COMMUNITY MANAGEMENT OF WETLAND ECOLOGY AND SOCIO-ECONOMIC COSTS OF WETLAND DEGRADATION IN MUDASWALI WETLAND, LIMPOPO PROVINCE, SOUTH AFRICA

By

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DECLARATION

I, **Sinyati Mollel** hereby declare that this dissertation for the Master of Environmental Science degree submitted by me, has never previously been submitted for a higher degree and that, it is my own work in design and execution, and all references and materials contained therein have been duly acknowledged.

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ABSTRACT

Wetlands are one of the most degraded ecosystems on the earth's surface. In South Africa, loss and degradation of wetland ecosystems have occurred particularly through a variety of human activities. This loss of value of wetlands have impacts on functions such as water purification, flood control, ground water recharge/discharge, sediment/pollutant and nutrient retention which have serious consequences on socio-economic benefits of wetlands. However, there is still little knowledge amongst the local communities of what wetland degradation costs them.

This study therefore, explores ways in which local communities value and engages in the management of wetlands by quantifying and costing (in financial terms) wetland degradation vis-a-vis socio-economic costs. Judgemental assessment method was used to select the site for observations and availability of respondents. A structured questionnaire with open and closed ended questions was administered to 65 respondents who reside in the vicinity of the Mudaswali wetland. Focus group discussion helped to provide a technical perspective on the quantum of each wetland value and the estimate of wetland degradation in the region. Willingness to accept (WTA) technique was used to facilitate the estimate of socio-economic costs of wetland degradation by the local community. In addition, the use of willingness to pay (WTP) method helped in determining the value of wetland in the local community.

As part of the major findings of this study, the majority of the respondents were females in the study. The most frequently stated value of the wetland resource was water for household consumption, land for cultivation; and fibre for handcraft and construction materials for example; clay and reeds used for thatching/roofing houses. A total of 51% of the respondents stated the degradation of wetlands in the area is between 51-80% (that is; significant). The results of respondents' willingness to accept (WTA)

compensation for degradation and loss of wetland was a sum of R390 per month. Given the relatively low level of income (R500-R800) within the community, a loss of R390 constitutes a drawback to the community. On average, the respondents' willingness to pay (WTP) for wetland conservation was a sum of R30 per month. It should be noted that earlier the cost of wetland degradation to the community as a whole was estimated at R390 per month. The suggested value (R30) for conservation is therefore a strong expression for the value of wetlands to the individuals in the community.

This research recommends the empowerment of local community using various incentives to encourage them to participate in conserving and managing the wetlands. There is also a need to carrying out further research on the proper utilization of wetlands and monitoring of wetland uses at local community scale.

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ASSUMPTIONS AND OPERATIONAL DEFINITIONS/ACRONYMS

This research work assumes that human activities result into degradation of wetland ecosystems in the study area. Thus, other non-human possible causes of wetland degradation will be held constant. The following concepts have been used in this research and should be understood as explained below.

Wetlands: refers to areas which are permanently, seasonally or occasionally waterlogged with water that is static or flowing, fresh, brackish or salt, including both natural and artificial areas that support typical aquatic or semi-aquatic flora and fauna. They include areas of swamps, floodplains, river valleys, deltas, shallow lakes, marine water (the depth of which at low tide does not exceed six metres).

Wetland degradation: refers to the impairment of wetland functions as a result of human activities through upstream or downstream impacts on biodiversity, hydrology; soils, water quality and water resources.

Wetland function: are processes among and within the various biological, ecological, chemical and physical components of a wetland, such as nutrient cycling, water storage, water purification and groundwater recharge.

Valuation: assessment by quantification or qualification of the values of wetland resource.

Value: is the economic worth of goods or services, generally measured in terms of what individuals are willing to pay (example, the wetland has value because it supports commercial fishery).

Willingness to pay: is the amount that someone is prepared to pay or sacrifice to purchase a good or to obtain a change in environmental improvement/deterioration or use of a service regardless of whether there is a prevailing market price or the good or service is available free of charge.

Contingent valuation: is a valuation from a survey technique using direct questioning of individuals/ society to estimate individuals' willingness to pay for a non-market environmental goods or services.

ACRONYMS

T.E.V:	Total Economic Value
C.V.M:	Contingent Valuation Method
T.C.M:	Travel Cost Method
W.T.P:	Willingness to Pay
W.T.A:	Willingness to Accept
C.W.A:	Clean Water Act
U.S.A:	United States of America
N.E.P.A:	National Environmental Policy Act
E.A:	Environmental Analysis
E.I.S:	Environmental Impact Statement
F.W.P.C.A:	Federal Water Pollution Control Act
C.Z.M.A:	Coastal Zone Management Act
E.W.R.A:	Emergency Wetlands Resources Act
F.S.A:	Food Security Act
U.S.D.A:	United States Development Agency
N.R.C.S:	Natural Resources Conservation Service
P.R.A:	Participatory Rural Appraisal
N.E.M.A:	National Environmental Management Act
E.A.W.S.P:	Eastern Africa Wetlands Support Program
W.W.F:	World Wildlife Fund
I.U.C.N:	International Union for Conservation of Nature
D.C:	Dichotomous Choice
R:	Currency in Rand

CHAPTER 1: INTRODUCTION

1.1 Research Orientation

This thesis is focused on ways in which communities residing close to Mudaswali wetland in Matangari village, Limpopo Province of South Africa; value and engage in the management of wetlands. It further quantifies wetland degradation to determine the socio-economic costs involved and to recommend relevant management strategies for adoption of sustainable management of wetlands.

Wetlands are amongst the most threatened and destroyed or degraded ecosystems on earth. Historically, wetlands have been destroyed through agricultural drainage and more recently through urban expansion (Kotze, 1996). As a result, wetland degradation has become one of the most serious environmental concerns in today's world. Degradation in this dissertation refers to the impairment of wetland functions as a result of human activities through upstream or downstream impacts on biodiversity, hydrology; soils, water quality and water resources.

Several studies have shown evidence of wetland degradation and loss of value in some parts of the world (Schuyt, 2005; Turpie et al. 1998; Deborah and Frederick, 1998). For example; the United States has lost 54% of its original wetlands mainly to agriculture. In the late 1900's, drainage of the Pinsk marshes in Russia led to destruction of about 1.5 million hectares of wetlands. Additionally, in Europe, Italy had about 94 per cent loss of its wetlands (www.panda.org/wetthreatseng.doc, 18 June 2010)

In recent years, parts of South Africa have experienced problems of wetland degradation (Kotze, 1996). Population pressures on limited wetland resources and increased demand for domestic and commercial value of wetlands have consequently impaired wetland functions to provide water quality protection, natural floodwater storage, fish and wildlife habitat and reduction in the erosive potential of surface water. Direct anthropogenic activities have thus reduced the ability of wetlands to provide such benefits to humankind and to support biodiversity (Davies and Claridge, 1993).

Management of wetlands is important in maintaining the biological productivity of the fragile wetland ecosystems in order to sustain rural livelihood. A fragile ecosystem in this study refers to an ecosystem which reacts abruptly and sometimes catastrophically to slight/minor changes to the ecosystem. Wetland management involves control of activities that are conducted within and around wetlands. These activities can be either natural or human-made processes and may lead to abrupt changes in wetland ecosystem conditions. The management functions are to protect, restore, manipulate or enhance the value of wetlands. Wetland management also involves natural wetland protection activities which are specifically exempted from regulatory requirements, including wetland creation and restoration for water quality improvement.

So far, much has been written on environmental degradation in general (Kikula, 1986; Omara-Ojungu, 2000) and wetland degradation in particular (Schuyt, 2005., Cowardin et al. 1997; Kotze et al. 1996; Turner, et al. 2000:7). From these previous researches and documents, symptoms rather than evidence of wetland degradation can be discerned. However, what is inadequately addressed is the issue of quantifying and cost (in financial terms) of wetland degradation. Without such quantification and costing, the rationale for effort on sustainable management of wetlands remains on shaky ground. It is through knowing what it costs society, that sustainable management of wetland resources can be better promoted and justified.

1.1.1 Background to the Research Problem

Wetlands are the most productive lands on earth's surface. They provide abundant supplies of both nutrients and water in a stable environment. The waterlogged soils in the wetlands facilitate the rapid growth of grasses, particularly those adapted to anaerobic conditions like river reeds (*Phragmites australis*). Wetlands are also valuable in economic terms; they support the growth of crops such as maize on floodplains; and pastures such as the grasses of the Kafue and Okavango floodplains. They also provide raw materials such as reeds for thatching and basket weaving and edible food such as fish for household consumption (Davies and Day, 1998). Despite their high productivity wetlands are very fragile.

In spite of the provision of a range of community livelihood resources, wetlands are being threatened by increasing pressure to convert natural habitats into land use activities that have adverse impacts on the sustainability, safety and health of an ecosystem (Schuyt, 2005). Population increase coupled with intense anthropogenic activities and unplanned developmental activities, such as settlement, timber production, burning, over-harvesting of wetland products, irresponsible damming, cultivation, livestock grazing and areas for waste disposal, have often impaired the wetland ecosystems' functions and are resulting in the extinction of these fragile ecosystems. The consequence may be long-term, and possibly irreversible and therefore reduced value of wetland ecosystems (Deepa et al. 1998).

The Mudaswali wetland is experiencing on-going degradational effects. According to DWAF 1998; Kotze et al. 1996) these effects are from encroaching agricultural activities on buffer zones, livestock grazing and poultry activities. Other effects are due to burning, settlement and the invasion by alien plants for example; eucalyptus (Le Maitre et al. 2002). The intensified human uses within wetlands have resulted into problems like sedimentation, soil erosion, declining water quality (presence of algae) and species diversity thus reducing the sustainability of wetlands. It is because of such degradational effects that this research was undertaken in Mudaswali wetland.

Existing literature and practical experience indicate that economic returns from natural or sustainably used habitats exceed those from systems which have been disturbed or degraded. In spite of this observation, loss and degradation of the remaining natural habitats continue largely unabated (Maclean et al. 2003). These losses are often attributed to under valuation of wetland goods and services by the user (Turner et al. 2000). Several recent studies have attempted to quantify wetland goods and services in terms of human welfare (Balmford et al. 2002:950; Turner, 2000; Batagoda et al. 2000 Costanza et al. 1997:253). In this study, community management of wetlands, quantifying and costing degradation on Mudaswali wetland of Limpopo Province in South Africa will be undertaken. The ultimate purpose is to determine the socio-economic costs, and therefore loss of value in order to justify presenting better management strategies for wetland ecology.

1.1.2 Statement of the Research Problem

This study investigates the socio-economic costs of degradation of the Mudaswali wetland. Recently, parts of South Africa have experienced problems of wetland degradation (Kotze, 1996). Direct anthropogenic activities are said to have reduced the ability of wetlands to provide benefits to humankind and to support biodiversity (Deepa et al. 1998). As indicated earlier, much has been written on environmental degradation in general. There is however inadequate knowledge in the communities in terms of what wetland degradation costs them. This study therefore sets out to quantify and cost (in financial terms) wetland degradation and to advance appropriate management strategies for wetland ecosystems.

1.1.3 Objectives of the Study

1.1.3.1 General Aims

The aim of this study is to investigate ways in which communities residing close to Mudaswali wetland in Matangari village, Limpopo Province of South Africa value and engage in the management of wetlands in order to quantify the socio-economic costs of wetland degradation and recommend strategies for improved management of wetlands. The research will further quantify the socio-economic costs of wetland degradation and recommend strategies for improved management of wetlands.

1.1.3.2 Specific Objectives

In order to accomplish the above aim, the following specific objectives are pursued in the study area:

- To describe the nature of wetland ecology and resource potential in Mudaswali study area.
- To identify the socio-economic value of the wetland as perceived and realized by the local community.
- To estimate the loss of wetland values and the socio-economic costs of wetland degradation in the study area.
- To recommend relevant management strategies for the wetlands in the area of study.

1.2 Hypotheses

The research is premised on the hypotheses outlined below, which serve as the guiding points in the research process.

- The nature of wetland ecology and resource potential are related.
- Wetlands provide both social and economic benefits as realized by the local people.
- Wetland degradation is a result of inadequate knowledge by the community of better management methods.
- Wetland degradation can be quantified and the associated socio-economic costs can be determined.
- Effective management strategy for wetlands can be developed.

1.3 Justification

After the Ramsar convention ratification in 1975 (Ramsar, 2004), many countries signed the treaty to help prevent detrimental changes to wetlands. South Africa is one of the countries that are party and signatory to that convention. Since then, various researches on wetlands have been generally undertaken in South Africa (Kotze 1996; Acreman and Hollis 1996; Wyatt, 1995; Begg, 1990). In the Limpopo Province of South Africa, and particularly in Vhembe District, scholarly researches with different objectives within the wetland domain have recently emerged (Modau, 2006; Nemukula, 2006; Sinthumule 2001). The majority of the research on wetlands in South Africa and elsewhere has concentrated on the effects and impacts of anthropogenic activities in wetland ecosystems. So far, hardly a research has been done on quantification and costing, in financial terms, of degradation of wetland ecology. This study will build on the earlier research and will put emphasis on the analysis of wetland benefits and associated costs of wetland degradation. This will provide baseline information for management of wetland resources.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature in the context of environmental economics approach, and evidence of wetland degradation at Global, African; South African and at local scale (Mudaswali wetland in Matangari village). This study will therefore apply theoretical premises from environmental economics as a field of study.

2.2 An Overview of Environmental Economics

Environmental economics deals with the study of the economic impact of goods and services and particularly of the market systems of allocation on environmental quality and ecological integrity (Pearce and Turner, 1990; Tietenberg, 2000) and the appropriate way of regulating economic activity so that balance is achieved among environmental, economic and other social goals. Furthermore, environmental economics is concerned with the applications of economic theory in identifying and solving environmental damage associated with the flow of residuals from economic activity back to nature.

A residual is the amount of pollutant that remains in the environment after a natural or technological process has occurred (http://coe.mse.ac.in/eeenvironmentaleconomics.asp, 7 August 2010). The most destructive residuals to wetlands are liquid residuals such as industrial wastewaters and solid residuals like municipal trash and hazardous waste materials, which have a negative impact on wetlands. Other residuals like emission of carbon dioxide from the combustion of fossil fuels such as oil, coal and natural gas can be absorbed naturally through the assimilative capacity of the environment (http://coe.mse.ac.in/eeenvironmentaleconomics.asp, 7 August 2010). The utilization of wetlands for biomass harvesting and/or waste dumping leads to the generation of other residuals that are potential threats to the stability of ecological systems in general and wetlands being fragile, are particularly sensitive to disturbance by human activities.

These assertions provide a perspective of environmental problems and the important connections between economic activity and nature. It is the existence of these connections that motivates the discipline of environmental economics, which uses economic theory to analyse environmental damages and the policy initiatives to curb such damage (Callan and Thomas, 1996). In environmental economics, the basic economic concept of valuing environmental resources has its foundation in neo-classical welfare economics. Neo-classical welfare economics suggests that economic value of changes in environmental goods and services can be derived from measuring the effects of changes in human welfare (Acharya and Barbier, 2000:247). In this research, the economic theories of willingness to pay (WTP) and willingness to accept (WTA) will be used to estimate the socio-economic costs (in financial terms) of wetland degradation.

2.3 Benefits of Wetland Utilization

Wetlands are some of the most valuable ecosystems worldwide. This may be because their functions have proved useful to both humans and ecological stability. Wetlands are exceptional ecosystems which provide both land and water for social and economic uses such as agriculture, fishing, livestock grazing and hunting. They are also effective for purifying water by removing particulate pollutants, thus enhancing water quality (Davies and Day, 1998). Both direct and indirect benefits of wetland utilization are described below;

2.3.1 Direct benefits

Wetlands serve as an important source of water supplies necessary for maintaining life as well as to support biodiversity. They offer large quantities of water for industrial, agricultural and domestic use such as drinking, cooking, irrigation, manufacturing, and washing. Some wetlands serve as recharge areas for groundwater, and some as discharge areas where groundwater flows into the wetland. However, groundwater recharge refers to the movement of surface runoff down through the soil into the zone of permeable rock where (sub) surface runoff saturates the soil. The water which moves from the wetland to an aquifer can then remain part of the shallow groundwater system, which may supply water to surrounding areas and sustain the water-table. In addition, wetland vegetation helps to extract impurities from the water thus filtering it to enhance water quality (Davies and Day, 1998).

Wetlands serve as valuable fisheries. Many species of edible fish breed exclusively in inundated floodplains because they retain a lot of nutrients that provides planktons for the fish. For example, the Pongola River floodplain in South Africa typically produces a substantial population of fish suitable for human consumption. Some species of sea fish usually depend on estuaries as breeding grounds (Davies and Day, 1998).

Wetlands support high plant growth and provide abundant supplies of both nutrients and water for crop cultivation. Thus, wetlands are valuable in supporting the production of cereal crops such as maize on floodplains and rice in paddy fields, and provide raw materials such as reeds for thatching and basket-weaving. In addition, the periodic inundation of wetlands supports dry-season agriculture through irrigation farming. For example, the inner Niger Delta is significantly utilized for rice cultivation in the floodplain (Barbier et al. 1997).

Wetlands support some of the best forage for livestock, which tends to spend a disproportionately large time in wetlands. Grazing of livestock in wetlands is mostly proper in the early growing season and during dry period when the grazing pastures are poor in the surrounding rangeland. Permanently wet marsh areas are often not good for grazing because most mature marsh plants are unpalatable. As a result, most of the wetlands in South Africa, especially in rural areas, are used as grazing lands for domestic stock during dry season. The margins of large wetlands also provide suitable lands where cattle herders benefit from the harvest of natural fodder (Kotze, 1996).

Similarly, papyrus sedge harvested from wetlands provides suitable materials for construction and handcraft products such as mats, baskets and thatching. Handcraft production from harvested wetland plants is usually for subsistence and income generation hence the development of local economies. Building materials such as clay, sand, wood and papyrus are also collected from the wetlands. The plant species commonly known as reed (*P. australis*) is often used for construction of houses in many rural areas. Also, some wetland plants offer valuable medicines for various ailments (Schuyt, 2005:182).

Wetland offers suitable sites for hunting of waterfowl such as ducks and spine and other wildlife such as reedbuck. For example, many people in South Africa and USA take part in recreational hunting of waterfowl. The hunters often value the importance of wetlands for ducks by willing to pay to ensure that wetlands retain their natural functioning condition (Kotze, 1996).

Wetlands are valuable for aesthetic purposes. They provide spectacular places to see birds that have diverse range of colours and texture. Most of the migratory birds are often attracted to the natural wetland habitats as haven and thus add to the diversity and beauty of the landscape. For example, the Hadejia-Nguru wetlands in Northern Nigeria provide one of the most spectacular sites for seeing birds of over 265 distinct species (Schuyt, 2005). Moreover, some wetlands have very attractive flowers like those of water lilies and ground orchids (Netshavhakololo, 2007).

