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Social Valuation of wetlands: A case study of Intunjambili wetland in Matobo district, Matabeleland South, Zimbabwe

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Social Valuation of wetlands: A case study of Intunjambili wetland in Matobo district Matabeleland South, Zimbabwe

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in

Integrated Water Resources Management

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DECLARATION

I, Phathisani Tabengwa, declare that this research report is of my own work. It is being submitted for the degree of Master of Science in Integrated Water Resources Management (IWRM) at the University of Zimbabwe and all the sources that I have quoted have been indicated and acknowledged by means of complete citation and reference. This work has not been submitted before for examination for any other University.

Date: _____

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

DEDICATION

Life is a journey, mine continues. This dissertation is dedicated to my late father. Thank you for believing in me. May your soul rest in peace. And to my wonderful boys, follow mummy`s footsteps.

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I would not have come this far if it was not God`s will. His love for me is everlasting and I continue to pursue every opportunity I get. He blesses me all the time. Praise be to the Almighty.

Extension of my sincere gratitude goes out to the local communities of Intunjambili village, who were very corporative and willing to assist me in every way they could. The welcome they gave me was immeasurable, especially during my fieldwork. A special thanks goes to Mr. John Dube (local member of the village) and Mr. Ncube, the Kraal Head, who were so accommodative, willing to advise me and share information.The two reminded me of my father. I would also like to appreciate and share my gratitude to my supervisors and lecturers, Dr. Collin Mabiza and Dr. Krysposy K. Kujinga. Thank you especially for your patience through the course of this study. If it was not for your belief in my potential, I would have not made it the way I have. *Ngiyabonga ngenhliziyo yami yonke, Inkosi ilibusise!*

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ABSTRACT

Wetlands have been described as "*the kidneys of the landscape*, and as "*biological supermarkets"*. However, more than half of the world`s wetlands have been lost and/or degraded. This has caused alteration of vegetation, biodiversity and productivity in wetlands. Understanding local people's social values of wetlands and traditional mechanisms of managing natural resources forms the basis of conserving them. This study reviews the social valuation of functions and services provided by wetlands. The main objective of this study was to come up with a social value for Intunjambili wetland, which is located in Matobo district of Matabeleland South Province (South East of Bulawayo) in Zimbabwe.The study specifically sought to: i) map the extent of Intunjambili wetland and its Land Use/Land Cover (LULC) of 1980 and 2015; ii) assess the ability of Intunjambili wetland to deliver particular wetland services; iii) identify resource use behavior of households in Intunjambili wetland; and iv) determine the value of Intunjambili wetland services. The extent of Intunjambili wetland and LULC change was sought through a comparison of images from GIS and maps drawn by the local communities. The results from the mapping exercise indicated that vegetation cover has decreased over time and land uses have changed. A rapid assessment of the mapped area using the WET EcoServices Assessment tool was conducted to assess Intunjambili wetland ability to deliver the eight selected services. From the eight functions assessed, results showed a rank in the following order from high to low potential respectively: provision of water supply for direct human use, provision of harvestable natural resources, education and research, provision of cultivated foods, stream flow regulation, tourism and recreation, cultural significance and maintenance of biodiversity. A household survey and focus group discussions were also conducted with an aim to determine resource use behavior of households and the value of these uses. These indicated a variation in resource use behaviour. Those that live on the wetland, value the wetland for the provision of water which sustains the livelihood of vegetable gardening whilst those that do not live on the wetland, value the wetland for the provision of water for their livestock, grazing land for their livestockand natural resources. Results from this study indicated that the wetland is being highly used for agriculture; it is gradually degrading and soon will not be unable to sustain its functions it is currently offering.This study recommends the application of the ecosystem approach will help to reach a balance of conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilization of the wetland resources.

Key words: Wetland, Value, Valuation, Functions, Importance

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LIST OF ABBREVIATIONS AND ACRONYMS

AGRITEX	Department of Agricultural Technical and Extension Services
BT	Benefit Transfer
CAMPFIRE	Communal Areas Management Programme for Indigenous Resources
CM	Choice Modeling
CVM	Contingent Valuation Method
EMA	Environmental Management Agency
ES	Ecosystem Services
EU	European Union
FDGs	Focus Group Discussions
GIS	Geographic Information System
HGM	Hydro-geomorphic unit
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
LULC	Land Use/Land Cover
MA	Millennium Assessment
PHHE	Participatory Health and Hygiene Education
RDC	Rural District Council
RP	Revealed Preference
SP	Stated Preference
TEV	Total Economic Value
WRC	Water Research Commission
ZESA	Zimbabwe Electricity Supply Authority

1. Chapter One: Introduction

1.1 Background

Ecosystems provide an array of essential services, ranging from direct benefits such as food, water, fuel and timber, to indirect benefits such as flood mitigation and climate regulation and less tangible benefits such as spiritual and aesthetic wellbeing (MA, 2003). Wetlands are one of the most important ecosystems and in Zimbabwe, they have a strong link with the development of the society and a broad range of activities (Matiza and Crafter, 1994). Wetlands are also the only single group of ecosystems to have their own international convention, called the Ramsar Convention of 1971 (Turner, 2004). Zimbabwe is a signatory to the Ramsar Convention and has domesticated provisions for the protection of wetlands under the Environmental Management Act Chapter 20; 27, Statutory Instrument 7 of the 2007 on the Environmental management (Environmental Impact Assessment and Ecosystem Protection) (Muserere *et al.*, 2014).

However, lack of understanding and appreciation of wetland values, functions and products by decision makers has led to irreversible damage to the wetland systems in Zimbabwe (Matiza and Crafter, 1994). In an aim to make informed decisions regarding the use and management of wetland ecosystem services, their value to the human society must be assessed (Turpie *et al.*, 2010). Valuation' is defined by the Millennium Ecosystem Assessment of 2003 as "*the process of expressing a value for a particular good or service…in terms of something that can be counted, often money, but also through methods and measures from other disciplines (sociology, ecology and so on)"* (De Groot *et al.*, 2006).Valuation of wetlands assists the understanding of the degree to which wetlands contribute to the local communities benefiting from the wetland services (Turpie, 2010).

Ecosystem services values can be expressed using socio- logical or ecological metrics, but are most are often expressed in monetary terms (MA, 2003). Economic valuation methods are used to determine the Total Economic Value (TEV) of an ecosystem, which is a monetary figure representing the total net value of the change in the flow of ecosystem services to society, occasioned by a marginal change to the conditions of that ecosystem, such as a change brought about by a proposed economic development (Knights *et al.*, 2011). Economic valuation methods

assist to compare the actual costs and benefits of ecosystem use and degradation, and they allow for more balanced decision-making concerning the protection and restoration versus degradation of wetlands (Turpie and Kleynhans, 2010).

However, there are structural shortcomings in economic valuation and decision-making procedures leading to incomplete cost-benefit analysis of planned interventions in wetland systems (De Groot *et al*., 2006). Economic valuation often excludes social and environmental costs and benefits, thus economic valuation does not represent a full measure or total value of wetland services (Palma, 2005). Economic valuation also assumes that money can be used as a neutral measuring stick of people's preferences and they misunderstand and motivate policies which fail to respect, the way in which people value nature (Knights *et al*., 2011). To ensure more balanced decision-making (where multiple uses and values are considered), it is crucial that the full importance (value) of wetlands should be recognized (Turpie *et al*., 2010).

This study focuses on the social valuation of Intunjambili wetland, which is found in a village called Intunjambili. The village is located in Ward 15 of Matobo district in Matabeleland South province of Zimbabwe. Steps taken in the valuation process of Intunjambili wetland follow an Ecosystems Approach (EA). This approach is based on the application of appropriate scientific methodologies which encompass the essential structure, processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems (MA, 2003). Zimbabwe is one of the few countries in the developing world that adopted the Ecosystems Approach in Environmental Management., (Zimbabwe's Fourth National Report to the Convention on Biological Diversity, 2010). The anthropocentric approach within the EA is due to the fact that recognition of the value of ecosystems to human well-being can focus mindsets on improved sustainable use of those ecosystems (Kusler, 2004). An assessment of the services that Intunjambili wetland had a potential of delivering and their relation to human well-being was adopted as an Integrated Ecosystems Approach towards valuation of the wetland.

1.2 Statement of the problem

The concern with economic valuation is that where rural people live, their ecosystem resources are valued at lower rate since they are unable to respond with high figures of valuation studies in urban

areas (Knights *et al.*, 2011). Although a variety of methods have been developed by economists to express the value of water-related goods and services in quantitative, monetary units, have a potential of being very useful, they are also quite complicated and demanding in terms of the expertise, time and data required for their application (Hermans, 2006). This has hindered their widespread application, particularly in developing countries, which often experience challenges with the availability of expertise, data and resources for the execution of value assessments (FAO, 2004). As a result, development in the field of valuation has been mainly academic and there is a need to improve the connection with the actual water resources management processes (Hermans, 2006). This study examined the social value for Intunjambili wetland using an Ecosystems Approach. This was done through a deeper understanding of the concept of value, wetland functions and services and resource use behavior. Therefore, there was need of household level processes that determined resource use behavior, which was closely linked to environmental conditions and ecosystem functions.

1.3 Objectives of the study

The main objective of the study was to examine the social value for Intunjambili wetland.

Specific Objectives were to:

1. To map the extent of Intunjambili wetland and its land use changes of 1980 and 2015
2. To assess the potential ability of Intunjambili wetland to deliver particular wetland services
3. To identify resource use behavior of households in Intunjambili wetland
4. To analyze the social value of resource use of households in Intunjambili wetland

1.4 Justification

Value of wetland services is placed by local communities in Zimbabwe is based on contribution towards family subsistence and livelihood (Zinhiva *et al*, 2014). Wetlands are often particularly important to the rural communities who lack alternative sources of income and livelihood (Lopez *et al*, 2008). However, it is becoming apparent that wetlands in Zimbabwe are losing most of their products, functions and attributes (Matiza and Crafter, 1994). Current trends in wetland

degradation necessitate greater recognition and improved stewardship of wetland services of value to human wellbeing not to be undermined (Kusler, 2004). A number of threats to wetlands in Zimbabwe stem from national problems of poverty, population increase and uncoordinated sectorial developments (Matiza and Crafter, 1994). This is due to the fact that there are many services and multiple values of wetlands, multi-stakeholders are involved in wetland use, often leading to conflicting interests and the over-exploitation of some services (e.g., wetland cultivation) at the expense of others (e.g., biodiversity conservation) (De Groot *et al.*, 2006). To address the problem of social conflict, potential wetland loss and degradation, a valuation process was undertaken.

1.5 Scope of study and limitations

The study limited itself to estimation ofthe social value of Intunjambili wetland.Valuation process attempts to follow an Ecosystems Approach which incorporates the assessment of wetland services and resource use behavior by wetland users of the Intunjambili wetland. The study could not conduct the economic and ecological values. The study could not make a comparison between villages with access to wetlands and those without.

1.6 Thesis outline

The thesis is divided into five chapters. The first chapter has set an introduction to the study, the research problem, justification of the study and the objectives. Chapter two presents literature review of the economic and social valuation methods. The chapter discusses the concept of wetland functions and social value. Wetland assessment is also touched in the chapter to give a detailed explanation of the importance of assessing wetland functions before evaluation them. Chapter three is a description of the study area and the research methods. It presents an overview of location of Intunjambili wetland, the village demographics, the vegetation, the climate and description of what type of hydro geomorphic feature is Intunjambili wetland. Methods that were used encompass research design;data sources, data collection as well as models/tools used to acquire, assess and analyze data are discussed in the chapter. Presentation of the results and analysis of these results and their discussion are done in chapter four. The final chapter, Chapter five, gives a summary of the study and recommendations.

2. Chapter Two: Literature Review

This chapter explores the economic valuation methods, and gives an in-depth of conceptualization of "value" as a theory and linking it to wetland functions, goods and services contributing to value. The chapter also includes the HGM descriptions as part of the Ecosystems Approach.

2.1 Economic valuation methods

Economic valuation methods are divided into market-value approaches, surrogate-market approaches and simulated market approaches. Surrogate-market and simulated-market approaches measure the demand for wetlands, and hence willingness to pay. Market value approaches are based on market prices (revealed willingness to pay) and do not necessarily include consumers' surplus, or peoples' willingness to pay over and above what they actually have to pay (Turpie *et al.*, 2010).

Value, is termed economic based on principles of rationality and consumer sovereignty (Mulatu, 2014). Rationality according to Mulatu (2014) is that an individual constantly knows what she or he wants and needs and consumer sovereignty being that an individual is also best able to make choices that affect her or his own welfare. Similarly, through different lenses, Turpie *et al, (*2010) state that economic value can be defined in terms of peoples' willingness to pay for a commodity or state of the world. Net economic value can be expressed as the sum of consumer surplus and producer surplus, (Turpie *et al,* 2010). The economic valuation approach refers to the assignment of monetary values to non marketed assets, goods and services (Palma, 2005). This helps to compare the real costs and benefits of ecosystem use and degradation, and allows more balanced decision-making regarding the protection and restoration versus degradation of wetlands (De Groot *et al.*, 2006).

There are three categories of the economic approach to valuation, namely, the Revealed Preference (RP), the Stated Preference (SP) and the Benefit Transfer (BT). The Benefit Transfer relies on the estimates from the Stated Preference and Revealed Preference. The Revealed preference which is more indirect is an approach that infers what the value indirectly is (Turpie *et al.*, 2010). This involves observing individuals` behavior in actual or simulated markets (Kadisa, 2013). Stated

preference approaches elicit values directly from respondents by asking them about their preferences for given wetland services (Mulatu, 2014).

These methods used to value wetlands are no different from the methods used to value any other type of environmental asset. These include market value approaches (which rely on quantification of production), surrogate market or revealed preference approaches (which rely on observation of related behavior) and simulated market or stated preference approaches (which rely on direct questioning). The simpler methods produce a total value, whereas those that involve construction of models are better for estimating marginal values (the additional value generated by each unit of production) (Turpie *et al*, 2010). There are different approaches that have developed under the three categories of the economic approach for valuation: the Revealed Preference (RP), the Stated Preference (SP) and the Benefit Transfer (BT).

2.1.1 Revealed Preference Approaches

These approaches are basically the observation of preferences revealed by actual market behaviors and represents the real-world evidence on the choices that individuals exercise (Stephens, 2010). The approaches are indirect and they look into the related or surrogate markets in the wetland where goods are traded. Calculations are derived using different methods; namely, the Hedonic Pricing Method, the Travel Cost and the Residual Analysis (see Appendix 1).

2.1.2 Stated Revealed Approaches

These approaches include both non-use and option use value, which can be used to measure Total Economic Value (TEV). They can be used to value potential future or hypothetical (but realistic) wetland functions (Kadisa, 2013). The methods are more direct as they seek the monetary value of wetland functions from respondents by asking them about their preferences for the given wetland functions. The main choice of methods in the approach include: the Contingent Valuation Method (CVM) and the Choice Modeling (CM). They both have the same theoretical framework of Random Utility model (See Appendix 2).

2.2 The Value Theory Concept

According to Novitzki *et al, (*1997), if something is said to have "value," then it is worthwhile, beneficial, or desirable. Values play a central role in society. They have since been analyzed from different disciplines, (not only sociology but also psychology, anthropology, ecology and other related disciplines) (Schwartz, 2012).

Schroeder (2012), states that the concept of value in theory takes into account a various range of approaches to understanding how, why, and to what degree humans value things, whether the thing is a person, idea, object, or natural resource such as wetland resources. To date value as a theory is scientifically empirical, recording what people value and attempting to find out why and what they value (Schroeder, 2012).

The Millennium Ecosystem Assessment (2005) defined value as "*The contribution of an action or object to user-specified goals, objectives, or conditions*" (De Groot *et al.*, 2006). In the Ramsar Technical Report No. 3 by De Groot *et a l* (2006), the term value is used in three main ways:

i) ***Exchange value***: the price of a good or service in the market (market price).

ii) ***Utility***: the use value of a good or service, which can be very different from the market price (e.g. the market price of water is very low, but its use value is very high; the reverse is the case, for example, for diamonds or other luxury goods).

iii) ***Importance***: the appreciation or emotional value we attach to a given good or service (e.g. the emotional or spiritual experience some people have when viewing wildlife or natural scenery or our ethical considerations regarding the existence value of wildlife).

De Groot *et al* (2006), states that value can be defined as importance that is relayed as an appreciation or emotional attachment of a given resource. The importance of value can be expressed in terms three domains: ecological, socio-cultural and economic value. Ecological value encompasses the health state of a system, measured in ecological indicators. Socio-cultural values include the importance people give to, for example the cultural identity. Economic value is broadly recognized as use value and non-use value (De Groot *et al.*, 2006).

According to the Schwartz Value Theory (2012), the concept of value adopts the basic values that people in all cultures recognize. The Schwartz value theory first adopts that the conception of value expressed is in six different features:

i. Values are beliefs
ii. Values refer to desirable goals
iii. Values transcend specific actions and situations
iv. Values serve as a standard or criteria
v. Values are ordered by importance
vi. The relative importance of multiple value guides action

Although values may be structured in similar ways universally, they differ according to individuals or groups. The substantial difference is in the relative importance individuals or groups attribute to the values. This means that individuals or groups have varying priorities or hierarchies because a particular value may be important to one person but unimportant to another (Schwartz, 2012).

In relation to wetlands, while their functions are natural processes that continue regardless of their perceived value to humans, the value people place on those functions in many cases is the primary factor determining whether a wetland remains intact or is converted for some other use (National Audubon Society, 1993).

All the perceptions of the value theory are nearly similar differing in the expression in words and change of time. Novitzki *et al* (1997) looks at the concept of value as something worthwhile, beneficial or desirable. In 2003, The Millennium Ecosystem Assessment defines value from the "contribution towards a condition" point of view. This could be role or input in terms of action played towards change of condition. De Groot *et al* (2006), state that a value as an importance expressed through "appreciation or emotional attachment of a given resource". In 2012, Schwartz expressed the conception of value in six different features which follow that value are beliefs, desirable goals, transcending actions, ordered by importance, serve as standards and importance guides action.

However, this study adopts part of what Schroeder (2012) considers as a concept of the value theory. The study will take into account a various range of approaches to understanding how, why,

and to what degree humans value things, whether the thing is a person, idea, object, or natural resource in this case wetland resources.

This means that the concept of value in this study takes an anthropocentric perspective. Value is expressed using a hierarchal approach (illustration shown in Figure 2.1), adopting the principle of:

- Identification of what is important, how these are ranked and why are ranked in that manner. Importance of a resource or object is the significance of that resource/object to the beneficiaries of that resource. Significance can be direct or indirect to the beneficiaries.
- The degree of dependency on resource. Dependency considers the reliability of that resource to the beneficiaries.
- The extent of how much contribution from the relevant resource to their lives (income) derived benefits.

