.* (2007) in Zungwi wetland, permission to cut down trees in Chebvute wetland was only granted by the village head (Marambanyika *et al*., 2012). A rich diversity of societal values, customary beliefs and practices has therefore emanated from most wetlands (Papayannis and Pritchard, 2018). The role of spiritual beliefs, religion, cultural beliefs, customs and social norms should not be disregarded since they play a vital role in wise use and protection of wetland biodiversity (Rai, 2006). However, protecting this legacy depends on appreciating and respecting these cultural practices (Oviedo and Kenza-Ali, 2018; Papayannis and Pritchard, 2018).

2.10 The role of institutions in wetland management

As natural resources such as wetlands continue to be destroyed through anthropogenic processes, the conservation of wetlands is a challenge (Andersson and D'Souza, 2014). Changes in the perceptions of wetlands from wastelands to key resources sustaining livelihoods have attracted the need for wetland management (Hartter and Ryan, 2010). Studying the role played by different institutions in the management of wetlands is important in maintaining wetland health and restoring their ecological integrity (Marambanyika and Beckedahl, 2016a). The increased destruction and loss of wetlands in most developing countries is often allowed through different institutional frameworks supporting wetland governance (Mbereko *et al*., 2007; Marambanyika and Beckedahl, 2016a). Although wetland management plans are the most ideal to protect wetlands, it has not been easy for governments, especially in developing countries, to identify and enact management plans for wetlands (Xu *et al.*, 2019). However, the setting of the Ramsar Convention on Wetlands has assisted in the protection of some wetlands, especially the identified Ramsar sites (Xu *et al.*, 2019). The Ramsar Convention act as the basis of national policies for wetland management. Therefore, the contracting parties should mandate themselves to change ongoing wetland loss by conserving remaining wetlands (Ramsar Convention Secretariat, 2013).

In the past, management of natural resources such as wetlands was influenced by indigenous knowledge systems which required effective and reliable traditional leaders who derived their power from their ancestors (Rebelo *et al.*, 2010). However, in many parts of sub-Saharan Africa, management of wetlands is determined by a combination of modern and traditional customs, but the success of combining these two is not comprehensive (Rebelo *et al*., 2010). Khan and Haque (2010) indicated that community involvement in community resources management could be the most effective way of managing the Hakaluki haor freshwater wetland in Bangladesh. The exclusion of the community in wetland management decisions in led to the degradation of freshwater wetlands. The presence of formal wetland management institutions with decentralised (bottom-up) approaches in wetland management can ensure its sustainable management.

Similarly, a study by Hartter and Ryan (2010) on forest and wetland rights for western Uganda reported the importance and effectiveness of local institutional arrangements in sustainable wetland management. Although the Ugandan government had successfully implemented a bottom-up approach in wetland management, there was confusion amongst wetland users and the village heads on the access, use and management of wetlands. Despite the efforts by the Ugandan government to transfer wetland management powers from central government to local and regional administrations, regulations put into place are sometimes disregarded by wetland users. Management confusion can be reduced if local wetland users are also consulted in land use planning (Kangalawe and Liwenga, 2005). However, a bottom-up approach is also challenging in highly populated but isolated rural areas where people mostly rely on natural resources for survival (Hartter and Ryan, 2010). Newaz and Rahm (2019) revealed that co-management with the involvement of the community to address centralised resource management was difficult to implement in Tanguar Haor wetland northeast of Bangladesh, since the people relied more on the wetland for their survival.

Xu *et al*. (2019) reported loopholes within many wetland management plans in Africa and Asia. They argued that although many European countries had developed management frameworks for its wetlands, 49% and 45% of wetland Ramsar sites in Africa and Asia respectively lacked management plans. Effective wetland management plans can only be guaranteed if more scientifically-based laws, regulations and policies on wetland conservation are disseminated at all levels to discourage continuing destruction of wetlands (Hartter and Ryan, 2010; Xu *et al.*, 2019). Information dissemination using appropriate language with illustrations or based on discussion (not just based on written materials where there are issues of illiteracy) needs to be increased in most remote rural areas where wetlands face pressure from rapid population growth and human dependency on wetland resources (Hartter and Ryan, 2010). Since countries are different, their laws should be issued in accordance with local developments within each country (Xu *et al.*, 2019). Mvula and Haller (2009) observed that there are ill-defined management roles between different formal institutions on Chilwa wetland in Malawi. Since Chilwa wetland was used for different activities, different management options may come into conflict as, for example, where bird hunters are disturbed by fisherman. Mvula and Haller

(2009) argue that the most practical way to manage wetlands is to have an inter-sectorial plan incorporated with a participatory approach to empower local wetland users. Decentralised plans for resource-based wetland management may only be successful if bonded with social relationship networks that exist amongst local people (Rahman *et al*., 2015). Thus, governments should invest more in local institutions involved in wetland management (Sellamuttu *et al*., 2011). For example, the formulation of the Kimana Wetland Association in Kenya assisted in resolving tensions between different stakeholders and helped in planning for wetland management, enabling wetland users to cope with increased pressure on wetlands and under different changing socioeconomic and environmental circumstances (Sellamuttu *et al*., 2011).

Rural wetlands in Zimbabwe are considered common property, and therefore local management structures and institutions should be recognised (Mbereko *et al*., 2007; Marambanyika and Beckedahl, 2016a; Marambanyika *et al*., 2017a). The collective ownership of wetlands enables communitarian management of wetlands where traditional leaders are involved (Manyanhaire *et al*., 2008a; Marambanyika *et al*., 2017b; Marambanyika and Beckedahl, 2016b, 2016c). Since these rural wetlands in Zimbabwe are communally used, different institutions play a role in ensuring the controlled use of these ecosystems (Mbereko *et al*., 2007; Marambanyika and Beckedahl, 2016a). However, Mbereko *et al*. (2007) and Marambanyika and Beckedahl (2016a) observed a lack of institutional frameworks where the mandate, task, control and coordination of these distinct institutions are precisely stated in order to avoid overlapping of roles and possible conflicts. Mbereko *et al*. (2007) discussed the engagement of different institutions in managing Zungwi wetland in Zimbabwe and, contrary to the government approach, showed that wetland users preferred management by local institutions (traditional leaders) rather than the government. However, local institutions may always be incapacitated by resource pressure due to population increase, food insecurity and climate change (Mbereko *et al*., 2007; Ndiweni, 2013). The presence of 12 different institutions in the management and use of Zungwi wetland causes confusion since these institutions had different agendas (Mbereko *et al*., 2007). The traditional leader was meant to have authority over the distribution of natural resources in the interest of the ancestors and local people. In this case, the traditional leader worked with the spiritual guardian and the administrative board. Although the traditional leader made sure that there was decentralisation of wetland management powers to the headman and the Kraal head and traditional institutional courts that would try offenders, too many institutions had reduced their powers on wetland management

(Mbereko *et al*., 2007). Similarly, a study by Marambanyika and Beckedah (2016a) on the role of institutions in wetland use and management on six rural wetlands (Dufuya, Madigane, Tugwi, Guruguru, Chebvuterambatemwa and Zungwi) in Zimbabwe showed the involvement of different institutions in wetland management such as the Rural District Council, Agritex officers, wetland committees, EMA, non-governmental organisations, the Zimbabwe Republic Police and traditional leaders. Differing intentions amongst the different institutions increased disputes, tension and confusion which compromised wetland management.

The involvement of different institutions and stakeholders in wetland management can affect the implementation of regulations, and the role of traditional and indigenous knowledge systems and sources as each group focuses on its own interests (Weber *et al*., 2017). Potential conflicting and overlapping roles and lack of strategic plans for wetland management often lead to wetland degradation (Mbereko *et al*., 2007; Marambanyika and Beckedahl, 2016a, 2016c). Thus, inconsistencies in the roles of different institutions (Marambanyika and Beckedahl, 2016a) and lack of coordination of multi-stakeholder participation (Mbereko *et al*. 2007; Marambanyika and Beckedahl, 2016a) can lead to conflicts and confusion (Mbereko *et al*., 2007; Marambanyika and Beckedahl, 2016a; Matamanda *et al*., 2018). Traditional structures, different institutional arrangements and indigenous knowledge systems on wetland management in Zimbabwe have been weakened by the continued influence of former colonial systems (Marambanyika and Beckedahl, 2016a). Thus, the colonial management systems (which were also largely continued by post-colonial governments in most developing countries such as Zimbabwe) had resource management systems that failed to incorporate indigenous knowledge systems and local wetland use practices (Marambanyika and Beckedahl, 2016a, 2016c). However, if local people continue to use indigenous and traditional knowledge and capacity coordinated with modern government and private institutional management frameworks, then sustainable wetland management may be promoted (Thompson *et al*., 2010; Weir *et al*., 2013). More so, the cultural identities of local people who are associated with wetlands should be recognised as an integral element of wetland management (Ramsar Convention Secretariat, 2010b).

The EMA is mandated to monitor and control access to wetland use in Zimbabwe (Marambanyika and Beckedahl, 2016a). However, sometimes due to politicians pursuing their own interests on wetlands, the EMA is unable to execute its duties (Marambanyika and Beckedahl, 2016a). Although the EMA rarely participated in wetland management through educating wetland users and monitoring policy implementation, the institution was well known for its stringent measures for offenders engaging in activities that degrade wetlands (Marambanyika and Beckedahl, 2016a). Government, private institutions and conservationists should work together to manage wetlands and control the different anthropogenic activities taking place there, such as agriculture (Marambanyika and Beckedahl, 2016a). This is because existing locally-based indigenous knowledge systems are not adequate to ensure controlled use of wetlands (Dixon, 2005).

Although intergenerational transfer of indigenous and traditional knowledge has played an important role in assisting farmers with techniques on wetland management, in some communities they are portrayed as promoting the mismanagement and deterioration of wetlands (Dixon, 2005). On Illubabor Zone wetlands in western Ethiopia, farmers relied on indigenous knowledge of hydrological, ecological and tilling processes, but their knowledge and experience was not enough to cope with the requirements of intensified wetland use (Dixon, 2005). Insufficient knowledge of wetland management therefore affected the integrity of Illubabor wetlands. Marambanyika and Beckedahl (2016a) showed that Agritex officers assisted wetland users with agricultural extension information on suitable farming methods, which helped in ensuring wetland management, but their efforts were sometimes not recognised by the EMA. Therefore it is important that indigenous and traditional knowledge systems are complemented with modern management practices and support from government and private institutions. However, government intervention in natural resources management in some rural areas in Zimbabwe has adversely affected traditional management structures, and some sacred places in wetlands which could have been protected are now being used uncontrollably (Mbereko *et al*., 2007; Marambanyika *et al*., 2012, 2017b).

Although local people are often viewed as the main causes of wetland loss, local users have often been left behind in most initiatives on the wise use and management of wetlands (Wood *et al*., 2013). Wood *et al*. (2013) advocated for a 'livelihood-wetlands nexus' and 'people-centred sustainable wetland management' that involves indigenous knowledge to promote community-based natural resources management. Community participation and local management institutions are important, especially in rural areas, as wetlands are considered as common property (Mbereko et al., 2007; Shrestha, 2013; Marambanyika and Beckedahl, 2016a, 2016b). Conversely, barring local people from participation in natural resources management can lead to uncontrolled wetland use (Mbereko *et al*., 2007; Marambanyika *et al.*, 2012; Marambanyika and Beckedahl, 2016c). Some stakeholders, such as wetland users, do not have the power to make decisions on legislation pertaining to the use and management of wetlands, despite the fact that they regularly interact with them (Matamanda *et al.*, 2018).

Although the EMA Act Statutory Instrument 230 of 2001 permits the impartial, effective involvement of all interested stakeholders in wetlands management, Marambanyika *et al*. (2012) indicated that most decisions on wetlands were controlled by the EMA, limiting the wetland users' independence on decision making. However, local-level involvement in wetland management can be enhanced by understanding the effects of cultivation on the ecological condition of wetlands and the institutional and policy structures that control access to, utilisation and management of wetlands (Marambanyika and Beckedahl, 2016c). However, in some communities with a heterogeneous population with differences in age and religious affiliations, different conflicting attitudes and perceptions are normally displayed on issues concerning wetland management (Ndiweni and Onalenna, 2014). A study by Ndiweni and Onalenna (2014) in Matobo district, Zimbabwe revealed conflicts between wetland users on management issues because of the varied population which affected their management attitudes and perceptions, and as a result some wetland users were against the use of indigenous knowledge in wetland management. Therefore conflicts resulted on management issues as the community failed to agree on different ways of management. Decision making and planning pertaining to wetlands management and sustainable use need to be distributed from one authoritative group (decentralised) to local people to promote responsibility, liability and transparency (Matamanda *et al.*, 2018). However, there are inconsistencies in some cases on policy implementation when law-makers use the top-down approach and contributions by key stakeholders are left out (Matamanda *et al.*, 2018).

It is important that institutions involved in protecting wetlands are able to develop suitable wetland management schemes (Chatterjee *et al*., 2008). A wetland management scheme is essential as it helps in identifying the aims of the management at that site, ways of resolving management conflicts, recognising and outlining what needs to be done for management objectives to be achieved, assisting in securing funding, and ensuring conformity to local, national and international policies (Chatterjee *et al*., 2008). It also enhances proper communication amongst different stakeholders involved in the management structure (Chatterjee *et al*., 2008). Successful wetland management can be influenced by acknowledging how the benefits derived from wetlands contribute towards livelihoods, understanding how wetland ecosystem services are distributed, and how these services are modified by human activity (Adekola and Mitchell, 2011).

Zimbabwe is a signatory of a variety of international environmental agreements that assist in the conservation of natural resources such as wetlands. Some of the treaties include the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITIES), the Convention on Biodiversity, the Montreal Protocol, and the Ramsar Convention (Matamanda *et al.*, 2018). Besides being a signatory of these international treaties, Zimbabwe has its own regulations that help in the conservation of wetlands, and these include the Constitution of Zimbabwe, The National Water Policy of 2013, The Water Act of 1998 (Chapter 20: 24), and The Environmental Management Agency Act of 2007 (Chapter 20:27) (Matamanda *et al.*, 2018). As an organisation with authority to control the use of wetlands, the EMA is entitled to implement environmental legislation to ensure sustainable and controlled use of wetlands (Matamanda *et al.*, 2018). Thus, the EMA is expected to disseminate knowledge, educate and train people on sustainable use, conservation and management of wetlands. However, the EMA's failure to stop the uncontrollable use of wetlands reflects its lack of commitment to the mandate of the Ramsar Convention and the wise use of wetlands (Chirisa, 2019). Although Zimbabwe is expected to have draft policies to promote sustainable use and management of wetlands as a signatory of the Ramsar Convention, it does not have a specific wetland policy (Marambanyika and Beckedahl, 2016b). This makes it difficult for the EMA to have comprehensive and implementable wetland management and conservation strategies. A study by Marambanyika and Beckedahl (2016b) on six rural wetlands in Midlands province of Zimbabwe revealed that wetland activities such as agriculture were done without permits from the EMA, even though this is a requirement. However, most people had limited knowledge about wetland laws because of the lack of information dissemination, awareness, education, or implementation of these laws from responsible institutions such as the EMA, and active undermining of these measures by wetland users. This results in illegal utilisation of wetlands which compromises the integrity of these ecosystems. In carrying out its mandate, the EMA should have a comprehensive management framework and encourage the participation of different multi-sectoral institutions (Matamanda *et al.*, 2018). As was reported by the EMA official, 90% of wetlands in Zimbabwe are in rural areas where 20% of these wetlands are stable, and 70% were moderately or severely degraded.

Although Matamanda *et al.* (2018) argued that EMA has been reaching out to the public and teaching rural wetland users on the importance of wetlands and motivating people to take action against wetland destruction, lack of knowledge on wetland laws in some locations shows that

EMA was not consistent in spreading information to all rural communities in Zimbabwe (Marambanyika and Beckedahl, 2016b). However, studies done in some rural areas (Mbereko *et al*., 2007; Marambanyika *et al*., 2012; Marambanyika and Beckedahl, 2016a) showed inconsistencies in how the EMA recognised the role of traditional institutions in wetland management. Formal institutions therefore failed to acknowledge and promote wetland stewardship by local management systems through economic incentives (Ramsar Convention Secretariat, 2010a). It is also essential for management institutions to ensure that monitoring, funding, public awareness and private sector involvement are considered (Ramsar Convention Secretariat, 2010b; Xu *et al.*, 2019).

Community-based organisation such as the Harare Wetland Trust and Conservation Society of Monavale (COSMO) have been fighting for the sustainable use and management of wetland only in urban areas such as Harare (Matamanda *et al.*, 2018). Although there are legislation and institutions to guard against the destruction of wetlands in Zimbabwe, minimal effort is given to wetland management, and therefore these regulations are more on paper than they are practically implemented (Matakana *et al.*, 2018). The development of infrastructure on Borrowdale, Belvedere and Monavale urban wetlands in Harare reveals that the hands of the EMA are tied when it comes to making decisions on contested wetland land uses, especially when politicians are involved (Murungweni, 2013; Matamanda *et al*., 2018). The efforts by EMA to stop development on such sensitive wetlands have been overruled by corrupt political desires and economic interests (Murungweni, 2013; Matamanda *et al*., 2018; Chirisa, 2019). It has been therefore the responsibility of politicians in Zimbabwe to decide on how wetlands should be used (especially urban wetlands), and in such cases the EMA has failed to stop them. Thus, institutions that should fight against the unsustainable use of wetlands in Zimbabwe are rendered powerless because of political practices (Matamanda *et al.*, 2018; Chirisa, 2019). The government of Zimbabwe seems to have ignored the effects of infrastructural developments on wetland integrity because land barons are still continuing allocating people housing stands on wetlands (Chirisa, 2019).

Although information from inventories on the size, characteristics, distribution and state of wetlands is essential for wetland management and conservation initiatives (Dugan, 1990; Finlayson and van der Valk, 1995; Taylor *et al*., 1995; Finlayson *et al*., 1999), most countries, especially in Africa, have been relying on outdated and incomplete inventories (Dugan, 1990; Finlayson and van der Valk, 1995; van der Valk, 2012). Lack of up to date inventories makes it impossible to determine the general status of most wetlands (Finlayson and van der Valk, 1995; Finlayson *et al.*, 1999). However, knowledge about the state, location and distribution of wetlands help decision-makers in making informed and wise decisions on the sustainable use of wetlands (Taylor *et al*., 1995). Since it is expensive to make a complete inventory, no informative countrywide inventory has been made (van der Valk, 2012). In-depth inventories were only made in the USA (by the US Fish and Wildlife Services in 1974) and Canada (Finlayson and van der Valk, 1995; Finlayson *et al*., 1999), but they are still lacking in Africa (Dugan, 1990; van der Valk, 2012). Although different institutions play a vital role in wetland management, lack of sound legislation and information on the status and distribution of wetlands and the variety of management programs available can affect wetland management decision-making (Shrestha, 2013). In cases where the community is not involved in wetland management, the social behaviour of wetland users can also cause wetland loss (Shrestha, 2013). However, the participation of communities in wetland conservation is important as they can provide valuable information used for inventory making (Shrestha, 2013). More so, the involvement of local people in management decisions is vital for well-structured development and conservation planning (Byomkesh *et al*., 2009; Shrestha, 2013). It is therefore important to include peoples' skills, knowledge and practices for wetland management plans (Byomkesh *et al*., 2009; Shrestha, 2013). Thus, community-based wetland management systems are of great importance, although they alone cannot prevent wetland loss (Byomkesh *et al*., 2009).

Therefore, it is important to understand the ecological processes, hydrological functioning, and biodiversity supported by wetland ecosystems and the interactions between these services in order for management to be effective (Chatterjee *et al*., 2008). The natural processes that support wetland species and factors that affect its regulatory processes also need to be understood (Chatterjee *et al*., 2008). Furthermore, it is crucial for management to grasp how people have used wetlands in the past and are using them at present in order to predict the present and future effects of such usage (Chatterjee *et al*., 2008). This will then assist in determining the nature of sustainable usage for individual wetlands (Chatterjee *et al*., 2008). Wetland management is therefore influenced by the values that local people attach to wetlands, and this will eventually influence land use types, the nature of agricultural activities, and the alteration of wetland ecological characteristics (Marambanyika and Beckedahl, 2016c). Institutions should therefore appreciate how local people manage their wetlands and use this information in formulating policies for wetlands management that help in protecting their cultural beliefs that are founded on wetland characteristics (Chunhabunyatip *et al.,* 2018).

Therefore, successful localised wetland conservation can only be achieved if this information is disseminated at all different levels and amongst all stakeholders (Hartter and Ryan, 2010).

Although different institutions can make efforts to conserve and manage wetlands, sometimes such efforts are affected by the actions of wetland users. However, people's environmental behaviour can be related to Tolman's (1948) cognitive map behavioural theory, in which he uses rats to assess how relationships between entities in the world supports behaviour. The rats learnt the complex details of the mazes in the presence and absence of food, and after being exposed to mazes, the rates took shortcuts to reach the rewards (Behrens *et al.*, 2018). Thus, the cognitive map of wetland users determined their relationship with wetlands and their resulting actions. This predicted the consequences of their actions on wetlands. The continual exploitation of wetlands by farmers for agriculture was driven by the fact that they could get more food in wetlands than in dryland farms. Thus, farmers were compelled to engage in different agricultural practices that could ensure good harvests. Since the farmers are mainly concerned about the rewards or benefits from wetlands more than wetland integrity, wetland conservation and management is often neglected. In light of this background, this study therefore seeks to assess the role of different institutions in ensuring sustainable wetland use and management.

2.11 Knowledge gap

Whilst most research and the Zimbabwe government has concentrated on the benefits of wetlands and increasing food output through agriculture, the essential wetland ecosystem services and the ecological processes that support agriculture or local communities seem to be ignored. Previous studies have focused on monitoring and assessing wetland use without fully understanding the sustainability of the different wetland land uses (Musasa and Marambanyika, 2020). Therefore, previous research in Zimbabwe has not paid attention to the sustainability of exploiting wetland ecosystem services. The interactions between people and these small valley bottom wetlands has not been explored. Hence, there are gaps in understanding the relationship between different exploited wetland resources and wetland ecosystem services.

2.12 Conceptual framework for understanding wetland systems

The utilisation of rural wetlands has increased in Zimbabwe due to climate change (little rainfall and increased heat waves) and increased population pressure. Since rain fed and dryland agriculture have proved to be unproductive due to climate variability, wetland agriculture has become common in Zimbabwe (Mbereko *et al*., 2007; Marambanyika and Beckedahl, 2016a) because wetlands provide off-season and more reliable food and water (Scoones, 1991). Changing hydrological regimes due to global climatic variability could further increase the encroachment of human activities such as agriculture into wetlands (Hartig *et al*., 1997). Since temperature and rainfall are the main factors contributing to crop growth, crop production remains dependent on climate (Rosenzweig *et al.*, 2001). Since agriculture is the backbone of the Zimbabwean economy, the cultivation of wetlands has become necessary for most rural farmers to ensure regular crops (Whitlow, 1983). Wetland ecosystem services are crucial to livelihoods for people who depend on the wetlands for survival. Therefore, Zimbabwe's rural wetlands have been exploited mainly for provisioning and cultural ecosystem services (Mbereko *et al*., 2007; Marambanyika and Beckedahl, 2016). Since human wellbeing is naturally linked to wetland ecological status, managing and using wetlands sustainably provides better services for livelihoods and sustenance (Millenium Ecosystem Assessment, 2005b). In this study, different concepts were explored to understand best the use of wetlands in the study are. Figure 2.5 shows the basic concepts explored in this study and the relationship between these concepts. The exploitation of the ecosystem services, agricultural practices and impacts, interactions between wetland users and institutions, and problems and solutions in wetland farming were examined in relation to socioeconomic and environmental sustainability, which helped determine the overall sustainable use of rural wetlands.

In this review, two hundred and ten articles from peer-reviewed journals were used to gather relevant literature related to the objectives of this study and these were not confined to a specific period. Hence, they were openly obtained. The keywords used to select these articles included "wetlands types", "human use of wetlands", "wetland ecosystem services and human wellbeing", "wetland management and conservation", "the role of different institutions in wetland management", "wetland and sustainability", "wetland use in Zimbabwe", "history of wetland use in Zimbabwe", wetland and climate change", "challenges faced by smallholder farmers", amongst others. The main sites used to identify these articles were Scopus (http://www.scopus.com/home.url) and Web of Knowledge (http://webofknowledge.com).

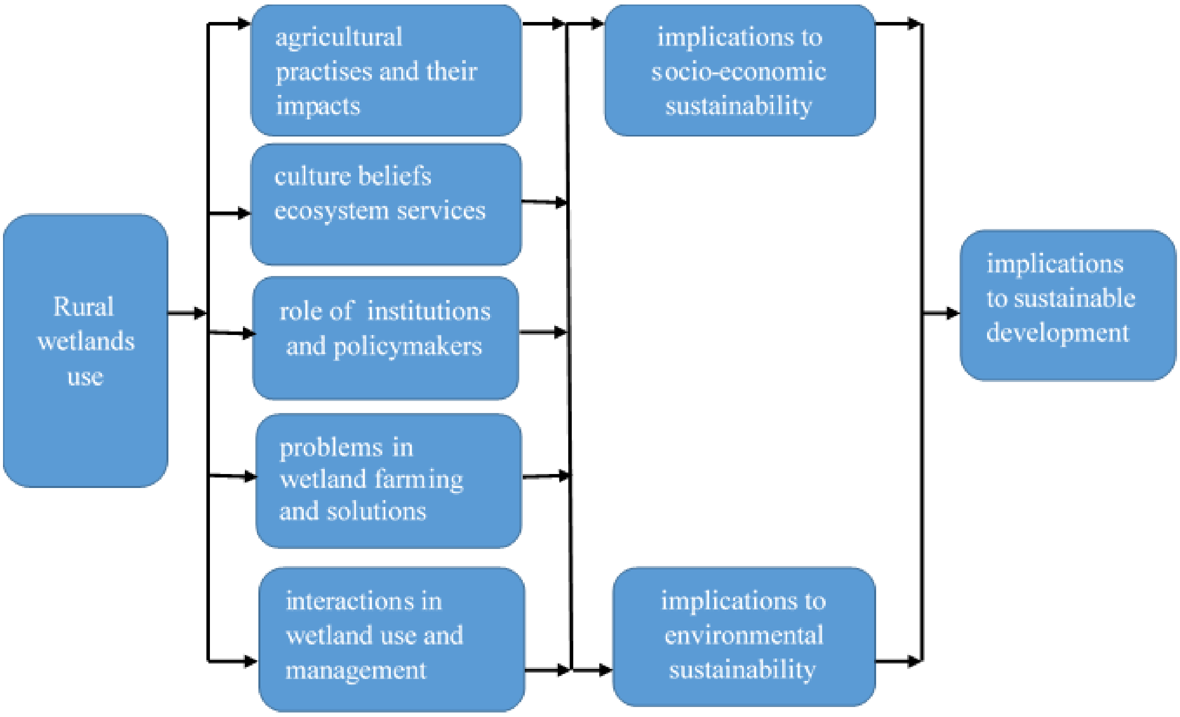

Figure 2.4: Conceptual framework for rural wetland use examined in this study. Source; diagram by Emmah Mandishona

2.13 Chapter summary

This review of previous studies shows the contribution of wetlands to human wellbeing globally and in sub-Saharan Africa, the impacts of unsustainable exploitation of wetlands on wetland integrity, how wetlands have been used by local communities in the past, the contribution of cultural beliefs and different actors in wetland management, and how such roles affect wetland conservation and management strategies today. Previous studies have also revealed the effects of climate change on wetlands and the associated problems faced by smallholder farmers. It is therefore crucial for future studies to look into the impacts of wetland loss on people and communities, the ecological status of wetlands in semiarid regions, the different restoration and management strategies that can be applied, and implications of global change for wetland ecosystem services and socioeconomic and environmental benefits of wetlands. In light of these previous studies, this study seeks to understand how people interact with mostly-neglected valley bottom wetlands in eastern Zimbabwe that have been intensively used to support livelihoods in rural areas. This study also unpacks the challenges encountered specifically by wetlands farmers as they continuously grow crops on wetlands.

Chapter 3: Study area

3.1 Introduction

This chapter describes the geology, topography, climate, ecosystems and human and economic activities of the study area. The study area is Zindi, Honde Valley rural area, located in Mutasa district in the Manicaland province of Zimbabwe (Figures 1.1b, 3.1). Honde valley is 130 km from Mutare and 110 km from Nyanga district. Six wetlands (Tawarara A, Tawarara B, Rutsate, Mareya, Chiwira and Madimbo) were selected as case studies. These wetlands located in the northern part of Honde Valley were purposively selected since they are among only a few valley bottom wetlands that are still available in the Zindi area and are intensively exploited for their different ecosystem services, mainly for agriculture by local communities. This study focuses on the valley bottom wetlands located in the mountainous area of Zindi because they have biophysical characteristics different from the majority of wetlands in other agro-ecological regions of Zimbabwe. The selected wetlands from two different district wards (ward 3 and 6) in Honde Valley provide direct and indirect ecosystem services for livelihood sustenance.

3.2 Geology and Topography

The Honde Valley forms part of the Zimbabwe Eastern Highlands and is located in Mutasa district (18°29′S, 32°50′E; elevation 912 m asl) (Sande *et al.*, 2016). Since it is part of the Eastern Highlands Mountain range of Zimbabwe, it extends from the eastern border of Zimbabwe into Mozambique (Dalu *et al.*, 2017). The Honde Valley area is part of the Odzi-Mutare-Manica Greenstone Belt, which is made up of Archaean granites (Koistinen *et al.*, 2008). The area has orthoferralitic soils that are red and yellowish-brown in colour and have high organic matter content (Nyamapfene, 1991). The soils have high clay content and are therefore fertile (Nyamapfene, 1991).

3.3 Climate

The Honde Valley study area has a subtropical to temperate climate and lies within agro-ecological region 1 with the total annual rainfall in the range 900-1000 mm (Mugandani *et al.*, 2012). The mean annual temperature ranges 15-18ºC with mean minimum temperatures of 10-12ºC and mean maximum temperatures of 19-23ºC (Mugandani *et al.*, 2012). Although the most common type of rainfall experienced in Honde valley is convectional, orographic rainfall is also experienced at different times of the year because of the mountain ranges. Most of the rainfall falls in summer and is caused by the movement of the Inter-Tropical Convergence Zone (ITCZ), leading to the convergence of the south-east and north-west trade winds (Taylor *et al*., 1995; Love *et al.*, 2010). The main rivers found in Honde Valley are Pungwe and Honde rivers. A variety of riverine wetlands such as Pungwe, Honde and Mutarazi and Nyamigura rivers are also found around the Zindi area.

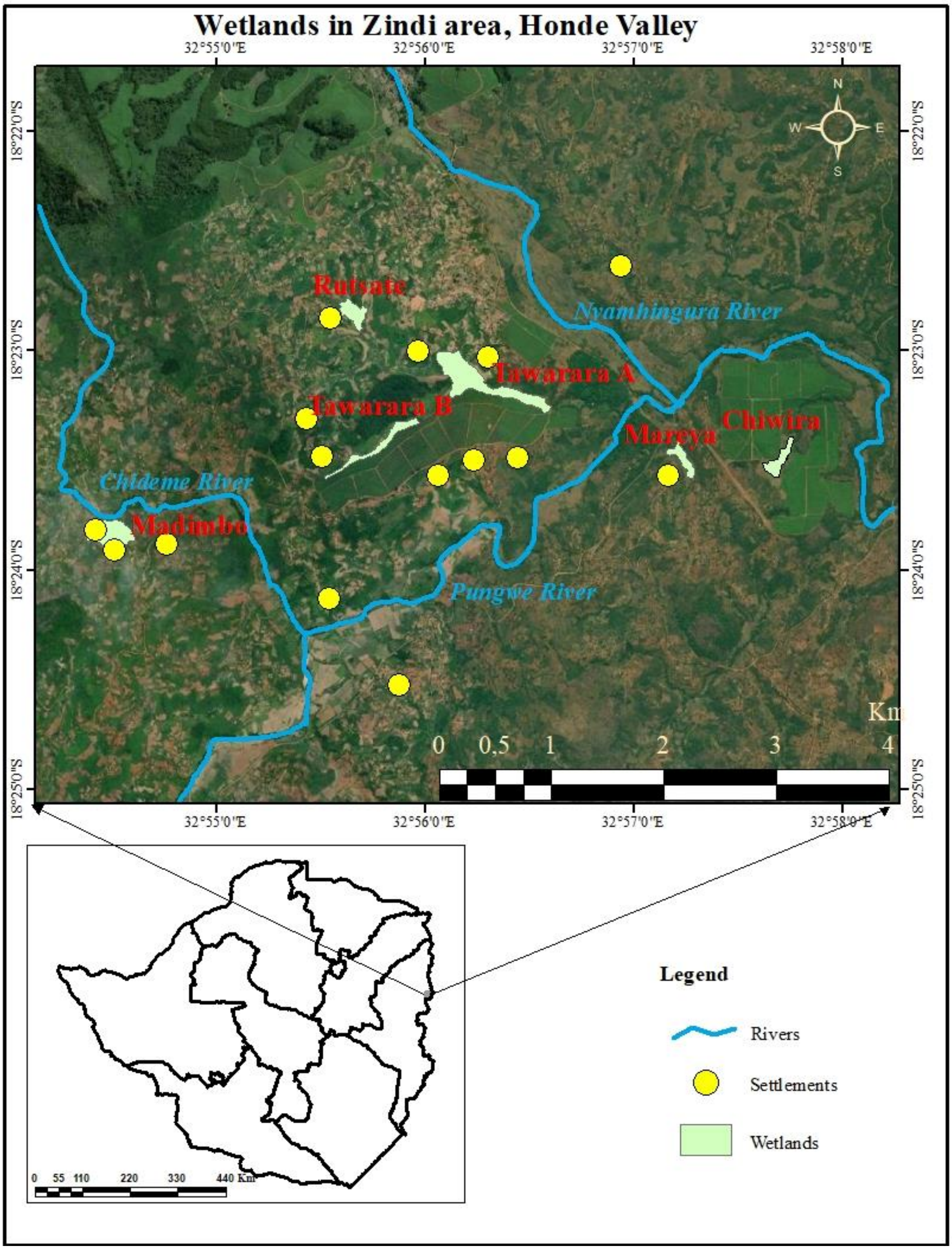

Figure 3.1: Wetlands in Zindi rural area, settlements and rivers (see Figure 1.1b)

3.4 Ecosystems

Zimbabwe is divided into three phytogeographic regions: the Afromontane, the East African coastal, and the Zambesian (Garwe *et al*., 2009). Honde Valley is part of the Afromontane region and has the highest level of endemism (Garwe *et al*., 2009). Honde Valley has a diversity of habitats and bushveld wilderness which harbours a variety of species (Lister, 1987). The forest below the Mutarazi falls is one example of the pristine mid-latitude forest and is the only place where *Aningeria adolfi-friedericii* (an evergreen tree species) is found (Childes and Mundy, 1998). Montane grassland and ericaceous shrublands (plants that need acidic soils such as heather, rhododendron, *Azaea* and *Arbutus)* are also found around Mutarazi Falls in Honde Valley (Childes and Mundy, 1998). There are also some patches of montane (the southeastern slope of the steep-sided valley beneath Mt Rupere) to the submontane moist evergreen forest (Childes and Mundy, 1998). A variety of plant species such as *Chrysophyllum* and *Croton* are found in the mid-latitude forests, and *Newtonia*, *Maranthes* and *Xylopia* are common in the low altitude areas (Childes and Mundy, 1998). Pungwe Bridge and Rumbise Hill forests are dominated by *Newtonia* and *Aidia* plant species. Near the upper eastern slopes of Mt Chinyamariro, there is a well-developed *Syzygium* forest with *Podocarpus* forest further down the slope and *Craibia* forest on boulder-scree (Garwe *et al*., 2009). A rare plant species *Encephalartos manikensis* has also been observed in Honde Valley. Due to the ruggedness of the topography, erosional cycles and different geological processes have occurred, and waterfalls of different heights such as Pungwe Falls and Mutarazi Falls (tourist attractions) have been formed along Pungwe River and Mutarazi River, respectively (Lister, 1987).

The tributaries that carry water to the main rivers, such as Pungwe and Honde, are in mountainous regions with steep slopes, and they flow through narrow channels with a thick riparian canopy (Dalu *et al.*, 2017). The study area is endowed with small valley bottom dambos (small wetlands) in which a variety of crops such as yam, maize and potatoes are grown. Six small valley bottomland wetlands (Tawarara A, Tawarara B, Rutsate, Mareya, Chiwira and Madimbo) were examined in this study. These wetlands are small in size (presented in Chapter 5) and located near rivers. Tawarara A, Tawarara B and Rutsate, Mareya and Chiwira wetlands are located near Pungwe and Nyamhingura rivers, whilst Madimbo wetland is located near Chideme River (Figure 3.1). These valley wetlands are mountain and headwater slope wetlands located in mountain valleys (valley bottomland dambos) in which shallow groundwater is discharged from springs contributing to streamflow, creating an area of perennial moisture. These wetlands appear where there is a break of slope from the hilly area to the low lying area (valleys of mountains), and therefore they are surrounded by steep slopes. However, due to the nature of these wetlands, people in Honde Valley prefer growing water-loving crops such as yam, and in most cases, they grow the yams on ridges to drain excess water.

3.5 Human and economic activities

The study area has an agro-based economy with many rural dwellers practising subsistence, semi-commercial to commercial agriculture (Zinyuke, 2019). Rural dwellers keep a variety of livestock (cattle, goats, and sheep) and grow a variety of crops such as potatoes, maize, coffee, tea, yam, groundnuts and sugarcane. Fruits such as apples, bananas, pineapples are produced in this area because of the cool climate (Shambare, 1997). Market gardening is also practiced, and people grow different types of vegetables for consumption. Bananas, pineapples and apples are grown mostly for sale. Smallholder farmers in Honde Valley also grow yams (madhumbe and magogoya) on wetlands and near river banks for sale and consumption. However, due to climate variability (short rainy seasons and unpredictable rainfall), many wetlands in Honde Valley are drying up and areas for the growing of yams are dwindling (Zinyuke, 2019). Bananas have also become a source of income for some smallholder farmers in Honde Valley since they continue to grow them through irrigation and some in wetlands (Shambare, 1997). Farmers sell these bananas to cities such as Mutare, Harare and Bulawayo and towns such as and Rusape and Chivhu (Zinyuke, 2019).

There are also large tea and coffee estates such as Katiyo, Mpudzi, Rumbizi, Chiwira, Aberfoyle and the Eastern Highlands and commercial timber plantations such as Selbourne, Wattle Company and Stapleford (managed by Mutare Board Timbers). Some rural dwellers in Honde Valley therefore have seasonal jobs from commercial timber, tea and coffee plantations.

Chapter 4: Research Approaches, Procedures and Methods

4.1 Introduction

This chapter focuses on methods and data collection techniques used in this study. It also describes the researcher's positionality, research strategies, procedures, ethical considerations, sampling procedures, data collection processes, and study limitations. Thus, the methods, data collection tools and procedures discussed in this chapter were applied to address the research aims, achieve the stated objectives, and answer the research questions.

4.1.1 Research strategy

Different research strategies or approaches can be used to collect and analyse data. This can be done using quantitative or qualitative methods or mixed methods. Thus, the approach chosen by the researcher depends on whether the strategy is relevant to allow the collection of data that can address the research objectives and answer the research questions. A quantitative approach uses objective, systematic procedures with statistical analysis to describe hypotheses and variables (Bryman, 2012; Creswell, 2012; Neuman, 2014). A qualitative research approach focuses on conducting a detailed study of specific cases that arise in context and collecting data from people to obtain detailed participants' views (Bryman, 2012; Creswell, 2012; Neuman, 2014). A mixed methods approach uses both quantitative and qualitative strategies in collecting and analysing data.

Previous wetlands studies have used qualitative (Ndlovu and Manjeru, 2014), quantitative (Dube and Chitiga, 2011) and mixed method approaches (Marambanyika and Beckedahl, 2016a, 2016b, 2016c). Mixed methods approaches have been used in some wetland studies, for example the use of interviews, questionnaires and document review by Marambanyika and Beckedahl (2016b) allowed for examination of people's perceptions on the effectiveness of wetland conservation policies and legislation on six wetlands in the Midlands province of Zimbabwe. Understanding how people have used wetlands for different services in the past and present could be done through understanding participants' experiences within their natural setting.

Quantitative methods have also been used in some wetland studies. For example, Dube and Chitiga (2011) in Dufuya and Madikane wetlands of lower Gweru, Zimbabwe, included plant diversity assessment which was done by ecosystem composition and species percentage cover in quadrants, testing the soil for ammonium nitrate, nitrogen and pH and testing wetland water for ammonium nitrate, nitrogen and chloride to assess how the use of wetlands affected wetland water, soil and vegetation. Statistical analyses such as ANOVA was used to test for differences in water and soil variables. Although Dube and Chitiga (2011) established the extent to which wetland water, soil and vegetation had been affected by human activities, their research could not establish why and how these wetlands were affected.

A qualitative approach is an exploration process based on investigating human and social issues whereby the researcher builds comprehensive pictures, evaluate words, reports attributes of informants and carries out the study in a natural context (Khan, 2014). Since qualitative research provides an informative account of what takes place in the context of the phenomenon being explored (Bryman, 2012), it is a suitable approach to understand how people make use of wetlands. Qualitative research methods are suitable for investigating this problem and to create a comprehensive understanding of the central phenomenon (Creswell, 2012) in which information about wetlands can be conveyed through informants' thought-processes and emotions (Strauss and Corbin, 1998). A qualitative strategy was therefore chosen for this study, in line with its use in some previous wetland studies. For example, Ndlovu and Manjeru (2014) used a qualitative approach to assess the influence of rituals and taboos in managing wetlands in Matobo rural area of Zimbabwe. They used interviews and observations of the sacred shrines within the wetlands to collect data. Matenga (2019) also used a qualitative approach to investigate climate change and urban wetland conservation in Zimbabwe. In-depth semi-structured interviews, observation of how wetlands were used to examine how urban agriculture affected wetland conservation. Thus, this study adopted a qualitative approach in conducting a detailed assessment of how people were using wetlands in their natural setting. A contextual understanding of social behaviour (Bryman, 2012) was crucial in unpacking how people use wetlands and why they were using them in such a manner.

4.1.2 Philosophical considerations

Research philosophy refers to a set of beliefs and assumptions that assist in developing knowledge (Saunders *et al.*, 2018). Philosophical views are essential in revealing assumptions made by the researcher, which assist in making choices related to the research design methods of data collection, analysis, and interpretation (assist the researcher in building the basis of approaching his or her research) (Creswell, 2007; Wilson, 2014). Philosophical approaches which guide the research process include epistemology (knowledge possessed by the researcher about what she or he knows), ontology (nature of what is real), axiology (considers role played by values in research), methodology (data collection tools used in the research process) (Creswell, 2007; Kivunja and Kuyini, 2017) and rhetoric (nature of research language) (Creswell, 2007).

In carrying out qualitative research, ontological philosophical issues are revealed through multiple realities (Creswell, 2007). Therefore, numerous realities in this study were understood through different views shown through the participants' quotes, which revealed different informants' perspectives on how they interacted with wetlands. The researcher valued the views of different informants, which allowed her to understand the external reality of how people were using wetlands. Axiological qualitative research informs how the researcher perceives values that shape the narrative, which reflect the researcher and the participants' interpretations (Creswell, 2007; Kivunja and Kuyini, 2017). Thus, axiology was applied in this study when the researcher took note of the participants' interpretations and her interpretations in reporting the results in the next chapter (Chapter 5). Epistemological assumptions in qualitative research refer to how the researcher gathers knowledge about what is being researched (Kivunja and Kuyini, 2017). In this study, the researcher collected data by getting close to the participants and spend a lot of time in the field where the participants resided and worked (Creswell, 2007; Kivunja and Kuyini, 2017; Saunders *et al*., 2018). In this study, the researcher had to spend some time in the field to understand the participants' responses about their interaction with wetlands and the problems they were facing in using wetlands

Rhetorical philosophical assumptions in qualitative research indicate that the researcher's language is informal, personal, and literary and relies on meanings that develop during a study instead of those assigned meanings (Creswell, 2007). Rhetorical philosophical assumptions were therefore applied in this research as the researcher engaged the participants during participant observation. The researcher's language and informal interviews during participant observation were based on what she was observing and some issues that arose during the fieldwork. The methodological assumption in qualitative research implies that the research process is characterised as inductive logic, emerging and framed by the researcher's understanding in gathering and analysing data (Kivunja and Kuyini, 2017). The research methodology was, therefore, significant as it assisted the researcher to clarify and state the research strategy (Neuman 2014) and design used in the study. This included the type of data collected and its origin, the methods used to interpret such data and how it assisted in addressing the research questions (Neuman 2014). Thus in this study, the researcher adopted a qualitative research strategy that used ethnographic techniques such as participatory action research, participant observation, direct observation, individual interviews and focus group discussions to collect data.

The above-mentioned philosophical assumptions show the different viewpoints made by researchers when choosing qualitative research, which is further elaborated by bringing in paradigms or worldviews. Paradigms are perspectives, concepts and ideas that direct research (Creswell, 2007). As a qualitative research, this study was based on the interpretive and constructive paradigms. Interpretive worldviews in qualitative research mean that the researcher makes interpretations based on what he or she sees, hears and understands (Creswell, 2012). Thus, interpretive views suggest that the world's realities can be understood by grasping the social phenomenon under study, which can be unpacked by taking note of the participant subjectivity in the process (Creswell, 2012; Wilson, 2014). Social actors are studied within their cultural setting to understand reality (Wilson, 2014). Hence, this study was done through fieldwork. The researcher investigated how people interacted with wetlands and their challenges in using wetlands for agriculture in their natural setting to address the research questions. As an interpretive research, the researcher also assumed a naturalist methodology (Kivunja and Kuyini, 2017) which intends to develop new deep understandings and interpretations of human societies in context (Saunders *et al.*, 2018). Therefore the researcher used different ethnographic methods to acquire knowledge on human-wetland interactions and the challenges encountered by farmers in using wetlands for agriculture. Such techniques also assisted in answering the research questions and achieved the stated objectives.

4.1.3 Researcher positionality

Previous research approaches to understand the human use of wetlands exploring peoples' lived experiences have focused on their interaction with wetlands. Some of these previous approaches used different methods such as participatory action research (Dixon, 2005); questionnaires, focus group discussions, trend analysis, observations, mapping, and interviews (Mbereko *et al*., 2007); questionnaires, interviews and observations (Svotwa *et al*., 2008a) questionnaires, focus group discussions, observation and interviews (Hardlife *et al*., 2014), and interviews and questionnaires (Mbereko *et al*., 2015; Marambanyika and Beckedahl, 2016a, 2016b). Thus various combinations of qualitative instruments can be used to investigate wetland users and their interactions with wetlands. Therefore, in this study, semi-structured interviews, observation, focus group discussions and participatory action research were used in order to derive detailed descriptions of individual experiences, focusing on how wetlands are used in Honde Valley, Zindi rural area, Zimbabwe. As an interpretive research, knowledge about the use of wetlands was understood through the respondents' perceptions of their actions and their socioeconomic and cultural relations to their local wetlands. Hence, this study used field data collection methods in which human use of wetlands was studied in its natural setting.

Since this type of interactive qualitative research is shaped by both the researcher and the researched, it is crucial to define both the researcher's and the research participants' identities in this process (Bourke, 2014). This is because both groups' identities or positionalities can impact the research process and the nature of the collected data (Srivastava, 2006). Depending on how the participants accept and receive the researcher, one can have multiple identities when collecting data (Bourke, 2014). In this study, the researcher's position was as both an insider and an outsider. Different aspects of the researcher's identity, such as race, class, gender and sexuality, can inform the researcher's positionality (Srivastava, 2006). The researcher's social position in interviewing illiterate participants in the rural areas was different from that of conducting interviews with elite company officials. As an outsider, the researcher had to gain access to the study area through gatekeepers and create rapport with the participants. However, gaining access to conduct interviews with the company officials was less complicated as permission letters had been sent to companies, and the researcher had been granted permission before commencement of the interviews. However, in some cases, the researcher was suspected of working for the EMA and had to deal with questions in line with whether she had come to stop people from using wetlands. As an insider, who was born and bred in Zimbabwe, the researcher appreciate how important wetlands are to rural communities. Being a black female researcher who speaks the participants' local language (Shona) also helped the researcher position herself as an insider. Being familiar with rural life and speaking the same language as the participants made it easier for the researcher to be accepted, trusted as an insider and allowed the participants to be comfortable during informal and formal interviews.

Since I was familiar with some of the Honde Valley peoples' daily activities, I became part of the group as I investigated how people were using wetlands. My position as an insider also gave me privileged access to the key informants' thoughts, feelings and behaviour, allowing me to have a deeper understanding of how people interacted with wetlands, interact with each other and different stakeholders. As part of the social group (as an insider), I studied how and when the wetland users worked in the wetland, which gave me knowledge on when to collect data. Thus, participants' daily activities were observed concurrently with formal interviews. Although I sometimes participated in hands-on activities on wetlands with the wetland users, appointments were made on some instances with participants if they were too busy to respond to questions whilst working in the wetlands. Setting appointments with the respondents helped me in not becoming too 'native' and forget my role as a researcher.

As an insider, I also prolonged observation periods and the participants became used to my role and presence. As an outsider, I may not have been aware of some of the different ways people interacted with wetlands and each other. Hence, being an outsider assisted me in observing and questioning the unique differences in human wetland interaction. I also tried to wear appropriate clothing to fit in the social group being studied. Since I was careful of the contextual ethical matters, I had to change identities. Changing, mediating, and adapting to an insider-outsider position in this study gave me a deeper understanding of how people are and have been using wetlands in the past and present. This also helped me answer questions on how and why people interacted with wetlands, each other, and different stakeholders on wetland use. Although my position as both an insider and outsider allowed me to have a deeper understanding of human wetland use, some participants held back some information from me. For example, some participants who were using hired farms and were not originally from Zindi were scared of saying much when responding to questions. Some farmers were also reluctant to answer some questions on the traditional and cultural use of wetlands because of their Christian beliefs.

4.1.3 Research design

Different research designs can be used, and these include cross-sectional, longitudinal, case study, ethnographic, comparative and experimental approaches (Bryman, 2012; Creswell, 2012; Neuman, 2014). This study used a case study design that adopted ethnography techniques. A case study refers to the in-depth examination of any real-life situation, for example, an activity, event, process or individual placed in time and space (Brewer, 2005; Creswell, 2007; Yin, 2009; Neuman, 2014). Therefore, a case study is defined by concentrating on the situation of the phenomenon, not by the techniques used to study it (Brewer, 2005). A case study design was used since it ensured extensive data collection about a few units or cases for several periods (Yin, 2009; Creswell, 2012; Neuman, 2014). This study can be considered as a case study because it intensively investigated how a specific community was using their local wetlands, with the researcher deriving in-depth data from several examples (wetlands) within the same locality. In this study, in-depth data collection was done using multiple sources of information, including researcher observations, participatory action research, interviews, and focus group discussions. The study was carried in two different seasons to gain a deeper understanding of how people were using wetlands and why they were using them in such a way.

In this case study design study, the researcher spent a month on the first visit and a week on the second visit, both on a full-time basis doing fieldwork in the Zindi rural area of Honde Valley, Zimbabwe. When the researcher was in the field, data were collected using various ethnographic techniques to understand how people in Zindi were using the six wetlands (case studies) in the past and present. Ethnographic approaches allowed the researcher to capture what people say and what they do (peoples' daily activities in the wetlands) (Rieprich and Schnegg, 2015). Spending a month in summer on one occasion and a week in winter on the other occasion in the field was crucial in comparing peoples' actions in these different seasons. Thus, the short period the researcher had to spend in the field allowed her to study real-life human-wetland interactions and have an in-depth understanding of these interactions. However, the researcher had to spend more time in the summer than in winter because subtropical wetlands are exploited more by farmers in winter (dry season) than in summer (wet season). In this study, therefore, the researcher immersed herself into peoples' daily social lives, getting close to the natural setting and observing human activities on wetlands. This immersion was essential to solicit rich data that could address the research questions.

4.2 Data collection processes and analysis

This section describes how the study was carried out. It describes how the researcher identified the participants, gained access into the field, and the different instruments used to collect and analyse data.

4.2.1 Finding research participants

This study participants were representatives from seed companies, an official from the EMA, agricultural technical and extension officers (Agritex officers), village heads, and Zindi rural area residents. Since the main activity on the six wetlands was agriculture, the researcher targeted seed companies to assess how the seeds they were breeding and producing contributed to sustainable wetland agriculture. Seven seed companies were selected on the basis that they are known for breeding and producing a variety of seeds in Zimbabwe. The seed companies were Seed-co, Pioneer, International Maize and Wheat Improvement Center (CYMMTY), National Tested Seeds, Mkushi Seeds, Prime Seeds and Agriseeds. The EMA was targeted since it is the main government statutory board that is responsible for ensuring the sustainable management of natural resources and protection of the environment. Also, the EMA ensures the prevention of pollution and environmental degradation and the preparation of Environmental Plans for the management and protection of the environment. It was essential to select the EMA to assess how they have been implementing wetland laws and assisting rural farmers in ensuring the sustainable use and management of wetlands. Selecting the EMA and assessing its role in sustainable use and management of wetlands also helped understand how wetlands were used in the Zindi area.

Agritex officers were targeted in this study since they live and work with rural farmers providing different agricultural extension services from the Department of Agricultural Technical and Extension Services under the Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement. Thus, Agritex officers were important participants for this study to assess the different extension services, agronomy practices and training they offered to wetland farmers to ensure sustainable use and conservation of wetlands. The Agritex officers can be considered as important potential links between government agencies and rural agricultural communities.