Wetlands are crucial ecosystems for the well-being of many communities. Mudaswali wetland where this study was undertaken, provides people with direct benefits such as fibre for handcrafts production, supplies of domestic water, valuable land for crop cultivation, construction clay, fuel wood and fishing grounds (Kotze, 1996).

Several studies in southern and eastern Africa by Turpie (2000); McCartney and van Koppen (2004); Masiyandima et al. (2004) also indicated the value of wetlands particularly, in supporting the rural livelihoods through provision of natural resources such as water, soils and plants. The natural resources are used by rural households in a wide range of activities such as salt making, pottery, plant harvesting for medicinal use, craft, provision of fuel wood and materials for house building and fishing. Apart from harvesting and processing of natural resources, uses of wetlands also include cultivation and livestock grazing and watering. Some of the activities such as cultivation and fishing provide economic benefits, and are a source of income for the households. Other uses such as water for domestic purposes, river reeds for thatching/roofing and soils for decorating houses, contribute directly to household needs.

2.3.2 Indirect benefits

Indirect benefits of wetlands are derived from ecological functions through functions such as maintenance of water quality, flow and storage; groundwater recharge, erosion /flood control and sediment/nutrients retention. In addition, wetlands serve as an important breeding ground for migratory birds, such as waterfowl which play a significant role in ecological balance in the country (Kotze, 1996). The following is the discussion of some indirect benefits of wetlands.

Wetlands serve as floodwater storage and for stream-flow regulation. This is practically so if it spreads out and slows down water moving through the catchment. The gentle slope of wetlands and resistance offered by wetland vegetation help to reduce the velocity of floodwater, hence, stores it. Furthermore, wetlands help to regulate stream-flows more especially during low flow periods (Kotze et al. 1997). In the USA, for example, the wetlands of Charles River are valuable in floodwater control, especially during extreme flood periods. Natural wetlands of the Zambezi Basin in southern Africa also are effective in floodwater control and estimates proved to have a net present value of more than 3million US dollars in reducing flood-related damage costs (Davies and Day, 1998).

In addition, wetlands are also good at purifying water by removing both dissolved and particulate pollutants. The plants adapted to anaerobic wetland conditions are capable of extracting impurities from the water as it flows through it. The pollutants in water may be inform of excess nutrients like phosphorus and nitrogen, heavy metals (mercury and lead), disease causing bacteria, viruses and synthesized organic pollutants such as pesticides. Also, wetlands perform this function by slowing down the surface runoff and so causing pollutants attached to soil particles and sediments carried in the water to be deposited into the wetlands (Kotze et al. 1997).

A study on Aloe boom wetlands of Black Mfolozi River in KwaZulu-Natal by Davies and Day (1998) demonstrates that natural water purification of wetlands is more effective than artificial treatment of water. The cost of artificially cleansing effluent water from local coal mines was estimated at R2.6 millions per year, while the Aloe boom wetlands would have performed the purification at no cost.

Similarly, in the United States, natural wetlands are considered very active in purifying storm water and treating municipal wastewater. In the course of treatment, these natural wetlands are able to remove 70% to 90% of organic matter, 26% of nitrogen, and 12% to 70% of phosphorus and a significant percentage of other metals (Deborah and Frederick, 1998).

Moreover, wetlands provide suitable conditions for the denitrification process to take place. The close link between anaerobic and aerobic zones in wetlands facilitates the denitrification process. This process helps to convert nitrates (which pollute water) to gaseous nitrogen which is not a pollution hazard. While, some nitrates are absorbed directly by the rapidly growing wetland plants, the soils of wetlands are also valuable for trapping certain pollutants such as heavy metals. Micro-organisms in wetlands play a role in purifying water by decomposing some of the man-made organic pollutants such as pesticides (Kotze et al. 1997).

As mentioned before wetlands have a potential influence on the recharge and discharge of groundwater aquifers. In this way, empty aquifers are quickly recharged by surface runoff. For example, previous studies by Barbier (1998) on Hadejia-Jama' wetlands in Nigeria have proved the potential for groundwater recharge.

Despite their importance and value in maintaining the hydrological balance, water quality and provision of a variety of habitats and community livelihood resources, natural wetland habitats around the world are being rapidly degraded or destroyed by a range of social and economic activities/developments. Below is the discussion of evidences of wetland degradation from global, African, South African and local perspectives.

2.4 Evidences of Wetland Degradation from a Global, African, South African and local (Limpopo) perspective.

2.4.1 Introduction

Generally, wetland degradation involves the impairment of wetland functions by human activities through upstream or downstream impacts on biodiversity, soil and water quality. Anthropogenic activities such as livestock grazing, irrigation agriculture, excessive extraction of wetland products and introduction of alien species may eventually reduce the capacity of wetlands to perform their functions. As indicated earlier, these wetland ecological functions include flood control, groundwater recharge, water purification, sediment/pollutant and nutrient retention. The loss of value of these functions has serious consequences on the socio-economic benefits of wetlands.

Table 2.1: Selected Examples of Wetland loss in the World's Continents (1980-1997)

Continent	Country	Responsible activities	% loss of wetland
Europe	Portugal	Agriculture and industrial development	70
	Netherlands	Drainage or filling for human settlement and agriculture	55
	Switzerland	Drainage for settlement and conversion for agriculture	95
America	California	Oil drilling, agriculture and industrial development	91
	United States	Urban and rural development and agricultural production	54
	South America	Drainage for agriculture and pollution	80
Asia	Phillipines	Conversion to aquaculture ponds	67
	South-East Asia	Fishing, rice cultivation and associated disturbance	19
	Singapore	Rice cultivation and settlement	97
Africa	South Africa	Agriculture production and unwise development	50
Australia	Swan coastal Plain of Western Australia	Filling of wetland for human settlement, recreational facilities and agriculture development	75
	South-east South Australia	Drainage or filling of wetland for industrial and waste disposal	89

Source: (Barbier et al. 1997)

2.4.2 World Perspective

Since 1900 wetlands have increasingly disappeared all over the countries of the world (Schuyt, 2005) due to human activities and changes in land use. Land uses with the greatest impact on wetlands are grazing, agriculture, road building as well as mining activities, which deposit mine wastes in the floodplains.

Previously, wetlands were regarded as wastelands, homes for pests and swamps of despair that have to be avoided or to be drained and filled. For example, in the United States, these social factors led to the destruction of more than half of the total wetlands in the lower 48 states over about 200 years. In New Zealand, settlements by Europeans in the mid 1800's, contributed significantly to a 90% loss of wetlands in a relatively short time (Crooks et al. 2001). In addition wetlands are said to have degraded due to other economic and social activities including filling, reclamation and sediment interception for port expansion, urban and industrial sprawl.

For example, South America lost 80% of its wetlands from reclamation activities of mangrove wetlands in the Gulf of Mexico and throughout the Caribbean regions involved purposeful clearing of mangrove forest for residential and recreational development (Turner et al. 2000). It is estimated that the decrease in land cover of mangrove wetlands was from 4567 hectares in 1952 to 3471 hectares in 1984 (Deborah and Frederick, 1998).

Deborah and Frederick (1998) have also highlighted loss of mangrove wetland in Southwest Florida at Marco Island due to the impact of large-scale residential development that involves significant loss of forested wetlands. Indeed, the losses are of great concern because these wetlands provide valuable functions, including nursery and stock habitats, water purification and shoreline stabilization.

In Asia, most of the wetlands have been destroyed by human activities including filling and wetland reclamation. For example Aral Sea wetlands were threatened by water shortages due to water diversion upstream for cotton-fields irrigation. Also, in South-East Asia, several mangrove forest wetlands were lost as a result of fish harvesting and business in shrimp production (Turner et al. 2000).

In Eastern North Carolina of the USA, the use of Pocosin wetlands for agriculture and recently for timber harvesting, peat mining, and phosphate mining led to massive destruction of organic soil swamps (Deborah and Frederick, 1998). It involved the building of Dismal Swamps Canal and Lake Phelps Canal. There were also logging activities which became more significant especially south of Albemarle Sound. There were also severe problems associated with conversion of Pocosin wetlands into intensive agriculture highlighted by Skaggs et al. (1994) which include changes in salinity of the adjacent estuaries which reduced the quality of habitat in primary nursery areas for fish and shellfish; and increased concentrations of nitrate, ammonia and phosphate in streams and estuaries which affected the soil and water quality in the wetland.

In California, 91% of the wetlands were lost as a result of human activities such as oil drilling, agriculture and development. The birds' species which were endangered by the loss of coastal and riparian wetlands include the California clapper rail, brown pelican and South Western willow flycatchers. New Zealand has about 90% loss in wetland, while South East part of South America has lost about 89% of its wetland (Michael et al. 1996).

2.4.3 African Perspective

In Africa, wetlands are still experiencing immense pressures. Major current threats to most of African wetlands are largely drainage for agriculture and settlement, excessive exploitation of wetland resources by local communities and improperly planned development activities.

Maclean et al, (2003) identifies factors that put severe strains on wetland resources in African wetlands. These are population growth, desire for increased income and pressures of the development process. In Senegal, for example, the Djoudj National Bird Park is being threatened by construction of dikes and dams for the promotion of rice agriculture in the Senegal River valley. These activities have changed the quantity and quality of freshwater in the area, compounded by the use of fertilizers and pesticides to improve yields and control pests in rice fields.

Furthermore, water development projects in the Hadejia River basin, predominantly upstream had serious effects on the timing and extent of flooding in the Hadejia-Nguru wetlands. The Challawa Gorge, Tiga dam and more recently constructed Hadejia Valley Project in a tributary of the Hadejia River resulted in decline in the flooding of the Hadejia-Nguru wetland located downstream of the catchment's basin (Schuyt, 2005).

In Uganda, the Lake George wetland is also threatened by pollution from copper and cobalt mines; and uncontrolled tree harvesting for charcoal burning which depleted the tree resources of the lake. Likewise, in Northern Nigeria, pastoral activities have led to increased problems of overgrazing, soil erosion and siltation of many wetlands in Northern Nigeria (Sinthumule, 2001) such as, the weltlands of Fadana.

Anthropogenic activities such as agriculture, cattle grazing, settlement areas and pollution from industrial and municipal wastewater have negatively impacted on wetlands in the Lake Victoria basin (Kassenga, 1997). The problems include sedimentation in the wetlands and hydrological changes of wetlands due to road construction and subsidence of wetlands. In addition, management issues associated with the open-access regime and absence of an institution to deal specifically with wetland management have also contributed to the degradation of wetlands in the Lake Victoria basin.

Extensive drainage of wetlands for agriculture and over-harvesting of wetland products by local populations have also caused rapid degradation of wetlands in Lake Bunyonyi of Uganda. In addition, expansion of road network to facilitate easy access to market for wetland products such as papyrus for building material and handcrafts contributed to increased degradation of wetlands in the lake Bunyonyi basin.

Schuyt, (2005) indicates that the Zambezi basin wetlands are being threatened by reduced flows caused by droughts and water abstractions, aquatic weed infestation, pesticides (especially DDT), infrastructure development, such as dams, overuse of resources due to human pressures, uncontrolled fires, pollution, and deforestation.

2.4.4 South African perspective

In South Africa, wetlands are extensively utilized for domestic and commercial purposes. Given the obvious benefits obtained from the use of wetland resources, most of the wetlands have been destroyed to such an extent that they can no longer be valuable for most needs of plant, animals and humans. Kotze and Breen (1994), asserts that approximately 50% of wetlands South Africa were lost predominantly through unwise development and poor land management.

In South Africa, farming activities such as cropping and livestock grazing have caused soil erosion hence increased sedimentation in wetlands by excessive surface run-off. Also, development activities such as settlement, construction of roads, bridges and dams have changed the hydrological and ecological systems of wetlands in many parts of the country. Moreover, household and industrial effluent and street runoff also deposit harmful chemicals into the wetland water (Kotze, 1996).

Mining is one of the leading disruptive activities on the wetlands in South Africa (Deborah and Frederick, 1998). This is because it permanently destroys the substrate of wetlands. Large public works and mining projects have changed the hydrology over much of the bottomland areas. For example, road construction at the mouth of Orange River by the diamond miners in Alexander bay disrupted the flow of water into the wetlands, increasing the salinity of soil and destroying the natural vegetation, which, in turn impacted on the migratory birds. Also, in the Gauteng province, mining operations destroyed about $100km^2$ of wetlands (Kotze, 1996).

Evidence from Kwazulu-Natal wetlands shows considerable effects, with most of the areas being reduced by 45% and the remainder by 20-40%. For example, in a detailed study of Mfolozi catchments in the Natal Province, it was found that 1485 wetlands previously occupying 50244 hectares had been reduced by 58%, which means a loss of 29000 hectares of wetlands had occurred over a decade (Netshavhakololo, 2007).

2.5 World efforts in Managing Wetlands

The most important international watchdog for proper management of wetlands especially in relation to plant and animal habitat is the Ramsar Convention. Ramsar, (which is named after the Iranian city of Ramsar where the treaty was signed in 1971) is an intergovernmental treaty at first aimed at the conservation of wetlands as a habitat for water birds that became officially operational in 1975. The convention on wetlands broadened its scope to cover all aspects of wetland conservation for biodiversity and well-being of human communities (Turner et al. 2000).

The Ramsar Convention focused on safeguarding the natural environment of wetlands especially for their significance in terms of ecology, botany, zoology, limnology, hydrology and socio-economic values. The convention also recognized local participation and the vital importance of people and their wetland heritage in achieving the wise use of wetlands and, that social and economic factors are the main reasons for wetland loss. The importance of people is reflected in the utilization of wetland resources for water, food and other materials such as sand and clay, as well as their many vital functions for safeguarding human health.

Also, there are a number of conventions on wetlands administered throughout the world. These conventions on wetlands are; the Convention on Biological Diversity (CBD), World Wildlife Funds (WWF), International Union for Conservation of Nature (IUCN) and the Framework Convention on Climate (Turner et al. 2000).

Wetland management practices such as wetland rehabilitation and restoration are crucial for the maintenance of health and sustainability of degraded wetlands. Several countries, for example, the United States, are currently investing huge sums of money in the restoration of wetlands, which they had reclaimed for other uses such as canalization. For example, a sum of 1.8 billion US dollars is being invested in the Rhine river basin project for a period of 35 years. The project aims at managing floods by bringing back the ecological functions of the Rhine delta (Schuyt, 2004).

The Rennies wetland project is a project of the Wildlife and Environmental Society of South Africa. It is the National wetland initiative working outside of natural areas. The main objective of the project is to identify the status of wetlands based on qualitative and quantitative impacts due to urbanization and various anthropogenic activities, and explore suitable restoration, conservation, and management strategies against pollution. The project uses wetland rehabilitation as a vehicle to promote wetland conservation on private land. It is through the rehabilitation that the projects for programme, fieldwork, capacity building, and lobbying are implemented. The Rennies wetland project has assessed the condition of over 23 000 hectares and by educating people about the wetland value of wetlands through a published field guide called wetland fix. The guide shows how the wetlands can be managed and rehabilitated simply and cost effectively (Wyatt, 1995).

A number of wetland regulations have been formulated that underpin the management of wetlands in the United States. The strategy specifically aims to reduce land-use activities such as agriculture, settlement, grazing, road building and mining activities which had detrimental effect on the sustainability of wetland ecosystems. The wetland regulations involve legislative, judicial and institutional actions. Some of the relevant policy acts in the management of wetlands in United States of America include; the National Environmental Policy Act (NEPA) of 1969.The main objective of the policy was to create and maintain conditions under which man and nature can co-exist in productive harmony while preserving the environment and resources for future generations of America. The Emergency Wetland Resource Act of 1986, this legislation, specifically dealt with the variety of benefits associated with wetlands. The North American Wetlands Conservation Act of 1989 helped to protect and restore wetland ecosystems and other habitats for migratory birds and other wildlife.

2.6 Wetland Management in Africa

Generally, management of wetlands especially in Africa is a subject of concern that needs immediate solutions to tackle the attendant problems associated with poor management of wetland ecosystems. As elsewhere, many parts of Africa, wetlands are perceived to have little or no value unless drained for agricultural activities, waste disposal areas, settlement, and livestock grazing which often constitute opportunity costs for wetland protection hence degradation of wetlands (Schuyt, 2005).

The major threats to the wetlands come from both direct and indirect human actions such as pollution, excessive extraction of water for gold mines, over-utilization of wetlands for agriculture and livestock grazing. Another example is the famous Botswana's magnificent

Okavango delta which was threatened by the possible canalisation of Boro River to supply water for both domestic and industrial uses. Threats to Okavango delta and other wetlands elsewhere led to a group of researchers striving to determine best ways to manage them. Several wetland management strategies such as participatory management have been applied to the most threatened or degraded wetlands in some African countries. For example, a participatory approach applied to the Djoudj National Park in Senegal together with the establishment of consultation structures (the Management Committee and Inter-Village Committee) brought about a closer relationship between the local populations in the park and the park managing authorities. Awareness about the nature of the problem regarding wetland destruction and possible solutions was promoted through extension campaigns involving traditional institutions. This approach proved successful because the communities identified the problem and therefore motivated them to act without relying on the government. Likewise, Uganda succeeded in developing a national wetlands policy, which was approved in 1995, and is implemented at national, district and community levels to maintain the ecological character of wetlands, and promotes the sustainable management of wetlands (Gawler, 1998).

Table 2.2: Wetlands under threat in Africa

Country	Area	Cause of threats on wetland
Botswana	Okavango Delta	Canalisation of Boro river to supply water for domestic and industrial use
East Africa	Lake Victoria basin	Pollution, excessive extraction of water for gold mine, over-utilization of wetland for agriculture and grazing
Uganda	Lake George wetland	Pollution from copper and cobalt mines, tree harvesting for charcoal burning
Senegal	Senegal river valley	Construction of dikes and dams for rice agriculture
Northern Nigeria	Wetlands of Fadana	Pastoral activities; overgrazing, siltation and soil erosion
Zambia	Zambezi basin wetlands	Pesticides (especially DDT), infrastructure development, such as dams, and overuse of resources due to human pressures.

2.7 Wetland Management in South Africa

A majority of the South African wetlands have degraded to such an extent that they are longer ecologically viable. This realization motivated the South Africans to formulate regulations on proper wetland management (Kotze et al. 1994). The South African government has been responsible for the formulation and implementation of legislations to promote sustainable utilization of wetlands and to ensure its management. In the 1990's, the government adopted the National Policy for Conservation and Management of Wetland Resources. This policy was implemented through various formulated laws and Acts. Some of the legislations and Acts passed to control the activities on the wetlands and to ensure sustainable utilization and management of wetlands in South Africa include the National Water Act (NWA) Act No. 36 of 1998 and the national environmental management act (NEMA) No.53 of 1998.