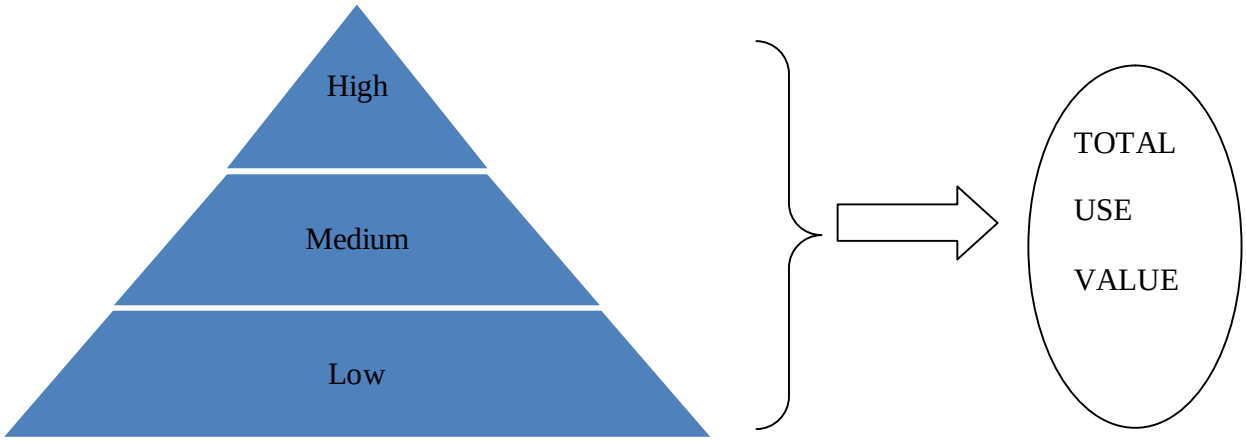

Figure 2.1: Illustration of the hierarchy of importance and value according to researcher

This pyramid then must prompt the expression of value in terms of the relationship of “total use value” and importance. The higher the total use value, the more the importance of the resource or object. Total use value is a combination of different rankings of the direct, indirect, bequest, existence values.The higher the dependency on the resource by the community, the higher the

value is also expected to be. However, measures of community dependence on wetlands would not necessarily be correlated with wetland value (Turpie and Kleynhans, 2010).

2.3 Social value of wetlands

Kennedy and Thomas (1995) developed a conceptual model of social values used in natural resources management. The conceptual model placed natural resource values in an interrelated set of four systems:

i. The natural environmental system of biosphere elements
ii. The social system of human attitudes, values, behavior, institutions, and technology
iii. The economic system that focuses on human attitudes, institutions, and behavior related to the allocation of land, labor and capital
iv. The political system of policy, laws, courts, and public agencies.

In their model, social values of wetlands originate or are endorsed in one system only: the social system. The environmental system itself neither originates nor expresses natural resource or environmental social value. Only human interaction with the natural environment originates social values (they may be utilitarian or bio-centric), which are expressed in various ways, (Kennedy and Thomas (1995).

Novitzki *et al* (1997) added that values are assigned to wetland functions may change over time as society perceptions and priorities change. They can also change as the wetland itself changing over time as well. Changes to wetlands could be natural or due to human activities, consequences of these activities may also be because of a certain value placed on the wetland. The values that benefit society as a whole tend to change slowly, however, the values assigned by individuals or small groups are subjective, and most are subject to rapid and frequent change and may even conflict.

Furthermore, society may have to choose among wetland functions that benefit individuals or the whole community, that are of value to most of society, or that are important to the maintenance of the wetland itself. Society may have to resolve conflicts regarding the management or preservation of wetlands and their functions (Novitzki *et al*, 1997).

2.4 Wetland Functions

An international Wetlands Values and Management Conference held in 1981 came up with definitions of wetland functions. Wetland functions were defined as a process or series of processes that take place within a wetland (Novitzki *et al,* 1997). These included:

i. The storage of water
ii. Transformation of nutrients
iii. Growth of living matter
iv. Diversity of wetland plants.

Functions were grouped broadly as

- Habitat
- Hydrologic
- Water quality (Novitzki *et al*,1997).

(Kaggwa *et al.*, 2009) state that the importance of wetland functions to water resources management is observed through groundwater recharging, water storage and water purification. In and in this way, wetlands serve as water reservoirs that slowly release water to the major drainage basins. This slow release ensures continuous water availability, particularly during the dry season, to support the economy (Kaggwa *et al*., 2009).

However, wetland functions have been taken to mean the same as services by Millennium Assessment (MA), 2003. These services/functions are defined by MA, 2003 as benefits that people obtain from ecosystems (De Groot *et al.*, 2006). MA, 2003 distinguishes ES into four classes of services which are categorized as follows:

- Provisioning
- Regulating
- Supporting
- Cultural

The European Union (EU) views functions as benefits that wetlands provide either directly or indirectly, through the interactions of biotic and abiotic components (Maltby, 2010). The MA,

2003 and the EU, 2010, similarly state functions as benefits provided by wetlands. However, what the MA, 2003 classifies into four classes of functions are what the EU, 2010 take as the biotic and abiotic components` interactions.

Thus benefits are a corollary of these functions. "*From a human perspective it is sometimes not the function itself that is of interest but the result of the function*" (Bullock, 2007). Unlike MA, (2003), both Bullock and EU insinuate that functions generate services and goods. Thus, in this study, functions and services are not the same. Although there is a thin line in distinguishing between functions and services and these terms are used interchangeably, more often implying the same meaning (Kaggwa *et al.*, 2009). Kaggwa *et al* (2009) state that wetlands have intrinsic attributes, i.e. they perform functions and services, and produce goods, this is how the study views the concept of wetlands. Table 2.1 shows the linkage between functions, goods, services, attributes, products and values.

Table 2.1: The linkage between functions, goods and services, attributes, products and value

Function	**Services and Goods**	**Attributes**	**Products**	**Value**
Provisioning	Food , Fresh water, Fuel, Timber, Fiber	Livelihood	Fishery, Mats, vegetables	• Economic • Social • Ecological
Regulating	Flood control, Climate stabilization Land degradation control Climate stabilization	Biodiversity	Tourism	
Supporting	Soil formation, Nutrient cycling Primary production	Minerals	Food	
Cultural	Spiritual, Religious, Educational Aesthetic and emotional Educational	Cultural heritage	Recreational	

2.5 Putting wetland values into perspective

Following the researcher`s concept of the linkage between functions, goods and services, attributes, products and value, value is then categorized into three types. According to De Groot *et al* (2006), these three main types of wetland value determine the Total Value of wetlands. These are:

i. Ecological
ii. Social
iii. Economic

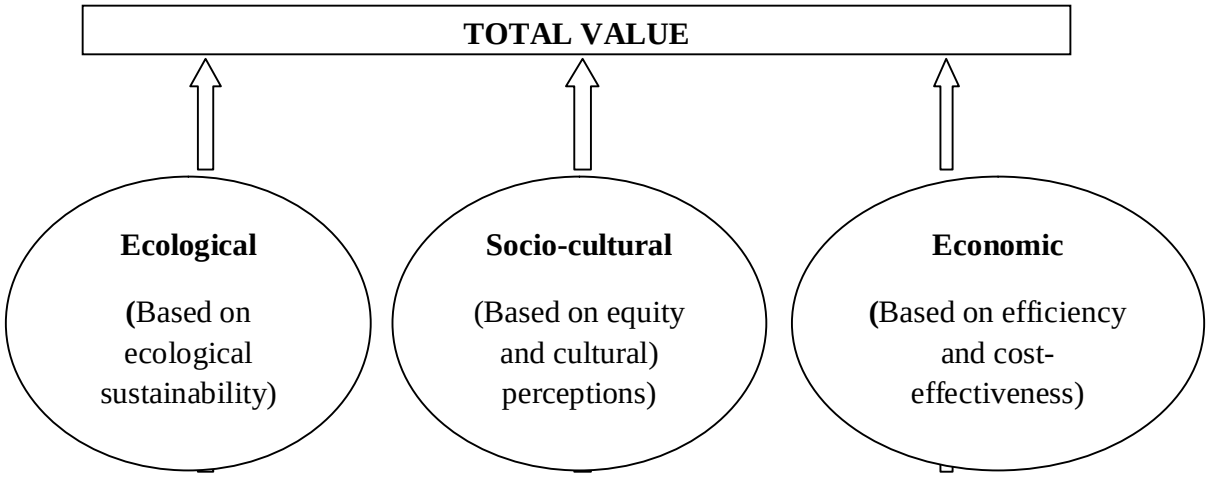

Figure 2.2. Components of Total Wetland Values
(Source:(De Groot et al., 2006))

Although De Groot *et al (De Groot et al., 2006),* highlight that wetlands have 'socio-cultural' values this study focused on the "***social value"*** only without cultural.

These values have various benefits termed as "total *use values"*. Total Use Value is divided into:

a) Use value
b) Non-use value

Use value is divided into:

i. Direct use value
ii. Indirect use value (Arntzen *et al*., 2000)
iii. Optional use value

Direct use value is consumptive, extractive (non consumptive) or structural use value. For example, direct for wetlands can water for bathing, fishing, farming or sport. Indirect use value consists in which wetland benefits are used to produce a good. These values occur from wetland functions which are not traded in any market and are at times referred to as un-priced benefits of wetlands (Arntzen *et al.*, 2000). A functional approach to wetland assessment is one that

acknowledges that wetlands can perform work at a variety of scales in the landscape, which may result in the significant direct or indirect benefits to people, wildlife and the environment (Maltby, 2010).

Non-use value is divided into:

I. Existence use value
II. Bequest use value

These values include intangible benefits that local communities derive without any direct or indirect use (Dixon, 2008). Existence use value is the value of knowing that a resource exists, despite the fact that the local community have never used or seen the resource, or intend to see or use it in future. Bequest on the other hand is the value an individual places on the ability to conserve the resource so that it can be used in the future generation (Farolfi, 2011).

Figure 2.3 illustrates the concept of total use value adopted from a model which was specific to the economic value Plottu and Plottu, (2006). The same model was used for the ecological and social values of a wetland in this study.

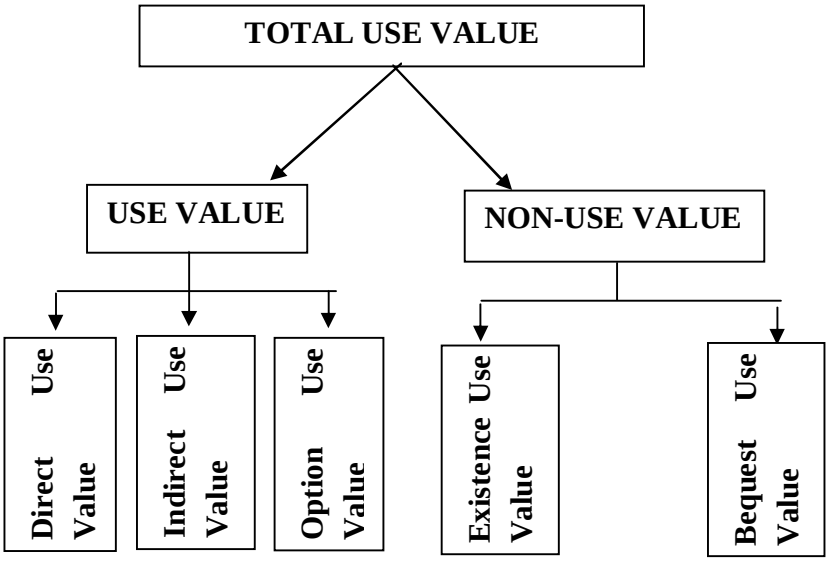

Figure 2.3 Total use value (*An adopted source by Plottu and Plottu, 2006)*

Table below illustrates the link between functions of wetlands and use values.

Table 2.2: Linkage between the functions of wetlands and the use values

Functions	**Type of Use Value**
Provisioning	Consumptive use value (Direct)
Regulating	Indirect use value
Cultural	Non-consumptive use value (Direct)
	Option use value
	Existence value
	Bequest value
Supporting	n/a

Table 2.3: Summary of use values

Direct values	**Indirect values**	**Option values**	**Non-use values**
Production and consumption goods and services	Ecosystem services	Premium placed on possible future uses and application of these	Intrinsic significance
Examples: Fish, Fuel wood, Building poles Sand, gravel, clay, Thatch Water Wild fruits Medicines Cultivation, Pasture, Recreation Transport	Examples: Water quality, Water flow Water storage Water purification Water recharge Flood recharge Nutrient retention Micro-climate stabilization	Examples: Pharmaceutical Agricultural Industrial Leisure Water use	Examples: Cultural Aesthetic Bequest Existence Heritage

Source: WID/IUCN, 2005

2.6 The Hydro-geomorphic (HGM) Approach in Wetland assessments

A Hydro-geomorphic unit (HGM) is an area of homogenous geomorphology, hydrology and/or hydrogeology and water under normal conditions, homogenous soil/sediment (Kotze *et al.*, 2004). The characteristics of a natural wetland are determined by the interaction of the quality and quantity of inflows and outflows, the geology, soils and topography, the climate and how they are used or managed (Kotze, 2009). Wetlands may receive water from rainwater, surface water, groundwater or a combination of these. They lose water through evaporation, transpiration, surface flows or groundwater flows. The ecosystem services provided by wetlands are driven by hydrology, and understanding how changes in hydrological processes affect the delivery of these services is critical to determining the impact on human welfare (Kotze and Breen, 2000).

The ability for wetlands to deliver ecosystem services arises out of their position within the landscape, as they are often located at significant positions along hydrological pathways where they are able to interact with hydrological processes (Turpie *et al.*, 2010). In the HGM approach, functions that are performed by wetlands in a specific hydro-geomorphic setting in that region are identified. Wetland characteristics (indicators) are also identified, such as plant communities, plant species, and density of stems, that suggest whether or not a wetland is performing a specific function, such as slowing the flow velocity of floodwater, (Novitzki, 1997). The value of each function is determined by measuring the degree to which that same function is likely to be performed (Turpie, 2010).

There are variety of types of wetlands that differ in their characteristics and functioning. Wetlands classified in terms of HGM Units (See Appendix 4) are defined primarily according to:

- Landform (which defines the shape and setting of a wetland)
- Hydrological characteristics, which describe the nature of water movement into, through and out of the wetland
- Hydrodynamics, which describe the direction and strength of flow through the wetland (SANBI, 2009).

3. Chapter Three: Materials and Methods

3.1. The study area

The study area lies in the headwaters of the Tuli River which runs through the sub-catchment of Umzingwane catchment. The wetland is located at Intunjambili village, at 28° 41´ East and 20° 27´ South at an altitude of 1350m above sea level. Intunjambili village is in ward 15 of Matobo District in the Matabeleland South province in southwestern Zimbabwe. Figure 3.1 shows the position of Matobo District in Zimbabwe, Ward 15 in Matobo district and Intunjambili wetland.

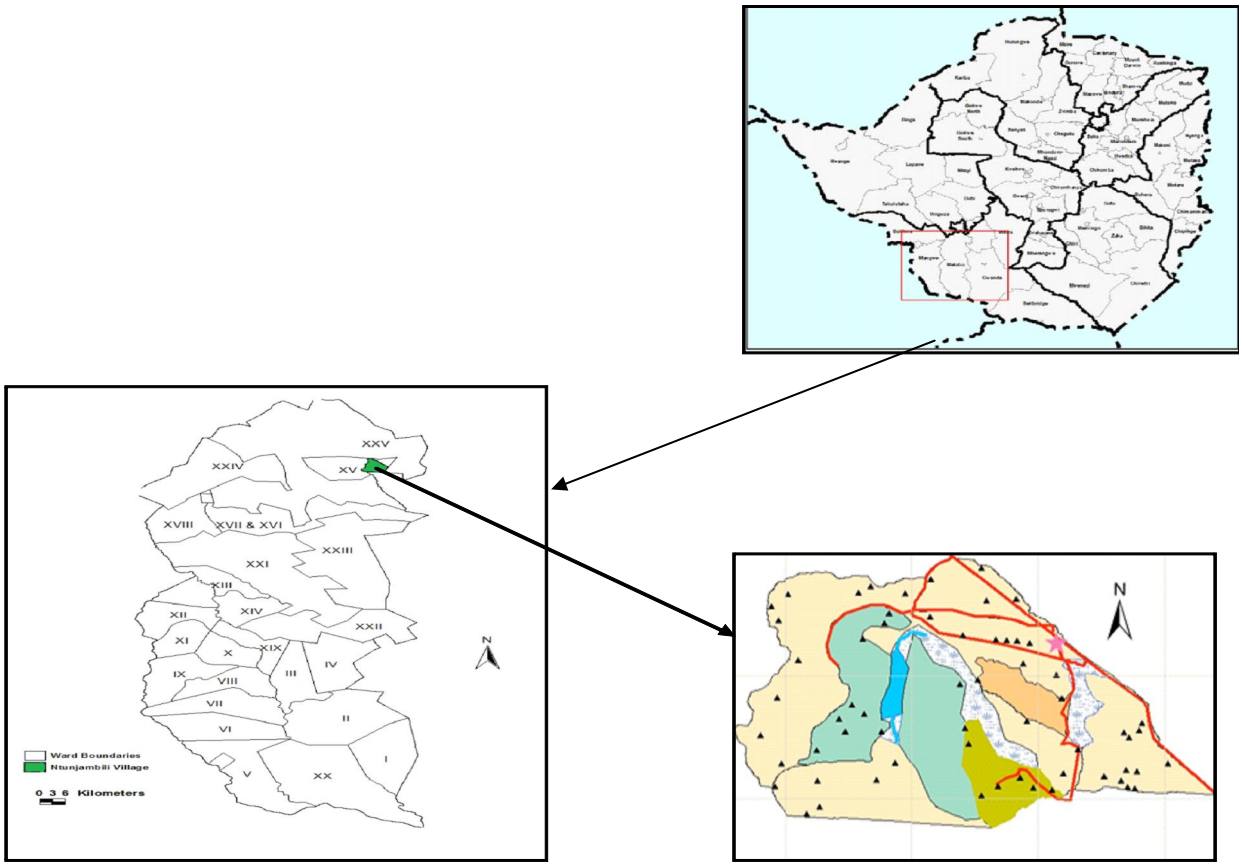

Figure 3.1: Position of Matobo District in Zimbabwe, Ward 15 in Matobo district and Intunjambili wetland in ward 15

(Source: Ndlovu, 2009)

The study area was chosen because of Intunjambili village's proximity to Bulawayo and its suitability as reference type of wetland site found in Zimbabwe. Intunjambili village is located 60km south of Bulawayo, which is Zimbabwe's second largest city, along Old Gwanda Road, of Bulawayo. The wetland has an area of about 30 hectares in a 4.3km^2 catchment. Intunjambili wetland has a potential to be a Internationally recognized wetland with its unique features. It is located in a valley within an undefined channel next to Intunjambili hill well known for its Intunjambili cave. Intunjambili hill is the main gentle slope that drains run-off into the wetland to Intunjambili River and Intunjambili Dam. The area is also characterized by scattered rock outcrops that also contribute to existence of dispersed wetland fields in and around the village (Masiyandima *et al.*, 2003). Wetland users in Intunjambili village therefore can be classified into two broad categories:

1. Users that adjacent to the valley bottom and along the main river catchment area that result from the Intunjambili hill (on the wetland).
2. Users that result from scattered rock outcrops around the area (outside the wetland).