The residents of Zindi area were targeted in this study since they resided in the area, used wetlands on a daily basis, and their socioeconomic and cultural activities were embedded in wetlands and the local environment and often over many generations. Amongst these residents, most of them were using the wetlands for provisioning services such as agriculture, water, collection of fruits, indigenous vegetables and traditional medicines. Therefore, residents were also called farmers in this study (these terms are therefore used interchangeably here). Since most of these residents would interact with wetlands daily, they had extensive valuable knowledge and information on how wetlands were used. Village heads were also targeted as participants for this study to assess how they were interacting with the residents of Zindi on wetland use and how village heads liaised with EMA and other officials. Village heads were also considered as knowledge banks for the historical and cultural use of wetlands in their communities.

4.2.1.1 Sampling strategies

The sampling frame for residents included male and female residents of Zindi rural area. This study also targeted Agritex officers, an official from the EMA and seed companies' representatives. All participants from all groups were above 18 years of age. From this sampling frame (units of the population from which the sample was selected), non-probability strategies were used to select research participants in this study because it is suitable for real-life phenomena such as case study research in which logic is required for the selection of some units in the population (Taherdoost, 2016). The use of non-probability sampling ensured that a random selection of unsuitable respondents was prevented.

Purposive (judgemental) and snowball non-probability sampling strategies were also used in this study. Purposive sampling means that the researcher used her judgement to select unique participants for the study since they could purposefully provide the information required to understand the research problem and important phenomenon of the study (Creswell, 2012). Purposive or judgemental sampling was used to ensure the selection of information-rich participants whose study was meant to address the research questions (Patton, 2002; Neuman, 2014). Thus, the researcher sampled strategically to ensure variety in the final sample so that participants varied from each other concerning the key attributes applicable to the research question (Bryman, 2012). Stakeholders such as Agritex officers, seed companies, village heads and the EMA were purposively selected based on their knowledge on wetlands. Purposive sampling was therefore used to access people who had in-depth knowledge about wetland use in Zindi rural area.

Snowball sampling, also known as chain referral, reputational, network, and respondent-driven sampling (Neuman, 2014), was also used to select participants. Snowball sampling involves sampling initially a small group of people by the researcher who has the relevant knowledge to address the research questions (Bryman, 2012; Creswell, 2012). The selected participants then suggest other participants with the same characteristics and experience applicable to the study, and these, in turn, propose other respondents, and the process is repeated (Cohen *et al.*, 2007;

Bryman, 2012; Creswell, 2012; Neuman, 2014). Snowball sampling was an appropriate sampling technique for residents since the topic was sensitive for people in Zindi, and access to more interviewees was recommended by other interviewees. Therefore residents were selected on the basis that they resided in Zindi rural area, and as residents, they knew how wetlands were used in the past and present. Thus, more participants were found through referral. Respondents for in-depth informal individual interviews (conversations with participants without using a structured or semi-structured interview guide) and formal individual interviews (interviewing participants using a semi-structured interview guide) and focus group discussions were selected through snowball sampling.

The sample size in this study was determined by data saturation. Data saturation refers to the point in the data collection process when no new concepts or themes are reflected in the data (Saunders *et al.*, 2018). Specifically, during data collection in this study, the maximum sample size by data saturation was determined when new data, identified codes and themes merely repeated what was shown in previously-identified codes, themes and data (Saunders *et al.*, 2018). In this study, several interviews were done, and the researcher monitored what the respondents were saying and evaluated the cut-off of saturation. Through iteration, no new concepts and themes were reflected in the data after conducting 49 face-to-face in-depth interviews with residents. The saturation limit was therefore determined to be 49. Since methodological triangulation ensures that rich, in-depth data are collected, this was one method of ensuring data saturation (O'Reilly, 2012; Fusch and Ness, 2015). As various levels and views of the same phenomenon are explored through methodological triangulation, the validity of the results can be assured (Fusch and Ness, 2015).

In this study, triangulation of various methods such as participant observations, individual interviews and focus group discussions ensured examining the same phenomenon in various ways for data reliability, validity and credibility. Therefore, it is vital to consider the depth of data or data richness rather than the absolute number of people interviewed (Burmeister and Aitken, 2012). Since there is debate on how researchers determine data saturation, this study used the Comparative Method for Themes Saturation (CoMeTS) proposed by Constantinou *et al*. (2017). The themes that were identified from all the interviews and focus group discussions using this method were compared with each other. The series of interviews was then reordered several times to check for data saturation. Interview sequencing throughout this check ensured that saturation varied, and hence reordering assisted in validating saturation (Constantinou *et al*., 2017).

4.2.2 Gaining access

Access to EMA and seed companies was gained before the onset of data collection. Letters (Appendix 19) seeking permission to conduct interviews with representatives were sent to seed companies before granting of ethics clearance by the University. Permission to conduct interviews was granted by the seed companies and EMA through emails and letters. Permission letters from the seed companies also allowed the researcher to be granted the ethics clearance certificate. Since permission to conduct interviews was granted before data collection, access to the companies was less challenging during data collection. The researcher then used permission letters and emails from the companies to gain access to company officials to conduct interviews. Access to Zindi rural area to conduct interviews with residents, Agritex officers and the village heads were gained through gatekeepers, depending on their role in the villages. In this case, the primary gatekeeper was the District Administrator (DA) of Mutasa district, who administers all activities in that district.

Apart from showing him the ethics clearance certificate, the DA required a confirmation letter with details of my research, requesting permission from the administrator to facilitate my access to the field. Using the confirmation letter (Appendix 1) from the researcher's supervisor and the ethics clearance certificate from the University, access into the field was then granted by the DA. The researcher took the letter (granting permission to carry out research in Mutasa District) written by the DA to the other gatekeeper (the regional Agritex officer) since he was worked closely with the village heads and village chiefs. As an overt researcher (participant-as-observer), bureaucracies had to be followed. Therefore entry into the wetlands and villages was negotiated by the Agritex officers through the village heads (the third gatekeeper). After permission to move around the wetlands and villages, observing and conducting interviews with the residents was granted by the village heads of Zindi, the researcher then found a research assistant through the Agritex officer. The presence of the research assistant who was familiar with the people and the area since she grew up in that area allowed the researcher to quickly build up relationships and trust with the residents of Zindi. Assistance and support from the research assistant made access to wetland farms and homes less complicated for the researcher.

4.3 Data collection instruments and processes

Data collection instruments used in this study had different schedules, which will be described in this section. Data collection was undertaken in different ways following the different instruments used.

4.3.1 In-depth face to face interviews

Face to face in-depth interviews were conducted with residents, Agritex officers, village heads, seed companies' officials and one EMA official. Each group had a different semi-structured interview schedule with open-ended questions. These different questions allowed the researcher to gather varied subjective information on how people were using wetlands and to probe more questions during the interview sessions. Open-ended questions also allowed the respondents to best voice their experiences without being limited by the researcher's views or assumptions (Creswell, 2012). The fact that the respondents answered some of the same questions increased the chances of comparing the responses and reduces the researcher's bias (Creswell, 2007). Interview schedules were drafted in a semi-structured format to get descriptions of the real-life world and for the respondents to be able to interpret meaning associated with the described phenomena (Denzin and Lincoln, 2018). A pre-test and pilot study for the interview with key informants that excluded the main study subjects was done with five farmers in Hauna area, Honde Valley. A pilot study was also done with one village head in Hauna. These pilot studies were carried out in a different area from the study area, although the area is also in Honde Valley. Changes were then made on the instruments based on the responses from this pilot study. A pre-test and pilot study for the interviews with seed companies, EMA and Agritex officers was conducted with colleagues and some postgraduate students at the University. Changes were then made on the instruments, based on feedback from the pilot study.

4.3.1.1 Individual interviews with the EMA official and seed companies officials

The semi-structured interview schedule for EMA had 19 open-ended questions (Appendix 2), which focused on management issues such as whether there were laws in place to guard against wetland use in Zimbabwe, challenges they were facing in implementing wetland laws, the support they were giving the wetland users in ensuring sustainable wetland use, and whether they were engaging rural communities in making decisions about wetland use and management. In-depth interviews were also conducted with representatives of the seven different seed companies in Zimbabwe. The semi-structured interview schedule for seed companies had 12 open-ended questions (Appendix 3). These questions focused on whether the seed companies were considering wetland agriculture in breeding their seeds, whether they were engaging smallholder farmers in breeding their seeds, and problems they were facing in trying to make sure that the farmers adopt their seeds.

Interviews with the EMA and seed companies were conducted by visiting the companies by appointment. Access to company premises was not challenging since the researcher had permission letters and emails from the companies. Although appointments were made, it was sometimes difficult to find the relevant officials who dealt with seed breeding and production. In such cases, rearrangements for the interviews were done. A participant information sheet (Appendix 9) was given to each company official before starting the interview. This was then followed by the consent form (Appendix 14), which they signed, agreeing to participate in the interview. Although all the questions were written in English, clarification of the questions was not required during these interviews since all the officials understood English well. An interview with the EMA official took approximately 40 minutes, while those with the seed companies took about 30 minutes since there were fewer questions. During the interview process, the researcher jotted down notes in a field notebook while audio recording the interviews with a recording device, with permission.

4.3.1.2 Interviews with the Agritex officers

The Agritex officers' interview schedule had 17 questions (Appendix 4), with some focusing on the main duties of the Agritex officers, how the Agritex officers were ensuring the implementation of laws and regulations put by the Ministry of Lands, Agriculture Water, Climate and Rural Resettlement on wetland use, and the assistance they were giving to smallholder farmers.

Two Agritex officers were also interviewed on different days and places. Participant information sheets (Appendix 10) were given to the Agritex officers, and they signed the consent forms (Appendix 15) after agreeing to take part in the research. There was no need for translating the questions to Shona since all the Agritex officers could read and understand English. Respondents' responses were audio-recorded with permission, and the researcher also took notes during the interviews. Each interview with the Agritex officers took approximately 40 minutes.

4.3.1.3 Interviews with residents of Zindi

The interview schedule for Honde Valley residents in Zindi had 40 questions in total, divided into two sections (Appendix 5). Section A had questions on the respondents' demographics and background information such as age, employment status, education, size of family, any farming activities they practised and whether they were using wetlands and in what ways. Section B had open-ended questions which included the types of crops they were growing on the wetlands, methods they were using to grow such crops, changes observed on wetland water, soil, plants and animals, wetland users' interaction with different stakeholders on wetland use, and conflicts related to wetland land use.

Most of the interviews with residents were conducted in the wetlands between 9 am and 5 pm. where most of the people were found working on wetland fields. Some of the interviews were conducted at residents' homes. Appointments for interviews were made with some respondents who were working on their farms since they could not spare their time for an interview at that moment. In the interviews, introductions were done by the research assistant in Shona, and upon agreeing to be interviewed, the respondent was then given the participation information sheet (Appendix 11) to read. Since most of the respondents could not understand English well, information on the participation information sheets and the consent forms was, therefore, explained to the respondents in Shona by the researcher. Respondents who agreed to be interviewed then signed the consent forms (Appendix 16). During the interview process, each question was explained in Shona to the respondents to make sure they understood it. Interviews were conducted with 49 (19 males and 30 females) residents over the age of 18. Each interview session took approximately 1 to 1½ hours. With permission, the researcher audio-recorded and wrote notes during the interviews.

4.3.1.4 Interviews with village heads

An individual semi-structured interview schedule with 15 open-ended questions was prepared for village heads (Appendix 6). These questions focused on issues such as their views on how wetlands were used in the past and present, whether they were also using wetlands, the traditional beliefs they had on the use of wetlands, whether they were imposing regulations on the use of wetlands in Zindi area, and challenges they were facing in trying to enforce wetland regulations.

Interviews with village heads were conducted concurrently with Agritex officers' interviews, focus group discussions, and residents interviews. Three village heads from three different villages were interviewed on different days and places. One interview was carried out at the shopping centre, where the researcher met him. The second was interviewed in the wetland field, where he was working on his farm. The third village head was interviewed at his home. Information sheets (Appendix 12) were also given to the village heads before the interviews. Since they could not understand English very well, the information was explained in Shona by the researcher. Upon agreeing to be interviewed, the respondents signed the consent form (Appendix 17), which was also explained to them in Shona. Each interview took about an hour, and with permission, the researcher audio-recorded and wrote notes during the interviews.

4.3.2 Focus group discussions

Besides in-depth face-to-face individual interviews, focus group discussions were also conducted with residents. However, participants of focus group discussions were different from those for in-depth face to face interviews. Focus group discussions allowed group interactions, giving the researcher an opportunity to explore the differences and similarities of multiple perspectives on the subject whilst interviews focused on individual perspective expressed in line with the individual's experiences. Focus groups were chosen because they gave respondents an opportunity to question each other's views (Bryman, 2012). Focus groups were also used since they gave data on various ideas and feelings that participants had about certain issues and also providing their different perspectives on such issues (Rabiee, 2004). The focus group schedule had 25 open-ended questions (Appendix 7), which focused mainly on how people were using wetlands for traditional and cultural purposes and whether the residents were aware of any EMA wetland laws.

Three focus group discussions were held, and all of these included both female and male residents aged 18 and above. Focus group discussion 1 had five respondents (three females and two males). Focus group discussion 2 had eight respondents (four females and four males), and focus group 3 had six respondents (three females and three males). The participants of all three focus groups knew each other. Focus group discussions were conducted during the day at the respondents' homes. These were done concurrently with the individual interviews.

Respondents for focus groups were selected through snowball sampling. The first focus group discussion was held after the research assistant had introduced the researcher to one family, which was at their home. Members of that family called their neighbours so that they could be part of the discussion. The other two focus group discussions were held with respondents who were found gathered at two different homes. Participants for all the focus groups were given information sheets (Appendix 13). The researcher explained them to all participants in Shona since some could not understand English. All participants then signed the consent forms (Appendix 18). Questions were explained to the participants in Shona, and they discussed and responded to the questions in Shona. Each focus group discussion took about two hours to complete. The responses were audio-recorded with permission, and the researcher wrote down some notes during the discussions.

4.3.3 Participatory action research

Participatory action research involves the active engagement of the community being affected by the phenomenon under study (Clifford *et al*., 2010). Since participatory action research promotes the community's ability in problem-solving and action design (Clifford *et al*., 2010), residents were also invited to be involved in collecting data through the use of disposable cameras. Disposable cameras were given to six different wetland farmers in January 2019 to take photographs of their activities on the wetlands. Recipients of the six cameras were selected with the help of the Agritex officer. The researcher was referred to these recipients on the basis that they were actively involved in wetland farming. The researcher collect the cameras in August 2019. Training on how to use the camera was done by the researcher. The farmers were encouraged to use the cameras. Since this participatory action research was built on the farmers' observations and feelings, the photographs they took opened different perspectives of inquiry and understanding (Clifford *et al*., 2010). Therefore, these photographs were important in complementing observation, interviews, and focus group discussions by depicting the reality of what was happening and observed in the wetlands by these wetland users.

4.3.4 Mapping of the wetlands and wetland features

During direct observations, the researcher used a handheld GPS (Garmin eTrex 20 model) to mark the geographical position of the wetlands, delineate wetland extent and map different features and land uses in the wetlands. Wetland extent was first demarcated by looking at the soil, vegetation and water. Thus, areas with a lot of water, hydrophytic soil and wetland plants such as reeds were identified as part of the wetland, and their distributions were used to identify the boundaries of the wetlands. This was followed by moving around each wetland, delineating the wetland extent by recording the coordinates. Different features and land uses were identified and recorded through transecting across all six wetlands. Coordinates for wetland delineation, different land uses and features found in each wetland were recorded and saved in the GPS receiver and the field notebook.

4.3.5 Observations of the physical environment and peoples' activities in wetlands

Data were also collected through researcher observation to gain insight into some of the information that was difficult to capture during formal interviews and focus group discussions. Both direct and participant observation were therefore used to collect data.

4.3.5.1 Direct observation of the physical environment

During direct observation, the researcher observed the physical environment and how people were interacting with the wetlands. The researcher visited the six wetlands, transacting across the wetlands and recorded the different features and elements observed on the wetlands. Elements that were identified and recorded included different plant and animal species, the soil type and the sources of water found in the wetlands. Thus, the researcher recorded different physical objects in the physical space and wrote down descriptive field notes on these objects. The researcher also took photos during direct observation using a digital camera. Photos focused on the different features found in the wetlands, such as plants and water sources.

4.3.5.2 Direct and participant observations of peoples' activities in wetlands

During direct observation, the researcher tried to be unobtrusive by observing objectively without taking part in people's activities. Besides observing human activities on wetlands, the researcher also observed the general characteristics (gender, appearance and age group) of people who were using wetlands as well as the patterns and frequency of people visiting the wetlands. During direct observation, the researcher also acted as an overt non-participant observer. The researcher would walk around the wetlands with the research assistant, observing, jotting down notes and taking photos of what the wetland users were doing without being part of their activities or disturbing them. The researcher also wrote descriptive field notes on the observed different activities and how these were carried out. These field notes included the appearance of the people, mannerisms and gestures during various wetland activities. The researcher also wrote reflective field notes, which reflected the researcher's thoughts on what she observed during the observation period. Therefore, direct observation was done when the wetland users (those observed) knew they were being observed, albeit unobtrusively.

Participant observation was used in this study because it gave the researcher direct access to the phenomena, allowing her to build a detailed description of people, place and behaviour (Clifford *et al.,* 2010) of human activities on wetlands. Since participant observation involves observing and also participating in some of the respondents' activities on the wetlands, the researcher prepared an observation schedule before starting the participant observation process. The observation schedule (Appendix 8) had a list of activities that guided the researcher in making notes. The checklist included issues in the physical space, the people involved in different activities in the physical space, activities that people do, the time that those events took place, emotions expressed by people when they do different activities, and the different issues and different things that people were trying to achieve as they engaged in different activities on the wetlands. The observation schedule checklist allowed the researcher to gather information as a participant-observer. Watching, talking, and conversing with the wetland users was crucial to enable the researcher to find out their explanation and meanings associated with their various behaviours and activities. Intensive participant observation was done during fieldwork, with the researcher observing and engaging in informal interviews with the wetland users and engaging in some of the wetland activities.

Participant observation was done overtly. As an overt participant-observer, the researcher had an opportunity to observe and engage in different activities in the wetlands. The same research assistant who helped the researcher during the interviews and focus group discussions with the residents would first explain to the wetland users the details of the research in Shona and make it clear that the researcher wanted to observe how they were using the wetlands. Some of the activities that the researcher took part in included harvesting maize, digging and weeding. Activities that the researcher participated in were not pre-planned but were those activities that the researcher found the wetland users engaging in. The researcher had to observe carefully and patiently some of these activities, such as weeding and digging, before asking to participate in them. Although the researcher was familiar with some of the activities, such as weeding and crop harvesting, she had to learn how to dig.

As the researcher observed how wetland users were doing different activities such as weeding, digging and harvesting crops, she would also converse with them, asking them open-ended questions. These informal conversations with the wetland users helped the researcher to understand why and how they were doing some of the activities in the wetlands. Informal conversations were carried out in Shona, and during the process, the researcher would jot down some field notes and write full field notes in the absence of the participants at night. During participant observation, the researcher had an opportunity to view different experiences and incidences within the wetland as a participant, and this helped her record information and getting to understand different activities in wetlands. Thus, participating and trying to be part of the different activities that the researcher observed gave the researcher an insightful perception of what was taking place in the wetlands. The researcher's role as an overt observer allowed her to create rapport with the respondents making it less challenging for her to further probe some questions during formal and informal conversations. With permission, photos were also taken by the researcher during participant observation. These photos were saved in the digital camera so that they could be used to complement the interviews and focus group data by providing more details about different activities in the wetlands.

4.4 Data analysis

Data collected through in-depth interviews and focus group discussions were analysed through qualitative content analysis. Data gathered through direct observation were analysed through description analysis.

4.4.1 Direct observation

Description analysis was used as a tool to examine data gathered through direct observations (Flick, 2014). Descriptive field notes from observations of the physical environment were therefore used to describe the context. Thus, the eyewitness accounts of the wetland features and peoples' behaviour and activities in wetlands were used in describing the setting and providing the social context for respondents' views about their different activities (Flick, 2014). The relationship between the different physical features that were observed on the six wetlands was examined and then interpreted in the context of the literature. Different features identified in all the six wetlands were reviewed and organised and used to describe wetland physical characteristics. These descriptions were complemented with photos (and are presented in Chapter 5).

Descriptive field notes and reflective field notes gathered whilst directly observing people carrying out different activities in the wetlands were also analysed using description analysis. This was also followed by data interpretation. Direct observation results were then integrated with results from participant observation, interviews and focus group discussions and are presented in Chapter 5.

4.4.2 Participatory action research

Disposable cameras that participants used during participatory action research were collected in August 2019. Disposable cameras were taken to Kodak photo shop for photograph development. Thirty photos were developed, but not all of them were used as evidence because some photos were obscured or blurred. The researcher looked at the photos and classified the relevant photos into different categories according to the different significant elements that were seen in the images. These photos were integrated with textual data from interviews and focus group discussion and presented in Chapter 5 to illustrate the participants' perspectives on wetland use.

4.4.3 Photographs taken by the researcher

Appropriate photos taken by the researcher using a digital camera during direct and participant observation were selected and edited. Edited photos gathered during direct and participant observation were organised into different categories according to the different significant elements that were related in the images. These photos were integrated with textual data from direct and participant observation to describe how people were using wetlands.

4.4.4 Wetland delineation

The GPX file for wetland delineation and different features found in the wetlands, which was saved in the handheld GPS receiver during direct observation, was imported into Google Earth Pro on the computer, where the six wetlands and wetland features were mapped and saved as KML files. KML files were then converted to layer and shapefiles in ArcMap version 10.5, and six wetland maps (shown in Chapter 5) showing different wetland features were produced. The area of each wetland was also calculated in ArcMap 10.5 using the Geometry tool.

4.4.5 Participant observations

The initial stage of field notes analysis was done by answering the following questions adapted from Silverman (2013); what were people doing and what were they trying to achieve; what strategies were they using to carry out the different activities; how were they talking during informal conservations; what assumptions were they making; what the researcher can conclude from these field notes, and why some of these field notes were included. After answering these questions, the field notes were rearranged and organised. This also included the organisation of exact quotes which were written during informal conversations with wetland users. Relevant textual data were then coded inductively, and themes were developed through data interpretation to address the research questions. These were complemented with photos taken by the researcher (presented in Chapter 5).

4.4.6 Interviews and focus group discussions

Qualitative content analysis was used to analyse interviews and focus group discussions in this study. Qualitative content analysis involves examining qualitative data and reducing it into a summary form using previous categories and themes that emerge to generate new information (Creswell, 2007; Neuman, 2014; Lindgren *et al*., 2020). Content can be suggestions, concepts, signs or any communicated message, whilst the text can be anything put in writing or uttered that acts as a channel of communication to infer meaning (Neuman, 2014). Audio-recorded interviews conducted with residents, village heads, Agritex officers, the EMA and seed companies and from focus group discussions were transcribed from audio to text. The researcher checked and listened to all the audio recorded responses and wrote them down, translating those that were in Shona to English. Therefore, all responses were transcribed in full to text in English as a complete dataset to make it less challenging to present and analyse the data.

The researcher first prepared, organised and sorted the transcribed data and read and reread to derive meaning (Vaismoradi *et al*., 2013; Neuman, 2014). The transcribed data were organised into different datasets of responses from residents, Agritex officers, seed companies, the village heads, EMA, and focus group discussions. These datasets were then coded separately. Codes refer to labels, words or phrases that assigns attributes and meaning to the descriptive information collated during a study (Vaismoradi *et al*., 2013; Neuman, 2014). The initial stage of coding was open coding, whereby the researcher identified critical terms, dominant events from the transcribed text and wrote down the labels. The labels were then highlighted with different colours, and similar codes were labelled with the same colours. During open coding, initial descriptive codes were located and set to reduce the voluminous data (Clifford *et al*., 2010; Vaismoradi *et al*., 2013; Neuman, 2014). The researcher read and reread the data and think and rethink to develop tentative and temporary codes (Clifford *et al*., 2010). The data were thoroughly scrutinising to 'open up' and break the data in preparation for concepts that would emerge in the later stages of coding the data (Clifford, 2010). Codes that assisted in addressing the research questions were therefore identified during open coding.

Open coding was then followed by axial coding, whereby key categories were identified, and this allowed the researcher to follow a specific category to test its relevance (Clifford *et al*., 2010). Axial coding involves organising the different codes and connect them to locate key analytical categories (Neuman, 2014). Axial coding led to the breaking down of data into relational codes by assessing the similarities and differences between the codes (Vaismoradi *et al.*, 2016) to create categories. Important codes were then identified to create categories by putting particular codes together. Categories were labelled, and several relevant and related categories were put together to form logical categories. The researcher went through all the initial codes and created new codes by combining two or more codes. A continuous revisiting of the data during the coding process allowed the researcher to identify common categories and differences between the codes. Sub-categories were then created from the categories by pointing out the meaning associated with each category (Vaismoradi *et al.*, 2016).

Axial coding was followed by selective coding, whereby the previously created codes were assessed to point out and select the information that supported categories for theme development (Neuman, 2014). Selective coding involves examining the codes and all the data, and specific cases that illustrate themes (Neuman, 2014) was then done as the researcher interpreted and abstracted the data. Repeated patterns within the categories were identified, and themes were created by putting together essential categories representing similar themes.

The researcher did the interpretation by assessing the in-depth meaning and significance of the categories and sub-categories (Lindgren *et al*., 2020). The researcher explored the underlying meanings of the words said by the participants. Thus, through interpretation, the researcher created logic out of the data to show understanding by explaining and reframing it (Lindgren *et al*., 2020). Data abstraction was done by reorganisation and re-contextualisation of categorised data in a hierarchical structure (Graneheim *et al*., 2017; Lindgren *et al*., 2020). Thus, during abstraction, the researcher arranged the data systematically to determine its significance as she compared the categories and sub-categories to create themes (Graneheim *et al*., 2017). Themes were created by arranging various groups with repeating ideas (Vaismoradi *et al.*, 2016). Data reconciliation was done by retrieving, comparing and integrating relevant themes from observation field notes and interviews and focus group discussion datasets. Created themes were then discussed in the results.

Even though interviews and focus group discussions were analysed using content analysis, the interpretations were not the same. Different interpretations were created because individual interviews reflected one person's viewpoint, whilst focus group discussion reflects composite viewpoints.

4.5 Ethical considerations

The research process was guided by ethical guidelines related to the collection and analysis of data and in report writing (Creswell, 2012). Therefore, applying appropriate ethical practices during research is vital for protecting human subjects (Arising, 2018). Ethical guidelines should be considered by obtaining informed consent from the participants (Bryman, 2012; Smith *et al.*, 2015). Therefore, it is crucial to give the participants a detailed explanation of the reasons for conducting the research, why they are being asked to take part, and the possible advantages, dangers, and stresses that may result as they take part in the research (Smith *et al*., 2015). Thus, adequate and detailed information on what the research entails allows the participants to decide whether to take part in the research or to decline (Arifin, 2018).

Since this study involved face to face interviews and focus group participants with different participants, ethical clearance was obtained before the study was carried out. Permission to carry out this research was granted by the University of the Witwatersrand Research Ethics Committee (Non-Medical) through an ethics certificate (Protocol Number H18/09/013) (Appendix 20) after a rigorous process of checking whether the research instruments, participation information sheets and participation consent forms were in line with the ethical guidelines. The University Research Ethics Committee, in its feedback, helped the researcher to plan an appropriate way of carrying the research, thereby reducing ethical risks. Thus, in carrying out this study, informed consent, confidentiality and anonymity were considered.

Different participant information sheets (Appendices 8, 11, 14 and 17) were therefore given to potential participants to explain the purpose of the study and the nature of their participation. Participants were also informed about confidentiality and anonymity, that participation was voluntary and that they could withdraw at any time without consequences. Informed consent was attained by allowing participants to sign informed consent forms (Appendices 9, 12, 15 and 18). Informed consent forms gave the respondents a chance to be fully versed with the kind of research involved and the importance of their participation in the study (Creswell, 2007). Each interview and focus group discussion schedule had its participant information sheet and consent form.

4.6 Limitations of the study

Participants for this study were different stakeholders found in different sites. Visiting different seed companies and EMA in different industrial areas of Harare to conduct interviews with officials from these companies and visiting the different wetlands and the residents at their homes was therefore cumbersome and time-consuming. The EMA official from the EMA main office in Harare was targeted instead of the local EMA officer because the EMA wetland ecologist could only be found at the main office. The research instruments were all written in English, and most residents could not understand English. It, therefore, took a lot of time for the researcher to translate and explain the information on the participation information sheets, consent forms, interview and focus group discussion schedules in Shona. Although the researcher is a Shona native speaker like people in Honde Valley, the respondents and the researcher had some problems understanding each other during the interview process due to the differences in Shona dialects. Some interviews and focus group discussions took more time than was expected since the research assistant had to explain some of the complicated Shona words to the participants and the researcher. During data collection, some participants would divert from the asked questions and in some cases, formal interviews and focus group discussions took more time than was expected. When such incidences occurred, the researcher would try to divert back and focus on the interview schedule questions and focus group questions. Some participants did not agree to be audio-recorded, and the researcher ended up writing down their responses.

Regardless of having a research assistant from the same area who explained to the residents my position as a researcher and the nature of my research, some participants thought that I was from EMA, and hence they were giving calculated responses. Since some were sceptical, they would even ask if I would not stop them from using the wetlands after they had agreed to be interviewed. Although the open-ended questions used in all the research instruments helped reduce response bias by not limiting the answers, bias was not wholly avoided. Some participants would give responses that they think were correct but yet biased. Since data saturation was used to determine this study's sample size, representativeness was therefore not guaranteed since the number of interviews was determined by the researcher, who monitored what the respondents were saying and evaluated the cut-off point of saturation. The responses that were given by village heads and Agritex officers were also calculated since they wanted to protect their positions as leaders. Thus, some of the responses they gave on sustainable wetland use and management were more theoretical than practical since they could not confirm some of these practices.

Out of the six participants who were given disposable cameras, only four managed to take the photos, and the other two did not take the photos. One of the two farmers who failed to take the photos reported that she had to attend a relative's funeral. Thus, she could not find time to take photos. The other participant indicated that he forgot to carry the disposable camera whenever he would go to work in the wetlands. The researcher collected the two unused disposable cameras from the participants and decided to work with the photos from the other four cameras, which the other participants had used.

The researcher only visited the wetlands twice in summer and winter. Since in some wetlands such as Madimbo, farmers were growing the major crops such as maize throughout the year, it could have yielded better results if these wetlands were visited more than two times. However, the researcher failed to visit the wetlands in all four seasons due to limited resources.

4.7 Chapter summary

Despite the limitations discussed above, the research strategy (qualitative strategy) and the research design (case study) that used various methods to collect data enabled the collection of 'rich' and 'thick' data for this study. The data analysis method used (content analysis) helped create relevant themes that addressed the research aim, objectives and research questions. This chapter, therefore, sets the tone for Chapter 5, where the analysed data will be presented.

Chapter 5: Results

5.1 Introduction

This chapter presents the data collected between December 2018 and August 2019 to address this study's research objectives. Findings obtained in this research are presented in line with the mentioned research objectives (Chapter 1). Relevant data analysed and categorised through content analyses (discussed in Chapter 4) were presented through graphs, pie charts, tables, photographs, and the use of direct quotes from anonymised participants. Data collected through different instruments (discussed in Chapter 4) were integrated to understand how people are using wetlands in Zindi rural area, Honde Valley. Data on the structure, location, size and physical features of the six wetlands (Tawarara A, Tawarara B, Rutsate, Mareya, Madimbo and Chiwira) are presented first maps and photographs of the wetlands. This is followed by demographic data on participants, which are presented in graphs, pie charts, and tables. Findings on human-wetland interaction obtained through participant observation, formal and informal interviews with the key informants are then presented. The following subsections present the different ecosystem services obtained by the wetland users, methods of farming used in the wetlands, use of wetlands in the past, the challenges faced by smallholder farmers in using wetlands, and the different changes observed on different wetland elements by the wetland user and the cultural uses of wetlands. The last section of this chapter presents data on the interactions of wetland users with different stakeholders.

5.2 The physical features of the wetlands

5.2.1 Tawarara A wetland

Tawarara A is a small valley bottom vlei (dambo) wetland that is 136 194 m^2 (13.6 ha) in area. Blackish clay soils make up the wetland, with red clay soils at the outskirts of the wetland. The wetland is all covered with a variety of crops (Figures 5.1, 5.2 and 5.3a) from the end of July to the end of March.

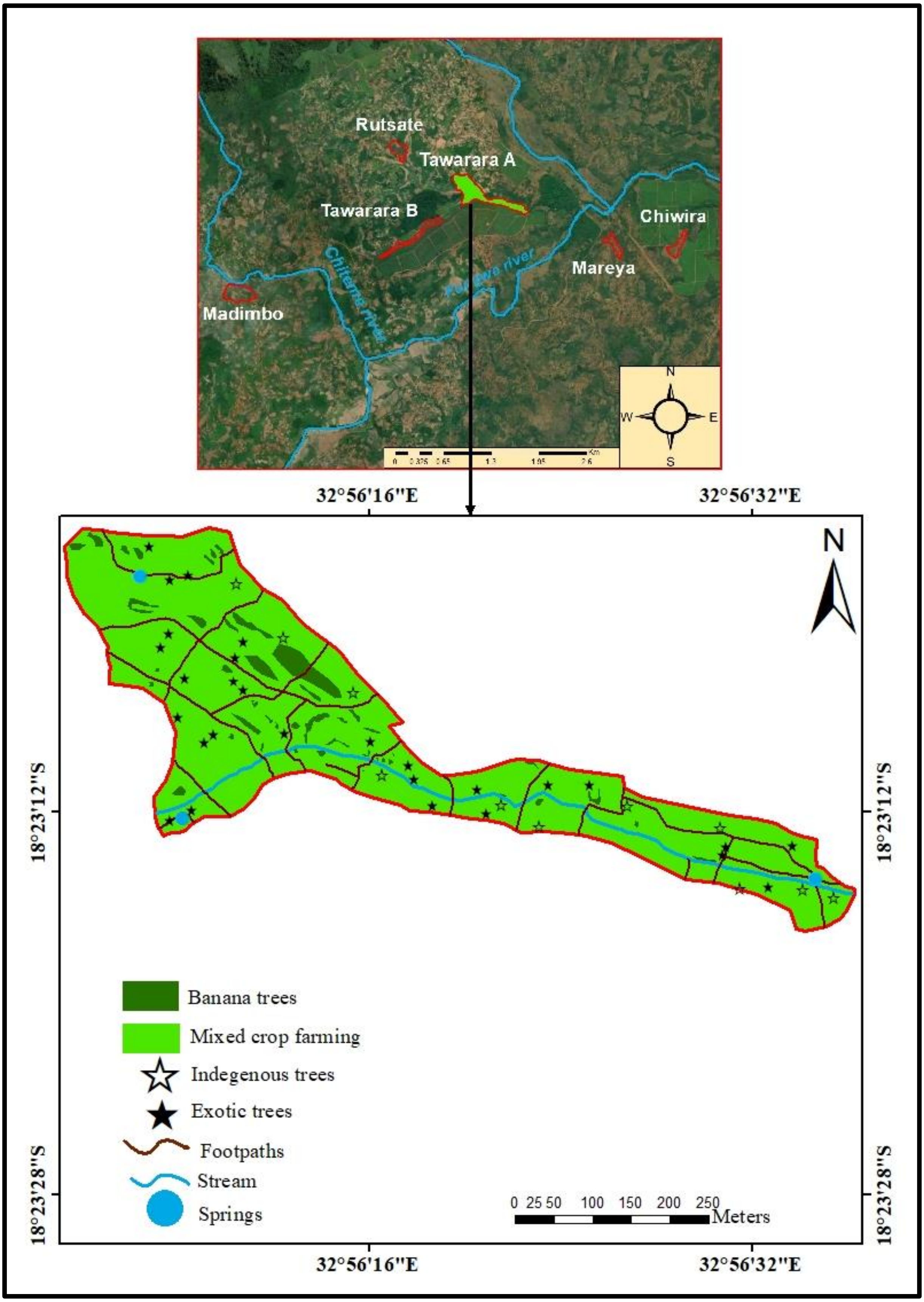

Figure 5.1: Tawarara A wetland features

Tawarara A is left idle from April to July when grass and weeds grow again into the wetland except on small portions where farmers plant vegetables after harvesting their main crops (Figure 5.3b). A few scattered indigenous trees locally known as *mukute* (*Syzygium cordatum*) and *mugopokopo* (*Mystroxylon aethiopicum)* and exotic trees such as banana, peach, avocado, lemon, and mango trees are found in the wetland (Figures 5.1 and 5.2). Weeds found in the wetland, such as *Carex acutiformis*, slender knotweed, sedges, blackjack, reeds, rushes and water speedwell, are unevenly distributed during the rainy season and only increase when the wetland is left idle. Woody vegetation is also found adjacent to the wetland on its eastern side with the Eastern Highlands Tea Estate Company's tea field on the western upland part of the wetland. Strips of grass can be found adjacent to the rivers and streams during the summer season. Most parts of Tawarara A wetland are covered by grass and weeds in autumn and winter.

Figure 5.2: Photo of Tawarara A wetland (photo: Emmah Mandishona)

A small perennial stream flows through Tawarara A wetland (Figure 5.1). Spring protected wells and a few shallow open wells can also be seen (Figure 5.3c, d) in Tawarara A wetland. The wetland is inundated by water, mostly during the rainy season. In autumn, winter and spring, most parts of the wetland will be moist, with some parts showing surface water. Tawarara A wetland has a variety of animals and bird species. Animals such as moles, rats and mice can be spotted in this wetland. Monkeys from the adjacent hill are sometimes seen in the wetland as they come to look for food. Snakes such as green mambas are common and widespread in Tawarara A wetland. Birds such as blackbirds (yellow-headed and black-winged blackbirds), rails, golden-crowned sparrows, cranes, heron, marsh wren and flicker hive are also native to this wetland. A variety of crawling and flying insects are also seen, especially during the rainy season. Some of the crawling insects include water beetles, water scorpions, snails, water bugs, worms, frogs, caterpillars, and the flying insects include dragonflies, crane flies, locusts, and grasshoppers. However, intensive cultivation of the wetland has reduced the population of wildlife within the wetland. Settlements of grass thatched, zinc and asbestos roofed houses are located between 0 to 2 kilometres from the wetland and are concentrated on upland areas and on slopes, whereas the lowland area (the wetland area) is left for crop production. Some of the wetland users' houses are even located less than 200 m from the wetland.

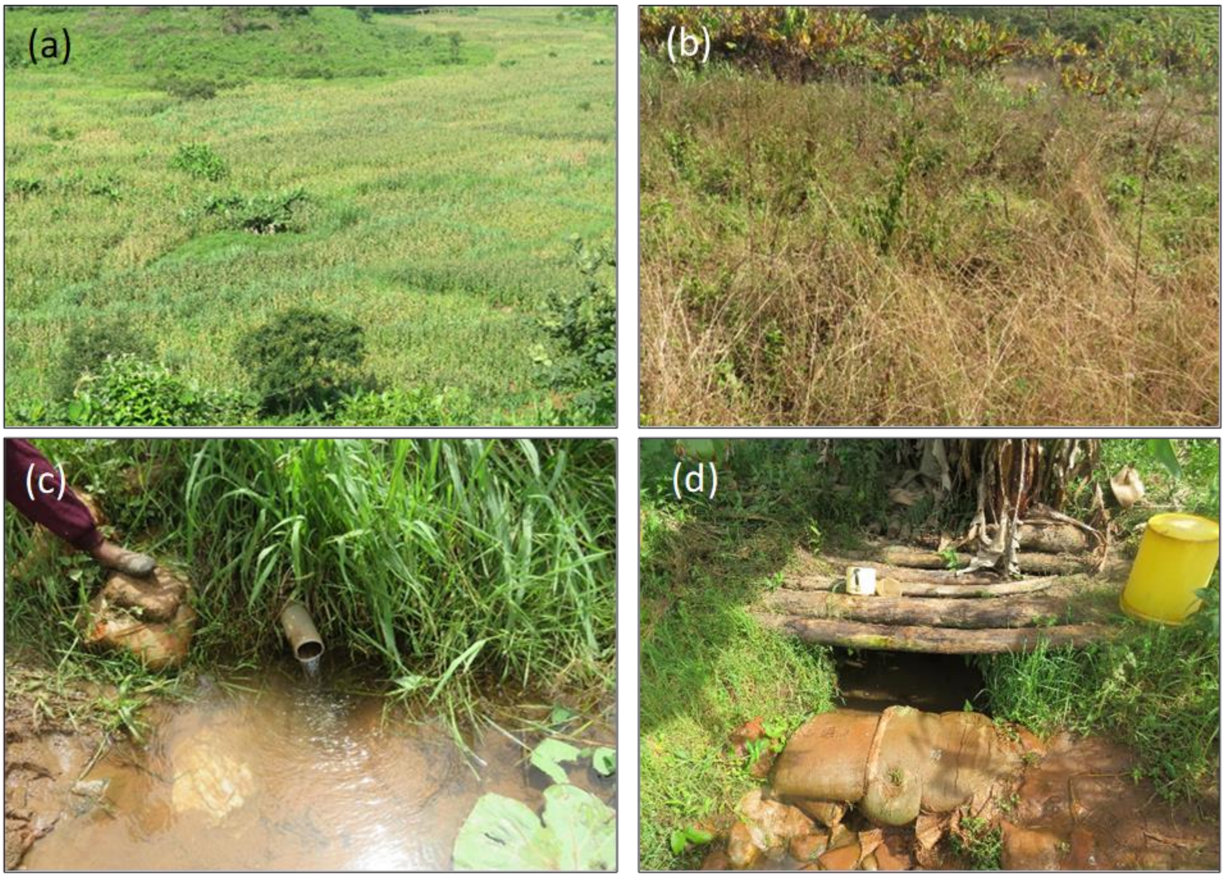

Figure 5.3: Photos of Tawarara A wetland. (a) View of the wetland covered with crops during the rainy summer season; (b) part of the wetland showing grass and weeds growing when the wetland is left idle; (c) a spring with a pipe inserted so that people can have access to clean water, and a sandbag for people to stand on as they fetch water; (d) wooden logs used to protect a spring well. The sandbag below acts as an infiltration bag

for filtering dirty water, and the spring is covered over to avoid birds from defecating in the well (photos: Emmah Mandishona)

5.2.2 Tawarara B wetland

Tawarara B is also a small valley bottom vlei that covers 41 093 m^2 (4.1 ha) (Figures 5.4, 5.5). It lies adjacent to Tawarara A wetland and has similar physical characteristics. Tawarara B has blackish clay soils and some reddish clay soils at the outskirts of the wetland. Like other wetlands, Tawarara B is mostly covered with crops from the end of July to the end of March. Grass and weeds (Figure 5.6b) grow into the wetland after it is left idle from April to July, when the farmers have harvested their main crops. During this period, only small portions of the wetland are used to grow a variety of vegetables. A few indigenous trees such as *mukute* (Figures 5.4, 5.5) are found in the wetland. Tall evergreen trees are also found adjacent to the wetland (Figure 5.6c). The tea farm for the Estate Highlands Tea Estate Company is located close to the wetland on the western side. Some exotic fruit trees such as banana, mango, peach, and avocado trees are grown in the wetland (Figures 5.4 and 5.5). Some weeds such as reeds, rushes, water speedwell, slender knotweed, sedges, blackjack, and *Carex acutiformis* are mostly seen in the wetland during the rainy season. Strips of grass can be found adjacent to the wetland stream and trenches during the rainy season (Figure 5.7).

Tawarara B is saturated with shallow surface water during the rainy season and has a small perennial stream (Figure 5.4) flowing past the wetland. Few protected spring wells can be seen in the wetland (Figure 5.6d). Although most parts of the wetland are moist in autumn, winter and spring, few areas will have surface water during these seasons. Few snakes such as green mambas and cobras can sometimes be spotted in Tawarara B wetland. Moles, rats, mice and monkeys from the adjacent hill can also be found in this wetland. Native to this wetland are different kinds of birds such as marsh wren, sparrows, flicker hives, blackbirds, rails and cranes. Crawling insects such as water beetles, water scorpions, snails, caterpillars, and frogs are present in Tawarara B wetland. Few flying insects such as caddisflies, locusts, mosquitoes, grasshoppers, crane flies and dragonflies can still be seen in this wetland. The wildlife population in Tawarara B wetland has been reduced as habits were destroyed through crop cultivation. Some wetland users' houses are located in the upland areas between 0 to 2 kilometres from Tawarara B wetland, whilst the wetland area on the lowland is used for crop production.

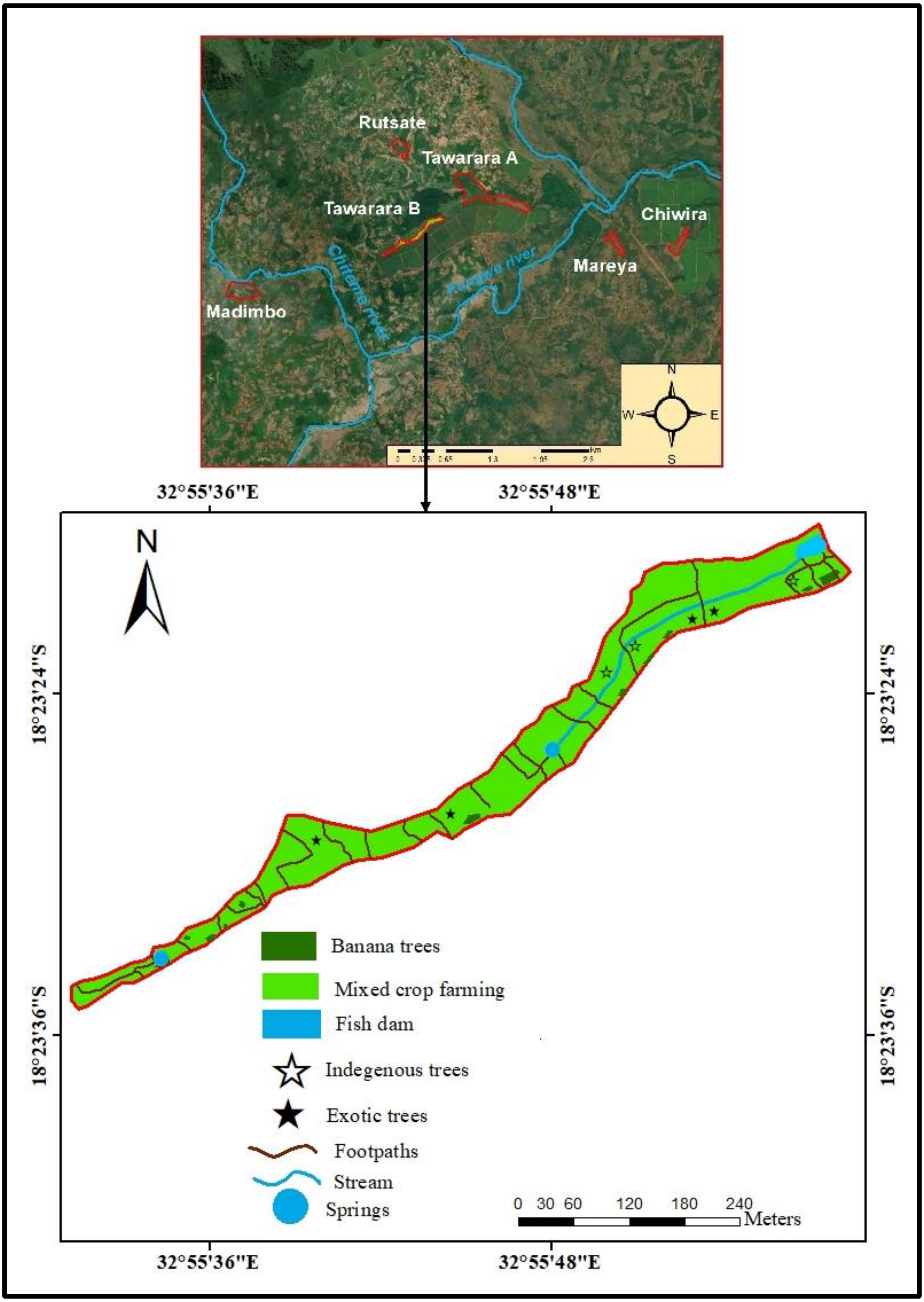

Figure 5.4: Tawarara B wetland features

Figure 5.5: View of Tawarara B wetland (photo: Emmah Mandishona)

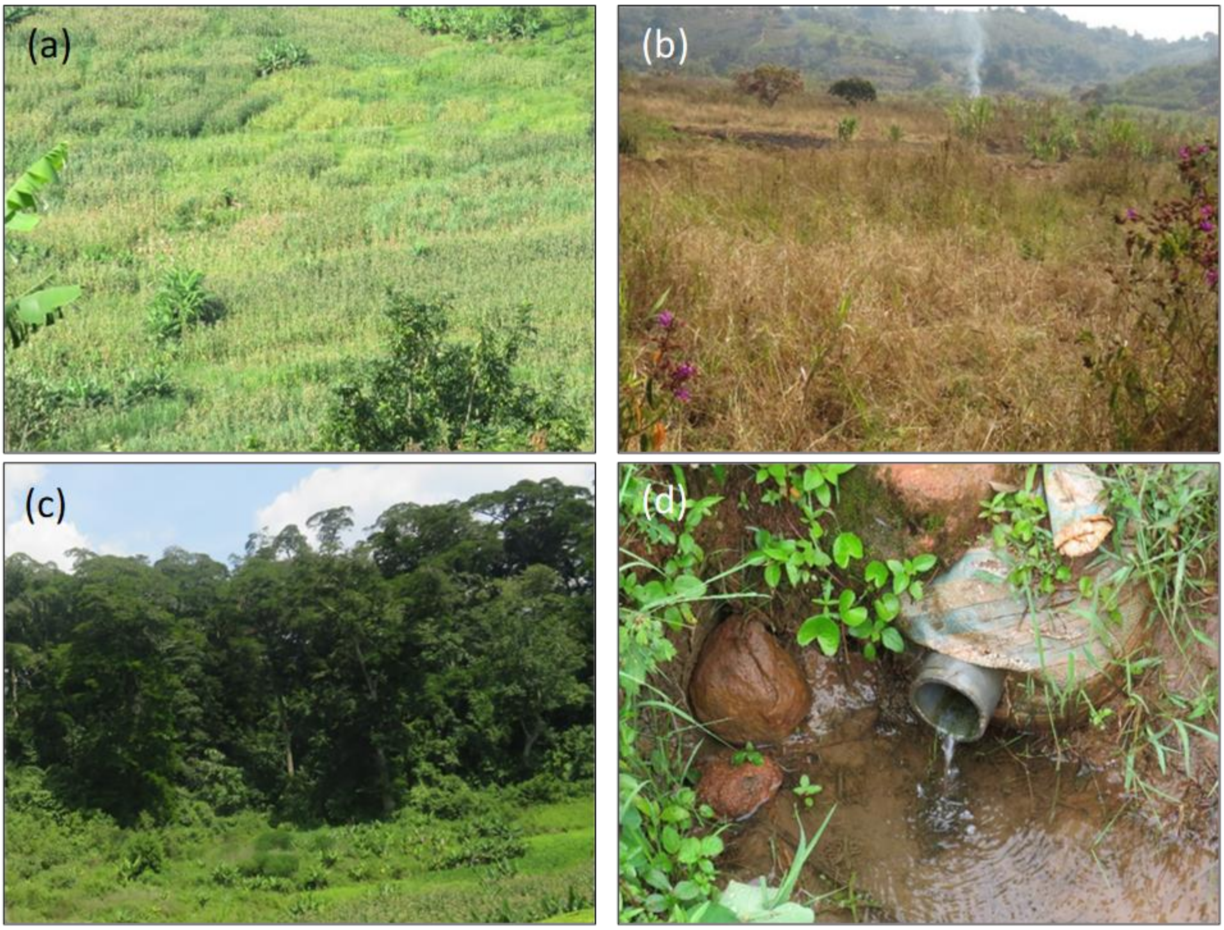

Figure 5.6: Tawarara B wetland features. (a) Wetland covered with crops during the rainy season; (b) part of the wetland before it is cleared in preparation for crop growing; (c) indigenous trees surrounding the wetland; (d) protected spring well (photos: Emmah Mandishona)

Figure 5.7: A strip of grass left adjacent to a stream on Tawarara B wetland during the rainy season (photo: Emmah Mandishona)

5.2.3 Rutsate wetland

Rutsate wetland is a small valley bottom vlei (dambo) wetland with dull grey, rich clay soils with some patches of reddish clay soils at the outskirts of the wetland (Figures 5.8, 5.9). It has an area of 33 178 m^2 (3.3 ha). The wetland is covered with a variety of crops from the end of July to the end of March and is also surrounded by woody vegetation (Figure 5.10a). Some reeds, rushes, water speedwell, slender knotweed, sedges, *Carex acutiformis* and blackjack, grow in the wetland during the rainy season and are found in abundance when the wetland is left idle after harvesting. The wetland is left idle between April to July when the grass and weeds grow again into the wetland except on small portions where farmers plant vegetables after harvesting their main crops.