2.7.1 The South Africa's National Water Act (NWA) Act No. 36 of 1998

The National Water Act is the principal legal instrument relating to water resources management in South Africa. Its main objective is to manage and control South African water resources. It also deals with integrated water resource management, thus, a number of factors are taken into consideration. Most relevant to rehabilitation of wetlands are: meeting the basic human needs of present and future generations, reducing and preventing pollution and degradation of water resources, promoting the efficient, sustainable and beneficial use of water in the public interest.

The National Water Act also controls and protects the use of water resources. Relevant to wetland management are controls subject to various provisions concerning the right to: take or use water, to obstruct or direct a flow of water, and to affect the quality of any water (National Water Act, 1998).

2.7.2 The South Africa's National Environmental Management Act, 1998 (Act No.53 of 1998)

The National Environmental Management Act (NEMA) is an overarching statute intended to regulate various aspects of natural resource use. It also deals with integrated environmental management and pollution control. The Act, defines 'environment' as the surroundings within which humans exist, as made up of the land, water and atmosphere of the earth, micro-organisms, plant and animal life, any part or combination of/and the inter-relationships among and between them and the physical, chemical, aesthetic and cultural properties that influence human health and well-being [National Environmental Management Act, 1998, Definition, section 1 (xi)]

NEMA provides a number of basic environmental management principles some of which deal with the control of wetland ecosystems. These management principles apply to all organs of state, individuals and companies engaged in mining, developmental projects and any other activities that significantly affect the environment. For the protection of wetlands, the following principles of the act are relevant.

- The development must be socially, environmentally and economically sustainable. Sustainable development requires the consideration of all relevant factors that affect the environment including: the disturbance of ecosystem and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimized and remedied [National Environmental Management Act, No.107 of 1998 section 2 subsection (1-5)].
- Pollution and degradation of the environment are avoided, or, where they cannot altogether be avoided, are minimized and remedied.
- The development, use and exploitation of renewable resources and the ecosystem of which they are part do not exceed the level beyond which their integrity is jeopardized.
- Sensitive, vulnerable, highly dynamic or stressed ecosystems such as wetlands, coastal shores, estuaries and similar ecosystems require specific attention in

management and planning procedures, especially where they are subject to significant human resource usage.

- Negative impacts on the environment must be anticipated and prevented and where they cannot be prevented they must be minimized or remedied.
- The vital role of women and youth in environmental management and development must be recognised and their full participation therein must be promoted.

The implementation of these Acts, legislation and associated policies has been reviewed by Nemukula (2006) and Netshavhakololo (2007). The reviews reveal a partial success in the management of wetlands in South Africa.

2.8 Valuation and Assessment of Wetlands

One of the objectives of this research is to estimate quantitatively the value of wetlands and cost of wetland degradation. It is therefore necessary to identify and use a technique that can achieve this goal. This section of the chapter will therefore outline the various valuations methods for assessing wetland values.

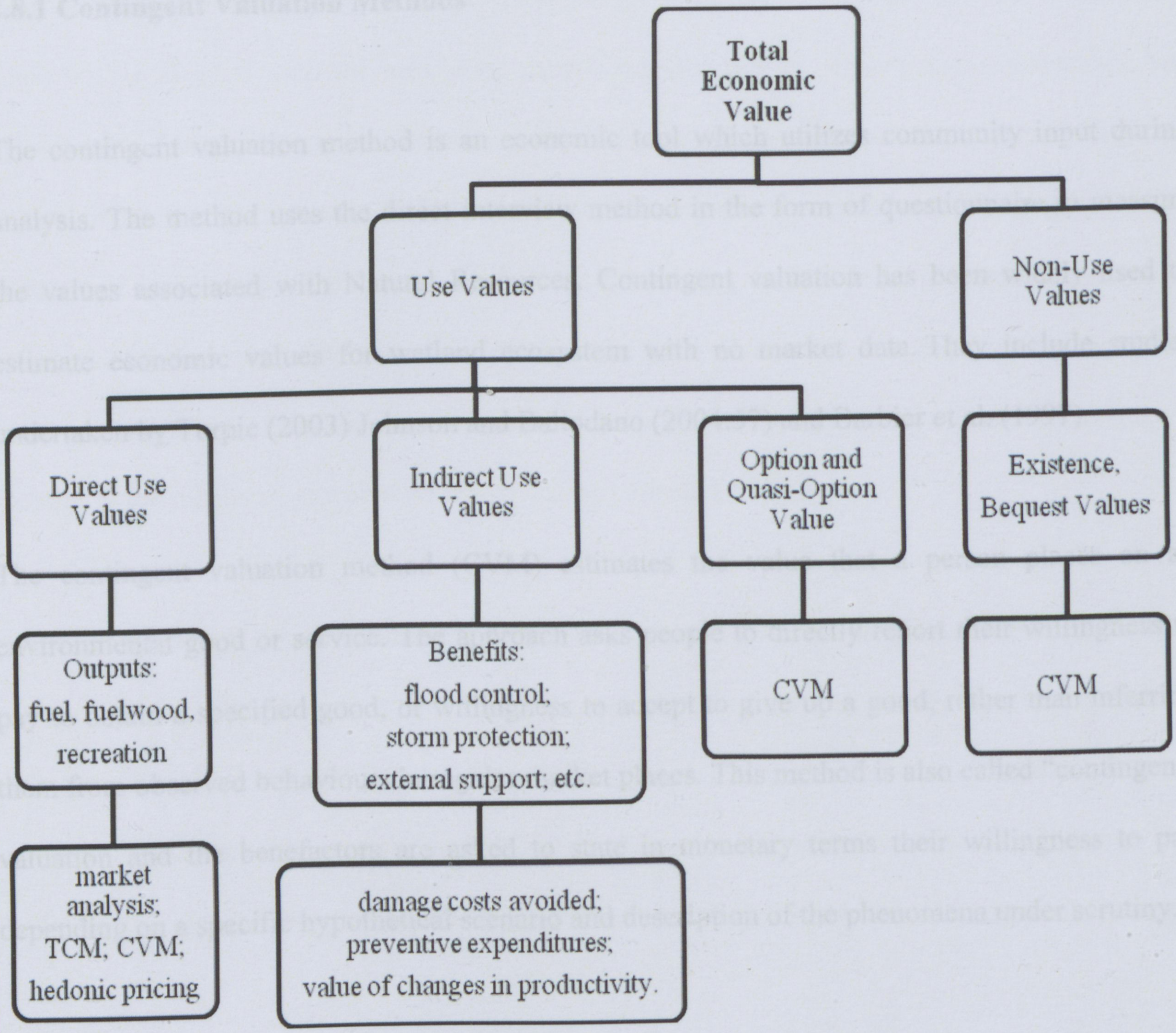
The lack of sufficient understanding of the economic value of wetland goods and services has often resulted in misallocation of resources as well as enormous economic costs. Therefore, economic valuation of wetlands is necessary as a tool to aid and improve the use of wetland resources, thus, providing a means for measuring and comparing the various benefits of wetlands (Barbier et al. 1997).

In general, economic valuation is concerned with assigning quantitative values to the goods and services provided by environmental resources such as wetlands, whether or not market prices are available to assist (Ramsar, 2003). One of the valuation tools is the determination of people's preferences regarding how much they are **willing to pay** for goods and services associated with an environmental resource and how much better or worse off they would consider themselves to be as a result of changes in their supply (Barbier et al. 1997). Such estimations are useful for justifying efforts or costs to be involved in the conservation of wetlands.

Economic value of any good or service, according to the economists, involves measuring individuals' or society's **WTP** for the commodity, less what it costs to supply it. Where an environmental resource, such as wetlands, simply exists and provides for the society or individuals' needs with products and services free of charge, then it is willingness to pay which may describe the value of wetland goods and services like fertile land, water purification and biodiversity. Therefore, the economic concept of willingness to pay is the basis for quantifying economic valuation of wetland goods or services and it can measure total economic value of wetlands by distinguishing and grouping user values from non-user values (Pearce and Turner, 1990). In this study, willingness to pay technique is used to estimate the cost of wetland degradation and conservation in quantitative terms.

Total Economic Value (TEV) of a wetland can be categorized into Use Value (UV) and Non-Use Value (NUV). Use value relates to direct use of wetland resource which involves harvesting of wetland resources like firewood, reeds/papyrus, harvesting of fish and use of wetlands for recreation. The wetland resources are usually sold in the local market, thus the local market prices serve adequately as a measure of quantitative value. Most of the wetland values can however not be directly quantified and priced due to the public nature in which market systems fail to allocate market prices. Hence, the need to use such indirect measures as willingness to pay as a technique widely used to determine individuals' or society preferences for a variety of wetland resources (Omara-Ojungu, 1992).

Indirect use value (IUV) constitutes those values that are not consumed directly by users, and they are not fully reflected in market prices such as water purification and storage, floodwater control and pollutant/sediment retention. This is obvious for wetland functions which provide a variety of off-site economic benefits. Moreover, option value arise when an individual is uncertain about the future demand for a resource and/or its availability in the wetland in the future, whereas quasi-option value is derived from delaying the development activity because of the belief that it may be high or that current exploitation and conversion may be irreversible. It is however important to use such indirect methods like; surrogate market method to value unquantifiable wetland services. The techniques used to measure the total economic value of wetlands are shown in Figure 2.1.



Source: adapted from Barbier (1989)

Figure 2.1 Techniques and Classification of Total Economic Value of Wetlands (TEV)

There are various methods or techniques of measuring the value of wetlands (Turner et al. 2000).The most recognized techniques and indeed used in this study are **willingness to pay method** or **contingent valuation** and **hedonic pricing techniques**. The willingness to pay method is used in this study in order to measure individuals' willingness to pay for the perceived value of wetland goods or services in form of contribution towards the conservation of wetland.

2.8.1 Contingent Valuation Methods

The contingent valuation method is an economic tool which utilizes community input during analysis. The method uses the direct interview method in the form of questionnaire to measure the values associated with Natural Resources. Contingent valuation has been widely used to estimate economic values for wetland ecosystem with no market data. They include studies undertaken by Turpie (2003) Johnson and Baltodano (2004:57) and Barbier et al. (1997).

The contingent valuation method (CVM) estimates the value that a person places on an environmental good or service. The approach asks people to directly report their willingness to pay to obtain a specified good, or willingness to accept to give up a good, rather than inferring them from observed behaviours in regular market places. This method is also called "contingent" valuation and the benefactors are asked to state in monetary terms their willingness to pay depending on a specific hypothetical scenario and description of the phenomena under scrutiny.

Also, contingent valuation method is based on survey that employs a dichotomous choice (DC) questionnaire. The dichotomous choice approach was first employed by Bishop and Heberlein (1979:926) in their study of measuring the economic value of goose hunting. Respondents in the dichotomous choice approach are asked to accept or reject a suggested monetary price under a hypothetical market situation. They only need to answer "yes" or "no" when presented with a price. It is easier for respondents to answer dichotomous choice questions than open-ended question.

Although CVM is a recommended method for measuring the unquantifiable values of environmental goods and services, it has major sources of bias. Among them is strategic bias; this occurs where respondents behave strategically to the hypothetical experiment and do not reveal their true preferences. Information bias occurs where respondents are given too little background information about the choice and misleading statement by the interviewer. Also, hypothetical bias can arise as a result of potential error induced by confronting the respondent with an imaginary situation. Instrumental bias, on the other hand, arises if the respondent is hostile to the means of payment which would be collected.

However, there are recommendations from Arrow et al. (1993) on contingent valuation cited in Turpie, (2003:199). Among them were that interviews must be face-to-face, the valuation, question should be in a WTP rather than WTA format, and should be a referendum-type (yes / no) question, rather than open-ended. WTP format gives a more truthful (lower) response than WTA format. In this research the WTP (and to accept) format is used in order to avoid potential bias.

2.8.2 Hedonic Pricing Method

Hedonic pricing is another method used to estimate the value of environmental amenities. The basic premise of the hedonic pricing method is that the price of a marketed good is related to its characteristics, or the services it provides. Hedonic pricing method has the potential for valuing wetland functions, such as storm protection and groundwater recharge, in terms of their impact on land values (Barbier et al. 1997).

The environmental functions of wetlands requires the values to be reflected in surrogate market prices which is the use of an actual market price of a related good or service to value the wetland use that is non-marketed. In the case of harvested or directly used wetland resources that are not marketed (like, fuelwood), the value of their use can be estimated by the market price of similar goods (example, fuelwood purchased from other areas) or of the next best alternative or substitute good (for instance, charcoal or kerosene). In essence, the value of wetland goods or services reflects the price people are willing to pay for its characteristics. In addition, where other factors are constant, a positive relationship exists between the prices that people are willing to pay for housing or a stand nearby a wetland (Barbier et al. 1997).

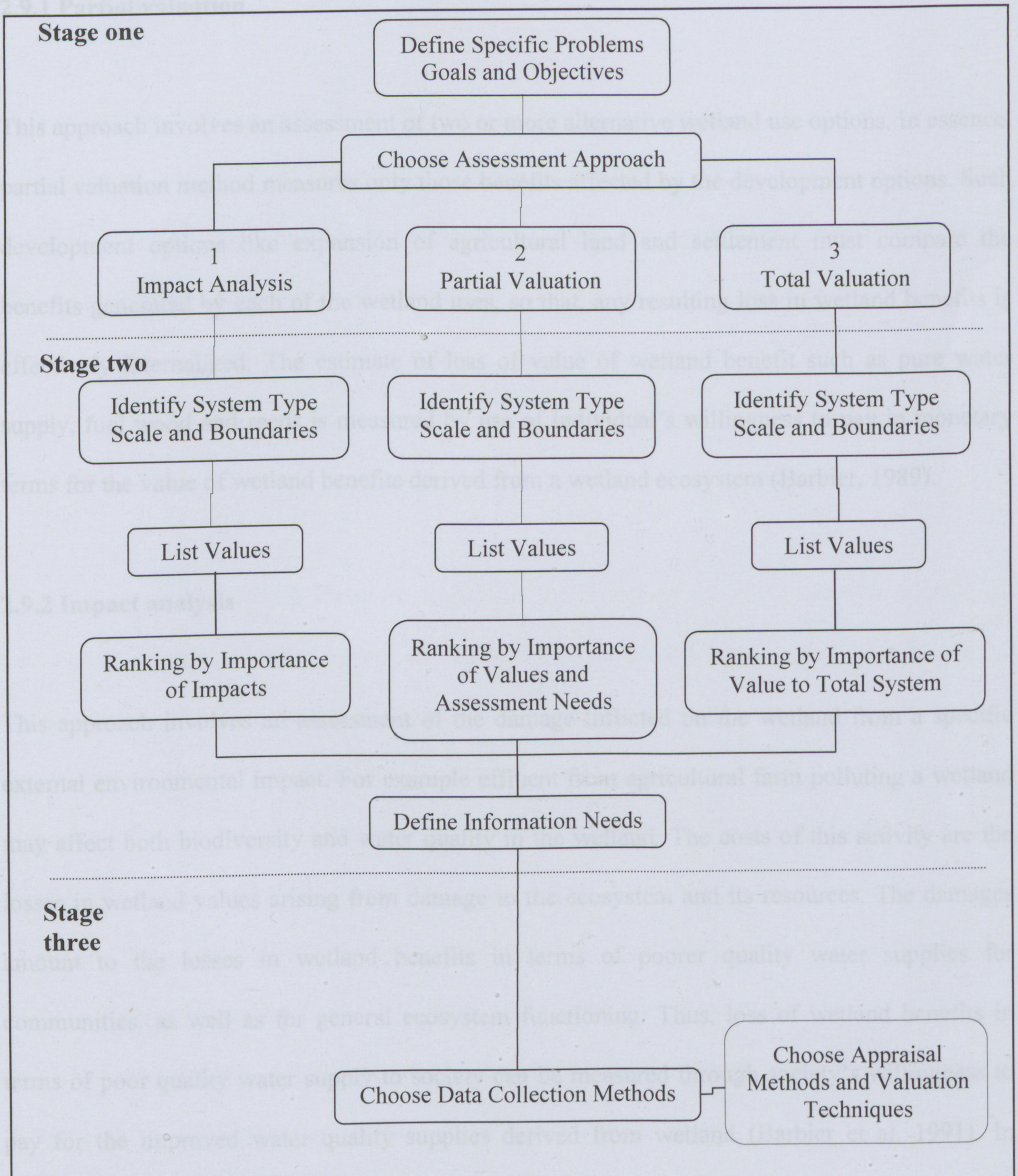
The advantage of hedonic pricing method is its versatility and can be adapted to consider several possible interactions between market goods and environmental quality. The method is used to estimate values based on actual choices and provides good indications of value to environmental amenities (Barbier et al. 1997). However, there are limitations in the application of the hedonic pricing method. Among them is that the method does not give explicit linkages between the environmental attribute and benefits to the users or their property.

2.9 Assessment for Economic Valuation of Wetland

The assessment framework for economic valuation is important for any study of wetland resource valuation (Ramsar Convention, 1997). Such a framework was initially developed by Barbier (1994) for economic valuation of tropical wetlands. Further example of such economic valuation studies of tropical wetlands are provided by Barbier (1989 and 1994:155). Other studies that attempted to use economic valuation method to examine and identify the economic value of wetlands were undertaken by Dixon and Hufschmidt, (1986); Mitchell and Carson, (1989); Braden and Kolstad, (1991); Freeman, 1993; Bateman and Willis, (1999:645); Pearce and Moran, (1994); and Turner, (1993).

Barbier, Costanza and Twilley (1991), as cited in Barbier et al. (1997:127), introduced a summary of the overall assessment framework for economic valuation of wetland. The framework involves three stages of analysis in the valuation process that is; impact analysis, partial valuation and total valuation. The aim of these stages is ultimately an economic assessment of wetland values. Moreover, all wetland values reflect the true 'willingness to pay' by society for wetland benefits. It is therefore possible to assess the economic value of wetland for the study area because the framework is flexible and the results may be useful in decision-making process.

The most relevant approaches to the economic analysis of wetlands include; impact analysis, partial valuation and total valuation. Figure 2.2 presents the assessment framework including approaches for economic valuation of wetlands. However, this subsection describes only the approaches which can be adopted for any study of economic valuation of wetlands.



Source: adapted from IIED (1994)

Figure 2.2: The Assessment Framework for Economic Valuation of Wetlands

2.9.1 Partial valuation

This approach involves an assessment of two or more alternative wetland use options. In essence, partial valuation method measures only those benefits affected by the development options. Such development options like expansion of agricultural land and settlement must compare the benefits generated by each of the wetland uses, so that, any resulting loss in wetland benefits is effectively internalized. The estimate of loss of value of wetland benefit such as pure water supply, fuel wood and reeds is measured by use of individual's willingness to pay in monetary terms for the value of wetland benefits derived from a wetland ecosystem (Barbier, 1989).