3.1.1. Climatic conditions in Matobo district

The Intunjambili wetland is in Ward 15 of Matobo District in Matabeleland South province where climate is characterized by a short wet season and a very long and hot dry season (Chuma *et al.*, 2007). The mean runoff in the area is between 17-18mm with a typical coefficient of 3% (Ndhlovu, 2009). Rainfall is the main source of water for the catchment where the wetland is situated and ranges between 450-600mm, per annum (Masiyandima *et al.*, 2003). The rainfall is normally erratic and when it occurs it is usually associated with strong and localized convective storms. The rainy season occurs from mid-October through to mid-March with the rest of the year dry (Ndhlovu, 2009).

3.1.2. Geology of Intunjambili wetland

Intunjambili wetland is part of the Matobo district areas well known for its plethora in surface rocks, hills or *dwalas*. This implies that the area is very much prone to a lot of surface and ground water run-off that emanates from these rocks which lead to generally higher ground water tables

that result in areas around these hills or rocks to be seasonally or perennially inundated with water (Chiputwa, 2006). The geology of the Intunjambili catchment is mainly granite (Masiyandima *et al.*, 2005). The wetland and the rest of the catchment are composed of soils of the fersiallitic group (Nyamapfene, 1991). The soils are moderately leached and of the kaolinitic order, derived from granite. They have low clay content (10%) in the top soil. The soils can be classified as Ferralic Arenosols or simply Arenosols. The large portion of the soils is hydromorphic due to the

poor drainage particularly in the valley bottom. The wetland soils have low clay content, high soil organic matter in the central wetland, and sandy soils further away from the center of the wetland (Masiyandima *et al.*, 2005).

3.1.3. Vegetation cover at Intunjambili wetland

The wetland is bordered by rock outcrops which are believed to contribute to most of the run-offthat contributes to surface and sub-surface flow for the wetland (Chiputwa, 2006). Certain sections close to the rock outcrops are permanently water-logged, while others have intermittent water on the surface, and in some the water table rises to the surface in very wet years, (Ndhlovu, 2009). Vegetation in the ward is dominated by *Acacia fleckii*commonly known as blade thorn. Other species include (mopane) *Colophospermummopane*, *Brachystegiaspiciformis*, *Terminaliasericea*, *Julbenardiaglobiflora*, *Bakikeiaea sp*. The shrub community is dominated by the invasive *Lantana camara*that occupies about 60% of the wetland area. The other shrub species is *Euphorbia sp*. commonly known as Cactus, a dry land plant species (Ndhlovu, 2009).

3.1.4. Socio-economic aspects at Intunjambili village

The district where Intunjambili wetland is found is renowned for a lot of rituals and taboos due to its association with the Njelele “sacred” shrine, which for a long time housed *uNgwali*, the Ndebele spirit medium (Ndlovu and Manjeru, 2014). Intunjambili village in which the wetland is located is in a ward which consists of two tribes; the Ndebele and Khalanga tribes. The main language in the area is Ndebele.

The community still practices their local culture and believes in respect for each other, the elderly and traditional authority. Traditional leadership in the ward consists of Chief Malakhi Masuku, the

Village Headman, June Sheleni. The community has both Christianity and traditional religions. The village has approximately 180 households, with a total population of 512 inhabitants according to the village head records. These community members use the wetland mainly for cultivation, provision of domestic water, livestock grazing, fishing, vegetable gardening and water abstraction for irrigation (see Figure 3.2). Cultivation activities mainly consist of vegetable gardening and maize crop farming.

Figure 3.2: Vegetable gardens at Intunjambili wetland

3.2. Research design

This study used both qualitative and quantitative data collection methods. The qualitative methods used included focus group discussions, key informant interviews, stakeholder analysis, transect walk, review of documents for various concepts and further information about the wetland. Quantitative methods incorporated a WET-EcoServices assessment and comparison of GIS/Earth Observation technologies with community mapping.

3.2.1. Mapping the extent of Intunjambili wetland and its LULC changes

In an endeavor to map the extent of Intunjambili wetland and analyze the trend of land cover/use changes, cloud free LandSat 8 OLI of 2014and TM of 1986 images were acquired from the Glovis website (www.glovis.usgs.gov). The images were acquired with a difference of 28 year, in order to

obtain significant variation in the land use change. Table 3. 1 shows the details of the specification of data used in the land use classification.

Table 3.1: LandSat images used in the classification of landuse in Intunjambili Wetland

LandSat sensor	Path/Row	Date of acquisition
LandSat 8(OLI)	171/74	24.09.2014
LandSat 5 TM	171/74	07.11.1986

3.2.2. Image pre-processing and classification

The Integrated Land and Water Information System (ILWIS 3.3 academic) was used to process the LandSat images and conduct spatial analysis. Before undertaking image classification, LandSat images for 2014 and 1986 were imported in GeoTiff format into ILWIS interface via the Geo-gateway, an in-built ILWIS function to ensure compatibility.

Consequently, a Maplist was created in ILWIS interface using three selected bands, 5, 4 and 3 for LandSat TM and 6, 5 and 4 for LandSat 8 OLI image which were assigned to red, green and blue colours in ILWIS respectively. The bands were then opened as pseudo-natural colour composites so as to enhance visual interpretation of features like vegetation, water and Bareland. As a requirement for supervised classification in ILWIS, a sample set was developed with six landuse classes' namely cropland/settlement, marsh, natural forest, irrigated fields, Bareland/rock and open water. These six classes were chosen based on background knowledge of the area under study. Supervised classification was then used to classify the images in ILWIS framework based on the six classes generated using the sample set to demonstrate the patterns in land cover and land use change around Intunjambili wetland. Classification was done using the maximum likelihood classifier algorithm.

3.2.3. Validation of classification output

A total of 20 Ground control points (GCPs) were collected using Global Positioning System (GPS) from different land use classes. The Confusion matrix which is an inbuilt function in ILWIS was used to determine the accuracy of the classification and to identify where misclassification occurs.

3.2.4. Assessment ofIntunjambili wetland services

The WET EcoServices tool was developed in South Africa as part of a nine year research programme on wetland management which was initiated in 2003 by the Water Research Commission (WRC) and partners. Although the tool was made from South Africa but it can be applied in Zimbabwe because it was developed for inland wetlands of which Intunjambili wetland is inland. The tool is used to assess the goods and services offered by wetlands. This study used this tool to assess the goods and services provided by Intunjambili Wetland. This was in the form of a desk study and rapid assessment. The tool was designed for a specific class of wetlands known as palustrine which are also known as the in-land wetlands. Types of wetlands include non-tidal dominated by emergent plant species (reeds), shrubs or trees and includes marshes, flood plains, vleis and seeps. The assessment was used to come up with a score of the importance of the wetland in delivering its functions. Although the tool recommends fifteen functions to be assessed, this study examined eight functions only. This is because the rest of the functions were time consuming and difficult to characterize at a rapid assessment level.

i. The first step was a desk assessment, characterizing Intunjambili wetland according to its hydro-geomorphic (HGM) setting.

ii. The second step was a field assessment of the key descriptions. Each function was assessed based on a list of characteristics that were relevant to the benefit.

3.2.5. Description of the wetland

Since the study was on one wetland, there was no need to determine the number of wetlands to be assessed, thus the step was omitted. Desktop description involved characterization of Intunjambili wetland into a specific HGM type. HGM types are based geomorphic setting of the wetland in the landscape, water source, how water flows through the wetland and how water exits the wetland. Screening the wetland into a HGM type establishes whether it is likely to be providing any hydrological benefits. The limitation to the desktop study is that HGM types are recommended to be identified based on interpretation of aerial photographs of a 1:30 000 and experience or local knowledge about the wetland. Ground truthing was done in the rapid field assessment. This step was done to establish whether the wetland hada likelihood to provide any of the fifteen selected

benefits. The same guideline used in South Africa for characterizing wetland HGM types typically supporting inland wetlands. Out of the fifteen, eight services were identified as feasible for further field assessment in this study.

Preliminary rating of hydrological benefits likely to be provided by a wetland based on its particular hydro-geomorphic type was done following the guideline provided by the WET-EcoServices assessment tool. The results are shown in Table 3.2.

Table 3.2: Rating of hydrological benefits provided by Intunjambili wetland

Wetland HGM Type	**Regulatory benefits potentially provided by the wetland**							
	Flood attenuation		Stream flow regulation	Enhancement of water quality				
	Early wet season	Late wet season		Erosion control	Sediment trapping	Phosphates	Nitrates	Toxicants
Non channel valley-bottom	+	+	+ ?	++	++	+	+	++

Rating: 0 = Benefit unlikely to be provided to any significant extent

+ = Benefit likely to be present at least to some degree

++ = Benefit likely to be present (and often supplied to a high level)

3.2.6. Rapid field assessment of Intunjambili wetland functions

The identified eight services were assessed based on a list of characteristics that are relevant to the particular benefit. For example, for the stream flow regulation, characteristics were linked to the stream network, hydrological zonation, presence of fibrous peat or unconsolidated sediments below floating marshes and HGM unit`s catchment occurs on underlying geology characterized by ground surface water linkages. Each characteristic had a rationale for choice of score and aids on how to assign the scores. Guidance was given on how to collect the necessary data. Thus score sheet was used to score characteristics contributing to each of the services. Using the MS Excel file attached with the tool, a scale of 0.0 to 4.0 was used to summarize the overall score for each service. Appendix 5 gives more detail on the scores and how they were determined. The eight selected services were mainly as follows:

i. Stream flow regulation
ii. Maintenance of biodiversity
iii. Provision of water supply for direct human use
iv. Provision of harvestable natural resources
v. Provision of cultivated foods
vi. Cultural significance
vii. Tourism, recreation and scenic value
viii. Education and research

For each characteristic to which score was allocated, the datasheet allowed for the assessor to rate the confidence that they placed in their score. This was based on reliability of the source of information and level of accuracy.

The following scale was used (as guided in the toolkit):

- Very high confidence = 4
- High confidence = 3

- Moderate confidence = 2
- Marginal/Low confidence = 1

The fact that the WET-EcoServices determines the score for the benefit based on an average of scores for the relevant characteristics makes it possible to calculate a score even if not all of the characteristics are known. Thus the overall score was not penalized by any missing characteristics.

Ratings were derived to a large extent from qualitative data and provide only preliminary indication of the likely provision of ecosystem services. When interpreting the scores, it was important to pay attention to current *versus* potential future benefit and accounting for the size of the HGM unit that was being assessed.

3.2.7. Identification of stakeholders benefiting from Intunjambili Wetland

In the process of wetland valuation, the subsequent groups benefiting from the wetland services were identified. This was particularly important because in almost all steps of the valuation procedure, stakeholder involvement is essential in order to determine, identify the main relevant services and assess their value, (De Groot *et al,* 2006). Thus, a stakeholder analysis was conducted by the researcher through data review, observation, formal and informal interactions during field visits. The first step of stakeholder analysis was to identify people/groups/organizations that were important to involve in the valuation process. The first entry was the Matobo Rural District Council who gave guidance on who to see and talk to.

From the data gathered, people/groups/organizations were further analysed through the use of a stakeholders` analysis tool called the Goal Oriented Project Planning (GOPP). This was a tool adopted from the International Training Kit on Integrated Water Resources Management (Wetlands perspective) developed by trainers of the Centre for Development Innovation at the Wagenningen University of The Netherlands. It was one of the tools used for stakeholders analysis in the process of coming up with a Wetland Management Plan.

Similiar stakeholders in terms of wetland use and roles from the list were placed in one row in one group under a selected name in one column. A list of oberseved characteristics were listed in the

second colunm. Their interest and problems with regards to the wetland were listed in seperate columns. Possible solutions and resources each group could possible provide for these solutions were also listed in seperate columns too.

The second step was to categorize these stakeholders according to priority, since not all the identified stakeholders were directly relevant to the exercise. This was done through categorizing stakeholders into four groups of A, B, C and D according to presumed level of importance and influence in the valuation process. This was to determine whether stakeholders were primary, secondary or external and then look into the level of involvement in the whole process. De Groot *et al* (2006) defines importance as "the degree to which the stakeholder is considered and focus of a decision to be made" and influence as being, "dictated by stakeholders' control of, or access to, power.

Group A was of stakeholders that had a likelihood of significantly being directly affected by the wetland and their activities could affect the wetland. Group B consisted of stakeholders that stand to be affected by actions in the wetland but whose actions would not affect the wetland while Group C were stakeholders whose actions could affect what happens in the wetland but are not affected by what happens in the wetland. Group D were those stakeholders operating in the area but would not be affected by the wetland nor would their actions affect the wetland in any way.

3.2.8. Focus Group Discussions

Assessment of wetland benefits were finalized in focus group discussions and household surveys. Wetland benefits were demarcated into its different ecosystem services. Focus group discussions are one of the Participatory Rural Appraisal approaches that can be used in valuation of wetlands. This approach used materials and methods that empowered local people to express and analyse their knowledge. Visual sharing of maps, models, diagrams or units (stones, seeds etc.) provided the means, by which even illiterate people could quantify, rank or score, point to, see, discuss and manipulate physical representations. Rural people have a greater capacity to map, model, observe, quantify, estimate and compare than outsiders often suppose. Two focus group discussions were conducted. The groups were composed of:

- Community members who have plots which are adjacent to the valley bottom and along the main river catchment area that result from the Intunjambili hill (those on the wetland).
- Community members with plots that result from scattered rock outcrops around the area (those outside).

The groups consisted of 43 locals that lived on the wetland and 45 that lived outside the wetland. These were large numbers for an effective FGD, thus each group was further divided into three teams that were assigned tasks. Each group had an average of ten locals from each FGD that consisted of the elderly that ranged in the age of 50 years and above were tasked to sketch maps that show land use/cover change between the 1980 and 2015. This was because they could remember how the wetland looked liked 35 years ago and manage to relate those changes to the current situation in the year 2015.

Tools used for this exercise were adopted from the Participatory Health and Hygiene Education (PHHE) toolkit. The tools are both investigatory and informative. A minimum of three tools were used for each discussion. These were as follows:

(a) Community/Participatory mapping

The main purpose of the tool was to create maps that represented the wetland resources and uses and conduct a trend analysis. In each FDG, a group was separated into three teams which were then tasked to draw a map of:

- The entire village, highlighting the major features including the main road, business centre, rivers.
- Extent of the wetland highlighting the land uses
- Historical trend in the land cover over an agreed period of time (1980 and 2015)

Each group would then report back in plenary discussing the main features of the wetland or what the community considers as main features and the trend analysis of the wetland land cover.

(b) The Task Target Analysis (Tasks in terms of roles/responsibilities that are activities carried out by the local community)

The main purpose of the tool was to depict and analyze gender roles/responsibilities in the wetland. The roles would then relate to the services provided by the wetland and how these are used. The exercise also required the tasked groups to report back in plenary, discussing:

- The main activities performed in the wetland
- Who performs these activities?
- How are they performed?
- Why are these activities important to you as a community?
- Whether these activities have changed over time?
- Which activities can be shared and cannot be shared?

(c) Three pile sorting

The main purpose of the tool was to understand the different levels of importance the local community puts on benefits derived from wetland functions. Participants were tasked to sort given pictorials into three piles as:

- Low importance
- In-between importance
- High importance

(d) Pocket chart

The main purpose of the tool was to assist individuals and communities to identify and assess the importance attached to wetland functions.

3.2.9. Household survey

A household survey was conducted as a form of follow up for the FDGs aimed to get individual perceptions and ranking of values they attach to the Intunjambili wetland. The target population was the households that have plots surrounding or on the wetland and the rest of the households outside the wetland area but in the same village. The village has a population of approximately 180 households (source was the register book kept by the Kraal head). From this, a sample size was determined.

(a) Sample size calculation

In determining the sample size, one ideal approach is to use the entire population, a census is attractivefor small populations (e.g., 200 or less) (Israel, 1992; 2009). However, there are some considerations that were made that made in this study that made it impossible for carrying out the survey for the entire village. These included cost considerations and time. *Ibid* Yamane (1967) provided a simplified equation to calculate sample sizes. The following Equation (1) was used to calculate the sample size for this particular study, where the confidence level = 95%and P = 0.5 areassumed.

Equation (1) $$n = \frac{N}{1+N\,(e^2)}$$

Where n = the sample size

N = the population size

e= the level of precision

The level of precision for this study was 0.05

If the population is small then the sample size canbe reduced slightly. This is because a given samplesize provides proportionately more information for asmall population than for a large population (Israel, 1992; 2009). Thesample size (n_o) can be adjusted using Equation (2).

Equation (2): $$n = \frac{n_o}{1 + (\frac{n_o - 1}{N})}$$

Where n = the adjusted sample size

n_o= sample size

N = the population size

(b) Questionnaire design

The questionnaire for the survey was composed of closed ended questions. This researcherdesigned the questions for the questionnaire with input from the WET-EcoServices assessment tool and the findings from the FDGs. The main functions that were identified from the assessment and FDGs were further explored as a guideline in the development of the questionnaire. Some of the questions were adjusted from the one developed for contingent valuation survey by Kadisa (2013). After designing of the questionnaire, a pre-test-testing exercise was in one of the adjacent village by trained enumerators. This allowed the researcher to note certain issues which needed attention on the questionnaire.

The pre-test exercise paved a direction to the categorization of values for the responses. The final questionnaire was divided into three sections as followed:

1. Section A encompassed the socio-demographic characteristics of the respondents, specifying whether the respondents were the household head or not. Household characteristics were also covered in this section, showing for an example, the religion of the household, assets, and livestock.

2. Section B was on natural resources in the wetland and their usage. The core of the section was splitting the respondents into the two defined groups in terms of location, those that live within and outside the wetland. How the respondents perceived the extent of the wetland. Other questions covered uses of the wetland, rankings of importance, dependence and reliance.

3. Section C covered mainly the socio-cultural aspects.

(c) Data Analysis

The design of the SPSS template for data entry was also developed before the survey was rolled out. This template also guided the structure of the questionnaire and the layout of values of the variables. Data from the household questionnaire administration was done using the Statistical Package for Social Sciences (SPSS) and this analysis consisted of bivariate cross tabulation. This is an analysis that involves two-way tables. This allows the analysis of how two variables relate. Cross tabulation is a joint distribution of cases based on two or more categorical variables (Michael, 2001). A distribution of cases by their values on two or more variables is displayed in analysis known as the contingency analysis. This is commonly used in the social sciences. The joint frequency distribution can be analyzed with chi square statistic to determine whether the variables are statistically independent or if they are associated.

4. Chapter 4: Results and Discussions

4.1. Introduction

The main objective of the study was to examine the social value for Intunjambili wetland. Thus in this chapter findings of the study are presented and discussed. The findings are from the data collection for the social valuation of Intunjambili wetland using an Ecological Approach. Data was gathered to map the extent of the wetland and analyze the LULC changes between the years of 1980 and 2015.The resource use behavior of households in Intunjambili wetland is presented as well along with further analysis of these results to determine the social value.

4.2. Mapping Intunjambili wetland and its LULC changes

The first objective was to map the extent of the Intunjambili wetland and its land use changes between 1980 and 2015. This aim was to bring out what locals of Intunjambili wetland regard as the wetland and what changes had occurred in the last 35 years.