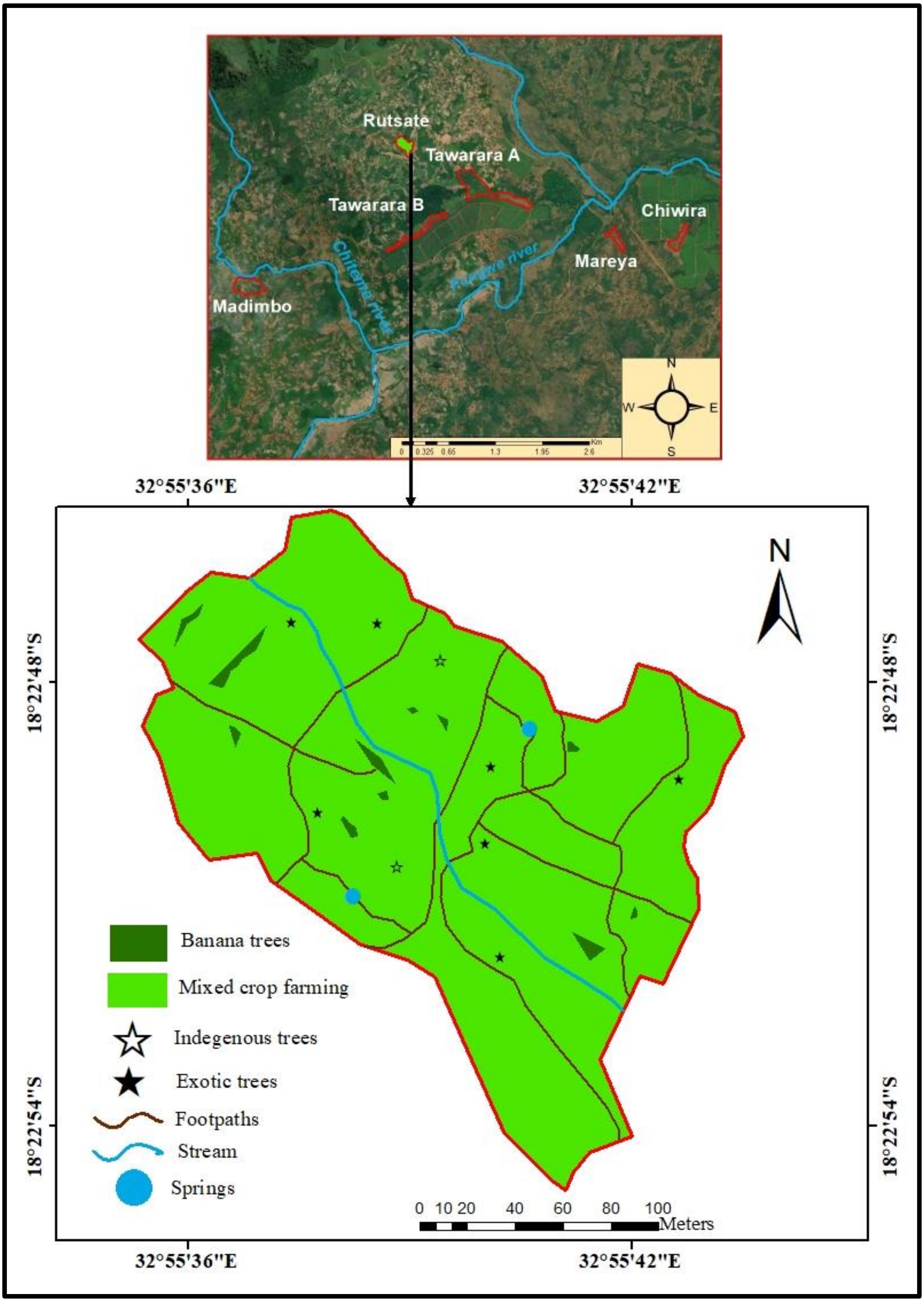

Figure 5.8: Rutsate wetland features

Some indigenous trees, locally known as *mukute* (*Sysygium cordatum*), *muchakata* (*Parinari curatellifolia*) and *mugopokopo* (*Mystroxylon aethiopicum*) are found within the wetland (Figures 5.9, 5.10), and tall evergreen indigenous trees such as those found near Tawarara B wetland are also found adjacent to Rutsate wetland.

Figure 5.9: View of Rutsate wetland (photo: Emmah Mandishona)

Some exotic fruit trees such as banana, avocado and mango trees are found in the wetland (Figures 5.9, 5.10). Rutsate is the only one with big scattered bamboo trees (Figure 5.10b). Strips of grass can be found near the small perennial stream that flows through Rutsate wetland and some trenches dug in the wetland. Spring wells are also found in Rutsate wetland with one spring protected well that the villagers rely on for clean water (Figure 5.11). The wetland is saturated by water, mainly during the crop growing summer season. During the other seasons such as autumn, winter and spring, most parts of the wetland will be moist, with some parts covered with surface water. Birds such as the yellow-headed and black-winged blackbirds, wooly-necked stork, crowned sparrows, heron, flicker hive and marsh wren can be seen in Rutsate wetland. Besides birds, small mammals such as moles, rats, and mice can still be found in this wetland. Amphibians such as frogs and toads are also native to Rutsate wetland. Few snakes, such as the green mambas, and other reptiles such as chameleons, tortoise and lizards, are still available in this wetland. Crawling and flying insects are still seen in Rutsate wetland. Some of these crawling insects found in Rutsate wetland include worms, sow bugs, pill bugs, water scorpions, water beetles, snails, caterpillars, ticks and spiders. Flying insects seen in Rutsate wetland include butterflies, dragonflies, locusts, grasshoppers and toad bugs. Adjacent Rutsate wetland is a hill where some of the monkeys hide. However, the destruction of animal habitat through intensive cultivation has reduced the number of animals found in Rutsate wetland. Some grass-thatched, zinc and asbestos roofed houses are located between 100 metres and 2 kilometres from Rutsate wetland. These settlements are located on the upland and sides of the upland areas, whilst the lowland wetland area is used mainly for crop production.

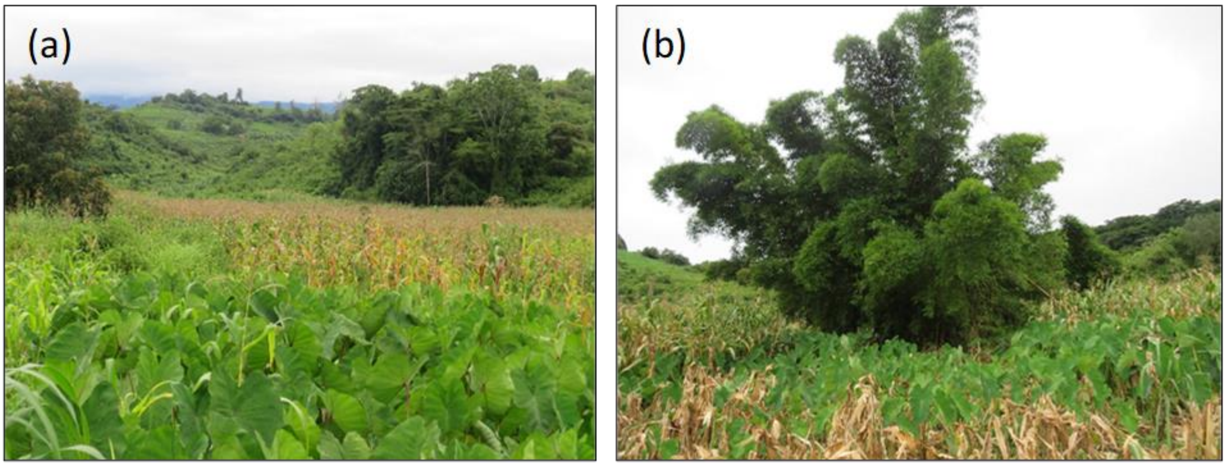

Figure 5.10: Rutsate wetland features. (a) Area of crop growth surrounded by woody vegetation; (b) bamboo tree (photos: Emmah Mandishona)

Figure 5.11: *Kushinga kwakanaka* spring in Rutsate wetland, protected by USAID in 2015 (photo: Emmah Mandishona)

5.2.4 Madimbo wetland

Madimbo wetland is also a small valley bottom vlei (dambo) which covers 69 736 m^2 (6.9 h) (Figure 5.12). It is slightly different from the other wetlands since it has a sloping terrain (Figure 5.13) and has less surface water. Madimbo wetland has blackish clay and some leached sandy soil at the outskirts of the wetlands. It is covered with a variety of crops grown throughout the year (Figures 5.13, 5.14). Woody vegetation surrounds the wetland, and a lot of exotic fruit trees such as banana, peach, litchi, orange, lemon, orange and naartjies, mango and avocado are grown (Figures 5.13, 5.14) in this wetland. Besides having a lot of banana trees planted in it, Madimbo wetland also has an orchard of naartjies (Figure 5.12).

Small portions of lantana bushes and hedge are also found in Madimbo wetland. Although indigenous trees are few, the most common indigenous tree found in wetlands (locally known as *mugopokopo*) is also found here. A few reeds, rushes, water speedwell, slender knotweed, sedges and blackjack are unevenly distributed in this wetland.

Chiteme River (a perennial river) flows adjacent to Madimbo wetland. There are also unprotected spring wells where people get water for domestic use. The wetland is inundated by water, mainly during the rainy season. During autumn, winter, and spring, most parts of the wetland will be moist, while surface water will be seen in some parts. However, Madimbo wetland has drier conditions than the other wetlands hence the use of irrigation by some farmers even during the rainy season on crops such as yam, which require a lot of water. Since crops are grown throughout the year on this wetland, few animals and bird species are found. Moles, rats and mice are still being seen in Madimbo wetland. There are also a few snakes seen in the wetland, such as cobra. Birds such as yellow-headed and black-winged blackbirds and golden-crowned sparrows are still seen in the wetland. Some flying insects such as locusts, butterflies, wetland flies, wasps, dragonflies can be spotted in Madimbo wetland. Few water beetles, water scorpions, snails, water bugs, worms, frogs, caterpillars are also native to this wetland. Zinc and asbestos roofed and grass-thatched houses are located between 0 and 500 metres from the wetland, with one of the homesteads located within the wetland (Figure 5.12) and another one less than 100 metres from the wetland (Figure 5.14a). Although most of these settlements are concentrated on the upland areas and sides of the upland areas, some of them are in proximity to the wetland.

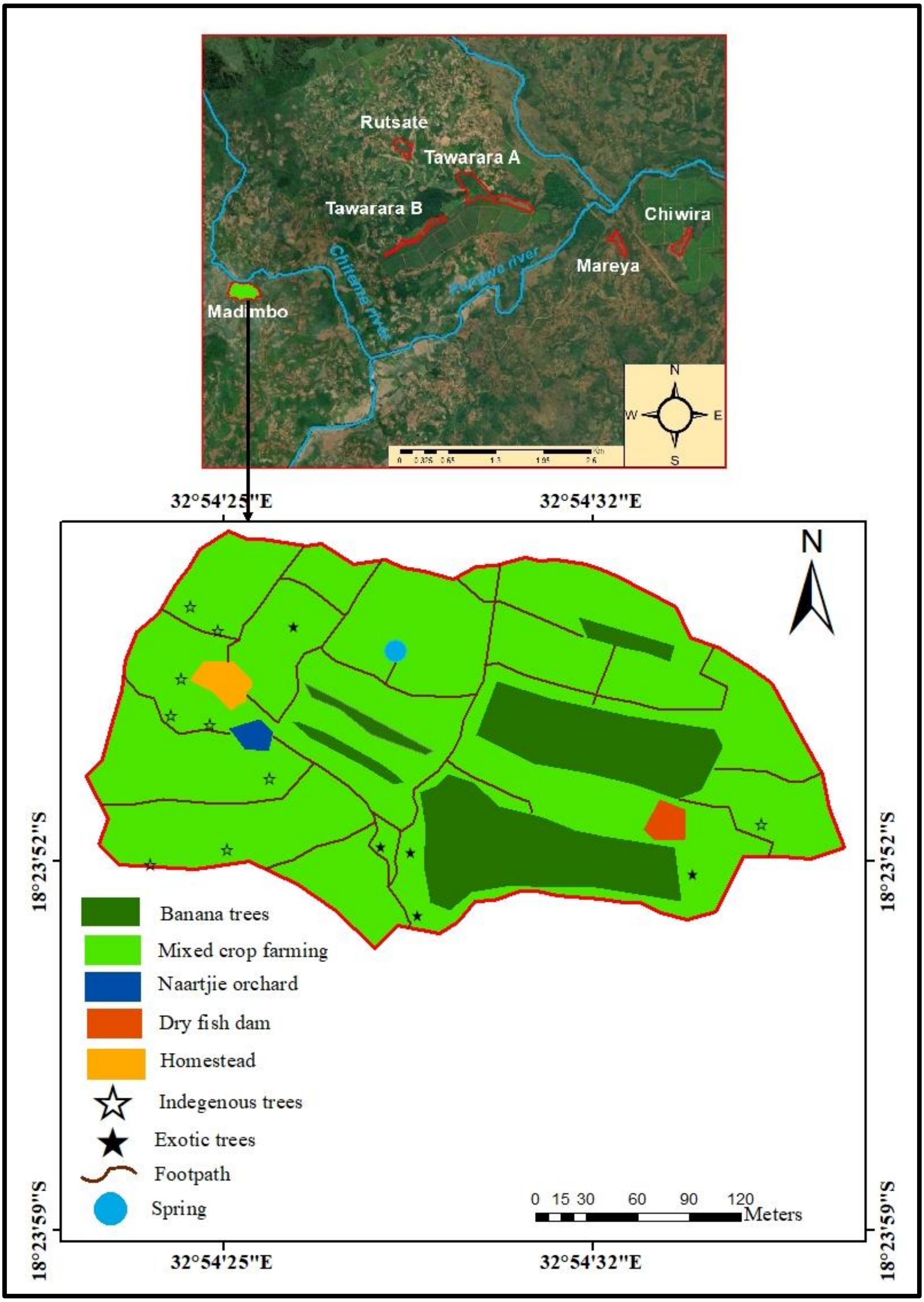

Figure 5.12: Madimbo wetland features

Figure 5.13: View of cropping on Madimbo wetland (photo: Emmah Mandishona)

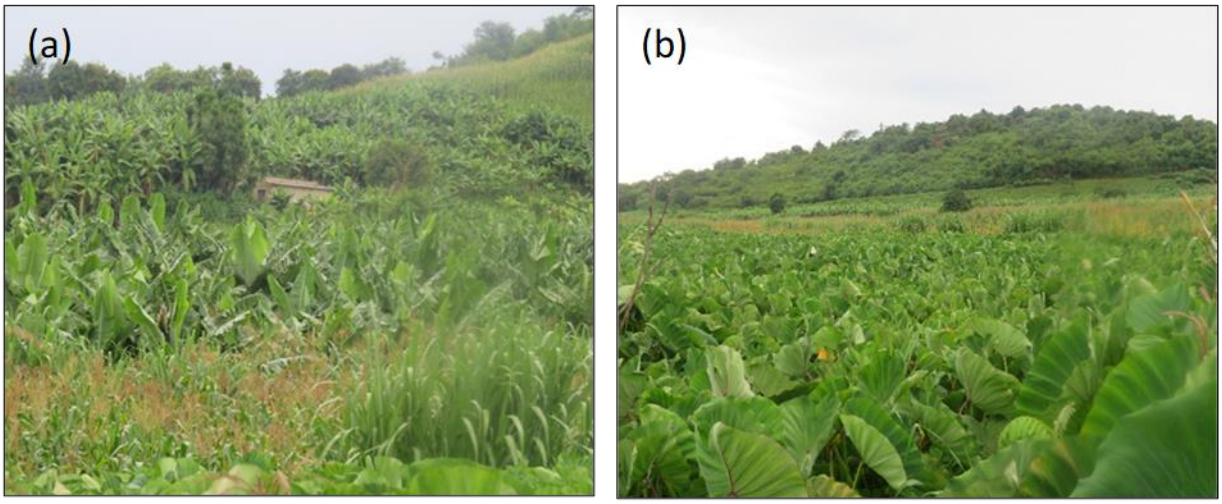

Figure 5.14: Elements within Madimbo wetland. (a) A house built close to the wetland; (b) crops present during the rainy season (photos: Emmah Mandishona)

5.2.5 Mareya wetland

Mareya wetland is a small valley bottom vlei (dambo) which is 24 326 m^2 (2.4 ha) in size (Figure 5.15). The wetland is made up of blackish clay soil with red clay and some leached sand soil at the outskirts. Mareya wetland is covered with a variety of crops (Figure 5.16) from the end of July to the end of March. It is left idle from April to July when the grass and weeds grow again into the wetland except on small portions where farmers plant vegetables after harvesting their main crops. Few scattered indigenous trees locally known as *mukute, mugopokopo* and exotic trees such as banana, peach, avocado, lemon, orange, and mango trees are found in the wetland (Figure 5.15).

Some weeds such as reeds, rushes, duckweed, water speedwell, slender knotweed, sedges, blackjack, and *Carex acutiformis* can be spotted in the wetland during the rainy season. These weeds increase between April and July when the wetland is left idle. Woody vegetation of big trees surrounds the wetland (Figure 5.17a). Strips on grass can be found near the perennial stream and along the trenches during the summer season, whilst in autumn, most parts of the wetland are covered with grass and weeds.

A small perennial stream flows through Mareya wetland (Figure 5.15). Spring protected wells (Figure 5.17b) and a few shallow open wells are found in the wetland. Mareya wetland is mostly covered with surface water during the growing season. In other seasons such as winter, spring and autumn, some parts of the wetland remain moist while some parts dry up. Few rats and mice can still be found in this wetland. Snakes such as the green mambas and cobras can be spotted in Mareya wetland. Although birds such as cormorants, spoonbills, golden-crowned sparrows, heron, marsh wren, and flicker hive can still be seen in the wetland, their population has been reduced since their habitats, such as trees, were cut. Insects such as beetles, snails, worms, toad bugs, pill bugs, water scorpions, snails, worms, frogs, caterpillars, crane flies, dragonflies, locusts and grasshoppers can be found in Mareya wetland. However, clearance of land for cultivation has also reduced the population of some of these insects. Houses for wetland users are located on the upland areas between 2 to 3 kilometres from the wetland.

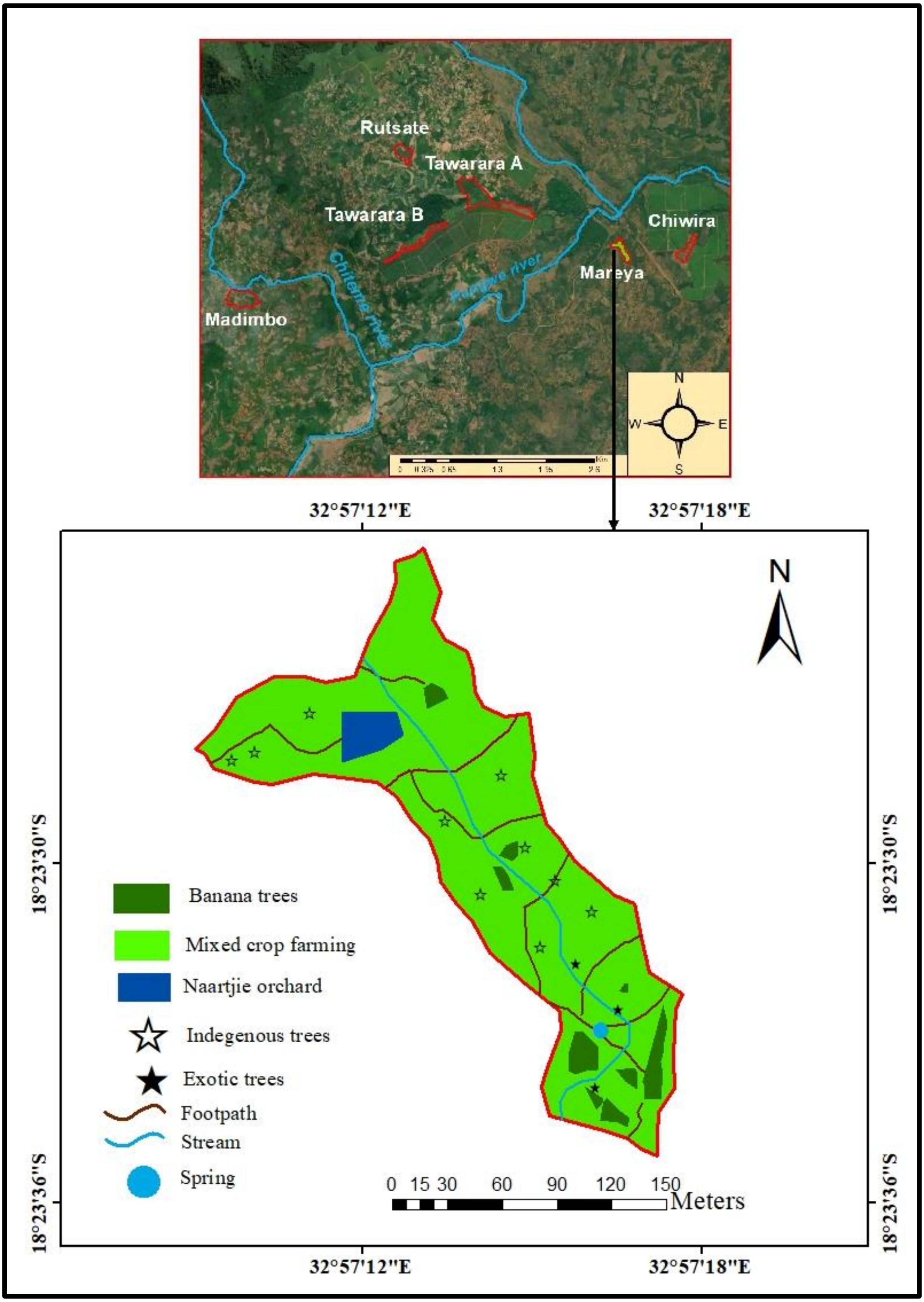

Figure 5.15: Mareya wetland features

Figure 5.16: View of Mareya wetland (photo: Emmah Mandishona)

Figure 5.17: Features of Mareya wetland. (a) View of crops and indigenous trees found adjacent to the wetland; (b) a spring protected well (photos: Emmah Mandishona)

5.2.6 Chiwira wetland

Chiwira wetland is a small valley bottom vlei (dambo). It has an area of 29 444 m^2 (2.9 ha) (Figure 5.18). Reddish clay soils make up the wetland. The wetland is covered with a variety of crops (Figures 5.19, 5.20a) from the end of July to the end of March and is left idle from April to July when grass and weeds grow except on small portions where farmers plant vegetables after harvesting their main crops. Clustered indigenous trees of *mukute* and *mugopokopo* are found on the eastern part of the wetland (Figures 5.18, 5.19, 5.20a).

Some exotic fruit trees such as banana, avocado, mango trees are also found in the wetland. Native to this wetland is a variety of weeds such as reeds, rushes, water speedwell, slender knotweed, sedges, blackjack that are unevenly distributed during the rainy season and increase when the wetland is left idle. Strips of grass can be found near the trenches during the summer season, whilst most parts of the wetland are covered with grass and weeds in autumn.

Spring protected wells can also be seen in Chiwira wetland (Figure 5.20b). Although this wetland is also saturated with water during the summer season, it is drier on other parts of the wetlands in winter, spring and autumn than the other wetlands. Birds such as marsh wren, water rail, swamp sparrow, blackbirds, golden-crowned sparrows, and flicker hive are also seen in the wetland. Reptiles such as water dragons, lizards and tortoise are also found in this wetland. Some animals such as rats, moles and mice can sometimes be seen in Chiwira wetland. Similar to other wetlands, a variety of insects are found in Chiwira wetland. Some of these insects include locusts, grasshoppers, toad bugs, pill bugs, water scorpions, frogs, crane flies, dragonflies, caterpillars and snails. The upland areas surrounding Chiwira wetland are covered with tea for the Eastern Highlands Tea Estate Company. Villagers' houses are located between 2 to 3 kilometres from the wetland.

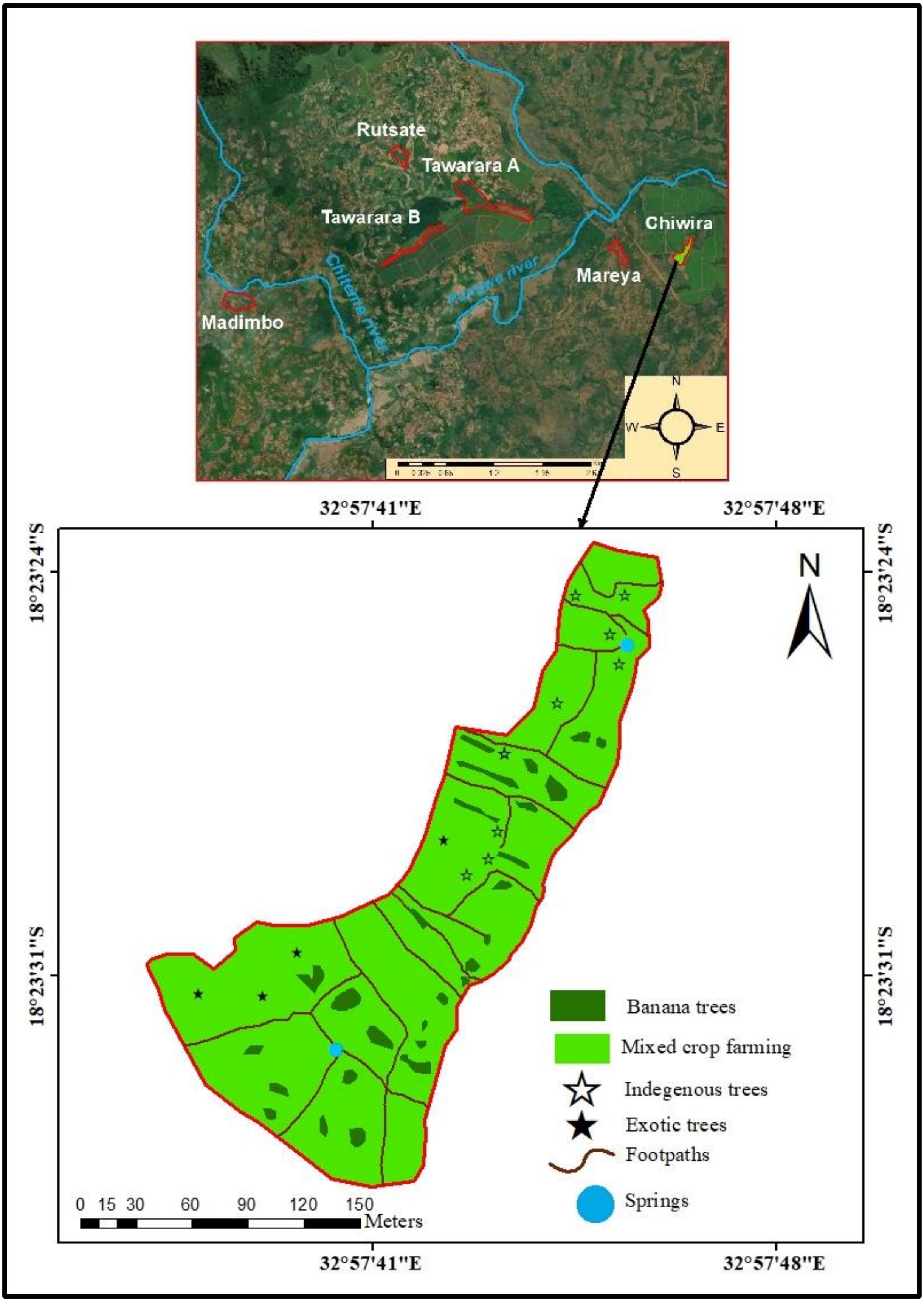

Figure 5.18: Chiwira wetland features

Figure 5.19: View of Chiwira wetland (photo: Emmah Mandishona)

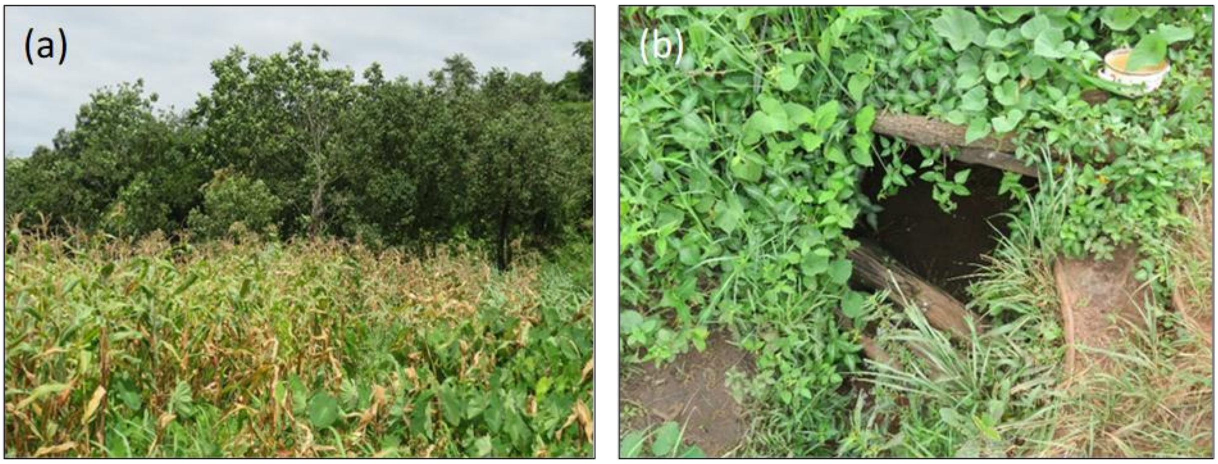

Figure 5.20: Elements seen in Chiwira wetland. (a) Crops and indigenous trees; (b) spring well (photos: Emmah Mandishona)

5.3 The demographic structure of the key informants

5.3.1 Age

Interviews with the key informants were conducted with 49 Honde Valley residents in Zindi rural area where the six wetlands are located. Of the 49 respondents, 61% were females, and 39% were males (Table 5.1). Most of these respondents were between 46 and 59 (49%) and over 60 years (31%). Few respondents were between 26-35 (8%), 36-45 (10%), and only 2% were 18-25 years (Table 5.1). Focus group discussions were administered to three groups, with the first one having three females and two males, the second one had four females and four males, and the third group had three females and three males.

5.3.2 Education

The respondents' education qualification ranges from primary, but none attained advanced level education, and only 2% attained tertiary education. Most of the respondents attained primary (49%) and secondary (41%) education, and 8% did not go to school at all (Table 5.1).

5.3.3 Distance from the wetlands

Most of these wetland users resided close to the wetlands. Of the 49 respondents, 24 respondents (49%) stayed less than a kilometre from the wetland, and 25 respondents (51%) stayed between 1 to 2 km from the wetland.

Table 5.1: Respondents' demographic structure (n=49)

Gender	**Male**			**Female**				
Number of respondents	19			30				
Percentage	39			61				
Age	**18-25 years**		**26-35 years**	**36-45 years**	**46-59 years**		**60+ years**	
Number of respondents	1		4	5	24		15	
Percentage	2		8	10	49		31	
Education	**None**	**Primary**	**Secondary**	**A-Level**	**Tertiary**			
Number of respondents	4	24	20	0	1			
Percentage	8	49	41	0	2			
Employment status	**None**		**Employed**		**Self-employed**			
Number of respondents	1		4		44			
Percentage	2		8		90			
Employment type	**None**		**Farming**		**Other**			
Number of respondents	1		44		4			
Percentage	2		90		8			
Distance from the wetland	**Less than a km**		**1-2 km**		**3-5 km**		**More than 5 km**	
Number of respondents	24		25		0		0	
Percentage	49		51		0		0	
Number of people in the household	1	2	3	4	5	6	7	8
Number of respondents	1	3	12	11	11	6	3	2
Percentage	2	6	24	22	22	12	6	4

5.3.4 Employment status

Out of the 49 interviewed residents of Zindi area of Honde Valley, only 4 respondents (8%) were employed, and 44 respondents (90%) were self-employed. Only 2% were not working, and these were older people who reported that they were no longer strong enough to go and work for themselves (to do farming). All the self-employed respondents survived on farming, growing a variety of crops, keeping livestock, practising fish farming, and keeping bees. 8% of the respondents indicated that they were employed formally. These were employed in the local area as a grinding meal attendant, Agricultural Extension officer for the Eastern Highlands Tea Estate, security guard and green leaf clerk. Since most of these farmers were from households with three or more people (Table 5.1), they were compelled to grow crops to feed their families.

5.3.5 Number of people using wetlands

Most of these respondents (45=92%) were using wetlands for different purposes to sustain livelihoods and only 4 (8%) were not using wetlands at all (Figure 5.21). Although some people were exploiting wetlands for different ecosystem services, many (44 respondents) (90%) had farms in the wetlands (90%) and were growing a variety of crops. Only a few (5 respondents) (10%) of the respondents did not have farms on the wetlands (Figure 5.22).

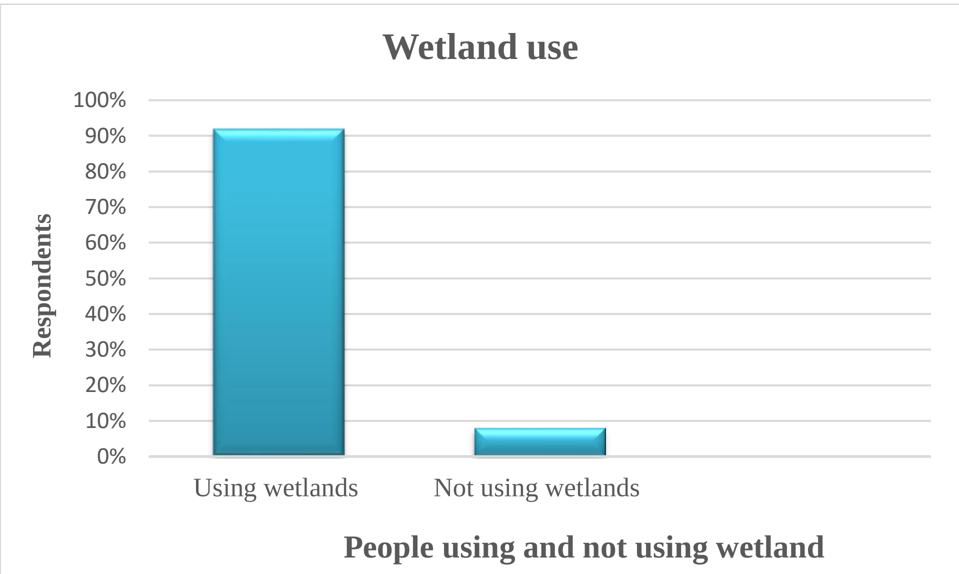

Figure 5.21: Percentage of respondents using wetlands (n=49)

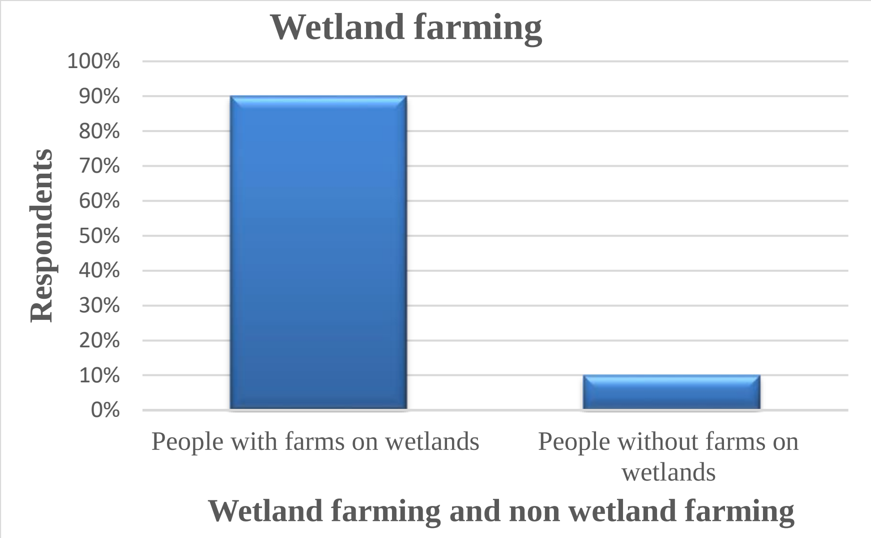

Figure 5.22: Percentage of respondents practising wetland farming (n=49)

5.3.6 Wetland farming versus dryland farming

Since most of the framers had farms in wetlands and on dry land, out of the 5 respondents (10%) who did not have farms in the wetlands, 3 respondents (6%) were practising dryland farming only, and 2 respondents (4%) were not farming at all (Figure 5.23).

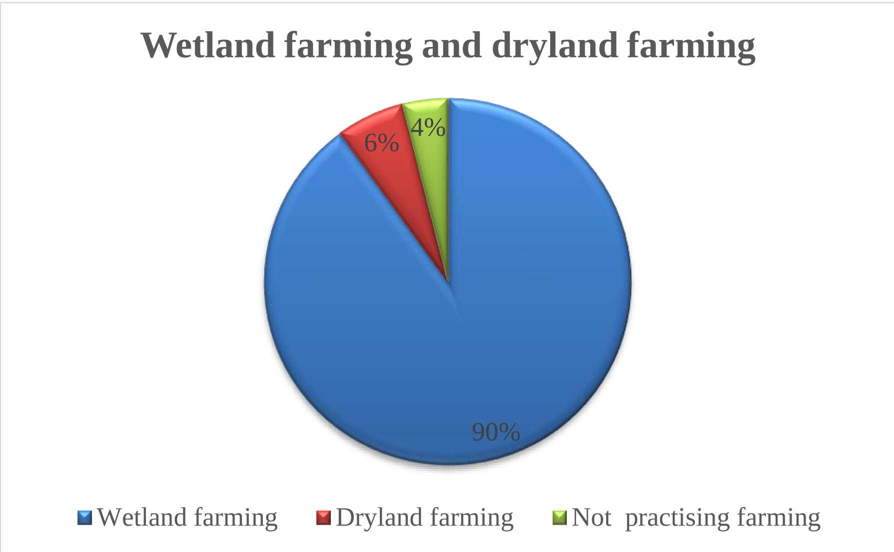

Figure 5.23: Wetland farming and dryland farming (n=49)

5.3.7 Crop production and livestock keeping

Out of 49 respondents, 39 (80%) engaged in livestock keeping, whilst 10 (20%) did not keep any livestock (Figure 5.24). The respondents revealed that they were keeping a variety of livestock, but few were keeping cattle. Some were keeping chicken only (11 respondents) (27%), goats only (6 respondents) (16.3%), pigs only (3 respondents) (6.1%), cattle only (1 respondent) (2.4%), chicken and goats (7 respondents) (18.3%), or cattle and goats (4 respondents) (10.2%). Although cattle are a source of wealth for most rural people in Zimbabwe, few farmers in Zindi rural area were keeping cattle. They reported that there were no pastures for cattle since most of the upland areas had tea estates for the Eastern Highlands Tea Estate Company. Those who had cattle were driving them into the nearby mountains (with pastures) and would leave them there wandering. However, they risked losing most of their cattle to thieves hence most farmers had stopped keeping cattle.

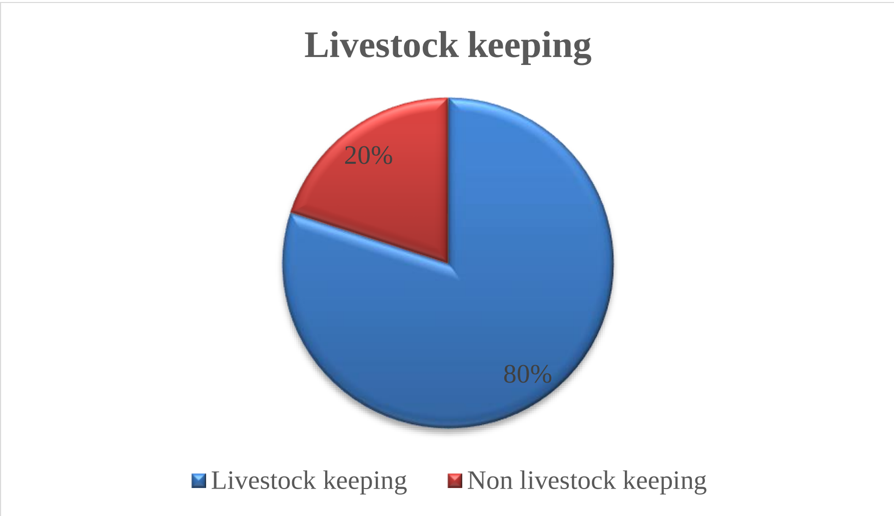

Figure 5.24: Number of farmers keeping livestock (n=49)

Out of the 20% who were not keeping livestock, 18% were involved in crop production only, and 2% were neither keeping livestock nor growing crops (Figure 5.25). However, the other 2% were keeping livestock only and were not growing crops, and 78% were practising both (livestock keeping and growing crops) (Figure 5.25).

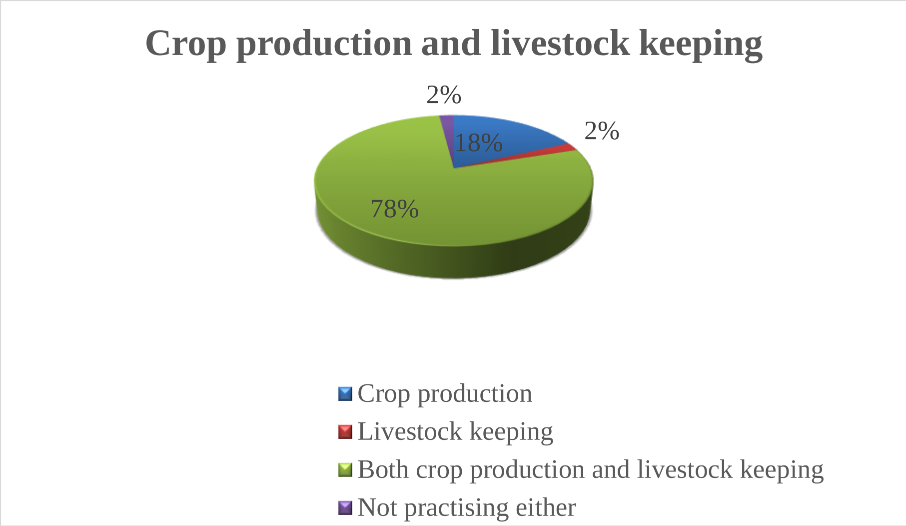

Figure 5.25: Percentage of respondents involved in crop production and livestock keeping

5.3.8 Period farmers have been using wetlands

Most farmers indicated that they have been using wetlands for their entire lifetime (Figure 5.26).

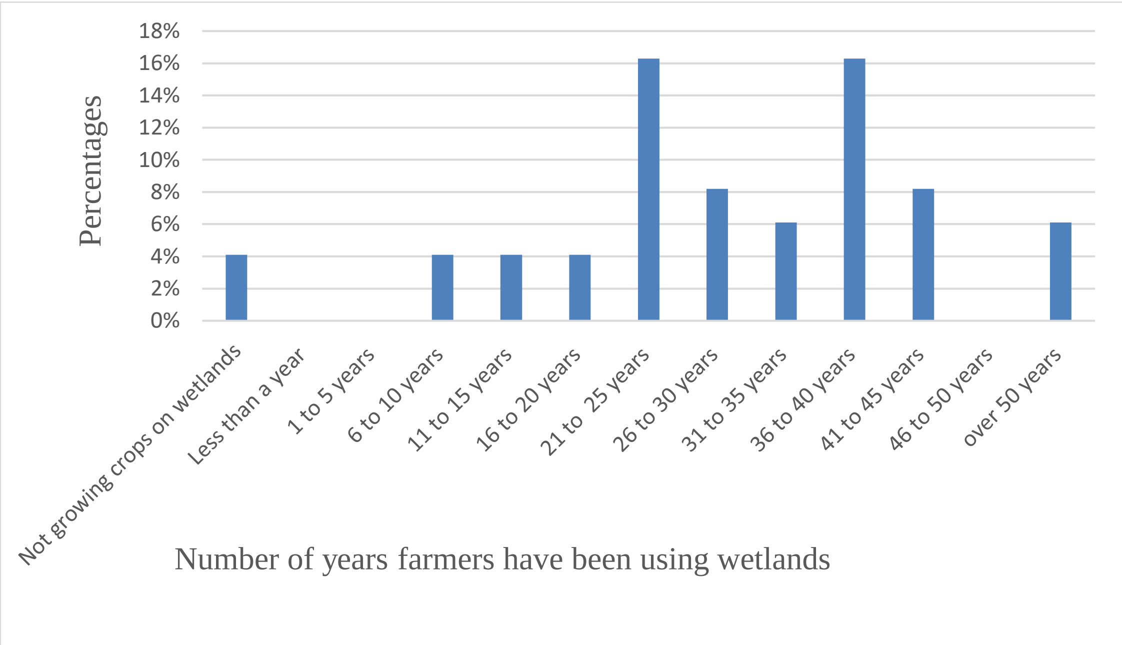

Figure 5.26: Total number of years different farmers have been using wetlands (n=49)

Many respondents showed that they have been growing crops on wetlands for more than 50 years 13 respondents (26.5%) (Figure 5.26). However, none of the respondents indicated that they have been using wetlands for less than a year or between one to five years.

5.4 Human-wetland interactions

Honde Valley wetlands, like many wetlands in rural areas in Zimbabwe, are exploited for the different ecosystem services they provide. In explaining how residents of Zindi area interact with the wetland in different ways, this section will present data obtained through participant observations, informal interviews during conversations with wetland users, and data yielded through formal interviews with key informants, focus group discussions and interviews with village heads. Description of how people interacted with wetlands through exploiting different wetland ecosystem services will be complemented with photographs. Photographs taken by the researcher using a digital camera and those taken by the wetland users using disposal cameras will also be presented.

5.4.1 Ecosystem services derived from Honde Valley wetlands

Wetlands in most rural areas in Zimbabwe are being exploited for their different ecosystem services. Information obtained from the Zindi rural area residents and researcher observations show that the wetlands in Zindi rural area were mainly exploited for their provisioning services. Results from participant observation and formal and informal interviews with wetland users showed that the wetlands were mainly utilised for food provision. Wetland farmers were growing a variety of crops such as tea, pineapples, maize, yam, sugarcane, groundnuts, cassava, beans; leafy vegetables such as cabbage, kale; fruit vegetables such as okra, eggplant, tomatoes and peppers; tuber vegetables such as potatoes, ginger, turmeric; and bulb vegetables such as onion and shallots. They also grew fruit trees such as bananas, mangoes, avocados, lemons, oranges, litchis, and naartjies (tangerines). The researcher also observed most of these crops growing in the six wetlands during the summer season.

Residents of Zindi revealed varied reasons for choosing to grow such crops in wetlands. Some of these reasons included the favourable conditions for plant growth available in wetlands (89.8% of respondents), food security and income generation. Since these are valley bottom wetlands surrounded by woodland, wetland soil fertility is enhanced by the humus deposited into the wetlands when water flows downslope. Inorganic fertilisers from the tea farms on the upland areas adjacent to Chiwira, Tawarara A, Tawarara B and Rutsate wetlands also enhanced wetland soil nutrients, thereby making them more productive than the dryland farms. Commenting on why they favoured growing crops on wetlands, one respondent said:

> *We choose to grow these crops on wetlands since they do well because of enough water and good soil. We, therefore, harvest more in the wetlands than in our dryland* (Respondent 28, female over 60 years)

One male respondent (aged 46-59 years) from focus group 1 also emphasised that they were guaranteed to harvest whenever they grow crops on wetlands because of the water availability. Interview female respondent 4 (aged 46-59 years) also added that some farmers had abandoned most of their fields in dryland areas because the soil was exhausted and was therefore no longer fertile. Giving other reasons on why they had abandoned dryland farming, respondent 4 said:

> *We are not guaranteed to harvesting from our dryland farms because nowadays the rainfall is no longer reliable. Hence most people are no longer growing crops on the dryland farms because sometimes we do not harvest. Sometimes we receive a lot of rainfall, and the crops in the dryland farms are affected, and they do not grow well. We are therefore surviving on wetlands and solely relying on them* (Interview respondent 4)

The shortage of land in dryland areas also forced farmers to turn to wetlands for farming. As was revealed by interview respondent 34 (male, aged 36-45 years), there were too many people in Zindi area, and there was not enough land in dryland areas for people to grow crops since most of their fields had been taken by the Eastern Highlands Tea Estate Company for tea growing.

Out of 49 respondents, 89.8% concurred that early harvest from wetland crops cushioned them against late and unreliable harvests from dryland farms, hence they were growing most of these crops for sale and consumption. Crops such as yam, ginger, turmeric, and fruits such as litchis, bananas, naartjies, and avocadoes were mainly grown for sale. All respondents from all three focus groups revealed that they would get excited when they hear of the word wetland because they would start thinking about growing yam, maize, and bananas and different crops for consumption and sale. Besides growing bananas and sugarcane mainly for sale, they were also grown for conservation purposes and reducing water in wetlands. Commenting on this issue, interview respondent 21 (male, aged 46-56 years) said:

> *Banana plants also help bind the soil together to avoid erosion, so we grow most of these bananas around our fields to reduce soil erosion. We also grow sugarcane in waterlogged areas to suck the water and reduce its amount in these areas* (Interview respondent 21).

The researcher also observed that these wetland users were attached to the wetlands mainly through agriculture, hence they would spend most of their time working in the wetlands during the rainy season. Observing them working on the wetlands, these farmers were enthusiastic about growing and managing their wetland crops. Figure 5.27 shows some of the farming activities the farmers engage in on wetlands during the day.

Figure 5.27: Different activities in wetlands. (a) Earthing up yams, involving mounding soils around yams to prevent new tubers from growing and allowing the developing tuber to grow big; (b) weeding and earthing up yams; (c) harvesting undried maize; (d) fishing from a wetland fish pond (photos a,c,d: Emmah Mandishona; photo b: Photographer 1)

Besides growing a variety of crops in these wetlands, some wetland users were practising fish farming in Tawarara A and Madimbo wetlands (Figures 5.29, 5.29). Two farmers were only involved in fish farming which was done for consumption and sale. Farmers constructed the fish ponds within the wetland (Tawarara B) (Figure 5.29) and at home (near Madimbo wetland using water from the wetland and Chiteme River) (Figure 5.28a, b). Explaining why she decided to move the fish pond from the wetland closer home, a Madimbo farmer said:

> *I used to keep fish in this wetland (Madimbo wetland). There was still a lot of water in the wetland, but that part of the wetland where I dug the fish dams is drying up. So, I am now relying on drawing water to the fish dams from the river close to Madimbo wetland and some from the wetland itself. Since we were no longer relying on the spring water, which was naturally flowing into the fishponds, we decided to dig the fish dams at home. We were also losing a lot of fish to thieves when our fishponds were in the wetland* (Interview respondent 20)

Figure 5.28: Fish dams in Madimbo with water drawn from Chiteme River located adjacent to Madimbo wetland (photos: Emmah Mandishona)

Figure 5.29: Fish dam in Tawarara B wetland (photo: Emmah Mandishona)

Tawarara B wetland male fish farmer (interview respondent 22, aged 46-59 years) reported using less money in constructing the fishponds because of a lot of water in Tawarara B wetland. By contrast, the female fish farmer in Madimbo wetland (interview respondent 20, aged 49-59 years) treated her fish farming project as more commercial. She spent a lot of money to buy equipment such as pipes (to draw water from the wetland and nearby river) and plastic material to put on the surface of the pond before putting water inside. She also had to buy fish pellets to ensure that the fish multiply quickly. Both farmers were keeping fish for consumption and sale.

Although fish farming was not done by a lot of farmers in Honde Valley, most of the people in Zindi rural area could also have access to the fish since the fish farmers were selling the fish to people in their village and surrounding villages. The Madimbo fish farmer said that she would normally harvest about 100 kg of fish after six months, for sale to people in Zindi. She was also selling some of the fish to Hauna Growth point (a business centre nearby). Besides harvesting a variety of crops and fish, people in Honde Valley were also collecting a variety of fruits from the wetlands (from both indigenous and exotic trees). Residents in Zindi were collecting indigenous fruits such as *maonde* (from *muonde* or fig trees) *hute* (from *mukute* or *Syzygium cordatum* trees), and *magopokopo* (*Mystroxylon aethiopicum*) trees (Figure 5.30b) from the few indigenous trees left in these wetlands. Since exotic trees were doing well in the wetlands, most farmers planted these exotic fruit trees in their fields. They would collect fruits such as avocadoes, litchis, peaches, guavas, mangoes, lemons, oranges, and naartjies for consumption and sale. Indigenous vegetables were also found in the wetlands during the rainy season. Some of these that farmers were surviving on were locally known as *derere* (*Corchorus olitorius*), *teketere* (*Calinsoga parviflora*), *nhungunira* (*Bidens pilosa*), *tapa* (*Justicia* spp), *mutsematsema* (*Cleome monophylla*), *mutsungura* (*Solanum nigrum*) and *mubvunzandadya* (*Chenopodium album*). Mushrooms grew in some of the wetlands during the rainy season and some wetland users would collect these (Figure 5.30a).

As observed by the researcher, some farmers kept bees in the wetlands for honey (Figure 5.30a, d) which they would eat or sell. Bee farming was common in Madimbo wetland, where farmers kept their beehives in and around the river adjacent to the wetland. One male farmer (interview respondent 19, aged 46-59 years) explained that they preferred placing the beehives on trees in and around the wetland rivers because they believed that flowers in these wetland trees attracted a lot of bees.

Figure 5.30: Other food resources from Zindi wetlands. (a) A farmer picking mushrooms; (b) indigenous fruit collection; (c, d) beehives placed on trees around a river; (c) a beehive

made by the owner of the beekeeping project; (d) a beehive that was bought from a carpenter (photos: Emmah Mandishona)

Besides the abovementioned variety of foods they were getting from the wetlands, wetland users would also catch mice and locusts in these wetlands. As was observed by the researcher, the children were hunting for mice, birds, and locusts when the wetlands were left idle from April to the end of July. This was the time when grass and weeds grew again in the wetlands providing shelter for these animals and insects. However, besides food, people in Zindi rural area derived a lot of other benefits from wetlands. For example, wetland water was used for domestic purposes such as cooking, washing, bathing and drinking. The wetland users were fetching clean water from the wetland spring wells (Figures 5.3c, d, 5.6d, 5.11, 5.17d, 5.20b). Some farmers would also bath and wash their clothes in the wetlands before going home after working for long hours in the fields. However, detergents have the potential to affect the breeding ability of aquatic plants by lowering the surface tension of the water, making it harder for aquatic insects like water striders to float on the surface and survive in the wetlands. The detergents could also possibly lower dissolved oxygen and this could alter the chemistry of the sediments under water and release toxins that harm aquatic life. Figure 5.31 shows a place on the wetland stream prepared by farmers for bathing and washing their clothes.