2.9.2 Impact analysis

This approach involves an assessment of the damage inflicted on the wetland from a specific external environmental impact. For example effluent from agricultural farm polluting a wetland may affect both biodiversity and water quality in the wetland. The costs of this activity are the losses in wetland values arising from damage to the ecosystem and its resources. The damages amount to the losses in wetland benefits in terms of poorer quality water supplies for communities, as well as for general ecosystem functioning. Thus, loss of wetland benefits in terms of poor quality water supply to society can be measured through society's willingness to pay for the improved water quality supplies derived from wetland (Barbier et al. 1991). In addition, the use of observed water use behaviour like perceptions of water quality can be also used to assess the response of households to different characteristics of an improved wetland ecosystem (Barbier, 1994).

2.9.3 Total valuation

This method involves an assessment of the total economic contribution to society of the wetland ecosystem. In principle, to arrive at an aggregate measure of value (total economic value) economists begin by distinguishing user values from non-user values (Pearce and Turner, 1990). For example; developing a conservation strategy or to determine its worth as a protected area. This requires assessment of total net benefits of the wetland ecosystem.

2.10 Summary

This chapter has reviewed literature regarding the overview of environmental economics, perspective on wetland management and evidence of wetland degradation at Global, African continent, South Africa and local levels. Human activities are the major causes of wetland degradation. These activities include agriculture, fishing, livestock grazing; peat mining and plantation of exotic trees. The negative impact of these include destruction of wetland ecosystem functioning and the embedded values. This study sets out to investigate the socio-economic costs of wetland degradation at the community level. Environmental economic tools are applied in this study in order to identify and solve environmental damage such as pollution of water quality and degradation of wetland biodiversity. In particular the environmental economic technique of WTA is used to estimate the quantitative cost of wetland degradation.

CHAPTER 3: DESCRIPTION OF THE STUDY AREA

3.1 Introduction

This section presents the ecological setting of the study area in terms of location, geology and geomorphology, climate, hydrology, economic activities/land uses, as well as settlement and population.

3.2 Location

The study area is situated north-east of Thohoyandou (the former black homeland of Venda), the capital city of Vhembe District in the northern part of Limpopo Province. It is located at latitude 22° 49' 0" S and longitude 30° 32' 0" E. Neighbouring villages include; Muhuyu to the West, Muthambi, Khubvi and Makonde to the East and Damani and Tshirongana to the South (PlanetGIS, 2008).Vhembe District is composed of four local municipalities, namely; Mutale, Thulamela, Makhado and Musina. It covers 21,407 km^2 and is predominantly rural. This study will assess the Mudaswali wetland in Matangari village of the Thulamela local municipality. Figure 3.1 shows map of the study area within Limpopo Province and the Republic of South Africa.

Coordinates & Location Type

Location Type: Intermittent Stream
Latitude: -22.81667
Longitude: 30.53333
Latitude (DMS): 22° 49’ 0” S
Longitude (DMS): 30° 32’ 0” E

Forest	
Cultivated land	
Farming	
Intermittent streams and swamps	
Villages	
Vegetation	
Non-perennial water	

3.3 Geology and Geomorphology

The study area is underlain by granite gneisses and basalt rocks (Kabanda, 2004). The older basalts are highly weathered compared to the new basalts of the Sibasa region. Deep and variable weathering is often associated with the basaltic rocks underlain by igneous rocks to the west of the Greater Nzhelele region. The Sibasa basalt formation and the granite gneisses to the north are characterised by sharp changes in topography from slightly undulating to a more dissected terrain. The undulating terrain contributes to the development of wetlands at the foot slopes of the hills and mountains. Generally, formation of these landforms has been as a result of processes such as erosion and peneplanation. Geomorphological processes, such as volcanic eruption, also played a role in the development of rugged terrains dominated by igneous rock types. Because of geology and topographic arrangements, there is high potential for erosion and sedimentation of wetlands in the valleys below the hilly topography (Netshavhakololo, 2007).

3.4 Climate

3.4.1 Rainfall

Generally, the area experiences a hot, sub-humid warm climate. The rainfall received in the study area is highly seasonal (Figure 3.2), and most of it falls between October and March, with a total of 313.6mm. The high rainy month is mainly confined to the summer months (October and March) in the form of thunderstorms (Kabanda, 2004) and is much influenced by topography. Little rainfall is experienced during winter months from April to October. This may influence the occurrence and nature of the wetland in the area by making it possible to inundate the wetland for a considerable amount of time.

Figure 3.1: Rainfall distribution for the study area (1997-2004)

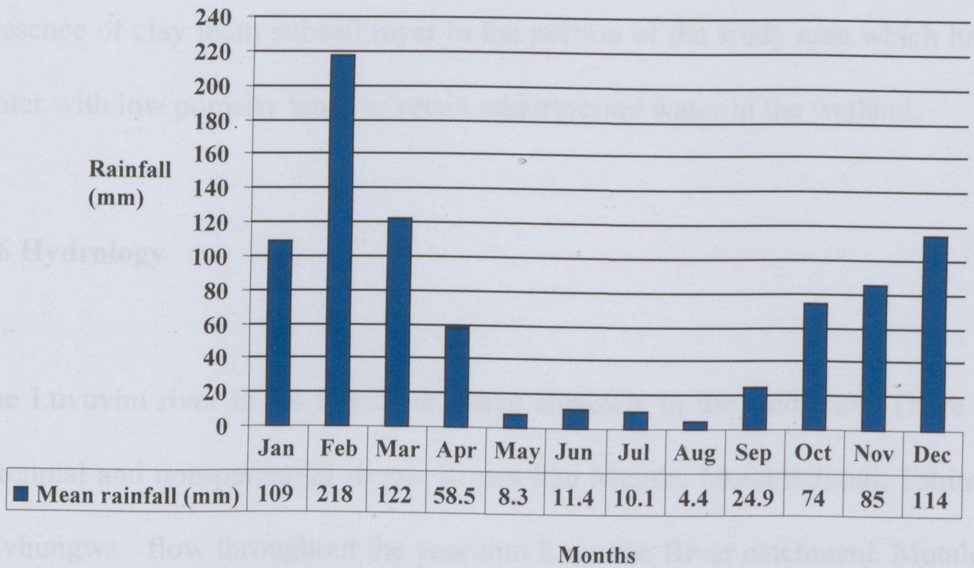


Figure 3.2: Mean monthly rainfall from January to December (1997 – 2004) for Thohoyandou (Source: Thulamela Municipality)

3.4.2 Temperature

In the study area, temperatures vary seasonally. During wet (summer and mild winters) season between October and March, temperatures are relatively warm while the dry (winter) season between April and September, usually brings chilly and cold conditions. Average summer temperatures vary from 25 degrees Celsius to 31 degrees Celsius and winter temperatures vary from 8 degrees Celsius to 15 degrees Celsius. Planting at these months (November to March) can result in high mortality of seedlings (Nemukula, 2006)

3.5 Soil

The area is composed of fertile, clay loamy soil which is grey in colour with high potential for agriculture (Aamadale et al; 2005 and Modau, 2006). The soils have high clay content. The presence of clay loam subsoil layer in the portion of the study area which has high resistance to water with low porosity tends to retain underground water in the wetland.

3.6 Hydrology

The Luvuvhu river is the largest drainage channels in the study area.There are several smaller perennial and non-perennial rivers. Rivers like Mutale, Mutshindundi, Tshirovha, Tshinane and Luvhungwa flow throughout the year into Luvuvhu River catchment. Mutale river which flows from north to north-east, plays an important role in the streamflow regime of the Mudaswali River Swamp within the study area. The hydrology of the study area is largely influenced by the topographical and geological features such as foothills of the Soutspansberg Mountain.

3.7 Vegetation

The vegetation of the study area is mainly comprised of shrubs, grasses and sedge species which include *Cyperus latifolius* commonly used for the production of woven sleeping/sitting mats. There is also a large dominance of river reeds (*P.australis)*. Exotic species such as *Lantana camara* (Lantana) also dominate parts of the area. According to Sinthumule (2001) other common alien plants found in wetlands include, *Acacia saligna* (Port Jackson willow), *Acacia* *cyclops* (Rooikrans), *Azolla filiculoids* (Water fern), *Eichhomia crassipes* (Water hyacinth), *Sesbania punicea* (Sesbania-red), and *Nicotiana glauca* (Wild tobacco).

3.8 Economic Activities/Land use

In the study area of Matangari village, industrialisation is insignificant; the economy is mainly based on subsistence farming where pastoralism, and hunting supplement seasonal crop production (Modau, 2005). The economic activity of the people within the Mudaswali wetland include the harvesting of river reeds which are used for thatching/roofing houses as well as market gardening of vegetables such as spinach, cabbage and onions; maize, potatoes and production of fruits such as avocadoes, mangoes and banana for domestic use and/or for sale to the local market. In addition, water from the wetland is used for washing clothes and cars, bathing and livestock watering. These intensified human uses within wetlands have resulted into problems like sedimentation, erosion, declining water quality (evidenced by presence of algae) and declining species diversity.

3.9 Population and settlement

The total population of the Matangari village is roughly 11 310. The study area is composed of a cluster of five neighbouring villages. The west side of the area is bordered by Muhuyu village, Tshandama and Bashasha villages to the North, Muthambi village to the East and Khubvi village to the South. In the study area, settlements of high density population are situated about 100m from the vicinity of the wetland. Moreover, these villages fall within the Thulamela Local Municipality (Falling Rain Genomics, 2004).

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction

This chapter describes the methods utilised in data collection in order to determine the socio-economic costs of the degradation of Mudaswali wetland. The types of data used in this study were mainly primary data which include data on wetland ecological features, community perception of wetland degradation and data on socio-economic value of wetland while secondary data include published material on wetlands in order to accomplish the objectives of this study. Primary data collection entailed using a structured questionnaire at the household level.

4.2 The Data

4.2.1 Physical and human setting in the wetland environment

The data in this section facilitates the understanding of the nature of the wetland ecology and resource potential as well as the way of life adopted by the people within the study area. Data on ecological features of the wetland environment comprise a complexity of environmental elements such as hydrology, soil and vegetation. This data was collected using site observation in the area to identify the soil types, the vegetation cover, land use activities and to check the water level (high or low) in the wetland during rainy season and no rainfall season.

4.2.2 Local perception of wetland degradation

The data in this regard facilitate the estimation of the degree of wetland degradation in the study area. Local perception data represent awareness and concern of the people about the changes in wetland value over time. It is therefore, necessary to integrate local views regarding wetland changes in order to find out the significance of the problem of wetland degradation to the local communities. The data was collected using structured questionnaires (see appendix A) administered to the household respondents residing close to the wetland. Each household was required to answer a couple of questions in the structured questionnaire and mostly in vernacular language. It is important to use the household respondents residing close to the wetland because they have enough knowledge on wetland destruction since they use the wetland on a daily basis.

4.2.3 Socio-economic value of wetland

These data are required to find out the social and economic value of the wetland as perceived by the local communities close to the Mudaswali wetland. The data was obtained by the use of structured questionnaires. Part of the structured questionnaires contains a question on the wetland usage (section B of Appendix A). The respondents were required to rank the different values of wetlands to the household. The reason of obtaining this data was to find out a range of direct use and indirect use values of the Mudaswali wetland.

4.3. Data Collection Methods

4.3.1 Sampling method

This study used a judgemental assessment method for the household respondents close to the wetland. A total of 65 households were selected for the study. The respondents were from all the households who reside within a radius of 100m from the edge of the Mudaswali wetlands. The reason for choosing the households close to the wetland was to make sure that information about wetland degradation and associated socio-economic costs come from individuals or families who have practical experience with the wetland's ecosystem and resources. This sampling method also allows the researcher to explicitly define the population being studied based on judgment (Modau, 2006).

4.3.2 Reconnaissance survey

A reconnaissance survey was undertaken around Matangari village a month before the actual field work. This included determination of the accessibility of the area and getting an insight into the degradation of the wetlands in the area. Preliminary investigation was conducted by use of site observation in order to precisely obtain enough information about the accessibility of the study area. Verbal interview was also conducted during the site observation and some of the local communities within the wetland were asked how they feel about wetland degradation. Moreover, notifications were made to the local authorities about the oncoming visit to the study area. This involved the letter of intent detailing the starting date and end of the research exercise in the study area.

4.3.3 Questionnaire survey

This research was undertaken at Mudaswali wetland and a total of 65 respondents were interviewed using a structured questionnaire with open-ended and close-ended questions developed on the basis of the issues identified during the reconnaissance survey (Appendix A). The questionnaire is categorised into four sections. Section "A" deals with the key variables measured in the socio-demographic survey included gender, age, level of education, household income per month and household size. Section "B" contains questions on the usage and the value of wetland, the changes and problems faced in the wetland and the reasons for such changes in wetland values. A structured questionnaire administered to the respondents with an open-ended question asked for "the reasons for such changes in wetland values". Another question was on rating the significance of changes in wetland value, a questionnaire with a close-ended was administered asking the respondents "to rate the significance of the changes in wetland value". Section "C" contains a willingness to pay question used to estimate the value of wetland in the local communities. A structured questionnaire with a close-ended question administered to the respondents asked "would you be interested in wetland conservation" and how "much you would be willing to pay per month for wetland conservation" (see Appendix A) and the last section contain a willingness to accept question.

The household survey was carried out during the rainy months of December 2006 and February 2007. This is the period most households are busy in the fields tending to their crops. Hence, the time was chosen as a convenient time to carry out the questionnaire exercise because of the greater availability of respondents. Each member of the household had to complete a set of questions on a structured questionnaire with open-ended and close-ended questions and was conducted using local vernacular language for easy communication.

A structured questionnaire with a close-ended question asking could "you estimate the percentage of degradation and loss of wetlands in the region" was also directed to a focus group with expertise on wetlands from the Department of Environmental Affairs and Tourism in Thohoyandou Parliament Offices. The questionnaire sought to get information based on the knowledge and reasons for wetland degradation in general; rating the significance of changes experienced in the wetland and to estimate the percentage of each of the wetland values, and the percentage of wetland degradation in the area (see Appendix B). Although, questionnaire method is quick and a cheap research method, there are limitations such as; not everyone may understand the questions, some may not answer honestly, no presenting chance to ask the respondent to clarify unclear answers and make follow up on interesting answers. These pitfalls were minimized by using simple and clear questions (Appendix B) administered in the local vernacular language.

4.3.4 Contingent valuation method

As discussed in chapter 2, there are two plausible methods of evaluating wetland benefits and costs. This study used contingent valuation method to determine the value of wetland through direct measurements of local people's willingness to pay value for various wetland goods and services. The method is employed because of its advantages over other techniques as described in chapter 2. The main advantage of CVM is the ability to measure unquantifiable values of environmental resources such as wetlands. Another advantage is that the interview data can be subjected to statistical analysis. In the CVM survey, respondents were asked about their willingness to pay for conservation of wetlands using the following question "would you be interested in conservation of wetlands". Respondents were asked to answer "yes" or "no" to the question. When the respondents answered "yes" then they were asked if they would be willing to pay the amount of money per month; beginning with R5 per day (equivalent to R150 per month) and ending with R1 per day (equivalent to R30 per month) in increment of R2 per day (equivalent to R60 per month), the highest response is then recorded. The researcher had to explain to respondents the goal of the survey which was to determine how important the conservation of wetlands was to the local community (see Appendix A: section C).

4.3.5 Estimation of wetland degradation

This section describes the procedure used to estimate the loss of wetland values and the socio-economic cost of wetland degradation as realized by the local community in the study area. The respondents were asked to rate the significance of change in wetland values (Table 5.17) in accordance with the scale 0-20% (not significant), 21-50% (significant), 51-80% (very significant) and ≥ 81% (extremely significant). The change in wetland value is not significant (0-20%) when the respondents show tolerance to put up with the change in wetland values. The change in wetland values is significant (21-50%) when respondents acknowledge the shortage of several wetland values. The change in wetland values is very significant (51-80%) when respondents acknowledge there is a substantial loss in wetland benefits to the household. Lastly, when respondents acknowledge the change in wetland values is extremely significant (≥ 81%) this means that there is an irreversible change or extinction to the wetland value. In addition, WTA question was utilized as a proxy for estimating the cost of wetland degradation in the area.

A structured questionnaire with a close-ended question administered to the respondents asked the respondents'"to state the maximum willingness to accept amount of compensation for degradation and loss to the wetland values in the area" (see Appendix A).

4.4 Technique of data analysis

4.4.1 Descriptive analysis

This section introduces the technique used in the analysis of data for this study. This study utilized a descriptive analysis method to provide descriptive information required to make general statements about the degradation of Mudaswali wetland and also to test the hypotheses of the study. Descriptive analysis is used to summarize or describe the phenomena under scrutiny. It uses simple techniques such as graphical description involving the use of graphs and pie charts; and tabular description where tables are used to summarize or describe data for different categories.

4.5 Problems encountered

The main problem encountered was communication barrier during the questionnaire exercise. Most of the people in Matangari village of the study area cannot read, and write, and as a result, the questions in a structured questionnaire were asked exactly as written to all the respondents that is; males, females, old and youth. However, those questions which respondents found difficult to answer were translated into the relevant local language that is; Tshivenda. The use of local language placed the respondents at ease to respond to the questions and ensured that an interviewer converses at the level of the interviewee (Spaul, 1988).

5.1 Socio-Demographic Profile of the Households

5.1.1 Gender and Age

Table 5.1: Gender proportion of households in the study area

Gender	Number of respondents	Percentage (%)
Female	40	61.5
Male	25	38.5
Total	65	100

Gender and age of the respondents were considered in order to see whether these variables are linked to the management of wetland in the study area. Females are the most dominant gender that participated in the study, and constitute 62% of the total respondents (Table 5.1). The males constitute 38% of the total respondents. The lower figure for male than female is because most men are employed elsewhere. This observation is in agreement with Omara-Ojungu (1999) who indicated that, in Limpopo province, able-bodied persons look for employment outside the Province or to the cities. This practice leaves mostly women responsible for the day-to-day activities in the rural areas.

In the rural areas, it is mostly women who bear the responsibilities for collecting water, collecting fuel wood, making charcoal, tending the land and using wetland products for household use. In this context women are more important in managing the environment than men. This study also, found that more women (62%) than men are knowledgeable on the

CHAPTER 5: RESULTS AND DISCUSSION

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In the rural areas, it is mostly women who bear the responsibilities for collecting water, collecting fuel wood, making charcoal, tending the land and using wetland products for household use. In this context women are more important in managing the environment than men. This study also, found that more women (62%) than men are knowledgeable on the importance of the wetlands, and hence, their management. This is because women are more involved than men in the utilization of wetland resources for subsistence purposes such as agriculture, harvesting of river reeds, and collection of clay used for decorating houses.