4.2.1. The extent of Intunjambili wetland

Methods used to collect data included participatory mapping by the locals of Intunjambili village compared with GIS techniques of image processing and household questionnaires. Participants considered the extent of the wetland to be marked by the marshy area. In local Ndebele language, a wetland is known as "*ixhaphozi*". Within the "*xhaphozi*", there is an area called, "*Inuta*". However this a local khalanga expression that entails the heart of the wetland which is swampy, never dries up and where farming activities are impossible because the area is muddy and animals can get trapped in it if they attempt to go near it. Figure 4.1 (a) on the left is a photo that shows the "*ixhaphozi*" and 4.1 (b) on the right is the location of the "*inuta*".

Figure 4.1: a (left)The marshy area regarded as the wetland and b (right) the "inuta"

The area from the point where the photograph was taken to the "*inuta*" itself was all wet as shown in Figure 4.1 (b). This made it difficult to take a closer picture of the "*inuta*". Figure 4.2 shows the extent drawn by the local communities.

Figure 4.2: One of the maps drawn by locals showing the extent of the wetland

Results from the household questionnaires, both groups from the two locations (on and outside the wetland) had almost similar perceptions that the extent of the wetland was the marshy part where the *"inuta"* is located. However, there was a higher percentage from the group outside the wetland that defined the extent of the wetland that also included the dam.

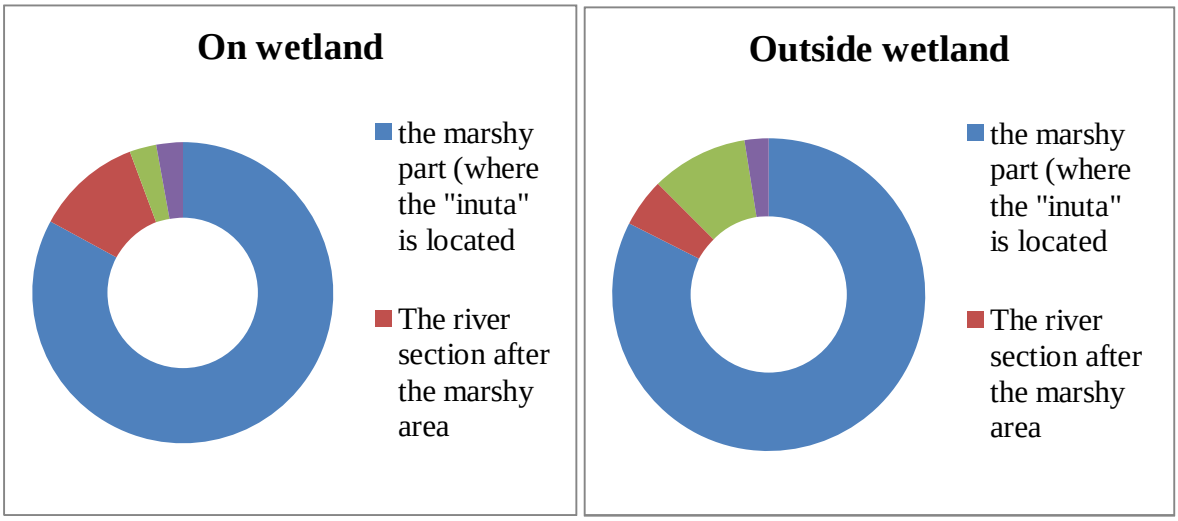

Figure 4.3: Perceived extent by those on wetland, Figure 4.4: : Perceived extent by those outside wetland

According to the locals, the wetland only covers the part that is always wet and marshy. Thus households close to these parts believe they are the only ones living within a wetland area. This also determines and demarcates the differences in value put by those that live on the wetland and those that live outside the wetland.

Although from the features that the village has of hills and rivers, most parts of village might be regarded as part of a wetland because the hills provide water and most areas have perennial sub surface water. Figure 4.5 (a) on the left shows the extent of the wetland followed *(highlighted by a black bold line*) by the locals and 4.5 (b) on the right in this study.

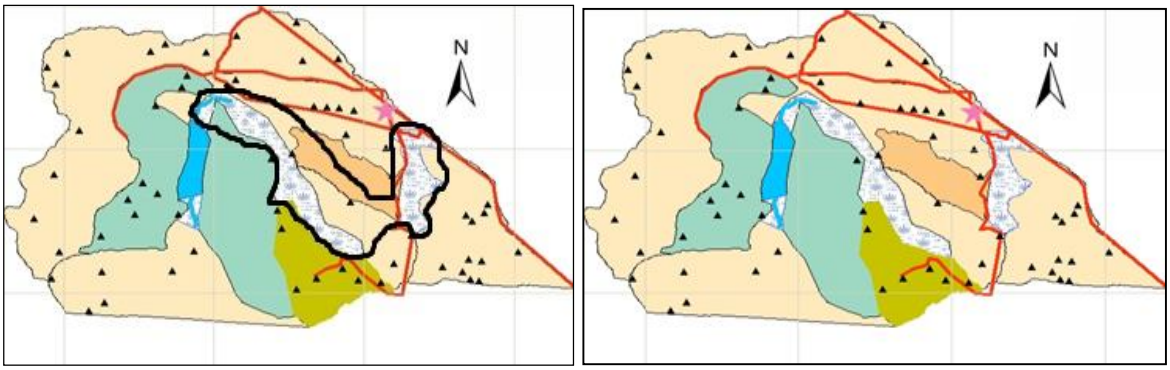

Figure 4.5: Extent of the Intunjambili wetland by (a) on the left locals and (b) on the right by the study

The definition of a wetland will continue to be subjective. For the purposes of this study however, a basic and simplistic definition of a wetland is preferred as "being that land which is subject to permanent or temporary waterlogging, resulting in land use that supports aquatic or semi-aquatic plant life cycles permanently or temporarily in its natural state". Intunjambili wetland has a permanent surface water level with ground flow that seeps into the Intunjambili River which inflows into the Intunjambili dam. According to the Ramsar convention of 1971, the whole area from the marshy area of permanent surface water level, the river and the dam would be one wetland with different characteristics at each section.

However, that is an international context which differs from the local communities of the Intunjambili wetland. The local communities regard only the part that is swampy as the wetland. There are some areas within the village that are swampy but are not regarded as "*ixhaphozi*" but are known as "*umsehla*" meaning the place is poorly drained and holds water for a very long time. In Zimbabwe such wetland ecosystems include dambos (mapani), flood plains, artificial impoundments and pans. All of them share the common factor of having excess water retained or

passing through for a long enough period to influence the soil characteristics, land use and life forms that flourish within them.

4.2.2. LULC changes of Intunjambili wetland

Another objective of this study was to determine wetland loss and degradation of Intunjambili wetland using GIS and Participatory Mapping by the locals of Intunjambili wetland. Using remote sensing techniques combined with GIS help save considerable effort, time and costs in land change detection and analysis (Camacho-Valdez *et al,* 2014). However, Participatory/Community mapping is also a powerful tool that increases stakeholder involvement and provides a means for participants to express their ideas in an easily understandable visual format (NOAA, 2009). Participatory mapping was done during the two FGDs that were carried out at the village.

Both groups produced maps that showed a decrease in the vegetation cover between the two years, thus they had the same interpretation. The group members explained that the wetland, referred to as "*ixhaphozi", had* abundant trees and there were places that used to have only grassland and woodland which have been cleared for settlement. Gardens used to be just for consumption with the families but in the downturn the national economy has seen the numbers of gardens increasing as families try to increase household income. The changes in the land use cover of the wetland were attributed to that.

The dam was not clearly illustrated though it is a change from the 1980s. This is because it is not regarded as a wetland by the local communities. The maps drawn show more of an increase in size of the wetland (see figure 4.6 a) and b) but when follow up visits were made regarding this, the local communities concurred that the size of the wetland had decreased instead of increased. They drew the map of 2015 a bit larger so as to show more of the changes that had taken place since 1980 without realizing that it now depicted an increase in size of the wetland instead of a decrease.

The illustration of the two maps shows more trees/vegetation in the year of 1980, few gardens within the wetland while the 2015 map shows less trees/vegetation going upstream towards the dam, more gardens within the wetland and increase in homesteads (human settlement). The reason

for the fewer trees towards the dam is that, more land was cleared up for dam construction purpose.

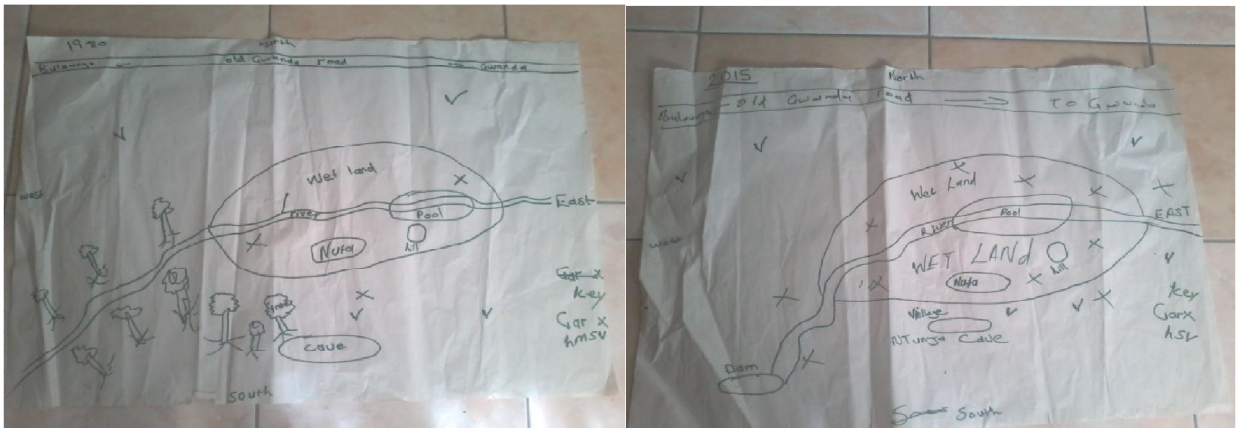

Figure 4.6: a (on the left) shows the map drawn for 1980 and b (on the right) is the one for 2015

However, from the discussions between the two groups, those that live on the wetland insisted that water level reduction and the drying of the "*inuta*" was because of climate change.Whilst a few individuals whose homesteads are on the wetland concurred with those that live outside the wetland that these changes have been worsened by members who keep on encroaching in on the wetland, decreasing its size and affecting its water provisioning function.

Land use/cover change mapping was similar for both groups although reasons for the changes differed slightly. Those that lived on the wetland gave a reason that climate change had caused the LULC changes over the years and those that lived outside the wetland blamed the locals within the wetland for encroaching further on the wetland. There was a hint of conflict over the reasons of what was causing decreasing water level. Those from outside the wetland felt that their livestock would be affected if conservation measures were not taken while the irrigators feared that the wetland might not supply enough water tothe dam which might result innot enough water for the irrigation scheme. This indicates the value put on the provision of water such that shortage of it might cause conflict.

Results from the GIS and Remote sensing maps illustrated in figure 4.7 show decreases and increases in LULC within the wetland but do not specifically show changes in the size of the wetland.

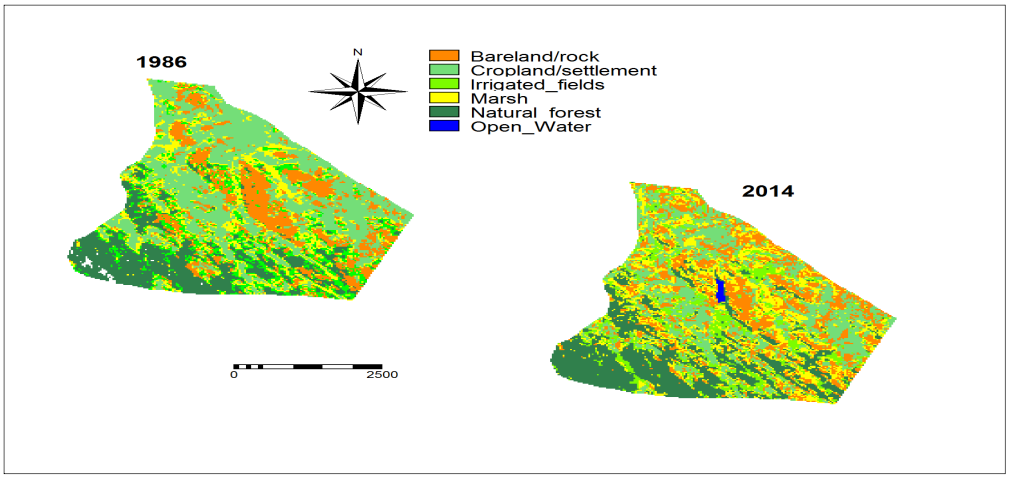

Figure 4.7: LULC maps produced using GIS

The data collected from the image processing and classification was also used to come up a summry analysis of LULC of 1986 and 2014 as illustrated in figure 4.8.

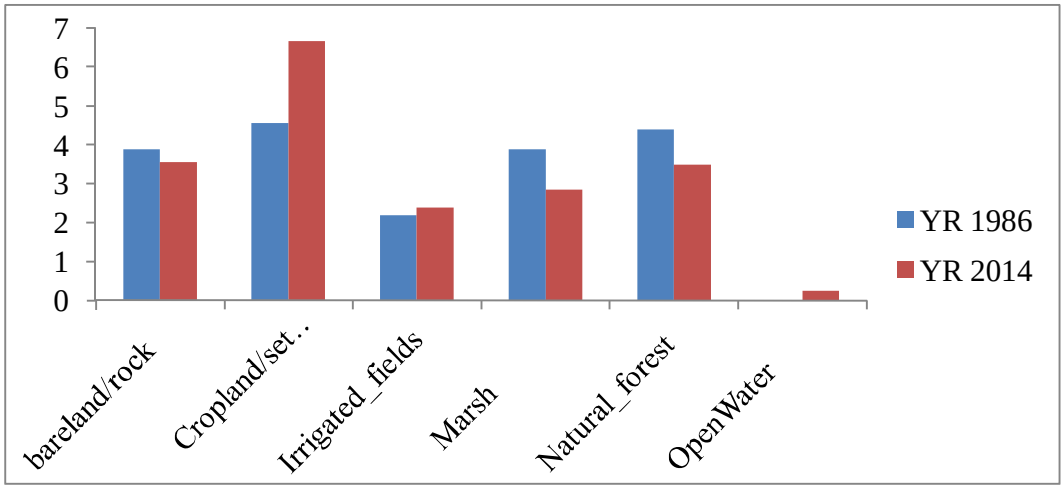

Figure 4.8: LULC changes of 1986 and 2014

Bare land/rock and natural forest cover show a decrease in terms of LULC from 1986 to 2014 whilst irrigated fields increased. Clearing of bush for cultivation (in this case study, the irrigated fields) could be the major cause of reduction in bareland and natural forest cover Ndlovu. The impacts of land use on the wetland is explained by the decrease in bareland and natural forest. Impact on land cover has significantly contributed to the impact on species richness and species evenness. Conversion of native landscapes for agriculture has resulted in extensive loss of wetlands globally as well as increased runoff of nutrients from agricultural lands. Vegetation has been altered, biodiversity lost and productivity in wetlands decreased because of encroachment of wetlands (Bayle, 2013). A similar study on LULC in Intunjambili wetland by Ndlovu also showed that the most significant change was the increase in cultivated area and decrease in woodland and water. Replacement of natural vegetation with crops and other vegetative plants also affect the interactions and energy flows within the wetland (Hove and Chapungu. 2013).

A study conducted in Australia revealed that, clearance of indigenous riparian vegetation and removal of woody species from streams and wetlands, combined with planting of exotic plant species, resulted in widespread detrimental effects on fluvial geomophorlogy and aquatic ecology of Australian rivers and wetlands (Webb and Erskine, 2003). Land clearance destroys the habitat of wetland faunal species; as a result such organisms like frogs, fish, matapi and aquatic snakes.

Generally reduction in natural forest was also in grazing areas, probably due to the fact that more areas were claimed by overgrazing. The changes in land cover in Intunjambili wetland may lead to catchment degradation. The most common causes of catchment degradation in southern Africa are; over-cultivation, overgrazing, deforestation and invasion of alien plants, which is often ignored (Mazvimavi, 2002).

Declining productivity in other areas due to dry conditions could have prompted an expansion of cultivation in Intunjambili. Rainfall patterns may also be modified by the defrayal of the natural forest leading to a drier climate. Similar observations made by (Heyns et al., 1994; Hove and Chapungu, 2013) in different studies on freshwaters and human perspectives on wetland degradation respectively, they found out that clearance of vegetation decreases evaporation, transpiration and humdity, thereby decreasing moisture available for rain formation, negatively impacting the hydrological cycle.

The cropland/settlement also showed an increase between 1986 and 2014. The study by Ndlovu illustrated that as population grew in the catchment, an increasing area of land cover types such as woodland and grassland were opened up for cultivation. Ndlovu`s study had census results for 1982, 1992 and 2002 showing the total population in the Matobo district to be 53 534, 89 139 and 99 836 respectively. The population of Intunjamili wetland area had increased rapidly from 1982 to 1992 and slightly less increase from 1992 to 2002 in the Matobo district (Central Statistical Office, 1985; 1994; and 2003). The specific census results in that study showed that for ward 15 in 1982, 1992 and 2002 was 4 725, 5 345 and 5 490 respectively.

Settlement patterns in Intunjambili wetland increased due to an increase in population and the driving force of income generation from the wetland through vegetable gardening. Thus areas of woodland and grassland decreased as they were cleared for cultivation and settlement. An increase in settlements also had an implication of an increase in livestock thus leading to a reduction of the grazing areas. Declining productivity in other areas within the village due to the erratic rainfall patterns could have prompted an expansion of cultivation in Intunjambili wetland (Ndlovu, 2009).

The interaction between human beings and the environment is the driving force behind ecosystem changes over time. Thus, an increase in an area's population would mean an increase in the interactions and therefore ecosystem changes (Zinhiva *et al,* 2014). The growth in population means increased pressure on limited environmental resources as households continuously exploit the environment to meet the demands of the growing household size. Thus, population growth can be used as a proxy indicator for increased human impact on wetland ecosystem.

The marshy area, being that land which is subject to permanent or temporary waterlogging decreased from 1986 to 2014. A decrease in the marshy area might be an indication of the drying up of the wetland on other words reduction in permanently wet areas. This could be attributed to cultvation or effects of climate change. The reduction of water or drying up of the wetland means loss of aquatic habitat and hence aquatic biota is affected.

Hugget *et al,* (2004) claimed that excessive water abstraction due to gardening activities in communal areas depletes ground water and disturbs the hydrology of an area. Thus, water

abstraction on the wetland has an impact on the wetland's hydrology. This in turn affects land cover which consequently influences species richness and evenness.

In a similar study, Hove and Chapungu. 2013, in their case study of Magwenzi Wetland in Chivi District, Zimbabwe on Human Perceptions on Degradation of Wetland Ecosystems observed that respondents highlighted that gardening has had effects on Magwenzi wetland ecosystem. Land cover and hydrology were reported to be the most affected. The abstraction of water from the wetland for watering the garden heavily depletes the ground water.