Figure 5.31: Bathing area on a stream in Tawarara A wetland. The wetland users used the rocks as a clean and safe platform to stand when they wanted to bath. They avoided

making the water dirty by standing on the rock whilst bathing. The big stones created a clean area for them to put their toiletries (photo: Emmah Mandishona)

Apart from using wetland resources such as water for various purposes, some farmers were making a variety of items such as baskets, lamp holders, handbags and toiletry holders from bamboo found in the wetlands (Figures 5.10b, 5.32). Besides relying on natural bamboos that were growing, respondent 20 said that they were also planted bamboo trees in the wetlands.

Figure 5.32: Items made from bamboos (lamp holder and toiletry holders) (photo: Emmah Mandishona)

Residents of Zindi area also collected a variety of medicinal plants from the wetlands to treat various diseases (Table 5.2).

Table 5.2: Medicinal plants found in the wetlands

Botanical name	**Plant species local name**	**Type of illness to be treated**
Ximenia caffra	*Bawa*	Backache
Breonadia salicina (Adina microcephala)	*Muonya*	Backache
Grewia bicolor	*Mungurawe*	Stomach-ache
	Ngarura	Stomach-ache
Erythrina abyssinica	*Mutiti*	Diarrhoea
Syzygium cordatum	*Muhute*	Coughing
	Munjeraira	Stomach ache
Scleria foliosa	*Jekacheka*	Menstrual cramps
Carissa bispinosa	*Kayanyasika*	Backache
Zingiber officinale Roscoe	*Tsangamidzi*	Stomach ache

Ochna pulchra	*Nunera*	High blood pressure
Diospyros mespiliformis	*Sumba*	High blood pressure

Although some respondents reported that they were collecting a variety of traditional medicine from the wetlands, some interview respondents, such as female respondents 1 and 11 (both over 60 years), reported that it was difficult to find some of these medicinal plants in the wetlands since most of them were cut when farmers were preparing the land to grow crops. However, some interview respondents were reluctant to talk about these traditional medicinal plants because of their religious affiliations and beliefs. For example, respondent 3 had to pretend as if she was not aware of these traditional medicines and said:

> *I am now a Christian. I am a member of the apostolic sect, so we are not allowed to use these traditional medicines, and we are also not allowed to talk about them. I do not know any of these medicinal plants* (Interview respondent 3, female, over 60 years)

A male respondent (aged 46-59 years) from focus group 2 blamed Christianity for stopping them from using these traditional medicines, although he was also a Christian. He said:

> *As Christians, we are not allowed to use these traditional medicines. Our hands are tied hence, we rely more on prayers and the medicines we get from hospitals whenever we get sick* (Focus group 1)

Another female respondent from focus group 3 (aged 46-59 years) who also blamed Christianity pointed out that there were few people left to teach them about these traditional medicines. She said:

> *Because of this Christianity, there is no one to teach us about these traditional medicines. There are also few traditional healers left here in Zindi who can teach us about these traditional medicines. So, we do not know most of these traditional medicines* (Focus group 2)

5.4.2 Agricultural practices and their environmental impacts

As was observed by the researcher and reported by the farmers through informal and formal interviews, farmers in Zindi rural area used various farming methods to grow and manage their wetland crops. Some of the methods they were using included applying organic and inorganic manure, ridge system, holes, mulching, trenches, digging, and zero tillage (Table 5.3).

Although farmers used different methods to grow crops in wetlands, few farmers reported that they were using zero tillage (26.5%) (Table 5.3). However, those who preferred preparing the land through digging (73.5%) (Table 5.3), such as respondent 4 (female aged 46-49 years), pointed out that there was a lot of weeds in the wetlands, so they had to dig first to remove the weeds before planting their crops. Mulching was a common practice by wetland farmers (Figure 5.33). Crop residues, weeds and grass were used to mulch crops, and these would eventually rot and become organic manure (Figure 5.33a, b). Besides mulching with crop residues, weeds and the grass cut from wetlands, leaf litter and tea leaves (Figure 5.33c, d) were also used for mulching and later as humus. Farmers would collect leaf litter from the surrounding bushes and tea leaves from adjacent tea estates around Tawarara A, Tawarara B and Chiwira wetlands.

Table 5.3: Different methods used to grow crops in the wetlands

Method of farming	Number of respondents	Percentage
Zero tillage	13	26.5
Digging	36	73.5
Making trenches	49	100
Organic manure	49	100
Organic and inorganic fertilisers	32	65.3
Holes	28	57.1
Ridges	21	42.9
Mulching	37	75.5
Not mulching	12	24.5

Wetland farmers would choose different methods of farming for a variety of reasons. For example, commenting on the importance of using zero tillage, respondent 19 had this to say;

> *Zero tillage helps because we will not disturb the soil that much. This area receives a lot of rainfall. If we use zero tillage, the soil will not be loose enough to be carried away by water* (Interview respondent 19, aged 46-59 years).

One of the farmers (interview respondent 11, female over 60 years) who concurred with interview respondent 19, pointed out that she was using zero tillage since it allowed minimal soil disturbance. Wetland farmers practised mulching because of the advantages it had on the soil. For example, when highlighting the importance of mulching, one respondent said:

> *We use grass and these weeds for mulching. These methods help maintain soil fertility. Although mulching is essential in preserving soil moisture, it also helps in enhancing soil fertility. We do not remove the weeds and grass that we use for mulching, but we leave them to rot and become organic manure. We used to burn these weeds and later realised that we were losing the organic manure. Since we are continually using the wetlands for agriculture, we have realised that we need to replace the nutrients naturally. That is why we retain the weeds and grass as manure* (Interview respondent 33, aged 36-45 years)

Besides relying on crop residue, leaf litter, tea leaves, grass and weeds for organic manure, farmers would also make compost. As was reported by respondent 33, they made compost using weeds and grass from the wetlands (Figure 5.34). The researcher also observed that some farmers would collect leaf litter and twigs from leaves to add to their compost manure. As was reported by interview respondent 16 (female over 60 years), compost manure was also made from maize leaves, husks and stalks. Interview respondent 16, who concurred with respondent 33, also reported that they would retain the maize leaves, stalks and husks to make compost during harvest time. She also pointed out that they would make most of their composts in March, and these would be used in August as they started to plant crops in the wetlands.

Figure 5.33: The use of mulch and compost in farming methods. (a) Mulching using maize stalks; (b) maize stalks left standing in the field, and in this case managing yams becomes difficult since the farmer is supposed to mound soil around the yam; (c) weeds retained for mulching and as organic manure in fields after weeding; (d) tea leaves (to be used as mulch and manure in the wetland fields) collected by a farmer from an adjacent tea estate (photos: Emmah Mandishona)

Figure 5.34: Farmer collecting grass for compost manure during land preparation (photo: Photographer 1)

Although all the farmers were using organic manure, most of them felt that organic manure on its own was not enough to enhance production. Hence, most farmers were using both organic and inorganic fertilisers (65.3%) (Table 5.3), and some (34.7%) were using organic manure only. As was reported by interview respondent 6 (female, aged 26-35 years), farmers who were using organic manure for yams were doing it to ensure that the yam bulb developed. Respondent 6 also reported that she avoided using artificial fertilisers because affordability was not guaranteed in the future. She also believed that when the soils adapt to artificial fertilisers, they will produce lower yields if farmers then revert to organic manure if artificial fertilisers become unaffordable. Respondent 6 explained that artificial fertilisers were also not good since they would make yams rot if they receive too much rainfall. Despite these negative perceptions of using artificial fertilisers, some farmers felt that they could not grow crops in the wetlands without it. For example, interview respondent 8 (male, aged 46-59 year), who concurred with most farmers who were using inorganic fertilisers, reported that most farmers preferred to use artificial fertilisers to increase their yields. Hence, farmers were using compound D fertiliser when planting the crops and then ammonium nitrate fertiliser in the later stage of plant growth. However, to ensure that their crops grow faster, respondent 8 further pointed out that they would apply compound D fertiliser three times (when burying the seeds in the soils, soon after germination and after sprouting of five to six leaves). The same applied to ammonium nitrate, which they were also applying at three different times at a later stage of plant growth before the crops were ready for harvesting. However, the application of inorganic fertilisers at different stages of plant growth would depend on the amount of inorganic fertilisers one would afford to purchase.

The wetland farmers were either digging ridges or holes to plant their seeds (Figure 5.35). Many farmers preferred digging holes to plant yam (57.1%) (Table 5.3). Although many people were planting their crops in holes instead of ridges, one male interview respondent (respondent 5, aged 26-35 years) reported that the hole system was an old system and preferred to use ridges which he said gave the yam and cocoyam bulb more room to grow. Another respondent with simiar views said:

> *When I got married here, we used to dig holes, but now we are digging ridges. I am the one who started the ridge system here on Madimbo wetland, and people started copying. I decided to use the ridge system because it makes it easy to bury the yam into the soil when planting it. When using ridges, you have to go inside the ridge and start putting the soil on top of the yam from both sides. It is also easy to mound soil around the yam when using the ridge system. When the yam is planted using the ridge system, it also has more room to grow big. I thought of this ridge method after spending a lot of money contracting people who would help me mound soil on the yam* (Interview respondent 20).

As was indicated by interview respondent 20, the ridge system made it easy for farmers to bury the yam and mound the soil around the yam to enhance the size of the yam. She also added that ridges allowed for a higher plant population density than holes and therefore used the land more efficiently.

However, one farmer who was amongst those who were using the hole system (female interview respondent 16, over 60 years) revealed that she was unwilling to change to the ridge system since she once tried it and it was difficult for her to mound soil around the yam and cocoyam. As was observed by the researcher, farmers made use of the limited space within their wetland farms to plant a variety of crops, hence they were all practising intercropping and mixed farming. Thus, after planting the yam, maize was planted on top of the yam two weeks later before the yam started germinating (yams take longer to germinate). Although wetland farmers were using different systems to plant their crops, the process was still the same. This entailed digging holes or ridges, stuffing them with organic manure, applying inorganic fertiliser (if available), then planting the yam, bury it with soil, and then applying organic manure on top again.

Figure 5.35: Methods of planting yams. (a) Digging holes. This was done without measurements. People would dig the hole size they preferred; (b) farmer digging ridges to plant yam. Likewise, the depth and size of the ridges were not known (photos: Emmah Mandishona)

All the wetland farmers indicated that they were digging trenches (Table 5.3, Figure 5.36) to drain both surface and underground water, since there was a lot of water in most parts of these valley bottom vleis. The researcher observed trenches that were dug around each farmer's farm to drain water, and these trenches also marked the boundaries of the farms (Figure 5.36). The trenches were normally directed into one big trench, which sometimes grew into a small stream. Farmers would leave grass adjacent to the trenches and sometimes plant sugarcane at the edges of the trenches to hold the soil together. Ironically, most of the wetland farmers supported the digging of trenches as a way of conserving wetlands and ensuring that people benefit from these ecosystems. For example, female interview respondent 23 (aged 36-45 years), reported that trench digging was a crucial system that enabled them to access the wetlands for agriculture while conserving the wetlands. Another male farmer said:

> *We usually dig trenches to drain water, and this helps because the soil will not be eroded. The water flowing into the wetlands will then flow through these trenches instead of flooding our fields and erode the soil* (Interview respondent 12, aged 46-59 years)

Another interview respondent (male respondent 3, over 60 years of age) pointed out that they would prepare these trenches every rainy season by removing the weeds from them, and by so doing, they were guaranteed good harvests.

Although most farmers supported the trench digging system, some were aware of its consequences. Another male interview respondent (respondent 13, over 60 years of age) suggested that people were supposed to avoid digging trenches to drain water since this would lower the water table. Interview respondent 9 (male, aged 46-59 years) also pointed out that trenches were supposed to be closed so that the water would flow underground to keep the wetland moist. Some wetland farmers were not digging the trenches properly, and as a result some would overflow and cause soil erosion.

Figure 5.36: Different types of trenches dug by farmers to drain water in valley bottom wetlands. (a) Trench reopened during the crop post-germination period; (b) trenches being channelled into one big trench during the crop growing period; (c) trenches channelled into one big trench to drain water into the nearby stream; (d) trench dug during land preparation (photos: Emmah Mandishona)

The researcher observed these trenches (Figure 5.36) in all six wetlands. However, if these trenches were not continuously opened, they could result in gullies, and sometimes soil erosion would occur, as was observed in Rutsate wetland (Figure 5.37).

Figure 5.37: Soil loss in Rutsate wetland. (a) A gully being formed and erosion taking place along a trench; (b) erosion taking place where trenches meet a pathway (photos: Emmah Mandishona)

Numerous trenches had developed into small streams in some of the wetlands such as Tawarara A and Tawara A, Mareya and Rutsate (Figure 5.38), and these compelled farmers to build access bridges to the wetlands. Besides cutting down vegetation when digging the trenches, farmer would also cut trees to make these wooden log bridges (Figure 5.38).

Figure 5.38: Wooden log bridges. (a) Wooden log bridge with supporting side logs that people can hold to assist them when crossing one of the rivers in Rutsate wetland; (b) wooden log bridge with supporting side logs built over a trenches that had developed into a stream in Mareya wetland; (c) log bridge on one of the trenches in Mareya wetland;(d) log bridge built on one of the small streams in Tawarara A wetland (photos: Emmah Mandishona)

However, some respondents related the continual use of old and unsustainable farming methods to lack of proper training and monitoring of wetland farming. For example, respondent 42 said:

> *Farmers continue to use old and unstainable farming methods because no one monitors how people are using these wetlands* (Interview respondent 42, male, aged 36-45 years)

Another respondent said:

> *We want to continue growing our crops on these wetlands, but no one teaches us sustainable farming methods. We would appreciate it if someone teaches us*

how to use these wetlands and manage them sustainably (Interview respondent 11, female over 60 years)

Although many farmers commented on the different farming methods they were using in the wetlands, a few farmers were reluctant to comment. For example, respondent 41, who was afraid of being victimised, said:

> *I was not born in this area. I came to settle here permanently, and I was given this wetland farm. I am renting this farm so that I can also grow crops and feed my family. I am scared to talk about people' farms and how they are using them. They will chase me from their area* (Interview respondent 41, male, aged 46-59 years)

5.4.3 Use of wetlands in the past

This section was informed by information collected through interviews with the three village heads. Evidence from interviews conducted with village heads revealed some changes in the way people are using wetlands today compared to how they have used them in the past. These changes were based on the type of crops grown in the wetlands, the methods used to grow crops, and the amount of land used for agriculture in the wetlands. In discussing these changes, Village head 1 said;

> *Although people used to grow crops such as yam and maize in the past, farming was not as developed as it is now. Besides maize and yam, people are now growing a variety of crops such as beans and different types of vegetables. People are growing bananas that were not grown in these wetlands in the past* (Village head 1, over 60 years)

Village head 3, whose views on the change of crops grown on wetlands concurred with Village head 1, said:

> *We also used to grow rice in these wetlands, and people are no longer growing rice. We used to harvest about six to seven ninety kg bags of rice. We used to grow cowpeas in the past instead of beans which are grown nowadays. Many wetland farmers used to grow a lot of sugarcane in the wetlands, but nowadays, few people are still growing sugarcane* (Village head 3, over 75 years).

Although some new crops had been introduced in the wetlands, wetland users had stopped growing crops such as rice because it was challenging to manage. For example, Village head 1 said:

> *We used to spend the whole day in the fields chasing the birds from our rice farms. But most of the time, we would go in the morning and evening to chase these birds. However, people are no longer growing rice because it is laborious, and it is challenging to manage the crop until it is ready to be harvested* (Village head 3, over 75 years)

Although people in Zindi area had abandoned rice growing in wetlands, Village head 1 believed that people were supposed to go back to the primitive ways of using wetlands, such as growing rice. He indicated that soil loss through erosion was limited in the wetlands long ago because of rice growing. He thought that rice helps bind the soil together. Therefore once it was grown, there was less weeding (reducing the number of times people would tamper with the wetland). Alongside an increased number of crops grown in wetlands, the amount of land used for agriculture had also increased. Village head 3 said:

> *Long back, people were also not using big pieces of land, like what we are doing now. Wetland use for agriculture has increased now than long back. Wetlands are being utilised intensively for agriculture these days than in the past* (Village head 3, over 60 years)

Farming methods had also changed. Village head 3 said:

> *In the past, we never used inorganic fertilisers to grow crops because the wetland soil was fertile than it is now. Now people are using inorganic fertilisers to boost their production* (Village head 3, over 60 years)

Village head 2's response concurred. In explaining how wetland use had changed, he said:

> *Initially, few people were using wetlands to grow crops but later own as some people continued to grow crops on wetlands, some farmers realised that those who were growing crops in wetlands harvested more. They then decided to move from dry land farming (growing crops on these highlands and the mountains to these lowlands (valley bottomland wetlands). Back then, people were not using wetlands as they are doing today. Wetlands use has increased in the past years. Discovering these valley bottomland wetlands as the most productive land for crop production enabled people to change their diet since they could grow a*

> *variety of crops such as maize, yam and beans on these wetlands* (Village head 2, over 60 years)

5.4.4 Cultural, myths and beliefs on the use of wetlands

This section was informed by information collected through focus group discussions and interviews with the village heads. Results from focus group discussions with the wetland users and interviews with the village heads revealed that some people in Honde Valley were still using wetlands for cultural purposes. For example, in revealing how they were using these wetlands for traditional purposes, Village head 1 said:

> *We are still burying children in the wetlands, especially those who die soon after birth and stillbirth. We bury these children in wet places such as wetlands* (Village head 1)

Village head 2 and respondents for focus group 1 and 2 also concurred with the idea that babies were buried in wetlands or riverbanks because, as babies, they were not supposed to be exposed to the heat from the sun, but they wanted cool areas. However, village head 2 pointed out that although some people were still following this practice, some had stopped following it hence these people were burying babies on dryland areas.

Besides burying children, there were also some sacred places in the wetlands and in explaining these sacred places, village head 1 said:

> *Some places are still sacred though there are few. There are also sacred wells that do not dry up. All metal things are not allowed to be brought close to these wells to fetch water on these sacred wells except clay pots* (Village head 1)

One male respondent from focus group 1, whose views concurred with village head 1 pointed out that dirty clay pots and metal pots put on fire were not allowed around such sacred wells. Focus group 1 respondents explained how taking dirty metal pots to sacred wells led to the drying up of one of their wells, and they said:

> *Our well called Ben's well dried once up another year because we had taken some dirty pots from the fire and soap there. We had to spend almost a year fetching water from a well further away until our elders performed some rituals, then the spring water came out of Ben's well* (Focus group 1)

Focus groups 2 and 3 revealed that traditional leaders did not allow older people to clean around these sacred wells since they considered it taboo for older people to do such duties when young people were there. Young mothers and girls were therefore sent to remove dirty items around such wells. Focus group 1 also reported that the village heads did not allow people to visit the wetlands at night or dressed in tattered clothes or half-naked. However, as was reported by focus groups 2 and 3, most of these spring wells that used to be sacred were no longer considered as such because people had stopped following some taboos and myths associated with such wells. There were also some traditional practices that people were supposed to follow in the wetlands. However, few villagers were adhering to such practices as was explained by village head 3 who said:

> *It used to be a traditional practice that village members would come and help the village head weed his wetland fields to honour him. But now people are not doing that. People are now practising modern ways of living which do not respect our traditional practices. So, if I call people for such gatherings, few people come. Most people no longer understand our culture and practices* (Village head 3)

Brewing beer before the onset of the crop planting season was a common practice in Zindi area. In explaining how this was done, Village head 1 revealed that before planting their crops on wetlands, they would brew beer at the chief's home and then the chief would announce the beginning of the planting season after performing traditional rituals. He also pointed out that some farmers were impatient to wait for the announcements marking the beginning of the planting season to be made by the chief after performing these rituals. Hence, these farmers would plant their crops on the wetland before the ceremony. One female respondent (aged 45-59 years) from focus group 2 revealed that some of these traditional practices were eroded by Christian beliefs, which did not allow them to be involved in such traditional ceremonies and practices.

5.4.5 Challenges faced by wetland farmers

Although wetland farmers in Zindi rural area were facing many challenges, such as those encountered by most small-scale farmers in rural areas in Zimbabwe, some of these challenges were particularly related only to wetland farming. This was mainly because of the unique wetland conditions which are different to dryland conditions. Some of the challenges were related to too much water in the wetlands, and pests, mammals, birds, insects and diseases that affected their harvests. However, to ensure that they continually benefited from these wetlands regardless of the challenges they were facing, farmers improvised different ways to deal with these challenges. Wetland users had problems accessing some parts of the wetlands because of too much water. As observed by the researcher and reported by some interview respondents (respondent 2, male aged 46-59 years), 39 (female over 60 years) and 12 (male aged 46-59 years), it was difficult for farmers to access the wetlands because of too much water in some areas, especially during the rainy season. As a solution, they decided to dig trenches (Figure 5.36) to drain the water before they start to grow crops. Besides having problems of access, wetland farmers also experienced problems with various pests. For example, some interview respondents (e.g. respondent 48, female aged 46-59 years; respondent 47, male aged 46-59 years; respondent 5, male aged 26-35 years; respondent 40, female aged 46-59 years) reported that pests such as stalk borer worms were eating maize which was affecting their harvests.

Although it was difficult to get rid of the stalk borer worms (as was reported by female interview respondent 49, over 60 years), farmers were using various natural and artificial ways to reduce pests in their farms. Some of the materials used to eradicate stalk borer included wet soil, pepper, salt, washing powder and cow dung. In some cases, certain wetland plants were used to kill stalk borer worms. For example, female interview respondent 48 (aged 46-59 years) reported that some farmers would plant an indigenous plant in wetlands locally known as *mutika* (fish poison shrub) (Figure 5.39a, b) and use its leaves to eliminate the stalk borer worm. Respondent 48 explained that they would crush the leaves of *mutika* plant, mix them with water and then pour the mixture on each maize cob where the stalk borer would be hiding. The smell of the crushed *mutika* leaves would then suffocate the stalk borer worm.

Figure 5.39: *Mutika* plant. (a) A farmer harvesting *mutika* leaves; (b) pruned *mutika* plants in Madimbo wetland (photos: Emmah Mandishona)

Apart from using *mutika* tree leaves to control the stalk borer, some farmers would also use wet soil to suffocate these worms. When explaining this method, interview respondent 6 (female aged 26-35 years) reported that farmers would take wet soil and place it on top of the tassel of each maize plant to suffocate the stalk borer. Farmers also used synthetic fertilisers such as ammonium nitrate to control stalk borer worms. Interview respondent 28 (female, over 60 years) said this process entails putting 2 to 3 grains of ammonium nitrate fertiliser on the maize tassel. The smell of ammonium nitrate would then suffocate the worm. Although the use of ammonium nitrate was an effective method in eliminating the stalk borer worm, it had some challenges. One interview respondent (female respondent 29, aged 36-45 years) indicated ammonium nitrate would sometimes burn the maize plant if it falls on the other parts of the plant. Some farmers were also using washing powder to kill the stalk borer worm. For example, female respondent 15 (aged 46-59 years), who was one of the farmers using this method, revealed how she would use the washing powder brand Omo to control the stalk borer worms. They would mix the Omo washing powder with water and salt and then pour it where the maize tassel grows on the maize plant. The smell of the washing powder would kill the stalk borer. Other farmers also used ash and pepper. Some farmers, such as interview respondent 21 (male) and respondent 22 (female) (both aged 46-59 years), explained that they would crush pepper, mix it with water, and then pour it on the maize plant where the tassel grows. The smell of pepper would suffocate the worm.

Apart from using materials that were readily available to them, some farmers were using pesticides. For example, male interview respondent 9 (aged 46-59 years) reported that they were using pesticides such as Grayson GA lambda (Figure 5.40a) and Ecolex and Dithane M-45 to control the worms. Despite using pesticides recommended by the Agritex officers, male interview respondent 19 (male aged 46-59 years) pointed out that most of these pesticides could not eradicate the stalk borer worms hence they looked for alternative methods. One female interview respondent (respondent 27, aged 26-35 years) said that they had opted to use chemicals for mosquitos such as Zenivex Larvicides to eradicate the stalk borer. She explained that they were getting Zenix Larvicides from Ministry of Health officials who were coming to spray in Zindi rural area to stop mosquitos from breeding, since Honde Valley is a malaria-affected area. She added that it was difficult for most farmers to purchase pesticides hence most of them were using anything available to them that could help reduce the stalk borer worm.

Besides this worm, wetland farmers also had problems with moles that were eating yams, maize, and bananas. Some farmers were also using natural materials to control moles, such as millipedes. For example, interview respondent 6 explained that the millipede was crushed, mixed with water and then poured on the molehill. The mole would then be forced to move since it does not like the smell of the crushed millipede. Other farmers used water, cow dung and donkey waste to control the moles. As was reported by male respondent 43 (aged 46-59 years), they would mix the cow dung or donkey waste with water and dig a hole in the molehill and pour the mixture into the hole. The smell would force the mole to change its habitat. However, some farmers were using pesticides to control moles if they were able to afford to purchase them. For example, interview respondent 28 (female, over 60 years) said that she was using a particular pesticide that looked like a pill. Farmers would place it on the molehill, and the mole would then be forced to leave the molehill because of the smell. However, as was reported by respondent 43, it was difficult for them to kill the mole because it was considered as a sacred animal that could not be seen. He also pointed out that it was a bad omen to see a mole, hence they could not hunt for it. Sometimes they would leave the mole to eat the yam, maize and bananas and harvest what is left.

Figure 5.40: Pests on crops. (a) A farmer spraying the maize with lambda (pesticide) to control pests; (b) a maize cob that was eaten by a rat (photos: Photographer 3)

Farmers growing crops in wetlands also had problems with mice and rats that ate their maize (Figure 5.40b). However, as was reported by interview female respondent 3 (over 60 years), farmers would regularly weed their farms to destroy the habitats for rats and mice. Interview respondent 4 (female, aged 46-59 years) also indicated that some farmers were using mice and rat traps to kill these mammals. As observed by the researcher, some parts of the wetlands except Madimbo wetland would be left idle after farmers had harvested their crops. As a result, weeds and grass would grow again in the wetlands, sheltering mice and rats and giving these mammals more room to breed. However, the mice were hunted for food during this time. As a result, the number of mice present in the wetlands would have been reduced by the crop planting season.

Some diseases such as red spider mite disease were noted on some crops. Red-spider mite affected tomatoes in these wetlands. Interview male respondent 7 (aged 46-59 years) said that some farmers were using insecticides such as Dimethoate and rogo to control the aphids that cause red spider mite. However, as was reported by female interview respondent 28 (over 60 years), some farmers were not aware of the pesticides and insecticides to control some diseases, hence they would leave the pests and insects to eat their crops and harvest what would be left. She also added that she did not know what pesticides to use in controlling aphids that cause red spider mite. Respondent 19 reported that it was difficult for some farmers to purchase some pesticides and insecticides most since they were expensive. However, as was reported by male interview respondent 30 (aged 46-59 years) in some cases, farmers would use biological control methods whereby they would leave the predators to consume the pests and insects.

Some farmers in some of the wetlands had problems with monkeys that were eating maize and bananas. As was revealed by female interview respondent 35 (over 60 years) and observed by the researcher, farmers would spend the whole day guarding their crops against monkeys. Guarding fields was done in Tawarara A, Tawarara B, and Rutsate wetland, where monkeys were commonly seen because of the woody bushes around these wetlands. Farmers on these wetlands build small shelters to protect them from the rain and heat as they would be working and guarding their fields against monkeys (Figure 5.41a). These shelters were also used to cover fires from rain for some who favoured cooking food whilst guarding their fields. Respondent 22 (male, aged 46-59 years) reported that some farmers also had farms in the drylands, hence they could not spend the whole day guarding the fields against monkeys. Therefore some opted to use dogs. Since monkeys were scared of dogs, they would run away after hearing the dog barking. Respondent 22 also reported that tying the dog in the fields for the whole day was a form of animal abuse, but it was convenient for them. Some farmers would use a catapult and stones (Figure 5.41b) to chase away monkeys. One female farmer (interview respondent 15, aged 46-59 years) revealed that monkeys were not scared of female farmers, hence they were forced to put on trousers to look like male farmers (Figure 5.41b) when chasing the monkeys.

Figure 4.41: Methods to combat monkeys. (a) Shed built by a farmer to protect her against harsh weather when guarding her farm; (b) a female farmer using a catapult to chase away monkeys (photos: Emmah Mandishona)

Commenting on guarding their fields against monkeys, respondent 10 said:

If we are not here this time of the year (January), we will not harvest. The maize is ripe, and these monkeys finish our maize. It is hard to be here the whole day, but we have to do that. Sometimes we take turns to come and guard the fields with our neighbours, and it is easy that way (Interview respondent 10, aged 46-59 years)

In some fields, the researcher observed scarecrows made from old clothes and sacks (Figure 5.29a, b) to scare away monkeys and birds. One farmer (female interview respondent 16, over 60 years) reported that they had problems with birds that ate maize, vegetables and litchis. The birds would usually eat maize during the germination stage and when it was ripe. Respondent 16 also revealed that the maize that was mostly affected at the germination stage was the one that farmers would have planted later after most farmers have planted the crop. Despite having scarecrows on all wetlands, one female farmer (interview respondent 11, aged 46-59 years) reported that they were no longer effective in chasing monkeys away since most of the monkeys were now used to the scarecrows. Instead of making scarecrows from old clothes and sacks, one female interview respondent (respondent 27, aged 26-35 years) reported that they would use old cassette tape strings to scare away the birds. In this case, they would put the cassette tape string on different maize plants and logs. The glittering of the tape would then scare away the birds. As was reported by interview respondent 13 (female, over 60 years), wetland farmers were also having problems with grasshoppers and locusts that ate vegetables but that farmers would leave them eating the crops and harvest what they have left.

Figure 5.42: Examples of scarecrows on the wetlands. (a) Scarecrow made from old clothes; (b) scarecrow made from an old hat and sacks (photos: Emmah Mandishona)

A lot of weeds grow in the wetlands, and farmers weed their fields with hoes and sometimes by hand (Figures 5.43, 5.44) to stop the weeds from affecting crop growth. Some farmers would use herbicides (Figure 5.43a), while others used slashers to cut away weeds (Figure 5.43b), as was observed by the researcher.

Figure 5.43: Examples of farmers removing weeds. (a) A farmer spraying herbicide to eliminate weeds in the tea farm, without protective clothing; (b) a farmer using a slasher to remove weeds (photos: Emmah Mandishona)

Figure 5.44: A farmer hand weeding a ginger farm (photo: Photographer 2)

Commenting on how they were trying to deal with weeds, one farmer who was using herbicides said:

> *A lot of weeds grow in these wetlands. Sometimes we weed our farms more than three times before the crops are ready for harvesting. Since I do not have enough time to weed my field more than three times, I use herbicides. I know that it is not good to use these herbicides since they kill small organisms, but I have no choice. I have a lot of fields, and I cannot manage to finish weeding using a hoe. As one of the tea out-grower farmers, we are not allowed to spray this tea by the Eastern Highland Tea Estate Company, where we sell our tea. They do not want us to spray these herbicides because they say that we are not using the proper measurements of the chemicals, and they are worried about our safety. Unfortunately, we cannot afford to buy protective clothing that should be worn whilst spraying. If they find me spraying, they will not buy my tea* (Interview male respondent 22, aged 46-59 years)

This reveals that although farmers were using herbicides in their fields, they were aware of their effects.

Farmers encountered problems whilst working in the wetlands because of itchy weeds and itchy yam leaves. On farmer (interview respondent 41, male over 60 years) reported that they had problems with different types of noxious weeds. He pointed out that these noxious weeds were quite dangerous since they could cut them and cause itchy rash whilst working in the wetlands. As was observed by the researcher, most women would wear long-sleeved tops and trousers whilst working in the wetlands to protect their legs and hands from the itchy weeds. One female farmer (interview respondent 24, aged 46-59 years) said that they wore such clothes to protect themselves from the weeds, when cutting grass (*Carex acutiformis*), from itchy wetland climbers *(Mucuna prurita),* from itchy yam leaves, and the noxious itchy-rash plants locally known as *hurukuru* in Shona. However, one interview respondent (female respondent 33, aged 36-45 years) said that although burning vegetation was not allowed by the EMA, they were burning some of the weeds during land preparation if they saw the itchy weeds. With a variety of agricultural activities to be done in the wetlands during the rainy season, most of the farmers would come to the wetlands around 9 am. One male farmer (interview respondent 2, aged 46-59 years) reported that most farmers avoided going into the wetlands during the early morning because of dew. Besides having problems with noxious weeds and dew, farmers also had challenges carrying water and harvested crops from the wetlands to their homes. For example, interview respondent 49 (female, over 60 years) complained that it was difficult for them to carry their harvests from the valley bottom wetlands to their homes because of the steep terrain.

Changes in water availability in the wetlands due to human activities and changes in rainfall patterns also affected wetland agricultural activities. Commenting on this problem, one respondent said:

> *Some parts of the wetlands dry up when the temperatures are too high, and this affects the maize, which we grow early before the onset of the rains. Most parts of the wetlands are drying up because we are draining water with these trenches* (Interview respondent 4 female, aged 46-59 years)

Although some farmers, such as interview respondent 4, complained about the drying up of some parts of the wetlands, some farmers such as interview respondent 38 (male over 60 years), complained about too much water in Tawarara A, Tawarara B and Rutsate especially in years in which there is a lot of rainfall. She added that this would sometimes result in their farms being flooded during the rainy season, and in most cases those farmers practicing stream bank cultivation would be affected most. For example, interview respondent 36 (male, aged 46-59 years) reported that his crops were usually swept away by the water whenever the stream was flooded because he was using streambank cultivation. However, he knew that it was not a good practice.

Farmers also had problems reaching the market since they were located far away. The nearest market is Mutare city which is about 200 km from Zindi. Interview respondent 12 (male, aged 46-59 years) complained that it was difficult and expensive for them to transport their harvest to the most viable markets in places such as Mutare and Harare. Transporting their crops to the market entailed paying for their bus fare and the luggage (the crops). Interview respondent 12 added that they were sometimes forced to wait for people who would come to visit and then sell to them. Some people would drive from Mutare and Harare and buy bananas and yams from the farmers. This would cut the transport cost for the farmers. He also indicated that for them to reduce costs, they would sometimes give their crops to those farmers who would be going to sell so that they also sell on their behalf. Wetland farmers were also losing some of their wetland products to thieves. To cope with this problem, one male interview respondent (respondent 22) reported that they would make the thief pay if they manage to catch them. In such cases, they would take the thief to the village head to pay a fine. However, it was difficult for them to deal with such cases when they did not catch the thief. Another interview respondent (female respondent 37, aged 46-59 years) said that some wetland farmers had decided to abandon growing some crops such as sugarcane which attracted thieves. One farmer who was practising fish farming in the wetlands (respondent 22) indicated that he was using thorns to trap the thieves whenever they come to steal fish at night. As was observed by the researcher, the farmer placed thorns in his fishponds so that the thieves would be distracted and be caught on the thorns instead (Figure 5.45).

Figure 5.45: Thorn branches placed in the fishpond to deter thieves when fishing (photo: Emmah Mandishona)

5.4.6 Changes observed in different wetland elements

The wetland farmers reported different changes in wetland water, soil, plants, and animals from the time they started using the wetlands. These various changes were observed in all the six valley bottom vleis.

5.4.6.1 Changes in wetland water

Human and climate-related factors affected water availability in these valley bottom wetlands. In explaining how wetland water had deteriorated in the past years, one respondent said:

> *There used to be a lot of water in these wetlands. Although we are still digging the trenches to drain the water, the amount of water is no longer as it used to be in the past. We used to have natural water pools in these wetlands. It was difficult back then even to walk in these wetlands because of too much water. However, the trenches we are digging help us drain water from these wetlands, and there is little water now* (Interview respondent 2)

Respondent 6 also reported that sometimes the water in the wetlands would change because of change in seasons and rainfall amount:

> *It all varies with different years. Sometimes the water can be too much, and the maize will just dry up because of too much water before it is ready to be harvested. When we started using these wetlands long back, we used to receive a lot of water, but these days we no longer get a lot of water, and as a result, the water in the wetland is also being affected. Sometimes there is little water in the wetlands. If the water is little, and if the rainwater is not a lot, we can grow and harvest. If the rainwater is too much, then the yam can rot before it is ready, and one can even smell the rotten yam from afar* (Interview respondent 6)

As was reported by respondents, some parts of the wetlands were also drying up. For example, interview respondent 11 (female, over 60 years) reported that there was little water in some parts of Tawarara A and Tawarara B wetlands, compared to the time she started using the wetlands in the 1960s. Interview respondent 47 (male, aged 46-59 years) also said that some parts of Madimbo wetland were drying up, compelling farmers to turn to irrigation (Figure 2.46). These farmers were drawing irrigation water from Chiteme River (Figure 2.46). He also reported that he was using the irrigation system in some of his fields located in drier parts of the wetland. Respondent 47 also pointed out that when he was young, the wetland used to have water throughout the year, and they never used to water their crops but would rely on the wetland moisture and rain for plant growth.

Figure 5.46: Sprinkler irrigation in Madimbo wetland, using water drawn from Chiteme River (photo: Emmah Mandishona)

Some respondents were aware of human activities that had contributed to reducing the amount of water found in the wetlands:

> *This time the water is little in this wetland (Mareya wetland). We discovered that in one part of the wetland, which was too wet, we planted the gum eucalyptus trees, and the wetland has dried up. We are busy now uprooting these eucalyptus trees. We have already removed most of them, and we are left with only two eucalyptus trees. We want to remove all these trees because they have destroyed the wetland* (Interview respondent 12, male, aged 46-49 years)

5.4.6.2 Changes in wetland soil

As reported by some respondents, changes in wetland soil observed in the six valley bottom wetlands were caused by anthropogenic activities. One female respondent (respondent 11) reported that some dug trenches had developed into gullies (Figure 5.37) and this had caused erosion of fertile topsoil in Rutsate, Tawarara A, Tawarara B and Mareya wetlands. Continuous cultivation of wetlands was also causing soil fertility loss which affected the farmers' yields. Commenting on this issue, one respondent said:

> *The soil is gradually losing its fertility. When I got married 50 years ago, we were not using chemicals and organic fertilisers on this wetland (Tawarara B*

wetland), but still, we would harvest a lot (Interview respondent 3, female, over 60 years)

Interview respondent 49 (female, over 60 years) said that they were now harvesting small-sized yams compared to the big ones they used to harvest in the past because the soil was no longer as fertile as it used to be. Another respondent (respondent 1) also pointed out that they used to harvest a lot of pumpkins in the past, but pumpkin yields had been reduced since the soil was no longer as productive as it was when she started using wetlands. Interview respondent 21 (male, aged 46-59 years) also revealed that when he started using wetlands, he used to harvest three 90 kg maize bags, but he was now harvesting only five 20 kg bags of maize on the same piece of land.

Respondents pointed out different anthropogenic factors that had caused the deterioration in soil fertility. These included poor farming methods and the intensive use of wetland for farming due to population increase. Commenting on soil fertility loss, respondent 3 said:

> *Since we continuously grow the same crops on the same piece of land every year (monoculture), the soil nutrients are deteriorating, and the soil is no longer fertile. The soil fertility needs to be boosted now, so we are applying artificial fertilisers and organic manure. There were few people using wetlands back then when I got married. We, therefore, used to leave some of our fields idle in these wetlands for a year or two and start growing crops on a new field (shifting cultivation). We cannot do that nowadays because there is not enough space since many people are using the wetlands* for agriculture (Interview respondent 3)

Although wetland farmers acknowledged that the wetland soil was losing its fertility, they still preferred to continue growing crops on wetlands rather than on dryland areas. For example, interview respondent 36 (male, aged 46-59 years) appreciated that wetland soil remained more fertile than the dryland soil, compelling most farmers to continue growing crops on wetlands. He pointed out that *Carex* grass that was still growing in the wetlands was important for preserving soil fertility since it helped bind the soil together. Although this grass was important, farmers continue to uproot it during land preparation and when weeding, since it is itchy.

5.4.6.3 Changes in wetland plant species

Respondents reported that they were observing changes in the types of plants growing on wetlands. This includes new plant species and that some of the plants they used to see were no longer found. Some plants were also becoming less common. One respondent said:

> *I no longer see some plants that I used to see when I was a child accompanying my parents to work in the fields about fifty years ago. Long back, there used to be a lot of this cutting plant (noxious weed) called carex. Nowadays, the plant is no longer in abundance as it was long back. There are few trees left in this wetland, such as water berry trees, and some people avoid cutting such trees because our elders used to tell us that they help preserve wetland water. A new weed is now growing in this wetland, which we decided to locally call nyachitonho in Shona. There is also another new type of grass which we call jengeya in Shona, and it likes to grow near the yam crops in these wetlands* (Interview respondent 15, female aged 46-59 years)

Interview respondent 34 (male, aged 36-45 years) reported that they were no longer seeing different indigenous fruit trees and medicinal plants that used to grow in the wetlands. Some of the indigenous trees that were no longer found in these wetlands included *musekesa* (*Piliostigma thonningii*) *and muonde* (fig). Medicinal plants locally known as *muremberembe* (wild garlic) were also no longer growing in these wetlands. Interview female respondent 39 (over 60 years) also reported that they were no longer seeing some of the common wetland reeds, shrubs and rushes in most parts of the wetlands, and new plant species were growing mostly in waterlogged areas. However, some respondents were worried about the new plants since they were disturbing the growth of their crops. For example, interview respondent 35 (female over 60 years) said that the new plant locally known as *jengeya* favoured growing near cocoyam, hence it would disturb the growth of the cocoyam. Another interview male respondent (respondent 45, aged 46-59 years) complained about a new weed locally called *ruwani*. He pointed out that wherever this weed grows near the maize plant, the maize plant would dry up. However, in commenting about some of the new wetland plants they failed to name, one respondent said:

> *There is another new weed that is reducing soil fertility as it uses most of the soil nutrients. Where this new weed grows, the soil loses its fertility and one will be forced to use a lot of artificial fertilisers to make sure crops are healthy. This*

weed is like herbicides because where it grows, some valuable wetland plants such as carex that help in preserving the soil fertility will not grow. We do not know the name of this weed and where it came from (Interview respondent 36, male, aged 46-59 years)

Although a lot of plants were growing in the wetlands during the rainy season, some respondents reported extinction of some plants was due to agricultural activities. In explaining this, one respondent said:

We no longer see some of the plants that used to grow in these wetlands because when we dig, we uproot these plants and bury them in the soil. Sometimes we burn these plants, and some of these plants will not grow again (Interview respondent 4)

5.4.6.4 Changes in wetland animal species

Respondents revealed some changes in the number of animals, insects and mammals found in the wetlands. Most of these animals have reduced in number. In some wetlands, respondents reported that they were seeing new animal species. Respondent 9 indicated that grasshoppers and frogs have declined. One respondent said:

We no longer see some frogs we used to see, such as glassy frogs and leptopelis frogs (the small green frogs). We no longer see the different types of grasshopper we used to see, such as acridoidea (Interview respondent 24)

Another respondent said:

There used to be wild warthogs, hare, and cane rats in these wetlands, but we no longer see them. We now see a few crabs, worms, catfish, and tadpoles (Interview respondent 36, male, aged 46-59 years)

However, some of the animals had disappeared in the Zindi area as they were hunted for meat. Respondent 36 reported that these include hare, warthogs, cane rats and barks. Besides killing these animals for meat, interview respondent 1 reported that some animals have migrated to other areas because their habitats were destroyed when people occupied the wetlands for agriculture.

Although there were different animals that had reduced in numbers, some animal species had increased and some new animals were seen in some wetlands. For example, interview respondent 4 reported that although some snakes, such as pythons, were no longer seen in the wetlands but that green mamba snakes had increased in numbers. Respondent 36 pointed out that they were now seeing a lot of monkeys around Tawarara A, Tawarara B and Rutsate wetlands that they never used to see in the past.

5.5 Farmer and stakeholder interactions on wetland use

Apart from interacting with the wetlands as they exploited different ecosystem services, wetland farmers also interacted with different stakeholders on wetland use. Wetland users interacted with the other wetland users such as farmers, village heads, Agritex officers, EMA officials and the seed companies. Wetland users interacted with these different stakeholders in various ways (Figure 5.47).

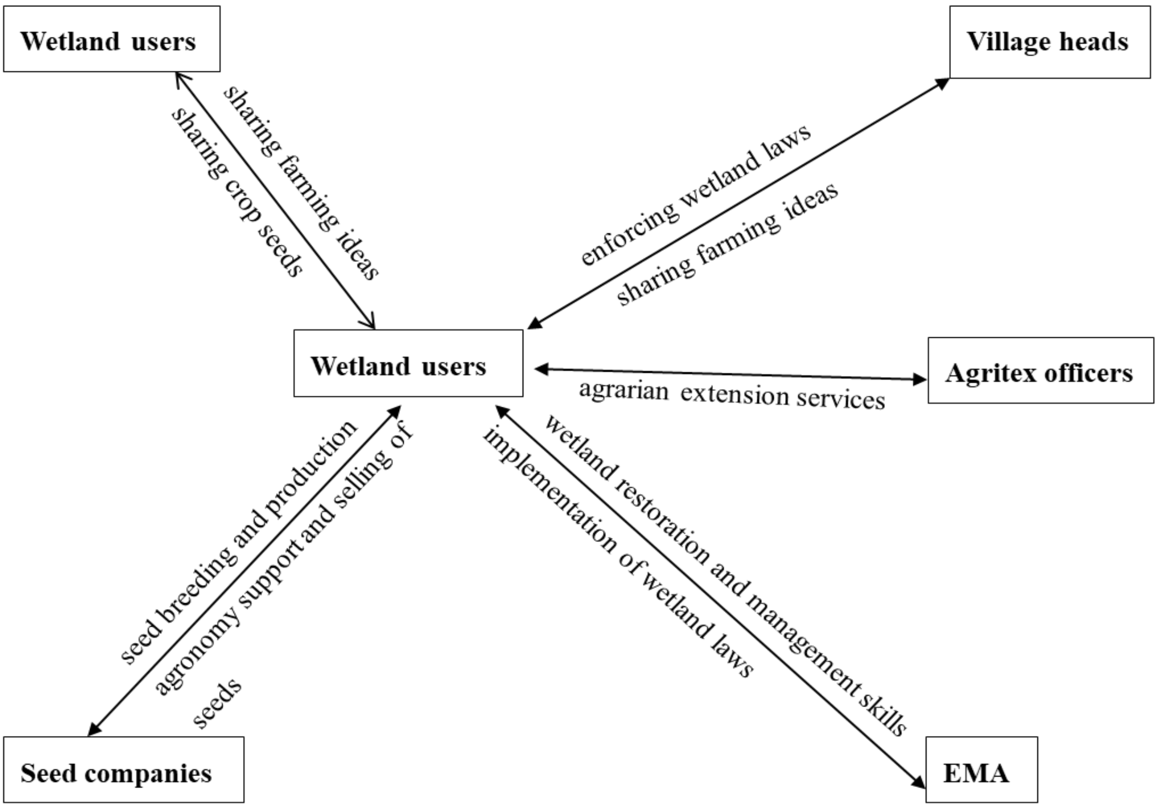

Figure 5.47: Illustration of the varied interactions between wetland users and other stakeholders

5.5.1 Interactions between the wetland farmers on wetland use

Respondents revealed that wetland farmers interacted with each other in different ways when exploiting wetland ecosystem services and in developing their agricultural practices. Of the 49 interview respondents, 71.4% reported that they interacted with each other when sharing information on farming methods and agricultural inputs such as seeds, and how and when they should plant and manage their crops in wetlands. For example, the following respondents described how they were getting farming ideas from one other:

> *We get information from our neighbours, especially about the right time we should start to grow our crops in wetlands. We, therefore, always advise each other to start growing maize in August and September to make sure that the maize will not be affected by too much water (waterlogging) in the wetlands when the rains come* (Interview respondent 2, female, aged 46-59 years)

> *We also walk around and see other peoples' fields and copy them after seeing that their crops look healthy. I might not ask for ideas or information, but I can just learn as I observe and see where I am lacking and will come and implement what I would have seen at my neighbour's farm* (Interview respondent 7, male, aged 46-59 years)

> *We share ideas with our neighbours on different ways of farming. We share ideas on how we should grow our crops. I used to dig holes for yam, but this year I made ridges to sow the yam. I learnt about the ridge system from my neighbours* (Interview respondent 18, female, over 60 years)

> *We get information from our neighbours, and we also copy the way they grow the crops. We also ask how they grow their crops, and they can give us information on how they are growing the crops on wetlands. They can also advise on the requirements of each crop* (Interview respondent 10, female, aged 46-59 years)

Farmers would also ask for help from their neighbours after realising that their yield has been reduced. For example, interview respondent 36 (male, aged 46-59 years) said that after discovering that his neighbour's yields are more than his, he could sit down with the neighbour to discuss the factors that could have affected his yields. He pointed out that he would then copy what the neighbour was doing to boost his harvest. Besides sharing information about farming skills, farmers interacted with each other when sharing farming inputs such as seeds. In explaining how they were doing this, some of the farmers had the following comments:

Sometimes we ask for seeds from our neighbours. For example, I can borrow banana shoots from my neighbour if I do not have enough to plant (Interview respondent 39, male over 60 years)

We also share the seeds when we want to change the type of maize seed that we will be growing in the wetlands. If we want to try a new maize seed, we can share that maize seed among ourselves (Interview respondent 16, female over 60 years)

We share seeds for some crops such as cocoyam since they cannot be found in these shops that sell seeds (Interview respondent 29, female aged 36-45 years)

Farmers were helping each other when choosing the type of maize seed to plant in the wetlands. Respondent 26 (female aged 26-35 years) reported that farmers would, for example, encourage each other to grow a Seed-co maize variety called 513 because it matures early. Farmers would sometimes meet in groups to discuss issues about their wetland farming. For example, interview respondent 12 said that they were having meetings in their village more often to discuss what crops they wanted to grow and the best growing methods. In sharing these ideas, some farmers were also practising cooperative farming (collective farming) in wetlands such as Madimbo. One female interview respondent (respondent 20), a member of this cooperative group, said that cooperative farming in Madimbo included both female and male farmers. This cooperative was an initiative of one of the Agritex officers. Besides growing crops in one joint farm, this cooperative also had individual farms where each farmer would grow crops of their choice. She revealed that they would meet every Tuesday to deliberate on the problems they were encountering and discuss the different ways they could manage their crops. In this cooperative, farmers were growing crops such as ginger, yam, turmeric, okra, tomatoes and maize. Respondent 20 also pointed out that they had divided some collective farms into individual fields after realising that some farmers were not taking the project seriously. Commenting on this, she said:

As you can see, these small farms are individually owned. It used to be one farm, but we decided to divide this big farm into individual farms. Some farmers were very lazy. They did not want to come and work with others. That is why we decided to divide the farms. We grow the same crops simultaneously in these cooperative farms, but the crops do not look the same as you can see. Some people do not want to manage their crops properly. Some people do not want

> *to weed on time, and the weeds will affect the growth of the crops, and they will not do well. Although we meet every Tuesday to deliberate on the problems we encounter when growing our crops, no one is forced to weed when they do not feel like weeding. We just encourage each other to manage our crops well, but no one is forced to work. Some people who work hard end up harvesting a lot and get a lot of money after selling their crops* (Interview respondent 20)

The researcher also observed that the farms for the cooperative members in Madimbo wetland had similar crops, but some looked healthy and well managed, whilst in some farms the plants were unhealthy due to poor management. However, these cooperative farmers would interact and work together in preparing seedbeds and planting seedlings in the wetlands (Figure 5.48).

Figure 5.48: Cooperative farming activities on Madimbo wetland. (a) Farmers hand weeding tomato seedlings; (b) farmers preparing vegetable beds; (c) farmers applying compound D chemical fertiliser onto the vegetable beds before planting the seedlings; (d) farmers sowing onion seeds on the vegetable beds; (e) farmers transplanting tomato seedlings; (f) a farmer watering the vegetable bed after planting the onions and applying fertilisers (photos: Photographer 4)

Besides growing crops on the wetland as a group, these same farmers in Madimbo wetland had basket weaving as another joint project. They were making a variety of items such as baskets, lamp holders, handbags, and toiletry holders from the bamboos they collected from the wetland (Figure 5.32). Commenting on how they got the skills to do basket weaving and fish farming, one farmer said:

> *We went to India to learn about fish farming and basket weaving. We were sponsored by the United Nations Development Programme Global fund to go to India, where we were trained to weave these items. We went to India in 2012, and we were 18 (9 from Masvingo Province and nine from Manicaland province). We went again in 2013, and we were 20 people from Honde valley area* (Interview respondent 20)

Besides being taught how to weave different bamboo items, these farmers were also taught to grow bamboo trees. They were also growing the bamboo trees as a group in wetlands. Commenting on growing bamboo trees, respondent 46 said:

> *We were taught to grow bamboos whilst in India. We also plant bamboos in these wetlands instead of relying on those that grow naturally. It is a project, and we are a group of people who grow these bamboos on this wetland (Madimbo wetland)* (Interview respondent 46)

Respondent 20 revealed that they would sell most of the items they were making from bamboos such as baskets and lamb holders (Figure 5.32) to urban areas:

> *I send these lamb holders and baskets to Harare every month for sale. I sell a lamb holder for $10 (US dollars). Sometimes I sell about twenty to 25 of these lamb holders at once* (Interview respondent 20).