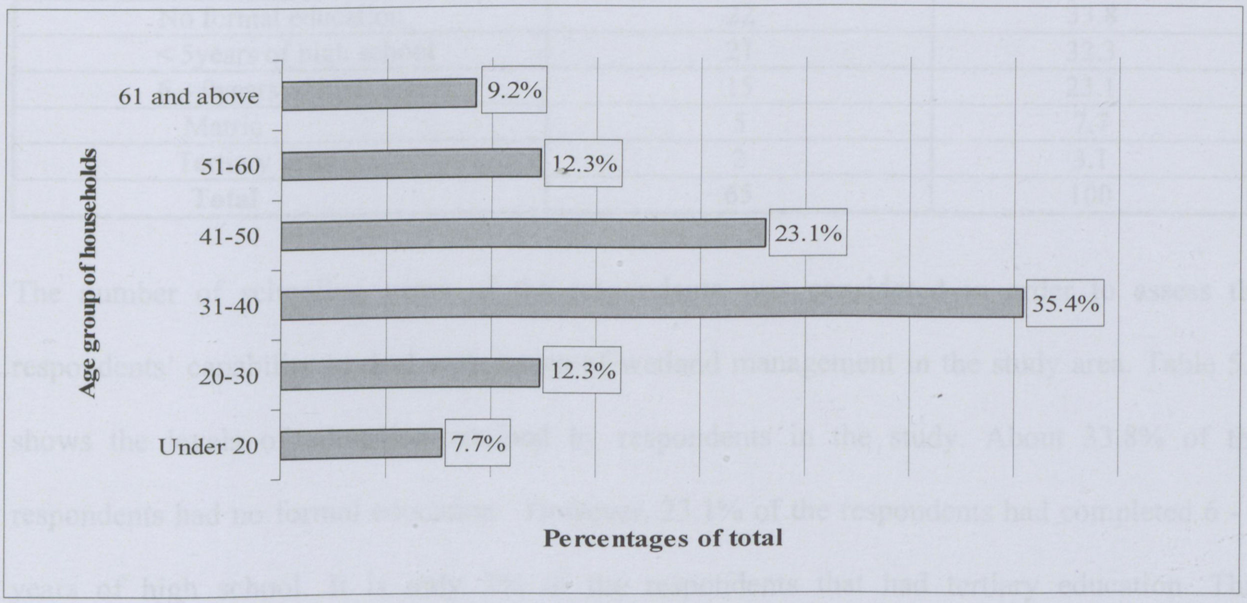

Figure 5.1: Age groups (years) of the respondents in the study area

The gender groups indicated in Table 5.1 were partitioned in different age groups as shown in Figure 5.1, combining both male and female respondents. Different age groups range from < 20 to ≥ 61 years of age. From Figure 5.1 more than half (59%) of the respondents fall within 31-50 years age category, and are the most dominant age group that participated in the study, while 12.3% were in the 20-30 years age group. The study also indicate that young people less than 20 years comprise 7.7% of the respondents; with older people between age group 51-60 years and ≥ 61 years and more to be 12.3% and 9.3%, respectively. From this result; management of wetland in the study area appear to be linked to a particular age group; for example, people below 60 years can be considered agriculturally active.

5.1.2 Level of Education

Table 5.2: Education levels of the respondents in the study area

Level of education	Number of respondents	Percentage (%)
No formal education	22	33.8
< 5years of high school	21	32.3
6 – 9years of high school	15	23.1
Matric	5	7.7
Tertiary level	2	3.1
Total	65	100

The number of schooling years of the respondents was considered in order to assess the respondents' capability to deal with issues of wetland management in the study area. Table 5.2 shows the levels of education attained by respondents in the study. About 33.8% of the respondents had no formal education. However, 23.1% of the respondents had completed 6 - 9 years of high school. It is only 3% of the respondents that had tertiary education. This observation shows that the majority of the respondents did not attempt a formal education. As a result, the basic education can be a useful indicator for assessing the people's understanding of issues of wetland management. The challenge is on how to communicate the wetland management strategy to the 33.8% of the people who never attended school. According to the observations by DWAF (1998) and Modau (2006) most people without formal education tend to depend directly on the environment. Based on the findings it can be said that households without formal education tend to rely much on the state of natural environmental resources such as wetlands.

5.1.3 Household Income

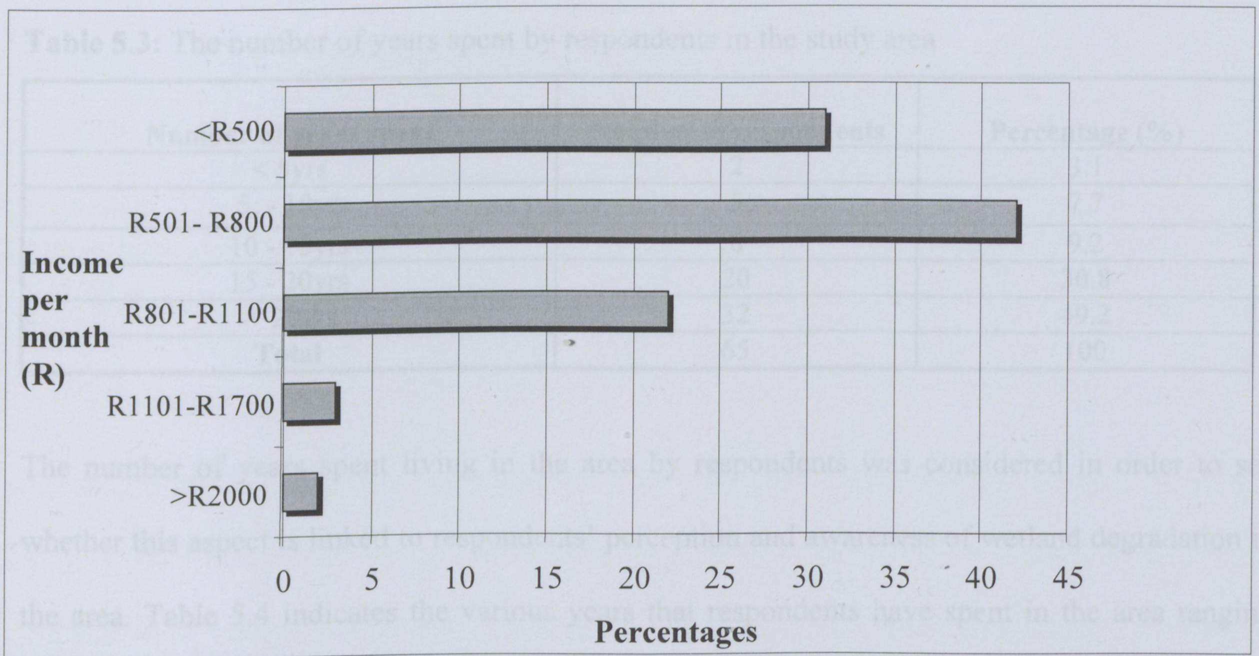

Figure 5.2: Household income distribution per month in the study area

Household income per month was considered in order to find out whether it compares well with willingness to pay some amount for wetland conservation in the study area. Figure 5.2 displays the income groups of respondents in the study area, ranging from < R500 to ≥ R2000 per month. The data indicates that 42% of the respondents are in the income group of R501 - R800 per month. People earning an income of less than R500 per month constitute 31% of the respondents. The study further indicates that only 2% of the respondents are earning a salary of ≥ R2000 per month; this means that most of the respondents are in the lower income group. From this observation, it is clear that the average income in this area is relatively low, and hence, individuals' WTP value for wetland conservation/rehabilitation will be small.

5.1.4 The number of years spent in the study area

Table 5.3: The number of years spent by respondents in the study area

Number of years spent	Number of respondents	Percentage (%)
< 5yrs	2	3.1
5 - 10yrs	5	7.7
10 - 15yrs	6	9.2
15 - 20yrs	20	30.8
> 20yrs	32	49.2
Total	65	100

The number of years spent living in the area by respondents was considered in order to see whether this aspect is linked to respondents' perception and awareness of wetland degradation in the area. Table 5.4 indicates the various years that respondents have spent in the area ranging from < 5years to > 20 years. It is clear from Table 5.4 that a large percentage (80%) of the respondents had been living in the region for over 15years; this means that the respondents had been living in the area long enough to have experienced changes in wetland conditions. The study further indicates that 9.2% of the respondents had been living in the area for 10 to 20 years. While, 7.7% of the respondents indicated that they had spent at least 5 to 10 years in the study area. It is only 3.1% of the total respondents who had been living in the area for less than 5years. This observation shows that most of the respondents had been living in the area for a considerable length of time, and hence, they are more likely to recognize change in wetland values than would those that had spent less than 5 years in the area.

5.1.5 Use of wetland resources by respondents

Table 5.4: Use of wetlands by respondents

Wetland values	Number of respondents	Percentage (%)
Subsistence farming	31	47.7
Harvesting of reeds	19	29.2
Market gardening	8	12.3
Fishing in wetland	2	3.1
Livestock grazing	5	7.7
Total	65	100.0

The occupation of respondents in relation to use of wetland's resources was considered in this study in order to see whether the respondents' engagements on wetland resources are linked to degradation of wetland in the area. A total of 65 respondents were interviewed during the period of December 2006 to February 2007. It is indicated from Table 5.4 that 60% (47.7% + 12.3%) of all the respondents are farmers while 29.2% said they harvest river reeds used for thatching houses as their occupation.

The study further shows that 7.7% of the respondents engage in livestock keeping. From Table 5.4 it is only 2 (3.1%) respondents who do fishing in the river as their main occupation in the area. Although a total of 40% (29.2+7.7+3.1) derive resources directly from the wetlands, a large number is engaged in farming by 60% (47.7+12.3). From the observations by the researcher, it was noted that the wetland resources provide a source of employment as well as source of water for livestock, cropping and for household consumption to the local community in the study area.

5.2 The Wetland Ecology and Resource Potential

5.2.1 Gender and perception of wetland potential

Table 5.5: Relationship between wetland resource use and gender of respondents

Wetland values	Number of respondents	Percentages	Gender of respondents	
			Females	Males
Subsistence farming	31	47.7	21	10
Harvesting of reeds	19	29.2	14	5
Market gardening	8	12.3	5	3
Fishing in wetland	2	3.1	0	2
Livestock grazing	5	7.7	1	4
Total	65	100	41	24

Gender, age, monthly income and level of education are closely related to the perception on wetland potential in the area. Table 5.5 shows the relationship between use of wetland resource and gender of the respondents. The Table indicate 31(47.7%) out of 65 respondents used the wetland for subsistence farming and of these 21 were females and 10 were males. Of the 19 (29.2%) respondents who used the wetland for harvesting of reeds 14 females and 5 males. The data also indicate 5 females used the wetland for market gardening while 4 males used the wetland for grazing of livestock. It is only 2 males who used the wetland for fishing. From this observation; it is clear that most of the females acknowledged that they use the wetland for subsistence farming, harvesting of reeds and market gardening because women particularly in rural areas usually bear the responsibility for providing basic needs (like; food and shelter) to their families, and that they would depend on wetland resources for such provisions. However, most men are employed elsewhere in the cities.

5.2.2 Age group and perception of wetland potential

Table 5.6: Relationship between wetland resource use and age groups of respondents

Wetland values	Number of respondents	Percentages	Age of respondents				
			<20	20-30	31-40	41-60	>60
Subsistence farming	31	47.7	0	5	8	16	2
Harvesting of reeds	19	29.2	0	3	5	10	1
Market gardening	8	12.3	0	1	5	2	0
Fishing in wetland	2	3.1	0	2	0	0	0
Livestock grazing	5	7.7	4	1	0	0	0
Total	65	100	4	12	18	28	3

Table 5.6 shows the perception of wetland potential by age groups of respondents, ranging from age 20 years to 60 years old. Of the 65 respondents interviewed 31 (47.7%) used the wetland for subsistence farming and of these 16 were in the 41-60 years age category, 8 were in the 31-40 years age category, 5 were in the 20-30 years age category and 2 were above 60 years. The research also revealed 29.2% of the respondents used the wetland for harvesting of reeds and the majority fell within 41-60 years age category. Those that used the wetland for market gardening constitute 12.3% of the respondents. Livestock grazing was mostly done by young people in the 20-30 years age category. Only 2% of the respondents used the wetland for fishing. The wetland has an insignificant value as a source of fish because the water is polluted by washing detergents which makes it not suitable for fishing. From this result; it is clear that most of the respondents (in the 41-60 years age category) use the wetland for subsistence farming and harvesting of reeds for household consumption, and that they would attach more importance to the wetland than other age groups hence proper management of wetland resources.

5.2.3 Monthly income of respondents and perception of wetland potential

Table 5.7: Relationship between wetland resource use and monthly income of respondents

Wetland values	Number of respondents	Percentages	Monthly income				
			<R500	R500 - R800	R801 - R1100	R1101 - R1700	R>2000
Subsistence farming	31	47.7	16	9	4	2	0
Harvesting of reeds	19	29.2	11	4	3	0	1
Market gardening	8	12.3	0	2	5	1	0
Fishing in wetland	2	3.1	2	0	0	0	0
Livestock grazing	5	7.7	1	4	0	0	0
Total	65	100	30	19	12	3	1

Regarding the perception of wetland potential by income group of respondents, Table 5.7 indicate 31 (47.7%) respondents who used the wetland for subsistence farming; 16 have an income of less than R500 per month, 9 respondents fell within R500-R800 income category, 4 respondents fell within R801-R1100 income category and 2 respondents fell within R1101-R1700 income category. It is also indicated that 11 (16.9%) respondents used the wetland for harvesting of reeds and these fell within an income of less than R500 per month. The researcher found that 8 (12.3%) respondents used the wetland for market gardening and the majority of these fell within R801-R1100 income category. Those that used the wetland for livestock grazing comprise 7.7% of the respondents. Only 3.1% of the respondents who used the wetland for fishing earned an income less than R500 per month. This observation shows that most of the respondents use the wetland for subsistence farming and these have an income of less than R500 per month; this means that majority of respondents heavily rely on wetland resources for their livelihoods at the local level scale.

5.2.3 Education level of respondents and perception of wetland potential

Table 5.8: Relationship between wetland resource use and education level of respondents

Wetland values	Number of respondents	Percentages	Level of education attained: No formal education	<5yrs of high school	6-9yrs of high school	Matric	Tertiary level
Subsistence farming	31	47.7	15	0	8	5	3
Harvesting of reeds	19	29.2	10	3	0	6	0
Market gardening	8	12.3	0	1	2	5	0
Fishing in wetland	2	3.1	0	2	0	0	0
Livestock grazing	5	7.7	1	0	4	0	0
Total	65	100	26	6	14	16	3

Of the 65 respondents interviewed 31 (47.7%) used the wetland for subsistence farming while 29.2% of the respondents who used the wetland for harvesting of river reeds and the majority of these did not have a formal education. Table 5.8 indicate that 5 respondents (have a matric qualification) used the wetland for market gardening. Those that used the wetland for fishing had at least spent 5 years of high school and comprise 3.1% of the respondents. The data also indicate 4 respondents used the wetland for livestock grazing and these had at least spent 6-9 years of high school. From this observation; it shows that most of the respondents who use the wetland for subsistence farming and harvesting of reeds never attempted any formal education hence they are likely to depend on the wetland resources for livelihoods.

5.3 Socio-economic value of wetland

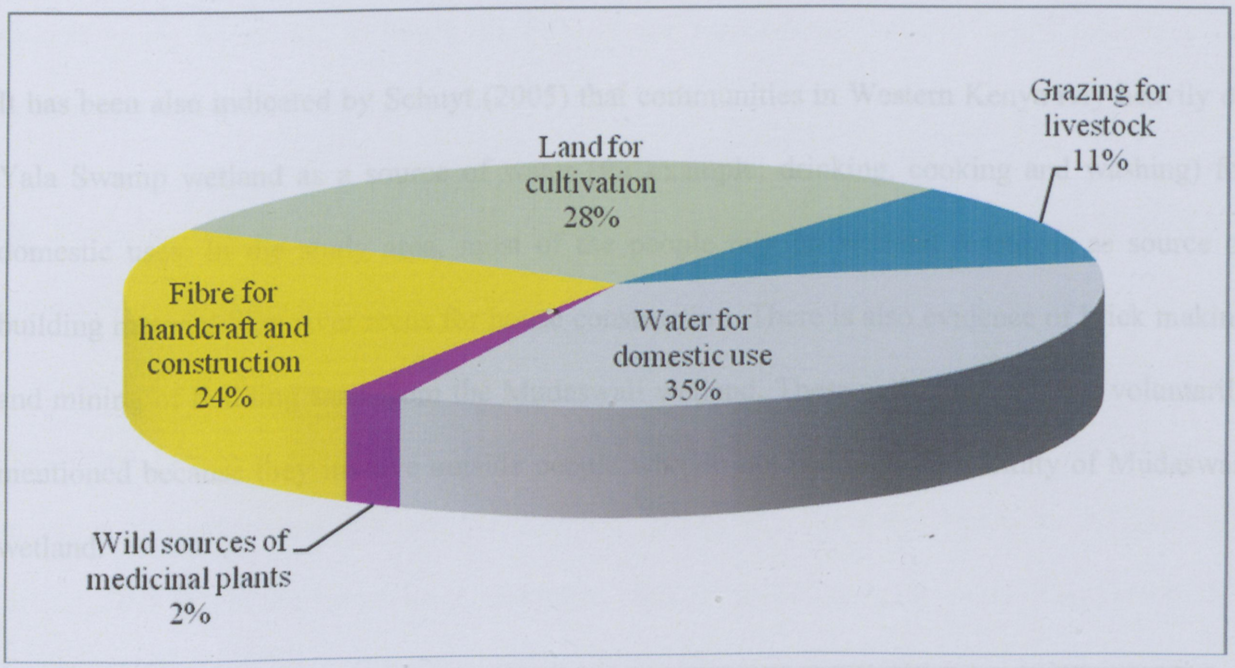

Figure 5.3: The utilization of wetland resources by respondents in the study area

From the questionnaire survey, the socio-economic value of the wetland in this study is inferred from the most frequent use of wetland resources as realized by the local community. A structured questionnaire with a close-ended question asked the respondents what "you often use the wetland resources for". It is clear from Figure 5.3 that the highest rated use of the wetland is water for domestic consumption as indicated by 35% of the respondents followed by the land for cultivation (28%). However, it was found that the water in the wetland is not suitable for domestic consumption particularly drinking because it contains washing detergents which may be harmful to human health. The study also indicate 24% of the respondents use the wetland as a source of fibre (river reeds) for handcrafts and house construction, while 11% graze their livestock in the wetland good pasture and water. It is only 2% of the respondents who used the wetland as a source of medicinal plants. From this observation; it is clear that the wetland in the study area provides diverse economic options to the local people.

It has been also indicated by Schuyt (2005) that communities in Western Kenya rely heavily on Yala Swamp wetland as a source of water (for example; drinking, cooking and washing) for domestic uses. In the study area, most of the people rely on wetland resources as source of building material like; river reeds for house construction. There is also evidence of brick making and mining of building sand from the Mudaswali wetland. These activities were not voluntarily mentioned because they involve outside people who do not reside in the vicinity of Mudaswali wetland.

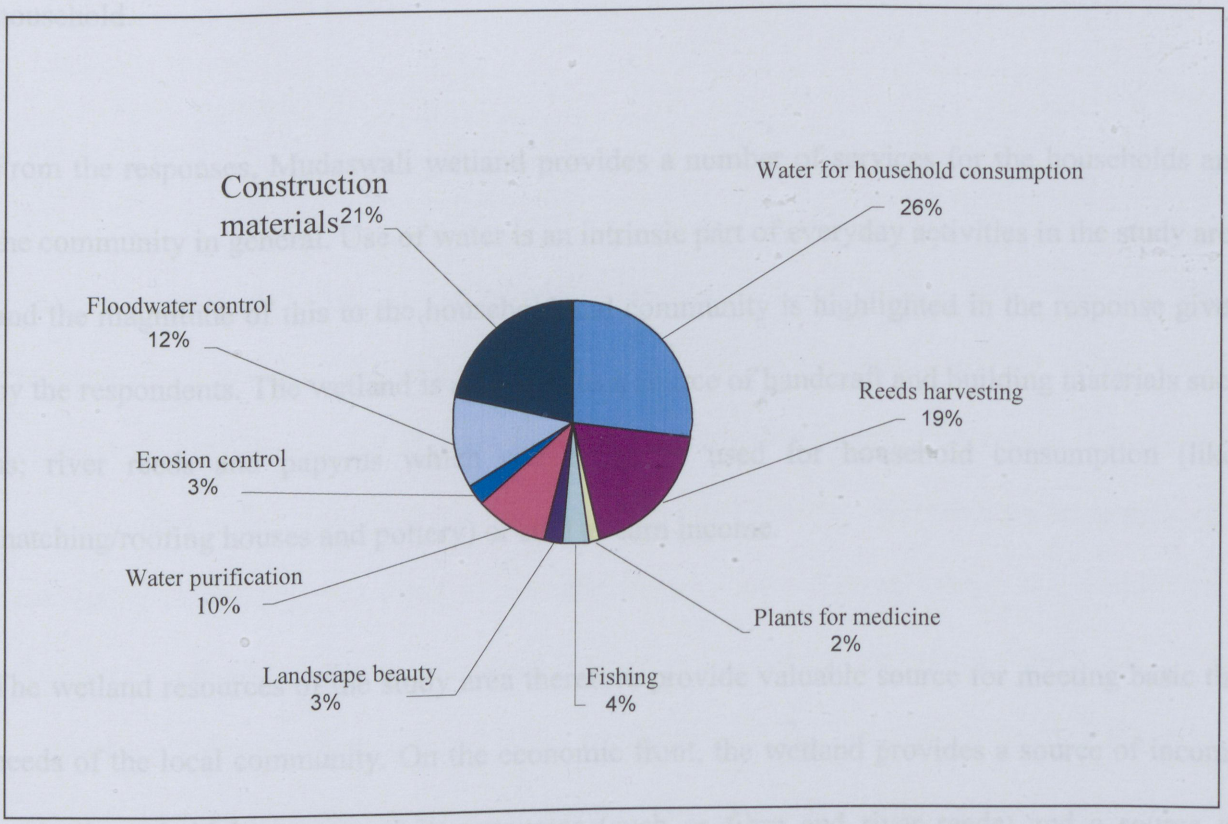

Figure 5.4: The percentages of the value of wetland resource to the household in the area

The inherent understanding of respondents on the value of wetland was evaluated. Figure 5.4 indicate 35% of the respondents' ranked water for household consumption as the most value of wetland to the household followed by 21% of the respondents that mentioned materials for construction as the most value of wetland.

The researcher also found that 19% of the respondents stated the harvesting of reeds used for thatching/roofing houses as the most value of wetland to the household. Those that mentioned floodwater control and water purification as the value of wetland constitute 12% and 10% of the respondents, respectively. A small percentage (4%) of the respondents mentioned that fishing is the value of wetland and 3% said that erosion control and landscape beauty is the value of wetland. Only 2% of the respondents mentioned plant for medicine as the value of wetland to the household.

From the responses, Mudaswali wetland provides a number of services for the households and the community in general. Use of water is an intrinsic part of everyday activities in the study area and the magnitude of this to the household and community is highlighted in the response given by the respondents. The wetland is also used as a source of handcraft and building materials such as; river reeds and papyrus which can either be used for household consumption (like; thatching/roofing houses and pottery) or sold to earn income.

The wetland resources of the study area therefore provide valuable source for meeting basic the needs of the local community. On the economic front, the wetland provides a source of income to the household by means of its resources (such as fibre and river reeds) and a source of employment such as farming and fishing. The wetland also provides a source of forage for the livestock. These livestock can be used both for commercial and personal uses. For commercial purposes, livestock can be a source of income to the household. On the social front, the wetland plays a very important part of everyday life of the community in the study area.

5.3.1 Relationship between gender and the value of wetland

Table 5.9: Relationship between wetland perceived values and gender of respondents

Wetland values	Gender of respondents		Total
	Females	Males	
Water for household consumption	13	4	17 (26%)
Reeds harvesting	10	2	12 (19%)
Floodwater control	3	5	8 (12%)
Water purification	5	2	7 (11%)
Fishing	0	3	3 (4%)
Erosion control	1	1	2 (3%)
Landscape beauty	0	2	2 (3%)
Construction materials	8	5	13 (20%)
Plants for medicine	1	0	1 (2%)
Total	41	24	65 (100%)

This subsection describes the relationship between wetland values and gender of the 65 respondents interviewed during the period of December 2006 to February 2007. Of the 17 (26%) respondents who mentioned that water for household consumption is the value of wetland 13 females and 4 males. Table 5.9 also indicate 10 out of 12 (19%) respondents who mentioned the harvesting of reeds as the value of wetland majority were females. Those that mentioned the floodwater control as the value of wetland comprise 12% of the respondents. The study indicates 11% of the respondents mentioned water purification as the value of wetland. Fishing in the wetland was done by 4% of the respondents. The research also revealed 8 out of 13 (20%) females said that they value the wetland as a source of materials for construction. A small percentage (3%) of the respondents mentioned erosion control as the value of wetland. Only 3% of the respondents said that they value the wetland because it offers landscape beauty.

This observation shows that most females value the wetland as a source of water for household consumption, reeds harvesting and materials for construction because women particularly in rural areas are usually responsible for household duties such as collecting water hence they are more likely to value of wetland than males.

5.3.2 Relationship between age of respondents and the value of wetland

Table 5.10: Relationship between wetland perceived values and age groups of respondents

Wetland values	Age group of respondents					Total
	<20	20-30	31-40	41-60	>60	
Water for household consumption	2	3	6	5	1	17 (26%)
Reeds harvesting	0	0	4	5	3	12 (18%)
Construction materials	0	0	7	4	3	14 (22%)
Floodwater control	0	0	4	3	1	8 (12%)
Water purification	0	2	3	1	1	7 (11%)
Fishing	1	2	0	0	0	3 (5%)
Erosion control	0	0	0	2	0	2 (3%)
Landscape beauty	0	0	0	1	1	2 (3%)
Plants for medicine	0	0	0	0	0	0
Total	3	7	24	21	10	65 (100%)

This subsection deals with the relationship between age of respondents and the value of wetland. Table 5.10 indicate 17 (26%) respondents who mentioned that water for household consumption as the value of wetland, 6 were in the 31-40 years age category, 3 were in the 20-30 years age category, 1 was in the 41-60 years age category, 2 were in less than 20 years age category and 5 were above 60 years old. The study indicates that 5 out of 12 (18%) respondents mentioned that reeds' harvesting as the value of wetland and these fell within 41- 60 years age category. A small percentage 3% of the respondents stated the erosion control as the value of wetland. The data indicate 7 out of 14 (22%) respondents who said they value the wetland as a source of materials for construction were in the 31-40 years age category. Those that mentioned floodwater control as the value of wetland comprise 12% of the respondents. It is indicated that 11% of the respondents who stated the water purification as the value of wetland the majority were in the 31-40 years age category. It is only 5% of the respondents mentioned that fishing in wetland as the value of wetland. This observation shows that most of the respondents who fell within 31-40 years age category value the wetland as a source of water for household consumption, reeds harvesting, materials for construction and floodwater control because they use the wetland on a daily basis for household use.

5.3.3 Relationship between income of respondents and the value of wetland

Table 5.11: Relationship between wetland perceived values and monthly income of respondents

Wetland values	Income group of respondents					Total
	<R500	R500 - 800	R801 - 1100	R1101 - R1700	R>2000	
Water for household consumption	4	10	3	0	0	17 (26%)
Reeds harvesting	8	2	2	0	0	12 (18%)
Construction materials	4	6	0	1	2	13 (20%)
Floodwater control	5	2	1	0	0	8 (12%)
Water purification	3	4	0	0	0	7 (11%)
Fishing	0	1	2	0	0	3 (5%)
Erosion control	1	0	0	0	0	1 (2%)
Landscape beauty	0	0	1	1	0	2 (3%)
Plants for medicine	0	2	0	0	0	2 (3%)
Total	25	26	10	2	2	65 (100%)

The subsection describes the relationship between income of respondents and the value of wetland. Of the 65 respondents interviewed 17 (26%) mentioned that water for household consumption is the value of wetland and the majority were in the R501-R800 income category. From the Table 5.11 it is clear that 8 out of 12 (18%) respondents mentioned reeds harvesting as the value of wetland and these earned a salary less than R500 per month. Those that mentioned floodwater control as the value of wetland constitute 12% of the respondents. The research also revealed that 6 out of 13 (20%) respondents who mentioned materials for construction as the value of wetland were in the R500-800 income category; while 11% of the respondents said that they value the wetland for water purification. From the Table, it can be seen that 5% of the respondents mentioned that fishing in wetland as the value of wetland. Those that mentioned landscape beauty as the value of wetland comprise 3% of the respondents. A small percentage (3%) of the respondents mentioned that plant for medicine as the value of wetland. From this observation, it is clear that respondents from lower incomes (example below R800) tend to depend on wetland resources for basic needs while such tertiary uses (example landscape beauty) are appreciated more by respondents earning above R800.

5.3.4 Relationship between education level and the value of wetland

Table 5.12: Relationship between wetland perceived values and education level of respondents

Wetland values	Levels of education attained					Total
	No formal education	<5yrs of high school	6-9yrs of high school	Matric	Tertiary level	
Water for household consumption	10	5	4	0	0	19 (29%)
Reeds harvesting	7	2	3	0	0	12 (18%)
Construction materials	5	3	6	0	2	16 (25%)
Floodwater control	1	1	0	3	0	5 (8%)
Water purification	2	2	3	0	0	7 (11%)
Fishing	0	0	1	1	0	2 (3%)
Erosion control	0	0	0	2	0	2 (3%)
Landscape beauty	0	0	0	0	1	1 (2%)
Plants for medicine	0	0	0	1	0	1 (2%)
Total	25	13	16	7	4	65 (100%)

Furthermore, this subsection describes the relationship between the education levels of respondents and the value of wetland. Looking at Table 5.12 it is clear that 19 (29%) respondents mentioned that water for household consumption as the value of wetland and the majority have no formal education. Those that mentioned the harvesting of reeds as the value of wetland comprise 18% of the respondents. The research revealed that 6 out of 16 (25%) respondents who said that they value the wetland as a source of materials for construction had at least spent 6-9 years of high school; while 11% of the respondents mentioned that water purification as the value of wetland. From the Table, it is indicated that 3 out of 5 (8%) respondents mentioned the floodwater control as the value of wetland and these had a matric qualification; while 3% of the respondents said that they value the wetland because it serves as erosion control. It is only 3% of the respondents that said they value the wetland as a source of fishing. This observation shows that most of the respondents who have no formal education value the wetland as a source of water for household consumption, reeds harvesting and materials for construction; this means that majority of respondents without formal education are likely to depend on the wetland resources for livelihoods. Clearly it is this user group that need education regarding to the proper management of wetland in the area.

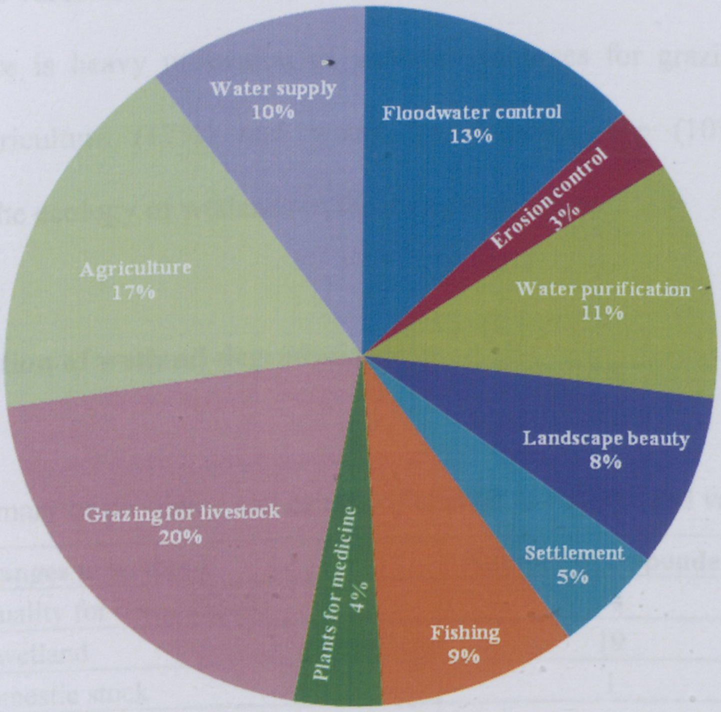

Figure 5.5: The percentages of each of wetland values by the focus group.

The knowledge of the focus group regarding wetland values was considered in order to determine the percentage of each of the wetland values in the study area. Figure 5.5 shows the percentages of each of the wetland values as realized by the focus group. A structured questionnaire with a close-ended question administered to the focus group asked what "the percentage of each of the following wetland values is to this community."

From the Figure, it is clear that the highest rated value of wetland is 20% for livestock grazing followed by 17% for agriculture. The Figure also indicate 13% wetland value for floodwater control; while 11% is the value of wetland for water purification; the wetland value for water supply is 10% and 9% is the wetland value for fishing. Landscape beauty is indicated by 8% and 5% is the wetland value for settlement. The wetland value for erosion control indicates 3% and 4% is the wetland value as a source of plants for medicine to the community. From this result, it is clear that there is heavy utilization of wetland resources for grazing of livestock (20%), followed by agriculture (17%) and water for domestic use (10%) suggesting serious consequences if the ecology of wetlands in the area deteriorates.

5.4 Local perception of wetland degradation

Table 5.13: Summary of problems and causes of change to the wetland value

Problems and changes in wetland	Number of respondents	Percentage (%)
Declining water quality for domestic use	38	58
Sedimentation in wetland	19	29
Low forage for domestic stock	1	2
None	2	3
Over-flooding	1	2
Shortage of materials for handcraft and construction	3	5
Shortage of reeds	1	2
Total	65	100

The perception of the local community regarding changes in wetland values was considered in order to help in estimating the degree of wetland degradation in the study area. Table 5.13 highlights the various problems and changes which respondents indicated to have occurred to the wetland in the area (see Appendix A; section B). Of the 65 respondents interviewed 38 (58%)

stated that declining water quality for domestic use is a problem that they have faced in the wetland, and 19 (29%) mentioned sedimentation in wetland due to human activities as a change that have occurred in the wetland. From the Table also indicates 2% of the respondents mentioned over-flooding as the problem faced in the wetland. The research revealed 5% of the respondents mentioned that shortage of materials for construction of houses as change that have occurred in the wetland; 2 respondent said that low forage for domestic stocks and shortage of river reed are changes that have occurred to the wetland due to increase in number of grazing stocks. However, when stocking rates increase, they are accompanied by degradation of pastures. Those that said they have not faced any problems in the wetland comprised 3% of the respondents. This observation shows that most of the problems and changes in wetland values seem to be human induced therefore participation of local community in the management of wetlands is vital.

It should be noted that there was no substantial signs of ecological degradation observed from human activities such as overgrazing; neither were signs of erosion like reels and gullies observed in the area.

The results of reconnaissance survey also revealed that the Mudaswali wetland in Matangari village is experiencing degradational effects. These effects are from encroaching agricultural activities in the wetland, increased numbers of grazing stocks, burning for farm preparation and over-exploitation of river reeds. These intensified human uses within the wetland have led to problems and changes such as; declining water quality for domestic use, shortage of materials for handcraft and construction of houses (like; river reeds and papyrus), low forage for domestic stocks and sedimentation in the wetland due to over-cultivation and over-exploitation of river reed. Similarly, Kangalawe et al. (2005) reports environmental concerns associated with increasing use of wetlands for cropping and other human activities including deforestation and trampling of soils by increasing livestock numbers in the wetlands of Kilombero Valley in Tanzania.

Table 5.14: Relationship between wetland changes and gender of the respondents

Problems and changes in wetland	Number of respondents	Gender of respondents	
		Females	Males
Declining water quality for domestic use	38 (58%)	28	10
Sedimentation in wetland	19 (29%)	11	8
Low forage for domestic stock	1 (2%)	1	0
None	2 (3%)	0	2
Over-flooding	1 (2%)	0	1
Shortage of materials for handcraft and construction	3 (5%)	3	0
Shortage of reeds	1 (2%)	1	0
Total	65 (100%)	44	21

This subsection describes relationship between the wetland changes and gender of the respondents interviewed during the period of December 2006 to February 2007. Of the 65 respondents interviewed 38 (58%) respondents mentioned the declining water quality for domestic use as the major change in the wetland. Table 5.14 indicate 11 out of 19 (29%) respondents who mentioned that sedimentation in wetland due to human activities is the problem that they have faced in wetland were females. Those that stated the shortage of construction materials as a problem that they faced in the wetland comprise 5% of the respondents. A small percentage (2%) of the respondents mentioned over-flooding as a change that has occurred in the wetland. It is only 2% of the respondents said that shortage of reeds is a change that has occurred in the wetland. However, 2 (3%) males said that they have no idea of any changes that have occurred in the wetland.

From this observation, it is clear that majority of females recognized the declining water quality for domestic use and sedimentation in wetland as the changes in wetland values because women particularly in rural areas usually bear responsibility of household duties such as collecting water thus they are likely to contributing in the degradation of wetland in the study area.

Table 5.15: Relationship between wetland changes and age groups of the respondent

Wetland changes	Age group of respondents					Total
	<20	20-30	31-40	41-60	>60	
Declining water quality for domestic use	2	6	18	9	3	38 (58%)
Sedimentation in wetland	0	3	8	6	3	20 (31%)
Low forage for domestic stock	0	0	1	0	0	1 (2%)
None	2	0	0	0	0	2 (3%)
Over-flooding	0	0	0	1	0	1 (2%)
Shortage of materials for handcraft and construction	0	0	0	1	1	2 (3%)
Shortage of river reeds	0	0	0	1	0	1 (2%)
Total	4	9	27	18	7	65 (100%)

Furthermore, the relationship between wetland changes and age group of respondents Table (5.15) indicate 18 out of 38 (58%) respondents mentioned the declining water quality for domestic use as a problem that they have faced in the wetland and these fell within 31-40 years age category. Those that mentioned sedimentation in wetland as a change that have occurred in the wetland comprise 31% of the respondents. From the Table, it can be seen that 3% of the respondents stated the shortage of materials for handcraft and construction as the change that have occurred in wetland and these fell within 41-60 years age category. A small percentage (2%) of the respondents mentioned that over-flooding and shortage of reeds are the changes that have occurred in the wetland. It is only 3% of the respondents said that they did not see any changes that have occurred in the wetland and these were young people in the less than 20 years age category. This observation shows that most of the respondents (in the 31-60 years age category) associated the changes in wetland values to the declining water quality for domestic use and sedimentation in wetland; this means that middle-aged people contribute substantially to the degradation of wetland because of the need of water for domestic use, reeds for handcraft and roofing of houses and cropping for livelihood.

Table 5.16: Relationship between wetland changes and education level of the respondents

Wetland changes	Level of education attained					Total
	No formal education	<5yrs of high school	6-9yrs of high school	Matric	Tertiary level	
Declining water quality for domestic use	20	12	4	2	0	38(58%)
Sedimentation in wetland	7	5	3	4	0	19 (29%)
Low forage for domestic stock	0	1	0	0	0	1 (2%)
Over-flooding	1	0	0	0	0	1 (2%)
Shortage of materials for handcraft and construction	2	0	0	0	0	2 (3%)
Shortage of river reeds	2	0	0	0	0	2 (3%)
None	0	0	0	0	2	2 (3%)
Total	32	18	9	4	2	65 (100%)

This subsection illustrates the relationship between the perception of wetland changes and education level of the respondents in the study area. From Table (5.16) it is clear that 20 out of 38 (58%) respondents mentioned the declining water quality for domestic use as a problem they have faced in wetland and these have no formal education. Those that mentioned the sedimentation in wetland as a problem that they have faced in the wetland comprise 29% of the respondents. A small percentage 3% of the respondents acknowledged that the shortage of materials for handcraft and construction and shortage of reeds as problems that they have faced in the wetland. The research also revealed that 2% of the respondents mentioned that over-flooding as the change that has occurred in the wetland. It is only 2% of the respondents mentioned that low forage for domestic stocks as a problem faced in the wetland and these had at least spent 5 years of high school. Nonetheless, 3% of the respondents said that they did not see any changes that have occurred in the wetland and these had a tertiary qualification.

This observation shows that most of the respondents have no formal education and they mostly mentioned the declining water quality for domestic use and sedimentation in wetland as the changes that have occurred in the wetland; this means that majority of people without formal education depend on wetland resources for livelihoods thus are likely to contribute substantially to the degradation of wetland in the study area.

This subsection deals with the estimation of wetland degradation as experienced by the local community. Of the 65 respondents, 33 (51%) stated that the changes in wetland value were very significant by 51-80%; 23 mentioned that the changes in wetland value were significant by 21-50%; 4 respondents said that the changes in wetland value were not significant by 0-20%; and 2 mentioned that the changes in wetland value were extremely significant. However, 3 individuals did not respond to the questionnaire interview.

Table 5.17: The rating of significance of wetland degradation in the area

Levels of significance		Number of respondents	Percentage (%)
0-20%	Not significant	4	6
21-50%	Significant	23	35
51-80%	Very significant	33	51
≥ 81%	Extremely significant	2	3
Total		62	95
Non-participant		3	5
Total		65	100

The results of the analysis on the perception of wetland degradation by the focus group indicate relatively similar percentage of wetland degradation in comparison to the results of the rate of significance of change by the local people. The questionnaire administered to the focus group asked 'what is your knowledge as far as wetland degradation is concerned in this region?' The focus group stated that the degradation and loss of wetland in general add to 70% while the local people said the degradation of wetland in the area was between 51-80% (that is; very significant). In addition, the focus group stated the reasons for wetland degradation in general. These include; unplanned agricultural systems, unplanned infrastructure developments such as construction of gravel roads near wetlands which results in siltation in the wetland, overgrazing of livestock in dry season and use of wetlands as dumping sites. It should be noted that currently there is no control measures used in the utilization of the wetland resources in the area.

Table 5.18: Summary of wetland values against reasons for wetland change in the study

Wetland values	Reasons for wetland change	Number of respondents	Percentage (%)
Water supplies	Drought/dry periods	27	41.5
Land for cultivation	Intensive cultivation in wetlands	15	23.1
Materials construction	Human activities	14	21.5
Grazing for livestock	Overgrazing	6	9.2
Reeds harvesting	Over-exploitation of river reeds	1	1.5
	I don't know	2	3.1
	Total	65	100

Table 5.18 illustrate the various reasons for wetland change as realized by the local community. It is indicated that 27 (41.5%) respondents mentioned dry periods/drought as the reason for change in wetland values, while 15 (23.1%) respondents mentioned intensive agricultural activities were the reason for change in wetland values. It is also revealed that 21.5% of the respondents mentioned human activities such as cropping, livestock watering and reeds harvesting, while 9.2% said that overgrazing were the reasons for change in wetland values. It is

only 3.1% of the respondents who did not know of any reason for the change to the wetland values. Only 1.5% of the respondents stated that over-exploitation of river reeds as the reason for change in wetland values. The reasons for changes in wetland value seem to stem from drought and shortage of water during dry periods. From this result, the problems and changes to the wetlands can be minimized by reducing the number of animal stocking that need to graze in the wetlands. However, shortage of water can be mitigated by construction of reservoir or boreholes for water storage and afforestation should be encouraged by the local authorities to mitigate drought in the area.

5.5 Estimation of the costs of wetland degradation

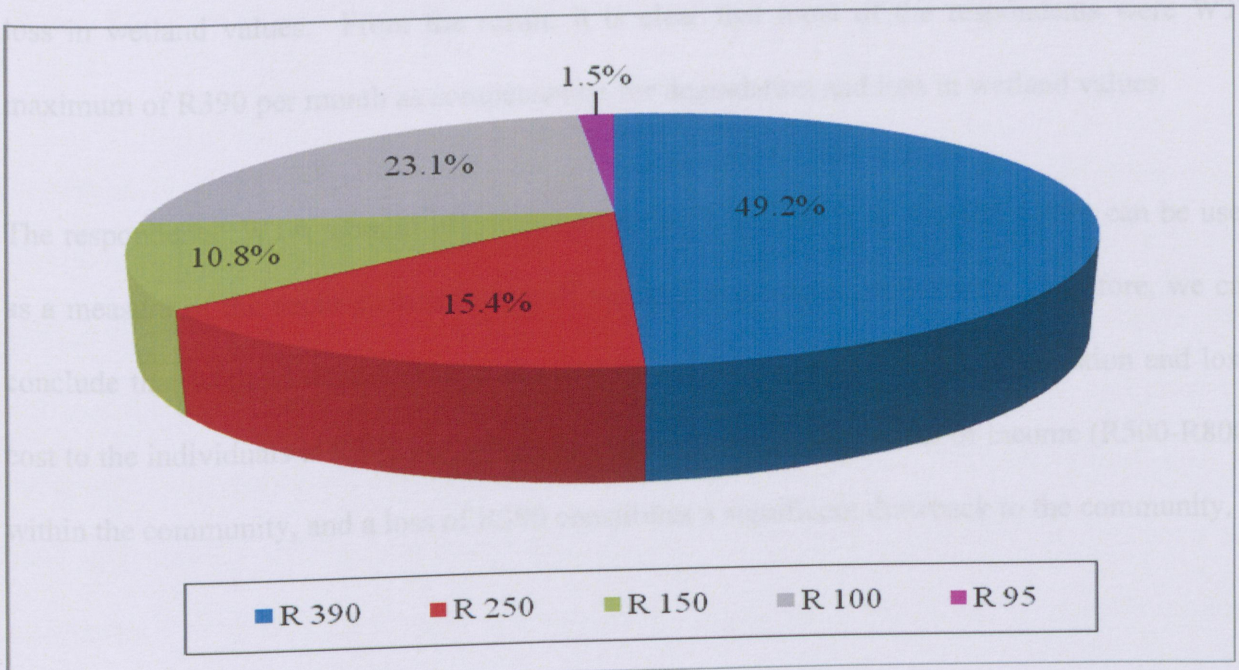

Figure 5.6: Distribution of the amount of WTA per month (**Amount in Rand**) for wetland degradation in the area among the respondents

The respondents' WTA an amount of money in compensation for degradation and loss in wetland values was considered in the study as a proxy for estimating the cost of wetland degradation in the area. Variation in respondents' WTA amount of money in compensation for the degradation and loss in wetland values ranged from < R95 to ≥ R390 per month.

Looking at Figure 5.6, it is clear that 49.2% of the respondents were willing to accept the amount of money (R390) per month on average, in compensation for the degradation and loss of wetland values, while 23.1% said they were willing to accept the amount of R100 per month in compensation for degradation and loss in wetland values in the area. It is also indicated that 15.4% of the respondents were willing to accept a sum of R250 per month, while 10.8% said they were willing to accept R150 per month. A small percentage (1.5%) of the respondents said they were willing to accept the amount of R95 per month as compensation for degradation and loss in wetland values. From the result, it is clear that most of the respondents were WTP maximum of R390 per month as compensation for degradation and loss in wetland values.

The respondents' WTA amount of compensation for degradation in wetland values can be used as a measure of the socio-economic cost of wetland degradation in the area. Therefore, we can conclude that wetland degradation in the area based on compensation for degradation and loss, cost to the individuals is R390 per month. Given the relatively low level of income (R500-R800) within the community, and a loss of R390 constitutes a significant drawback to the community.

5.6 Response on wetland management strategy

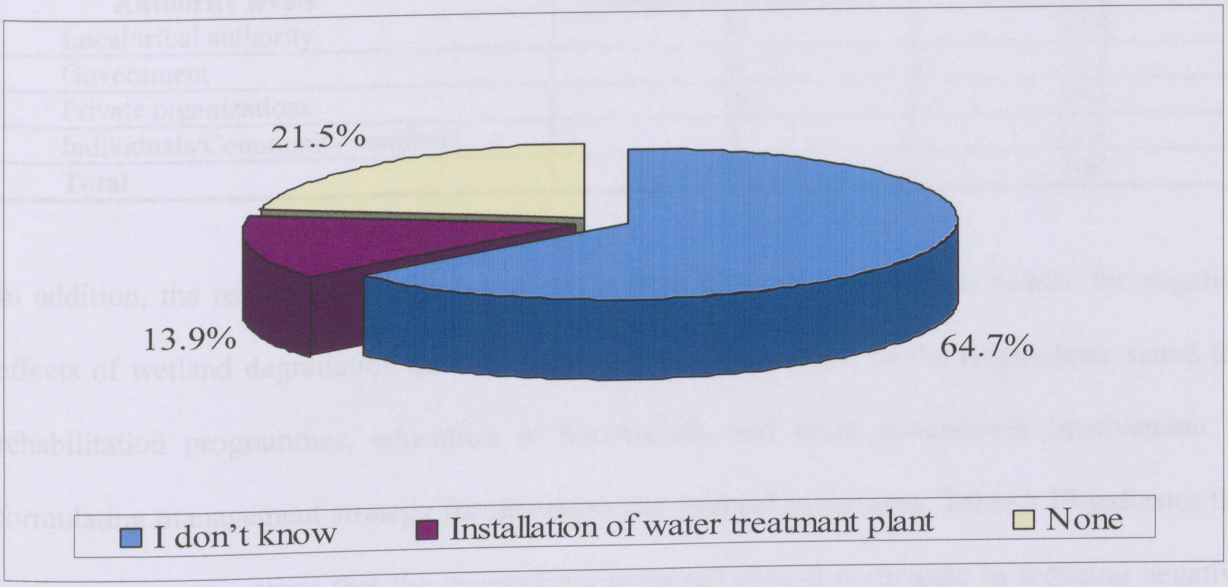

Figure 5.7: Respondents' awareness of wetland management strategy in the area

The respondents' awareness of wetland management strategy was examined in the study area. Over 60% of the respondents were not aware of any wetland management strategy, while 21.5% believed there was no wetland management strategy in place. The study, though, shows that 13.9% of the respondents acknowledged that there was installation of water treatment plant to supplement water purification function because of a degraded wetland. From this observation; it shows the absence of a management strategy for the wetland; and this is a challenge to policymakers to ensure that some environmental education is provided to support policy implementation.

Table 5.19: The authority responsible for curbing wetland degradation in the study area

Authority levels	Number of respondents	Percentage (%)
Local/tribal authority	33	50.8
Government	14	21.5
Private organizations	10	15.4
Individuals/Community members	8	12.3
Total	65	100

In addition, the respondents were asked "what they felt could be done to reduce the negative effects of wetland degradation and loss in wetland values". Most of the respondents stated the rehabilitation programmes, education of households, and more government involvement in formulating management strategy for managing the wetland in the area. Table 5.19 indicates the institutions/organisations that the respondents proposed should participate in reducing negative effects of wetland degradation and loss in the study area. More than a half (50.8%) of the respondents felt that the local/tribal authority should be responsible, while 21.5% stated the government should be in charge of reducing wetland degradation in the area. Close to 15.4% of the respondents stated that private organisations should be responsible, while 8 (12.3%) respondents were of the opinion that individuals/community members should assist in reducing wetland degradation in the area. From this result, it is clear that most of the respondents felt the local/tribal authority and government should intervene in reducing the negative effects of wetland degradation and loss in wetland values in the area.

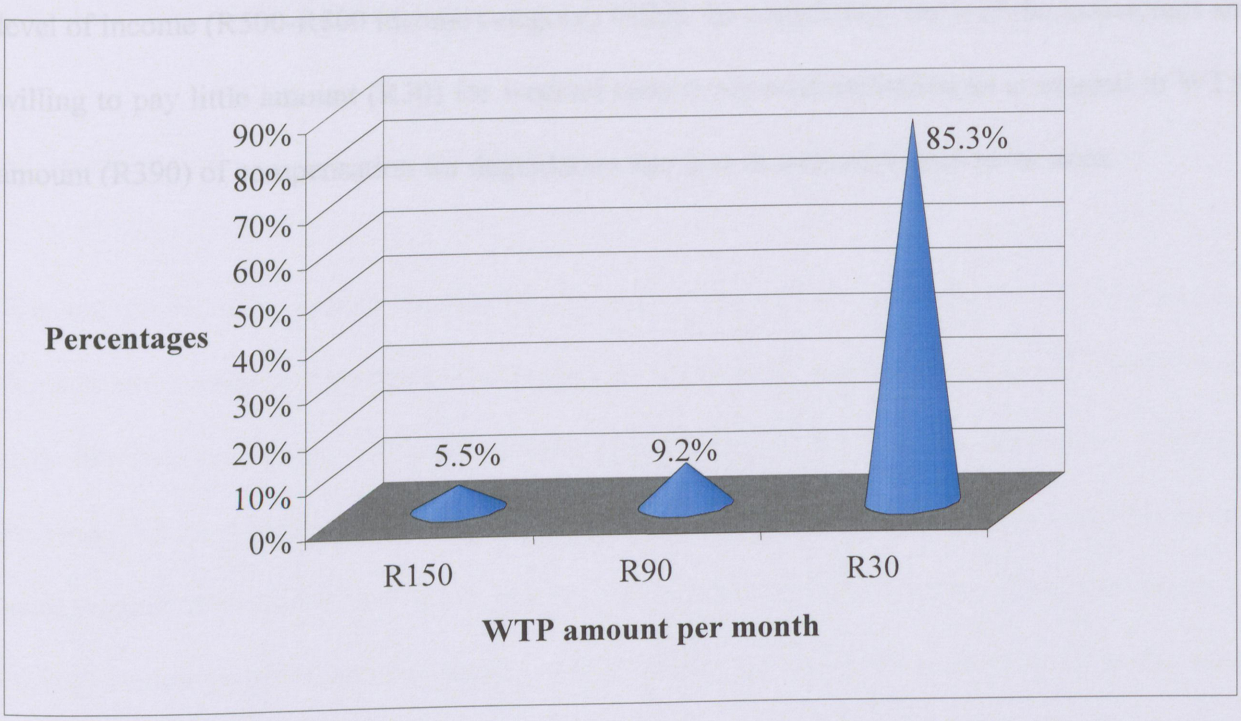

Figure 5.8: Respondents' WTP amount per month (**Amount in Rand**) for wetland conservation

The respondents' WTP amount per month for wetland conservation was considered as a proxy for estimating the value of wetland in the local communities and not in anyway intended to raise money for wetland conservation/rehabilitation.

From the Figure (5.8), an overwhelming percentage (85.3%) of the respondents said yes they are interested in wetland conservation and would be willing to pay for wetland conservation. On average, the respondents are willing to pay R30 per month for wetland conservation. It is also indicated that 9.2% of the respondents stated that they are willing to pay R90 per month, while 5.5% said they are willing to pay R150 per month for wetland conservation in the study area. It should be noted that earlier the cost of wetland degradation to the community as a whole was estimated at R390 per month. The suggested value (R30) for conservation is therefore a strong expression for the value of wetland to the individuals in the community. Given the relatively low level of income (R500-R800 income category) within the community, most of the individuals are willing to pay little amount (R30) for wetland conservation/rehabilitation as compared to WTA amount (R390) of compensation for degradation and loss in wetland values in the area.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

Wetland degradation affects the social and economic welfare of local people and wetland degradation is a result of inadequate management knowledge by the community. The study dealt with the socio-economic costs of wetland degradation in Mudaswali wetland of Limpopo Province, South Africa and investigated ways in which communities value and engage; in the management of wetlands and the associated socio-economic costs. In addition, the nature of ecology, resource potential and socio-economic value of the wetland in respect to the local community was studied. The study also estimated the degree and the socio-economic costs of wetland degradation in the area. The main hypotheses of the study were that wetlands are the most productive lands on earth's surface but have fragile ecosystems which are increasingly affected by human practices. They have become the most threatened and degraded ecosystems due to human activities. This is because of inadequate knowledge of the value and proper management in the communities that use them. In order to justify actions against wetland degradation, the costs of that degradation needs to be established hence this study.

6.2 Conclusion

This study demonstrated that Mudaswali wetland is valuable in supporting the local community both socially and economically. The nature of wetland ecology and resource potential as indicated in Table 5.5, support the use of the wetland resources either for subsistence farming or market gardening. The increasing human use of wetland resource such as for cropping, grazing of domestic stocks, and over-harvesting of river reeds for use in thatching houses are contributing substantially to the degradation of the wetland. The degradation of wetlands indicated in Table (5.18) was substantial and the associated socio-economic cost was estimated at R390 per month; this may affect in the longrun the social and economic welfare of the local community because the wetlands form part of the local livelihoods. Some of the identified changes in wetland values include sedimentation in wetland, declining water quality for domestic use, shortage of materials for handcraft and construction of houses (river reeds) and low forage for livestock because of intensive cultivation in wetland, overgrazing, over-exploitation of wetland plants like river reeds and limited areas for waste disposal. If these continue unchecked, the future existence of the wetland and its ecological functions will be seriously threatened. On the other hand, drought and lack of water supplies during dry period are natural agents which also threaten the quality of the wetlands.

Wetland degradation was a result of inadequate knowledge by the community of better management methods. A large percentage (60%) of the respondents was unaware of wetland management strategy. Little knowledge of wetland management strategy in the communities may lead to unwise exploitation and subsequent degradation of wetland in the area. This is a challenge to the policy makers to ensure that policies affecting wetland management are formulated and effectively implemented.

6.3 Recommendations

6.3.1 Capacity building

Building capacity should involve the participation of local communities including the local government structures and traditional leadership in campaigns for the conservation of wetlands and wetland commemorations, for example, the World Wetland Day on 2nd February. This will help in raising the local awareness of conservation of wetlands and also to teach them on the importance of wetlands and their management.

6.3.2 Wetland management programmes

Mondi Wetlands, Working for Water and Working for Wetlands as the principal programmes in managing wetlands need to empower local communities using various incentives to encourage them to participate in conserving and managing the wetlands. The wetland programmes also need to educate the local communities of the better strategies for the management of wetland in order to reduce effects of wetland degradation. In addition, it should promote new research projects and ideas to ensure the proper management of wetland resources in order to protect the wetland from degradation. This study therefore recommends carrying out further research on the proper utilization of wetlands and monitoring of wetland uses especially at the local level scale.

6.3.3 Management strategies for the study area

Several management techniques can be used to reduce the effects of cultivation in the wetland. This study however suggests the application of traditional practices to reduce the effects of cultivation in the wetland which is the main activity in the area.

These traditional cultivation practices include; planting of crops which are tolerant to wetter environments (waterlogging), in order to minimize the need to drain. The use of artificial fertilizers and pesticides should be avoided in order to reduce eutrophication in the wetland. Tilling the land and harvesting of wetland products should be done by hand or in a controlled manner. The use of machinery such as tractors in wetland should be avoided as it disturbs the structure of the soil and destroys the wetland species. Cultivation in rotations should be encouraged in the wetlands and the area should be left for at least 1 to 2 years without cultivating (that is; fallowing).

Periodic harvesting restrictions can be introduced in the wetland. Seasonal restrictions can be placed on the harvesting of reeds used mostly for mat making or the collection of plants for medicine. This may be to prevent overuse of wetland resources during stressed seasons or for wetland management purposes.

The participatory rural appraisal should be introduced in the study area. Participatory rural appraisal is one of the ways to facilitate a dialogue with local communities, particularly in the context of wetland resources management because the local people have a significant understanding of the ecosystem. It is clear that local knowledge of the functioning of the ecosystem is highly developed and that it would be indispensable for the drafting of the management plan that would help to reduce destruction of wetlands.

Networking mechanisms such as regular meetings and radio programmes should be introduced at local level in order to achieve information exchange for educational purposes. For example; ecological values of wetland can be conveyed through the educational curriculum of local schools. Also, wetland centres can catalyse active and informed participation of local people. It will serve as demonstration sites for sustainable wetland management through formal, informal and non-formal educational programmes. This will help to bring community concerns to the attention of decision-makers and provide information and advice on wetlands and their management.

The participatory environmental management should also be introduced in the study area. Participatory environmental management is a tool that includes knowledge from many sources such as traditional, scientific, technical and administrative that permits an integrated approach to problem solving and priority setting. This makes the management of ecosystems, specifically wetlands, more efficient, effective and sustainable in social, environmental and economic terms.

There should be promotion of public awareness and understanding of the wetland resource in the study area through actively encouraging participation of the local community.

For sustainable management of wetlands, the following critical aims and objectives should be pursued:

Working towards greater community awareness and understanding of wetland values include;

- To develop and implement a targeted national community awareness and education program about wetlands, their values and management models.
- To encourage the establishment of educational and interpretive facilities at wetlands in the study area.

Empowering the community to accept/adopt responsibility for using wetlands wisely include;

- To encourage the adoption of management practices that use and demonstrate the traditional wetland management knowledge of the local community and consider measures to encourage equitable sharing of benefits arising from utilisation of such knowledge.
- To assist and support, as resources allow, local community members to gain access to training in wetlands conservation and management within a broader context of environmental and natural resource management.

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APPENDIX A: QUESTIONNAIRE DIRECTED TO THE HOUSEHOLDS

Date of interview: ____________________________

Questionnaire number: ____________________________

Village name: ____________________________

SECTION A: SOCIO-DEMOGRAPHIC PROFILE OF THE RESPONDENTS

Indicate [x] in the appropriate spaces provided.

A1.Gender

1) Female [ ]
2) Male [ ]

A2. Age

3) Below 20 [ ]
4) 20 – 30 [ ]
5) 31 – 40 [ ]
6) 41 – 50 [ ]
7) 51 - 60 [ ]
8) 61 and Above [ ]

A3 Level of education acquired

1) No formal education [ ]
2) Less than 5 years of high school [ ]
3) 6 – 9 years of high school [ ]
4) Matric [ ]
5) College/University [ ]
6) Other (please specify)____________________________

A5. Occupation of respondent

1) Subsistence farmer [ ]
2) Commercial farmer [ ]
3) Harvesting of river reeds [ ]
4) Fishing in the river [ ]
5) Livestock keeping [ ]
6) Other (please specify) ______________________

A6. Total household income per month

1) Less than R 500.00 [ ]
2) R 501.00 – R 800.00 [ ]
3) R 801.00 – R 1100.00 [ ]
4) R 1101.00 – R 1400.00 [ ]
5) R 1401.00 – R 1700.00 [ ]
6) R 1701.00 – R 2000.00 [ ]
7) R 2001.00 and above [ ]

SECTION B: WETLAND USAGE

B1. For how long have you been living in this village?

1. Less than 5years [ ]
2. 5 –10 years [ ]
3. 10 – 15 years [ ]
4. 15 – 20years [ ]
5. 20 years and above [ ]

B2. What do you often use the wetland resources for?

1. Fiber for handcraft and construction [ ]
2. Land for cultivation [ ]
3. Grazing for livestock [ ]
4. Water for domestic use [ ]
5. Wild sources of medicinal plants [ ]
6. Others (please specify) ______________________

B3. Could you rank the value of wetlands to your household?

1. Water for household consumption [ ]
2. Reeds harvesting [ ]
3. Plants for medicines [ ]
4. Fishing [ ]
5. Landscape beauty [ ]
6. Water purification [ ]
7. Erosion control [ ]
8. Floodwater control [ ]
9. Construction material [ ]
10. Other (please specify) ______________________________

B4. What are the wetland management strategies currently employed in the area?

____
____
____
____
____
____
____
____
____

B5. Since you have been living here, what serious problems and changes have occurred to wetlands?

____
____
____
____
____
____
____
____
____

B6. Please rate the significance of such changes in wetland value?

1. 0 – 20% (Not significant) [ ]
2. 21 – 50% (Significant) [ ]
3. 51 – 80% (Very significant) [ ]
4. 81% and above (Extremely significant) [ ]

B7. If the change has taken place, what are the reasons for such changes?

____

B8. How have the changes affected the value of wetland to your household?

____

B9. How have the changes affected the value of wetland to the village community?

____

B10. In your opinion, what can be done to reduce the negative effects of wetlands degradation and loss?

____

B11. Who should be responsible for reducing effects of wetland degradation and loss?

1. Community members [ ]
2. Government [ ]
3. Local/tribal authority [ ]
4. Private organizations [ ]
5. Other (please specify) ______________________________

SECTION C: WILLINGNESS TO PAY

Opening statement

I am going to ask you some questions in order to know if your household will conserve the wetland in form of donation through willingness to pay. The wetland is going to be managed by people from your village. Imagine that it were possible to improve your most frequently used source of water for drinking, food preparation and personal hygiene, obtained from the wetlands. Improving or conserving the wetlands means that there would be more water of better quality plus valuable wetland functions including water purification, sediment/pollutant retention and storage of floodwater. Think about how much it would be worth to you to conserve the wetlands.

C1. Would you be interested in conservation of wetland in your area?

1. Yes [ ]
2. No [ ]

If yes, then go to question 3

C2. If no, what is your main reason?

1. The wetland has no value [ ]
2. It is not my responsibility to protect the wetlands [ ]
3. I do not see any reason why I should conserve the wetlands [ ]
4. Other (please specify) ______________________________

C3. Would you be willing to pay R5 per day or more (equivalent to R150.00/month) for wetland conservation?

1. Yes…………………………………..go to 6 [ ]

2. No…………………………………go to 5 [ ]

3. I do not know ……………………go to 6 [ ]

C4. Would you be willing to pay R3 per day (equivalent to R 90.00/month) for wetland conservation?

1. Yes ……………………………….........go to 6 [ ]

2. No …………………………………go to 5 [ ]

3. I do not know ……………………..go to 6 [ ]

C5. Would you be willing to pay R1 per day (equivalent to R 30.00/month) for wetland conservation?

1. Yes……………………………….....go to 6 [ ]

2. No……………………………………go to 6 [ ]

3. I do not know ……………………..go to 6 [ ]

C6. What is the highest amount you would be willing to pay per month for wetland conservation?

1. Amount of money R _______________

2. I do not know [ ]

SECTION D: WILLINGNESS TO ACCEPT

Now that you know the values of the wetland such as for agriculture, livestock grazing, domestic water supplies, harvesting of river reeds, construction clay and the ecological functions (like; floodwater storage, sediment and erosion control) of the wetland in the area. Wetland degradation means the loss of these valuable ecological, social and economic benefits to your household and the general functioning of wetland ecosystem. Think about how much it would be worth to compensate you for a loss to the wetland values in the area.

D1.State the maximum willingness to accept amount as your compensation for the degradation and loss to the wetland values in the area? Amount of money R ___________________

D2. State the minimum willingness to accept amount as your compensation for a loss to the wetland values in the area? Amount of money R ___________________

APPENDIX B: QUESTIONNAIRE DIRECTED TO THE FOCUS GROUP

E1. What is your knowledge as far as wetland degradation is concerned in this region?
____

E2. Please rate the significance of such changes in wetland value?

1. 0 – 20% (Not significant) [ ]
2. 21 – 50% (Significant) [ ]
3. 51 – 80% (Very significant) [ ]
4. 81% and above (Extremely significant) [ ]

E3. What is the main reason for continuing degradation of wetland in the region?

____
____
____
____
____

E4. What do you think can be done to encourage the community to participate in proper management of wetland in this region?

____
____
____
____
____

E5. Who should encourage the community to participate in proper management of wetlands?

____
____
____
____
____

E6. What percentage of each of the following wetland values in this community?

1. Water supply ______
2. Agriculture ______
3. Grazing for livestock ______
4. Plants for medicines ______
5. Fishing ______
6. Settlement ______
7. Landscape beauty ______
8. Water purification ______
9. Erosion control ______
10. Floodwater control ______

E7. Could you estimate also the percentage of degradation and loss of wetlands in the region with impact to each of the above?____

THANK YOU FOR YOUR CO-OPERATION.

APPENDIX C: QUESTIONNAIRE TRANSLATION INTO VENDA LANGUAGE

Duvha la Nyambedzano: ____________

Nomboro ya dzimbudziso: ____________

Dzina la vhupo (Kusi): ____________

Khethekanyo A

Sumbedzani Nga tshifhambano afho hurena magake[x].

A1. Mbeu

2) Musadzi [ ]

3) Munna [ ]

A2.Minwaha

1) Fhasi ha 20 [ ]

2) 20 – 30 [ ]

3) 31 – 40 [ ]

4) 41 – 50 [ ]

5) 51 - 60 [ ]

6) 61 na u fhira [ ]

A3. Mbingano

1) Vhingiwa [ ]

2) Khombe [ ]

3) Thalano [ ]

4) Tshilikadzi [ ]

A4. Pfunzo

7) Avho ngo Funzwa [ ]

8) Vho dzena lwa minwaha ya fhasi ha mitanu secondary [ ]

9) Vho dzena lwa minwaha ya rathi secondary [ ]

10) Murole wa vhufumi [ ]

11) Pfunzo dza ntha (Finyazwanda/ University) [ ]

12) Zwinwevho (sumbedzani)______________________________

A5. Mushumo

7) Vhulimisi ha mahayani [ ]

8) Vhulimisi ha vhubindudzi [ ]

9) Khano ya majesy [ ]

10) U rea khovhe [ ]

11) Vhufuwi [ ]

12) Zwinwevho (sumbedzani)______________________________

A6. Vhuhulu ha mudi

1) 1-2 ya mirado [ ]

2) 3-5 ya mirado [ ]

3) 6-8 ya mirado [ ]

4) 9 ya mirado na u fhira [ ]

A7. Mbuelo nga nwedzi

1) Fhasi ha R 500.00 [ ]

2) R 501.00 – R 800.00 [ ]

3) R 801.00 – R 1100.00 [ ]

4) R 1101.00 – R 1400.00 [ ]

5) R 1401.00 – R 1700.00 [ ]

6) R 1701.00 – R 2000.00 [ ]

7) R 2001.00 na u fhira [ ]

Khethekanyo B: Tshumiso ya matzhavani

B1. Ndi u bva lini vhatshi khou shumisa matzhavani

1. Fhasi ha minwaha mitanu [ ]
2. 5 –10 ya minwaha [ ]
3. 10 – 15 ya minwaha [ ]
4. 15 – 20 ya minwaha [ ]
5. 20 ya minwaha na u fhira [ ]

B2. Ndi vhukule vhungafhani u bva fhano ______________________________

B3. Vhashumisani matzhava na zwine zwa wanala ngomu

1. Khuni, thovho, u fhata [ ]
2. U lima [ ]
3. U lisa zwifuwo [ ]
4. Zwisima (U ka madi) [ ]
5. Mishonga ya tshirema [ ]
6. Zwinwevho (sumbedzani)______________________________

B4. Ndi ifhio ndeme ya matzhavha

1. U ka madi [ ]
2. U hwivha majesi na thanga [ ]
3. Mishonga ya tshirema [ ]
4. U rea khovhe [ ]
5. U zwima zwinoni [ ]
6. U nakisa shango [ ]
7. U kunakisa madi (U ita Zwisima) [ ]
8. U langula vhukumbi [ ]

9. U langula mikumbela [ ]

10. U wana thanga dza u fhata [ ]

11. Zwinwevho (sumbedzani)__________________

B5. Vha wana ngafhi mbuyelo ya mutani

1. Kha vhulimi [ ]
2. Vhufuwi [ ]
3. Kha majesi na thanga [ ]
4. U rea khovhe [ ]
5. Zwinwevho (sumbedzani) __________________

B6. Ndi zwifhio zwino khou itwa khau langula matzhavani

____

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____

____

____

____

B7. U bva tshe vha vha hone ndi dzifhio khaedu na tshanduko dzo no vhonalaho majesini

____

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B8. Khavha sumbedze masiandoitwa a tshanduko matzhavani

1. 0 – 20% (a si zwa ndeme) [ ]
2. 21 – 50% (Ndeme) [ ]
3. 51 – 80% (Zwa ndeme) [ ]
4. 81% and above (Ndeme na u fhira) [ ]

B9. Arali ho vha na tshanduko ndi zwito de zwo disaho idzo tshanduko

B10. Ndi a fhio masiandoitwa matzhvani kha mudi wavho

B11 Ndi a fhio masiandoitwa kha vha dzulapo vha muvhundu

B12. U ya nga ha vhone; Ndi zwifhio zwine zwa fanelwa u itwa u fhungudza masia ndoitwa

B13. Ndi nnyi ane a vha na vhudifhinduleli kha masiandioitwa

6. Vhadzulapo [ ]
7. muvhuso [ ]
8. Civic (vhaimeleli vha muvhundu) [ ]
9. Madzngano o diimisaho nga othe [ ]
10. Zwinwe vho (Sumbedzani)________________________

Khethekanyo C: vhudikumedzeli kha masiandoitwa

Ndi khouya u vha vhudzisa mbudziso u itela u divha arali vha tsshi nga kona u bvisa zwitukutuku u itela u tsireledza matzhavani zwi tshi bva mbiluni yavho. Zwo vha zwi tshinga nga konadzea u kunakisa madi a bvaho matzhani. Izwi zwo vha zwi do vha u itela unwa, u bika, u tamba. na u shumisa kha zwinwe zwingaho, u tanzwa madi, u thivhela mikumbululo, u lima, u fulisa zwi fuwo, u gwa mishonga, Kha vha humbule vhudi na zwivhuya izwi uri zwinga vha zwa vhuleme vhungafhani u londa matzhavani.

C1. Vha nga kona u tsireledz majesini

1. Yes [ ]
2. No [ ]

Arali phindulo I ee, kha vha ye kha mbudziso ya vhuraru

C2. Arali phindulo I hai ndi ngani

1. Majesini a huna ndeme [ ]
2. A si vhudifhindulelihanga u tsireledza majesi [ ]
3. A thi vhoni ndeme ya u tsireledza majesi [ ]
4. Zwinwevho (Sumbedzani) __________________________________

C3. Vhanga takalela u badela R5 nga duvha (Zwine zwa lingana R150.00 nga nwedzi) u tsireledza fhethu ho ambiwaho

1. Yes................ ....go to 6 [ ]
2. No......................................go to 5 [ ]
3. I do not know ....go to 6 [ ]

C4. Vhanga takalela u badela R3 nga duvha (Zwine zwa lingana R90.00 nga nwedzi) u tsireledza fhethu ho ambiwaho

1. Yes ....go to 6 [ ]
2. No ....go to 5 [ ]
3. I do not know ....go to 6 [ ]

C5. Vhanga takalela u badela R1 nga duvha (Zwine zwa lingana R30.00 nga nwedzi) u tsireledza fhethu ho ambiwaho

1. Yes..go to 6 [ ]
2. No..go to 6 [ ]
3. I do not know ....go to 6 [ ]

C6. U ya nga havhone ndi vhugai ine vhanga I kona u bvisa u londa matzhani?

1. Amount R ____________________
2. I do not know __________________