More vivid is the presence of an open water source in 2014 that was not in 1986. This is a dam that was constructed in the early 2000s. LULC for the dam were not explored but with potential depleting ground water, the dam also might reduce in terms of water storage. Those that live on the wetland already have gardens but also some community members that lived outside the wetland had gardens too on the wetland. These were the garden members sourcing their water from the dam. This means that the construction of the dam also increased cultivation and indirectly decrease in natural forest.

These LULC observations earlier also have potential conflicts within the community. Those that live in the wetland had a boundary where all their gardens and fields are fenced off from the so called "*inuta"* radius but there are cases of encroachment into this area. Further encroument might speed the wetland degradation as the ground water depletes and this will might arouse conflicts not only between those that live on the wetland but also with those that live outside the wetland who benefit from the wetland or the dam users upstream. There is also an individual tomatoes farmer upstream after the dam who might be affected by the reduction in water downstream.

4.3. Ecoservice assessment for the wetland

The objective was to assess which wetland service was likely to be delivered by Intunjambili wetland using a WET-EcoServices Assessment tool. Using guidelines of the assessment tool, the hydro-geomorphic (HGM) type for the wetland was classified to be a non-channeled valley bottom. This is because the wetland is at the valley bottom of the Intunjambili hill. Stream channel input is spread diffusely across the wetland even at low flows, resulting in extensive areas of

wetland remaining permanently saturated and tending to have high levels of soil organic matter (Kotze, 2009). Analyses of the origin and hydrogeomorphic setting of wetlands can provide valuable insight into the manner in which these systems are likely to be affected by changes in land use (Grenfel, 2005).

Since the wetland was categorized as a non-channeled valley bottom, using the Assessment tool guideline for the ratings, results show that all benefits are likely to be provided except for stream flow regulation. Stream flow regulation is given a rating with a question mark in the tool because it may take place to some extent, but this is likely to depend strongly on factors such as transpiration loss from the vegetation, and the nature of the soil, which required field description to characterize.

After establishing the hydrological benefits likely to be present at the wetland, further assessment was then done to then assess whether Intunjambili had the potential to provide hydrological and other benefits. The wetland services assessment consisted of field visits to the site and expert consultations from relevant stakeholders. Field visits were done during the wet season months between February and March. The summary for the scores is represented in Table 4.1.

Table 4.1: Summary score sheets for the eight assessed services

Condensed summary sheet	**Wetland unit**	
	Overall score	**Confidence rating**
Stream flow regulation	2.8	2.4
Maintenance of biodiversity	2.2	2.4
Water supply for human use	3.6	3.1
Natural resources	3.6	3.4
Cultivated foods	3.4	3.4

Cultural significance	2.5	2.3
Tourism and recreation	2.7	3.2
Education and research	3.5	4.0
Threats	**4.0**	**3.0**
Opportunities	**3.0**	**2.0**

According to the WET-EcoServices Assessment Tool Kit, Intunjambili wetland has a high potential of providing the following services: water supply for human use, education and research, harvestable natural resources and cultivated foods. It has a low potential for provision of the following services: stream flow regulation, tourism and recreation, maintenance of biodiversity and cultural significance. The scores were more summarized in the following bar graph**,** Figure 4.9.

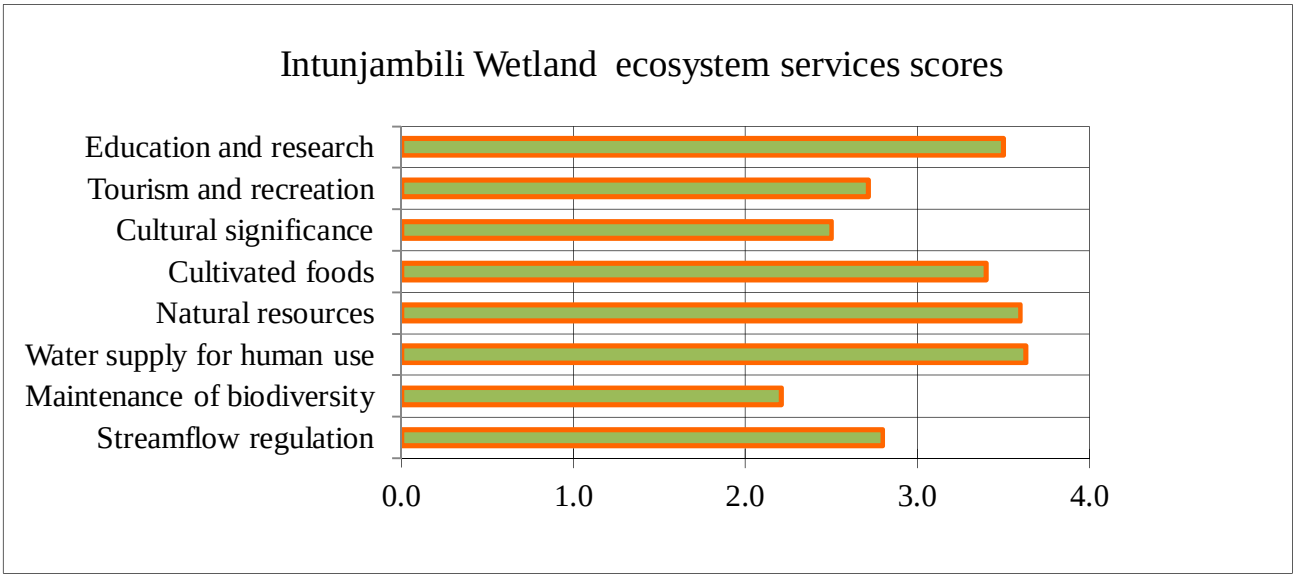

Figure 4.9: Scores for the eight services assessed

The potential of Intunjambili wetland to provide water supply for direct human use scored high which might the case that presence of wetlands reflect the presence of water in any landscape. Their dependence upon water, makes wetlands effective indicators of hydrological change at the catchment scale (Grenfel, 2005). Characteristics that determined the scores contributing to the supply of water included hydrological zones, importance for streamflow augmentation, current use for agricultural purposes, current use for domestic purposes, number of households and substitutability of wetland water source.

The foundation for hydrological zonation is that the more the persistent the wetness of an area, the more the reliable it will be as a source of water for human use i.e if a wetland is wet on a temporary basis only it is likely to be less suitable than the one which is permantly wet (Kotze, 2009). Thus this was given a score that implies that the wetland has both seasonal and permanent zones present and collectively these zones range between 30-60% of the total wetland area. In the same wetland, Mamane. S, 2005 studied the effects of wetland utilization on the water table and concluded that runoff from the surrounding rock outcrops significantly recharged the wetland as the water table had noted rises without rainfall. However, the presence of different hydrological zones might because of the different land uses and the type of HGM unit of the wetland.

Natural resources management also scored high, the same as the provison of water for domestic use. Characteristics that contributed to this score incorporated total number of resources, location in rural communal area, level of poverty, number of households depending on wetland and substitutability of the wetland resources. Generally wetlands provide multiple benefits and the greater the number of resources provided by an ecosystem, the more valuable it can be considered to be.

Intunjambili wetland was found to have an array of natural resources on offer which included land for cultivation, grazing land, gum tree plantations, trees that used for firewood, brooms, wild fruits, plants for crafts and construction, fish from the dam, sand, clay for brick moulding and most importantly water. The fact that the wetland in located in a rural communal area, local people are more likely to be directly dependent on that wetland for natural resources it has to offer (Kotze and Silima, 2003).

The ecosystem service of education and research scored second highest after water supply and natural resources. The wetland had been and continues to be used for research and education. This was confirmed by the locals during informal discussions and the studies available that had been about/on the wetland. The third in place was the provision of cultivated foods. Although most locals benefiting on the wetland have gardens or fields for crops, the total number of different foods cultivated within the HGM did not give a very high score. The logic being that if a single or fewer variety of crops are cultivated in the wetland, it would be considered of less potential of providing such a service. Stream flow regulation, tourism and recreation, cultural significance and maintenance of biodiversity were also assessed and they scored lower respectively. The ratings were derived to a large extent from qualitative data and provided only a preliminary indication of the likely provision of ecosystem services not the value of these services. These results fed into further investigation into the FGDs and household questionnaires.

4.4. Resource use behavior of households in Intunjambili wetland

The objective was to identify resource use behavior of households. A stakeholder analysis was carried out to identify the resource users of the Intunjambili wetland. After identification of stakeholders, resource use behavior identification was done through conducting two FGDs and a household questionnaire survey. The first FGD was conducted with eleven women, thirty men, one boy and one girl. This group was composed of households that live on the wetland. The second FGD was conducted with households living outside the wetland. The meeting was composed of fifteen women and twenty six men, three boys and one girl. the aim of having two separate groups was to compare findings from the different groups.

A total of 75 respondents were interviewed during the household questionnaire survey, where 37 (19 from within wetland and 18 from outside) were the house hold heads of the family (nine females and 28 males). From the 75 interviews, 40 (53%) respondents (17 females and 23 males) were located outside the wetland and 35 (47%) respondents (22 females and 13 males) were within the wetland, in the same village of Intunjambili. A total of 39 were females and 36 were males.

4.4.1. Resource users of Intunjambili Wetland

During the stakeholder analysis, the researcher had informal and formal interactions with stakeholders within the district, ward and village. The first entry was through introduction of the study to the Matobo Rural District Council where a meeting was held between the researcher and the Chief Executive Officer of the Council at the Matobo Rural District Council Offices in Matobo. Guidance on the important stakeholders to work with at district level and at village level was provided.

Further interactions were done with Caritas Bulawayo, a local Non-Governmental Organization (NGOs) operating in the district and, more specifically in, ward 15 where Intunjambili wetland is located. A visit was made to Gulathi village, a neighboring village in the same ward. The researcher also used any opportunity to note and observe more the stakeholders of Intunjambili wetland, for example when travelling to the study area. The findings were summarized for analysis using a goal oriented tool as shown in Table 4.2. Main groups of stakeholders observed consisted of lists of wetland users, the Governance group, those that were into the technical support categories, the business community, the external stakeholders and those in other structures.

Table 4.2: Stakeholder analysis using the GOPP tool

Stakeholder Groups	**Characteristics**	**Interests**
Wetland users ▪ Gardeners on the wetland ▪ Members outside wetland ▪ Farmers ▪ Livestock owners ▪ Brick molders ▪ Fishermen ▪ Reed cutters ▪ Irrigation members ▪ Traditional healers	▪ Direct beneficiaries of the wetland ▪ All from the same village but from different locations	▪ Water for domestic use ▪ Water for gardens ▪ Water for livestock ▪ Grazing land ▪ Harvestable natural resources ▪ Fish
Governance ▪ Traditional leaders ▪ RDC	▪ Locals at village level ▪ Locals are directly affected ▪ Government structures that operate	▪ Enforcement of law ▪ Wetland management and conservation

▪ Police ▪ Politicians ▪ EMA ▪ Elite local members	at district level (RDC) or national level (EMA) but governance disseminates to village level ▪ Officers that represent these structures operating from district level ▪ Officers indirectly affected	
Technical support ▪ Agritex ▪ EMA ▪ National Parks ▪ CAMPFIRE ▪ NGOs ▪ ZESA	▪ Officers representing the relevant sectors at village level ▪ Unaffected by any wetland challenges or benefits	▪ Provisioning of technical support ▪ Provisioning of services ▪ Wetland management
Business community ▪ Shop owners ▪ Vegetable vendor transporters ▪ Other public transporters ▪ Bulawayo and outside Bulawayo vendors	▪ Indirect beneficiaries of the wetland ▪ Indirectly affected by any wetland challenges ▪ Shop owners are at village level	▪ Income generation indirectly from the wetland
Other existing structures ▪ Schools ▪ Clinics ▪ Police ▪ ZESA ▪ Churches	▪ indirect beneficiaries of the wetland ▪ Comprises of: -school staff members and children -Clinic staff members and patients -Different church congregations and the members	▪ Provisioning of services
External stakeholders ▪ ICRISAT ▪ Matobo Research Centre ▪ Researchers ▪ NGOs	▪ indirect beneficiaries of the wetland ▪ Indirectly affected	▪ Research ▪ Development/ ▪ Humanitarian work in the wetland

The summary of stakeholders into four groups of A, B, C and D according importance and influence (Table 4.3). Group A was of stakeholders that had a likelihood of significantly being

directly affected by the wetland and their activities could affect the wetland. Group B consisted of stakeholders that stand to be affected by actions in the wetland but whose actions would not affect the wetland while Group C were stakeholders whose actions could affect what happens in the wetland but are not affected by what happens in the wetland. Group D were those stakeholders operating in the area but would not be affected by the wetland nor would their actions affect the wetland in any way.

Based on the four Groups of the identified, the stakeholders were grouped into three categories as follows:

1. Primary stakeholders. These are stakeholders with high importance in the wetland in terms of gains or losses.
2. Secondary stakeholders. These are stakeholders that can be potentially both important and influential. They are critical to be involved directly in activities in the wetland and its integral success. Some are those responsible for the institutional arrangements in the area and can be of law enforcement. Examples of such stakeholders are the RDC, the Traditional leadres, EMA or the police.
3. External stakeholders. These stakeholders have a potential to be influential in the wetland but will tend to have low importance in some activities. They can, however, be influential to outcomes, (de Groot *et al,* 2006).

Table 4.3: Importance/Influence Stakeholder Matrix

Degree of influence

Degree of Importance	High influence	Low influence
High importance	**A- Primary stakeholders** • EMA • Village members on the wetland • Vegetable vendor transporters • Fishermen • Livestock owners • Reed sellers • Brick molders	**B- Primary stakeholders** • Shop owners • Village members outside wetland • Vegetable gardeners outside the wetland • Public transporters • Irrigation members • Farmers • Bulawayo market vendors • Tourists
Low Importance	**C- Secondary stakeholders** • Traditional leaders • RDC • Politicians • Well known wealthy community members • Police • Campfire	**D-External stakeholders** • National Parks • ICRISAT • Matobo Research Station • Clinic • ZESA • Church congregations • NGOs, Researchers

For this study, primary stakeholders (Group A and B) were the locals from within the wetland and those from outside the wetland were selected to be priority. These were involved in participatory acvities of the valuation exercise. The Group C stakeholders were targeted for mobilisation purposes and were informed of all the proceedings. Findings of the whole study were accessed or shared with the stakeholders from Group D.

4.4.2. Trend analysis of represented wetland resource use of Intunjambili wetland

To analyze the trend of wetland resources uses, community mapping, also known as participatory mapping was used during the FGDs with a follow up by household questionnaires. Both groups from the FGDs were able to produce maps showing the entire village, highlighted nearly the same features such as shops, main road, wetland, Intunjambili dam, Intunjambili hill, borehole and school.

Figure 4.10: One of the maps drawn by the locals showing the village

Further discussions with the locals revealed that that both groups use Intunjambili dam for livestock watering, fishing and swimming. Swimming in the dam was known to be common amongst young boys only of primary school going age. There are also some members who live on the wetland and also members of the irrigation scheme at the dam. This group responded that they use the wetland for vegetable gardening and agriculture. Those who live along the river section often use a certain part of the river, which is like a pool for bathing during very hot days.

Respondents on and outside the wetland also had differences in choosing main wetlands uses during the household questionnaires.

Table 4.4: Land uses summarized from community maps

	Users on the wetland	**Users outside the wetland**
Differences	• Uses included vegetable gardens and fields • Source of water for domestic and agriculture	• Use excluded vegetable gardens and fields • Source of water for domestic purposes is from boreholes or open wells
Similarities	• Wetland has a grazing section for everyone • Harvestable natural resources such as reed, firewood, wild fruits, worms for fishing, peat used as manure	

There was gardening as use for the households on the wetland. Those outside the wetland responded that they do not use the wetland for gardening. This however did not mean that, households outside Intunjambili wetland do not practise gardening but that their source of water for their vegetables was not from the wetland. The same was with farming and grazing, although there were respondents that lived outside the wetland who benefited from the wetland through grazing and having portions of land for field crop farming. However, these were less than respondents who lived on the wetland. This showed that local communities from Intunjambili village had access to Intunjambili wetland whether or not they lived on the wetland. Other uses such as hunting, swimming, firewood and reed collection were more from respodents that lived outside the wetland than from respondents that lived on the wetland.

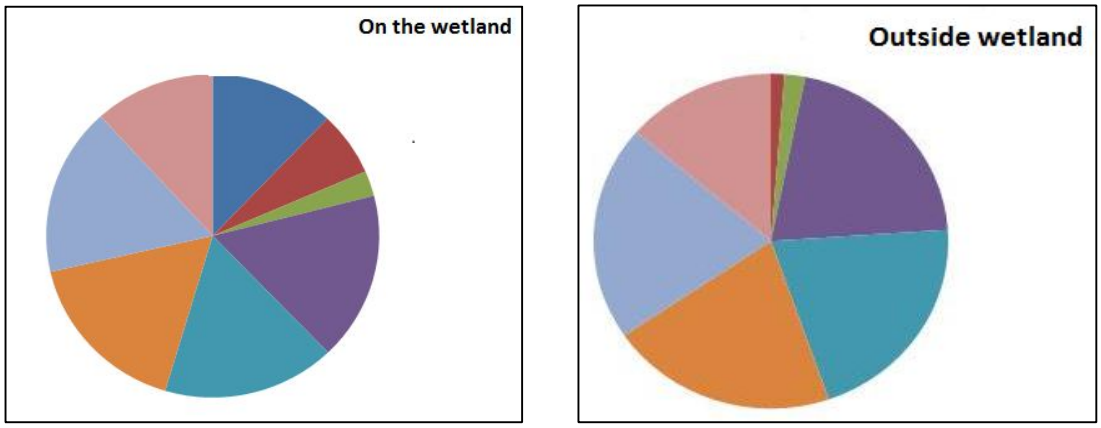

Figure 4.11: Land Uses of a) those on the wetland (left) and b) those outside the wetland (right)

However, study further explored the sources of water for different specified uses (as all the major land uses analysed are water related directly and indirectly) except for firewood. Main water uses were drinking/cooking, bathing/washing, gardening, livestock and other uses. Firewood was categorized as a source of energy for mainly cooking, although it was used in brick moulding and other domestic uses such as warming of water to bath or room heating during winter. Sources of water were also identified as the marshy area, the river, the dam and for firewood, sources were mainly either on the wetland, outside the wetland but within the village boundary and outside the village boundary.

60 respondents that lived on the wetland said that they fetched firewood from the wetland,whilst 31 said that they collected outside the wetland but within the village and 3 said that they sourced their firewood from outside the village. Contradictory, 30 respondents that lived outside fetched from the wetland whilst 55 sourced within the village but outside the wetland boundary and 15 collected firewood from outside the village.

This was the same with the sources of water for drinking/cooking, bathing/washing, gardening, livestock and other uses. More respondents that lived on the wetland sourced water for various uses from Intunjambili wetland that those that lived outside the wetland. Respondents said that their source of water was from within the village but not from the wetland. Everyone from the village sourced water for their livestock from Intunjambili dam and firewood was the only natural resource that had sources from outside the village. This means that, other water sources other than the wetland do exist within the village (as shown by the participatory map in figure 4.10).