5.5.2 Interactions between wetland farmers and village heads in wetland use

Besides interacting with other farmers on wetland use, wetland farmers also interact with the traditional leaders represented by the village heads with whom regular meetings took place. Of all respondents, 76% indicated that they have meetings with the village heads more often than in the past, but most of these meetings have nothing to do with wetland farming. For example, respondents 23 (female, aged 36-45 years), 24 and 25 (both females aged 46-59 years) indicated that it was rare for village heads to talk about wetlands and most of the meetings were to deal with political and social issues in their villages. Sometimes the village heads would advise people on natural resources management at the end of the meetings. Interview female respondent 1 (over 60 years) said that these meetings were called whenever the village head had something to announce to people. These meetings were held once every week or once every fortnight. There was little information they were getting from the village heads about sustainable wetland use and management. Respondent 2 said that sometimes they would have meetings with village heads at the chief's place, to tell them information that would have come from EMA officers, village heads rarely called for such meetings. However, as was reported by interview male respondent 17 (aged 46-59 years), village heads were encouraging their villagers to grow crops on wetlands for food security and to rest one day a week as chosen by the village head, locally known as *chisi* day. As was reported by interview respondent 15 (aged 46-59 years) village heads were there to maintain peace and would help in settling disputes on wetland field boundaries.

Some interview respondents indicated that the village heads did not have much knowledge about wetland farming. For example:

> *These village heads do not know much about wetland farming. They also want to be taught. Therefore, there is nothing much they can tell us about wetland management and sustainable farming* (Interview respondent 44, female aged 46-59 years)

Although the interview respondents indicated that village heads did not know much about wetland use and management, village heads put in place local regulations to preserve the wetlands.

5.5.2.1 Regulations set by village heads to control the use of wetlands

Village heads interacted with wetland farmers when implementing some of the local environmental regulations. Most of these regulations were concerned about the use of natural resources in general and not specifically about wetlands or agriculture. Although all Zindi residents were using wetland resources without seeking permission, there were some activities for which one needed to be granted permission. For example, as stated by Village head 1 and supported by some respondents such as interview respondent 11, villagers were supposed to seek permission to draw water from the wetlands using pipes because there were traditional rituals that were to be performed first. The village head was then meant to assess the source of water before the procedure took place. Village head 3 said:

> *If one of the villagers want to mount water pipes to draw water from the wetlands, they should come and tell us first so that we investigate and see whether the place is good enough to draw water from, and then we consult our ancestors. We do this by clapping whilst at the water source, asking for permission from the ancestors to draw water using the pipes. We have to inform the ancestors that we are taking water from a particular source to be guaranteed that the water will not dry up. After performing our rituals, we will then allow the person to go ahead and set up the pipes* (Village head 3)

This shows that it was important for the village heads to perform their traditional rituals before someone draws water from the wetland springs, since they considered these springs sacred. However, as mentioned by village head 1, some villagers would mount and install their pipes without telling the village head. He also pointed out that if these people were caught, they would be summoned to the traditional courts to pay a fine.

The village heads also revealed that they were teaching wetland users to preserve wetland vegetation and soil. Village head 1 said:

> *We advise the wetland users to stop clearing all the vegetation along waterways in wetlands to avoid too much erosion in their farms. They should also make sure that they do not remove all the vegetation from the wetlands and leave it bare since this will lead to the drying up of the wetland, hence, we encourage them to avoid cutting down trees in the wetlands* (Village head 1)

This regulation was also confirmed by village head 2 and some respondents. Village head 2 reported that they did not allow wetland users to cut large trees in the wetlands, such as water berry trees. Interview female respondent 32 (over 60 years) also reported that **v**illage heads discouraged people from cutting down trees in the wetlands, and if one were caught cutting down big trees without permission then he or she would be arrested. Village head 1 reported that before a farmer cuts down a tree in the wetland or elsewhere, they were supposed to call the village head. The village head would then assess to see whether it was beneficial to cut down the tree. Besides discouraging people from removing trees, the village heads also discouraged veld fires everywhere. Village head 3 said that villagers were supposed to consult the village heads before starting veld fires. In this case, the village head would assess and see whether it was necessary. Village heads also encouraged farmers to preserve wetlands by digging trenches. Village head 2 said:

I encourage the farmers to dig trenches in the wetlands so that the water flows along these trenches. These trenches allow water to flow without eroding the soil. So, I encourage them to preserve the soil. They dig deep trenches so that their fields are not flooded and eroded by water. We also do not allow them to dig too many trenches and dig the way they want in the wetlands as this might cause erosion (Village head 2)

Although interview respondents revealed that much was not being done by the village heads on wetland management and sustainable use, village heads said that they were enforcing the local regulations. In trying to enforce these, the village heads would punish offenders. However, village head 3 said that no punishment was given to those who committed a first offence. Village head 1 said that all the village heads had their village police who would move around and check whether the wetland users are observing the local wetlands laws and regulations. If one was caught not observing the laws, the policemen would arrest him or her and bring them to the chief's court. Village head 1 also said that besides the policemen, they had a committee in their village that investigated all the village issues, including those to do with people who fail to abide by the regulations. Village head 3 also said that he has a village committee. Village head 3 reported that they met with other villages (Pimai A, Pimai B (Gunhe) and Hamudikuwanda A) and formed a committee that investigates how people were using wetland water. He added that the committee that was formed in 2017 was made up of seven committee members (males and females) from all the three villages concerned. Commenting on how the committee monitors the use of water, village head 3 said:

Since we have some sacred water sources within these wetlands, people should not just use water the way they want, so this committee monitors how people use water in these wetlands. The committee members move around the wetlands observing and assessing how people would be using the wetland water and check whether the water would be flowing well. If they find some problems or catch some people abusing the water, they first come to report to us (village heads), and if we fail to handle the case, we can then send the committee to report the case to the Chief (Village head 3)

Village head 3 also said that sometimes they were helped by the chief to enforce local environmental regulations. He pointed out that the Chief would send his policemen to work with the village head's policemen to see whether people followed the regulations. If anyone was caught breaching the regulations, they would arrest that person. Commenting on how they deal with offenders, one village head said:

> *We enforce the laws and regulations through punishment. We punish those people who do not follow the regulations. If someone does not follow the regulations, we call that person and force him to pay the penalty. Some people are very stubborn such that they keep on breaking these laws, and we are forced to keep on punishing them. We do have some people who can pay the penalty several times, and I usually send such people to the chief. There are some cases I fail to handle, and even dealing with some people can be very hard. So I send some difficult cases to the Chief* (Village head 3)

Village head 1 also reported that if offenders refused to comply with the village head's punishment, they would be sent to the Chief's court. However, not all village heads were enforcing the laws or had set up committees that controlled the use of wetlands. Village head 2 indicated that he was not doing much to enforce the laws:

> *Even if we do not tell them or force them, they are forced by the water levels and the situation in wetlands to dig trenches, allowing water to flow. If they refuse to dig trenches, their farms will be flooded, and they will not harvest anything. I do not have committees specifically set for wetlands. Farmers know what they are supposed to be doing on their farms. They know how to preserve land in the wetlands. We need people like you to help us set these committees. We need someone to educate people on the state of these wetlands and what they are expected to do so that we can set a committee to monitor the use of these wetlands* (village head 2, over 60 years)

From this, village head 2 believed that wetland deterioration such as water use was the only yardstick to teach people to use wetlands wisely. He also believed that the wetland farmers knew how to manage the wetlands effectively on their own.

5.5.2.2 Challenges faced by the village heads in trying to enforce laws

The village heads revealed that they were facing challenges in trying to enforce their laws. Some of the challenges included offenders who refused to pay a fine and the issue of kinship. Commenting on how they would handle such cases, one village head said:

Sometimes a convicted person can be fined a cock or a goat depending on the severity of the case, and this cock usually is given to the village head. If the convicted person does not have the fine, we send him to do community services such as working at a school or mending a bridge and roads. Some offenders refuse to pay the penalty given to them by the village head and the chief after breaching the law. In such cases, we involve the police (Zimbabwe Republic Police), and the police will then handle the case (Village head 1)

Village head 3 also confirmed how difficult it was to deal with convicted people because of the sense of kinship with the villagers. Since they feared ruining their relationship with offenders, so they avoided reporting them to the EMA. Commenting on this issue, he said:

Although the EMA wants us to take the people we catch cutting down trees to them, we do not do that most of the time. Sometimes I tell the convicted person to give me a cock or goat as a fine or brew beer if they do not have the fine. We avoid taking people to the EMA because the EMA fines are too heavy, especially for those caught cutting down trees. These people struggle to get such money to pay the EMA. So, I do not send these offenders to the EMA in most cases because I feel pity for them. I also do not want to ruin the relationships I have with the villagers. I want us to live together in peace in this village (Village head 3)

The village heads also feared that the EMA's heavy penalty would create hatred between the village heads and the villagers if they were to report offenders to the EMA.

Lack of support from the government in implementing laws also made village heads reluctant to take action it brought them into conflict with wetland users through trying to enforce the laws. Asking for support from the government and how they had become unpopular with the villagers, village head 3 said:

We also want the government to help us. The government should enforce the laws and regulations themselves, especially those laws and regulations which discourage people from cutting down trees. We have become very unpopular in our villages because of trying to enforce these regulations. It appears as if we are enforcing our laws, and the villagers are mockingly saying the 'village head's laws'. We need support and help from the government to enforce these regulations. The government should take the lead in enforcing wetland laws so that we are also motivated to enforce these local regulations (Village head 3)

5.5.3. Interactions between wetland users and Agritex officers on wetland use

Apart from interacting with other farmers and village heads in wetland use, wetland users also interacted with the Agritex officers in different ways. Although interview and focus group respondents revealed that they were regularly having meetings with the Agritex officers, most of these meetings were not about wetlands. One interview respondent (respondent 3) reported that meetings that were called by the Agritex officers had low attendance. She said that most villagers would choose not to attend meetings called by Agritex officers only, hence, the Agritex officers relied mostly on meetings called by the village heads. Agritex officers were rallying behind the village heads' meetings and announce whatever they wanted to the farmers in these meetings. It was only in ward three, where Madimbo wetland is located, that Agritex officers held separate meetings with the farmers. Interview respondent 46 explained that the Agritex officers in ward three were very proactive and supported farming projects on wetlands, since Madimbo wetland farmers did not have alternative farms to use on drylands because of the hilly and rocky areas around this wetland. Respondent 19 also added that they have these meetings on Madimbo wetland farming every week. Besides these meetings, another interview female respondent (respondent 23, aged 36-45 years) said that they have a WhatsApp group with Madimbo wetland farmers and the Agritex officers. She pointed out that they interacted more often with the Agritex officers, where farmers would ask the Agritex officers many questions on crop management. Thus, farm demonstrations were therefore done on wetland farms by Agritex officers in ward 3.

However, Agritex officer 1 revealed that as government officials, they were mainly concerned with providing agrarian extension services for dryland farming. He pointed out that dryland farming was important since farmers would concentrate on growing crops such as maize which could be sold to the Grain Marketing Board (GMB) for storage. Most meetings held by Agritex officers in most villages except in ward 3 were therefore on dryland farming rather than wetland farming, which was confirmed by 85.7% of the interview respondents Focus group 1 respondents also said that some of the Agritex officer's meetings were on dryland farming demonstrations and distribution of farming inputs from the government such as seeds and fertilisers and explanation of different farming methods related to dryland farming. Agritex officer 1 also reported that they interacted with the farmers more often when doing demonstrations for dryland farms. However, as was reported by some interview respondents such as respondents 12 and 47 (all males aged 46-59 years), the Agritex officers would help when consulted if farmers were having problems with pests and diseases on their wetland farms.

5.5.3.1 Farming skills development by Agritex officers

Although Agritex officers were concerned about dryland farming, they were forced to engage in wetland farming also since most farmers in Zindi area were growing their crops on wetlands. Wetland users, therefore, said that they were receiving information from the Agritex officers that helped them develop their farming skills. When asked whether they were being taught how to use wetlands wisely, respondents had mixed responses, with most (51%) indicating that they received information from the Agritex officers (Table 5.4). Some respondents who indicated that the Agritex officers were not doing this (38%) said that the officers were concerned about dryland farming.

Table 5.4: The role of Agritex officers in teaching about the wise use of wetlands

Teaching about the wise use of wetlands	Number of respondents	Percentage of respondents
Agritex officers	25	51
Agritex officers used to teach	5	10
No one teaching them, people teaching each other	19	38

However, although most respondents indicated that Agritex officers gave them information on the wise use of wetlands, female interview respondents 29 (aged 36-45 years) and 16 (over 60 years) reported that most farmers had adapted to their wetland farms some of the dryland farming conservation methods taught by Agritex officers. However, when asked whether they were training farmers on how they should grow crops on wetlands, Agritex officer 1 indicated that their training was mostly focused on dryland farming, but that they would sometimes talk about wetlands.

Some of the conservation farming methods taught for dryland farming that farmers were using on wetlands included zero tillage, fish farming, organic manure and mulching. Some of the interview respondents, such as respondents 4, 3 and 2, reported that most wetland farmers were practising zero tillage that was locally referred to as *kukwetsa*. Agritex officer 2 also reported that they were encouraging minimum disturbance of wetland soil and that farmers were supposed to avoid too much digging in the wetlands. Agritex officer 2 said that they were encouraging fish farming because once the ponds were established, there would be limited disturbance to wetland soil and water. Thus, the fish pond would remain a conserved source that would also assist in boosting food protein. However, as was reported by Agritex officer 1, the rate of development of fish dams was still low, but it was the focus of an upcoming project. The Agritex officers were also encouraging farmers to use organic manure and mulching. For example, interview respondent 10 (female, aged 46-59 years) reported that the Agritex officers were encouraging farmers to retain weeds and plant residues as organic manure rather than burning them. The Agritex officers concurred that they were encouraging farmers to minimise burning of vegetation within the wetlands and use it as manure or mulch.

The Agritex officers also pointed out some of the agricultural approaches they were encouraging farmers to adopt in the wetlands. For example, Agritex officer 1 reported that they were encouraging farmers to grow crops suitable for wetland conditions. He said that some of the farmers knew about these wetland crops and were even growing bananas in low lying areas. Agritex officer 2 indicated that the farmers were not allowed to use wetlands randomly and were encouraged to dig canals so that the wetland would not dry out. However, there was no evidence of canals dug except for small trenches that farmers dug for drainage. Agritex officers reported that farmers were digging these trenches without proper guidance and that as a result these trenches were developing into gullies. However, Agritex officer 1 said that the valley bottom vleis in Honde Valley had heavy soils that could not be easily eroded.

The two Agritex officers also revealed that they were discouraging farmers from using herbicides in the wetlands since they would disturb wetland biodiversity and contaminate water. The Agritex officers said, as officials of the Ministry of Agriculture, they had a mandate to train farmers and spread awareness in cases of outbreaks of diseases and pests on crops and in initiating development by introducing projects. The Agritex officers also said that they were teaching farmers about soil conservation, disseminating information from researchers to farmers, and asking researchers to find solutions to the farmers' problems. They would also tell researchers about indigenous knowledge about wetland plants and agriculture. Agritex officer 1 pointed out that they show farmers the sensitive areas within the wetlands that were supposed to be protected. When explaining their role, one Agritex officer said:

> *We educate the farmers on how they can grow their crops. We teach them and guide them. We guide them when they have problems with different pests or diseases. We give them guidance on the type of chemicals to use and how to use them to get rid of certain pests and diseases* (Agritex officer 1)

The Agritex officers also discourage continuous cultivation of all the wetland area. Agritex officer 1 said that to avoid continuous cultivation, they were encouraging farmers to practice irrigation farming on drylands and create buffer strips within the wetlands. However, there was no evidence of buffer strips in any of the six wetlands. Although cocoyam was a common wetland crop in Honde Valley, Agritex officer 1 reported that they were encouraging farmers to grow it on dryland through irrigation. Dryland irrigation was encouraged to avoid disturbance of wetland resources. Agritex officer 2 pointed out that they were also helping in surveys for pipes and canals for irrigation. Agritex officer 1 indicated that some farmers were showing interest and taking heed of what they were telling them, but that others were far from understanding and still needed help. Commenting on what he expected from the farmers, Agritex officer 1 said:

> *My wish is for these farmers to adapt fully so that we conserve wetlands. Wetland utilisation should also be done with recommended standards, but you find that these farmers, in some cases they have not adapted fully. If they adapt to the laws too, it will help in preserving the wetlands for the future. Dryland irrigation has helped those who were relying on wetlands, and some have managed to grow wetland crops such as yam on dryland* (Agritex officer 1)

The Agritex officers were also teaching wetland farmers to avoid streambank cultivation. As was reported by focus group 2 respondents, the Agritex officers encouraged wetland farmers to leave an uncultivated strip 30 to 50 m wide from the main rivers before growing crops. Agritex officer 1 said they were encouraging farmers to observe the stipulated measurements from the river to avoid river siltation, and to dig storm drains and trenches with proper measurements to avoid soil erosion. Agritex officer 2 said:

> *We recommend conservation works, such as having storm drains. When they dig storm drains, they should put them on high land so that if the water is coming from the highland to the low land wetland area, it should be diverted and the speed reduced because if it gets in the wetland with that force, it will create gullies in the wetlands. Water should, therefore, be directed.* (Agritex officer, 2)

When explaining the criterion that should be followed when digging storm drains, Agritex officer 2 said:

Farmers should look at what the slope look like before they dig the trenches. If the percentage slope is more than 2%, then there should be some conservation methods such as the creation of storm drains and buffer strips, and if the percentage slope is lower than 2%, then it means that it will not quickly drain the water and it will need the drainage facilities such as the trenches, and they will not end up as gullies because the land will be flat and stable (Agritex officer 2)

However, there was no evidence from farmers that they knew about the storm drains or how to dig appropriate trenches, so they continued to dig trenches without proper measurements. There was no evidence of storm drains in any of the six wetlands.

Although the Agritex officers revealed different agricultural approaches they implemented to ensure the sustainable use of wetlands, some wetland farmers reported that these officers were not doing much about wetland farming. Although adapting dryland conservation farming methods, most farmers felt it important that dryland farming be distinguished from wetland farming methods. Thus, they advocated for the teaching of methods of farming specifically suitable for wetlands. One interview respondent commented:

The education given to people on dry land farming should be on its own, and the one on wetland farming should be on its own. People should be taught about wetlands whilst on the wetlands, not outside their wetland farms (education done on the ground), not only theory. It should be both theory and practice. Thus, the demonstrations should also be done on wetland farms. Farmers should also be taught how to use wetlands in relation to climate change (Interview respondent 12)

Although the Agritex officers were teaching farmers conservation agriculture methods, some farmers were not using them. One given reason is that farmers were mainly concerned about food production rather than conserving wetland resources. For example, farmers saw streambank cultivation as more beneficial because of the availability of fertile soils and moisture. Commenting on streambank cultivation, one interview respondent said:

Long back, some metres were supposed to be left from the river and streams. Agritex officers used to teach us about these metres and check whether people were leaving these metres from the River or stream (30-50 metres). Most people have refused to follow what the Agritex officers were teaching them, and *instead, streambank cultivation has increased. Fertile soils and moisture near the riverbanks have attracted many farmers. We no longer want to follow what the Agritex officers tell us. We just want to survive. Farmers used to leave 30 to 50 metres from the riverbanks long back. Nowadays, we just grow crops near the rivers and streams in these wetlands. I once lost the maize that I had planted close to the stream when the river flooded, but I will not stop planting crops near the streams or rivers* (Interview respondent 40, female aged 46-59 years)

Respondent 40's views concurred with focus group 3 respondents who said:

> *The Agritex officers teach people to leave some metres from the streams and rivers, but no one listens to them. They will die if they try to move people from where they harvest more and from growing crops in these wetlands. No one will follow what these Agritex officers tell us, especially here in Honde Valley. They cannot deal with us. They should keep quiet. They have tried to tell us to observe certain metres from the river when growing our crops, but we do not listen. We told them to stay away since we are surviving on these wetlands because that is the only place we can have good harvests* (Focus group 3)

Another male respondent (respondent 47, aged 46-59 years) explained that if they were to adhere to the 30 to 50 m rule, their fields would be out of the wetland. As revealed by focus group 3 respondents, stream bank cultivation was common in Zindi because some politicians who wanted to be voted into power came and changed the rule and advised farmers to leave only 5 m from the riverbanks.

Since these farmers depend on wetland farming, they felt that some of the methods they were taught were a threat to their yields, hence they chose not to listen to the Agritex officers. For example:

> *People no longer listen to the Agritex officers when they are taught to properly manage wetlands because they argue that they are surviving on wetlands. The Agritex officers are now tired, and it is like they are giving up on telling people the same thing* (Interview respondent 38, over 60 years)

Some farmers also did not listen to the Agritex officers because they were too familiar and did not take their advice seriously. For example:

> *Some of these Agritex officers were born in this area, so they are scared of teaching people and stopping them from doing things they have also been doing for years because they also grew up using wetlands. It is also difficult for them. I think if they are to teach people, they must teach in other areas, not where they grew up* (Respondent 7)

Although the Agritex officers had good intentions of ensuring the sustainable use of wetlands, as was argued by Agritex officer 2, they were unpopular with the farmers. This dates back to the colonial era when Agritex officers were stopping people from using wetlands and would sometimes beat those who were not observing environmental conservation measures. Respondent 38 said that some Agritex officers were even killed during the liberation struggle for discouraging people from using wetlands, and since then wetland issues have become very sensitive. Agritex officer 2 pointed out that they were implementing the natural resources conservation laws during the colonial era and were forcing farmers to dig contour ridges in their dryland farms and to strictly observe the 30 to 50 m rule from the rivers before they start growing crops. Besides having a history of being unpopular with farmers, the Agritex officers were also resented by wetland farmers in Zindi for other reasons. For example, one interview respondent said that wetland farmers saw Agritex officers as a threat to their livelihoods:

> *We do not want to work with the Agritex officers because what they want us to practise when growing crops in these wetlands show that they want to stop us from growing crops on wetlands. Yet, we are surviving on these wetlands* (Interview respondent 29, female aged 36-45 years)

Some farmers said that they did not want to work with the Agritex officers since they view some methods of farming they were teaching them as too difficult for them to follow and that took up a lot of time:

> *These Agritex officers can also teach us long farming methods, which are too challenging to follow, hence, they take our time. Most of these methods are not easy for us since we are used to our old farming methods* (Interview respondent 35, female over 60 years)

Apart from complaining about the methods of farming taught by Agritex officers, wetland farmers also complained about some of the chemicals they were advised to buy which they could not afford. One respondent said:

> *We also do not want to work with these Agritex officers because they can sometimes advise us to buy expensive chemicals which we cannot afford. The Agritex officer can tell me to buy, for example, a chemical such as mop and banana blend to apply on my banana trees to increase my production, but sometimes I will not have money to buy such chemicals. All these are very expensive, that is why you see us growing crops using mulching. We know what to use on our own* (Interview respondent 31, female aged 46-59 years)

Another reason for resentment by wetland farmers is that the Agritex officers wanted them to follow certain farming structures, which the farmers did not want. One interview respondent said:

> *These Agritex officers want us to do farming in groups so that when we apply for a loan, we are guaranteed to get it. It is also easy to make a follow up on a group if the members fail to pay back the loan. They always say it is difficult to trace one person when the group forfeits to pay back the loan. However, this group thing does not work for some of us, and I do not want such arrangements because I do not want to end up paying for someone's loan* (Interview respondent 7)

Although many wetland farmers (51%) indicated that they were being taught wise use of wetlands by the Agritex officers, some respondents view the Agritex officers as too passive and reluctant to assist. For example, one respondent said:

> *We used to have one Agritex officer who used to teach us, but no one has taught us for the past two years. The Agritex officer we have now is not active. Most Agritex officers do not like this area because it is difficult to walk around and visit the farmers. It is difficult for them to move around because of the terrain. Every ward has its Agritex officer, but some are lazy. The Agritex officers are difficult to work with these days. Most of them are not committed to their work. They also want to get incentives from different organisations which come here and from other farmers* (Respondent 6)

However, the Agritex officers reported that in ensuring the sustainable use of wetlands, they were relying on the laws and regulation from the EMA as an institution responsible for natural resources conservation. As reported by Agritex officer 1, as much as they were trying to ensure that these laws were observed, their mandate was to educate people about these laws and not to enforce them themselves. He indicated that some farmers would not listen to them. Therefore, the Agritex officers wanted the EMA to enforce wetland laws. Agritex officer 1 indicated that long ago the EMA officials used to come to the rural areas to ensure that these laws were observed. He said that the EMA officials would measure the distance from the riverbank to the farms to ensure that farmers avoid streambank cultivation, but the EMA had stopped coming.

5.5.4 Interaction between wetland farmers and the EMA in wetland use

The official from the EMA discussed the mandate of the institution to be to regulate, monitor and promote the sustainable management of natural resources and protection of the environment with stakeholder participation. The EMA regulates national rules and laws through enforcement and encouraging compliance of these rules by the general population. The promotion and management of the environment and natural resources encompasses educating people and proper planning, regulation and management of activities carried in preserving the environment. In trying to encourage people to comply with these laws, the EMA imposes penalties on offenders. However, these penalties are not considered to be an effective deterrent and regardless of paying penalties, the users of natural resources continue to abuse the environment. Although the EMA had a clear mandate on the management of natural resources, all 49 interview respondents and the three focus groups stated that they did not have meetings with the EMA officials. Only one interview respondent (respondent 42, male aged 36-45 years) reported that they had a meeting with officials from the EMA but that this took place in 2008.

5.5.4.1 Implementation of laws and regulations by the EMA to ensure the controlled use of wetlands

The EMA official reported that the national laws to protect and manage the wetlands enable them to fulfil their mandate and execute their duties. Amongst these laws is the First Environmental Management Act Chapter 20:27 of 2002 Subsection 113, which states that wetlands should be protected (Protection of wetlands). Some of the laws to protect wetlands include the EMA Statutory Instrument 7 of 2007, Parks Act (laws on buffer zones), and The Zimbabwe Water Act. In addition to these, the EMA has put in place the National Wetland Committee that is a multi-sectorial committee involving members include academics, government and the public sector. This committee also deals with wetland issues. However, the EMA relied on the media and other people, such as village heads and Agritex officers, to disseminate information about these laws. Commenting on how they were getting information from the EMA, one interview respondent said:

> *We usually receive information from the EMA through text messages on our phones. We also get information from the EMA through the village heads and the Agritex officers* (Interview respondent 39, female over 60 years)

However, information that wetland users receive from the EMA usually includes all aspects of natural resources in general. For example, one respondent stated:

> *Recently they have been sending messages encouraging us to avoid veld fires. The village heads have been telling us to avoid cutting down trees both on dryland these wetlands, and they got that information from EMA* (Interview respondent 40, female aged 46-59 years)

Even though wetland farmers knew that the EMA prohibited burning and veld fires, some farmers continued to burn weeds. Explaining why the used burning, focus group 3 respondents said:

> *Why would they want us to preserve some of these plants which are dangerous to our skin? We burn these weeds when we want to plant our crops because they disturb our peace when we are working in the fields. Some of them are itchy. One of the plants is locally known as hurukuru (cow itchy or cowhage plant). It is a common plant in all the wetlands. So we burn these weeds because of that itchy weed* (Focus group 3)

Although they did not have meetings directly with wetland users, the EMA officials held meetings with chiefs and village heads, and the village heads would disseminate information from the EMA to the farmers. Commenting on this, one interview respondent said:

> *Sometimes the EMA people come to have meetings with our chief and the village heads. Our village heads will then come to us and give us information from the EMA. But these EMA officials do not usually come here* (Interview respondent 15, female aged 46-59 years)

Although the EMA officials were meeting with village heads, wetland users suggested that it would be more effective if they also had meetings with the EMA. Commenting on this issue, one interview respondent said:

I have never heard of any meeting called by the EMA officials to teach people on using wetlands sustainably and manage them wisely. If they do not teach us, how are we going to know these wetland laws? I do not know the EMA officials, but I heard that their penalties are heavy. If the EMA officials come into the wetlands and see the deep trenches that we are digging to drain water, they will not be happy. We should be taught how to dig the trenches properly. They should look for strategies to teach us good methods of farming in these wetlands. If they stay in the offices and wait to give us tickets for fines when we do not abide by the laws, it is not good. They should come on the ground and visit the wetlands and teach people. If their organisation was formed to manage the natural resources, they should regularly visit the people who are using natural resources and be on the ground (Interview respondent 36)

This shows that wetland users felt the EMA was more concerned about punishing offenders rather than providing guidelines the wise use of wetlands.

Besides using the media, Agritex officers and the village heads to disseminate information on wetlands, EMA was also relying on the Pungwe sub-catchment council to implement EMA laws. As stated by interview respondents 47 and 48, the Pungwe sub-catchment council in Mutasa district controls the cutting down of trees and discourages people from growing crops on sensitive areas in wetlands. Respondent 47 said that the Pungwe sub-catchment council would sometimes call the EMA officials into their meetings and brief them on the management and use of natural resources in the Mutasa district. Apart from being assisted by the Pungwe sub-catchment council, the EMA also relies on volunteers in the communities to spread natural resource management information from the EMA to community residents. The EMA official said that these volunteers were their environmental monitors who would submit weekly reports to the EMA after an incident. The EMA also relies on environmental officers stationed in each district to assist people on environmental issues. These environmental officers were therefore working with the environmental monitors (volunteers). Commenting on how the EMA volunteers were working with people, one focus group respondent said:

The EMA relies on volunteers in our communities. These volunteers make announcements from the EMA at the gatherings such as funerals. At such gatherings, they tell people information from the EMA, such as discouraging people from cutting down trees (Focus group 1)

Although these volunteers were spreading information from the EMA to villagers, most of them were not bold enough to carry out some of their duties, such as reporting offenders to the EMA. The volunteers feared being victimised by their fellow villagers. Thus, the volunteers did not disclose to other people that they were volunteering for the EMA. Focus group 1 respondents said:

> *When we hear these volunteers making announcements at gatherings, we know that they are from the EMA, but they do not disclose it. They do not say openly that they are from the EMA. There is nothing to motivate these volunteers, hence they end on telling the people information from the EMA without monitoring how people use wetlands. They do not monitor how people are using wetlands here, in Zindi, because they fear for their lives. If they try to be strict and report offenders to the EMA, they will not have peace staying here. If people find out that they are reporting them to EMA, people will burn down their homes* (Focus group 1)

The EMA official and Agritex officers noted that the EMA and the government were implementing different measures to ensure that the laws meant to protect and manage wetlands were observed. The EMA official said that they were using Environmental Impact Assessments (EIAs) before approval of any development. A person had to go through the EIA process managed by the EMA to evaluate whether the project requested to be done on a wetland was permitted under scheduled activities. The EMA official said that they carried out everyday operations such as inspecting whether people were invading wetlands and monitoring how people were using wetlands. However, as noted above, inspection and monitoring of how people were using wetlands in rural areas were not directly done by the EMA but by the volunteers, but these people were not proactive in monitoring and inspecting how wetlands were being used. The EMA official said that in cities such as Harare, city officials would use the Rapid Results Initiative whereby it would send its layout plan to the EMA. In this case, the EMA would assess and advise on areas that were not suitable for certain developments.

The EMA encourage people to seek permission before using wetlands according to the EMA Act, which also states that EMA grants a permit before people use wetlands for any activity. For one to get a permit, the EMA should assess the type of wetland. The EMA official said that there are some sensitive wetlands, some have been destroyed, and some are in an intermediate state. She also reported that some perennial wetlands would be best left unused. When it comes to permits on seasonal wetlands, the EMA encourages wetland users to come up with a management plan proposing how they would use and manage the wetland, and this is part of the requirement to get a permit. Although wetland users were supposed to seek permission before wetland use, the EMA official said that some people would ask for permission after they had already pegged their farms in the wetlands. The EMA official stated that, if people complied with the permit issue, those who were continuously using wetlands would stop because most of the wetlands in Zimbabwe are of the perennial type. However, rural wetland users were generally not seeking permission to use wetlands for farming, and the EMA officials were not assessing these rural wetlands before they were being used. Commenting on seeking permission to use rural wetlands, one village head said:

> *We used to stay and grow crops on dryland (upland) areas. However, when the Eastern Highlands Tea Estate Company (Tea Company in Honde Valley) came, it took all our farms on the upland dryland area to grow tea. We were forced to move to the wetlands, and we started growing crops on wetlands. Village heads were therefore compelled to allocate people new farms on the wetlands. Nowadays, most people already have their farms on the wetlands therefore, they are not supposed to seek permission. The villagers know their farms and the boundaries to their farms. When it is time to grow crops, each farmer will grow crops on their farm without seeking permission. Some people have inherited these farms from their parents, and they know the boundaries of their inherited parents' farms.* (Village head 2)

Focus group 1 respondents who concurred with village head 2 said:

> *We grew up seeing our parents using wetlands. We do not know who gave them that permission. We inherited these fields from our parents, but if you do not have you ask for a piece of land from others, but if the land has not been used before, you ask for permission from the village head* (Focus group 1)

Although people were not seeking permission to use wetlands for farming, wetland farmers are also required to be granted permits by the Zimbabwe National Water Authority (ZINWA) to draw water for irrigation and domestic use from wetlands through the use of water pipes. As stated by interview respondent 47, the Pungwe sub-catchment council assisted ZINWA in granting water permits.

The EMA official revealed that they were also building the capacity of other law enforcement organisations such as the village heads and chiefs. In some rural areas, the chiefs were encouraging people to avoid practices such as streambank cultivation. The EMA official also indicated that most rural chiefs and village heads knew about veld fires and that they could be arrested if they start veld fires even on wetlands. Thus, they encouraged people in their villages to avoid veld fires. Although the EMA entrusted these traditional leaders with the implementation of some natural resources conservation laws, in Zindi some village heads were also in breach of these laws. For example, one interview respondent who commented on the issue of observing 30 to 50 m distance from rivers to avoid streambank cultivation said:

> *The village heads do not have the powers to reprimand us, and even when they tell us to manage wetlands, no one will follow what they say because the village heads are also not observing the wetland laws. For example, they are also practising streambank cultivation* (Interview respondent 48)

Although the EMA therefore relied on different stakeholders to ensure the implementation of wetland laws, some of the laws were not taken seriously by wetland users. However, to ensure that their efforts to protect wetlands are taken seriously, the EMA has been persuading the government to set up an environmental court. Explaining why an environmental court was necessary, the EMA official said:

> *We also have been persuading the government to establish an environmental court so that environmental issues can be taken there. Environmental cases are still being taken to criminal courts, but they are not being taken seriously since they will be compared to murder and other serious criminal cases* (the EMA official)

The EMA official also revealed that they were still in the early stages of probing for the environmental court and developing environmental court ideas.

The EMA official also said that they were engaging with communities in decision making on wetland use and management through Local Environmental Action Planning (LEAP). The LEAP process meant that the EMA would encourage local authorities and communities to identify priority environmental issues affecting their areas, and to come up with solutions. The local authorities spearheaded the process, and various committee members and councillors would consult the people on pertinent issues, identify management strategies and take them to the council. The EMA encouraged all local authorities to engage with the LEAP management planning process so that they can get funding from donors to address the environmental concerns affecting their communities. Although the EMA encourages councils to draft their environmental laws, the EMA official said that most councils did not yet have these laws, and not all local authorities were producing LEAP management plans. Thus, to some councils, environmental management was not a priority but only a component of their action plans. However, none of the Zindi residents reported the involvement of councillors from the Mutasa district in engaging with them on issues about wetland management in their area.

As was indicated by the EMA, wetlands should benefit the community and be protected, and therefore there should be a balance between use and management. The EMA official also reported that the National Wetland Utilisation Guidelines, which they had developed, were meant to address this balance. The EMA was expecting the National Wetland Utilisation Guidelines to be published immediately after the government review. Although the EMA official highlighted that they wanted to improve their wetland management strategies, she was not clear on how this could be done. The EMA was trying to elevate the wetland discourse by involving different stakeholders and working with cities and councils during city planning. Thus, in trying to make sure that wetlands were preserved, the EMA were involving ZINWA and the Ministry of Energy (depending on the nature of the project) when doing ecological assessments after EIAs have been submitted. Thus, projects related to museums were sent to the Ministry of Wildlife, whilst energy projects would be sent to the Ministry of Energy, and water-related projects would be sent to ZINWA.

When asked whether the EMA was advocating for a national wetland policy since Zimbabwe did not have one, the EMA official said:

> *Yes, we are. Since Zimbabwe is a signatory of the Ramsar Convention, we produce the national report after every three years. We have highlighted the development of a wetland policy in our most recent report. We prioritise (as we look for funding from Ramsar) tasks. Development of the national policy is a process, so we are asking for funding from Ramsar. From January 2018 to October 2019, we have been working on it. We also need technical support, or if the Ramsar has experts to help us draft the national wetland policy, we would appreciate it. We have not yet made a lot of noise about it, although the National Wetland Committee has identified the need for a national wetland policy. We have other policies. We were still thinking about whether we need this policy or to maximise the other policies we have already* (EMA official)

This shows that the EMA did not consider a wetland policy as crucial to achieve since they were not striving to develop one.

5.5.4.2 Support given to wetland users by the EMA

The EMA indicated that they are employing a variety of ways to ensure that wetlands are used sustainably. The EMA official said that they have community programmes on sustainable wetland utilisation. Some of these programmes were being facilitated by Agritex officers in rural areas. The EMA official said that Agritex officers would help in activities such as pegging gardens for the farmers and monitoring activities when they visit the areas. However, Agritex officer 1 said that it was in fact the EMA's duty to peg gardens in wetlands for wetland farmers. The EMA indicated that they would protect the core need in some of the wetlands, which was for livestock grazing, and would make demarcations to allow resource sharing to protect the wetland and use it sustainably. The EMA would also disseminate information on sustainable use to rural wetland users through awareness campaigns. As was reported by the EMA, official awareness of sustainable use was also done through various forms of media. Roadshow vehicles were also used to spread information on wetland sustainability in some parts of the country. She also pointed out that information on sustainable wetland use was also spread through the chiefs and the forest commission (to avoid cutting down of trees). Although these different activities were highlighted, there was no evidence of these in Zindi rural area - local farmers did not report any awareness campaigns through roadshow activities by the EMA, and the two Agritex officers also said that they were not facilitating the EMA's sustainable wetland projects.

The EMA was also involved in supplying materials to fence the primary wetland water source and then allowing people to use the surrounding part of the wetland protected area which they would also allow people to management through a committee. This committee would then develop a constitution and keep a file of what would be happening on the wetland. However, if the EMA was not monitoring such programmes, the committee would be reluctant to do these things. The EMA indicated that they were some significant wetlands, such as Driefontein wetland situated in Gutu district of Masvingo province in Zimbabwe, which were well monitored to ensure sustainable use, but other wetlands were neglected. To encourage the wise use of wetlands, the EMA initiated community and demonstration projects on some wetlands which would involve wetland restoration. The EMA official reported that they had been involved in wetland restoration and management with the community on Songore wetland in Murehwa district (Figure 5.49). She also indicated that they would use photos and pictures to teach people about wetland restoration, where people would see these images and learn from them.

Although the EMA did undertake sustainable utilisation projects in some rural wetlands around Zimbabwe, such as Gutu and Driefontein, there was no evidence of such projects in Zindi rural area.

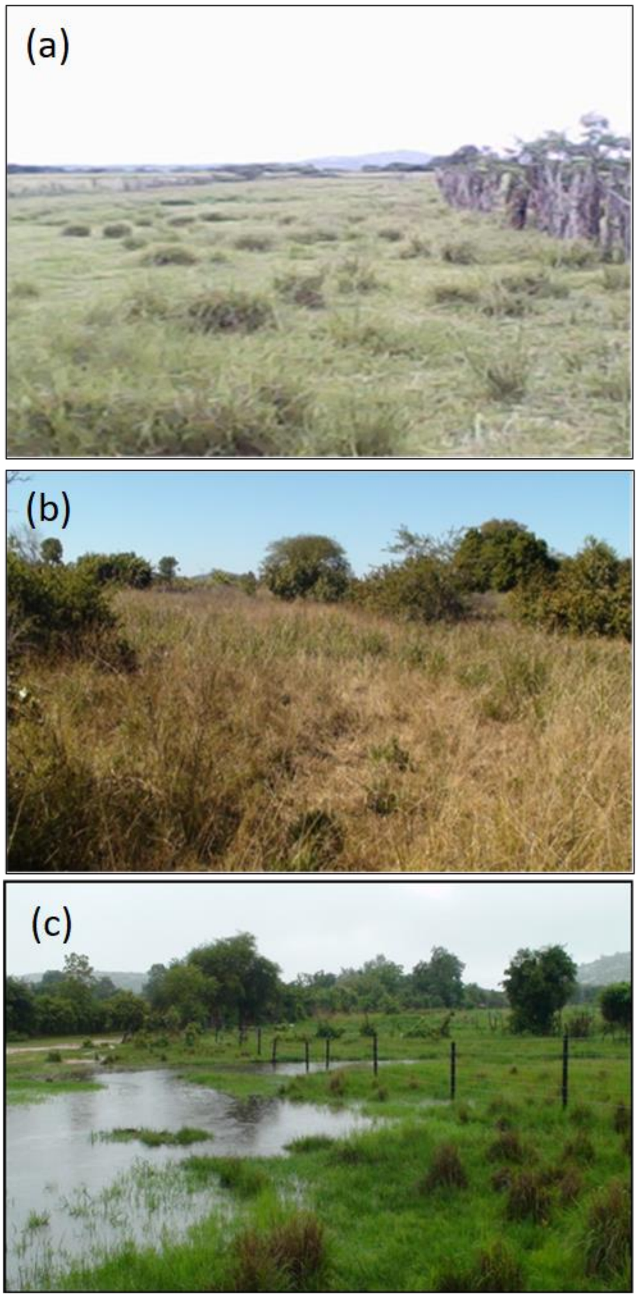

Figure 5.49: Songore wetland during stages of restoration. (a) In November 2010, before restoration and management; (b) in March 2012, soon after restoration and management had started; (c) in November 2013, after restoration and management (photos: EMA)

5.5.4.3 Challenges faced by EMA and Agritex officers in dealing with wetland users

The EMA official and Agritex officers all stated that they faced challenges in trying to make sure that wetland laws were observed. The EMA official indicated that part of her job involved environmental planning, community planning and ecological assessment in response to developers' proposals. These ecological assessments would be part of the wetland inventories, and some would be done under request and some done without request on the initiative of the EMA. The ecological assessment also involved EIA reviews undertaken by the EMA. Thus, the EIAs would be done for developers, individuals, and local authorities before they buy land so that the EMA can overlay them with the EMA wetland sites. However, the EMA official said that these people would come to their office for the EMA to do the ecological assessment, but they would not take the recommendations. Whenever the EMA does its inspection and finds these land developers building houses on wetlands, they would indicate that they visited the EMA offices for approval before they started developing. In dealing with such problems, the EMA indicated that they usually apply laws of 'natural justice'. However, in trying to apply this procedure, they faced some difficulties:

> *The structures for the EMA Act of 2003 came into operation in 2007, and people had acquired land before the Act was put into practice. Before the 2003 EMA Act, people had the right to use any land the way they wanted (either a wetland or not) for any form of development they wanted. For example, people who bought Borrowdale and Monavale (wetlands) for development bought them before the Act was implemented. When we took them to court, accusing them of putting structures on wetlands, we lost the case. We lost on technicalities. We lost the case of Borrowdale wetland because of the terms, and they had a good lawyer. For Monavale wetland, the courts ruled that we (the EMA) were supposed to engage the owner before marking privately owned land. The Monavale wetland owner bought the land in 1990 before enacting the EMA Act in 2003 and its operation in 2007* (EMA official)

This shows that in some cases, where the EMA would take offenders to court, there were some details the EMA overlooked which led to an unexpected ruling. As a result, the EMA ended losing such cases. Even though the EMA was doing ecological assessments and taking offenders to court, there was no evidence of these assessments and inspections by the EMA in Zindi rural area.

Besides having problems with land developers in urban areas, the EMA also had problems executing its duties in rural areas. The EMA was facing challenges with the absence of chiefs in some rural areas who were supposed to assist them in implementing wetland laws. Commenting on this issue, the EMA official said:

> *There are some resettlement areas without chiefs. There are many environmental problems, and it is difficult to communicate about these problems to the people in these rural areas. When there are chiefs in the communities, people who breach the laws are afraid of being taken to the chief's court for a penalty* (EMA official)

The EMA official also reported that sometimes they would not know about the extent of wetland degradation because people in rural areas are sometimes scared of reporting each other to the authorities:

> *Another challenge is that most people are scared to report when they find someone not doing the right thing (involved in environmental degradation). They fear being bewitched, and some preserve the kinship issue, hence they will not report an environmental offender to the chief or the EMA. Even the EMA volunteers fear reporting people. Hence, they protect each other* (EMA official)

The EMA official also expressed how difficult it was for the EMA to remove people from wetland since it was the only alternative for food security and water for rural dwellers:

> *Poverty has forced people to rely on wetlands for water and food. People need water from the wetlands to survive, and it seems there is no alternative in rural areas except for wetlands. Although we give them an alternative by pegging for them, this will not be sustainable for the farmers because of the long distance to the water sources if they are to use the water for irrigation. We also encourage community gardens, but we cannot do them everywhere* (EMA official)

The EMA official indicated that was lack of financial resources meant that they were failing to peg community gardens in all rural areas, and failing to update their inventory of all wetlands in Zimbabwe. They lacked the resources to take aerial photos and create a variety of high-resolution maps required when making an inventory. She pointed out that the EMA was still relying on the wetland inventory from 2011-13, and they were looking forward to updating it.

The Agritex officers also experienced challenges when trying to ensure that wetland users make use of their advice on wetland agriculture. Since it was not the Agritex officers' duty to enforce wetland laws, Agritex officer 1 pointed out that they can only educate the community on the importance of natural resources and how to conserve them but that the farmers were not practising what the Agritex officers were teaching them. Agritex officer 1 said:

> *There is an issue of understanding. Some people do not understand the negative repercussions of their activities on wetlands, and therefore they continue to do what they are used to even if we teach them. Some of these farmers do not follow the standard recommendations, and they seem as if their everyday life is being disturbed and that they want to be removed from the areas they have been using for a long time. For example, most of these farmers do not want to observe the 30 to 50 metres from the primary water sources* (Agritex officer 1)

Agritex officer 2 also reported that some farmers did not want change. The farmers wanted to stick to what they were doing in the past and argued that they have been using the same methods to grow crops for a long time and that the Agritex officers should not make them change these practices. Commenting on how the farmers were reluctant to follow their advice, Agritex officer 2 said:

> *We have a challenge here in Honde Valley. People do not want to adopt the farming methods that we are teaching them. They say they take their time, and at the same time, they do not understand the benefits of these methods. They want their easy and fast farming methods. They are used to these traditional methods and want to stick to them. However, their methods are not effective, and they can affect their production. We must lure them to implement conservation farming, yet it helps them. These farmers are so difficult to work with. They always complain and say we want to make their life difficult. Even when we tell them some conservation methods, such us digging of storm drains in the wetland so that the water will flow to the other side and the wetland would*

have been preserved, they do not listen. For a farmer to dig a storm drain is a struggle. They just do not want to dig the storm drains. They can even argue that digging a storm drain will take their time which they could have used to work in the farms (Agritex officer 2)

This shows that the Agritex officers felt that the farmers saw them as a threat to their wetland farming, and that most of their conservation methods were not welcomed by the farmers. Since these farmers were used to their traditional methods of farming, with some of them having negative repercussions, they were therefore resistant to adopt new conservation farming methods.

However, both Agritex officers indicated that the EMA was supposed to enforce wetland laws in cases where people were not adhering to what the Agritex officers were teaching them. Agritex officer 1 pointed out that the EMA used to enforce the wetland laws but was now reluctant to do so. Agritex officer 1 explained that the EMA's wetland laws were now mainly on paper and were not instituted on the ground. The Agritex officers said that the EMA and government were supposed to help them implement wetland laws but that they had problems with politicians who affected the ability of the EMA officers to undertake their duties, as these politicians were looking for support from local people. Agritex officer 1 said that some politicians had created hatred between them and wetlands users in Honde Valley:

Politics have affected the implementation of some wetland laws in Zimbabwe. When these politicians are campaigning to be voted for, they always mislead people and legalise the abuse of wetlands. One Agritex officer I used to work with was teaching people to observe 30 to 50 metres from the river before they start growing crops to avoid streambank cultivation. However, people had to report him to one politician who came campaigning to be voted in power as a member of Parliament. This politician was also the Minister of environment and tourism. When the Agritex officer was called to explain at the rally why he was discouraging people from growing crops on wetlands, he explained what the law said and the recommended measures from the river bank and then pointed out whether the people knew the minister who was proposing such laws and he pointed to that politician. The Minister was not amused because he wanted people to vote for him therefore, he did not want to be associated with these wetland laws and their implementation. Hence, he rebuked the Agritex officer. This Agritex officer became unpopular with people since they thought he was *mean and the laws he wanted to implement did not exist. Since the minister failed to support him and with pressure mounting from the people, this Agritex officer ended up transferring to another district.* (Agritex officer 1)

This shows that politicians would work hard to pursue their political interests at the expense of the environment. In such cases, the Agritex officers would become unpopular with people due to lack of support from those in power. However, when asked about the political challenges they face in protecting wetlands as an institution, the EMA official said that the president and his wife were environmental ambassadors who supported the EMA on environmental issues. The Zimbabwean government was also supporting the EMA in encouraging wetland management. The Zimbabwe Agenda for Sustainable Economic Transformation 2013-2018 (Zim-Asset), which changed to the Transitional Stabilisation Programme (TSP), also supported the protection of wetlands because it had a section on environmental management. The EMA official indicated that things had improved because previously land barons who were politically affiliated would settle people in the wetlands. Although the EMA official was reluctant to talk about some of the political challenges they face, the Agritex officers and wetland users pointed out that the political environment was affecting the implementation of wetland laws. For example, one interview respondent said:

Law implementation in Zimbabwe is also affected by the political environment. Some politicians can tell people to grow crops wherever they want, and people will grow crops near the rivers. This is usually done by those politicians who will be campaigning to be voted into power, and then the EMA becomes powerless. The EMA and the Agritex officers have no power over these politicians (Interview respondent 37, female aged 46-59 years)

In trying to deal with some of the challenges they faced when working with people on wetland management issues, the EMA indicated that they were forced to look for support from the government. The EMA official also said that they had tried to engage with politicians so that some environmental offences attract custodial sentences (going to jail without a fine) but that the EMA was yet to take an oral paper to parliament so that it could be discussed. This paper would focus on awareness so that people understand the consequences of abusing wetlands and make the right decisions about wetland use.

5.5.5 Interactions between smallholder farmers and seed companies

Interactions between the wetland users and seed companies were reflected through seed companies' engagement with farmers when breeding and producing seeds. The seed companies also interacted with wetland farmers whilst giving them agronomy support and during seed marketing.

5.5.5.1 Seed production for different crops

The interviewed seed company officials revealed that they were producing a variety of seeds that could be used by smallholder farmers. The Agriseeds official pointed out that they were producing small and large grain seeds such as sorghum, soya beans, millet, and maize, respectively. They were also producing legumes such as sugar beans and cowpeas. An official from Mkushi seeds said that they were producing seeds for maize, sugar beans, sorghum, millet and groundnuts. National Tested Seeds Company was producing seeds such as maize, sugar beans, vegetables and small grain seeds such as sorghum, wheat and millet. Pioneer Seeds Company was also producing maize seeds and seeds for other crops such as sugar beans, sunflower, soya beans and sorghum. The Seed-co official said that their company was also breeding and producing maize, wheat, soya, sugar beans, groundnuts, and sorghum and cowpeas seeds. Since Prime seeds concentrated on horticultural crops, it was breeding and producing open-pollinated and hybrid varieties of vegetables. However, the official from CYMMTY said they were not producing seeds but were concentrating on breeding wheat and maize varieties. Thus, CYMMTY would develop crosses (to come up with new varieties of maize and wheat seeds) that can be used by other seed companies for further research and production of seeds for the market.

When breeding different seed varieties, seed companies were mainly concerned about improving livelihoods and food security. CYMMTY official indicated that the role of CYMMTY, which was established in 1987, was to improve the maize seed varieties in Zimbabwe, and this involved maize improvement and sustainable education for livelihood. Agriseeds official also said that when breeding its seeds, it focused on food security both at household and national levels since 1988. Mkushi seeds which was established in 2014 was primarily focusing on maize breeding. However, in their efforts to improve livelihoods, the Mkushi seeds official said that they were the only seed company in Zimbabwe producing and selling a hybrid quality protein maize with improved status. He pointed out that hybrid protein maize was different from normal maize because normal maize was deficient in two essential amino acids, which are leucine and tryptophan. Protein maize had leucine and tryptophan, which are essential amino acids which the body could not manufacture but must be ingested. Mkushi Seeds was therefore recommending farmers to buy protein maize hybrid seeds. Protein maize was good for children weaned on maize porridge, primarily without additional protein. Although Mkushi Seeds was producing this high protein maize hybrid seed, none of the wetland farmers in Zindi area said they were using the Mkushi hybrid quality protein maize.

National Tested Seeds indicated that their mandate was to supply quality seeds (small grain and cereals), and they have been operating since 1978. Pioneer Seed Company focused on seed production to improve farm-level productivity. It was aimed at providing improved seeds to the farmers. Seed-co has been in operation since 1940, and as one of the oldest seed companies in Zimbabwe, it started a horticultural subsidiary (Prime seeds) in 1997, which focused on producing vegetable hybrid varieties.