Table 4.5: Sources of water and energy

		Source				
	Respondents(%)	Intunjambili wetland	Intunjambili river	Intunjambili dam	Within village, outside wetland	Outside village
Energy for cooking	On the wetland	60			31	3
	Outside wetland	30			55	15
Water for drinking and cooking	On the wetland	100				
	Outside wetland	5			95	
Water for bathing and washing	On the wetland	63	37			
	Outside wetland	10		30	60	
Water for gardening	On the wetland	71	29			
	Outside wetland	15		28	57	
Water for livestock	On the wetland			100		
	Outside wetland			100		
Water for other	On the wetland	51		48		
	Outside wetland	12		48	40	

From the above results, this might imply that source and location are directly related. Living on the wetland meant that most probably most sources and uses of natural resources such as water and firewood would also be from the wetland. There cases where respondents fro outside the wetland used water from the wetland for washing and gardening as well.

In conclusion, those settled on the wetland have more uses than those outside the wetland. This is mainly because of the wetland is a source of land for cultivation, water and settlement unlike than those outside the wetland. They have their water sources within the village which include boreholes, household wells but not on the wetland. They also have land for cultivation but not on the wetland. Similarities of tasks between the two groups were mainly because that the wetland is a common resource where everyone has access to it.

4.4.3. Gender roles/responsibilities on the wetland

In the aim of resource use behavior identification, gender roles/responsibilities of wetland users was assessed during the FGDs using the Task Target Analysis. The Task Target Analysis tool was used as a tool to find out gender roles and responsibilities in relation to the wetland uses. Participants were divided into two teams and given pictures of a man, woman, girl and boy. They were then tasked to use each picture to identify different activities carried by the person in the picture within the wetland. The tasks presented by the two were similar but with distinct differences. Table 4.6 presents the different tasks carried out according to gender dynamics.

Table 4.6: Representation of the tasks by gender in relation to uses within the wetland

		Users on the wetland	**Users outside the wetland**
Women	**Similarities**	Cutting reed for roofing and making brooms Gardening (for the irrigators as well) Baptism Herb collection Firewood collection	Cutting reed for roofing and making brooms Gardening (for the irrigators as well) Baptism Herb collection Firewood collection
	Differences	Gardening Fetch water from shallow wells Washing laundry	Gardening outside wetland Fetch water from borehole Washing laundry elsewhere

		Farming Branches from a trees used for sweeping the yard	Farming outside wetland
Men	**Similarities**	Fishing, Livestock grazing (Decisions over the grazing area), Baptism Herb collection, Brick molding	
	Differences	Gardening Farming	Gardening outside wetland Fetch water from borehole Washing laundry elsewhere Farming outside wetland
Girls	**Similarities**	Wild fruit collection, Firewood collection	
	Differences	Fetching water Gardening Washing	Gardening outside wetland Fetch water from borehole Washing laundry elsewhere
Boys	**Similarities**	Swimming, Fishing, Hunting, Wild fruit collection, Bathing, Livestock herding Livestock watering	
	Differences	Gardening Fetching water	Gardening outside wetland Fetch water from borehole

The differences of tasks between the two groups are mainly because of where they are settled.

4.4.4. Respondents preferences on the use of housing material

A total of 75 (100%) respondents stated that they either owned a homestead or lived in a family owned homestead (not rented). From the informal discussions and transect walks, it was noted that most households have a separate hut which they used as a kitchen built separate from other huts or if the homestead has one house with different rooms. At most, 57% of those located on the wetland have between four and six huts in a homestead and 65% from those outside the wetland. It was a challenge however, for those who built big houses with two to four rooms to count the whole house as a hut or the rooms. Thus each respondent was then asked on the materials they used to build the hut used as the kitchen and for other huts within their homestead. Responses are summarized in table 4.7 in percentage of each location (on and outside the wetland).

Table 4.7: Summary of materials used for the kitchen and other huts

Materials	Exterior wall		Kitchen floor		Other Huts Floor		Kitchen roof		Other Huts Roof	
	On the wetland	Outside	On the wetland	Outside wetland	On the wetland	Outside wetland	On the wetland	Outside wetland	On the wetland	Outside wetland
Mud	3	3	-	-	-	-	-	-	-	-
cement bricks (purchased)	17	10	-	-	-	-	-	-	-	-
cement bricks (locally molded)	23	45	-	-	-	-	-	-	-	-
mud bricks	57	42	-	-	-	-	-	-	-	-
earth/mud	-	-	54	60	57	45	-	-	-	-
Cement	-	-	14	20	40	53	-	-	-	-
ceramic tiles	-	-	0	0	3	0	-	-	-	-
cow dung	-	-	32	20	0	3	-	-	-	-
corrugated iron sheets	-	-	-	-	-	-	3	3	43	50

wood and grass	-	-	-	-	-	-	97	97	48	40
Asbestos	-	-	-	-	-	-	0	0	9	10

The exterior wall material for the entire homestead was taken to be the same. Thus, 57% of the households located on the wetland used mud bricks for the exterior walls and 42% for those outside the wetland obtained exterior wall material from the wetland. Nearly a quarter of the respondents on the wetland also used molded bricks using cement and other local available materials such as sand, pit sand and water whilst at most 45% use the same for their walls also obtained from the wetland.

Earth mud was the highest use for flooring for both the kitchen and other huts, also for both locations within the village, on and outside the wetland. One respondent that live on the wetland stated that they have ceramic tiles in their house meaning they did not use any material from the wetland. The popular roofing material for the kitchen was wooden poles and grass. Corrugated iron also emerged in the response for roofing for other huts. This showed that respondents used local available materials, and the main source was the wetland. This supporting the finding during the wetland services that the wetland was had a high capability of providing the service of the provision of natural resources and it was indeed providing various natural resources, used as building material.

4.4.5. Respondents knowledge on cultural practices on Intunjambili wetland

Since cultural practices were assessed during the WET-EcoServices, Intunjambili scores showed that it has a high potential for providing cultural services. Thus, respondents were asked if they were aware of any cultural/religious practices and their responses are the summarized in Table 4.8.

Table 4.8: Presence of religious/cultural practices

		Presence			
	Respondents (%)	none	Historically present but no longer practiced	Present but practiced to a limited extent	Present and still actively and widely held
Religious/ Cultural practices	On the wetland	14	23	29	34
	Outside wetland	15	35	32	18
Local Beliefs	On the wetland	14	72	11	3
	Outside wetland	0	22	70	8
Local taboos	On the wetland	0	9	43	48
	Outside wetland	0	8	47	45

72% of the respondents on the wetland said local beliefs are historical present but are no longer practiced whilst most from outside the wetland said that there are present but are practiced to a limited extent. This might be due to the fact that there are alternative places for cultural practices elsewhere, as shown in Fig 4. 12 below. However, there are beliefs that are known such as the sacredness of the "*inuta"*. Some locals said that there are traditional practices that were conducted around it but they are no longer done. Elders of the community said they grew up knowing that the "*inuta"* and its surroundingswas very swampy and was not be encroached for farming and settlement reasons. One elder explained in Ndebele about the Intunjambili, "*Wawuthi ungacela amasi aphume. Kwakulenuta eyayinkulukula zozonke"*, meaning that it was believed that if one

prayed for sour milk at the "*inuta*" it would come out and the "*inuta*" used to be one of the biggest in the whole area.

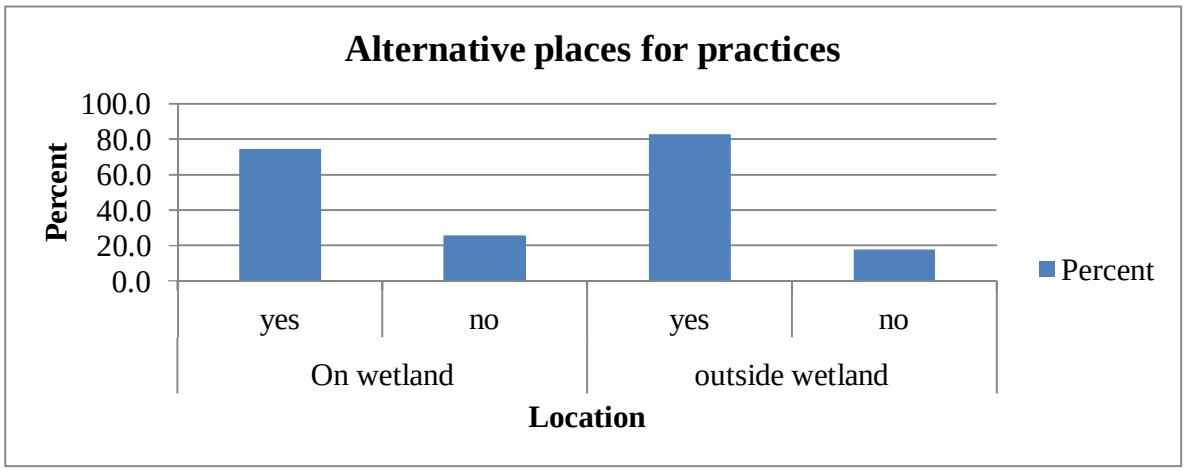

Figure 4.12: Existence of the presence of alternative places for practices

Between 70 – 80% of the respondents said there were alternative places for cultural/religious practices other than on the wetland. This was mostly religious and Christianity in particular. Those that said there were no alternative places for cultural/religious practices were the traditional healers, the cultural people who still believed in the "*inuta*" and the importance of preserving it and the Christians who had their churches on Intunjambili hill.

4.4.6. Respondents knowledge on tourism and recreation at Intunjambili wetland

For the further social valuation process, tourism and recreation prospects were explored. Both groups believed that their piece of land had a potential of tourist attraction.

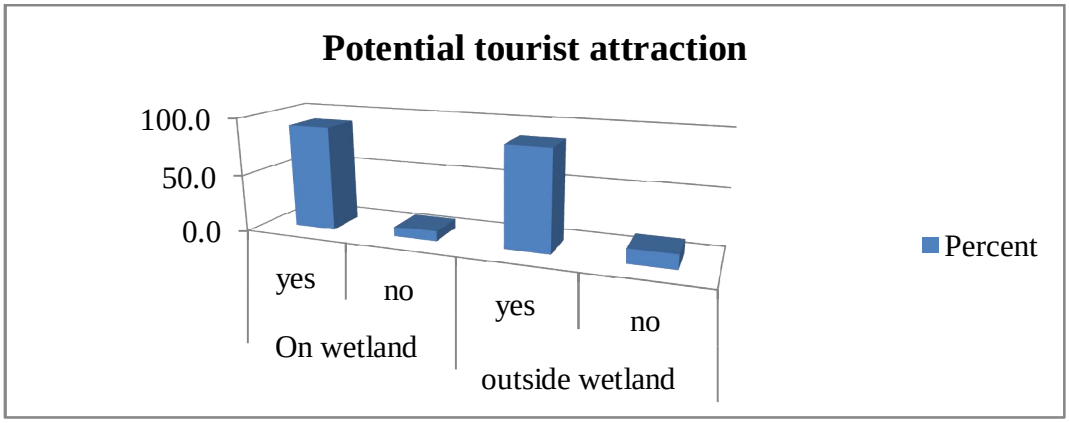

Figure 4.13: Presence of potential tourist attraction

However, currently the wetland was not being highly used for tourism. The wetland is adjacent to the Intunjambili hill which has the Intunjambili cave with ancient paintings on it and locals said that occasionally tourists would come and visit this cave.

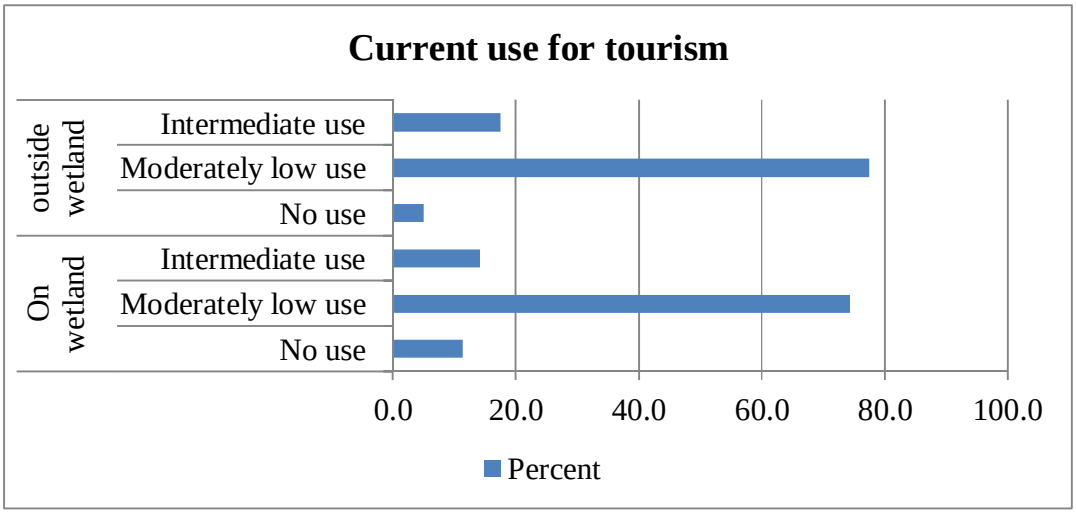

Figure 4.14: Current use of the wetland features for tourism

About 58% of the respondents living on the wetland said that the use of Intunjambili wetland for swimming was present but very limited whilst about 53% of those from outside the wetland said that swimming as an use was extensive but somewhat limited (shown in figure 4.15). Limitations were being that swimming was regarded for the young boys who would be herding livestock or

fishing. They regarded the water as dirty and also feared that they would drown. Some believed it was a taboo to play in open water such as the dam, as there myths surrounding that.

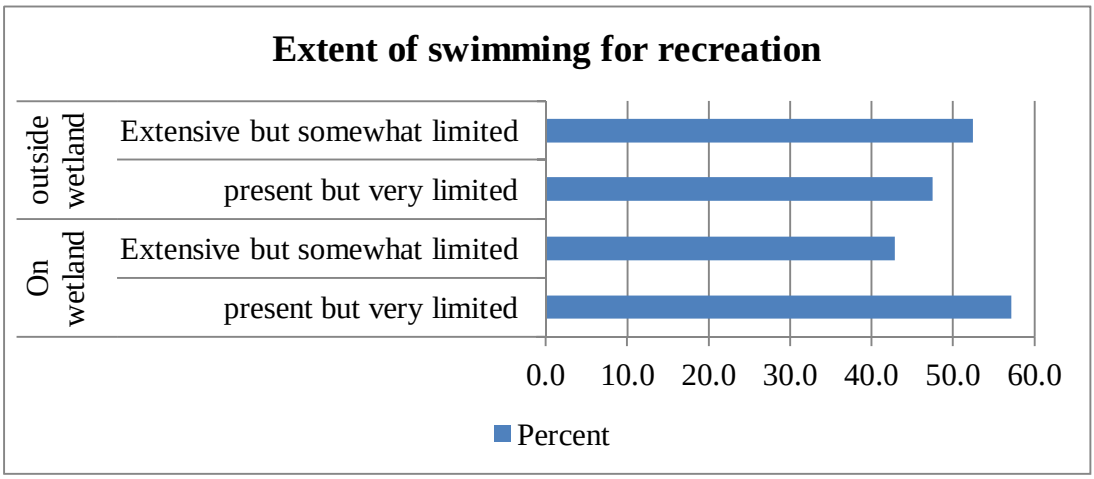

Figure 4.15: Extent of swimming for recreation

4.4.7. Education and research benefits from the Intunjambili wetland

The respondents were of the opinion that their wetland is being highly used for education and research. They mentioned as the researcher was carried the study, that they had assisted other researchers who have come to their wetland as well for research and education as well.

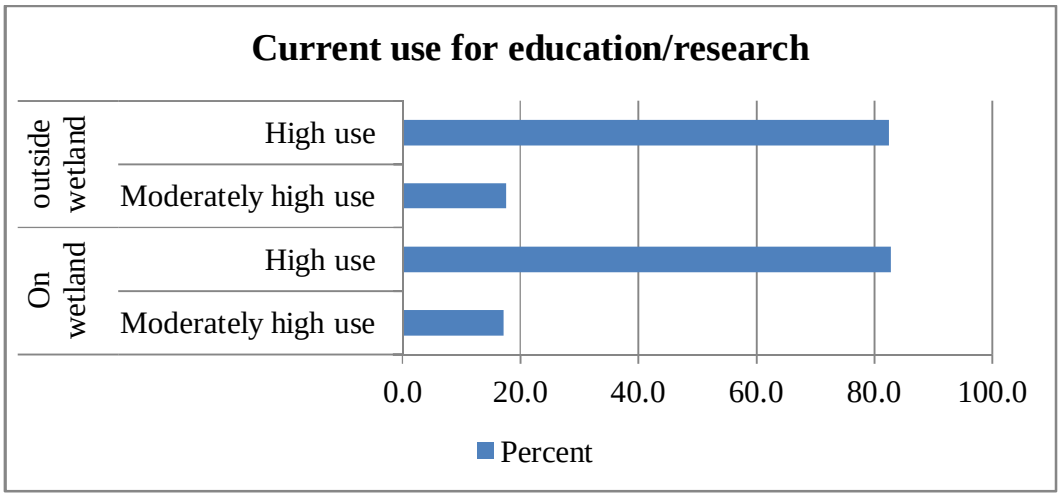

Figure 4.16: Current use of the wetland for education/research purposes

However, those living on the wetland have benefited more than those outside this boundary.

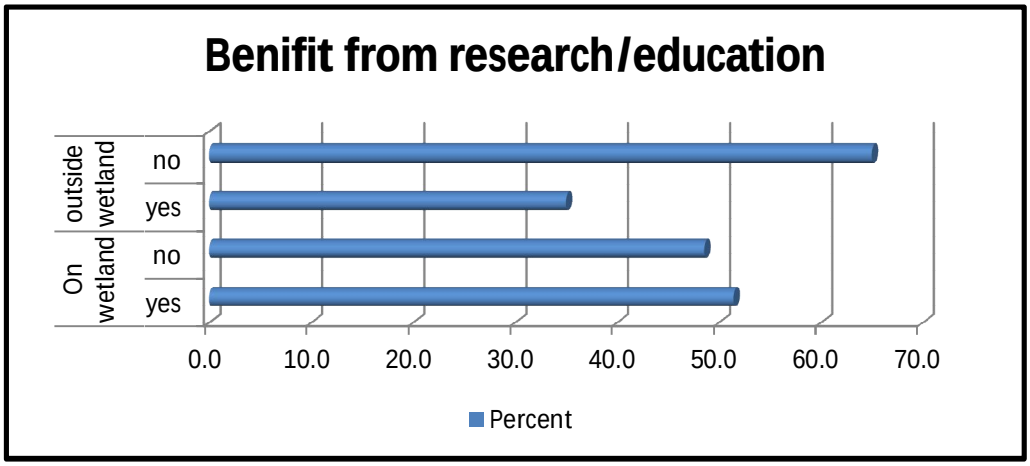

Figure 4.17: Percentage of households that have benefited from education/research done in the wetland

4.5. Importance of wetland uses derived from Intunjambili

The last objective of this study was to analyze the social value of resource use of households in Intunjambili wetland. The concept of value in this study took an anthropocentric perspective where it was expressed using a hierarchal approach, adopting the principle of:

- Identification of what is important, how these are ranked and why are ranked in that manner. Importance of a resource or object is the significance of that resource/object to the beneficiaries of that resource. Significance can be direct or indirect to the beneficiaries.
- The degree of dependency on resource. Dependency considers the reliability of that resource to the beneficiaries.
- The extent of how much contribution from the relevant resource to their lives (income) derived benefits.

Thus after exploring resource use behavior of the wetland, further investigations were done to find out what the locals placed as important during the FGDs and household questionnaires. During the FGDs, participants were tasked to sort the pictures into three piles of Low Importance, In-Between Importance and High Importance. Table 4.9 shows the results for Three Pile Sorting exercise for

the group of those living on the wetland and 4.10 summaries results for the group living outside the wetland.

Table 4.9: Three pile sorting by those on the wetland

Low Importance	**In-Between Importance**	**High Importance**
Wild fruits	Fishing	Gardening
Religious practices	Herbs	Livestock
	Reed	Water for domestic use
	Brick molding	

Table 4.10: Three pile sorting from outside wetland

Low Importance	**In-Between Importance**	**High Importance**
Water for domestic	Religious practices	Livestock
Gardening	Herbs	Fishing
		Reed
		Brick molding

The manner in which the two groups placed importance on the different presented uses or benefits differed. The group composed of members that live on the wetland placed high importance on gardening and provision of water whilst it was placed as low for the group of members who do not live on the wetland. This is probably because, the wetland is the only source of water for all activities for the group on the wetland, and they are highly dependent on it.

Vegetable gardening is the main livelihood and source of income for most locals in Intunjambili village. Those that live on the wetland use water from the wetland for their gardening. Unlike in some parts in the district where are garden activities are seasonal, in these parts of the ward, garden activities are year round. It has become part of their social system, where families all work together in gardens, where a garden is divided into vegetable beds and each family member is allocated a bed. Young ones are assisted in making decisions over the management of the vegetable beds but each member makes decisions over their own bed. A young man in the family can get married and bring his wife to stay in his father`s homestead and work on his vegetable garden for his new family.

Main vegetables grown are chomolia, *tsunga* and rape. The main market is in Bulawayo at the main vegetable market square in town. Customers as far as Victoria Falls also have arrangements for their vegetables. Wetland users of Intunjambili wetland can have a maximum of 120 bundles and a minimum of 20 bundles of vegetables and price range for a bundle in Bulawayo is between USD1.00 to USD2.00 depending on the season and demand.

However, those that do not live on the wetland have alternative water sources such as boreholes or shallow wells near their homestead, and it would not be necessary to fetch water for domestic purposes from the wetland. The whole village of Intunjambili has areas where water is near the surface, even outside the wetland and they have their own source of water for their gardens. They placed high importance on other uses such as water provision for livestock, fishing and access to reeds. The irrigation garden members by the dam however, place water for gardening as of high importance although they considered themselves as not living within the wetland. Both groups placed high importance on livestock because the wetland has a section that has been reserved for grazing between the months of May and November. This is when it is dry and the pastures are few and water available for livestock is also very little.

A pocket chart tool was then also used as a follow up tool from the three pile sorting in the FGDs. The pocket chart gives a chance for individual choice of ranking importance whilst the three pile was a group`s choice. A Pocket chart with three pockets with the following labels was made: Low Importance, In-between Importance and High Importance. Pebbles of blue and yellow were used, the blue colour to represent men and yellow women. One wetland benefit or use was agreed upon with the participants. This use/benefit was put as a title on the chart above the pockets. Participants were tasked to choose a pocket of their personal choice under the given title. This was done like a voting exercise where voting procedures were followed such that when a participant was choosing a pocket to drop in their pebble, no one would be near to influence their choice..

Votes were counted in a transparent manner. Imitating the procedures of the Presidential voting, the pockets (representing ballot boxes) were first checked in front everyone before the voting exercise. Three volunteers then were tasked to do the counting of pebbles from each pocket, separating them in the two different colours. One other volunteer was recording the results confirmed and agreed upon by the rest of the group. The results from the pocket exercise are represented in Table 4.12 for group with those that live on the wetland and Table 4.12 for the group that live outside the wetland.

Table 4.11: Pocket chart results for the households living within wetland

Wetland use	**Women**			**Men**			**Girls**			**Boys**			**Total**
	L	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**	
Gardening	0	0	10	0	0	28	0	0	0	0	0	0	**38**
Religious practices	4	4	1	5	10	14	0	0	0	0	0	0	**38**
Earth mud for flooring	8	1	1	20	3	7	0	0	0	0	0	0	**40**

L = Low importance M = Medium importance H = High importance

The total for the group on voting for gardening and religious practices was 38 instead of 40 because there were two spoilt votes. Spoilt votes were a result of that two men used yellow pebbles for women in voting instead of blue ones. Both men and women ranked gardening as an important activity on the wetland. More men than women ranked high importance for religious practices than women. The votes of both men and women showed that the use of earth or mud obtained from the wetland and used for flooring is not very important benefit from the wetland. They argued that this type of flooring is outdated, now most people prefer using cement for their floors.

Table 4.12: Pocket chart results for the households living outside the wetland

Wetland use	**Women**			**Men**			**Girls**			**Boys**			**Total**
	L	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**	
Gardening	7	5	1	20	1	5	0	0	0	0	0	0	**39**
Religious practices	4	3	8	4	9	12	0	0	0	0	0	0	**38**
Earth mud for flooring	7	3	5	10	7	9	0	0	0	0	0	0	**41**

L = Low importance M = Medium importance H = High importance

Both men and women ranked gardening on the wetland as of low importance. This is because those that do not live on the wetland do not use the wetland for gardening whilst those within the wetland use the wetland for gardening, thus ranked it as high importance. Most men and women voted for religious practices as of high importance. More women ranked for the use of earth mud for flooring as low whilst fewer men ranked this use as high. Women argued that earth mud floors are out of fashion, they preferred cement floors as they were easy to maintain. Non wetland dwellers valued what they get from the wetland as high than the group which that lives in the wetland, and vise verse.

In the household questionnaires, respondents were asked to place importance of the land uses for Intunjambili wetland. Water use was ranked as of high importance by respondents that live on the wetland followed by gardening. This is because water use is the main land use for the locals on the wetland. They use water for their drinking, domestic purposes, gardening, livestock watering and recreational purposes. Further investigations were done through asking the respondents about the degree of reliance of their water sources as shown in Table 4.13.

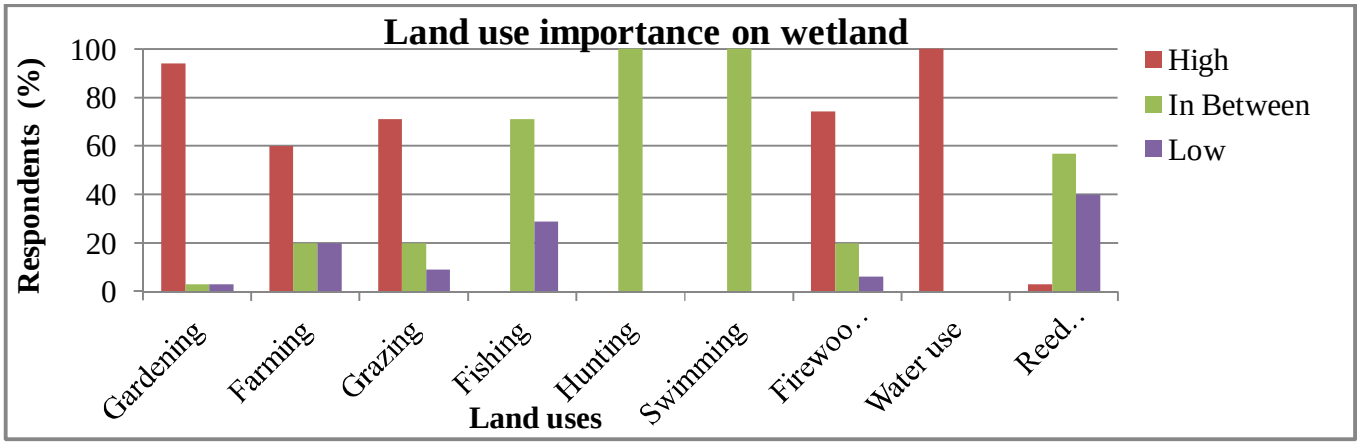

Figure 4.18: Land use importance rankings from within wetland

Respondents living outside the wetland also ranked water use as of high importance during the household questionnaires. However, the importance of water use was not the same as of those that live on the wetland. Respodents that live outside the wetland have other sources of water for their drinking, and with some, for gardening. Water from the wetland is used mainly for livestock with cases of those who did not have livestock but ranked water use as high because they mainly benefited from fishing from the dam. Thus grazing was the second to be ranked of high importance. This is as shown in figure 4.19.

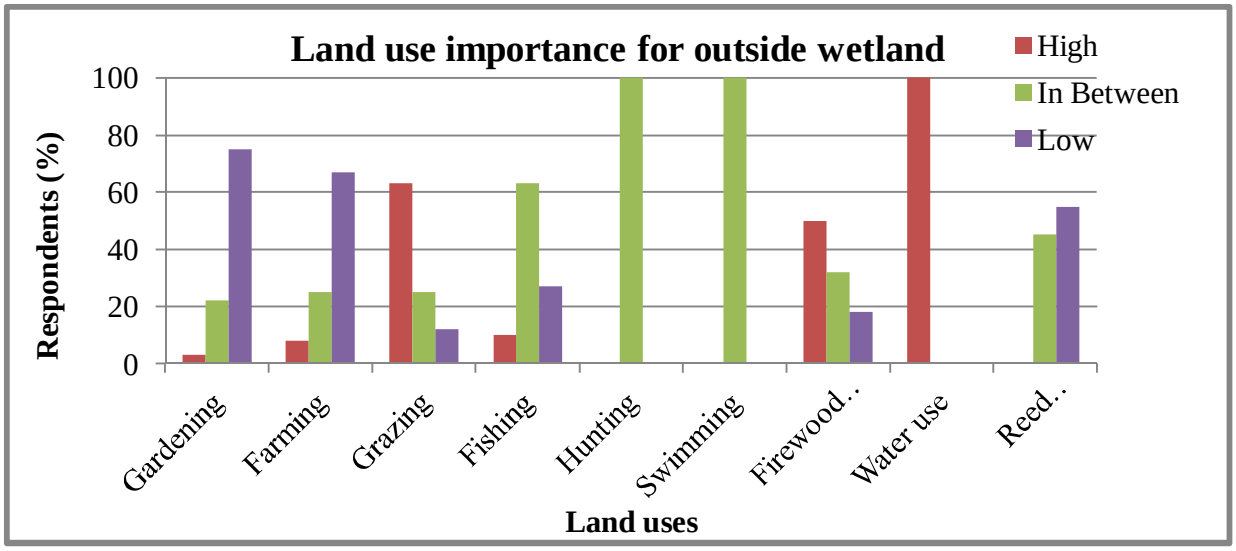

Figure 4.19: Land use importance rankings from outside wetland

Although there is a thin line between reliance and dependence, these were analysed separately. Degree of reliance for water sources was separated from the dependence on land uses of Intunjambili wetland. The main reasons why water was ranked as most important was because people highly rely on it, thus they value it more. 77% of the respondents that lived on the wetland critically relied on water for drinking and cooking because they had no source of alternative but 68% of those from outside the wetland felt there were highly reliant and alternatives for water sources were costly/problematic. 80% and 63 % of the respondents living on and outside the wetland respectively, acknowledged that their reliance on water for livestock was critical. However, there are some that felt they mostly used water for livestock from the wetland but they had other alternatives. These were mostly small livestock owners that watered their livestock from open wells, other small rivers and boreholes. There were also cases of those that kept their cattle in designated paddocks usually refered to as *"emlageni"* in Ndebele.

Table 4.13: The degree of reliance for water sources

			Degree of reliance			
		Respondents(%)	Regular use but alternatives	Most use but alternatives	Highly reliant and alternatives are costly/problematic	Critical (No alternatives)
Water use	Water for drinking and cooking	On the wetland			23	77
		Outside wetland		5	68	27
	Water for bathing and washing	On the wetland		100		
		Outside wetland		100		
	Water for gardening	On the wetland				100
		Outside wetland				100

	Water for livestock	On the wetland		37		63
		Outside wetland		20		80
	Water for other	On the wetland	89		11	
		Outside wetland	85		15	

The survey further required the respondents to rank these land uses by how much they depended on them which would signify how important they were and how much contribution the land uses were to their household income.

Table 4.14: Ranking of the dependence on land uses

			Degree of dependence			
		Respondents (%)	**very little dependence**	**little dependence but alternatives are available**	**mostly dependent but alternatives are available**	**highly dependent and alternatives are costly/problematic**
Land use	Gardening	On the wetland	6	20	9	65
		Outside wetland	3	20	15	62
	Farming	On the wetland		31	69	
		Outside wetland		38	62	

		On the wetland			43	57
	Grazing	Outside wetland			48	52
		On the wetland		100		
	Fishing	Outside wetland		100		
		On the wetland	100			
	Hunting	Outside wetland	100			
		On the wetland	100			
	Swimming	Outside wetland	100			
		On the wetland		83	17	
	Firewood collection	Outside wetland		55	3	42
		On the wetland				100
	Water use	Outside wetland				100
		On the wetland	34	46	17	3
	Reed collection	Outside wetland	13	72	12	3

Respodents from both on the wetland and outside the wetland were highly dependent on water use from Intunjambili wetland even though it was for different purposes. Those that were dependent on the wetland from outside the wetland were mostly garden members of the irrigation scheme from the dam. There cases of some locals who had gardens on the wetland but lived outside the wetland. High dependence after water use and gardening was that of grazing on the wetland. The wetland is the main source of grazing land for the locals of Intunjambili village.

5. Chapter Five: Conclusions and Recommendations

5.1 Conclusions

In conclusion, this study attempted to determine the social value of Intunjambili wetland by incorporating mapping of the wetland and investigating on the boundary of the wetland. The boundary of the wetland made the analysis of the structure and hydrological processes possible and also assisted in demarcating those who lived on and outside the wetland. The extent of the wetland encompassed the marshy area (upstream of the Intunjambili river), Intunjambili river and Intunjambili dam. Thus all the all the assessments, discussions with the reposndents and analysis covered all the three parts as one wetland. The LULC of the wetland showed that more forest areas have been converted to settlement and cultivation. A similar study have shown that population increase on the wetland has caused this conversion of Land uses. Thus this also means that values have changed over time.

Hypothetically keeping the wetland health condition at a constant, results from the WET-EcoServices assessment showed a rank in the following order from high to low potential respectively: provision of water supply for direct human use, provision of harvestable natural resources, education and research, provision of cultivated foods, stream flow regulation, tourism and recreation, cultural significance and maintenance of biodiversity. The assessment of these functions of the wetland then fed into a framework of the likelihood of wetland uses which were further evaluated through focus group discussions, thereby attempting to come up with rank of values for these uses.

The Total use value of a wetland consists of Use values and Non use values. Use values consist of direct and indirect values whilst Non use values are the existence and bequest values. Direct Use Values are includes value attached to the provision function where there is production and consumption of goods and services. Following this concept of wetland functions, goods and services, attributes, products leading to value, Intunjambili wetland social valuation can the be demonstrated in figure 5.1.

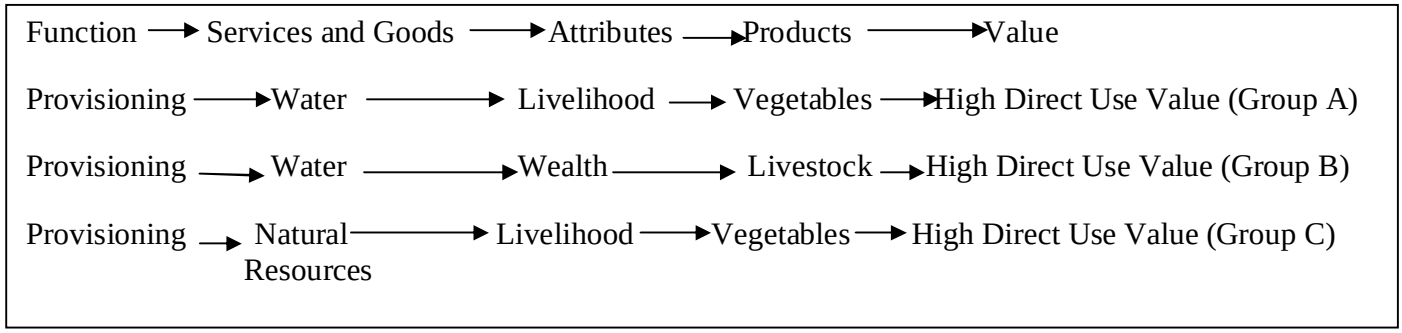

Figure 5.1: The concept of wetland values for Intunjambili wetland followed by the researcher

In figure 5.1 Group A consists of wetland users that are adjacent/live on the wetland. They highly valued the wetland for the provision of water more because water is able to sustain a livelihood of vegetable gardening. Group B consists of wetland users that are not adjacent/do not live on the wetland and they own livestock. They value the wetland for the provision of water and grazing land for their livestock. Group C consists of local members who do not live on the wetland and do not own livestock, thus they give value to the harvestable natural resources that they benefit from the wetland.

Thus overall conclusion to this study is as follows:

1. Vegetation cover has been cleared for livelihoods and development (dam constructed). Wetland encroachment is leading to wetland degradation, with the lowering of the water level and decrease in grazing area. Wetlands under greater agricultural encroachment tend to be under more threat of degradation than those with less agricultural activities.

2. Hydro-geomorphic setting plays an important role in the benefits that a particular wetland can offer. The source of water for Intunjambili wetland is from Intunjambili rocky hill that retains water even after the rainfall and slowly supplies the valley bottom, where surface runoff is low and infiltration high.

3. Althought values of people who do not use wetlands reflect the importance of the continued existence of the resource, or the option of using the resource in the future, importance is more reflected by those using the wetland and differs by whether live on or outside a wetland boundary.

5.2 Recommendations

Results from this study indicated that the wetland is being highly used for agriculture; it is gradually degrading and soon will not be unable to sustain its functions it is currently offering.

1. It is recommended that conservation measures be put in place in order for the sustainability of the wetland to survive. These measures will require an integrated approach as the wetland has various wetland users. This will have to include intensive education and awareness raising programs for the local communities to understand the situation at stake.

2. Further studies LandSat classifications canbe used to obtain coarse estimates of changes in the wetland services values. This could be done by obtaining value coefficients for wetland services that more accurately reflectlocal environmental conditions.

3. Total Use Value requires an Ecological, Social and Economic Valuation. This study recommends that further valuation is done to calculate the Total Value for Intunjambili wetland.

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7. APPENDICES

Appendix 1: Revealed Preference Approaches

HEDONIC PRICING METHOD

The Hedonic pricing method looks at price and quality variation across goods to infer implicit value of an environmental resource. Goods are considered as bundles of characteristics one which is the environmental resource of interest. These goods are sold at different prices. Once all other characteristics have been taken into account the differences in price reflect the market value for the environmental resource.