Amongst the seed varieties that were produced by different seed companies, wetland farmers were buying maize seeds more than any other seed types. Some of the maize seed varieties that the farmers reported planting in the wetlands included Pannar 53 (a Pioneer hybrid), ZAP 43 and 513 (Seed-co hybrids) and K2, K61, K65 (from Klein Karoo Seed Marketing company). Although some farmers planted seeds from different companies, some indicated that they were retaining the seeds. As reported by interview respondent 19, some farmers preferred some maize seed varieties because they were early to mature under wetland conditions. However, some farmers could not afford to buy these specific maize seeds. Interview respondent 1 said that since most farmers could not afford to buy these seeds, they were retaining seeds from previous years. She also added that most farmers also retained common maize seeds locally known as *chimanyika*, which was used in the past by their ancestors. Interview respondent 1 said that preservation of this type of seed involved drying the maize in the traditional African kitchen so that the smoke will protect it from being eaten by weevils. Commenting on how they get maize seeds to plant in the wetlands, one respondent said:

> *I usually plant seeds from the maize I would have harvested the previous year (retaining the seed). If I get ten US dollars, I can then buy half packets of seeds to add to my retained seeds* (respondent 49, female over 60 years)

5.5.5.2 Seed companies' engagement with farmers in breeding and producing seeds

The seed companies' officials all said that they interacted with farmers in breeding seed varieties. For example, CYMMTY reported that they were engaging with farmers through on-farm trials. In this case, the farmers would get to see the material and make comments regarding the traits of those seed varieties. CYMMTY was also engaging with farmers at harvest periods so that they evaluate these seed varieties. The CYMMTY official said:

> *During harvest periods, farmers from the surrounding areas come to evaluate the different materials and give comments on those varieties. Those comments are the ones we also use in assessing when releasing the varieties to companies. For example, the farmers can opt for a particular variety because of its advantages and might deny a particular variety because they had problems with that variety. We consider what the farmers will be saying about a particular variety before the variety moves forward* (CYMMTY official)

Besides farm trials, CYMMTY would also engage with farmers when doing socio-economic surveys on the different varieties they breed. In this case, they looked at the different stresses that the variety could endure, including its drought tolerance and heat tolerance. CYMMTY would ensure that the varieties with such traits are made available for farmer testing.

Some seed companies were engaging with smallholder farmers via production agronomists or with field extension officers. For example, Agriseeds was engaging both commercial and small-scale farmers in breeding and producing their seeds. The Agriseeds official pointed out that they had production agronomists who would identify farmers to work during the growing season with from planting to harvest. As the agronomists engaged with farmers in the process, the farmers would then make comments and suggestions. The agronomists would then get feedback on their varieties. The Mkushi official said that they were engaging smallholder farmers in seed breeding and development. However, for seed production, he reported that they were utilising large-scale commercial farmers. Mkushi had field extension officers who lived in rural areas and were front-people of the smallholder farmers. Mkushi had four field extension officers in total and had targeted rural areas such as Mutoko, Murehwa, Chiweshe Mount Darwin area, Gokwe Hurungwe and Karoi. Mkushi field extension officers were also working with Agritex officers to reach out to smallholder farmers in these rural areas. These field extension officers would identify smallholder farmers to test the new hybrids under farm conditions. Therefore, the seed was exposed to the farmer before it was approved and put on the market so that the farmer could help make the right decisions on whether the variety is appropriate under given conditions. However, the Mkushi official said that they have never tried breeding seeds with smallholder farmers under wetland conditions but rather under drought or optimum growing conditions with normal maize. Some farmers also confirmed that some seed companies were engaging with them in breeding new seeds. For example, village head 3 said that some seed companies would come to test their seeds, and they would inform the farmers of the areas with too much water and those with less water about the best seeds to use for such areas. Village head 3 also said that they were expected to give the seed companies feedback after testing their seeds. If the seeds were not suitable for the soil and water conditions, they would inform the seed company, and in that case, they would avoid purchasing the seeds.

The Pioneer official confirmed that they were also engaging with smallholder farmers during seed breeding. He reported that they would ask the farmers to come and test the seeds before the hybrid was registered or commercialised. He further explained that they would also test their hybrids with farmers across the board and would then consider their comments. Thus, the farmers would become part of the testing process before the registration or release of the hybrid. The Pioneer official reported that they had sites in rural areas where agronomists would plant seeds and manage the crops with farmers throughout the growing season. They would then get comments from the farmers during harvest since they would be comparing the new seeds with what they were growing already. Although Pioneer was engaging smallholder farmers during breeding, the official explained why it was difficult for them to engage the farmers in producing seeds. The process involved in producing seeds needed more space, so Pioneer was engaging with commercial farmers instead. The official pointed out that hybrid seeds were grown from their defined male and female lines, and therefore they had to avoid self-pollination. Thus, they would detassel (remove the tassel) from the female line during seed production and allow pollen to come from the male line only. They would then DNA tests to confirm whether there had been cross-pollination. For open-pollinated varieties, they would be dealing with population and self-pollination up to a certain level of saturation. The cross-pollination of hybrids and self-pollination of open-pollinated varieties required more land. Therefore, it was a challenge for them to engage with smallholder farmers in seed production because of the size of their landholding.

The Pioneer official pointed out that for hybrids seeds, they need a minimum of 400 to 500 m from another maize crop to avoid pollen coming from the other crop to contaminate the hybrid.

Therefore, this is difficult to achieve in a communal setting with many farmers in a small area. Hybrids are therefore produced where there is enough isolation to rule out any self-pollination. Pioneer was therefore engaging with commercial farmers in producing seeds because they had enough land to ensure isolation. The Pioneer official also said that since the seed companies such as Pioneer owned the seed parents and the commercial farmers owned the land, then they would enter into an agreement to produce seeds for sale. The National Tested Seed official attested that they were also contracting commercial farmers to produce seeds for them. Since commercial farmers were producers, the National Tested Seed Company relied more on their feedback because, during production, the commercial farmers would have discovered some traits which the seed company might not have observed. The commercial farmers would also inform National Tested Seeds on the advantages and the disadvantages of a seed variety and areas to improve. The National Tested Seeds official pointed out that commercial farmers were, therefore, an important source of information for their seeds. However, the Prime Seeds official reported that all farmers were important in seed breeding. He said that they were using the market concept to get information from the farmers, and whatever seeds they would put on the market was more like feedback from the farmers. They were also engaging with farmers through marketing research to find out what seed types they wanted.

However, the Seed-co official said that in engaging with farmers in breeding seeds, they would test what they bred in the farmers' fields. In this case, Seed-co would give the farmers different seed varieties to grow on their own, and farmers would then give Seed-co some feedback on the seed varieties through a questionnaire. On this questionnaire, farmers were asked about what they like or did not like about the varieties and what they expected to see in the future. Seed-co would then document the information, use it to improve the seed varieties and then put them on the market. However, this was not a participatory activity where they would bring the farmers to the breeding place and select what they thought they wanted. Seed-co would go to the farmers and test with them. Village head 1 attested that seed companies would sometimes come to the farmers to test and market their seeds. Interview respondent 19 pointed out that Klein Karoo Seed Marketing Company once came to Zindi in 2017 to advertise and market some of their seed varieties, and this prompted some farmers to change to some of Klein Karoo's maize varieties such as K2, K61 and K65 and started growing them. However, there was no evidence of the use of questionnaires by seed companies in Zindi rural area.

Although Seed-co was contracting only commercial farmers in producing seeds, it was engaging with both commercial farmers and smallholder farmers in the production of grain for food. In this case, the contracted commercial farmers were producing seeds as input for Seed-co, so that Seed-co would split the seeds and sell them to all the farmers to produce grain for food. When explaining how they were contracting to the commercial farmers, the Seed-co official reported that they would also provide inputs such as the seed parents and fertilisers. The contracted commercial farmers would therefore act as third parties in producing seeds for Seed-co, and Seed-co would buy back the seeds from them. Seed-co would then process the seeds for sale.

5.5.5.3 Agronomy support provided by seed companies to smallholder farmers

Officials from seed companies said that they were also interacting with farmers when giving them agronomy advice on conservation farming, proper management of crops to enhance productivity, and post-harvest controls.

CYMMTY said that they have a department of agronomists who would go to rural areas to teach farmers about conservation agriculture. These agronomists would also do demonstrations on CYMMTY farms, and this is called the Sustainable Intensification Programme (SIP). Through SIP, CYMMTY agronomists would teach farmers about sustainable and conservation farming. Some of the agronomic practices that farmers were taught included crop rotation, intercropping to improve the potential yield of seed varieties, the use of artificial fertilisers, the use and purchasing of open-pollinated and hybrid varieties. They encouraged farmers to retain the open-pollinated varieties twice and hybrid seeds three times so that the retained seeds do not deteriorate in terms of yields and performance. Thus they encouraged farmers to use hybrid varieties rather than open-pollinated seeds. The CYMMTY official said they were encouraging farmers to grow hybrid seeds because of their high returns of at least 15 t/ha of maize compared to 1-2 t/ha with open-pollinated seed varieties.

Agriseeds and National Tested Seeds officials also said that their agronomists were teaching farmers good agronomy practices, including land preparation, fertiliser application, weed management, disease control, harvesting techniques and post-harvest controls. The latter involves teaching farmers about grain storage since grain would sometimes be affected by weevils. The Agriseeds official said that during their field days, they would invite people specialising in post-harvest methods to teach farmers. They also had post-harvesting radio programmes. National Tested Seeds uses their farm shop managers stationed in each district to give agronomic advice to farmers in these regions. National Tested Seeds also have regional sales agronomists who visit the farmers to understand their challenges and give them agronomy advice. However, there was no evidence from farmers in the Zindi area of such visits and agronomy advice.

Seed companies were also giving farmers advice related to seed management. For example, Pioneer Seeds offer advice to farmers related to the advantages of adopting hybrid seeds and crop management. Pioneer Seeds encourages farmers to manage their crops to benefit from the hybrids they have bought. Some of the management techniques taught to farmers include land preparation and soil pH testing using samples from the lead farmer’s field. In this case, if there is a need for soil amelioration with lime, then this would be added. It is mainly during the field day when the crop is mature that the agronomists would go through the whole process so that the farmers can understand the benefits of good crop management. Seed-co also had sales agronomists around the country who offered agronomy support to farmers through field days. Seed-co agronomists held farmer competitions every year, and these motivated farmers to manage their crops properly in preparation for the competitions. The Seed-co official described that in 2018 they held the 10 Tonne Plus Club and the 11 Tonne Plus Club, which oversaw master farmers competitions. Although the farmers’ responses were positive due to these competitions, the official complained about distortions within the market because of the government command agriculture that gave farmers free seeds. Once the farmers get enough seeds to plant, there was no incentive to buy. However, once farmers get the free seeds, Seed-co was unable to determine the response and measure the performance of the farmers’ competitions.

Most smallholder farmers preferred growing open-pollinated varieties since they were cheaper than hybrid seeds. However, the Prime Seeds official said that they advise farmers to not only look at the prices but to consider the variety returns. Thus, they were encouraging farmers to consider buying hybrid seeds since they had high yields. The Prime Seeds official reported that they were encouraging farmers to move away from old agricultural practices and adopt modern practices that would contribute to better yields. Some of these modern practices include the use of drip irrigation because it saves water and reduces costs but maximises profits. The Prime Seeds official also said that they were discouraging overhead irrigation because it can wash away chemicals. Even though all the seed companies said that they were providing agronomy support to farmers, there was no evidence of such support from farmers in the Zindi area.

5.5.5.4 Production of seeds for specific agro-ecological regions

Officials from the seven seed companies indicated that they consider the different agro-ecological regions when producing their seeds. Thus, the seed companies consider the amount of rainfall received in different regions and the different soil type. For example, the CYMMTY official said that they were looking at high potential, medium potential and humid areas when breeding seeds. To find materials suitable for different agro-ecological regions, CYMMTY looks at the rainfall, altitude, temperature, soil and humidity of each region and tests each material under such conditions. Mkushi Seed Company provides seeds for every agro-ecological region from drought-prone to high potential irrigated situations. Thus, they had six maize hybrid seeds on the market, ranging from early maturity to late maturity. The very early maturing hybrid was meant for dry short-season areas such as regions 4 and 5, the medium maturing hybrid for region 3, and the late-maturing hybrid for regions 1 and 2. Pioneer Seeds considers the rainfall patterns in different agro-ecological regions when breeding their seeds. As a result, they had specific areas where their different varieties best apply. This includes early varieties for areas with short rainfall seasons and later varieties for areas like regions 1 and 2 where high rainfall is received. Similarly, Prime Seeds was producing short season, medium season, and late-maturing varieties to cater for the different agro-ecological regions. The Prime Seeds official stated that they would look at the days to maturity of a particular variety. For example, they had a cabbage hybrid called Fabiola which would mature after 65 days. They also had a cotton variety that matured in 90 days and butternut varieties that would mature in 45, 55, 70 and 80 days. Thus, they would look at the season length when considering the number of days taken by the variety to mature.

However, some seed companies considered latitudinal position as one aspect of agro-ecological regions when breeding their seeds. For example, Seed-co produces varieties suitable for low latitudes, mid-latitudes, and highland areas. Some companies were also driven by the preference of farmers. For example, the Agriseeds official said that the breeding and production of their seeds was market-driven according to the general requirements of the customer. Agriseeds would also look at rainfall patterns and soil types. Agriseeds also had different categories of maize hybrids (three, four, five, six and seven series). Three series was meant for low rainfall areas and matured very fast. Four series matured a bit later and was called very early maturity, whereas three series was called ultra-early. The five series was called early maturity, six series medium maturity and seven series long season maturity. Three series matured in 60 days and seven series took about 140 days and therefore required more rainfall and careful management. The Agriseeds official also noted that seven series was sensitive since it demanded a lot of chemicals and nutrients. Agriseeds was therefore recommending seven series to commercial rather than smallholder farmers since it was expensive to manage. Although most seed companies indicated that there were breeding seeds suitable for the different agro-ecological regions, National Tested Seeds does not have breeding programmes for specific agro-ecological regions. Thus, they depended on research institutions and the government to provide them with seeds for use.

5.5.5.5 Contribution of seed companies in developing and breeding improved seed varieties suitable for wetlands

Most seed companies stated that they do not breed seed varieties specifically for wetland agriculture. Instead, they produce seeds for different agro-ecological regions with different rainfall patterns, in which wetlands are included. The CYMMTY official said:

> *We have never produced seeds specifically for wetlands. Still, with what farmers are doing, I think there is a material they have found suitable for wetlands, but that material was not developed specifically for wetlands. However, on the other hand, the use of wetlands encourage environmental degradation. From our side, the reason why our researchers are not concerned about wetlands is that wetlands are protected environments. We are funded by donors, and they would not want to hear about varieties that will exploit sensitive areas like wetlands. Our sponsors are also sponsoring projects to protect wetlands* (CYMMTY official)

However, some companies were concentrating on other traits rather than wetland conditions when breeding their seeds. For example, Mkushi Seeds is not producing seeds specifically for wetland agriculture but was paying more attention to drought-tolerant, disease resistance and yield performance. The Mkushi official stated that they had not tested their varieties under wetland conditions, waterlogged or high water table areas. National Tested Seeds also said that they were concentrating on seed varieties that were drought-tolerant rather than for wetland agriculture. The National Tested Seeds official said that although their seed varieties were drought-tolerant, it did not necessarily mean that they would not do well in wetlands, and the highest potential yield could be realised in areas with more water, such as wetlands.

Breeding seeds specifically for wetlands requires more research because of the unique wetland conditions. Hence, some seed companies said that wetland conditions pose a challenge to them and that more resources were required to research on suitable varieties for wetlands. For example, Pioneer Seeds reported that they were not breeding seeds for wetlands because of the specific diseases that affect wetland crops:

> *We are not necessarily breeding seeds for wetland agriculture because wetlands present a continuous wet environment usually associated with specific pests and diseases. From our point of view, we know that wetlands are associated with perhaps streak virus (maize streak virus). Streak virus is a virus that affects maize under certain conditions. Streak virus is associated with wetlands. Therefore, the breeders would want to produce a variety that is resistant to or tolerant of that disease. More research and resources are therefore required to breed seeds suitable for wetland agriculture* (Pioneer official)

Although some seed companies acknowledged that farmers were growing crops in wetlands, they had not considered producing varieties specifically for wetland farming. For example, Seed-co stated that they were not producing varieties suitable for wetlands because wetland farmers were buying the same seeds they were using for dryland farming. The Seed-co official believed that these farmers already knew the suitable varieties wetlands:

> *We have not consciously bred seeds suitable for wetland farming, although we know that smallholder farmers in areas such as Gutu grow their crops early (in August) on wetlands. These are just spill over effects. We know that even these farmers in Gutu who grow their crops on wetlands buy the seeds from us. Farmers have studied the seeds and the conditions within the wetlands, and they know when to grow and how to grow these seeds in wetlands. These farmers know that they should grow early on the wetlands, like growing maize in August, so that they will be able to harvest before the rains* (Seed-co official)

Seed-co also said there was a need to quantify the size of the wetland seed market before they produce seeds for wetland farming. This official also reported that as seed companies, they knew that areas under wetland agriculture were already benefitting from the seed breeding efforts of the seed companies. Agriseeds however, considered wetland agriculture in breeding their seeds:

Yes, we have considered wetland agriculture. There is a lot of water in the wetlands, and people who grow crops in wetlands are mostly in rural areas, and they want early growing maturities. We have come up with early maturity that is resistant to diseases because there are many diseases in the wetlands. So, we have a maize variety called ZAP 43. It does very well in wetlands and matures fast. It is a very early maturity variety. We are also coming up with a new maize variety called ZAP 31, which was approved and will be on the market soon. It also does well in wetlands because it matures early. We have also sugar beans which work very well in wetlands, and we have tried them in wetlands Chimanimani and Nyanga rural areas (Agriseeds official)

5.6 Collaboration of village heads and different stakeholders in sustainable use of wetlands

The village heads revealed that they were working with the EMA and Agritex officers in ensuring the sustainable use of wetlands. They reported that Agritex officers would help them solve problems related to agriculture on wetlands, whilst the EMA was concerned about the more general management of natural resources. For example, village head 1 said that they have meetings with the EMA three times per year at the chief's place. At these meetings, they would discuss issues about natural resources management. However, village head 1 complained that they were not getting enough information from the EMA or the government on the wise use of wetlands. Although the EMA official said they were working with community volunteers, some interview respondents reported that the EMA was not active in collaborating with other stakeholders. For example, interview respondent 9 said that they heard about EMA officials from the village heads but had never met them or discussed any issues with them. Despite the EMA relying on local volunteers, some respondents, such as interview respondents 19 and 12, perceived direct involvement and active participation of the EMA as an effective measure of ensuring sustainable use and management of wetlands.

Wetland farmers were working with the Agritex officers whenever they had conservation problems on their wetland farms. For example, village head 1 reported that the Agritex officers would help them whenever they had erosion problems and when they wanted to learn about different farming methods. However, these village heads did not say how often they met with the Agritex officers. Although the EMA official said that they were working with the village heads and Agritex officers, the latter were not regularly involved in the EMA programmes. As reported by Agritex officer 2, the EMA had committees in rural areas that would help the EMA stop people from cutting down trees. These committees were made up of community representatives with minimal involvement of the Agritex officers. Although the Agritex officers knew that these committees existed, they were not aware of how they were executing their duties.

Agritex officer 1 also complained about the EMA's reluctance to address environmental concerns related to wetlands. He said the EMA officers were not visiting Honde Valley for inspection, only when there was an environmental event. Sometimes the EMA would visit the villages to have meetings with the village heads and committees. Agritex officer 1 also reported that there was no collaboration between the seed companies and other institutions in supporting sustainable wetland use, since the seed companies were focused on dryland farming.

ZINWA and the Pungwe sub-catchment council assisted the EMA by giving people permits to draw water from the wetland springs, streams and rivers. However, some wetland users felt they were being exploited because of the money they had to pay to different stakeholders for these permits. ZINWA, the village heads and chiefs were charging high fees for such water projects instead of collaborating to ensure sustainable water use. For example, interview respondent 7 said that for installing pipes for irrigation or domestic purposes, they have to pay USD 50 to ZINWA for a permit. After paying this, they would then register to pay an annual water fee of 12 US dollars. Respondent 7 also said that they would have to pay consultation fees locally known as *chitate* to the village head. This was followed by USD 7 given to the village head to assess where the farmer should install the pipes to draw water. After being granted permission by the village head, the farmer than has to pay another USD 15 to the village head. Besides paying ZINWA and the village heads, interview respondent 7 also said that the farmer was supposed to pay USD 100 to the chief to inform him that he was drawing water from the wetlands using pipes.

However, some respondents such as interview respondent 6 pointed out that they were entitled to these natural resources and that those in authority should allow them to exploit the resources free of charges. Respondent 6 also said that some farmers were refusing to pay ZINWA for water permits since it was not telling them how to mount and install the water pipes for irrigation. ZINWA was also not providing equipment such as pipes for the farmers to use. Although some people resented paying ZINWA for the water permits, interview respondent 7 reported that when people had conflicts on water sources, ZINWA recognised the person with the permit as entitled to a particular water source. Thus, getting a permit from ZINWA enabled one to have ownership of the source, and ZINWA could help if there was disagreement with other users.

Some farmers reported that the village heads were corrupt when executing their duties instead of assisting the farmers. For example, interview respondent 37 reported that village heads were corrupt when distributing free presidential agricultural inputs. He said that not everyone who was growing crops on wetlands could afford to buy the inputs but the village heads would distribute these free inputs to some wetland farmers rather than others. Some respondents also reported that the village heads were failing to work with the Agritex officers in distributing agricultural inputs. Interview respondent 47 reported that the village heads would control the Agritex officers since they claimed that they oversaw all the people in their villages. Thus, they were undermining the powers of the Agritex officers, who were entitled to distribute government inputs since they were government workers. Interview respondent 47 also said that during the input distribution process, the villagers would ask for money that would have been used to transport the inputs from the district to their villages. He also reported that the village heads would charge money that some villagers could not afford to keep the extra money for themselves. Interview respondent 46 added that the village heads were not concerned about the welfare of farmers and sustainable use of wetlands but were more concerned with benefiting from people in their villages.

5.7 Causes of conflicts on wetland farming

Some farmers reported that there were some conflicts related to land issues on the wetlands. For example, interview respondents 2 and 4 said that most wetland farmers usually had conflicts on farm boundaries, and these would emanate from when farmers were starting to plant crops. Respondent 6 reported that since these farmers were digging the trenches to drain wetland water at different times, some people would cheat when digging and take land from their neighbours' farms. One female respondent (respondent 27, aged 25-36 years) said that some farmers would peg their farm boundaries with stones. However, other farmers would move the position of the pegs, taking land from their neighbour's farm.

In one case, a conflict arose after one farmer borrowed a farm from another farmer. Interview respondent 22 explained that a farmer could lend their land to another farmer, but the latter would then refuse to return the farm to the owner even if they knew they were not the rightful owner. Such cases would then result in conflict. Explaining how he once experienced this, interview respondent 22 said:

> *I asked for this land when I wanted to start fish farming. I was allocated this piece of land by the Agricultural and Rural Development Authority* (*ARDA) after people who were growing crops in this wetland were chased away by the company because they did not want people to grow crops in wetlands. Since I wanted to do fish farming, they gave me the land, and I dug my two fishponds. When the government announced that "land to the people" in 2000 during the land resettlement programme the owners of the wetland fields I had occupied came and claimed their land. I had already put these fishponds, so there was no way I was going to give them the land* (Interview respondent 22)

Conflicts like this were usually resolved by the village head, as was confirmed by interview respondent 16 (female, aged over 60 years). However, in the case of interview respondent 22's case, he said that the village head failed to settle the dispute and they had to take it to the chief who then settled it. The chief asked the fish farmer to buy the land from the owners.

Misunderstandings sometimes arose in using wetland resources. For example, interview respondent 7 reported that he once had problems with a farmer after discovering that he had removed his pipes from a spring in the wetlands and inserted his own. Although such disputes were not common, they would sometimes happen when all farmers fighting to draw water from the spring did not have water permits. Such cases were also settled by the village heads. However, respondent 7 added that he had to pay USD 12 to the village heads to rule in his favour since he was the first to install his pipes.

5.8 Increased use of wetlands in Honde Valley

Respondents revealed various reasons why there was increased use of wetlands in Honde Valley. These include food security, shortage of dryland areas for farming, the unproductive nature of dryland farming due to climate variability, and unfertile soil. For example, interview respondent 34 said there were too many people in the Zindi area and not enough land to grow crops. There was a shortage of dryland areas for farming since most of this land was occupied by the Eastern Highlands Tea Estate Company. As was reported by interview respondent 2, farmers' fields in the dryland areas were taken by the Eastern Highlands Tea Estate Company, and as a result, most farmers turned to wetland farming. Commenting on this process, interview respondent 2 said:

> *Some of us do not own farms on these drylands. There is tea for the Eastern Highlands Tea Estate in all the productive land. The entire field you see with tea used to be our fields, but they chased us* from *our fields, and they planted tea. They came with guns, and we were ordered to leave. The tea estate has taken this whole area of Zindi. That is why you see tea covering the greater part of the land* (Interview respondent 2)

People in the Zindi area were also solely dependent on wetland farming because harvesting on drylands (to those with farms in these areas) was not guaranteed due to climate variability. Farmers reported that rainfall patterns had changed and had become more unreliable. One interview respondent said:

> *We are not guaranteed of harvesting from these dryland fields, but when we grow our crops on wetlands, we know that we will harvest because there is enough moisture. On dryland farming, we rely on rainfall, but nowadays, it is no longer reliable. Sometimes we receive a lot of rainfall, and the crops in the dryland farms are affected, and they do not grow well, and sometimes we receive little rainfall* (Interview respondent 4)

The farmers also abandoned dryland farming because the soil was exhausted and no longer productive. For example, respondent 5 (male, aged 26-35 years) said that they had abandoned dryland farming since their crop yields had deteriorated due to unfertile soil.

5.9 Agritex officers' views on the state of wetlands in Honde Valley

As was reported by the EMA official, 90% of wetlands in Zimbabwe are in rural areas where 20% of these wetlands are stable, and 70% were moderately or severely degraded. Agritex officer 1 also said that most wetlands in rural areas were degraded. He pointed out that they were encouraging farmers to test the soil but that most farmers did not understand why this was needed. He explained that the pH of soil in wetlands was affected by too much water, hence it was important for the government to encourage soil sample testing for farmers to know the soil requirements. The Agritex officers said that although they did not support wetland agriculture, there was a need for action to ensure that wetlands in Honde Valley were protected. Commenting on how wetlands were used in Honde Valley, Agritex officer 1 said:

> *There is a need to put emphasis on farmer education, especially the training part of it. It needs to be emphasised more here in Honde Valley, and then the recommendations should be instituted and enforced. They are not instated and enforced, so there is a need for EMA to preserve the sensitive areas in wetlands in Honde Valley. People in Honde Valley survive on these wetlands, and therefore there is a need for training the farmers on how to use these wetlands sustainably. There is also a need to install standard irrigation facilities to preserve the wetlands. It is not everyone who buys these pipes and can install them properly. Most farmers are installing these pipes to draw water without following the standard recommendations* (Agritex officer 1)

This shows that farmers did not know how to carry out some of their wetland activities due to lack of training. However, they continued to carry out these activities without proper guidance and this affected wetland resources.

Agritex officer 1 pointed out that it was the government's role to ensure protection and conservation works through institutions such as the EMA, ministries and departments. In highlighting conservation works, Agritex officer 1 said:

> *The government should also help with protection works and conservation facilities that are needed because there are some sensitive areas in wetlands that need to be protected. Support from the government is required because on conservation, in some cases we do earthworks. Still, in other cases, we need to construct the water channels, which will be taking a lot of water since the slope here is very steep. If they want to avoid erosion and the creation of dongas and gullies, the area should be protected so that water is directed into constructed waterways. The EMA should also stop people from using sensitive areas within wetlands for agriculture* (Agritex officer 1)

Some farmers also supported the protection of sensitive parts of wetlands. For example, interview respondent 12 said that the government was supposed to fence and protect wetlands and that it was the government's duty to explain to wetland farmers why some areas should be protected and not used for agriculture.

5.10 Chapter summary

The data presented in this chapter display how farmers are using rural wetlands and how different stakeholders have interacted with wetland users in the development of wetland agriculture and environmental protection. Wetlands provide different ecosystem services to support rural livelihoods, but poor implementation of laws and lack of collaboration between different stakeholders have compromised wetland sustainability. The results presented in this chapter are now analysed and discussed in line with the research context in Chapter 6.

Chapter 6: Analysis and Discussion

6.1 Introduction

This chapter analyses and discusses the meaning and relevance of the empirical findings presented in Chapter Five. The results show that wetlands are exploited mainly for provisioning and cultural ecosystem services. This chapter's discussion is also augmented by the literature addressing the research aims and objectives as outlined in Chapter One. This study aims at understanding how rural people in Honde Valley use and interact with wetlands, and then to evaluate the different problems encountered by farmers in using wetlands for agriculture. The way local people have been using wetlands in the past and present is evaluated with particular reference to culture, beliefs, agriculture and different wetland ecosystem services. The study also assesses the different agricultural practices undertaken on wetlands, how wetland farmers interact with other stakeholders, evaluates the actions taken by farmers to the different challenges encountered in using wetlands for agriculture, and assesses the role of different institutions and policymakers in assisting rural populations in wetland sustainable use and management.

6.2 Different ecosystem services provided by wetlands

Wetland use is discussed using the ecosystems approach to assess the relationship between different ecosystems and their contribution to human wellbeing**.** The ecosystem services approach is a way of assessing the intricate relationship between humans and wetlands (nature) to assist decision-making, aiming to reverse the diminishing status of wetlands and ensure their sustainable use and effective management (Ingram *et al*., 2012). Results show that the Zindi community benefits from wetland ecosystem services in various ways. Supporting services such as soil formation through accumulation of organic matter and nutrient cycling, then the storage, recycling, processing and acquisition of nutrients, allowed for wetland ecological processes and functions to support other ecosystem services such as provisioning, regulatory and cultural services (Figure 6.1). Various provisioning services derived from valley bottom wetlands include indigenous and exotic fruits (Figure 5.30b), traditional vegetables (Figure 5.30a), medicinal plants (Table 5.2), food crops (Figure 5.27a, c), fish (Figures 5.27d, 5.28, 5.29) and honey (Figure 5.30c, d). However, these could only develop in the wetlands due to supporting services such as soil formation (fertile soils due to organic matter accumulation) and nutrient cycling (storage, recycling, processing, and acquisition of nutrients) (Figure 6.1). Thus, while wetland users value the wetlands for their material provisioning services, these could only be attained through the non-material supporting services. A variety of plant species grow when the wetlands are left idle (Figures 5.3b, 5.6b) after crop harvest provides the suitable habitats for grasshoppers and mice that the farmers then hunted. Availability of fish, grasshopper, mice, traditional vegetables and wild fruits in the wetlands shows that people had diverse nutritional food sources. Fish is considered a delicacy in rural areas. Thus, fish were also essential for their protein diet and were harvested for consumption and sale. Similarly, fishing was also an important economic activity on Bahi wetlands in Tanzania, and the communities around these wetlands relied on fish for protein (Mwakaje, 2009). However, farmers in Zindi relied on fish farming, unlike on Bahi wetlands, where the community depended on wild fishing (Mwakaje, 2009). Through these provisioning ecosystem services, the valley bottom wetlands have contributed to human wellbeing as people extracted necessary and sustaining materials from them (Millenium Ecosystem Assessment, 2005a). These wetlands therefore acted as socioeconomic 'safety nets' for food security since they provided diversified diets with various nutrition-rich food that could be easily accessed and little or no cost.

The unique geographical location (valley) of these wetlands allowed the accumulation of organic matter from tree leaves in the upland areas, making them more fertile and productive than dryland rain-fed agriculture. As the main activity that significantly contributed to food security, agriculture was successfully carried out due to the availability of supporting services such as the accumulation and processing of organic matter and nutrient cycling, which ensured the availability of nutrients for crop growth within the wetlands (Figure 6.1). Wetlands in semi-arid areas have been used intensively for agriculture due to water availability and productive soils (Dixon, 2005; Mbereko *et al*., 2007; Svotwa *et al*., 2008b; Marambanyika *et al*., 2017). Thus, the availability of water and good soil also ensured the availability of provisioning services (Figure 6.1). Climate variability, which results in erratic rainfall patterns and unproductive dryland soils, compelled farmers to turn to wetlands for agriculture. This concurs with Marambanyika and Beckedahl's (2016c) findings that revealed an increase in wetland cultivation on six rural wetlands in Midlands province, Zimbabwe, due to a decline in rainfall for dryland farming and loss of soil fertility on arable fields. Climate variability had therefore increased pressure on wetlands. Politically supported action by the Eastern Highlands Tea Estate Company of grabbing large pieces of land on dry upland areas for tea growing had left most farmers without dryland farms. Hence, they were compelled to turn to wetlands for survival. Most of the respondents were not formally employed but were self-employed (90%) (Table 5.1) as subsistence farmers who depended on selling surplus yields for income generation reflected that the wetlands acted as economic hubs for the community.

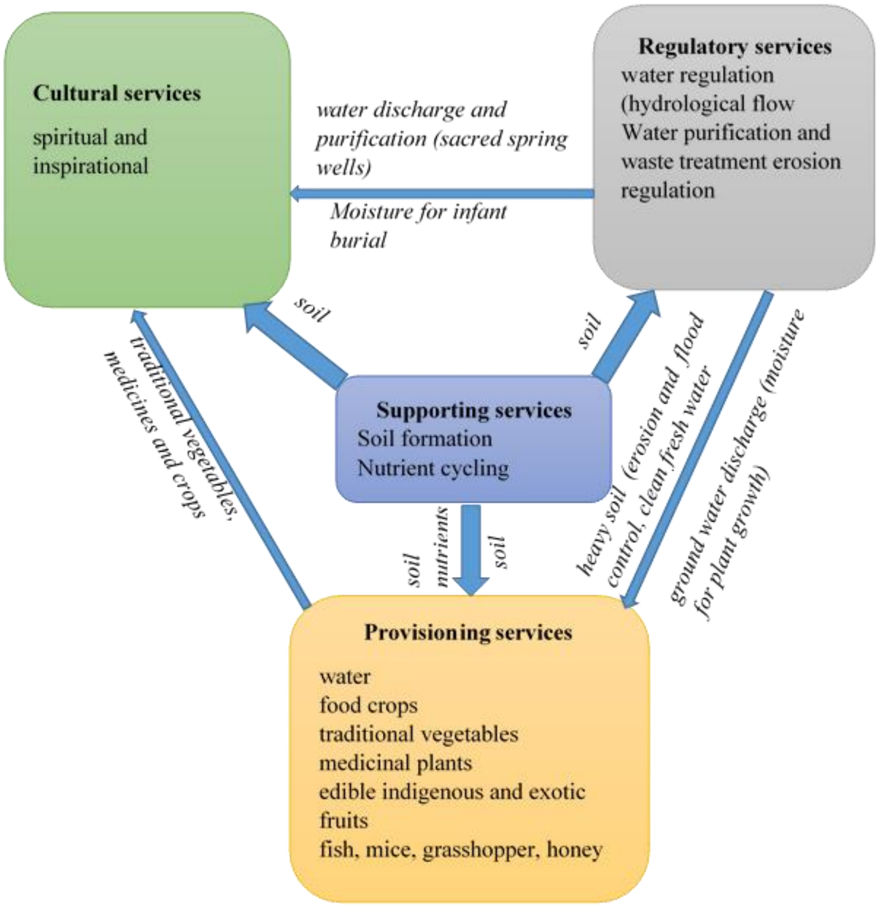

Figure 6.1: Relationships between different ecosystem services found in Zindi wetlands

Although only a few farmers did fish farming and basket weaving, these were considered critical economic activities significant to rural livelihoods since a high income can be generated through these activities. Different items made from bamboo and reeds such as baskets, bathroom containers and lamp holders (Figure 5.32) were made for use at home and for sale. These results agree with Mbereko *et al*.'s (2007) findings that revealed that reed harvesting from Zungwi wetland in Zimbabwe was used for making mats and food containers. These different items from Zungwi reeds were also sold for income. These services provided by bamboo and reeds in Zindi wetlands were due to supporting services (Figure 6.1) such as the hydric soils that helped plant growth. The Zindi valley bottom wetlands have therefore contributed to economic and livelihood sustainability.

Several wetland farmers reported selling crops at home, business centres and in urban areas. The income generated can be used to sustain livelihoods through paying school fees, buying other essential foodstuffs, and building comfortable homes. Smallholder farmers were therefore turning to different markets to generate additional income. It is also notable that the Zindi farmers were selling their crops in cities such as Harare and Mutare, where they had viable markets, implying that the urban population significantly benefitted from rural wetland provisioning services through the foodstuffs derived from wetlands, and that the economic activities of rural farmers are set into a wider national and international trade networks. Although the wetland farmers' produce could not necessarily meet demand from urbanites, food sold to these consumers also supplemented their diets. Alexander *et al.* (2016) argued that despite relying on food imports, the basic needs for food consumption in urban areas in Africa are supplied by rural farmers. A similar study by Marambanyika and Beckedahl (2016c) in the Midlands province indicated that rural people were using wetlands to grow various crops, which attracted external markets. However, increased crop diversity in Zindi (Figures 5.2, 5.3a, 5.5, 5.6a, 5.9, 5.10a, 5.13, 5.14, 5.16, 5.17a, 5.19, 5.20) was not only crucial for attracting big external markets but also for the economic and food security of local people. Various exotic fruits such as bananas and avocadoes were grown in the wetlands, and a few indigenous fruits found in the wetlands helped supplement the Zindi community's diets.

Water was a crucial wetland resource that the Zindi community relied on for domestic use and agriculture. Spring wells (Figures 5.3c, d, 5.6d, 5.11, 5.17b, 5.20b) which provided local people with clean and fresh water, were found in all the wetlands. Regulatory services such as water regulation through hydrological flows allowed groundwater discharge through the springs and water purification through absorption of pollutants. These results are partly similar to Rebelo *et al.*'s (2010) findings which show that people relied on wetland water from Kilombero and Bumbwisudi wetlands in Tanzania for domestic use. However, people only used this water during dry seasons and years of drought, whilst the Zindi community relied on wetland water for domestic use throughout the year. Thus, Zindi people would carry the water with containers for household use for drinking, cooking, washing dishes and clothes and bathing. They had also created bathing places (Figure 5.31) on streams in some wetlands. It was difficult to drill boreholes in Zindi on the upland dryland because of the terrain, making the water table too unreachable. However, at Kilombero and Bumbwisudi people had alternative water sources such as boreholes and wells in these drylands (Rebelo *et al*., 2010).

Although the hydrological flows and processes were significant for provisioning services such as clean and fresh water, they were continually being disturbed by the exploitation of wetlands for agriculture. Therefore, regulatory services were decreasing, which was evidenced by the reported drying up of some parts of the wetlands. Residents and the Agritex officers established that erosion in all the six wetlands was limited. Thus, the heavy wetland soil (supporting services) helped maintain regulatory services such as erosion regulation and allowed the retention of soils and sediments vital for agricultural activities and buffering of floods (Figure 6.1). Bengochea Paz *et al.* (2020) argued that agriculture significantly transforms the environment despite depending on the natural ecosystems. Thus, human activities such as agriculture can also impact regulatory services including pollination. Loss of biodiversity through human exploitation reduces the number of natural pollinators, increasing vulnerability to wetland change (Bengochea Paz *et al.*, 2020). Crop pollination is essential for food production and this might also be the case with the study area.

Figure 6.1 shows the relationship between different ecosystems found in Zindi wetlands. Supporting ecosystem services provide the primary ecosystem processes that lead to provisioning, regulatory and cultural services. Supporting services such as soil and sediment retention made it possible for wetlands to provide regulatory services such as regulation of hydrological flows, water purification and waste treatment (Figure 6.1). Simultaneously, the regulatory services such as hydrological flows through groundwater discharge and water purification through waste treatment ensured the availability of cultural services such as sacred spring wells found in the six wetlands.

The moisture retention capacity regulatory service allowed the residents of Zindi to carry out certain cultural practices such as burying infants in wetlands which took place because of the moist and wet conditions. Apart from ensuring cultural services, regulatory services such as water erosion and flood regulation played a vital role in ensuring provisioning services such as food crops, water, fruits, medicinal plants, traditional vegetables and fish (Figure 6.1). Agritex officer 1 reported that the wetland soil was heavy, meaning that it was not easily eroded and had high water holding capacity, crucial for controlling flooding and limiting waterlogging of crops. Limited soil erosion in Tawarara A, Tawarara B, Mareya, Chiwira and Madimbo wetlands was crucial for preserving the topsoil required for crop production. Regulatory services such as hydrological flows allowed the transportation of nutrients essential for crop growth. Supporting services such as soil formation and nutrient cycling, and water/nutrient retention were essential for provisioning services. Soil formation ensured sediment retention and accumulation of organic matter essential for the growth of crops, medicinal plants and fruit trees. Therefore, diverse crops were grown in Zindi wetlands because of the high nutrient retention and accumulation of organic matter. The provisioning services also ensured cultural services by providing traditional medicines, crops and vegetables (Figure 6.1) that linked the communities to their past. These cultural services could only be available in the wetlands due to supporting services such as soil formation.

These wetlands were also valued because of the different cultural ecosystem services, which may suggest that they gave the community a sense of identity, cohesion, place and relationship to past generations. A variety of food obtained from wetlands, including yam and cocoyam, which were grown in the past, linked the people to their traditional cultures, might imply that they gave them social identity (Costanza *et al.*, 2011). Some cultural activities such as collecting various traditional medicines (Table 5.2) were also considered vital for their health. Traditional practices such as burying infants in wetlands implied that these wetlands could still provide them with their traditional religious or cultural significance. Availability of traditional medicines and the respect given to sacred wells in wetlands played an essential role in the community's cultural beliefs. Such cultural ecosystem services also play a role in enhancing people's social wellbeing (Millenium Ecosystem Assessment, 2005b). However, these cultural services could only be attained through supporting services and partly by regulatory and provisioning services (Figure 6.1). While the traditional medicines which gave them attachment to their traditional cultural beliefs could be used to treat various diseases (Table 5.2), some respondents were reluctant to talk about traditional medicines due to their Christian religious affiliations. Similar findings were confirmed by Rebelo *et al*. (2010) on Kilombero and Bumbwisudi wetlands in Tanzania where community members were unwilling to talk about the traditional medicines they were using. Modernity and embracing Christian values reduced the Zindi community's attachment to some cultural services, although they were essential for their communal spiritual fulfilment. However, the deterioration of the values given to some cultural services led to the deterioration of these services. An increased demand for food and pressure on wetlands for food production led to the decline of some of these cultural practices where they become of less importance to come residents. For example, agricultural land use, which resulted in the removal of some vegetation, also led to the loss of some traditional medicinal plants. The loss of sacred wells in some wetlands may also weaken the spiritual benefits that people obtained from the wetlands. Such loss may also suggest the reason for having many villagers abandoning their traditional beliefs to Christianity.

The overexploitation of wetlands has always determined the trade-offs between different wetland services (Braat and de Groot, 2012). However, the overuse of valley bottom wetlands for agriculture has led to increased food production at the expense of other wetland services such as supporting and regulatory services. Several respondents reported the loss of supporting services and regulatory services evidenced by the loss of soil fertility, diversion of water due to trench digging, drying up of some parts of wetlands, and gully erosion (Figure 5.37). Thus, action to increase one ecosystem service led to the degradation of one or more other services. For example, the increased use of wetlands for agriculture led to an overall reduction in soil fertility and wetland integrity. Community responses revealed that they were adding inorganic and organic manure to the wetland soil to boost productivity to compensate. The deterioration of supporting services due to overexploitation for provisioning services also affected the regulatory and cultural services (Figure 6.1). Zindi residents reported the loss of plant and animal species and reduced water in some parts of the wetlands. As a result of different anthropogenic activities in wetlands, ecosystem services do not remain static. Different human activities on wetlands, such as agriculture, disturbed the ecological processes and functions of wetlands, which affected their supporting, regulatory, and cultural services.

Although the rate at which different ecosystems were being reduced was not measured, reports from respondents on the loss of wetland resources implied that some wetland ecosystem services would eventually be depleted due to uncontrolled and continuous exploitation. The cultural services provided by these valley bottom wetlands may continue to be affected by modernisation and Christian beliefs which weaken traditional practices. This can also lead to a complete loss of cultural services or transformation of one type of cultural use to another. The degradation of ecosystem services can have a social and economic impact since it can reduce agricultural yields (Bengochea Paz *et al*., 2020). Thus, the loss of these ecosystem services may impair the wetlands from sustaining livelihoods

However, failure to use wetlands sustainably undermines the different wetland functions that support agriculture and other different ecosystem services (McCartney *et al*., 2010). When people use wetland ecosystem services equally, they will not be equally depleted. However, the depletion of one ecosystem service can affect another service. For example, the depletion of water or the hydrological function of wetlands affected wetland agriculture, hence village head 3 reported that crop yields had deteriorated from how they were in the past. Wetland alteration due to agriculture can therefore lead to loss of human culture, animal and plant species and economic benefits from ecosystem services (Maltby *et al*., 2009).

6.3 Changes in the use of wetlands from the past to present

Some changes in the ways wetlands were used in the past and present are reported in this study. Although crop diversification was important for crop yield and nutrition improvement, most farmers were compelled to grow a variety of crops for sale. Farmers in Zindi were market-driven, and hence their main crops were cocoyam, yams and bananas since these were a delicacy and had high demand in urban areas. These results are different to findings by Whitlow (1983) on vlei cultivation in Zimbabwe, which revealed that rural wetlands were mainly used for rice growing and cattle grazing by subsistence farmers. However, Zindi was not using the wetlands for cattle grazing because there was no enough space for that activity since most parts of the wetlands were used for crop production. Farmers had abandoned growing rice since it was laborious and difficult to manage. Priority was therefore given to subsistence and cash crops that were less labour intensive.

Pressure on wetlands had increased due to the increase in population, leading to an increased demand for food. Zimbabwe's high unemployment rate also increased pressure on wetlands since the able-bodied population turned to wetlands to grow crops for income generation and food. During the colonial era, there was little pressure on wetlands because the colonial government prohibited wetland cultivation, although people continued to exploit them for agriculture (McFarlane and Whitlow, 1990; Bell and Hotchkiss, 1991; Svotwa *et al*., 2008). As reported by village head 2, few people were attracted to wetlands for agriculture in the past, since dryland farming was equally as productive and rainfall was still reliable. The recurring droughts in Zimbabwe, which occurred in 1991-92, 1997-98, 2002-03, and 2004-05 (Mazzeo, 2011), caused crop failure on rain-fed dryland farming, hence wetland soils which have high moisture retention capacity were then used to facilitate cropping during the dry seasons (Nyamadzawo *et al.*, 2015). Pressure on wetlands has increased in Zimbabwe since the cultivation of wetlands is now used by rural people as an adaptive strategy to climate variability (Nyamadzawo *et al.,* 2015). This result concurs with the observation that wetland cultivation is a form of insurance in droughts (Roberts, 1988).

Community responses revealed that pressure on wetlands increased after most farmers were dispossessed from their dryland farms by the Eastern Highlands Tea Estate in Zindi. However, to maximise the small fields they had, farmers practised mixed cropping (Figures 5.10, 5.13, 5.14, 5.16, 5.46). Therefore, mixed cropping was an alternative way to grow a variety of crops they would have previously been grown on dryland farms. Continuous use of all wetlands for agriculture was common in Zindi as farmers were trying to maintain food throughout the year. This is different to results from Whitlow (1990) which showed that farmers practiced crop rotation and rotational grazing in Zimutu Reserve in Zimbabwe in 1948. However, rotational farming was not possible on wetlands in Zindi due to limited space. Several respondents in this study also reported that methods of farming had changed from the past. The increased use of basal and top dressing inorganic fertilisers implied that the wetland soil nutrients were slowly being depleted, hence natural soil fertility was being lost. These results are consistent with those of Nyamadzawo *et al.* (2014b) that revealed increased use of inorganic fertilisers in wetlands in Chiota, Zimbabwe, due to the reduction in soil nutrients. However, these inorganic fertilisers have detrimental effects on wetland ecosystems, discussed below.

6.4 Challenges of using wetlands for farming

Crop production in wetlands is threatened by pests such as weeds and animal pests. Different insects, mammals, birds and mites were attacking wetland crops, creating what Hill (1983) termed a "complicated interacting pest complex". Most of these diseases were caused by the high density of a variety of crops in wetlands. Controlling different pests and diseases was, however, complicated. Although the amount of loss and damage caused by pests and diseases were not measured, evidence from interview respondents 5, 40, 47 and 48 (section 5.4.5), who reported a reduction in yields due to pests, established that these were causing harm to crops. The use of chemical, biological, behavioural, mechanical and physical methods helped farmers control the pests, although eradicating them was virtually impossible. Failure of some pesticides recommended by Agritex officers such as Grayson GA lambda (Figure 4.40a) and Dithane M-45 to control the stalk borer means that further research is required on the type of this stalk borer for the development of new pesticides which can be used on them. Continuous use of the same pesticides made some pests such as stalk borer resistant to the chemicals. Failure to practice rotational farming, which could contribute to the change in the planting of both immune and susceptible crops, contributed to creating pest resiliency to chemicals.

However, the use of Zenix Larvicides (for mosquito) by some farmers to control the stalk borer reflected that farmers were left with no choice but to try different ways that they thought could help. However, the effectiveness of such chemicals was not guaranteed. Chemicals such as Zenix Larvicides were not readily available since the farmers who were using it could only get it from Ministry of Health officials who would come every year to spray breeding places for mosquitos. Since these farmers were not taught proper measurements to use, they were most likely to have their health affected by these chemicals. Spraying herbicides (Figure 5.43) and lambda pesticides (Figure 5.40a) without proper protective clothing meant that these chemicals posed a threat to wetland biodiversity, water and farmers. Although associated risks were not explored, safety and health procedures were not considered, and this could affect the chemical sprayers. Failure to follow proper safety and health procedures can be alluded to the lack of financial capital to buy proper clothing or lack of information on using these chemicals. Gurr *et al.* (2016) argued that pest control has not been seriously considered in developing countries.

Although the use of pesticides was less common due to lack of financial resources, the community's capacity to control and adapt to an environment of diseases and pests by trying to improvise and use low-cost self-taught materials existed. Cultural and mechanical control proved to be more effective than pesticides and insecticides. Indigenous perspectives on controlling pests and diseases motivated farmers to use natural methods. These included readily available materials which were used for other things at home. Farmers reported using natural methods to control pests such as stalk borer worm, which ate maize, and moles that ate yams, maize and bananas. The use of soil, washing powder, pepper, and ammonium nitrate to control the stalk borer worm and cow dung to control moles (section 5.4.5) that were not scientifically proven revealed that the farmers had limited information about other scientific pesticides and insecticides, hence their reliance on low-cost methods to control pests. Although washing powder and ammonium nitrate were most likely to pollute the wetland water, environmental concerns were considered less important than food security.

Indigenous knowledge systems employed in using cultural methods included plant species such as *mutika* (Figure 5.39) and cow dung that helped control the stalk borer because of their insecticidal properties. Although such environmental techniques helped in reducing land degradation, not all farmers were using them. The use of scarecrows (Figure 4.42) made from old clothes and sacks and old cassette tapes to scare away the birds meant that farmers would try to use less costly methods of controlling the pests by using things they had available. However, in developing countries, technologies are limited in remote areas, and hence small scale farmers tend to rely more on traditional cultural practices to protect their crops (Gurr *et al.*, 2016). Mechanical or physical methods of weed control such as hand weeding (Figure

5.44), slashing (Figure 4.3b), and hoe weeding (Figure 5.27b) were standard and easy practices that most farmers. Several respondents also reported that they were also burning the weeds during land preparation. Although burning to destroy itchy and noxious weeds, which made it challenging to work in wetlands, was a convenient method for eradicating these weeds, it also led to the loss of biodiversity. Thus, in trying to eradicate problems that affected them, farmers created long term environmental problems. Rodent and mice traps (section 5.4.5) also helped reduce predators that were eating the maize. Hunting mice for meat and killing rodents and mice with traps were most likely to reduce the population of these small mammals in the wetlands.

Farmers also reported that they would kill the stalk borer with their bare hands (section 5.4.5) in some cases. This method was only viable to those farmers who had small fields and was impossible to use in big farms. Therefore, farmers used various methods to control pests, insects, and diseases affecting their crops. These results are different to Gurr *et al.*'s (2016) findings which revealed that despite small scale farmers in Papua New Guinea noticing the damage caused by pests and diseases on sweet potatoes, the farmers took no action in trying to manage the pests. Integrating traditional and modern techniques in controlling pests and diseases ensured Zindi wetland farmers of harvests. However, apart from being too costly, some pesticides could not help control the pests. As was reported by interview respondent 28, some farmers were unaware of the correct pesticides to use on aphids and red spider mite. She said that few farmers knew that Dimethoate could be used to control aphids which caused red spider mite diseases on tomatoes, hence some farmers would leave the aphids affecting the tomatoes. Failure to successfully control pests and diseases showed a lack of knowledge which could have helped them with skills and techniques to deal with these problems. Information to control pests and diseases was not disseminated by the Agritex officers equally amongst the farmers. These results corroborate a study by Dhar *et al.* (2018) in Jamalpur and Bogra districts in Bangladesh, which showed that subsistence farmers in these districts did not have enough knowledge to deal with pests and diseases, and this affected their yields. However, most farmers in Zindi would endeavour to manage these although they could not eliminate them. Their efforts to control pests allowed them to continue growing crops on wetland with much better harvests than dryland farming. Tolerance to both significant and insignificant damages caused by the pests made some farmers leave pests such as locust and grasshopper (section 5.4.5) eating their vegetables.

The interaction between subsistence farmers and wildlife in Africa has resulted in conflict, which has caused severe problems for already impoverished rural communities (Sillero-Zubiri and Switzer, 2001). Raiding of maize and bananas by monkeys in Rutsate, Tawarara A and Tawarara B wetlands which farmers would try to minimise through guarding their farms and using dogs and catapults (Figure 5.41b) caused hardship to farmers. Some would spend the whole day guarding farms whilst they had other chores to do, and some would tie dogs on trees to guard the farms the whole day. The determination of monkeys to raid the farms made them unafraid of women and children who were guarding the farms. Chasing and scaring away animals that ate crops was seen as a standard method of dealing with these animals in a study by Hill (2004) on conflicts between subsistence farmers and wildlife in Uganda. However, Hill (2004) also confirmed that baboons were not scared of children and women and it was difficult to chase them away. In Zindi, farmers had studied the monkeys' behaviour and hence women opted to dress like men (Figure 5.41b) as an alternative to scare away these mammals.