An example could involve differences in property values because of differences in air quality:

$HP = a + bQ + cZ$

With: b being the marginal effect on price of a unit change in air quality Q, and c the marginal effect of other features (Z) that affect house`s price such as size, relative location to public transportation, etc.

TRAVEL COST METHOD

The travel cost is mainly used for the valuation of environmental services from recreational sites (e.g. National Parks). This method measures the benefit (WTP) for a recreational experience by examining household expenditures on the cost of travel to a desired recreational site. There are single-site models and multiple-site models. The multiple-site model explicitly considers the fact that people can make trips to alternative recreational sites. This is important because the existence of relevant substitutes will influence the valuations. Data is needed on the characteristics of individuals, the number of visits to the site, information about the travel costs, etc.

The procedure for conducting a travel cost method analysis involves the following steps:

- Define the benefit to be valued
- Collect the necessary data
- Define the zones of recreation origin
- Calculate the visit costs for each zone
- Determine the visit rate for each zone
- Recognize the model assumptions and constraints
- Apply appropriate statistical methods to calculate WTP

The recreation demand model examines the following relationship:

COST OF VISIT= TRAVEL COST + OPPORTUNITY COST + COSTS DUE TO THE DURATION OF THE VISIT

Appendix 2: Stated Revealed Approaches

Valuation Method	Description of Method and Data Sources	Usefulness in Valuation of Wetlands
Choice Modeling (CM)	Expressed preference method using statistical techniques to infer WTP for goods and services from survey questions asking a sample of respondents to make choices among alternative policies	• At source valuations of the wetland (e.g. in stream) • Valuation of wetland attributes • If information is needed in relative values for different attributes of wetland goods and services
Contingent Valuation Methods	Expressed preference method using statistical techniques for analyzing responses to survey questions asking monetary valuation of proposed changes in environmental goods and services.	• At source valuations of the wetland (e.g. in stream) • Valuation of wetland goods and services in total

Source: Farolfi, 2011; Mulatu, 2014

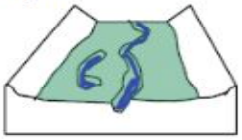
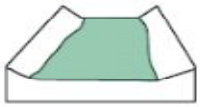
Appendix 3: GPS Coordinates collected during a transect walk

No.	Point description	GPS Coordinates
1	Intunjambili cave	20°27′06.1″S 028°′41′15.3″E
2	Intunjambili hill	20°27′18.6″S 028°′41′04.8″E
3	Dam_1	20° 27′ 13.9″S 028° 41′ 03.9″E

4	Dam_2	20°27′ 02.6″ S 028° 40′ 48.2″ E
5	Field corner	20° 26′ 15.9″ S 028° 40′ 45.6″ E
6	Intunjambili river_1	20° 26′ 51.8″ S 028° 40′ 45.0″ E
7	Intunjambili river_2	20° 26′ 50.4″ S 028° 40′ 45.9″ E
8	Intunjambili river_3	20° 26′ 49.1″ S 028°40′ 45.9 ″E
9	Intunjambili river_4	20° 26′ 48.1″ S 028° 40′ 47.0″ E
10	Intunjambili river_5	20° 26′ 47.2″ S 028° 40′ 47.0″ E
11	Intunjambili river_6 (pipe)	20° 26′ 47.6″ S 028° 40′ 48.3″ E
12	Intunjambili river_7	20° 26′ 47.3″ S 028° 40′ 49.6″ E
13	Intunjambili river_8	20° 26′ 47.3″ S 028° 40′ 51.2″ E

14	Intunjambili river_9	20° 26′ 47.0″ S 028° 40′ 52.2″ E
15	Intunjambili river_10 (bathing point)	20°26′51.1″ S 028° 41′ 00.0″ E
16	Intunjambili river_11	20° 26′ 51.6 ″S 028° 41′ 00.9 ″E
17	Intunjambili wetland_1	20° 26′ 56.3 ″S 028° 41′ 04.2″ E
18	Intunjambili wetland_2	20° 26′ 57.7 ″S 028° 41′ 07.5 ″E
19	Intunjambili wetland_3	20° 26′ 59.0″ S 028° 41′ 08.0″ E
20	Intunjambili wetland_4	20° 27′ 01.5″S 028° 41 08.8″E

Appendix 4: An illustration of Wetland hydro geomorphic (HGM) types typically supporting inland wetlands

Hydrogeomorphic types	Description	Source of water maintaining the wetland[1]	
		Surface	Sub-surface
Floodplain 	Valley bottom areas with a well defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel 	Valley bottom areas with a well defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/ ***
Valley bottom without a channel 	Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/ ***
Hillslope seepage linked to a stream channel 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defined stream channel connecting the area directly to a stream channel.	*	***
Isolated hillslope seepage 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans) 	A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining) and/or intersection of groundwater. It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/ ***	*/ ***

[1] Precipitation is an important water source and evapotranspiration an important output in all of the above settings

(*Source: Kotze et al., 2007)*

Appendix 5: Assessment characteristics of the eight services

a) Stream flow regulation

1.Link to the stream network

2.Hydrological zonation

3.Presence of fibrous peat or unconsolidated sediments below floating marshes

4.HGM unit`s catchment occurs on underlying geology characterized by ground surface water linkages

b) Maintenance of biodiversity

1.HGM unit is of a rare type, is wetland type subjected to a high level of cumulative loss or falls within a veldt or vegetation type or eco-region having high cumulative loss

2.Level of cumulative loss of wetlands in the catchment

3.Red Data species or suitable habitat for Red Data species present

4.Level of significance of other special natural features

5.Extent of buffer zone around the HGM unit

6.Connectivity of HGM unit to other natural areas in the landscape

7.Alteration of natural hydrological regime

8.Alteration of sediment regime

9.Alteration of water quality regime

10. Removal of the indigenous vegetation

11. Invasive and pioneer species encroachment

12. Presence of fences, roads, weirs, power lines or any other obstructive barriers

c) Provision of water supply for direct human use

1.Representation of different hydrological zones

2.Importance of stream flow regulation

3.Current level of water use for agricultural or industrial purposes

4.Current level of water use for domestic purposes

5.Number of households that depend on the resource

6.Substitutability of the water source

d) Provision of harvestable natural resources

1. Total number of different natural resources used in the HGM unit
2. Is the HGM in the rural communal area?
3. Number of households which depend on the natural resources in the HGM unit
4. Substitutability of the wetland resources

e) Provision of cultivated foods

1.Total number of different crops cultivated in the HGM unit

2.Location of the HGM unit in the local rural communal area

3.Number of households whose livelihoods depend on the crops grown in the HGM unit

4.Substitutability of the water source

f) Cultural significance

1. Registered cultural site
2. Known local cultural practices in the HGM unit
3. Known taboos and beliefs relating to the HGM unit

g) Tourism, recreation and natural scenic value

1. Scenic beauty of the HGM unit
2. Presence of any 'charismatic' species (e.g. cranes)
3. Current use for tourism or recreation
4. Location within an existing tourism route
5. Recreational hunting and fishing and birding opportunities
6. Extent of open water, particularly that which is safe for swimming

h) Education and research

1. Currently used for education/research purposes
2. Reference site suitability
3. Existing data and research
4. Accessibility

Appendix 6: Calculation of sample size for the household survey

$$n = \frac{180}{1 + 180(0.05^2)}$$

=**124. 138**

$$\therefore n = \frac{124.138}{1+(\frac{124.138-1}{180})}$$

= 74.71

= 75

Appendix 7: Pictures of the FDG meetings and community mapping exercise

Appendix 8: Household survey questionnaire

1. Gender of Respondent 1=F 2=M

2. Age of Respondent Range 1=<18; 2=19-25 ; 3=26-35; 4=36-45; 5=46-55 6=56-65 7=Over 65

3. Is the respondent the household head 1=Yes 2=No
(Household head is the one responsible for making major decisions and overall provision of income to the household)

4. Marital status of the

Status	1	2	3	4
Tick				

1:Married 2:Never married 3:widow 4:Divorced/Separated respondent

5. Education level attained by the formal education

Education level	1	2	3	4
Tick				

respondent 0=No

1=Primary education
2=O Level
3= A level
4=Tertiary

6. Gender of Household head (If the respondent is not the household head) 1=F 2=M

7. Age of Household head

Range 1=<18; 2=19-25 ; 3=26-35; 4=36-45; 5=46-55 6=56-65 7=Over 65

8. Marital status of household

Status	1	2	3	4
Tick				

head1: Married 2:Never married 3:widow 4:Divorced/Separated

9. Education level attained by the household head 0=No formal education

Education level	1	2	3	4
Tick				

1=Primary education
2=Secondary
3= A level
4=Tertiary

10. Household composition: Include everyone who lives in the household. (Tick where applicable)

Range		<18	19-25	26-35	36-45	46-55	56-65	Over 65
Number	**F**							
	M							

11. What is the occupation of the respondent or Household head? (Tick where applicable)

Occupation		**Household head**
1	Formal employment	
2	Informal employment	
3	Self employed (incl. farming)	
4	Other (Specify)	

12. Do you have any livestock? 1=Yes 2=No

(Please tick where applicable)

Number	**Cattle**	**Goats**	**Sheep**	**Donkeys**	**Other (specify)**
01-10					
11-20					
21-30					
31-40					
Over 40					

13. Does anyone in the household own the following currently?

Household asset	**Fill: 1=yes or 2=No**
Scotch cart (animal drown)	

Wheel burrow	
Hand hoes	
Plough	
Water pumping equipment	
Bicycle	
Tractor	
Vehicle	
Other (Specify)	

14. Do you own a homestead? 1=Yes 2=No If No, explain the arrangement?

.....

a) How many huts are there? Range: 1= 1-3; 2= 4-6; 3= 7-9; 4= More than 9 huts

b) What is the major material used for your huts?

		Fill in
Exterior wall	1=wood 2=mud 3=grass 4=cement bricks (purchased) 5=cement bricks (locally molded) 6=mud bricks 7=stones 8=other (specify)	
Kitchen Floor	1=Earth/mud 2=wood 3=ceramic tiles 4=cement 5=dung 6=other (specify)	
Kitchen Roof	1=corrugated iron sheets 2=wood and grass	

	3=asbestos 4=tiles 5=other (specify)	
Other huts` floors	=Earth/mud 2=wood 3=ceramic tiles 4=cement 5=dung 6=other (specify)	
Other huts` roofs	1=corrugated iron sheets 2=wood and grass 3=asbestos 4=tiles 5=other (specify)	

c) Source of the material? 1=within wetland 2=within village outside wetland area 3=outside village

d) What the reasons for the choice of the major material over the alternative?

1=strength of material 2=Cheaper

3=availability 4=other (specify)

15. Source of energy you use for cooking? 1=firewood 2=electricity 3=solar 4=other (specify)

a) Source of the resource? 1=within wetland 2=within village outside wetland area 3=outside village

b) What the reasons for the choice of the resource over the alternative?

1=strength of material

2=Cheaper

3=availability

4=other (specify)

16. a) What is the source of water?

1=Intunjambili wetland

2=Intunjambili river

3=Intunjambili dam

4=Other (specify)

Water use	**Source (fill in)**
Drinking and cooking	
Washing and bathing	
Gardening	
Livestock	
Other (specify)	

b) How would you rank the quality of the water for your household daily uses?

1=Poor quality

2=Not so good

3=Good quality

Water use	**Quality(fill in)**
Drinking and cooking	
Washing and bathing	
Gardening	
Livestock	
Other (specify)	

b) How would rank the degree of reliance on wetland water supply for your daily household daily uses?

Score	0	1	2	3	4	5
Degree	None	Very little use	Regular use but alternatives are available	Most use but alternatives are available	Highly reliant and alternatives are costly/problematic	Critical (No alternatives)

Water use	**Reliance (fill in)**
Drinking and cooking	
Washing and bathing	
Gardening	
Livestock	

Other (specify)	

c) How would rank the importance of water for your household uses?

Water use	**1=Highly important 2=In between important 3=Not so important**
Drinking and cooking	
Washing and bathing	
Gardening	
Livestock	
Other (specify)	

17. What is your perception on the extent of Intunjambili wetland?

1=Covers the entire village

2=The marshy part (where the *inuta*is located)

3=The river section after the marshy part

4=The dam

5=From the marshy area, to the river up to the dam

18. Do you have access to Intunjambili wetland? 1=Yes 2=No

Wetland use	**(List even if more than one use)**

a) What do you use the land for?

1=Settlement 2=Gardening

3=Farming 4=Grazing

5=Fishing 6=Hunting

7=Swimming 8=firewood

9=Water 10=Other (specify e.g. medicines)

19. How would you score the reliance of these uses?

Score	**0**	**1**	**2**	**3**	**4**	**5**	**Fill in**
Settlement	None	Meets less than 10% of hh needs	Meets less than half of hh needs		Just enough to meet hh needs	More than enough to hh needs	
Arable land for gardening	None	Meets less than 10% of hh needs	Meets less than half of hh needs		Just enough to meet hh needs	More than enough to hh needs	
Arable land for farming	None	Meets less than 10% of hh needs	Meets less than half of hh needs		Just enough to meet hh needs	More than enough to hh needs	
Grazing	No grazing land available	Lack of grazing land restricts the number of livestock			Just enough to meet hh needs	Not limiting factor in terms of livestock numbers	
Harvestable natural resources	N/A	Natural resources extremely scarce relative to household demand			Just enough to meet hh needs	Abundant natural resources relative to household demand	

Hh=household

b) Seasonality of the activities on the wetland

Wetland use	**1=Jan**	**2=Feb**	**3=Mar**	**4=Apr**	**5=May**	**6=Jun**	**7=Jul**	**8=Aug**	**9=Sep**	**10=Oct**	**11=Nov**	**12=Dec**

1=Settlement												
2=Gardening												
3=Farming												
4=Grazing												
5=Fishing												
6=Hunting												
7=Swimming												
8=firewood												
9=Water												
10=Other (specify)												

c) How would you rank these activities in terms of importance?

Wetland use	**1=Highly important** **2=In between important** **3=Not so important**
1=Settlement	
2=Gardening	
3=Farming	
4=Grazing	
5=Fishing	
6=Hunting	
7=Swimming	
8=firewood	
9=Water	
10=Other (specify)	

20. Livelihoods and wetland natural resources

a) What are the major activities do you perform in the wetland for as a form of livelihood?

1=Gardening 2=Farming

3=livestock rearing 4=Fishing

5=Hunting 6=Basket/mat making from reeds

7=Other (Specify)

b) Seasonality of the livelihood activities performed or derived from the wetland

Score	**0**	**1**	**2**	**3**
Seasonality of activities	N/A	Little period per year	Most of the times but all year round	All year round

Fill in applicable score

Livelihood	**Score**
Gardening	
Farming	
Livestock	
Fishing	
Hunting	
Basket/Mat Making	
Other (Specify)	

c) Degree of dependence on the livelihood

Score	**0**	**1**	**2**	**3**	**4**
Degree	None	Very little dependency	Little but alternatives are available	Mostly dependent but alternatives are available	Highly dependent and alternatives are costly/problematic

Fill in applicable score

Livelihood	**Score**
Gardening	
Farming	

Livestock	
Fishing	
Hunting	
Basket/Mat Making	
Other (Specify)	

d) How would you score the wetland contribution to the overall household income?

Score	**0**	**1**	**2**	**3**	**4**	**5**
%Contribution to overall income	0	1-5%	6-10%	11-15%	16-20%	>20%

Fill in applicable score

Livelihood	**Score**
Gardening	
Farming	
Livestock	
Fishing	
Hunting	
Basket/Mat Making	
Other (Specify)	

e) How would you rank the importance of the livelihood activities in terms of importance?

1=Not important 2=Important to a certain extent 3=Very important

Livelihood	**Score**
Gardening	
Farming	
Livestock	
Fishing	
Hunting	
Basket/Mat Making	
Other (Specify)	

Section C: Social aspects

21. Cultural practices

a) What is your religion (optional)?

0=None

1=Traditional

2=Christianity

3=Both Tradition and Christianity

4=Muslim

5=Other (Specify)

b) Do you have any religious practices that you perform in the wetland? 1=Yes 2=No

c) Is there any alternative place you can perform the same practice? 1=Yes 2=No

d) Do you know any local cultural practices, conducted in the wetland? (Specify)

0=None

1=Historically present but no longer practiced

2=Present but practiced to a limited extent

3=Present and still actively and widely held

e) Do you know any local cultural beliefs, kept in the wetland? (Specify)

0=None

1=Historically present but no longer kept

2=Present but kept to a limited extent

3=Present and still actively and widely held

f) Do you know any local taboos, held in the wetland? (Specify)

0=None

1=Historically present but no longer practiced

2=Present but practiced to a limited extent

3=Present and still actively and widely held

g) Are there are parts of the wetland that are sacred? 1=Yes 2=No

h) Are there are sacred animals in the wetland? 1=Yes 2=No

i) How would you rank the importance of the presence of the above in contributing to the sustainability of wetlands?

1=high importance

2=medium importance

3=low importance

22. Do you think the wetland holds scenic beauty? 1=Yes 2=No

a) Does the area have the presence of appealing features? 1=Yes 2=No

b) How would rank scenic beauty of the wetland and its feature?

1=high importance

2=medium importance

3=low importance

23. Tourismand recreation

a) Do you think the area you live in has a potential tourist attraction? 1=Yes 2=No

b) Current use for tourism or recreation in the wetland area?

0=No use

1=Moderately low use

2=Intermediate use

3=Moderately high use

4=High

c) Extent of open water particularly that which is safe for swimming?

0=None

1=Present but very limited

2=Extensive but somewhat limited

3=Extensive

d) Current use for tourism or recreation in the wetland area?

0=No use

1=Moderately low use

2=Intermediate use

3=Moderately high use

4=High

24. Education and research

a) Current use for education/research purposes in the wetland area?

0=No use

1=Moderately low use

2=Intermediate use

3=Moderately high use

4=High

b) Do you have any research on the wetland that you have benefited from? 1=Yes 2=No

25. In your perception, what would you say about the current state of Intunjambili wetland?

1=Bad

2=Better

3=Good

26. In your perception, how has the size of the wetland changed from 1990 to 2015?

1=Increased 2=Decreased

27. In your perception, how has the vegetation cover changed from 1990 to 2015?

1=Increased 2=Decreased

28. In your perception, how has the water level changed from 1990 to 2015?

1=Increased 2=Decreased

29. What are the main threats to the wetland?

    1=Climate change

    2=Wetland drying up

    3=Reduction in wetland harvestable natural resources

    4=Shortage of grazing land

    5=Reduction in fish

    6=Sedimentation of dam

    7=Other (specify)

30. Are you aware of any institutional mechanisms in place, in terms of management of the wetland? 1=Yes 2=No

31. Have you or are you taking part in any wetland management activities to address any of the threats? 1=Yes 2=No

32. If yes, which one of the threats?

    1=Climate change

    2=Wetland drying up

    3=Reduction in wetland harvestable natural resources

    4=Shortage of grazing land

    5=Reduction in fish

    6=Sedimentation of dam

    7=Other (specify)

33. Do you think current activities are sustainable to the existence of the wetland for future generation to benefit from?

    1=Yes 2=No

34. Are you willing to accept any measures that could be in place to address threats to the wetland and compensation that might be offered? 1=Yes 2=No