Digging trenches (Figure 5.36) to access wetlands for agriculture altered the wetland hydrology. Trench digging also contributed to reducing the amount of water in the wetlands through improving drainage. Although it was a convenient way to access wetlands easily, continuous draining of wetland water may eventually lead to the loss of wetlands and increased soil erosion. Farmers could also not ignore problems created by thieving since it reduced sugarcane yields and fish. However, the use of thorns in fish ponds (Figure 5.45) could only distract thieves during fishing but not prohibit them from stealing the fish. One farmer (interview respondent 20) had to abandon the fish dams in Madimbo wetland and dig fish dams close to her home due to the high rate of fish theft. Unlike sugarcane growing which most farmers had abandoned due to the high rate of theft, fish farming remained a valuable activity that farmers could not abandon. Although the profits made from fish farming as compared to the loss of fish to thieves were not quantified, the urge to continue with the project revealed that benefits were more than losses. The various challenges that wetland farmers encountered indicated that wetland farming was not as uncomplicated and straightforward as it appeared. Although farming in wetlands was productive, farmers would try as much as possible to manage and protect their crops for high yields. However, these farmers lacked adequate support from the government amongst other stakeholders to deal with the challenges they faced when using wetlands.

6.5 Methods of wetland exploitation and their impacts

The various methods that were used to exploit wetland resources impacted on wetland ecology and biodiversity. Although sustainable agricultural practices are essential for bringing about socioeconomic and environmental benefits (Adenl *et al*., 2018), wetland farmers employed sustainable (mulching, use of organic manure, zero tillage, mixed intercropping) and unsustainable (digging, burning of weeds, streambank cultivation, digging of trenches and use of inorganic fertilisers) practices (section 5.4.2) in exploiting wetland resources. Since the Zindi community relied on wetland farming for survival, the different farming practices are considered to be efficient enough to ensure high crop yield. The wetland users considered livelihood priority as the main factor determining how they were exploiting wetland resources. Sustainable farming methods such as zero tillage (Table 5.3) ensured minimum disturbance of wetland soil by preserving soil fertility and reducing soil erosion and compaction. Zero tillage also reduces production costs as it allowed tillage savings. However, few farmers (26.5%) were using zero tillage, whilst most farmers preferred digging (73.5%). Many farmers employed digging during land preparation to destroy weeds and grass. A similar study by Nyamadzawo *et al*. (2014a) on dambo cultivation in Chiota revealed that zero tillage and digging were standard methods used by farmers to clear the land before ploughing. However, since digging was done by many farmers in Zindi, there is likely to be high disturbance of soil in all the wetlands during tillage, which would impact on wetland ecological and hydrological processes.

A variety of leguminous, leaf and root crops that were grown in the wetlands ensured nutrient exchange within the soil. The main crops grown in wetlands such as bananas, yams and cocoyams play a vital role in binding soil together, reducing soil erosion. Similar sustainable crop growing strategies were observed by Svotwa (2008a) in Maonazvawo wetland in Zimbabwe, where crop diversification allowed the fixing of different nutrients within the soil, and crops such as yams also assisted in reducing soil loss. Soil nutrition retention through the different types of crops also ensured high yields, and social and economic sustainability. The use of organic manure (Figure 5.33d, Table 5.1) such as leaf litter, crop residue, weeds and compost manure (Figure 5.34) assisted in improving the soil texture, which enhanced the water holding capacity of the soil. Improved soil texture made wetlands constantly moist for crop growth, reducing crop vulnerability to dry periods, hence improving crop output. Organic fertilisers also improved the soil's fertility and productivity, increasing soil bacteria and fungi essential for enhancing wetland ecological processes. Sustainable farming methods, such as mulching which was used by most farmers (75.5%) (Figure 5.33a, b, c, Table 5.3), assisted in covering the soil and retaining soil moisture. Mulching also assisted in reducing the growth of weeds, soil erosion and soil compaction. The sustainable farming practices such as mixed intercropping assisted in suppressing the weeds, reducing soil erosion, controlling pests and diseases and improving crop yields (Gebru, 2015).

Results also showed that farmers were exploiting wetlands unsustainably. These unsustainable practices, such as digging, burning of weeds, streambank cultivation, digging of trenches and use of inorganic fertilisers, altered wetland resources and were a threat to ecosystem services. Although the rate at which the wetlands were changing was not measured in this study, the reported changes in different wetland elements such as water, soil, animals and plants showed that wetland sustainability was compromised. Svotwa *et al*. (2008a) argued that some of the sustainable methods used by farmers reflect their environmental appreciation, which establishes an attitude of attending to their crops and wetland integrity more generally. However, the loss of some wetland resources in Zindi due to unsustainable methods left the wetland environment threatened. Mixing both sustainable and unsustainable farming methods showed that they were mainly concerned about high yields. Farmers indicated that the trenches (Table 5.3) they dug to drain water was a sustainable way of using wetlands. The draining of the water from these trenches (Figure 3.36), which was also encouraged by village heads, affected wetland hydrological processes such that some parts of the wetlands were drying up. These results corroborate with Marambanyika and Beckedahl's (2016b) study on the implementation of wetland laws that revealed that farmers were digging canals in Dufuya and Madigane wetlands to drain water and enhance crop production, which then affected wetland hydrology. Such water diversion can also lead to water table lowering and causes water loss, thus threatening wetland health.

The adoption of an irrigation scheme on drying parts of Madimbo wetland (Figure 5.46), which was not used in the past due to abundant water supply, implied the drying up of some wetland areas. However, this is also likely to become the case in some of the five wetlands in which farmers turn to irrigation as the wetlands continue to dry up. Observed trenches dug without proper measurements that eventually developed into small streams (Figure 5.38) reflect how wetlands have been abused. Although human-wetland interactions were appreciated for livelihood sustenance, some practices such as trench digging resulted in wetland degradation, evidenced by gully erosion (Figure 5.37). However, in wetlands such as Rutsate, where gully erosion was evident, there was no willingness and action taken to control it, hence this compromised wetland integrity. Such environmental behaviour suggests the farmers' knowledge about environmental issues is not well developed. Failure to quickly act on such environmental degradation implies that total wetland loss is imminent if such damage persists uncontrolled.

Although organic manure was environmentally safe, it did not guarantee the wetland's integrity since most farmers were also using synthetic fertilisers (65.3%) (Table 5.3). The use of both organic and inorganic fertilisers indicated that organic manure only could not guarantee high yields. Although inorganic fertilisers ensured the availability of nutrients such as nitrogen, phosphorus and potassium for the fast growth of crops, the different chemical compounds were prompted to cause long term damage to the wetland. Inorganic fertilisers such as ammonium nitrate and compound D that most farmers reported using could pollute both underground and surface water. Nyamadzawo *et al.* (2015) argued that although the use of ammonium nitrate can lead to the emission of large amounts of nitrogen in the atmosphere, the application of organic manure can potentially assist in reducing the emission of greenhouse gases. These results concur with Rebelo *et al.*'s (2010) findings that farmers in the Bumbwisudi wetland in Tanzania had resorted to the use of inorganic fertilisers to solve the issue of declining soil fertility. Such an environmental attitude whereby the wetland users resort to agricultural practices that can benefit them more although they are detrimental to the environment can be related to Tolman's (1948) cognitive map behavioural theory. In Tolman's experiment with rats and mazes, the rates would find ways to manoeuvre through the mazes to get food. Thus, their focus was on food regardless of the complex nature of the mazes. This theory applied to the Zindi wetland users who used both inorganic and organic fertilisers to boost their yields irrespective of the detrimental impacts of inorganic fertilisers on the environment. Thus, in using their cognitive map to try and have high yields from the wetlands, the wetland users' actions negatively impacted the health of the wetlands.

Meanwhile, the need to apply inorganic fertilisers every planting season since it was a short term and quick solution to crop growth eventually has led to permanent damage to wetland soil. Thus, most farmers reported that their yields were affected if they were to grow crops with only organic manure. However, failure to keep large herds of cattle due to a shortage of pastures after they were taken by the Eastern Highlands Tea Estate Company for tea growing presented a challenge for farmers to adopt conservation organic farming fully. This is because cattle are considered the primary source of organic manure in Zimbabwe's rural areas (Svotwa *et al.*, 2009). These results are contrary to findings of a study by Nyamadzawo *et al.* (2015), which showed the use of cattle manure by most farmers in Chiota wetlands, Zimbabwe, for amending soil fertility within the wetlands. The use of leaf litter, grass, and crop residue by Zindi farmers was not enough to replace the soil nutrients without cattle manure.

Unsustainable practices such as burning grass and weeds to destroy noxious *Carex* itchy plants during land preparation led to biodiversity loss and disturbed the wetland ecosystem food chain. Evidence from the farmers indicated that animal species such as warthogs, hare, cane rats, glassy frogs and *leptopelis* frogs were no longer seen in the wetlands. Some animals such as crabs, worms, catfish, and tadpoles had reduced in number. Although the loss of such animals was due also to other factors, burning of vegetation and removal of semi natural vegetation during farm expansion may also have contributed. These results corroborate with those of a study conducted by Nyamadzawo *et al*. (2015) on wetland cultivation in Chiota wetlands in Zimbabwe, which revealed habitat destruction and loss of animal species due to cultivation. The conversion of wetland ecosystems to agriculture, overexploitation and continuous use of ecosystems had also contributed to biodiversity loss in Chiota (Nyamadzawo *et al*., 2015) and Zindi. This implies that agriculture had completely modified the wetlands as animal habitats were lost. If unsustainable use of these valley bottom wetlands persists, it can eventually lead to wetland loss. Burning may temporarily increase soil organic carbon and nutrients in the wetland, and stimulates new plant growth and higher biomass (Nyamadzawo *et al.*, 2015). Thus, the benefits of burning are short-lived, yet it affects ecological processes and wetland integrity in the long run.

Clearing natural wetland vegetation and replacing it with crops has altered animal and plant species' populations and composition within the wetlands. According to Hove and Chapungu (2013), vegetation removal reduces species richness and evenness. These observations were also noted by respondents in this study. As reported by interview respondent 15, they could no longer see some plants in the wetlands, and some plants such as *Carex* had become rarer. Several respondents also reported the growth of invasive species in these wetlands. These results corroborate Nyamadzawo *et al*.'s (2014a) findings in Chiota that digging and burning destroyed plant seedlings, saplings, and seed banks, which stopped the original plant species from recovering. However, continuous removal and burning of plant species in Zindi wetlands were most likely to cause the extinction of most wetland plants. Therefore, it is essential that management practices on wetlands should ensure that plant biomass is maintained in its natural state (Matayaya *et al*., 2017).

Although the Agritex officers reported that they were instructing the farmers to have storm drains and avoid streambank cultivation, none had adopted these wetland conservation measures. Some farmers practised streambank cultivation, yet it was most likely to cause soil loss and siltation of rivers. One farmer (interview respondent 40) reported that she once lost all her maize due to river flooding as it was planted next to the stream. However, in such cases, the soil could also have been eroded. As was revealed by respondent 40 and focus group 3, farmers were mainly concerned about high yields than some of their farming activities' environmental effects. Hence, they would instead grow crops near the rivers because of fertile soils and abundant moisture. Farmers valued and prioritised food security through growing crops in sensitive areas to increase their production more than protecting the wetlands. Agritex officers encouraged farmers to practice irrigation farming on dryland and create buffer strips within the wetlands to avoid the continuous cultivation of wetlands. Since cocoyam was the main crop grown in these wetlands, Agritex officers encouraged farmers to grow it in dryland areas through irrigation. However, there was no evidence of these buffer strips in any of the six wetlands, and few farmers had adopted irrigation since it was expensive to mound the pipes. The Agritex officers discouraged continuous cultivation of all the wetland areas. However, no area was left idle in some wetlands, such as Madimbo wetland, as the farmers cultivated the wetlands continuously. Failure to adopt techniques that could protect wetland biodiversity therefore compromised wetland health. The continuous use of the whole wetlands without protecting sensitive areas affected wetland hydrological and ecological processes and led to the loss of essential wetland animal and plant species. Farmers were also either using holes (basin tillage) (57.3%) or ridges (42.9%) (Table 5.3, Figure 5.35) to plant yams and cocoyam, but these ridges were dug without foreplanning, leading to wetland degradation.

6.6 The role of culture and beliefs in protecting wetlands

Natural resources conservation through customary laws and cultural beliefs have been common in many societies, especially in Asia and Africa (Mbereko *et al*., 2007; Chunhabunyatip *et al.*, 2018). Results from this study show that the indigenous knowledge systems revealed through the different customary laws and beliefs embedded in the Shona culture offered minimum assistance in managing wetlands since they could control people's behaviour when using wetlands. The reported myths such as the drying up of sacred wells due to fetching water with dirty materials controlled peoples' behaviour and through interactions between community members and traditional leaders (village heads and chiefs), hence the remaining sacred wells were protected. Since cultural services were not the community's primary focus when interacting with wetlands, they could not rely on them to manage and conserve wetlands. The fact that residents view wetlands as areas for burying infants revealed that they associated wetlands with their traditional practices, suggesting a need to preserve the wetlands because they have traditional cultural importance. This result is partly similar to Marambanyika and Beckedahl's (2016c) findings that rural wetlands in Midlands province of Zimbabwe were valued for their cultural significance such as performing traditional rainmaking ceremonies. In Zindi, preserving wetlands based on the wish to bury infants meant that what was of great importance to the residents was the moisture in the wetland and not the other wetland resources. However, whilst wetlands would be valued for their moisture retention properties, to continue burying infants, other wetland ecological processes were not considered.

Discouraging the use of dirt from traditional fired clay pots and soaps around the sacred wetland wells by the traditional leaders, in fear that they would dry up, reveals that the residents of Zindi treated some wetland resources as fragile and sensitive to disturbance. This might suggest that taboos and myths regulated the use of these resources since they were used to control the behaviour of wetland users. Similarly, Ndlovu and Manjeru (2014) revealed that taboos were used to protect water sources in wetlands in the Matobo district in Zimbabwe, where gourds and clay pots instead of metal ones were to be used to fetch water from the sacred well. As a result of such myths associated with breaching customary laws and taboos associated with such wells, they were able to be managed sustainability. These taboos did not only bring fear to the community but taught them to respect water sources such as spring wells. Such sustainability is therefore an indirect by-product of cultural practices, rather than these practices being central to ideas of ongoing sustainability.

The traditional and cultural laws, such as prohibiting older women from cleaning places around scared wells and prohibiting people from visiting the wetlands at night or whilst dressed in tattered clothes or half-naked, showed that wetlands have traditional and cultural significance. Mbereko *et al*. (2007) also described customary taboos and myths such as prohibiting people from walking across wetlands and not allowing laundry to be done near the wells, which were important in regulating the use of wetland resources in Zungwi vlei in Zimbabwe. Although village heads in Zindi acted as traditional custodians for these taboos and myths, most wetland users did not take heed of these taboos and myths. The traditional leaders noted that these have been gradually eroded by modernity and Christian beliefs. Some wetland farmers also failed to participate in some activities such as brewing beer to appease the ancestors before starting to plant crops on wetlands, or coming together as villagers to help the village head weed his wetland field. Failure to participate in these activities showed that cultural and traditional practices are now felt less strongly by community members than in the past, hence some farmers would start to plant crops before the appeasement ceremony. Since the Christian doctrine, which most villagers had embraced, did not accept traditional practices, different rituals associated with wetlands such as rainmaking appeasement ceremonies were ignored. Although the traditional chiefs (village heads) were custodians of such taboos and practices, they could not stop people from defying these traditions. Although it was expected that the traditional leaders would employ punitive measures on those who were not following these practices, no one was reported to have been punished after failing to observe these customary practices. Culture and beliefs could not, therefore, be relied on in controlling people's behaviour when using wetlands.

6.7 Implications of the interactions between different wetland users

Several farmers noted that they interacted with each other in wetland use. Such interactions played a significant role in strengthening social relations, which were essential for sharing agricultural ideas (section 5.5.1, Figure 5.48). These interactions had impact on food security such as sharing seeds and farming ideas that can be used to solve collective agricultural problems. Although cooperative farming was done in Madimbo wetland only (Figure 5.48), it was important for smallholder farmers to empower each other to improve their skills and yields. Interview respondent 20 reported that the Madimbo cooperative held meetings weekly to deliberate on issues they were facing. Therefore, farmers could mobilise the cooperative members to share ideas by empowering its members with farming skills that were important for tackling farming problems and improving crop productivity. These results are similar to Kumar *et al.*'s (2015) findings, which showed that cooperative farming was essential to smallholder farmers in India as it gave them free access to administrative support and provided services required to improve agricultural production and socioeconomic conditions. In a similar study, Sabir *et al.* (2012) showed that in central Punjab, Pakistan, through cooperative farming, smallholder farmers could use the inputs such as seeds jointly and employ improved farming methods on their small farms to increase their yields. Improved farming methods shared during cooperative farming in Madimbo wetland were significant in allowing farmers to appreciate the benefits of teamwork. Most individual farmers were sowing seeds directly in their fields whilst cooperative farmers in Madimbo were raising seeds in nursery seedbeds (Figure 5.48e), which uses only half of the seeds required for direct seeding and has also been proven to assist in weed control (Milovanovic *et al*., 2016).

Cooperative farming and weaving projects in Madimbo also empowered members to participate in cooperative activities (Figure 5.48). According to Sabir *et al.* (2012), cooperatives allow for social responsibility, bringing the members together and creating brotherhood among them. Although cooperative activities in exploiting wetland goods and services were more beneficial, interview respondent 20 stated that farmers in Madimbo divided one big farm into individual farms after some had experienced unequal labour contributions, which burdened some farmers. Although they would sometimes share sustainable wetland farming methods, their main focus was on ensuring food security and income generation. According to Marambanyika and Beckedahl (2016a), the collective effort and coordination amongst wetland users can lead to successful wetland management. However, there was no collective coordination by some wetland users in the other five wetlands (in Zindi) in sharing sustainable wetland management and conservation skills. As was noted by interview respondent 7, the Agritex officers encouraged farmers to do farming in groups in order to share farming skills and ideas, but cooperative farming was only done in Madimbo. However, in the other five wetlands, such arrangements were not welcomed due to trust issues. Although cooperatives were liable to agricultural loans, some farmers did not like to access the loans through cooperatives since some cooperative members would fail to pay back the loan. As a result, they were not willing to do farming in groups in Tawarara A, Tawarara B, Rutsate, Chiwira, and Mareya. While these individual framers would also sometimes share ideas on sustainable farming practices, most of the ideas were mainly about managing their crops rather than on other issues such as using organic manure and natural environmental methods of controlling disease and pests.

6.8 The role of different stakeholders in ensuring sustainable use and management of wetlands

6.8.1 The role of traditional leaders

The relationship between traditional leaders and wetland users affected the sustainable use and management of wetlands. The village head’s local wetland regulations were crucial in controlling the use of wetlands in Zindi. This was also noted by Mbereko *et al*. (2007) and Marambanyika and Beckedahl (2016a) who found that traditional chiefs controlled the use and management of natural resources such as wetlands by imposing and implementing local wetland policies on Zungwi wetland in Zvishavane and six wetlands in Midlands, Zimbabwe, respectively. This study showed a variety of regulations put in place by village heads in Zindi including discouraging veld fires, removing vegetation along waterways, cutting down trees, and encouraging drawing wetland water using pipes with village heads' permission. Although the regulations are theoretically sound in ensuring sustainable use and management of wetlands, practical implementation and enforcement of such regulations was met with challenges from wetland users. Village heads had legitimate powers over management of wetland resources but some villagers were not adhering to the environmental regulations, hence they would impose punitive measures on offenders. Encouraging people to dig trenches in wetlands to avoid flooding indicated that the traditional leaders were giving emphasis to food security rather than environmental protection, since they were also engaged in wetland farming. Ironically the traditional leaders were regarding trench digging as a way of preserving wetlands rather than drying them out through diverting wetland water.

Monitoring, implementing, and checking wetlands users' compliance with regulations was decentralised to the village police and the wetland committee. Similarly, Marambanyika and Beckedahl (2016a) described the wetland committees that monitored the use of wetland resources in Chebvuterambatemwa and Tugwi wetlands in Zimbabwe. Even though village heads 1 and 3 reported that they had wetland committees, wetland users' failure to confirm the work done by these committees shows that they were practically ineffective in their role. These results concur with Marambanyika and Beckedahl's (2016b) findings which showed that having wetland committees did not stop wetland degradation and drainage. There was also inconsistency amongst the village heads in Zindi in monitoring the implementation of these regulations. Village head 2 reported that he did not have a wetland committee and indicated that it was not his duty to teach people what to do in the wetlands. He assumed that the wetland farmers knew how to manage the wetlands and that the decline in wetland resources would teach the farmers to use wetlands wisely. These results contradict findings by Marambanyika and Beckedahl (2016a) which stated that all the traditional leaders upheld the implementation of wetland regulations and also supported each other.

Meanwhile, 75% of the residents of Zindi revealed that they had meetings with village heads more often, but that most of these meetings had nothing to do with wetland management. Failure to meet up with the villagers and discuss sustainable use and management of wetlands showed that it was not a priority. However, wetland users felt these leaders did not have enough knowledge to help them effectively. However, the village heads' minimal efforts were not recognised by the EMA and government who did not equip the traditional leaders with suitable information on wetland use and management. Hence, village heads were not confident enough to tell their farmers about sustainable wetland use.

Offenders of these regulations were taken to the traditional courts and made to pay a fine. The village head would also escalate some cases to the chief. Some offenders were taken to the Zimbabwe Republic Police (ZRP) depending on the seriousness of the case. Although these courts were fining offenders different amounts of money, depending on the severity of the case, these fines failed to wholly deter people from abusing wetlands. Since people knew the fine charged by the traditional courts were not difficult for them to pay, they would continue to use the wetland resources. Although the village heads outlined punitive measures and procedures that were to be taken if one was caught breaching local wetland regulations, some of them were not imposed due to the issue of kinship ties. Therefore, village heads were not prompted to report natural resource abusers to the EMA. Village heads feared that the EMA's hefty fines would strain the village heads' relationships with their villagers. Failure to report people who were caught participating in activities that would degrade the wetlands, such as burning and removing vegetation along waterways, implied that the village heads prioritised social relations rather than protecting the environment. This position is different to Marambanyika and Beckedahl's (2016a) findings that attributed the effectiveness of traditional leaders in managing wetlands to their kinship ties and closeness to people, which enhanced their respect for such social relations. Emphasis given to social relations whilst neglecting environmental concerns compromised the sustainable use and management of wetlands. Thus, the village heads did not have full capacity to stop the community from degrading wetlands completely. Although the traditional leaders tried to manage wetlands through the implementation of the local wetland laws, there was little evidence to reflect their efforts.

The village heads insisted that the government enforce regulations such as those that discourage people from cutting down trees, since they were facing challenges with people who kept breaching the regulations even after punitive measures had been imposed. Disobedient and stubborn wetland users who did not respect the village heads made it difficult for them to execute their duties. The village heads had become so unpopular as they tried to enforce the regulations such that the community resented them. As was reported by the village heads, the government and the EMA's support in implementing local regulations was lacking. Thus, the village heads' minimal efforts for wetland management were not acknowledged and appreciated by the EMA and hence the heads were not motivated to implement wetland laws. As villagers would ironically refer to these laws as ‘village head’s laws’, the village heads were demotivated. However, such terms used when referring to these local laws meant that the villagers’ relationships with the village heads were strained. Some village heads were therefore hesitant to continue implementing wetland regulations, and as a result some took a passive role. The village heads preferred to maintain good relations with the villagers rather than reprimanding them when they abused the wetlands.

6.8.2 The role of Agritex officers

The Agritex officers assisted farmers in developing their farming skills. In total, 51% of respondents (Table 5.3) said that Agritex officers were teaching them sustainable farming methods. This result partly concurs with Mbereko *et al.*'s (2007) results that showed that Agritex officers were providing technical advice to Zungwi wetland farmers in Zvishavane, Zimbabwe, on crop husbandry only. However, the Zindi Agritex officers were not consistent in disseminating information about conservation wetland farming, so some farmers had limited knowledge about sustainable use and management of wetlands. The Agritex officers provided extension services that entailed demonstrations and training mainly for dryland farming for staple crops such as maize, which was essential for the Grain Marketing Board (GMB). The Agritex officers give little attention to wetland farming, and despite being a signatory of the Ramsar Convention the Zimbabwean government failed to recognise the significance of wetland farming through the Agritex officers.

The adoption by farmers of dryland conservation farming practices such as zero tillage, mulching, organic manure and avoiding the burning of vegetation reflected that the Agritex officers were not fully involved in wetland farming methods except in Madimbo wetland. These results contradict Marambanyika and Beckedahl (2016a) who showed that Agritex officers at their site were involved in providing agricultural extension on wetland farming. Through the Agritex officers, the government was also inconsistent in providing agronomy support to rural wetland farmers in Zimbabwe. Adopting dryland conservation farming methods means that wetland farmers are not fully equipped with the relevant farming skills. Interview respondent 12 reported that farmers preferred demonstrations and training on dryland farming to be different from those on wetland farming, but despite this, little information was provided on wetland farming.

Madimbo wetland farmers benefited most from the Agritex officers' advice since they were not practising dryland farming due to the hilly and rocky local landscape. In Madimbo wetland, the Agritex officers regularly visited the wetland farms doing demonstrations and in training farmers, and farmers interacted with the Agritex officers more regularly than on the other wetlands. Similarly, Marambanyika and Beckedahl (2016a) showed that Agritex officers were peripheral on some wetlands but central to others when it came to wetland management. Agritex officers had weekly meetings with farmers in Madimbo wetland to discuss crop management issues. Failure of the Agritex officers to hold meetings on their own, fearing that people would not attend and rallying behind the village heads' meetings, implied that they were not being respected in the other five wetlands. In such meetings, the main issues discussed were dryland farming and the government agricultural inputs distribution. Wetland agriculture was not of great concern to Agritex officers and were only compelled to advise if needed. Lack of adequate, useful information about managing and using wetlands sustainably resulted in unsustainable wetland use which is often based on lack of information about that ecosystem's different functional characteristics (Beichler *et al.*, 2017). Besides lacking adequate knowledge about wetland function, Agritex officers were also not motivated to teach about wetland issues.

Although Agritex officers claimed that they were teaching wetland farmers to adopt conservation farming techniques such as creating buffer strips, digging storm drains, using irrigation to save water, growing crops suitable for wetlands and fish farming, it is not clear when and how they were doing these things since their contact time was limited. The adoption rate of these wetland sustainable farming methods was also low. There was no evidence of buffer strips and storm drains observed in any of the six wetlands or from the wetland users that they were being taught these conservation practices. Considering that only two farmers had adopted fish farming might reflect the Agritex officers' lower emphasis on such projects, hence the farmers did not see their importance. The limited space for fish ponds also could not allow wetland users an opportunity to engage in such activities. Although Agritex officers assisted in mounting up irrigation pipes and teaching people the importance of irrigation, few farmers had adopted irrigation since they could not afford to buy the water pipes. However, some wetland users embraced and practiced the different farming conservation methods the Agritex officers taught them, whilst others were reluctant to adopt them. As was reported by interview respondent 35, some farmers refused to adopt some techniques such as creating buffer strips and storm drains, blaming them for being time-consuming. The refusal of farmers to adopt these methods indicates that they did not have adequate information about these methods or their benefits to their crops and wetland ecosystems.

Despite the Agritex officers’ minimal efforts to teach farmers, there was no acknowledged by the traditional leaders or farmers. Some farmers felt that the Agritex officers were not doing enough. Some of the officers grew up in the area and were very familiar with the people, hence some farmers took them for granted and resented some of their instructions. Some Agritex officers also lacked confidence in performing their duties, which led to mediocrity in giving support to farmers for sustainable use and management of wetlands. Resentment of Agritex officers was mentioned by several respondents, which started during the colonial era when they were stopping people from growing crops on wetlands, and this may have persisted in Zindi. The stormy relationship between rural farmers and the Agritex officers made some farmers reluctant to adopt their guidance fully. Most politicians’ interests also affected wetland management agendas in which to gain more votes from the villagers, some politicians supported streambank cultivation which the Agritex officers were trying to stop.

Some farmers felt that practices such as leaving a 30 to 50 m buffer zone from the main rivers to avoid streambank cultivation were threats to crop production. As was identified by interview respondent 29, farmers thought it was a way of stopping them from growing crops in the most fertile areas of wetlands. Wetland users therefore failed to comply with wetland laws. Interview respondent 40 who reported that most farmers had refused to stop streambank cultivation said “we just want to survive”. This statement reflects that farmers prioritised getting high yields for livelihood sustenance rather than wetland conservation, and hence they violated some laws for their own personal benefit. These results complement Marambanyika and Beckedahl’s (2016b) findings that revealed stubbornness and disobedience by wetland users which compromised the health of wetlands in Midlands province, Zimbabwe.

One respondent from focus group 3 said, “The Agritex officers instruct people to leave some metres from the streams and rivers, but no one listens to them. They will die if they try to move people from where they harvest more”. Following the community’s dependence on wetlands in Zindi, Agritex officers could not continue to discourage streambank cultivation due to the threats they get from farmers. Since they also resided with the wetland users, the Agritex officers could not monitor whether some of these conservation methods were employed in fear of ruining their relations and to avoid victimisation. Therefore, the officers avoided monitoring wetland conservation measures. These results contradict Mbereko *et al.*'s (2007) findings on Zungwi wetland where Agritex officers were able to monitor whether farmers were adhering to sustainable farming practices. However, the complicated relationships between farmers and Agritex officers in Zindi made it difficult for these officers to monitor the wetlands. Farmers disagreed with what Agritex officers had to say, and this was confirmed by their failure to implement what Agritex officers were teaching them. The tension between wetland farmers and Agritex officers also affected the officers' enthusiasm in engaging with farmers in sustainable wetland use and management.

Although some farmers would consult the Agritex officers when there are disease outbreaks and pests, farmers reported that some of the chemicals the Agritex officers would advise them to buy were too expensive so they wanted to use their own controlling methods for diseases and pests. As reported by interview respondent 35, some farmers did not want to adopt the Agritex officers' advice because they preferred their traditional farming methods. Some farmers also resisted change because they felt their traditional methods were more beneficial. Despite the detrimental effects some methods had on crop production and wetland ecosystems, wetland farmers still implemented them. Besides complaining about the different agronomy extension practices that they could not adopt, some farmers complained about the Agritex officers being passive and not committed to their work compared to the ones they had before. Thus, some farmers felt that they were not getting enough information from the Agritex officers. Even though farmers in Madimbo wetland appreciated them, the Agritex officers were generally treated with contempt by farmers in the other five wetlands. This meant that wetland degradation was able to continue, evidenced by deep trenches (Figure 5.36) and erosion (Figure 5.37).

6.8.3 The role of EMA officers

Sustainable use and management of ecosystems are essential for preserving biodiversity and maintaining ecosystem services (Marambanyika *et al.*, 2012; Bailey and Buck, 2016). The EMA's mandate is to regulate, monitor, and promote sustainable management of natural resources in Zimbabwe and protect the environment through stakeholder participation. This mandate is guided on principles of inclusivity, transparency, accountability, *ubuntu*, responsiveness and professionalism. Despite having a clearly stated mandate, the statutory board had many loopholes in ensuring sustainable management of wetlands in rural areas such as Zindi. The promotion and management of the environment and natural resources by the EMA encompassed educating people and proper planning of their activities to preserve the environment. In Zindi, the EMA was not fully committed to educate people, and no proper planned structures existed for wetland preservation. Failure of the EMA to hold regular meetings, with the last meeting with wetland users held in 2008, as reported by one respondent, indicated that the EMA was not directly interacting with users on wetland use.

Demonstration of sustainable wetland use and management awareness campaigns was not done in Zindi as per the EMA mandate. Therefore, the EMA was failing to fulfil its statutory responsibilities. Such incompetence and reluctance of the EMA that was not anticipated left wetland users not equipped to develop sustainable use and management of wetlands. Failure to hold workshops and reliance on traditional leaders' and the Pungwe sub-catchment's meetings and using the same leaders in disseminating information on wetland use was not enough. Ironically in such meetings, wetland users were not consulted, and hence their decisions were not considered. This is a mistake since they are the primary users of wetlands and interact with the wetlands daily. This also contradicted the EMA's aim of public participation in promoting sustainable management of natural resources. These results are different to Marambanyika *et al.'s* (2012) findings in Chebvute wetland, Zimbabwe, that showed sustainable wetland use that was accomplished by empowering the community as the foremost users. However, such negligence in Zindi would always lead wetland users to become less motivated to use and manage wetlands sustainably. In some Zimbabwean regions, the EMA would engage the farmers but fail to do so in other regions. However, these results are similar to Mbereko *et al.*'s (2007) observations that in Zungwi wetland, the EMA and wetland regulation did not engage the local authorities or wetland users in decision-making or give them power over natural resources management. The top-down approach employed by the EMA in the management of wetlands in Zindi proved to be less effective. Failure to engage the local community in decision-making reflects the EMA's poor understanding of the complexities of community politics and community needs and has led to unfeasible development goals and absence of monitoring (e.g. Wood *et al.*, 2013). Thus, the EMA's failure to equip the farmers through training and decentralised wetland management has threatened wetland integrity. Similarly, Khan and Haque (2010) found that the community's exclusion in wetland management and decision-making led to the degradation of Hakaluki haor wetland in Bangladesh. Deliberately leaving behind wetland users also made them less concerned about environmental issues.

Although the EMA was trying to rely on traditional leaders in ensuring sustainable management of wetlands, their role was not well defined and hence they were not fully involved in wetland management. This joint position contradicts Hartter and Ryan's (2010) findings on wetlands in western Uganda that community-based resource management and involvement of the local institutions with well-defined roles in decision making (a bottom-up approach) led to successful management of these wetlands. However, having defined roles of traditional leaders was critical to allow them to feel acknowledged and valued. Although the EMA did not regularly visit the wetlands, hold meetings with wetland users or monitor how people were using wetlands, local communities were aware of the hefty fines if caught abusing the wetlands. These results concur with Marambanyika and Beckedahl's (2016a) findings that the EMA rarely participated in managing wetlands through education and awareness campaigns, even though the institution was well known to the rural community in Midland province, Zimbabwe, for charging hefty fines for offenders. Therefore the EMA was more known for its fines than for protecting the environment as an environmental statutory board.

6.8.3.1 Strategies used by the EMA

Zimbabwe became a signatory of the Ramsar Convention on wetlands in May 2013. Therefore, the EMA is liable for localising the Ramsar Convention mandate (Matamanda, 2018) by implementing policies to ensure wetland management and wise use. Despite the EMA having well-drafted wetland laws and a multi-sectorial national wetlands committee, wetland degradation persists. In the Zindi area, the EMA relies on traditional leaders, Agritex officers, ZINWA, EMA volunteers, the Pungwe sub-catchment committee and the EMA district environmental officers to enact wetland management at the local level, but the inadequate and ineffective implementation of these laws has meant that the EMA as the statutory body responsible was unable to fulfil its mandate. Thus, wetland laws were more theoretical than being practically implemented. Although the EMA trusted traditional leaders such as village heads to disseminate information on wetland conservation, the village heads did not have the knowledge, willingness or motivation to do this because they were also involved in wetland degradation.

The EMA had a legislative framework based on applying EIAs to assess whether requested projects on wetlands were falling under the EMA's scheduled activities. The EIAs were then followed by a permit that the EMA granted before the wetland could be used for any activity. The EMA permit system was not to stop crop production in wetlands but to ensure that agriculture and different activities do not cause wetland degradation. It also assist the EMA in having a wetland inventory that enabled it to keep track of the impacts of wetland activities

(Marambanyika and Beckedahl, 2016a). Permits were only granted after the EMA had assessed the wetland type and checked whether wetland users had management plans proposing how they would manage the wetland effectively. Despite having EIAs and permits in place, none of the Zindi residents knew about these rules, implying that these users received insufficient information about appropriate wetland laws. According to Marambanyika and Beckedahl (2016b), poor knowledge of wetland laws is mainly caused by the EMA's inadequate dissemination of information. Since wetland users in Zindi inherited farms from their parents, and some were allocated land in the wetlands after the tea estate took their dryland farms, none of these farmers were aware of the permit system requirement. However, the EMA emphasised the permit or licence system was mainly for people in urban areas whilst they did not consider rural farmers. This resulted in sensitive areas in rural wetlands being used for agricultural activities instead of being protected.

Although Matamanda *et al.* (2018) argued that the EMA had been involved in public awareness campaigns to teach people about wetlands and their management, none of these campaigns were done in Zindi. Therefore, the EMA still lacked suitable management strategies since it concentrated only on some wetlands and neglected others. The EMA official reported that the EMA would disseminate information to rural wetland users about laws, sustainable use, and wetland management through awareness campaigns such as roadshows. The EMA was also involved in wetland restoration and protection on some significant wetlands such as Driefontein and Songore. The EMA was therefore inconsistent in disseminating information to rural wetland users. These results are similar to the findings of Marambanyika and Beckedahl (2016b) on Dufuya, Madigane, Guruguru, Tugwi, Chebvuterambatemwa and Zungwi wetlands in Zimbabwe, where wetland users attributed their poor knowledge to inadequate information from the EMA. The fact that village heads were not aware of the EIAs and the permits shows that they were also not getting enough information from the EMA, even though the EMA relied on them to implement wetland policies and laws. According to the Ramsar Convention (2018), strategic environmental assessments are crucial since they can reinforce policies, schemes and projects that may affect wetlands. However, no strategic environmental assessment has been done for wetlands in Zindi. The wetland users were only getting permission from ZINWA to draw water from the wetlands using pipes, and these were granted through the Pungwe sub-catchment council. These permits were not robust enough to ensure sustainable use of the wetlands since the assessment was only done for water sources only whilst neglecting other aspects of the wetland.

The local EMA volunteers were also relatively ineffective in carrying out their duties. These volunteers who were trained by the EMA were supposed to disseminate information from the EMA, monitor how natural resources were used and write reports to the EMA. It was also part of their duties to report natural resource abusers to the EMA. As was noted in focus group 1, since the volunteers feared being victimised by the community, they were secretly carrying out their duties. Therefore, the volunteers were not popular with the community since wetland users considered them a threat. Although they would announce issues about natural resources management from the EMA at gatherings such as funerals, there was no evidence that they were monitoring whether people were degrading the wetlands. There was also no evidence of the volunteers reporting abusers to the EMA environmental officers even though wetland degradation took place. The volunteers ended up not willing to perform their duties considering the threats they received from wetland users.

The volunteers therefore acted as 'secret agents' for the EMA and were not working with the village heads, although the village heads and the villagers knew about them. The volunteers were consulting neither village heads nor wetland users when performing their duties. Failure of the volunteers to engage with the village heads who the villagers could respect meant that they were resented by the wetland farmers. Since the volunteers lacked backing from the local authority, it was difficult for them to execute their duties, and hence the villagers could not adhere to what they were telling them. The volunteers reside in the same villages as the wetland users and they were therefore compelled to maintain good relations with the villagers rather than push them to implement environmental laws. The volunteers were not motivated about their work because they were not receiving enough support from the EMA. This meant there was no proper monitoring of wetland policy implementation by the EMA in Zindi.

Although the use of social media through text messages sent to the residents' phones was a convenient way for the EMA to inform people about natural resources management, the residents reported that they only received messages encouraging them to avoid veld fires and not about any other relevant environmental issues. Although text messages were a convenient method of informing wetland users, some did not have phones and some could not read. Since they were no inspections or monitoring from the EMA, some farmers admitted that they used veld fires, resulting in loss of biodiversity and regulatory and support services. Therefore, text messages were not adequate to communicate environmental concerns from the EMA. Emphasise was also required through direct contact with wetland users.

The Local Environmental Action Plan (LEAP), which the EMA official noted that the EMA put in place to ensure that local authorities and the community identify environmental problems and solutions in their communities, was not implemented in Zindi. The local authorities such as councillors were expected to produce the LEAP management plans so that the EMA would help them source funds to address environmental concerns in their areas. Unfortunately, councillors were not involved in wetland management in Zindi, implying that they were either not aware of the LEAP process or that environmental management was not a priority. These results are different to Marambanyika and Beckedahl's (2016a) findings that showed that the rural district council was involved in managing wetlands. Non-participant in wetland management by the councillors in Zindi, who are considered high authorities in managing rural affairs, shows that wetland management was considered less important by the rural district authorities.

Although the EMA’s district environmental officers also resided in the district (Mutasa district), residents complained that their work was mainly on issuing fines to those caught degrading the environment rather than teaching people how to use and manage wetlands sustainably. The EMA official noted that the EMA relied on Agritex officers to implement wetlands laws but these officers were not fully involved in ensuring sustainable use and management of wetlands. The Agritex officers reported that they were mainly concerned with environmental and wetland education and not about law enforcement, because this was the remit of the EMA. Although the EMA relied on different institutions for enforcing wetland management laws, these institutions’ roles were not well defined. The traditional leaders, Agritex officers, EMA environmental officers and volunteers lacked planned institutional frameworks to implement wetland laws. These findings are similar to Mbereko *et al.* (2007) who argued that the failure of different institutions to manage wetlands resulted from the absence of institutional frameworks which affected how these institutions would enforce laws on behalf of the EMA.

Although the EMA had various laws that could be implemented, it does not have a national wetlands policy. The EMA official said that they were advocating for parliament’s approval of the National Wetland Utilisation Guidelines draft more than for development of a national wetlands policy. Since the national wetlands policy required more financial resources that were available, the EMA was still thinking about whether they needed the national wetlands policy in the first place, or whether to simply maximise the other policies they had. The EMA is answerable to the Ramsar Convention, and the Convention encourages its signatories to have a national wetlands policy. Therefore, the absence of this policy may make it challenging for the EMA to have comprehensive and implementable strategies for wetland management and conservation (Marambanyika and Beckedahl, 2016b; Matamanda *et al*., 2018).

6.8.3.2 Nature of support given by the EMA to wetland stakeholders

To ensure sustainable use of wetlands, the EMA official indicated that they relied on Agritex officers. Thus, they expected Agritex officers to peg gardens for farmers and then monitor wetland use. However, Agritex officers in Zindi were not doing this. The EMA assumed that the Agritex officers knew about community gardens yet the officers felt that it was not part of their job. Lack of communication with the EMA affected how the Agritex officers carried their duties. These results contradict Marambanyika *et al.*'s (2012) findings that showed that training programmes and awareness campaigns on wetlands at Chebvute wetland in Zimbabwe were carried out by the EMA officers, Agritex officers, donors and wetland users in collaboration. However, the general set-up on wetlands in Zindi was different, since no institution had primary control on wetland management.

Wetland restoration projects and sustainable wetland utilisation projects, which involve supplying fencing material to protect primary water sources, were being done in some areas by the EMA. The EMA official indicated that they gave such support to some large wetlands such as Driefontein in Masvingo and Songore in Murehwa. However, small valley bottom wetlands such as Zindi were usually overlooked even though they contributed to rural livelihoods. The EMA had limited capacity to support sustainable wetland utilisation projects on wetlands in rural areas, so small valley bottom wetlands continued to be used uncontrollably.

6.8.4 The role of seed companies

6.8.4.1 Production of seed varieties

The production of both hybrid and open-pollinated seed varieties by different seed companies for small and large grain seeds, legumes, and vegetables has helped improve Zimbabwe's food security. Some of the maize seeds used in wetlands included Pannar 53, ZAP 43, ZAP 513, K2, K61, K65. Despite the substantial effort made by seed companies in breeding seeds, the uptake by farmers was limited. Most farmers preferred retaining seeds and were using their traditional maize seed locally known as *Chimanyika*. However, traditional uncertified maize seed often loses its quality and production capacity, which is a problem. Limited resources to buy hybrid and open-pollinated seeds made farmers look for alternatives to grow in wetlands. Since there is limited research on wetland agriculture, most farmers used their discretion in selecting seeds that could ensure high yields. Farmers knew the importance of using certified seeds more than retaining low-quality seeds, although most farmers could not afford them. Breeding by Mkushi Seeds of nutritionally improved hybrid maize seeds with high protein value was crucial for peoples' health. Unfortunately, such maize seeds had not yet reached areas such as Zindi since Mkushi is still a small company. Some seed companies' failure to reach remote areas such as Zindi can be attributed to a lack of resources that left smallholder farmers with no choice but to use any seeds available to them. The smallholder farmers' purchasing power also determined the types of seeds they were receiving in their area.

6.8.4.2 Involvement of smallholder farmers in breeding and producing seed

Seed companies are engaged in participatory seed breeding. Participation of farmers in seed improvement research is essential for improving seed research by the contribution of farmers' suggestions and comments (Ceccarelli *et al*., 2009). Although seed companies said that they were engaging with smallholder farmers in breeding and producing their seeds, the contributions of these farmers were not considered at all research and development stages. CYMMTY seed company indicated that they were engaging with smallholder farmers during on-farm trials, however some farmers could not afford transport to visit the companies. Therefore, the on-farm trials were more beneficial to commercial rather than smallholder farmers. The Pioneer seed company official said that smallholder farmers' contributions were not considered during seed testing, which shows that they were not involved in all breeding stages. Failure to consider all the views of smallholder farmers meant that some seeds were not suitable for the different environmental conditions that affected their crops, or for addressing the specific needs of the farmers.

Agronomists and the field extension officers from seed companies such as Seed-co, Agriseeds, Pioneer and Mkushi stationed in rural districts were essential for occasionally engaging with farmers to get feedback about their seeds' performance. The engagement of farmers from planting to harvest is an appropriate way to get feedback from farmers throughout the crop growing process. Although seed companies would sometimes visit farmers in Zindi to test their seeds for breeding and marketing the approved seeds, not much was being done by these seed companies since the adoption rate of certified seeds was low. Provision of seeds to farmers for testing by Seed-co and Agriseeds motivated the farmers to engage in seed trials, and in these circumstances small-scale farmers were considered important stakeholders to test the suitability of hybrids under field conditions, because they were consulted before the variety was approved and put on the market. However, this was only done by large, well established companies. Small companies could not afford to provide farmers with free testing seeds. This meant that Zindi area would sometimes be left out of such programmes.

Although seed companies would engage smallholder farmers in initial stages of developing seeds, the seed companies were contracting large-scale commercial farmers to produce seeds by providing them with inputs. Most seed companies, except Agriseeds, did not involve small-scale farmers in producing seeds for sale due to their limited production capacity. At this stage, the views of the smallholder farmers were therefore neglected and the large-scale farmers tended to benefit more. Since the seed companies emphasised developing hybrid seeds more than open-pollinated varieties, it was the commercial farmers that were mainly consulted when breeding seeds. Failure to engage with smallholder farmers throughout all the breeding stages would leave some wondering whether the seeds made available to farmers were suitable for their specific agro-ecological conditions, or that they were just being persuaded to buy them. The commercial farmers' market would be given priority for the hybrid seeds, rather than the small-scale farmers who preferred open-pollinated varieties since they are cheaper. According to Morris *et al*. (1998), seed companies tend to neglect smallholder farmers in marginal zones who do not represent a good market for selling improved hybrid seeds. Thus, apart from consulting the farmers for breeding and producing seeds, the seeds companies were also looking for profitable markets which meant they sidelined smaller wetland farmers.

6.8.4.3 Agronomy support given by seed companies

The study established that seed companies were giving agronomy support to smallholder farmers on conservation farming. Some of these sound conservation farming methods included crop rotation, intercropping, retaining open-pollinated varieties twice only, and encouraging farmers to use hybrid seeds rather than open-pollinated seeds, and crop management that included land preparation soil testing and crop post-harvest controls. Despite having different seed companies that all reported supporting smallholder farmers with different agronomy practices, none of the residents reported being taught conservation farming methods or crop management techniques. Poor delivery of agricultural extension services to communities such as Zindi revealed that seed companies were selective when delivering their services since they mainly work with farmers from only specific areas. Seed companies stated that they wanted to support all livelihoods in Zimbabwe through breeding suitable seeds for all farmers, but they were not actually doing that. In the process, some rural areas were left behind while other communities benefitted. Since no institution was fully involved in teaching appropriate wetland farming methods, Zindi farmers still used traditional methods. Failure of the seed companies to be interested in dissemination agricultural extension services was also due to the community's low purchasing power. Despite encouraging smallholder farmers to buy hybrid seeds, few were buying them. Giving preference to those farmers who were buying the hybrid seeds would always leave poorer and more vulnerable farmers risking having low yields. In such cases, poverty's vicious circle is difficult to break since farmers would still use traditional seeds with low returns and traditional farming methods, hindering improved yields and food security.

6.8.4.4 Production of seeds for different agro-ecological regions and wetlands

The study established that seed companies took a holistic approach when breeding seeds by considering all the critical factors such as rainfall, altitude, temperature, soil and humidity. Coming up with open-pollinated and hybrid varieties was essential for farmers with variable incomes and those with high incomes so that each farmer could purchase what was affordable to them. The maize seed hybrids ranged from early maturity to late maturity or short season to long season, depending on the length of period that it would take for the crops to be ready in different agro-ecological regions. However, when looking at the different stresses the varieties could endure, the seed companies would look at whether the varieties were drought and heat tolerant. When evaluating the new seed varieties, wetland traits were not considered. Although most seed companies were breeding seeds suitable for different agro-ecological regions, which were drought and heat tolerant, they ignored the fact that most farmers in rural Zimbabwe had moved from dryland to wetland farming. Climate variability has also led to an increase in Zimbabwe's arid conditions overall (Chikodzi *et al.*, 2013), making rain-fed agriculture less productive, and wetland agriculture has become common. Research on wetland conditions for breeding seeds suitable for these conditions was therefore lacking among the seed companies.

Although the Agriseeds official attested that they were producing seeds suitable for wetlands, the only trait they were looking at was for water availability whilst ignoring other conditions such as soil type and the types of common plant diseases in wetlands. Although CYMMTY is the largest company for wheat and maize seed development in Zimbabwe, it does not research wetland farming since it relies on donors who consider wetlands as sensitive areas not to be exploited. Dixon (2005) argued that although wetlands play an essential role in livelihood sustenance, especially in developing countries, few governments openly encourage or support their utilisation and development. Since the EMA was not openly encouraging rural dwellers to use wetlands for agriculture, breeding seeds suitable for wetland agriculture was also not a priority for seed companies since (officially) they considered them as sensitive areas not meant for agriculture.

The Pioneer official mentioned diseases associated with wetland crops such as the maize streak virus, and that more research needed more resources for breeders to develop seeds suitable for wetland agriculture. Seed companies were therefore reluctant to invest in research on wetland agriculture since it was costly. Since some companies saw growing of crops on wetland as a sideline effect from dryland cultivation, they were not motivated to produce seeds suitable for wetland agriculture specifically. Breeding and producing seeds for wetlands was therefore not seen as a priority since wetland farmers were planting the same seeds they were purchasing for dryland farming. Also, since they were not actively soliciting reviews about their seeds' performance in wetlands, the seed companies assumed that all the small-scale farmers were satisfied with the performance of seeds bred for drylands but used in wetlands. While small-scale farmers would buy seeds and retain them several times, it was a less profitable market and seed companies lacked the drive to engage in wetland research. Zimbabwe has regulations on seed breeding such as the Seed Certification Regulations and the Plant Pests and Diseases Regulation which was passed in November 2016, but it does not have a specific seeds policy (Mabaya *et al*., 2019). The absence of a seeds policy affects the type of research done on breeding because of the lack of proper seed breeding guidelines.

6.8.5 Interactions between different stakeholders

The study revealed that village heads interacted with Agritex officers in natural resources management but neither of these had wetland management guidelines and frameworks to help them. The absence of meetings between village heads and Agritex officers implied a lack of coordination to ensure sustainable wetland use and management. According to Marambanyika and Beckedahl (2016a), how different stakeholders relate to each other in controlling the use of wetlands is essential in eliminating possible conflicts. Village heads and Agritex officiers did not have a consistent approach of ensuring the sustainable use of wetlands. Although village heads had meetings with the EMA three times per year, Agritex officers were not invited. Village heads also felt that the information they were getting from the EMA about wetland use and management was inadequate. The village heads' adverse reporting about these meetings revealed that the EMA left a lot to be desired and that these meetings were not helpful in ensuring wetland sustainability.

Although the EMA official reported that they were relying on Agritex officers to implement wetland laws, there was no evidence of any interactions through meetings between the EMA and Agritex officers. The EMA assumed that Agritex officers would carry out their roles of implementing wetland laws whilst Agritex officers did not see this as their duty but rather to guide and teach people. Lack of collaboration between the EMA and Agritex officers led to confusion and significant information gaps.

Although agriculture was a primary activity on all the six valley bottom wetlands, the EMA and other stakeholders were not concerned with interacting with seed companies which meant that the needs of wetland farmers continued to be neglected. Marambanyika and Beckedahl (2016a), however, showed that there was active collaboration between the EMA, rural district council, environmental officers and councillors on wetland issues in Tongagara, Runde and Vungu districts, Zimbabwe. Such collaboration ensured greater sustainable use and management of wetlands in the districts where different stakeholders interacted. However, such interactions did not take place in Zindi.

Instead of the different stakeholders collaborating, some were just concerned with ensuring that people pay for specific wetland resources. When Zindi farmers were meant to pay for permits to draw water from wetlands using pipes, they felt that they were being manipulated because seeking permission for these permits prompted them to pay at every stage. Payment to different people such as village heads, the chief and ZINWA in US dollars was too expensive. Therefore such fees discouraged people from legally engaging in irrigation farming. However, water permits were seen as an appropriate method of trying to control the use of wetland resources. The traditional leaders and ZINWA failed to coordinate to reduce the fees or assist more residents in drawing water for irrigation. The traditional leaders also insisted on payment of hefty fees that were not even gazetted, instead of supporting irrigation agriculture for free.

Although ZINWA, as a government body, could have been charging gazetted fees, their fees were too high for farmers who mostly could not afford them since many were not formally employed. Charging these fees made wetland users angry where they felt they had a right to use the wetland resources for free. The fees were therefore viewed by the community as exploitative and explains why the community failed to respect and trust traditional leaders and ZINWA officials. Thus, tensions between wetland users and local leaders hindered cooperation. Since no explanation was given to wetland users on the nature and purpose of fees for using pipes, the different institutions such as ZINWA and traditional leaders were viewed as threats to their free access to wetland water.

6.9 Implications of wetland conflicts

Conflicts on land, as reported by interview respondents 2, 4 and 27, indicated increased pressure for crop production on wetlands. As the number of people using wetlands increased, there was increasingly limited space. Thus, through manipulating boundaries by taking other pieces of land from their neighbours' fields, some people thought they could increase the land in their farms to increase productivity. Wetlands are considered valuable and a source of wealth for residents of Zindi. In some cases, conflicts were resolved by paying for the land as compensation to the landowner, and this was done by traditional leaders who would successfully preside over these land conflicts. Thus, traditional leaders were valued most for settling social issues to ensure peace in their communities, more than they were valued for providing leadership on wetland use and management.

6.10 Factors that affect the general conditions of rural wetlands in Zimbabwe

The EMA and Agritex officials reported that most rural wetlands in Zimbabwe were degraded and that this was due to increased rate of wetland destruction by human activities. People were carrying out different wetland activities without proper measures that could ensure wetland sustainability. Lack of proper training on wetland management was compromising wetland integrity. The Ramsar Convention encourages the wise use of wetlands for livelihood sustenance as well as wetland sustainability but residents in Zindi were not sure whether the government had legally allowed people to use wetlands or not. Although Agritex officers reported a need for soil testing, such assessments were supposed to be done by the EMA and seed companies but did not take place. Failure of the EMA to protect sensitive areas of wetlands reflects the fact that the EMA did not readily engage with farmers on the support they required for wetland management. The farmers continued to grow crops in sensitive areas that were not meant for crop production.

6.11 Wetland use and sustainable development

Human wellbeing and wetland ecosystem services are linked. According to the Millenium Ecosystem Assessment (2005b), the ecosystem services provided by wetlands include provisioning (food, fresh water, fibre, fuel, biochemical and genetic materials), regulatory (water purification, water treatment, water regulation, climate regulation, erosion regulation, natural hazard regulation and pollination), cultural (spiritual, inspirational, recreational, aesthetic and educational), and supporting services (soil formation and nutrient cycling). The valley bottom wetlands provide various ecosystem services that support livelihoods (Figure 6.1). However, exploitation of wetland ecosystems services also affected other services, either negatively or positively. While humans influenced provisioning services through agricultural exploitation, they also modified supporting, cultural, and regulatory services. According to the Millennium Ecosystem Assessment (2005c), the growing demand for food and clean water has increased the exploitation of provisional services whilst at the same time reducing the potential of other services to meet these demands. The main challenge in wetlands is the increase of one ecosystem service at the expense of others. Thus the increase in food production in Zindi affected soil fertility and the water regulation capacity of the wetlands. Diversion of water through trench digging led to the drying up of some areas whilst soil was also losing its fertility due to agriculture. Although these wetlands could still supply people with food, respondents reported a reduction in yields as compared to the past. However, changes in other ecosystem services resulting from unsustainable agricultural practises also affected provisioning services. Thus, the growing demand for provisioning services has increasingly led to wetland degradation and reduced capability of wetlands to provide these services (Millenium Ecosystem Assessment, 2005c).

Although some services such as soil fertility could be replaced with fertilisers, some services were difficult to replace. As was noted by some respondents, the removal of wetland vegetation led to the local extinction of some plant species and the spread of invasive species. The valley bottom wetland helps in ensuring food security and socioeconomic sustainability. The exploitation of the wetlands' ecosystem services therefore play a vital role in achieving the

United Nations' Sustainable Development Goal (SDG) number three, which is to ensure good health and wellbeing for all people. However, such an achievement cannot be generalised for all the Zimbabwean population, or for the developing world as a whole. The challenges of pests and diseases that people were facing when utilising wetland for agriculture also impacted on the farmers. Support from different institutions such as seed companies and the EMA for sustainable use of wetlands was lacking. If support was fully rendered, yields may have been increased to improve social and economic status through high yields for food security and more income generation.

The methods used to derive benefits from the wetlands have caused the loss of water, biodiversity and soil fertility, thereby compromising the wetlands' integrity, intactness and hydro-ecological health. The unsustainable agricultural methods farmers were using have led to wetland degradation. In this case, wetland sustainability is threatened. Wetland exploitation for agriculture has concentrated on reducing poverty at the expense of wetland integrity (Nyamadzawo *et al.*, 2015a). The continuous loss of these ecosystem services will in turn decrease the benefits that future generations can obtain from wetlands (Millenium Ecosystem Assessment, 2005b). Management institutions seemed to be unaware of the wetlands' status, and how other ecosystem services had deteriorated, hence they continued to be reluctant to enforce wetland laws. However, reversing the wetlands' damage can be challenging since wetland restoration is not common in Zimbabwe and requires significant, coordinated and integrated management strategies.

Although these wetlands ensured local socioeconomic sustainability, this cannot necessarily be enjoyed for the long term if agriculture practices are not sustainable. Thus, the exploitation of these wetlands was crucial in partly fulfilling SDG number 2. Through provisioning services they help achieve food security and improve nutrition, but sustainable agriculture was not fully supported by all stakeholders. However, wetland farmers in Zindi prioritise food security at the expense of environmental sustainability. Failure of management institutions such as the EMA to monitor the other wetland ecosystem services makes it challenging to measure the altered ecosystem services' influence relative to socioeconomic and cultural issues that affect the residents' livelihoods (Millenium Ecosystem Assessment, 2005b). Although the Ramsar Convention encourages the wise use of wetlands by preserving the ecological characteristics of wetlands using conservation approaches of biodiversity (Ramsar Convention Secretariat, 2010c), 'wise use' has been shown not to have been achieved in Zindi wetlands. Since biodiversity supports all types of ecosystem services, the loss of support services means losing other important ecosystem services to people, such as provisioning services (Christie *et al.*, 2012). As the supporting services deteriorate, the cultural services provided by wetlands are also being lost.

Sustainable development can only be achieved if the three pillars of sustainability (social, economic and environmental) are fulfilled (Albaladejo *et al*., 2021). However, overexploitation of provisioning services in Zindi compromised environmental sustainability, and hence overall capacity for sustainable development. Since these ecosystem services are related (Figure 6.1), one ecosystem service cannot be exploited without affecting other services. Thus, the sustainable development of wetlands needs to be considered holistically through the interlinkages between different services of different types. Overexploitation of wetlands through continuous uncontrolled use is putting the wetlands at risk of destruction. As a result of the weak management institutions such as the EMA, traditional leaders and Agritex officers, wetland ecosystem services will continue to be depleted unless action is taken. SDGs number 6 (clean water and sanitation), and number 13 (climate action by reducing carbon and greenhouse emission) can be challenging to achieve in Zimbabwe if wetlands are not used sustainably. The loss of regulatory services can affect the climate regulation potential of wetlands achieved through carbon absorption, flood regulation and pollution control. The absence of clean water and effects of climate change can also influence the achievement of SDG number 1 (eradication of poverty) since these two factors can affect livelihoods. Since wetland farmers could send their children to school using the income generated through provisioning services, the deterioration of supporting and regulatory services may then affect education and socioeconomic development. This is because diminishing supporting services and regulatory services can affect agricultural yields leaving farmers with no surplus for sale. Continuous depletion of the critical ecosystem services will affect the poorest and most vulnerable societies like wetland farmers in rural areas, since it would be challenging for them to derive significant benefits from provisioning services. Such a scenario will then increase poverty.

The various qualitative ethnographic techniques such as participatory action research, individual interviews, focus group information, direct observation and participatory observation used in this study were appropriate in investigating the use of wetlands. These ethnographic techniques gave an understanding of how people were interacting with wetlands and the challenges farmers were facing in using these wetlands for agriculture. These methods also assisted in answering the research questions. Most previous research approaches used to explore people’s lived experiences as they interact with wetlands have employed mixed methods approaches, combining qualitative and quantitative methods (Svotwa *et al*., 2008a; Hardlife *et al*., 2014; Mbereko *et al*., 2015; Marambanyika and Beckedahl, 2016a, 2016b). Although some previous wetland studies such as Dixon (2005), Ndlovu and Manjeru (2014) and Matenga (2019) used qualitative methods only, they did not use various ethnographic techniques. Since the use of various qualitative enthographic techniques has proven appropriate in soliciting rich data about the use of wetlands, it is crucial that future similar studies adopt similar techniques. Future studies can also subtantiate these ethnographic techniques with quantitative approaches.

6.12 Chapter summary

The results of this study show that while wetlands are utilised for various purposes, wetland users prioritise provisioning ecosystem services at the expense of other yet critical services. However, exploiting wetlands for agricultural purposes was met with many problems such as pests and diseases. The use of some sustainable farming methods helped improve the yields, whilst unsustainable farming methods threatened wetland integrity, ecosystems and ecosystem services. Poor implementation and enforcement of wetland laws and lack of coordination between the varied stakeholders affected the sustainable use and management of wetlands. Lack of cooperation from wetland users also discouraged the traditional leaders, volunteers and Agritex officers from implementing and enforcing wetland laws and monitoring the use of wetlands. These results are summarised and set in a wider future research context in the next chapter (Chapter 7), where conclusions of this study are presented.

Chapter 7: Conclusions and Recommendations

7.1 Introduction

In this concluding chapter, a summary of the essential findings and lessons learnt from how people use rural wetlands is presented. Three components are discussed in this chapter. These are exploring the summaries of the main findings and their implications in line with the study aims, recommendations for different stakeholders such as the government, environmentalists, seed companies and policymakers, and possible future research focusing on sustainable rural wetland use.

7.2 Recapping of the findings

This study aimed at understanding how rural farmers in Honde Valley, Zindi area, use and interact with wetlands, and evaluating the different problems encountered by the farmers in using wetlands for agriculture. This study provides substantial evidence on how small valley bottom wetlands have contributed to livelihood sustenance and food security through provisioning ecosystem services. Valley bottom wetlands play an essential role in providing basic requirements for rural livelihoods. Apart from contributing to food security, these small wetlands also contribute to income generation by providing different natural resources and agricultural products. Rural livelihoods in semiarid or seasonally water-scarce areas are therefore dependent on wetlands for agriculture as a key element of their sustainable development strategies. The exploitation of wetlands through agriculture by growing various crops and collecting traditional vegetables, medicines and hunting of mice and grasshopper increased the interactions and synergies between local people and the wetlands.

The conversion of valley bottom wetlands for agriculture was seen as the only solution to the socioeconomic needs of food insecurity caused by unemployment, and shortage of land for farming after the Eastern Highlands Tea Estate Company occupied community dryland farms. A decrease in rainfall by climate change also compelled farmers to turn to wetland farming as an alternative way to deal with the risk related to climate variability, such as poor crop yields. However, wetland farmers have encountered significant challenges such as diseases and pests that have affected crop yields, and these have been difficult to control. Emphasis on conservation dryland farming by the government through the Agritex officers has led to the adaptation of dryland conservation methods on wetland farms. Failure to fully adapt to new sustainable farming practices such as the use of storm drains and buffer strips in preference to traditional farming practices such as streambank cultivation, burning of vegetation, and digging of trenches revealed some farmers' stubbornness and lack of information about the benefits of sustainable wetland farming methods. Therefore, farmers were giving priority to high yields at the expense of sustainable use of wetlands. However, unsustainable farming methods also compromised wetland sustainability, where trenches developed into streams, some plant species and animal species were no longer found in the wetlands, and some parts of the wetlands were drying up. Although wetlands contributed to socioeconomic sustainability, unsustainable agriculture affected wetland integrity, and hence sustainable development was threatened.

Interactions between different users and stakeholders has influenced how wetlands were used and managed. Interactions between different farmers allowed them to share farming ideas and seeds, which helped them improve their yields. Although interactions between traditional leaders and wetland users enabled them to share farming ideas and enforce local wetland laws, the traditional leaders were not keen on enforcing wetland laws due to kingship issues. Therefore, not much was being done by traditional leaders. The EMA indirectly interacted with the farmers in implementing wetland laws, wetland restoration and management. The investment of wetland management powers in the formal government structures such as the EMA and the use of a top-down approach to wetland management proved to be unsuccessful in ensuring sustainable use and management of wetlands. The interactions between Agritex officers and farmers reflected by hostile relations in five of the wetlands, and only good relations found in Madimbo wetland contributed positively to its sustainable use. Reliance of the EMA on other stakeholders such as traditional leaders, EMA volunteers and Agritex officers in the implementation of wetland laws was not effective. This management structure threatened wetland sustainability since the EMA did not have a structured framework for wetland management.

Failure to have defined roles among the traditional leaders and Agritex officers affected how the wetlands were used and managed. The EMA relied on the traditional leaders and Agritex officers to implement wetland laws since they had everyday interactions with wetlands users. However, the traditional leaders and Agritex officers felt that they were not getting enough support from the EMA who did not acknowledge their efforts. This meant they were not motivated to participate in ensuring sustainable use of wetlands. Seed companies were not all actively involved with wetland farmers, to receive their ideas and contributions in breeding seeds or in teaching them different agronomy practices that could boost farmers' yields. However, small-scale farmers were not engaged throughout the crop breeding process. Most seed companies were not producing seeds suitable for wetland agriculture since the EMA was not openly encouraging wetland farming. The interaction between wetland users and other stakeholders also impacted on wetland management strategies and coordination. Surprisingly, there was no collaboration between different stakeholders on wetland use and management. The complexity of rural livelihoods and the dependence of local people on wetlands for survival made it challenging to engage with external authorities and institutions in wetland management.

7.3 Conclusions

The following conclusions are drawn from this study:

(i) The Zindi community benefited from the valley bottom wetlands through different ecosystem services but the different agricultural practises impacted affected the wetland integrity.

(ii) Some farmers were using certified seed varieties from the seed companies but the seed companies were excluding the views of smallholder farmers during seed breeding process.

(iii) The Zindi Community valued the wetlands mainly for their provisional services. The EMA was therefore not consistent in spreading awareness about management of wetlands and valuing other ecosystem services such as regulatory, cultural and supporting services.

(iv) The use of top-down approach has proven to be unsuccessful in ensuring sustainable management of wetlands since the traditional leaders and Agritex officers had limited powers and undefined roles in enforcing wetland laws.

(v) There was no integration between the indigenous knowledge systems, customary laws and modern arrangements for sustainable use of wetlands.

(vi) The Ministry of Lands, Agriculture, Water, Climate and Rural Settlement through the Agritex officer give emphasis to conservation dryland farming only whilst ignoring wetland farming.

(vii) The EMA was not carrying out ecological assessments on small wetlands such as valley bottom wetlands. Sensitive areas these valley bottom wetlands were not protected through fencing hence the farmers continued to grow crops on these sensitive areas. The EMA concentrated on protecting mainly the Ramsar sites.

(viii) There was lack of co-operation between different stakeholders such as the EMA, traditional leaders, Agritex officers, ZINWA, seed companies and wetlands users in ensuring sustainable use and management of wetlands.

(ix) The ZINWA was charging exorbitant fees for water permits and annual water payments for those farmers using water pipes. However, most farmers could not afford to pay these fees hence they resorted to use water without paying these fees.

(x) The EMA did not have legal frameworks that assisted other institutions such as traditional leaders, Agritex officers, EMA environmental officers, the ZINWA and the EMA volunteers in implementing and enforcing wetland laws and monitor the use of rural wetlands in a coordinated way. There are limited resources allocated by the government to ensure management of different types of natural resources in Zimbabwe. Wetland management is not clearly considered in government plans as such the Zimbabwean government does not have an updated wetland inventory and a wetland policy.

7.4 Recommendations

Based on the abovementioned results, the following recommendations for wetland users, traditional leaders, the government, the EMA, ZINWA and seed companies can be proposed.

(i) Although wetland users benefitted from wetlands in different ways, they should reflect on the impacts of different methods of exploitation on wetland integrity, ecosystems and ecosystem services. The increased use of wetlands for farming has caused wetland degradation. Therefore, emphasis should also be placed on sustainable agricultural methods and management of wetlands by wetland users, rather than only focusing on food security.

(ii) Since wetland farmers also used certified seeds in wetlands, seed companies should contract the small-scale farmers throughout the seed breeding process and avoid excluding their suggestion, ideas, and contributions at some stages, such as the seed production stage. Seed companies should monitor yields and agricultural practices on wetlands.

(iii) The EMA should be consistent in spreading awareness, training, and education on sustainable use and management of wetlands to Zimbabwe citizens and wetland users. Apart from valuing wetlands mainly for provisioning and cultural services, the EMA environmental officers should teach the wetland farmers to value wetlands for regulatory, cultural and supporting services. Since the study has shown that the small valley bottom wetlands are important in supporting rural livelihoods, the EMA should also consider these wetland types when monitoring and inspecting the use and management of wetlands in Zimbabwe. These wetlands should also feature in any future national wetlands inventory.

(iv) Since the top-down approach has proven unsuccessful in ensuring the sustainable use and management of wetlands, the government and EMA should rethink implementing a bottom-up approach which encourages the decentralising of wetland management powers through the active involvement of local communities and user groups. Traditional leaders and Agritex officers should have more powers to implement and enforce wetland laws and that these roles and actions are overseen by the EMA. The roles of the Agritex officers and traditional leaders should be well defined to avoid overlap of duties. The EMA should rethink community-based resource management structures that ensure that the communities are engaged in sustainable wetland use and management decisions, and that these groups are held accountable to the EMA.

(v) The government and the EMA should ensure that indigenous knowledge systems, customary laws and modern arrangements are integrated as a holistic approach to ensure sustainable utilisation and management of rural wetlands.

(vi) The Ministry of Lands, Agriculture, Water, Climate and Rural Settlement should restructure the Agritex officers' duties so that emphasis is not given on dryland farming only but also to wetland farming, and that this is set according to the principles of sustainable and conservation agriculture.

(vii) The EMA should reconsider carrying out ecological assessments on small wetlands such as valley bottom wetlands and protect sensitive areas on such wetlands through fencing and other measures. The EMA should be consistent in discouraging agriculture on sensitive wetland areas. Protection should not be given only to Ramsar sites and extensive wetlands but to smaller wetlands as well because of their roles in biodiversity and ecosystem services for local communities.

(viii) The EMA should spearhead cooperation between different stakeholders such as the EMA, traditional leaders, Agritex officers, ZINWA, seed companies and different wetlands users. Such collaboration can be encouraged through meetings and openly declaring the wise use of wetlands as a shared and primary goal. Thus, the EMA should openly encourage and support the wise use as declared by the Ramsar Convention. The EMA and the Ministry of Lands, Agriculture, Water, Climate and Rural Settlement should then engage with seed companies to ensure that they support farmers by breeding seeds suitable for wetland agriculture, and actively engage with such farmers in seed research.

(ix) The ZINWA should review the fees charged for water permits and annual water payments for those farmers using water pipes, so that affordable fees are charged to encourage farmers to engage in irrigation farming on dryland to reduce pressure on wetlands. The ZINWA should also encourage sustainable water use and the collection of rainwater. Alternative farming and economic activities such as fish farming and beekeeping should also be encouraged to minimise wetland resources disturbance.

(x) The EMA should structure legal frameworks that assist other institutions such as traditional leaders, Agritex officers, EMA environmental officers, ZINWA and EMA volunteers in implementing and enforcing wetland laws and monitor the use of rural wetlands in a coordinated way. The government should prioritise and mobilise resources to ensure natural resource management of different types. Thus wetland management should also be explicitly considered in government plans. As encouraged by the Ramsar Convention, the government should have a wetlands inventory and policy to assist in protecting wetlands in Zimbabwe.

7.5 Future research priorities

A number of future research priorities can be identified.

(i) Since agriculture is the dominant economic activity on rural wetlands, there is a need for further research by seed companies in collaboration with the EMA on different wetland conditions and their soil and water requirements, to breed improved seed varieties suitable for wetlands. Such research should consider testing wetland soil and water in breeding appropriate seeds.

(ii) More research should be done on the nature of pests and diseases that affect wetland crops to develop effective pesticides to control pests and diseases. Research should look into environmentally friendly and sustainable methods of eliminating pests and diseases, such as biological control. This also includes monitoring and eradicating invasive species that can threaten wetland biodiversity and agricultural production.

(iii) More research should also be done on the impacts of the loss of wetlands on rural livelihoods, including socioeconomic factors, cultural factors, and local governance.

(iv) Not all rural wetlands are used in the same ways. Wetlands in different agro-ecological regions have different characteristics from the ones examined in this study. Since these wetlands have different characteristics, they might be used differently by people or concern different stakeholders. Therefore there is a need for research to be carried out in other regions in Zimbabwe in order to identify national-scale factors related to wetlands and their uses.

(v) Wetland inventories need to be established that consider and examine the properties and dynamics of wetlands as integrated environmental and hydro-ecological systems. This will allow for a better understanding of wetland processes and dynamics and therefore can help identify the best strategies for wetland sustainable development.

(vi) Future research should focus on the economic valuation of wetlands (assigning quantitative and monetary values to ecosystem services and goods that wetlands provide) to guide policymakers and planners in making policies and developmental plans suitable for such valuations.

(vii) Most wetland restoration programmes have concentrated on the restoration of large wetlands such as the Songore wetland, but have neglected small wetlands. Future research should also look into favourable ways of restoring small wetlands, such as the valley bottom wetlands since they contribute most to rural livelihoods.

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Appendices

Appendix 1: Confirmation letter from supervisor

School of Geography, Archaeology and Environmental Studies

Private Bag 3, Wits 2050, South Africa   Enquiries: GEOGRAPHY: TEL: +27 11 717-6503 • Fax: +27 11 403-7281
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UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

To:
District Administrator
P. Bag 7113
Mutasa

Dear Sir/Madam,

Letter of confirmation for Emmah Mandishona (965109)

This letter is to confirm that Emmah Mandishona is a fulltime PhD student in the School of Geography, Archaeology and Environmental Studies at the University of the Witwatersrand, Johannesburg, under my supervision. The title of her study is *Rural wetlands use and sustainability, The case study of Honde Valley rural area in Zimbabwe*. Emmah has so far completed her research proposal, which has been approved by the Faculty of Science, and she has also received ethics clearance from the university for her project. I would be very grateful if you can facilitate her access to wetlands and communities in the Honde Valley, Zimbabwe, so that she can collect field data. Please do not hesitate to contact me if you have any questions.

Yours faithfully,

Prof Jasper Knight
Professor of Physical Geography
School of Geography, Archaeology and Environmental Studies
jasper.knight@wits.ac.za
tel 0027 11 7176508

Appendix 2: Interview Schedule for in-depth interview with EMA official

1. Would you please introduce your history with this organisation?

2. What is the mandate of your organisation?

3. Do you expect to have an inventory of all the wetlands in Zimbabwe?

4. What challenges are you facing in trying to make an inventory of all the wetlands in Zimbabwe?

5. Do you have laws that guide against wetland use in Zimbabwe?

6. What measures have you put in place to ensure that these laws are implemented?

7. What challenges do you normally face in trying to ensure that these laws are implemented especially in rural areas?

8. Do you ever face political challenges as an organisation in trying to execute your duties?

9. If so what type of political challenges do you normally face?

10. How have you dealt with these challenges?

11. How do you support the rural people in using the wetlands sustainably?

12. What do you encourage people to do before they start using wetlands?

13. How have you tried to engage the rural communities in making decisions pertaining to wetland use and management (making wetland laws)?

14. How have you been helping people to use wetlands wisely?

15. Do you have other management institutions in rural areas that ensure sustainable use of wetlands?

16. What can you say about the status of rural wetlands in Zimbabwe?

17. What are you planning to do to stop continuous loss of wetlands?

18. Since Zimbabwe does not have a national wetland policy, are you advocating for a national wetland policy?

19. What plans do you have pertaining to the use and management of rural wetlands?

Appendix 3: Interview schedule for in-depth individual interview with the seed companies officials

1. What is the main focus of your organisation?

2. How long have you been operating?

3. What type of seeds do you make?

4. Since you started operating what has been the impact of your seeds to the rural farmers' crop production?

5. Do you make a variety of specific seeds for specific agro ecological regions in Zimbabwe?

5. How have you improved your seeds to suit wetland agriculture?

6. Do you engage rural farmers in making your seeds? If so how do you consider the ideas from these farmers?

7. Do you have competitors who focus on producing seeds for specific areas such as wetlands?

8. What are people' perceptions on your seeds?

9. What advice do you give to rural farmers who use your seeds?

10. What challenges have you faced in trying to make sure that people adopt your seeds and ideas?

11. What have you done to solve these problems?

12. What policy advice can you suggest for the government, EMA and Ministry of Lands, Agriculture and Rural Settlements to impose especially for those people in rural areas who use wetlands for agriculture?

Appendix 4: Interview schedule for in-depth individual interview with the Agritex officer

1. For how long have you been working in this area?

2. What are your main duties as an AGRITEX officer in this rural area?

3. How do you encourage people to grow crops on wetlands?

4. What laws and regulations have been put by the Ministry of lands, Agriculture and Rural settlements on rural wetland use?

5. As an AGRITEX officer how do you ensure the implementation of these laws and regulations?

6. What support services do you give to these small holder farmers pertaining to all the challenges they face in growing their crops on wetlands?

7. What new agricultural extension approaches are you employing to ensure the farmers to take initiatives in the sustainable use of wetlands?

8. What is your opinion on these agricultural extension approaches on sustainable farming?

9. Do you train farmers on how they should grow their crops on wetlands?

10. What have you observed on the way people are using wetlands for agriculture here in Honde Valley?

11. What challenges do you face in dealing with these farmers?

12. What advice do you normally give people pertaining to growing crops on wetlands?

13. What sustainable methods of agriculture would you want the farmers to use when growing their crops?

14. What are your perceptions on how people are using wetlands here in Honde Valley?

15. What do you think the government should do to ensure that wetlands are used sustainably?

16. How do you work with the following people in ensuring sustainable use and management of wetlands: the village heads, EMA officials and different seed companies?

17. Are the wetlands in Honde Valley in your opinion in good health or they are degrading?

Appendix 5: Interview schedule for in-depth interview with Zindi, Honde Valley residents

Section A: Background information

1. Gender: Male ☐ Female ☐

2. Age: 18- 25 years ☐ 26-35 years ☐ 36-45 years ☐ 46- 59 years ☐ 60+ years ☐

3. Education qualification: None ☐ Primary ☐ Secondary ☐ A-level ☐ Tertiary ☐ other (specify)………………………………………………………………………………………

4. Employment Status: None ☐ Employed ☐ Self employed ☐

5. What is your job?

6. If employed, what type of employment? temporary permanent ☐ full time part time ☐ contract ☐

7. In what employment sector? ☐ ☐

8. If not employed, what is your source of income?

9. Where do you stay from this wetland? Less than a km ☐ 1-2km ☐ 3-5km ☐ more than 5km ☐

10. How many people are in your household?

11. Do you have a farm on the wetland? ☐ ☐

12. Do you have livestock?

13. What type of farming do you practice? crop production ☐ livestock keeping ☐

14. If you don't have a farm where do you grow your crops?

15. Do you use wetlands?

Section B

16. What type of crops do you grow on these wetlands?

17. Why do you choose to grow such crops on wetlands?

18. How is the land managed in this area?

19. Do you get help from your neighbour or headman to use this wetland?

20. How long have you been farming on this field?

21. Do you have a permanent field?

22. In which season of the year do you choose to grow your crops in the wetlands?

23. Why do you choose to grow your crops on the wetlands in that season of the year?

24. What problems do you encounter in growing crops over these wetlands?

25. How have you been copying with these problems?

26. What methods do you use to grow different types of crops on these wetlands?

27. Why do you choose to use such methods?

28. Besides agriculture do you get water from these wetlands?

29. What challenges do you face in using wetlands for different purposes such as drawing water, fetching firewood, collecting fruits and medicinal plants?

30. How long have you been using this wetland for these different purposes?

31. What changes have you observed on the following wetland elements since you started using this wetland?

a) wetland water
b) wetland soil
c) wetland plants
d) animal species

32. How have the local community been using wetlands over the years?

33. Are you being taught about on how you should use these wetlands wisely?

34. In your opinion what can be done to make sure that people are benefiting from wetlands and also conserving them?

35 a) How do you work with the following people in managing and using wetlands sustainably;

a) EMA officials,
b) the village heads and
c) the AGRITEX officer?

36. Are there any problems you encounter in working with these people?

37. Do you work effectively with these people?

38. What are the advantages and disadvantages of working with these people?

39. Do you have meetings with these people?

40. Is it good to work with these people?

41. Are there any conflicts between different land users (competition and how you work with your neighbours) on this wetland?

42. Do you think people should continue using wetlands or they should be protected?

43. Would you want to make any comments about wetlands and how they are managed and used here in Honde Valley?

Appendix 6: Interview schedule for in-depth individual interview with the village heads

Sex…………………….. Age…………………….

Name of village ………………………

1. How long have you been a village head for this village?

2. What are the different uses of wetlands in this area?

3. What can you say about the way people were using wetlands in the past and how they are using them these days?

4. Do you also use wetlands? If so, how are you using wetlands?

5. Do you have a farm on wetland?

6. How have people used these wetlands for traditional purposes, celebrations and ceremonies?

6. What beliefs and opinions do you have pertaining to human wetland use in your village?

7. Are your village members supposed to seek permission from you to use the wetlands?

8. As a village head have you imposed local regulations to guard against uncontrollable use of wetlands?

9. If so what are those regulations?

10. How do you enforce wetland regulations in your village?

11. Do you have wetland committees in your village that help in ensuring that wetlands management and sustainable use of wetlands?

11. What challenges have you encountered in enforcing these regulations?

12. What penalty is given to people who forfeit these regulations?

13. How do you send information about wetland use to people in your village?

14. How do you work with the following people to ensure sustainable use and management of wetlands; AGRITEX officer, EMA officials and the different seed companies?

15. Are there any conflicts pertaining to wetland use and management in your community?

Appendix 7: Interview schedule for focus group discussion with residents of Zindi, Honde Valley rural area

1. How long have you been a resident in this area?

2. What comes into your mind when you hear of the word wetland?

3. How have you used these wetlands for traditional purposes, celebrations and ceremonies in the past?

4. How are you using these wetlands for traditional purposes, celebrations and ceremonies nowadays?

5. Besides using wetlands for traditional purposes, celebrations and ceremonies what else are you using wetlands for nowadays?

6. Do you use these wetlands for medicinal purposes?

7. If so, which plants in the wetlands do you use for medicinal purposes?

8. How long have you been using wetlands?

9. Do you have any myths associated with wetland use?

10. Have the wetland you have been using changed in shape and what -*does it look like?

11. What is the most common activity on these wetlands?

12. Why is that activity common?

13. What different methods do you use to grow crops on these wetlands?

14. Do you think these methods ensure continual existence of the wetlands for future use?

15. Do you need permission to use these wetlands? If so how do you get the permission?

16. Are there any other activities which are not allowed by EMA officials, AGRITEX officers and village heads on these wetlands?

17. If so which activities?

18. Why are these activities not allowed on wetlands?

19. Do you have any regulations pertaining to wetland use (from the village head, government and EMA?

20. How are you implementing these regulations?

21. How often do have meetings with the following people: village heads, AGRITEX officers, and EMA officials to discuss wetland use and management?

22. What have you learnt from these meetings?

23. Do you get help or training on using wetlands sustainably in these meeting?

24. What do you think the government should do to ensure that you benefit from wetlands and conserve them at the same time?

25. How has access to natural resources and different wetland services in the wetlands got more difficult Or less difficult? Over the past five years? The past 10 years?

26. What are the reasons for access getting worse or better?

Appendix 8: Observation Schedule

Checklist to guide in the making of field notes

1. Space: The physical place or places
2. Actor: The people involved
3. Activity: a set of related acts people do
4. Object: the physical things that are present
5. Act: single actions that people do
6. Event: a set of related activities that people carry out
7. Time: The sequencing that takes place over time
8. Goal: The things people are trying to accomplish
9. Feeling: the emotions felt and expressed

Appendix 9: Participant Information Sheet for in-depth interview with an official from Seed Companies and the EMA

Participant Information Sheet (In-depth interview with an official from EMA)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Good day

My name is Emmah Mandishona and I am a PhD student in Geography at the University of Witwatersrand. In fulfilment of my studies I have to undertake a research project and I am investigating on; Rural wetlands use and sustainability, a case study of Zindi area in Honde Valley, Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

As part of this project I would like to invite you to take part in an interview asking about your organisation (EMA) and how you have ensured sustainable use and management of wetlands. This activity will take around 40 minutes. With your permission I would also like to record the interview using a digital device. This will involve audio recordings not video recordings. The recordings will be downloaded and transferred from a recorder and stored into a computer with a password. If you have any question you are free to ask before, during or after the interview.

You will not receive any direct benefits from participating in this study, and there are no disadvantages or penalties for not participating. You may withdraw at any time or not answer any question if you do not want to. The interview will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will not use your names in my thesis. If you experience any distress or discomfort we will stop the interview or resume another time. If you have any questions afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research thesis which will be available online through the University website. If you wish to receive a summary of this thesis, I will be happy to send it to you upon request.

If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), telephone + 27(0)11 717 1408, email Shaun.Schoeman@wits.ac.za

Yours sincerely,

Emmah Mandishona

Email: emandishona@gmail.com cell number+27845526223

Prof Jasper Knight

Email: Jasper.Knight@wits.ac.za phone number +271177176508

Participant Information Sheet for in-depth interview with an official from Seed Companies

Good day

My name is Emmah Mandishona and I am a PhD student in Geography at the University of Witwatersrand Johannesburg. In fulfilment of my studies I have to undertake a research project and I am investigating on; Rural wetlands use and sustainability, a case study of Zindi area in Honde Valley, Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

As part of this project I would like to invite you to take part in an interview asking about your organisation and the impacts of your seeds to crop production in rural areas and whether you have considered wetland agriculture in producing your seeds. This activity will take around 30 minutes. With your permission I would also like to record the interview using a digital device. This will involve audio recordings not video recordings. The recordings will be downloaded and transferred from a recorder and stored into a computer with a password. If you have any question you are free to ask before, during or after the interview.

You will not receive any direct benefits from participating in this study, and there are no disadvantages or penalties for not participating. You may withdraw at any time or not answer any question if you do not want to. The interview will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will not use your names in my thesis. If you experience any distress or discomfort we will stop the interview or resume another time. If you have any questions afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research thesis which will be available online through the University website. If you wish to receive a summary of this thesis, I will be happy to send it to you upon request.

If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), telephone + 27(0)11 717 1408, email Shaun.Schoeman@wits.ac.za

Yours sincerely,

Emmah Mandishona

Email: emandishona@gmail.com cell number +27845526223

Prof Jasper Knight

Email: Jasper.Knight@wits.ac.za phone number +271177176508

Appendix 10: Participation Information Sheet for in-depth interview with the Agritex officer

Good day

My name is Emmah Mandishona and I am a PhD student in Geography at the University of Witwatersrand. In fulfilment of my studies I have to undertake a research project and I am investigating on; Rural wetlands use and sustainability, a case study of Zindi area in Honde Valley, Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

As part of this project I would like to invite you to take part in an interview asking about yourself how you have been encouraging people to use wetlands sustainably and ensuring enforcement of wetland regulations. This activity will take around 40 minutes. With your permission I would also like to record the interview using a digital device. This will involve audio recordings not video recordings. The recordings will be downloaded and transferred from a recorder and stored into a computer with a password. I may take photos of your house or farm for use in my research thesis. Photos of houses and farms will be taken to provide an insight into how people interact with wetlands. If you have any question you are free to ask before, during or after the interview.

You will not receive any direct benefits from participating in this study, and there are no disadvantages or penalties for not participating. You may withdraw at any time or not answer any question if you do not want to. The interview will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will not use your names in my thesis. If you experience any distress or discomfort we will stop the interview or resume another time. If you have any questions afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research thesis which will be available online through the University website. If you wish to receive a summary of this thesis, I will be happy to send it to you upon request.

If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), telephone + 27(0)11 717 1408, email Shaun.Schoeman@wits.ac.za

Yours sincerely,

Emmah Mandishona

Email: emandishona@gmail.com cell number+27845526223

Prof Jasper Knight

Email: Jasper.Knight@wits.ac.za phone number +271177176508

Appendix 11: Participant Information Sheet (individual interview with residents of Zindi, Honde Valley rural area)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Good day

My name is Emmah Mandishona and I am a PhD student in Geography at the University of Witwatersrand. In fulfilment of my studies I have to undertake a research project and I am investigating on; Rural wetlands use and sustainability, a case study of Zindi area in Honde Valley, Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

As part of this project I would like to invite you to take part in an interview asking about you and your use of wetlands or how you have seen wetlands being used in this rural area of Honde Valley. This activity will take around 1 hour. With your permission I would also like to record the interview using a digital device. This will involve audio recordings not video recordings. The recordings will be downloaded and transferred from a recorder and stored into a computer with a password. I may take photos of your house or farm for use in my research thesis. Photos of houses and farms will be taken to provide an insight into how people interact with wetlands. You will also be requested to take pictures of people showing how they interact with the wetlands. You are kindly asked not take people. If you have any question you are free to ask before, during or after the interview.

You will not receive any direct benefits from participating in this study, and there are no disadvantages or penalties for not participating. You may withdraw at any time or not answer any question if you do not want to. The interview will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will not use your names in my thesis. If you experience any distress or discomfort we will stop the interview or resume another time. If you have any questions afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research thesis which will be available online through the University website. If you wish to receive a summary of this thesis, I will be happy to send it to you upon request.

If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), telephone + 27(0)11 717 1408, email Shaun.Schoeman@wits.ac.za

Yours sincerely,

Emmah Mandishona

Email: emandishona@gmail.com cell number+27845526223

Prof Jasper Knight

Email: Jasper.Knight@wits.ac.za phone number +271177176508

Appendix 12: Participant Information Sheet for in-depth interview with the village head of Zindi, Honde Valley rural area

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Good day

My name is Emmah Mandishona and I am a PhD student in Geography at the University of Witwatersrand Johannesburg South Africa. In fulfilment of my studies I have to undertake a research project and I am investigating on; Rural wetlands use and sustainability, a case study of Zindi area in Honde Valley, Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

As part of this project I would like to invite you to take part in an interview asking about how people in your village are using wetlands. This activity will take around 1 hour. With your permission I would also like to record the interview using a digital device. This will involve audio recordings not video recordings. The recordings will be downloaded and transferred from a recorder and stored into a computer with a password. I may take photos of your house or farm for use in my research thesis. Photos of houses and farms will be taken to provide an insight into how people interact with wetlands. If you have any question you are free to ask before, during or after the interview.

You will not receive any direct benefits from participating in this study, and there are no disadvantages or penalties for not participating. You may withdraw at any time or not answer any question if you do not want to. The interview will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will not use your names in my thesis. If you experience any distress or discomfort we will stop the interview or resume another time. If you have any questions afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research thesis which will be available online through the University website. If you wish to receive a summary of this thesis, I will be happy to send it to you upon request.

If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), telephone + 27(0)11 717 1408, email Shaun.Schoeman@wits.ac.za

Yours sincerely,

Emmah Mandishona

Email: emandishona@gmail.com cell number +27845526223

Prof Jasper Knight

Email: Jasper.Knight@wits.ac.za phone number +271177176508

Appendix 13: Participant Information Sheet (Focus group discussions with residents of Zindi Honde Valley Rural Area)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Good day

My name is Emmah Mandishona and I am a PhD student in Geography at the University of Witwatersrand in Johannesburg South Africa. In fulfilment of my studies I have to undertake a research project and I am investigating on; Rural wetlands use and sustainability, a case study of Zindi area in Honde Valley, Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

As part of this project I would like to invite you to take part in a focus group discussion. This discussion will involve five or more people. This research will take place at any place convenient to participants where you are all comfortable with. This focus group will be done in the afternoon. This activity will take around 2 hours. With your permission I would also like to record the discussion using a digital device. This will involve audio recordings not video recordings. The recordings will be downloaded and transferred from a recorder and stored into a computer with a password. If you have any question you are free to ask before, during or after the interview.

You will not receive any direct benefits from participating in this study, and there are no disadvantages or penalties for not participating. You may withdraw at any time or not answer any question if you do not want to. Confidentiality and anonymity cannot be guaranteed since these are focus groups discussions with more than one person but will be guaranteed for all participants when findings are made available in a public forum since pseudonyms will be used. I kindly ask you to keep the information discussed in this group to yourself. I will not be asking your name or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will not use your names in my thesis. If you experience any distress or discomfort we will stop the group discussions or resume another time. If you have any questions afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research thesis which will be available online through the University website. If you wish to receive a summary of this thesis, I will be happy to send it to you upon request.

If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), telephone + 27(0)11 717 1408, email Shaun.Schoeman@wits.ac.za

Yours sincerely,

Emmah Mandishona

Email: emandishona@gmail.com cell number +27845526223

Prof Jasper Knight

Email: Jasper.Knight@wits.ac.za phone number +271177176508

Appendix 14: Consent forms for company officials

Consent form for participating in an individual interview as an official from the seed company

Rural wetlands use and sustainability: A case study of Zindi area in Honde valley, Zimbabwe

I………………………………… agree to participate in this research project. The research has been explained to me and I understand what my participation will involve.

I agree that my participation will remain anonymous YES NO (please circle)

I agree that the researcher may use anonymous quotes

in her thesis YES NO

I agree that the interview may be audio recorded YES NO

Researcher……………………………………………………….. (signature)

…………………………………………………………………(name of participant)

……………………………………………………………………….date

Consent form for participating in an individual interview as an official from EMA

Rural wetlands use and sustainability: A case study of Zindi area in Honde valley, Zimbabwe

I………………………………… agree to participate in this research project. The research has been explained to me and I understand what my participation will involve.

I agree that my participation will remain anonymous YES NO (please circle)

I agree that the researcher may use anonymous quotes

in her research report YES NO

I agree that the interview may be audio recorded YES NO

Researcher……………………………………………………….. (signature)

…………………………………………………………………….(name of participant)

………………………………………………………………………….date

Appendix 15: Consent form for in-depth interview with the Agritex officer

Rural wetlands use and sustainability: A case study of Zindi area in Honde valley, Zimbabwe

I………………………………… agree to participate in this research project. The research has been explained to me in the language I fully understand (English/ Shona) and I also understand what my participation will involve.

I agree that my participation will remain anonymous YES NO (please circle)

I agree that the researcher may use anonymous quotes

in her thesis   YES NO

I agree that the interview may be audio recorded YES NO

Researcher……………………………………………………….. (signature)

…………………………………………………………………(name of participant)

……………………………………………………………………date

Appendix 16: Consent form for residents of Zindi, Honde Valley rural area

Rural wetlands use and sustainability: A case study of Zindi area in Honde valley, Zimbabwe

I………………………………… agree to participate in this research project. The research has been explained to me and I understand what my participation will involve.

I agree that my participation will remain anonymous YES NO (please circle)

I agree that the researcher may use anonymous quotes

in her thesis   YES NO

I agree that the interview may be audio recorded YES NO

I agree that photos of myself, my house or farm may be taken during

the interview   YES NO

I agree that I can take pictures showing how people interact

with the wetlands   YES NO

Researcher……………………………………………………….. (signature)

…………………………………………………………………(name of participant)

…………………………………………………………………….date

Appendix 17: Consent form for the Zindi, Honde valley rural area village heads

Rural wetlands use and sustainability: A case study of Zindi area in Honde valley, Zimbabwe

I………………………………… agree to participate in this research project. The research has been explained to me and I understand what my participation will involve.

I agree that my participation will remain anonymous YES NO (please circle)

I agree that the researcher may use anonymous quotes

in her thesis YES NO

I agree that the interview may be audio recorded YES NO

I agree that photos of my house or farm may be taken during

the interview YES NO

Researcher……………………………………………………….. (signature)

…………………………………………………………………(name of participant)

……………………………………………………………………date

Appendix 18: Consent form for focus group discussion with residents of Zindi, Honde Valley Rural Area

Rural wetlands use and sustainability: A case study of Zindi area in Honde valley, Zimbabwe

I……………………………… agree to participate in this research project. The research has been explained to me and I understand what my participation will involve.

I agree that my participation will remain anonymous in my thesis YES NO (please circle)

I agree that the researcher may use anonymous quotes

in her thesis   YES NO

I agree that the interview may be audio recorded YES NO

Researcher…………………………………………………….. (signature)

……………………………………………………………………(name of participant)

……………………………………………………………………….date

Appendix 19: Letters seeking permission to conduct interviews with the company

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

6 November 2018

Environmental Management Agency

685/6 Lorraine drive/ Faber Drive

Bluffhill

P.O Box 385

Causeway

Harare

Zimbabwe

Telephone: +263 4 308881/8, 308127/ 08677006244

Email: eep@ema.co.zw

Dear Sir/Madam

RE: REQUEST FOR AN INTERVIEW FOR ACADEMIC RESEARCH

My name is Emmah Mandishona, a PhD candidate at the University of the Witwatersrand, Johannesburg, in the School of Geography, Archaeology and Environmental Studies. I am doing a research on; Rural wetlands use and sustainability, The case study of Honde Valley rural area in Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

This interview could be face to face or over the phone or even by email if easier. I would appreciate if I could be granted access in the form of a letter or email to meet briefly for an interview for about 40 minutes with a representative in your department who deals wetland management and use. I wish to discuss about your organisation (EMA) and how you have ensured sustainable use and management of rural wetlands. I hope this request meets your most favourable consideration.

Yours faithfully

Emmah Mandishona

Email: emandishona@gmail.com cell number +27845526223

Prof. Jasper Knight Email: Jasper.Knight@wits.ac.za phone number +271177176508

6 August 2018

Agriseeds (Pvt) Ltd

5 Wimbledon Drive

Eastlea

Harare

Zimbabwe

Telephone: +263 (4) 701795/ 772 249 198

Dear Sir/Madam

RE: REQUEST FOR AN INTERVIEW FOR ACADEMIC RESEARCH

My name is Emmah Mandishona, a PhD candidate at the University of the Witwatersrand, Johannesburg, in the School of Geography, Archaeology and Environmental Studies. I am doing a research on; Rural wetlands use and sustainability, The case study of Honde Valley rural area in Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

This interview could be face to face or over the phone or even by email if easier. I would appreciate if I could be granted access in the form of a letter or email to meet briefly for an interview for about 30 minutes with a representative in your department who deals with production of seeds. I wish to discuss about your organisation and the impacts of your seeds to crop production in rural areas and whether you have considered wetland agriculture in producing your seeds. I hope this request meets your most favourable consideration.

Yours faithfully

Emmah Mandishona

Email: emandishona@gmail.com cell number +27845526223

Prof. Jasper Knight Email: Jasper.Knight@wits.ac.za phone number +271177176508

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

6 August 2018

Cimmyt Zimbabwe

P.O Box MP 163 Mt Pleasant

12.5 km Mazoe Road

Harare

Zimbabwe

Telephone +263 369 126

Dear Sir/Madam

RE: REQUEST FOR AN INTERVIEW FOR ACADEMIC RESEARCH

My name is Emmah Mandishona, a PhD candidate at the University of the Witwatersrand, Johannesburg, in the School of Geography, Archaeology and Environmental Studies. I am doing a research on; Rural wetlands use and sustainability, The case study of Honde Valley rural area in Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

This interview could be face to face or over the phone or even by email if easier. I would appreciate if I could be granted access in the form of a letter or email to meet briefly for an interview for about 30 minutes with a representative in your department who deals with production of seeds. I wish to discuss about your organisation and the impacts of your seeds to crop production in rural areas and whether you have considered wetland agriculture in producing your seeds. I hope this request meets your most favourable consideration.

Yours faithfully

Emmah Mandishona

Email: emandishona@gmail.com cell number +27845526223

Prof. Jasper Knight Email: Jasper.Knight@wits.ac.za phone number +271177176508

6 August 2018

Pioneer Hi-Bred Seeds Zimbabwe (Pvt) Ltd.

Mutual Gardens

100 The Chase

Emerald Hill

Harare

Zimbabwe

Telephone +263 339301

Cell +263 712602119, +263 712 602 122

Dear Sir/Madam

RE: REQUEST FOR AN INTERVIEW FOR ACADEMIC RESEARCH

My name is Emmah Mandishona, a PhD candidate at the University of the Witwatersrand, Johannesburg, in the School of Geography, Archaeology and Environmental Studies. I am doing a research on; Rural wetlands use and sustainability, The case study of Honde Valley rural area in Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

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Yours faithfully

Emmah Mandishona

Email: emandishona@gmail.com cell number +27845526223

Prof. Jasper Knight Email: Jasper.Knight@wits.ac.za phone number +271177176508

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

6 August 2018

Prime Seeds (Pvt) Ltd

318 Hillside Road

Msasa

Harare

Zimbabwe

Telephone: (04) 447118 / 480501 / 485572 / 73

Dear Sir/Madam

REQUEST FOR AN INTERVIEW FOR ACADEMIC RESEARCH

My name is Emmah Mandishona, a PhD candidate at the University of the Witwatersrand, Johannesburg, in the School of Geography, Archaeology and Environmental Studies. I am doing a research on; Rural wetlands use and sustainability, The case study of Honde Valley rural area in Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

This interview could be face to face or over the phone or even by email if easier. I would appreciate if I could be granted access in the form of a letter or email to meet briefly for an interview for about 30 minutes with a representative in your department who deals with production of seeds I wish to discuss about your organisation and the impacts of your seeds to crop production in rural areas and whether you have considered wetland agriculture in producing your seeds. I hope this request meets your most favourable consideration.

Yours faithfully

Emmah Mandishona

Email: emandishona@gmail.com cell number +27845526223

Prof. Jasper Knight Email: Jasper.Knight@wits.ac.za phone number +271177176508

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

6 August 2018

Seed Co Zimbabwe

Shamwari Road, Stapleford

P.O Box 64

Westgate

Harare

Zimbabwe

Telephone: +263 4 308881/8, 308127

Dear Sir/Madam

RE: REQUEST FOR AN INTERVIEW FOR ACADEMIC RESEARCH

My name is Emmah Mandishona, a PhD candidate at the University of the Witwatersrand, Johannesburg, in the School of Geography, Archaeology and Environmental Studies. I am doing a research on; Rural wetlands use and sustainability, The case study of Honde Valley rural area in Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

This interview could be face to face or over the phone or even by email if easier. I would appreciate if I could be granted access in the form of a letter or email to meet briefly for an interview for about 30 minutes with a representative in your department who deals with production of seeds. I wish to discuss about your organisation and the impacts of your seeds to crop production in rural areas and whether you have considered wetland agriculture in producing your seeds. I hope this request meets your most favourable consideration.

Yours faithfully

Emmah Mandishona

Email: emandishona@gmail.com cell number +27845526223

Prof. Jasper Knight Email: Jasper.Knight@wits.ac.za phone number +271177176508

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

6 August 2018

National Tested Seeds

750 Lorraine Drive

Bluffhill,

Harare

Zimbabwe

Tel: 04-310284-7
Whatsapp: +263772235000

Dear Sir/Madam

RE: REQUEST FOR AN INTERVIEW FOR ACADEMIC RESEARCH

My name is Emmah Mandishona, a PhD candidate at the University of the Witwatersrand, Johannesburg, in the School of Geography, Archaeology and Environmental Studies. I am doing a research on; Rural wetlands use and sustainability, The case study of Honde Valley rural area in Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

This interview could be face to face or over the phone or even by email if easier. I would appreciate if I could be granted access in the form of a letter or email to meet briefly for an interview for about 30 minutes with a representative in your department who deals with production of seeds. I wish to discuss about your organisation and the impacts of your seeds to crop production in rural areas and whether you have considered wetland agriculture in producing your seeds. I hope this request meets your most favourable consideration.

Yours faithfully

Emmah Mandishona

Email: emandishona@gmail.com cell number +27845526223

Prof. Jasper Knight Email: Jasper.Knight@wits.ac.za phone number +271177176508

31 August 2018

Mkushi Seeds Zimbabwe (Pvt) Ltd

17.5 km Lomagundi Road

Mount Hampden

P.O Box MP287

Mount Pleasant

Harare

Zimbabwe

Telephone: +263 335047
Mobile: 0782808080

Dear Sir/Madam

RE: REQUEST FOR AN INTERVIEW FOR ACADEMIC RESEARCH

My name is Emmah Mandishona, a PhD candidate at the University of the Witwatersrand, Johannesburg, in the School of Geography, Archaeology and Environmental Studies. I am doing a research on; Rural wetlands use and sustainability, The case study of Honde Valley rural area in Zimbabwe. The aim of this research is to understand how rural people in Honde Valley rural area of Zimbabwe have used and interacted with wetlands in the past and present times and evaluate the different problems encountered by wetland users in using wetlands for agriculture.

This interview could be face to face or over the phone or even by email if easier. I would appreciate if I could be granted access in the form of a letter or email to meet briefly for an interview for about 30 minutes with a representative in your department who deals with production of seeds. I wish to discuss about your organisation and the impacts of your seeds to crop production in rural areas and whether you have considered wetland agriculture in producing your seeds. I hope this request meets your most favourable consideration.

Yours faithfully

Emmah Mandishona

Email: emandishona@gmail.com cell number +27845526223

Prof. Jasper Knight Email: Jasper.Knight@wits.ac.za phone number +271177176508

Appendix 20: Ethics clearance certificate

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Mandishona

CLEARANCE CERTIFICATE	PROTOCOL NUMBER: H18/09/013
PROJECT TITLE	Rural wetlands use and sustainability. The case study of Honde Valley rural area in Zimbabwe
INVESTIGATOR(S)	Ms E Mandishona
SCHOOL/DEPARTMENT	GAES/
DATE CONSIDERED	14 September 2018
DECISION OF THE COMMITTEE	Approved
EXPIRY DATE	24 October 2021

DATE 25 October 2018 CHAIRPERSON ______________ (Professor J Knight)

cc: Supervisor : Professor J Knight

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to completion of a yearly progress report.**

____________________ Signature

_____/_____/_____ Date

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES