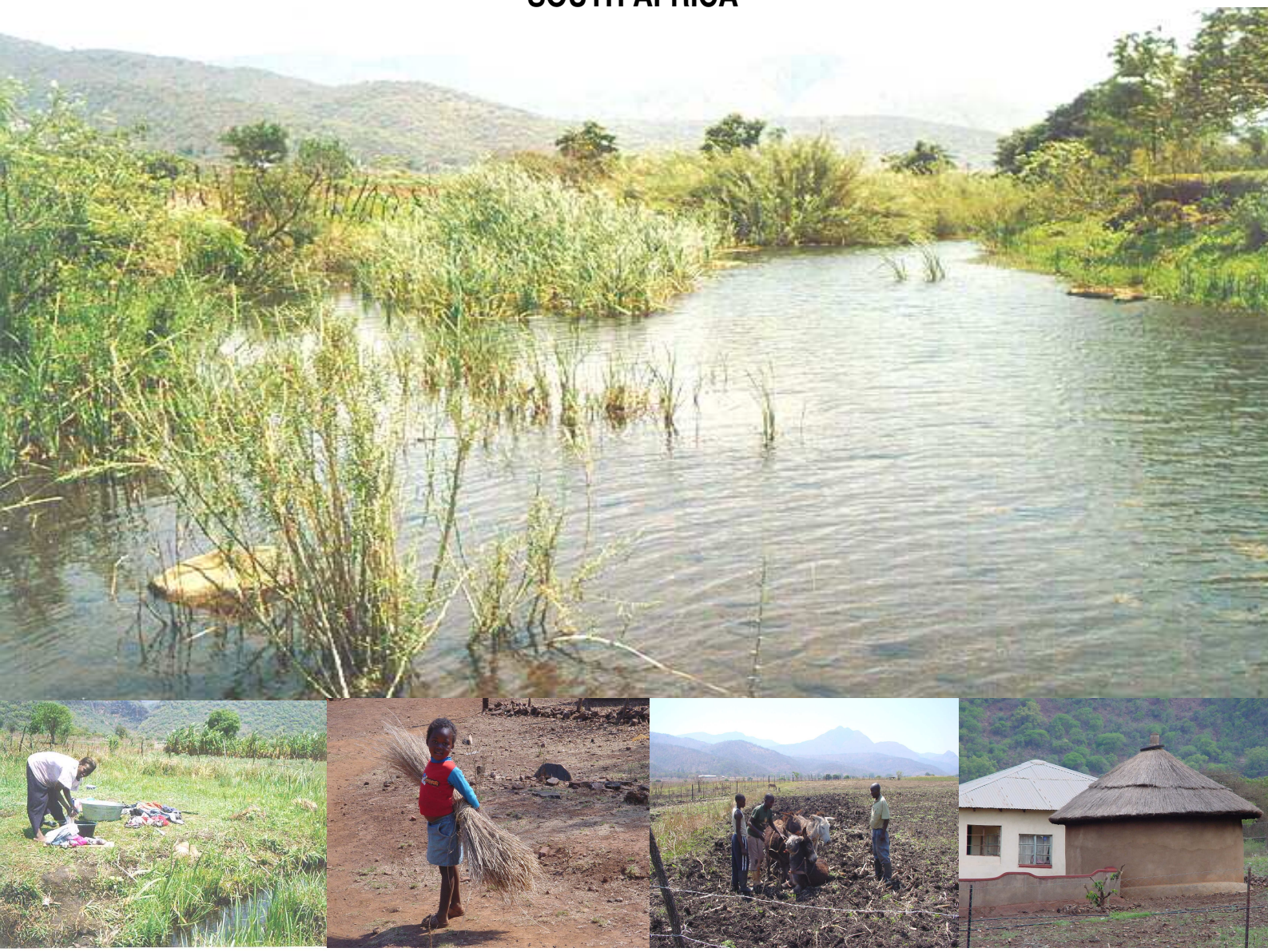
ECONOMIC VALUATION AND LIVELIHOOD ANALYSIS OF THE PROVISIONING SERVICES PROVIDED BY GA-MAMPA WETLAND SOUTH AFRICA



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MSc. Thesis in Environmental Sciences
April 2007

Supervised by: Dr. Rudolf De Groot Environmental Systems Analysis

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IWMI
International
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ECONOMIC VALUATION AND LIVELIHOOD ANALYSIS OF THE PROVISIONING SERVICES PROVIDED BY GA-MAMPA WETLAND SOUTH AFRICA

(As a contribution to the International Water Management Institute (IWMI) project on "wetland based livelihood in the Limpopo basin: balancing social welfare and environmental security")

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Cover photos: credits and date (from top, left to right)
(1) The Ga-Mampa wetland showing a part of the Mohlapitsi River (Olalekan Adekola, November 2006); (2) A young female washing in the wetland (Olalekan Adekola, November 2006); (3) A young girl, carrying a bundle of reed (Olalekan Adekola, October 2006); (4) A farmer with his sons preparing their wetland cropping plot for the cropping season (Olalekan Adekola, October, 2006); Showing a traditional house roofed with reed and a modern one roofed with Zinc (Olalekan Adekola, November 2006)
Photos in report: *All unreferenced photos contained in the report were taken by Olalekan Adekola unless stated otherwise.*

SUMMARY

This MSc thesis is conducted as a contribution to a research project by the International Water Management Institute (IWMI) in South Africa and its partners, on analyzing "wetland based livelihood in the Limpopo basin: balancing social welfare and environmental security". The Overall goal of this project is to develop tools and guidelines to assist decision making regarding the use of wetlands in the Limpopo basin in order to ensure that livelihoods continue to be supported in a way that does not compromise environmental security.

The study area for the thesis research is Ga-Mampa Valley, in the Limpopo province of South Africa. This is a rural area with seven small villages under two main villages- Ga-Mampa and Mantlhane. This area lacks basic necessities and modern infrastructure and this influences the living standard of the local inhabitants. The people and their livelihoods depend basically on natural resources through agriculture at subsistence level and collection of materials from the environment. The area is also blessed with a wetland ecosystem, the Ga-Mampa wetland, measuring about 120 hectare. Hitherto, agricultural activity in the Ga-Mampa valley concentrated on the irrigation schemes located in Mashushu (*Mashushu),* Mapagane *(Fertilis)* and Ga-Moila *(Vallis).* However, due to deterioration of hydraulic equipment combined with a massive flood in the area in 1995, some farmers abandoned irrigated farming and moved to cultivate in the wetland. There was a further destruction to the irrigation scheme, especially that of *Fertilis* after a second flood in 2000. This, coupled with subsequent drought in the area in 2002, led to a larger encroachment and conversion of the wetland for agriculture. With this development, there is concern that Ga-Mampa wetland ecosystem is under threat. In fact, the wetland was halved in size between 1996, just after the first encroachment into the wetland, and 2004. This will influence the benefit that people obtain from the wetlands and jeopardize its integrity.

Acknowledging the importance of the Ga-Mampa wetland, especially to the continued sustenance of livelihood of the local community and the fact that economic factors underlie many decisions, this study aims to provide information that is useful for wetland management and decision making by articulating the economic values of the provisioning services derived from the Ga-Mampa wetland and by evaluating their contribution to the livelihood of local stakeholders. It is hoped that the results will be useful for improving the management of the wetland.

In order to estimate the economic value of resources harvested from the wetland by the local stakeholders, this study adopted an integrated environmental assessment framework, employing several methods and tools. Questionnaire survey, focus group discussions, key informant interviews, field observation and measurements and collection of market prices were the most important methods of data collection. While in the field, an initial reconnaissance survey provided adequate insight into the study area and was used to test a draft questionnaire. The unit of analysis was the household. A first focus group discussion (held on 14th September, 2006) helped to identify wetland croppers and to gain further insight into the study area. Based on the outcome of the survey and focus group discussion, the final questionnaire was developed. Households were classified into wetland croppers and non wetland croppers. A total of ninety-nine wetland croppers were identified, out of which thirty three were randomly selected for the questionnaire survey. Subsequently, thirty-three non-wetland cropping households were also selected for

questionnaire survey using a systematic random sampling technique. In all, there were sixty-six responding households representing about 17% of the total household population of Ga-Mampa valley. After the completion of the questionnaire survey, group discussions were held with selected members of each user group.

The study showed that the main direct benefit of the Ga-Mampa wetland is its use for cropping, livestock grazing, edible plant collection, reed collection, sedge collection, fuel-wood collection, fishing, hunting, medicinal plant collection and collection of water for drinking, washing and bathing. Other services (regulating, cultural and supporting) were not evaluated in this study. Except for cropping, all households in Ga-Mampa valley have equal access to services provided by the wetland. About a quarter of the households use the wetland for cropping, sedge and reed collection, while up to 96% of the households depend on the wetland for edible plants. The proportion of the households using the wetland for fishing, fuel-wood collection, and hunting are in single digits. Overall, all households in the valley depend on the wetland for at least one of these service. Annual quantities harvested of each service vary, depending on the type of service and proportion of household participating in its use. The total annual gross financial value (economic value of annual production) of the provisioning services of Ga-Mampa wetland is estimated $170, 000; the net financial value (gross financial value less cost, whereby household labor time is not included as cost) $162, 000 and cash income (economic value of quantity sold) $14, 000. Most of the materials harvested from the wetland are used for household subsistence and are rarely sold. Livestock grazing contributes the highest gross and net financial value, whereas sedge collection yields the highest cash income. The wetland services are also essential to sustain the social and cultural responsibilities in gift giving to neighbors and relatives. If annual benefit from the wetland is shared equally, it can contribute about $430 per household. A significant difference was found to exist in economic value of services derived by households both within and between sub-villages. The most prominent is the significant difference in total monetary value of benefits between wetland cropping and non-wetland cropping households, this is due to disparity in distribution in benefits from cropping. This disparity is identified as a potential conflict point if not properly handled.

Although economic valuation studies are fraught with uncertainties, and this study is no exception, it is argued that economic valuation is useful. In practice, it is important to reach an agreement and make decisions with whatever partial information that is available rather than continuing theoretical disputes over the “real” value of environmental resources to stakeholders. The findings of this study underscore empirical facts that provisioning services provided by wetlands contribute a great deal to the sustenance of the livelihoods of local stakeholders (most of whom are often poor) depending on the wetland services. However, unlike other studies that focused on large lakes and deltas in which fishing was the most important wetland service contributing to household income, this study found that sedge collection is the most important income generating wetland service. When compared per hectare, value estimates of services in the Ga-Mampa wetland are higher, compared to other wetlands. For example, net value of cropping per hectare per year in Ga-Mampa is $263 relative to about $128 in Nakivobo Urban Wetland in Uganda. However, these values are in the range suggested in De Groot et al., 2002.

This study recommends governmental and non-governmental organizations to support the readiness and willingness of Ga-Mampa valley community to co-operate and organize to manage the wetland sustainably. They can do this by stimulating the optimization of

benefits derived from the wetland, by promoting alternative sources of income and by integrating local stakeholders into the wetland management system. In addition, the use of a mix of methods and data sources was recommend for such studies in the future.

KOPANOFATŠO

Thuto ye ya MSc thesis e hlahlilwe bjalo ka setseka go dinyakišišo projekeng ya ba tša taolo ya meetse (IWMI) ka Afrika Borwa le badirišani mmogo, go ya go hlahloba mehlaka go lebeleše maphelo a batho ka Profenseng ya Limpopo go leka go lekalekanya tša leago le tšhireletšo ya thlhago. Nthlakgolo ya projeke ye e be ele go hloma didirišwa le thlahlo go thuša go ka tšea magato a maleba ka go šomiša dinaga tšeo e le go mehlaka ka Limpopo go kgonthišiša gore go ba le kgatelopele maphelong a batho gomme seo se sa šiye tlhago nyanyeng e se ya šireletšga.

Thuto thlahlo ye e be e nyakišišetšwa seleteng sa Ga-Mampa profenseng ya Limpopo Afrika Borwa. Selete se ke se sengwe sa dilete tše šupa tšeo di lego ka fase ga metse megolwane e mebedi ya Ga-Mampa le Manthlane. Naga ye e hloka dinyakwa tše bohokwa le dišomišwa tša sebjalebjale e bile seo se huetša maemo a bophelo a batho ba gona fao metseng. Batho le tše dingwe tša diphedi di ithekgile go di tšweletšwa tša tlhago go tšwa go tša temo bjoo bo lego boemong bja fase, le go na go hwetša di dirišwa go tšwa tlhagong. Naga ye e na le mohlaka woo o bitswago Ga-mampa, wona o ka lekana dihektara tše 120. Hitherto ke tirišo ya tša temo moeding wa Ga-Mampa woo o lego motseng waga Mashushu, Mapagane (fetilis) le Ga-Moila (Vallis). Le ge go le bajlo ka lebaka la go hloka di dirišwa tša maleba, ka 1995 go ile gwa ba le dikgogola tše kgolo nageng ye gomme seo sa dira gore balemi ba bantšhi ba tlogele mehuta ya go nošetša ditšhemong tša bona gomme baya fao mehlakeng. Go ile gwa ba le tšhitišo go letšema la tša go nošetša kudu kudu ka Fertilis ka morago ga dokgogola tša bobedi ka 2000.Tše tšohle di ile tša latelwa ke komello ka 2002 yeo e ligo ya hlola go fetolwa ga mehlaka go ya go tša temo, diphetogo tše di dirile go re mehlaka ya Ga-Mampa e be ka fase ga ditšhošetšo tša go ka fela ka ge di ile tša kenellwa. Bonneteng mohlaka wo oile wa arolwa ka diripa tše pedi ka 1996, feela ka morago ga go šwahlelwa la mathomo ka 2004. Seo se tlile go huetša dipoelo tša batho ba fao go tšwa mehlakeng eo le serithi sa bona.

Batho ba Ga-mampa ba lemogil bohlokwa bja mehlaka le kgatelopele tšwetšopeleng ya maphelo a batho ba naga eo le mabaka a gore ikonomi e nale mabaka a mantšhi ao e ithekgilego ka wona mo mehlakeng ye. Thuto ye e ikemišeditše go fana ka molaetša wa bohlokwa go taolo ya mehlaka le go tšea dipheto tša maleba tšeo di tla diragatšago bohlokwa bja ikonomi le ditiro go tšwa mehlakeng ya Ga-Mampa le go lekola kabelano maphelong a batho. Re tshepa go re dipoelo di tla thuša go hlabolla taolo ya mehlaka.

Gore re kgone go fa dipalopalo le bohlokwa bja didirišwa tša dipuno go tšwa mehlakeng mo baleming, thuto ye e adimile dikakanyo le bohlokwa bja tša tlhago, le go šomiša mehuta le didirišwa tše difapafapanego. Dinyakišišo, dikopano, tekolo ya lefelo, go bapantshwa ga ditheko mebarakeng e be e le se sengwe sa dilo tše bohlokwa sa go ka kgoboketša dipoelo tše. Ge re sa le kwa ntle di nyakišišong re utulutše lenanego leo le thušitšego thuto ye le go thuša go leka dinyakišišo tšeo dingwadilwego. Re šomišitše di tšweleletšwa tša ka malapeng go hlahloba dinyakišišo tše. Ka di 14 Septemeber 2006 re ile ra swara poledišano ya mathomo go thuša go ka tsweleletša bašumi ba mo mehlakeng le go ka ithuta ka moo go keneletšego mo thutong ye ya mehlaka. Dipoelo tša di nyakisiso le dipoledišano tša dihlopha, re kgonne go ka hloma dinyakišišo tša mafelelo. Didirišwa tša ka malapeng di ile tša beelwa go šomišwa ke bašomi ba mehlakeng le bao ba sa šomego mehlakeng. Bašomi ba masome a senyane le metšo e senyane baile ba hlomiwa go ba bašomi ba mehlakeng, gomma go tšwa go bao ba sa šomego mehlakeng

go kgethilwe ba masome a mararo bona ba ile ba kgethelwa go laola di nyakišišo tša mehalka. Go na fao le didirišwa tša ka magaeng a masome a mararo di ile tša kgethwa go ka šomišwa go leka maano ao a ago leka di dirišwa tše mpsha. Go bile le diphetolo tše masome a tshelelago a di phetolo tšeo di emetšego diporesente tše lesome šupa 917%) ya didirišwa tšeo tša ka malapeng moeding wa Ga-mampa. Kamorago ga dinyakišišo dihlopha di ile tsa kopana go ahlaahla dipoelo.

Thuto ye ebontšhitše go re mehlaka ya Ga-mampa e ka ntša dipuno tša go lebana ge e ka šomiša bašomi ba mehlakeng, phulo ya diruiwa, kgoboketšo ya dimela tseo dilewago, go kgoboketša lmahlaka a go loga legoga, go ya kgonyeng, go tsoma, go ya go theya dihlapi, go kgoboketša dimela tsa kalafi le go kgoboketša meetse a gonwa, go hlatswa le go hlapa. Tše dingwe tša di tirelo go swana le tša setšo le thekgo ga se ra di lekola mo thutong ye. Kantle le bašomi ba mehlaka, didirišwa tsa ka magaeng kwa Ga-mampa di a lekana ka bohlokwa ditirišong mo mehlakeng. Pedi tharong ya di somišwa tša ka magaeng di šumišešwa ke bašomi ba mehlakeng go dimela tšeo dilewago. Kakanyo ya go šomiša mehlaka go theya dihlapi, go ya kgonyeng le go tsoma dophoofolo tsa naga go bopa setho se se tee. Ka kakaretšo di dirišwa ka moka tsa ka gae di itshepetše mo mehlakeng go tše dingwe tša di diršwa tša tšona. Ka ngwaga dipalopalo tša dipuno di a fapana ka ditiro, go ya le gore mohuta wa sedirišwa seo ka lapeng ke eng? Ka ngwaga bohlokwa bja ikonomi ditirišong mehlakeng ya Ga-mampa e balelwa go $17000,00 gomme morago ga ge go lefetšwe di theko moo e le go go re bašomedi ga se ba tšwe ba lefelwa ke $16200.00 le tšhelete eo e šomšswago go reka ditlabakelo ke $14000.00. Dipuno tšeo di bunnwego mehlakeng dišomišetšwa ka magaeng e bile ga do rekišswe kudu ke batho ba fao. Mafulo a diruiwa a tliša bohlokwa ditšheleteng, mo la e le go re legogwa leo lekgiwago letliša tšhelete entšhi. Mehlaka e bapala tema e kgolo maikarabelong a setšhaba ka go re go tšwa mo dipunong setšhaba se kgona go abelana dimpho tša setso le tlhago go baagišani le meloko. Ge ele go re dipoelo tša mehlaka di abelanwa ka go lekana, seo se ka dira gore lapa le lengwe le lengwe le hwetše $430.00. Go na le diphapano tšeo dilego gona ka bohlokwa bja ditlamorago go batho ba motse le ba metsana ya kgauswi. Se bohlokwa ke go fapana ga dipalopalo tša ditšhelete go bašomi ba mehlakeng le bao ba sa šomego mehlakeng, se ke ditlamorago tša go se lekalekanywe ga di kabelano go tšwa go bašomi ba mehlakeng.

Le ge go le bjalo ga go nthla le thito ditlhahlobong tša ikinomi, go akaretšwa le thuto ye, go gateletšwe gore tlhahlobo ya ikonomi e bohlokwa. Ka ditiragatšo, go bohlokwa go fihlelela tumelelano le go tšea dipheto ka se sengwe le se sengwe sa tša mehlaka eo e lego gona, go na le go re re tswele pele go se dumelelane godimo ga bohlokwa bja nnete bja tša ikonomi le maphelo a batho. Dipoelo tša thuto ye di gatelela dintlha tše bohlokwa ka didirišwa tšeo di hwetšwago mehlakeng e bile le tšona di na le setseka mo tšwelopeleng ya maphelo a batho ba motse (bao ba bantšhi ba bona ba šebago ka nta) ba tshepile yona mehlaka ye ka di dirišwa. Le ge go le bjalo go se swane le dithuto tše dingwe tšeo di lebeletšego matsha le melomong ya dinoka moo go rewaga dihlapi go be go le bohokwa, mehlaka e thuša batho ba metsana eo go re ba kgone go iphidiša, thuto e e hweditše go re go kgiwa ga legoga go kenya tšhelete entšhi le go na go hlola mešomo mehlakeng. Ge e bapišwa go ya ka hektara, bohlokwa bja ditirelo mo mehlakeng ya Ga-Mampa bo lenanegong le legodimo kudu, ge e bapišwa le mehlaka e mengwe. Mohlala hektara e nngwe le e nngwe ka ngwaga e kgona go buša $263 seo se lego kgauswi le $128 ya mehlaka ya kwa Nakivobo Urban, Uganda. Dipalopalo tše di šišintšwe ke De Groot et al ka 2002.

Thuto ye e tutuwetša mekgahlo ya mmušo le yeo e sego ya mmušo go re e thekge boineelo le maitukišetšo batho ba mo moeding wa Ga-Mampa le go šomišana le go na go hloma ketapele yeo e tla lotago mehlaka ye ya Ga mampa. Ba ka dira se ka go nyakisiša mathata ao a lego gona mehlakeng ka go hloma metheo e mengwe ya go hwetša tšehlete le go abela batho ba mo metsaneng eo ya go ba le mehlaka le taolo. Go tlaleletša ba ka šomiša mehuta yeo e fapana fapanego ya go hwetsa dipoelo tseo di šišintšego ke thuto ye ka moso.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variation
ARC	Agricultural Research Council of South Africa
CARA	Conservation of Agricultural Resources Act
CDDA	Capricorn District Department of Agriculture
CGIAR	The Consultative Group on International Agricultural Research
CIC	Cash Income
CoV	Coefficient of Variation
CPWF	The Challenge Program on Water and Food
CST	Cost
CV	Contingent Valuation
DEAT	Department of Environmental Affairs and Tourism
DFID	UK Department of International Development
DoA	Department of Agriculture
DPSIR	Driving force-Pressure-State-Impact-Response
DWAF	Department of Water Affairs and Forestry
EA	Ecosystem Approach
ECA	Environmental Conservation Act
EO	Extension Officer (Limpopo Department of Agriculture)
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
GCDF	Ga-Mampa Community Development Forum
GFV	Gross Financial Value
GPS	Global Positioning System
HH	Household
IEA	Integrated Environmental Assessment
IFAD	International Fund for Agricultural Development
IWMI	International Water Management Institute
LPDEAT	Provincial Department of Environmental Affairs and Tourism
LSD	Least Significant Difference
MLA	Multidisciplinary Landscape Assessment
MWP	Mondi Wetland Projects
NCH	Non wetland Cropping Households
NDA	National Department of Agriculture
NEMA	National Environmental Management Act
NEMBA	National Environmental Management Biodiversity Act
NFV	Net Financial Value
NGO	Non Governmental Organisation
NWA	National Water Act
ODI	Overseas Development Institute
PDM	Pebble Distribution Method
PHH	Participating Household
PRC	Price
QGT	Quantity Gift
QHU	Quantity Household Use
QSD	Quantity Sold
SSA	Statistics South Africa
TEV	Total Economic Value
TQH	Total Quantity Harvested or Total Annual Production
WCH	Wetland Cropping Households
WTA	Willingness to Accept
WTP	Willingness to Pay
WWF	World Wide Fund for Nature
USD	United States Dollar

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1. INTRODUCTION

1.1. Background information

Since the very beginning of human life on earth, wetlands have provided valuable resources and refuge for human populations and many other life forms Major civilizations have been established on their shores and have depended upon their resources; places like Amsterdam, Bangkok, Cairo, Tunis and Venice were built in their immediate vicinity (Ramsar Convention Bureau, 2002). Wetlands have been described both as "the kidney of the landscape" because of the functions they perform in hydrological and chemical cycles and as "biological supermarkets" because of the extensive food webs and rich biodiversity they support (Barbier et al., 1997). Through their ecological complexity-structure (flora, fauna, soil) and process (photosynthesis, biogeochemical cycling, ground water recharge) wetland areas perform many functions, which in turn provide the goods and services (hereafter called services[1]) that are important for human well-being (De Groot et al., 2002). These are the services that benefit humans (Millennium Ecosystem Assessment, 2005a). Wetland functions are the processes among and within the various biological, chemical and physical components of wetland, such as biological productivity, disturbance prevention, water supply and gas regulation (Barbier et al., 1997). Wetland ecosystem services include food provision, flood and storm protection, provision of water for consumptive use, carbon sequestration, and use as motive in books and films (Wetland International, 2005).

Inspite of their importance in sustaining human well-being, wetlands remain one of the most threatened ecosystems on our planet. Hitherto, wetlands have in most part of the world been viewed as wastelands and without economic value (Mmopelwa, 2005) resulting in their misuse, overexploitation and lack of adequate information and management attention on them. Since the 1960s wetland protection has gained increasing momentum, culminating in the Ramsar convention[2] in 1975 (Ramsar Convention Bureau, 2000), making wetlands the only single group of ecosystem with their own international convention (Turner et al., 2000). This convention aims to promote wise use[3] of wetlands, by creating a balance between the demands of humans for their services and maintaining their ecological health so that wetland dependents over spatial and temporal scales may continue to benefit from them (Ramsar Convention Bureau, 2000). In an attempt to "reconcile landscape conservation with changing human demands on land-use and natural resources, it is essential that their values (ecological, socio-cultural and economic) be fully taken into consideration in planning and decision making process" (De Groot, 2006). Assessments of these values will no doubt serve as important inputs in wetland management and decision making process. However, none of them (ecological, socio-cultural and economic values) alone is a panacea to all decisions. Resource management decisions are often based on economic factors which are available information on the cost and benefits of alternative activities and their effects on livelihoods (Turpie et al., 1999). Understanding these effects is essential to decision making and ability of the people to

[1] Adopting the terminology of Millennium Ecosystem Assessments, (2005ab).
[2] The convention on wetlands is an intergovernmental treaty whose mission is "the conservation and wise use of wetlands by national action and international cooperation as a means to achieving sustainable development throughout the world". It is named after the Iranian City of Ramsar.
[3] The wise use of wetlands is their sustainable utilisation (human use of wetland so that it may yield the greatest continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations) for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem.

continually sustain their livelihood from nature; this becomes more imperative in poor rural societies.

Schuyt (2005) identified that many wetland ecosystems in Africa lie within arid and semiarid climates (area which are susceptible to frequent drought) and that they are important for the well-being of the people living around them. Their ability to continually provide valuable services is therefore a crucial issue to long term health, safety and welfare of many African communities- without which their survival will be threatened. Specifically, wetlands in Southern Africa have been identified to support the livelihoods of many poor households (Turpie, 2000; Masiyandima et al., 2005; Morardet and Koukou-Tchamba, 2004). One of such is the Ga-Mampa wetland[4] in the Mohlapitsi River Catchment of the Limpopo basin, South Africa, known to support livelihoods of local inhabitants (Morardet and Darradi, 2006; Tinguery, 2006) but also can be important to the recharge of the Olifants River downstream (Masiyandima et al., 2005). Recent research has indicated its conversion for agriculture and drastic reduction in its spatial extent: a situation which is believed to be detrimental to the livelihoods of the predominantly poor wetland dependent inhabitants of this community. Lack of readily available data and information about the values of wetlands has been identified as a major reason why their conversion and development have been viewed as a generally more attractive option, most especially in developing countries. A step in the right direction will be to understand economic values of their direct uses (Turpie et al., 1999).

Three main motives for undertaking economic valuation of natural resources are discussed in literature.

First, economic valuation provides a framework for assessing how a myriad of goods and services provided by resources contribute to human welfare. However, in practical applications, valuing the total contribution of environmental goods and services to human welfare is difficult due to limitations associated with measuring some of the non-market environmental values provided by a resource. It is believed that the process of valuing the contribution of a resource to human welfare is an important step towards sustainable utilization of resources (Turner et al., 2003; Millennium Ecosystem Assessment, 2005a).

Second, economic valuation can be used to evaluate alternative development options by quantifying the costs and benefits associated with each resource use option. In this way economic valuation provides a tool to inform policy decisions regarding conflicts among alternative resource use strategies. However, economic values are solely based on economic efficiency and as such represent just one input into decision-making, alongside other important ecological, social and political considerations.

Finally, economic valuation can be used to attach monetary values to natural resources for the purposes of making adjustments to national income accounts. The rationale for undertaking economic valuation of wetland resources in this study is to assess the contribution of wetlands to human livelihoods.

[4] In previous studies, this wetland was referred to as Mohlapitsi wetland, discussion with local stakeholders led to change of name to Ga-Mampa wetland.

1.2. Context of the project

This thesis is conducted as a contribution to a research project organised by the International Water Management Institute (IWMI) South Africa and its partners on "wetland based livelihood in the Limpopo basin: balancing social welfare and environmental security". The project is part of the Challenge Program on Water and Food (CPWF) in the region of the Ga-Mampa wetland in the Limpopo basin, South Africa. The IWMI is one of the 19 institutions of The Consultative Group on International Agricultural Research (CGIAR). It is a non-profit, scientific research organisation specialising in water use in agriculture and integrated management of water and land resources[5].

The CPWF is a program by the CGIAR to meet the needs of a growing population and to produce more food using less water. CPWF has taken on this challenge from a research perspective. This initiative brings together research scientists, development specialists, and river basin communities in Africa, Asia and Latin America to create and disseminate International Public Goods (IPGs) that improve the productivity of water in river basins in ways that are pro-poor, gender equitable and environmentally sustainable[6].

Noticing the importance of wetlands in livelihoods of rural people in Southern Africa and at the same time, the lack of knowledge on the relationships between human uses and ecological processes which are taking place in wetlands in the area, several national research institutions in Mozambique, South Africa and Zimbabwe, together with IWMI have undertaken this research project with specific aims to:

- Develop and apply a trade-off based framework for making decisions about allocations of wetland resources to specific uses, including agriculture.
- Determine the trade-offs among different agricultural uses of wetland and the trade-offs between each of the agricultural uses and environmental use; develop guidelines on acceptable levels of wetland use for agriculture; and encourage this as best practice.
- Identify as part of the trade-off analysis who benefits, e.g., poor women and men farmers, herders, fisher folk; local business people; etc.
- Enhance capacity of wetland users, researchers, extension officers, natural resource managers, and policy makers.

The project is being conducted from 2004 to 2008 and focuses on three wetlands in the Southern Africa sub-region, these are, Ga-Mampa wetland- Polokwane (old name is Pietersburg) South Africa on which this study focuses, Chibuto wetland in Gaza-Mozambique and Intunjambili wetland, in Matopos- Zimbabwe. It proposes to develop guidelines and tools to assist decision making regarding the use of these wetlands to ensure that livelihoods continue to be supported in a way that does not compromise environmental security based on the basic hypothesis that wetlands can be managed in a sustainable manner, and that a balance between ecosystem protection and human use can be achieved, ensuring optimal use of wetlands.

[5] http://www.iwmi.cgiar.org/ (06-07-06).
[6] www.waterandfood.org (06-07-06).

1.3. Research problem

The Ga-Mampa wetland through its services provides diverse benefits that are useful in supporting livelihoods mainly through subsistence and sometimes income generation to the local population. Apart from these services for household subsistence, the wetland is believed to also perform vital ecological services. For example, the recharge of the Olifants River- benefiting stakeholders at other institutional scales (external stakeholders).

Despite benefits derived from this wetland at varying spatial and temporal scales, it is threatened. Sarron (2005) reported that the most striking change in the Ga-Mampa valley (including Ga-Mampa main village with 4 sub-villages and Mantlhane main village with 3 sub-villages) between 1996 and 2004 is the reduction of the wetland by half and an increase of agricultural activity in the wetland (see Figure 1 and Appendix 1). Agricultural colonization of the wetland by local inhabitants began around year 1995 due to the deterioration of hydraulic equipment of hitherto used irrigation schemes. This was combined with a heavy flood in the area in 1995, which led some farmers to abandon irrigation farming and start to cultivate in the wetland (this was probably the only available option for the people, as surrounding environment is mountainous and dry). A further destruction of the irrigation scheme after a second flood in 2000 and subsequent drought in the area in 2002, led to a larger encroachment and conquest of the wetland for agriculture. The rate of conversion of the wetland has been on the increase ever since. General assumption is that the reduction in the spatial extent of the wetland is due to the encroachment of agricultural activity. According to Dini et al., (1998) wetlands in South Africa are rapidly being degraded because of human activities. However, one should not make the mistake of thinking that wetland degradation is due only to human activities; they are sometimes due to complex global changes, some of which are least partly caused by humans (Barrow, 1991).

The cleaning of the Ga-Mampa wetland has also risen to be an important environmental issue in the area. The Limpopo Province Department of Environmental Affairs (LPDEA) and Mondi Wetlands Project (MWP) opposes farming in the wetland[7]. They claim that the current land uses threatens the integrity of the system, and has adverse effect on the hydrology of the Mohlapitsi River downstream. General perception is that this tributary makes a significant contribution to the flow of the Olifants River[8], particularly in the dry season. However, it is interesting to see that Ga-Mampa wetland farmers do not share this same viewpoint. Actually, they do not understand why they should be forbidden to farm in such areas while their grandparents were used to doing so[9] (Perret et al., 2004).

[7] The MWP is a joint Project of South Africa's two largest NGO conservation organisations, WWF - South Africa and the Wildlife and Environment Society of South Africa, together with two corporate sponsors the Mazda Wildlife Fund and the Mondi Forestry Company. The Project is WWF - South Africa's premier freshwater Project, and forms part of their global Living Waters Programme. The MWP's mission is to catalyse the wise use and rehabilitation of wetlands in South Africa (http://www.wetland.org/za 10-02-07).

[8] There are recent concerns that the Olifants River is drying up, due to decrease in water inflow from its tributaries. Apart from being the biggest river flowing through the Kruger National Park, over 2 million people are believed to depend on the river.

[9] Chairman and Secretary of Ga-Mampa Community Development Forum (GCDF) corroborated the fact that evidence such as old clay pots *(mangeta);* beacons and locally made farming hoes have been found in the wetland to suggest farming in the wetland by their forefathers (also see box 5, pp 49).

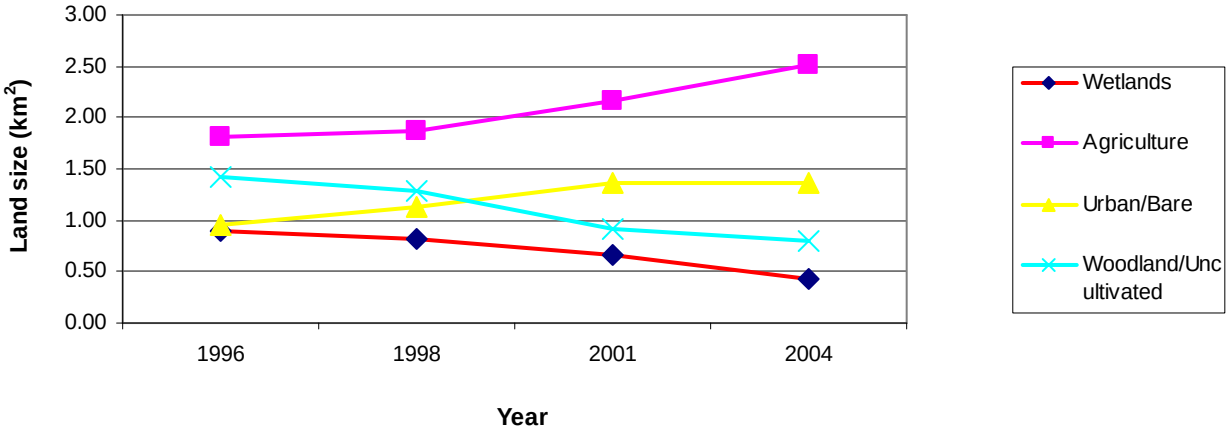


Figure 1: Land use evolution in Ga-Mampa valley from 1996 – 2004 (Graph plotted with data from Sarron, (2005).

Such change in the extent of the wetland is believed to have implication(s) for the level of benefits derivable from it to meet and satisfy livelihoods of wetland dependants. There is established evidence from other part of the earth that the changes being made in wetland areas are increasing the likelihood of abrupt changes in ecosystem with important consequences for human wellbeing (Millennium Ecosystem Assessment, 2005a). This means that the degradation of wetland ecosystems will reduce their capacity to continually support and supply services which are important to the livelihood of wetland dependent populations, particularly those living near the wetland. This negatively affect (undermine) their source of livelihood and can further exacerbate poverty. This leads to a crucial question: if this ecosystem is so vital for their (local stakeholders) livelihood, why do they take decisions that threaten its (wetland) health and their own livelihood.

One reason to explain the continued conversion of wetlands is the failure of information: lack of readily available data and information about the values of services supplied by wetlands due to non-valuation of their services which has not helped the full appreciation of their value (Balmford et al., 2002; Mmopelwa, 2005). Even where such information is available, it is often for bigger wetlands. There is minimal focus on understanding the economic values of smaller wetlands, probably, because they are considered insignificant. According to Turpie et al., (1999), in most developing societies valuation of the direct use values of wetland for subsistence users is the key to making their conversion and development to be generally perceived as the less attractive option. This appears to be the case in Ga-Mampa valley, as there is limited readily available data and information pertaining to the values (especially economic) of the Ga-Mampa wetland. Costanza et al., (1997); Barbier et al., (1997); Garrod and Willis (1999); Turner et al., (2000) have all also called for the valuation of services provided by nature because of its importance in improving awareness of the services derived from them. The idea is that, justification for their wise use to continually support the livelihoods of stakeholders may best be achieved if it can be proven to them that alternative action is more expensive. To do this in a society like Ga-Mampa valley, where educational level is low, the use of economic valuation is most useful. In addition, understanding the economic status of wetlands is critical to planning for their sustainable management and wise use. It is true that wetlands typically do have high economic values; it is also true that economic forces underlie wetland degradation and loss (Emerton and Kekulandala, 2003) thus warranting wetland management to more often requires a range of economic management responses.

This study will provide insight(s) into the economic value of the Ga-Mampa wetland, but its main focus is to evaluate the contribution(s) of the provisioning services provided by the wetland to the livelihood of local stakeholders.

There are quite a substantial number of empirical studies on valuation of wetland services- (Bell, (1997); Oglethorpe and Miliadou, (2000); Acharya and Barbier, (2000); Dubgaard, (2004); Chopra and Adhikari, (2004); Mmopelwa, (2005); Born et al., (2005); Schuyt, (2005)) some of which focuses specifically on African wetland ecosystems. Barbier et al., (1993) conducted a partial valuation to assess the economic importance of the Hadejia-Nguru wetland (Nigeria), Schuyt, (1999) applied market pricing methods to estimate wetland benefits associated with Lake Chilwa (Malawi). In another study Turpie et al., (1999) also applied market pricing methods to estimate the wetland benefits associated with the Zambezi basin wetlands. Emerton et al., (1999) undertook a wetland valuation study for the Nakivubo wetland (Uganda) aimed at quantifying the present and potential economic benefits of wetland goods and services and compare these with the potential gains from its conversion and modification to industrial and residential developments. The lack of specific economic information about Ga-Mampa wetland without which an effective management plan is difficult to develop, diversity among wetlands, and general lack of information on such small but important wetlands justifies this research.

1.4. Causal diagram

A causal diagram is presented (Figure 2) to describe the nexus between origin and consequence of environmental problems as could be applicable in the case of Ga-Mampa wetland.

The DPSIR framework is based on the logic of Driving Forces-Pressures-States-Impacts-Responses. Driving forces are the socio-economic and socio-cultural forces driving human activities, which increase or mitigate pressures on the environment. Pressures are the stresses that human activities place on the environment. State, or "state of the environment", is the condition of the environment. Impacts are the effects of environmental degradation on population, economy and ecosystem. Response refers to the responses by society to the environmental situation[10]. This framework is useful in emphasizing the importance of causality in environmental assessments (Smeets and Weterings, 1999); however a recent critique of it has been made in favor of an enhanced (e)-DPSIR, (Niemeijer and De Groot, 2006). For convenience and sake of reducing complexity a DPSIR framework has been presented as against an e-DPSIR. DPSIR Framework assumes causality which is not very conducive because it provides a much simplified relation that omits complicating external factors and many of the intermediate steps and (2) it does not account for the fact that we are seldom dealing with one to one relations. Niemeijer and De Groot (2006)

In Ga-Mampa valley, rapid increase in population (indicator: demography) and poor living standard (indicator- income) in the area coupled with natural disaster that lead to reduction of agricultural land available to the people for cultivation are major driving forces. These led to pressures on the wetland, seen in the form of increased human activities (increased demand in utilizing the provisioning services, such as increased

[10] http://maps.grida.no/go/graphic/dpsir_framework_for_state_of_environment_reporting.

grazing, cropping, and collection/harvesting of materials in the wetland). It is these stress/pressures that are believed to cause changes the functioning and state of the wetland, thus undermining the ability of the wetland to continually support livelihood of the local populace (Impact). There could be four paths of response, (indicated with broken lines in figure 2) focusing on the D-P-S-I. This thesis adopts the response line aimed at providing information by understanding the relationship between changes in function (state) and value of the Ga-Mampa wetland and its attendant impact on the local population (impact). This is indicated with filled box (Figure 2).

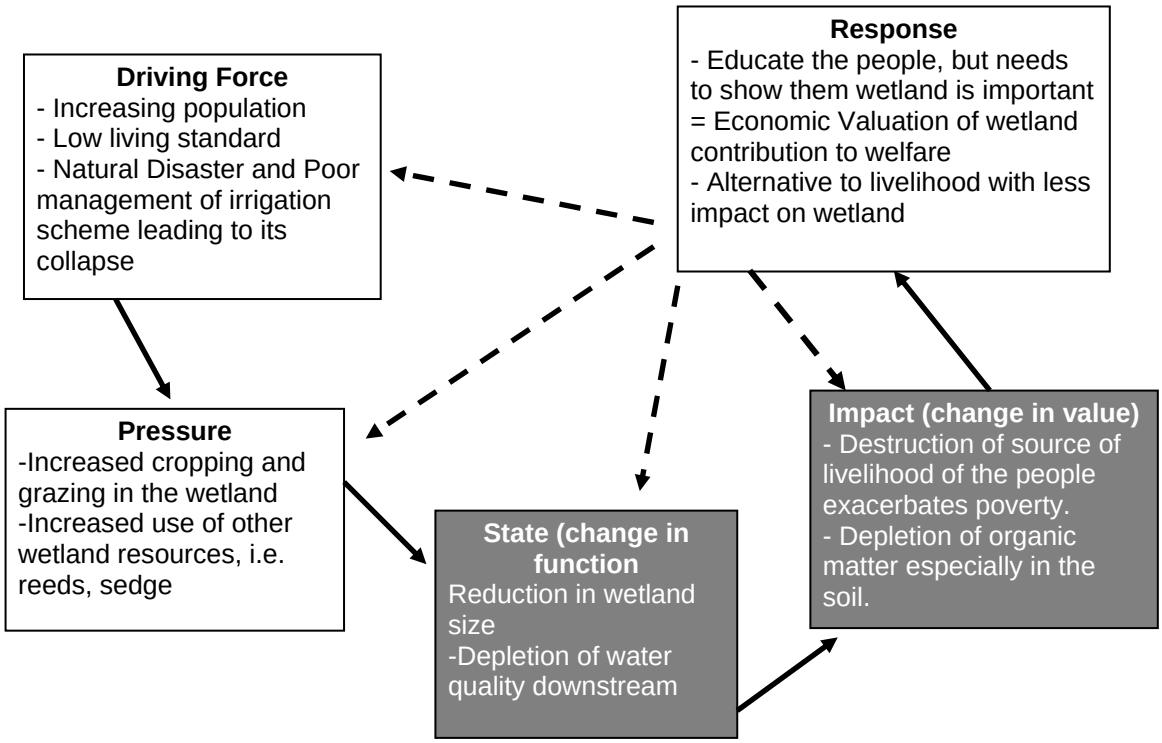


Figure 2: DPSIR framework describing causal chain of changes in Ga-Mampa wetland (Based on Smeets and Weterings, 1999).

1.5. Objectives of the study

Consistent with the overall goal of the CPWF project, this thesis has as its objective to

- provide economic information about the provisioning services of Ga-Mampa wetland.
- evaluate the contribution(s) of these services to the livelihood of local stakeholders.

These will be done by assessing the economic values of benefits derived from the provisioning services of the wetland with the sole aim of contributing knowledge to the enhancement of the livelihood of Ga-Mampa wetland dependants.

1.6. Research questions

To achieve these objectives, this thesis will attempt to address the following questions.

1. What are the main provisioning services provided by Ga-Mampa wetland?
2. What proportion of the households in Ga-Mampa valley depends on the wetland for supply of each provisioning service?

3. What quantities of provisioning services are harvested from the wetland annually?
4. How are these services used by participating households?
5. What is the annual economic value of the main provisioning services provided by the Ga-Mampa wetland (economic efficiency)?
6. How are the benefits of wetland services distributed among different household types in the Ga-Mampa valley (equity)?

1.7. Scope of study

It is important to clearly define the scope of any research. For this study, it is expedient to define the spatial and temporal scope as well as scope of stakeholders and ecological services covered in the study.

Spatial scope of the wetland

"Wetlands is a strange word, how can land be wet and how can water be land" (IUCN, 1997). The fact that wetlands are places often under water and sometime dry makes them a special phenomenon. There are some disagreements among scientists on what constitutes a wetland, partly because of their dynamic character and partly because of difficulties in defining their boundaries with any precision. For instance, what is/should be the acceptable flooding length and extent for a land to be considered a wetland (Mitch and Gosselink, 1993, cited in Turner et al., 2000). Variety of wetland definition exists in literature and even within and among nations. For example, in the United States of America, different wetland definition exists among states and with the federal government. However, the most widely and internationally acceptable definition was adopted by some 100 countries by signing the Ramsar Convention on wetlands of international importance. According to the convention a wetland is; "*an area of marsh, fen, peat-land or water, weather natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does exceed six meters" (Article 1.1 Ramsar Convention on Wetlands of International Importance)* In addition the convention provides that wetlands may incorporate; "*riparian and coastal zones adjacent to the wetlands, and island bodies of marine water deeper than six meters at low tide lying within the wetland" (Article 2.1 Ramsar Convention on Wetlands of International Importance).*

In South Africa, Wetland definition is based on the Cowardin classification system (Cowardin et al., 1979). This serves as the national working definition in identifying and delineating wetlands. By this system, wetlands are defined in Section 1.1 of the National Water Act as; *lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.* In order for an area to be classified as a wetland under this definition, it must meet at least one of the following criteria:

- *at least periodically, the land supports predominantly hydrophytes;*
- *the substrate is predominantly undrained hydric soil;*
- *the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season.*

The wetland definition also incorporates what Cowardin et al., (1979) termed "deepwater habitats", which are defined as: *permanently flooded lands lying below the deepwater boundary of wetlands. They include environments where surface water is permanent and*

often deep, so that water, rather than air, is the principal medium within which the dominant organisms live, whether or not they are attached to the substrate. The inclusion of Cowardin's deepwater habitats within the wetland definition for delineation of spatial extent of South African wetlands ensures compatibility with the definition for wetlands used by the Convention on Wetlands. South Africa, as a Contracting Party to the Convention, already makes use of this definition for a variety of applications, making compatibility of definitions an important issue (Dini et al., 1998).

It has been noted that in the face of the variation of definitions, it is important for integrated wetland research to some-how make compatible the different perceptions by experts (Hein et al., 2006). The Ga-Mampa wetland is therefore defined in terms of hydrology (flooded or saturated soils), plants (adapted to saturated soils) and soil (saturated)[11]. For this thesis, wetland was delineated using the Cowardian/South African model, based on soil moisture and hydrology of the area fitting more the third criterion above. This delineation also fits perfectly into the perception of the local stakeholders as to the meaning and extent of the wetland (Morardet and Darradi, 2006). An important point with this delineation is that the adjacent river (Mohlapitsi River) was clearly demarcated as not been a part of the wetland, as such, whereas, fishing and sand mining takes place in the river; these activities here are not regarded as wetland activities.

Scope of stakeholders and ecological services

Wetland ecosystems provide a diversity of services, (Millennium Ecosystem Assessment, 2005a) most of which are mentioned in literature (see Costanza et al., (1997); De Groot (1992); De Groot et al., (2002); Millennium Ecosystem Assessment (2005a)). Table 2 (pp25) provides a summary of ecosystem services (non exhaustive) that can be associated with a wetlands, these services accrue to stakeholders. The term stakeholder describes individuals, groups, or organizations that have an interest in a project and can mobilize resources to affect its outcome in some way. A formal definition of a stakeholder is: "Individuals and organizations who are actively involved in a project, or whose interests may be positively or negatively affected as a result of project execution or successful project completion" (Cleland, 1998). Morardet and Darradi (2006) conducted a stakeholder analysis for the Ga-Mampa wetland and reports that “communities see mainly the wetland as an agricultural resource for their livelihood while scientists perceive it as a basis to analyze its functions and the trade-offs existing between agriculture and environment, stakeholders outside the valley focus on the hydrological importance on the Mohlapitsi River to the Olifants River and an opportunity to develop economically the valley using alternatives as craft industry and tourism”. This difference in view among stakeholders re-echoes the fact that ecosystem services are generated at a range of ecological scales and are supplied to stakeholders at a range of institutional scales (Figure 3). Across the institutional scales, stakeholders can have very different perspectives on the values of the ecosystem services, based among others on their dependency upon specific ecological services to provide income or sustain their living environment (Hein et al., 2006). In most cases stakeholders at the local scale (individual–village) tend to be more interested in services that yield direct economic benefits while those at the higher scale are interested in ecological benefits. For example, Ga-Mampa wetland generates provisioning service like sedge and reeds, most of which are supplied mainly for the use of local stakeholders[12]. On the other hand, other services provided by the wetland such as

[11] Based on personal communication with Dr. Mutsa Masiyandima, a researcher with IWMI South Africa.
[12] Morardet and Darradi, (2006) divided Ga-Mampa wetland stakeholders into local (Individuals, households and village) and outside stakeholders (NGOs, Municipality, state and international).

recharge of the Olifants River are beneficial not only to the local stakeholders but also stakeholders from outside (municipal–international). The difference at institutional (stakeholder) scale and ecological scale introduces a complexity that needs to be well understood and taken care of. Whereas, it is important to assess the economic value of all services provided by nature to all stakeholders, this will no doubt be a time consuming and complex endeavor.

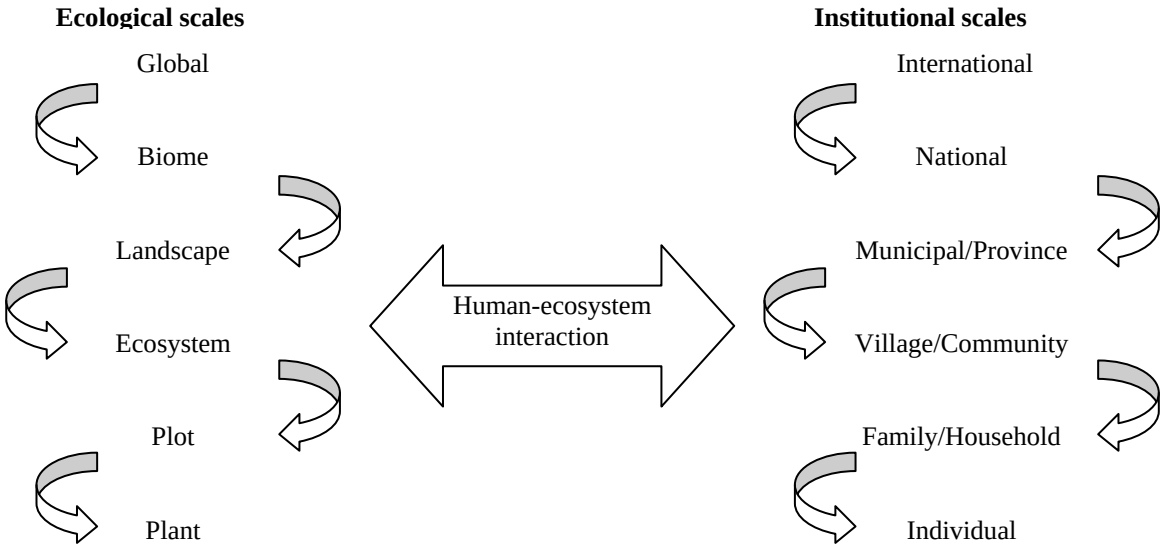


Figure 3: Selected ecological and institutional scales (adapted from Leemans, 2000).

Considering resources available (i.e. time) and need to conduct a thorough study coupled with the goal of the CPWF project, decision was made to limit the focus of this thesis only to services that are for direct human utilization most of which accrue directly to the local inhabitants of Ga-Mampa valley to sustain their livelihoods. In addition to time constraints, restriction of the valuation to provisioning services was motivated by uncertainties and controversies about the extent and scope of especially the regulating services of the wetland. For example, some external stakeholders (MWP) claim the role of the wetland in regulating river flow downstream and supplying water to the Olifants River, while hydrologists of the research team (IWMI) express some doubts on the contribution of the wetland itself to the river flow downstream. Such issue needs to be clarified before any economic valuation can be undertaken on this service. As such this thesis does not focus on all the known services associated with Ga-Mampa wetland ecosystem, rather focus is mainly on provisioning services (cropping, livestock grazing, collection of edible plants, collection of reeds, collection of sedge, fishing, hunting, fuel-wood collection, medicinal plant collection and collection of water for washing, bathing and drinking) provided by the wetland as identified through an integrated procedure. However, apart from these, effort was made to identify other ecological services (regulating, cultural and supporting) provided by the Ga-Mampa wetland.

Temporal scope

This study is using a static economic analysis to estimate monetary value (Gross Financial Value (GFV), Net Financial Value (NFV) and Cash Income (CIC)) of the wetland. As such, analysis is restricted to cover a year period- i.e. 2005/2006 cropping year only. A cropping year starts in September/October and ends the following September/October. For studies focusing on developing a dynamic model, it is imperative

to collect adequate data covering several years over different periods[13] to take care of the inter-temporal variability in phenomenon (quantity of harvest, price etc). Decision for a static analysis is based on the need to first understand the current situation and also time constraint which could not allow for adequate monitoring of wetland activities because respondents could hardly remember their activities beyond a year. Thus, results in this thesis are relative to a year period. Statistical generalization can however be made from these results, i.e. it can be inferred that what is true for this year is true for other years. Further studies could be conducted to take into full consideration the temporal dynamism in economic variables related to the wetland.

1.8. Outline of Report

This report is organized as follows; this chapter (chapter 1) discussed the background and focus of the study. In chapter two, the research study area is described with a view to providing basic information about the study area. Chapter three is a compendium of existing literature and details of the theories and methods adopted in the study. Results and their analysis are presented in chapter four to six. Chapter four provides an inventory of identified services provided by the Ga-Mampa wetland, it also provides an insight into local stakeholders' perception of these services. In chapter five results of the economic valuation of the wetland services are presented, the chapter ends with an uncertainty analysis of the valuation estimates. Chapter six analyzed the distribution of benefits derived from the wetland provisioning services across different household types. A discussion of the methods of study and results against other existing studies is presented in chapter seven, while the final chapter (chapter 8) provides conclusions and recommendations to the study.

[13] Attempts were made at the beginning of fieldwork to collect data for more than a year; this was not possible as most respondents can hardly recall most of their activities beyond one year.

2. DESCRIPTION OF STUDY AREA

2.1. Introduction to study area

This study was conducted at the lower catchment of the Limpopo River basin**.** The Limpopo River arises in the interior of Africa, and flows generally eastwards towards the Indian Ocean. The Limpopo is the second largest river in the region after the Orange River. It is around 1,600 kilometers long and its main tributary is the Olifants (Elephant)/Letaba River. The basin of the Limpopo straddles four countries, namely Botswana, Mozambique, South Africa and Zimbabwe (Appendix 2). About 14 million people live in the Limpopo river basin, an area of about 413,000 km^2. Most of the people living in this area are poor, while starvation and malnutrition are not uncommon during drought or crop failure[14]. The selected site for this thesis is in South Africa – Ga-Mampa wetland, located in the catchment of the Mohlapitsi River, a main tributary of the Olifants River in the Limpopo Province, Capricorn District, Mafefe Ward 24 (Figure 4 and 5). The Mohlapitsi River flows from the Wolkberg wilderness area within part of the northern Drakensberg and Strydpoort ranges, passing through Ga-Mampa valley before joining the Olifants River downstream. Its basin covers an area of about 490km^2 mainly composed of the Mohlapitsi river (50km long) (Chiron, 2005).

2.2. Location and extent

Ga-Mampa valley is a rural village located in the Mafefe tribal area of the Lepelle-Nkumpi Local Municipality of Republic of South Africa. The Ga-Mampa valley covers a land area of about 5km^2. It is adjacent to the Mohlapitsi River and mid-stream of the river course. Geographically, it is located on coordinates 24° 7' 0" South; 30° 5' 0" East[15], this is close to the centre of the Mohlapitsi catchment, immediately upstream of the DWAF (Department of Water Affairs and Forestry, South Africa) flow gauging station B7H013 (24:10:11 S, 30:06:11 E). The closest town to Ga-Mampa valley is Tzaneen, which is about 42km away. Ga-Mampa valley is about 120km and 87km to Polokwane and Lebowakgomo, district and municipal capital respectively (Figure 4 and 6). The wetland is approximately 120 hectare with a catchment of approximately 40,000 hectare (Kotze, 2005). The wetland could be divided into four main portions based on partitioning enable by strands of drier land (Appendix 1).

2.3. History

Just before the beginning of the 20th century, only black people were living and farming in the Ga-Mampa area. Two families mainly, were settled in the place called Mapagane and Mashushu, since a long time: The Mohaltlole and the Mampa families. The Mohaltlole family who arrived first in the area lived and ploughed along the river while the Mampa family was settled in the valley but ploughed more upstream in the mountains in order to protect their crops against floods. (Ferrand, 2004).

[14] http://en.wikipedia.org/wiki/Limpopo_River (30-10-06).
[15] http://www.maplandia.com/south-africa/northern-province/pietersburg/ga-mampa/ (15-01-07).

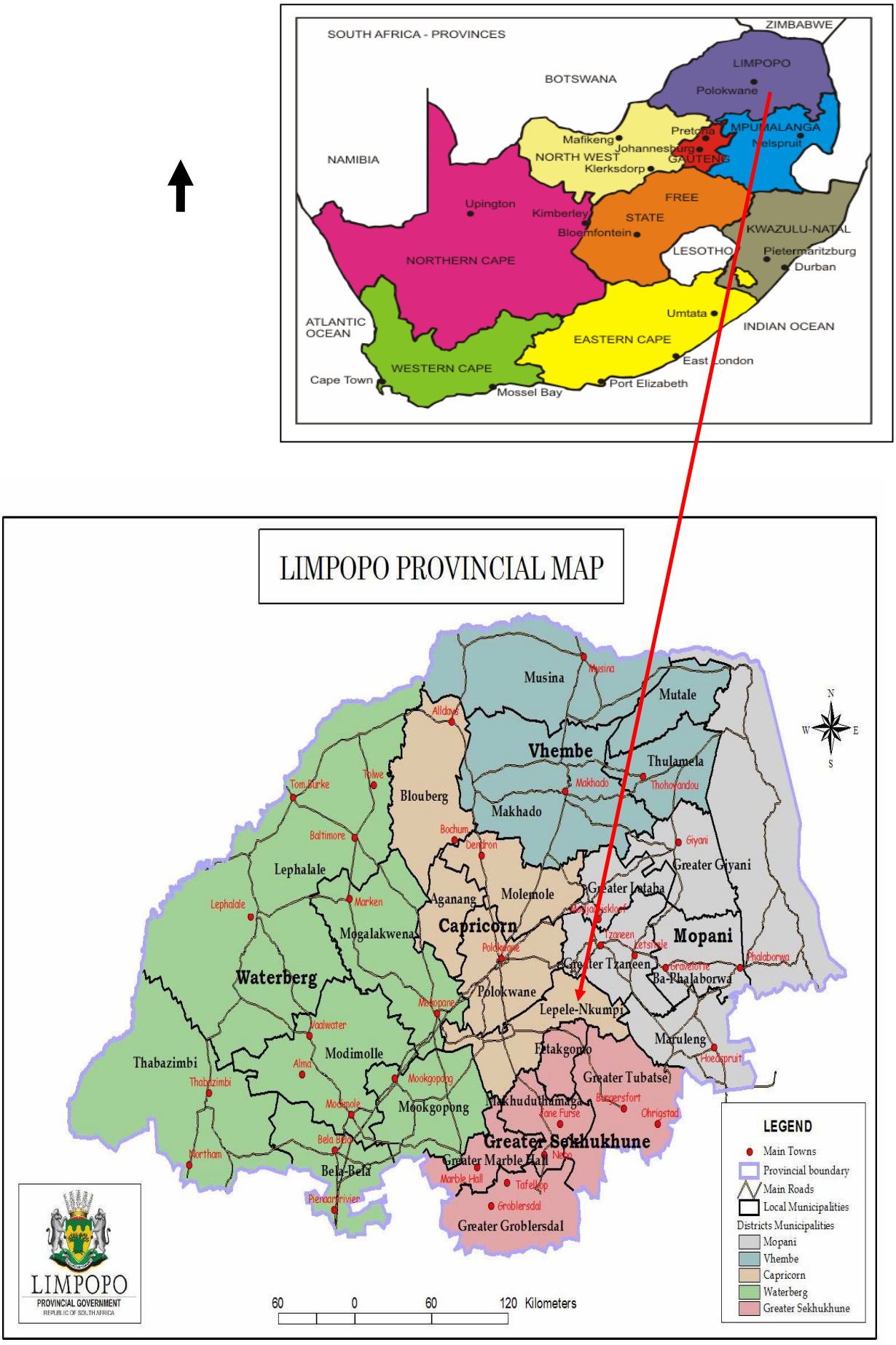


Figure 4: Map of South Africa and Limpopo province showing location of Ga-Mampa valley (Map above: http://www.anc.org.za/lists/maplist.html & map below:http://www.limpopo.gov.za/about_otp/location.asp).

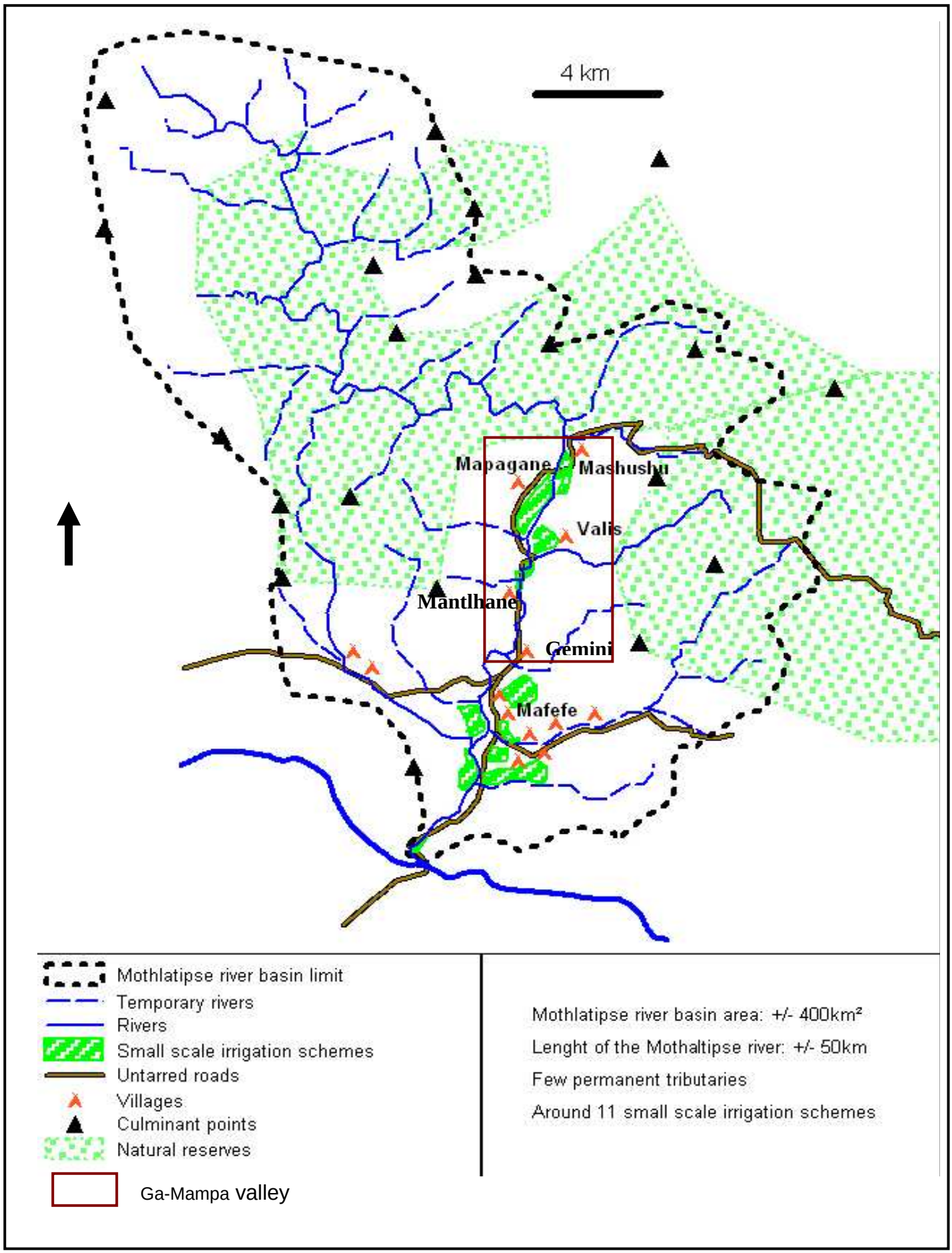


Figure 5: The hydrographic map of the Mohlapitsi catchment showing location of the Ga-Mampa valley (Source: Chiron, 2005).

According to (Sarron, 2005) as reported by (Chiron, 2005) the history of the area can be told in five main steps.

1. Before the beginning of the 20th century, the local population of the Ga-Mampa Valley lived near the river and practiced rain fed agriculture (sorghum). At the beginning of the 20th century, white farmers came and evicted the local population, leaving the valley under cultivation by white farmers up to 1959. The local population took refuge in the mountains and provided labor for the white farms. In 1959, the Native Government of Lebwagomo bought the 3 existing white farms located in Mashushu (called *Mashushu* irrigation scheme), Mapagane *(Fertilis)* and Ga-Moila *(Valis*) which were equipped by earth canal. The Government built cemented canals for the *Fertilis* farm which became the official *Fertilis* irrigation scheme. The Mashushu and *Valis* white farms (which became *Mashushu* and *Valis* irrigation scheme) got fence all around the cultivated irrigation scheme and also beneficiated of cement hydraulic equipments (Chiron, 2005).

2. In 1964, the government created natural reserves in the mountains while the local population returned to the river that the white farmers had left. During the 1960s, the natural wetland covered an area downstream of *Fertilis and Valis* of more than 90ha[16]. Irrigated agriculture dominated and rain fed (wetland access) production was rare in the valley. The Fertilis irrigation scheme grew by 10 more farmers with an area of 92 ha. At this point, farmers began occupying the natural wetland at *Fertilis* (Mapagane) and *Valis* (Ga-Moila) downstream.

3. In 1994, with the end of the apartheid era and the dawn of new political programmes, civil servants responsible for the irrigation scheme retired or were removed. The government decided to transfer the irrigation management to the black community. However, most of the Ga-Mampa citizens were unaware that they had to manage the irrigation scheme by themselves. The irrigation management was transferred to farmers too quickly which resulted in the decline of the irrigation scheme including deterioration of hydraulic equipment. This combined with decreasing water supply, stray animals, difficulties organizing farmers, and the 1995 flood, caused some farmers to discontinue winter crop production while others opted to cultivate the wetland. This migration corresponds to the first significant wetland conquest in the mid 1990s. As a result, fallow land area has increased inside the irrigation scheme while part of the wetland was transformed into cultivated land. At the end of the 1990s, the natural wetland had been reduced by a quarter, with most part of it having dried up.

4. In 1999, a local Extension Officer found funds to build a gabion weir for the *Fertilis* and Mashushu irrigation schemes. Farmers participated by providing the stones, but these dams were destroyed by the 2000 flood. The 2001 season was a bad one for farmers and with a similar fate in 2002 most farmers lost money. Following these bad years, farmers asked the headman for plots in the wetland signaling the second natural wetland conquest.

[16] Kotze (2005) approximates the wetland area to 120 hectare, based on my fieldwork and rough estimations; value by Kotze is the most probable size of the wetland.

5. In 2004, the wetland was divided into two parts: (1) the remaining natural wetland; and (2) the cultivated wetland. During this period an agreement was reached with the headmen to seize granting access to cropping plots in the wetland, even though there is rarely any left. Prior to 2005/2006 cropping season more than half of cultivated area is devoted to coriander production during the winter and maize during the summer.

2.4. Village organization and population

Inhabitants of Ga-Mampa valley are mainly black *Spedi* dialect (Northern Sotho language) speaking people of South Africa. There are two main villages with seven sub-villages in the Ga-Mampa valley. Ga-Mampa is the largest of the villages having sub-villages of Ga-Moila, Mapagane, Marulatchipigh and Mashushu. Mantlhane main village consists of sub-villages of Ditabogong, Gemini and Mantlhane Each main village has a headman[17] *(Induna)*. The *Induna* and his chief *(Kgoshi)* are the traditional and cultural custodians of the Ga-Mampa people; they oversee traditional development and addresses issues such as circumcision and conflicts among subjects. The *Induna* is elected and changed only after death. Administratively, Ga-Mampa valley (both main villages) falls under the same ward under an elected ward councilor. The councilor is the administrative representative of the people of Ga-Mampa valley at the municipality (Lepelle-Nkumpi). The people of Ga-Mampa have also formed for themselves a development forum (Ga-Mampa Community Development Forum- GCDF) responsible to formulate programmes for the development of the area. The forum also liaises with external organizations such as NGOs and research and academic organizations interested in the area. There are about 11 committees under the forum, one of which is the wetland committee.

Population statistics based on 2001 census figures provided by Statistics South Africa[18] reveal that in 2001, Mafefe ward 24 had a population of 9217 persons living in 1968 households with a population density of 223 people per km^2. Ga-Mampa valley accounted for 1679 persons (18% of the total in the ward) and 327 households (17% of the total in the ward). Since this time, population has increased with increasing fertility rate and springing up of new settlements especially in Marulatchipigh and Mashushu. Data[19] from field study estimate current population at 2364 persons in 394 households for Ga-Mampa valley (Table 5, pp38).

2.5. Infrastructure

The valley is served by a dirt road which is in poor condition and impassable by small vehicles, in the rainy season it would be totally deplorable. The only means of public transportation is a government bus which leaves Ga-Mampa valley daily for Polokwane at 06:00 o'clock and returns at 18:00 o'clock transporting people and goods. The main means of communication is a local radio station; while few households have access to cable television[20]. Telecommunication service is not available except for intermittent and weak signals at some specific locations (on mountain tops) only in Mapagane. There are no industries, but presence of small business shops selling groceries and liquor. There are

[17] Traditional head of the people.
[18] www.statssa.gov.za.
[19] Effort made to acquire current population data from relevant authorities was not successful. Average household size was related to average number of household to calculate current numbers.
[20] Its location in a valley makes television signal impossible without a cable television satellite.

three schools (2 primary and 1 secondary), churches, and a community hall[21]. Most of the houses have access to electricity except in Mashushu where new houses have sprung up of recent. In Ga-Mampa valley, no one household was observed to having water connection; the people go out to the river, springs, or wetland to get their domestic water needs. The sanitation systems used is pit latrine. Hospital, police station and wholesale market are kilometers away from Ga-Mampa valley (Figure 6).

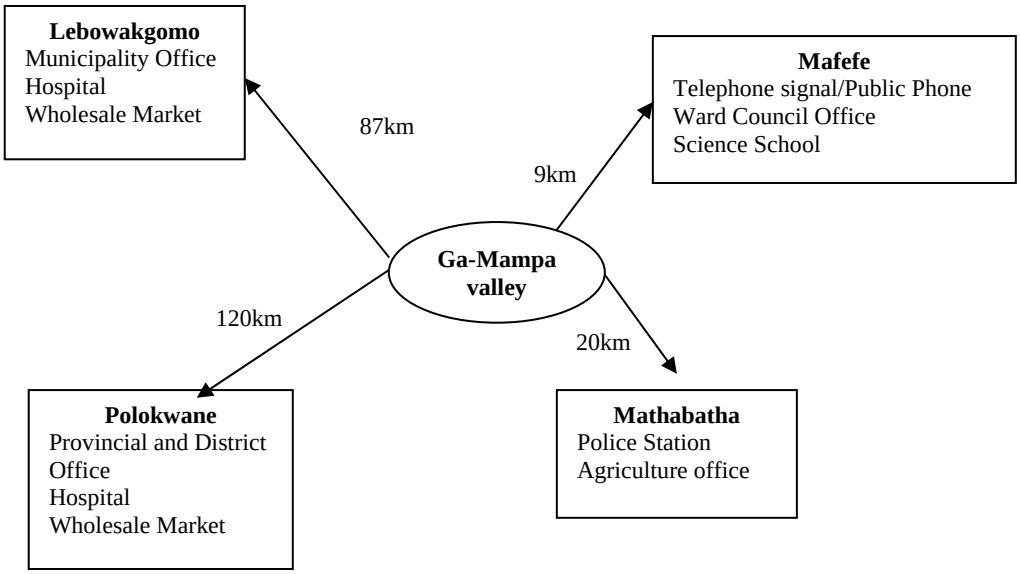


Figure 6: Sketch showing average distance of Ga-Mampa to neighboring towns and location of basic infrastructure and services (Adapted from Ferrand, 2004).

2.6. Climate and vegetation

Located close to South Africa's northernmost area and bisect of the tropic of Capricorn, Ga-Mampa valley generally experience sunshine, long summer afternoons and dry days for most periods of the year. Its position on the western side of the Drakensberg Mountains protects it from the dominating and humid winds coming from the east (Troy et al, 2006). This area experience high spatial and temporal variation in precipitation. Mean annual precipitation exceeds 1000mm in the higher elevations while in the valley it is between 500 and 600 mm (Schulze et al., 1997). Average temperature is highest between January and December, and lowest between June and July (Figure 7). Mean annual evapo-transpiration of the area (A-pan evaporation) is about 1652 mm with an average maximum daily relative humidity of 90.4[22].

Ga-Mampa wetland supports a range of different vegetation types, which vary according to particular site characteristics including wetness of area, location relative to river channel. *Phyragmites Mauritanians* was clearly established as the most widely occurring plant specie in the wetland only with small isolated strands of *Cyperus latifolis* and *Cyperus sexangularis* (Appendix 2). Not much is know at present of the fauna composition of the wetland (Kotze, 2005).

[21] The Ga-Mampa community centre was commissioned for use on 22-09-2006. It was built with funds from the French Embassy in South Africa in partnership with the Centre for Rural Community Development of the Limpopo University. The centre served this research as meeting place, venue for focus group discussions and feedback workshop to the local stakeholders.

[22] http://www.weathersa.co.za (15-01-07).

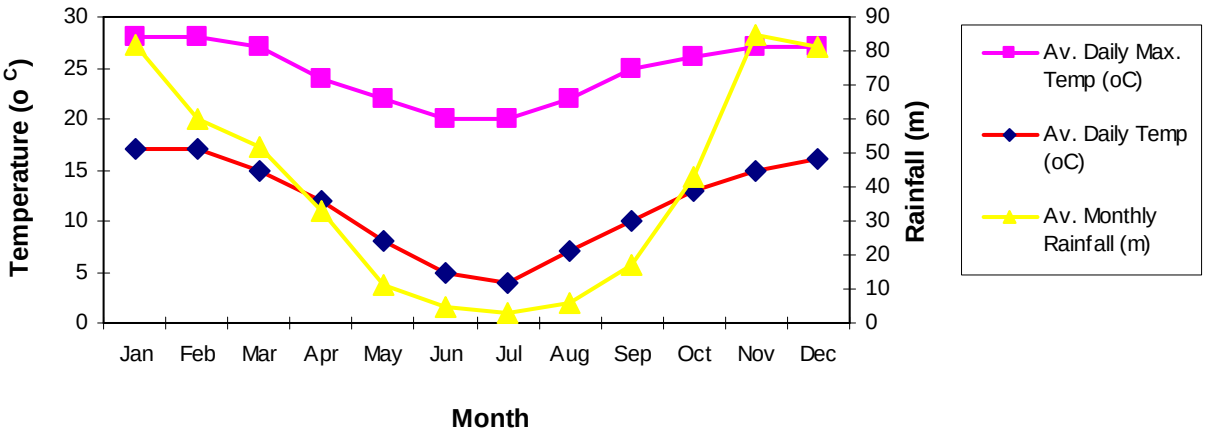


Figure 7: Average climatic condition in Ga-Mampa (Graph plotted with data from Polokwane station 23°52' S and 29°27' E height: 1230m perio d: 1961-1990: http://www.weathersa.co.za/).

2.7. Topography

Ga-Mampa valley is generally a rugged and mountainous area with an average altitude of 1305 meters (4281 feet)[23]. It is its location in such a mountainous area, coupled with periods of high temperature that makes the Ga-Mampa wetland attractive very attractive for human activities especially farming. Heights measured within the wetland ranged from 536-755 meters[24]. The geology underlying the wetland and its catchment is of Transvaal sequence, banded by ironstone and chert, which are likely to have intermediate capacity for ground water storage because of the presence of dolomite and limestone (Kotze, 2005). Rocks of the valley are observed to be igneous in nature.

[23] http://www.indexmundi.com/zp/sf/1460.htm.
[24] Personal field measurement with GPS.

3. RESEARCH FRAMEWORK AND METHODS

In the previous chapters, some concepts have been introduced. This chapter will review these concepts in order to fit the study in the perspective of existing literature, so as to facilitate understanding of the subsequent empirical chapters. The chapter begins by explaining the methodological steps taken to accomplish the stated objectives of this thesis, the second section discuss the theoretical frameworks (Integrated environmental (or ecosystem) assessment (IEA) framework and sustainable livelihood analysis framework) while the final section explains the tools, procedure of data gathering and analysis of data.

3.1. Methodological framework

Findeisen and Quade (1997) described a six steps procedure of systems analysis: formulating the problem (causal diagram), identifying designing and screening alternatives, forecasting future contexts or state of the world, building and using models to predict results, comparing and ranking the alternatives and communication of the result. On the other hand, Barbier et al., (1997) discussed a three stage evaluation process involved in economic valuation of wetlands as including; stage 1- defining the problem and choosing the correct economic assessment; stage 2- defining the scope and limits of the analysis and the information required and stage 3- defining data collection methods and valuation techniques required for the economic appraisal including any analysis of distributional impacts. Yet, Hein et al (2006) suggested a four step ecosystem valuation framework as follows; step 1- specification of the boundaries of the system to be valued; step 2- assessment of ecosystem services in bio-physical terms; step 3- valuation using monetary or other indicators and step 4- aggregation or comparison of the different values.

Note that, whereas the Findeisen and Quade (1997) approach is broader, the procedure described by Barbier et al., (1997) is focused and limited to economic valuation, while, Hein et al., (2006) is intermediary. However, synthesizing the procedures outlined by these frameworks, a methodological framework is developed for this study. Figure 8 presents the steps taken in this study (note that this process is iterative), the arrows represent steps taken in this thesis, while the broken line arrows indicate additional step that can be taken in future.

Opportunity to undertake this study came up in June 2006. The thesis began with the proposal stage which focused mainly on setting out the objective and a plan on how it will be achieved. This was followed by development of thesis proposal and questionnaire. The second cluster (field work) was aimed at data gathering. Field work which lasted from mid August to mid November 2006 and began with a five days reconnaissance survey conducted prior to questionnaire survey and interviews. Initial reconnaissance stage meetings were very vital in obtaining the cooperation of the local community, as well as to provide information for the appropriate design and improvement of survey instrument. During this period, circumstances prevalent in the field was observed; familiarization with field assistant who was responsible for translation during the interview process was made; also an already prepared draft questionnaire was tested with two randomly selected households. This set the stage for the first focus group discussion. Two questionnaires were administered after the discussion; with this, a final modification was made to the questionnaire. For example, a question asking respondents to “identify location where

they collect services from the wetland[25]" was found to be difficult for respondents. Other questions such as "village from which respondents migrated to Ga-Mampa valley" were found to be irrelevant. These questions were subsequently removed. However, some other questions found to be important, such as "reason why they use the wetland for each service" were included. Yet, some other questions were modified, for example to take care of unit of measurement understandable by respondents. During this stage other methods of data collection were also used (see section 3.9). The third stage in this study dealt with data analysis. Data was directly inputted into Excel file immediately after each survey on the same day, by so doing ensured that relevant data was not lost to time. The final stage of activity in this study was on reporting and communication of results to stakeholders. Apart from this report which will be shared with stakeholders, initial results were presented to local stakeholders in Ga-Mampa valley (on 10th November 2006) and IWMI research team on 17th November 2006). The broken line arrow in Figure 8 below indicates that feedback received from communication of results could as well lead to initiation of a new project.

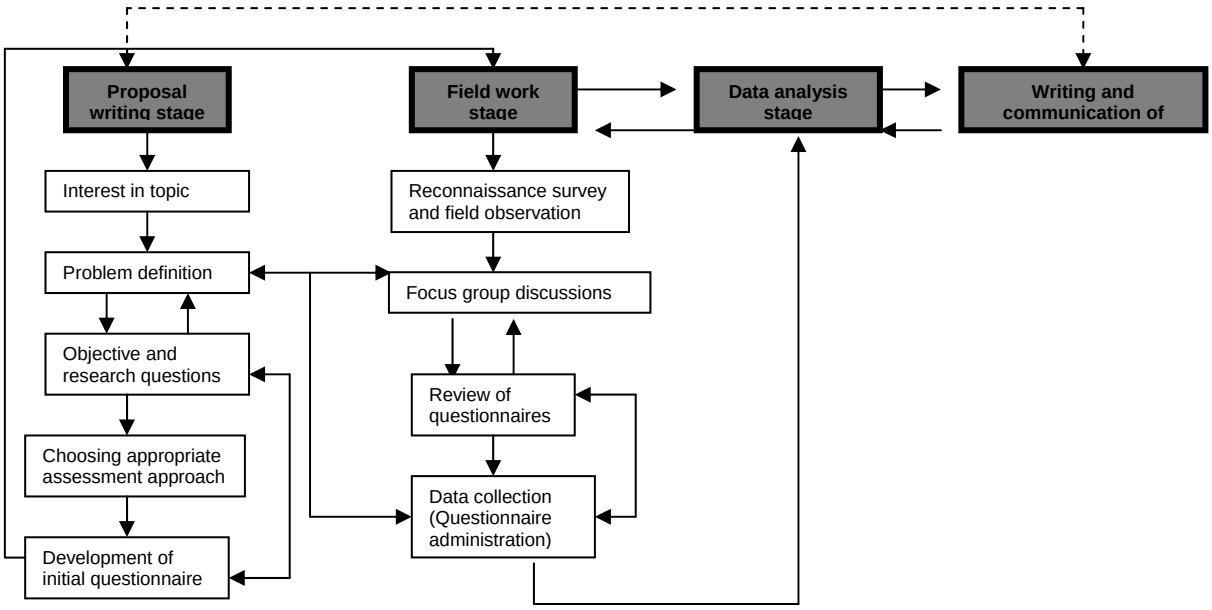


Figure 8: Methodological framework adopted for the valuation of Ga-Mampa wetland ecosystem (Drawn based on different steps taken in this study).

Table 1 below show how/where each of these methodological steps fits into each other. For example, the problem formulation stage of Findeisen and Quade (1997) corresponds with stage one of Barbier et al (1997) and step 1 of Hein et al (2006) and fits the proposal writing stage of this thesis. Whereas, Findeisen and Quade (1997) included a communication of result (which is an important stage of this thesis) it was not depicted in the steps described by Barbier et al and Hein et al.

[25] Respondents were not too literate to understand the map. This data could best be collected through a participatory mapping for which there was no time to conduct during this study.

Table 1: Synthesis of four methodological steps (Based on Findeisen and Quade, 1997; Barbier et al., 1997; Hein et al., 2006 and Figure 8).

Findeisen and Quade, 1997	Barbier et al., 1997	Hein et al., 2006	This thesis
formulating the problem	Stage 1	Step 1	Proposal stage
identifying designing and screening alternatives	Stage 2	Step 2	
forecasting future contexts or state of the world			Field work
building and using models to predict results	Stage 3	Step 3	
comparing and ranking the alternatives		Step 4	Data analysis
Communication of the result			Communication of results

3.2. Literature review

This thesis gained insight from existing literature. The next section explains major concepts relevant to understanding how this study fits into current trend in integrated environmental assessments.

3.3. Integrated environmental (or ecosystem) assessment (IEA) framework

Wetland ecosystems consist of different interacting components (structure and processes) human environment (society) and physical environment (biotic and a-biotic). On the one hand society wants to exploit wetland services for their benefit and sustain their livelihood; on the other hand there is the need to protect the health of the ecosystem. Balancing these demands introduces complexity in wetland management, such that decision making is not made easier. To aid decision making, a combination of social and natural sciences (scientific knowledge with policy issues) is necessary (Turner et al., 2000). This calls for a framework that will treat, view and approach wetlands as a system (a holistic view). A number of frameworks exist to support this perspective; notable is Integrated Ecosystem Assessment (Toth and Hizsnyik, 1998). Integrated assessments seek to adopt a holistic, cross-sectoral and multi-disciplinary approach as opposed to traditional sectoral approach in management of complex environmental issues. Integrated Environmental Assessment (IEA) provides a structured process of dealing with complex issues, using knowledge from various scientific disciplines and/or stakeholders. Such that an "integrated insight is made available to decision makers" (Rotmans, 1998). One important integration tool and guiding principle of the IEA found to be essential to ecosystem management is the ecosystem approach (EA)[26]. The EA is a strategy for the integrated management of land, water and living resources that promote conservation and sustainable use in an equitable way, it also seeks to recognize humans and their cultural diversity are an integral component of ecosystem to ensure integrated resources management and sustainable development including incorporating issues of access, benefits and equity[27].

[26] For more information, see http://www.cbd.int/programmes/cross-cutting/ecosystem/default.shtml.
[27] http://www.iucn.org/themes/CEM/ourwork/ecapproach/index.html.

There are a number of other IEA tools, such as function analysis, economic valuation, stakeholder analysis, trade-off analysis, cost benefit analysis and multi-criteria analysis among others. These tools are often used within various IEA frameworks; some of these tools are adopted for this study for their relevance in addressing questions raised and achieving study objective. This study tries to derive a single working framework (Figure 9) by combining the IEA framework of "Integrated assessment and valuation of ecosystem goods and services (De Groot et al., 2002) and "Total economic value" framework (Millennium Ecosystem Assessment, 2003; De Groot et al., 2006). Figure 9 shows that the translation of ecosystem structure and processes into a number of ecosystem services (functions) is the first step towards a comprehensive assessment of benefits (Goods and Services) derived from the ecosystem. It is the goods and services provided by these functions that are to be valued (De Groot et al., 2002). The total economic value is derived from the valuation. This framework also argues that it is possible to integrate ecosystem management (wise use) with stakeholders' interest (poverty reduction).

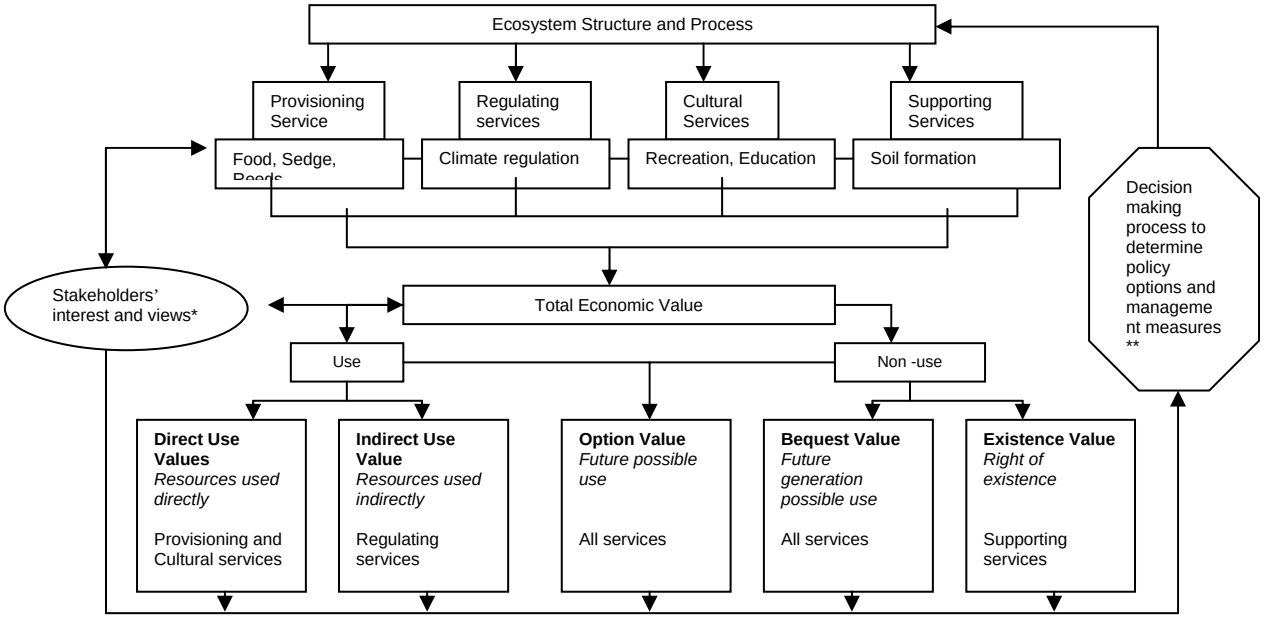


Figure 9: Framework for integrated assessment and valuation of ecosystem services (Adapted from De Groot et al., (2002); Millennium Ecosystem Assessment, (2003).
*Stakeholders interest and views should be considered in most steps of the assessment.
** Tools such as cost benefit analysis, trade-off analysis; multi-criteria analysis are used in support of the decision making process.

In literature, there are different classifications of ecosystem services with a distinction made between ecosystem services and ecosystem functions (see Box 1). This distinction represents the most widely used typologies. Millennium Ecosystem Assessment (2005ab) classified ecosystem services into provisioning, supporting, regulating and cultural services. Whereas, De Groot et al., (2002) using the organising principle of ecosystem functions, goods and services, classified ecosystem functions into regulation, habitat, production and information functions. This thesis adopts the typology and nomenclature of the Millennium Ecosystem Assessments for its wide acceptance and use in the United Nations commissioned reports.

Box 1: Definition and typology of ecosystem functions and services.

(1) Ecosystem function as explained by De Groot et al., 2002 refers to the capacity of natural processes and components to provide goods and services (regulation, habitat, production and information functions). The term goods and services were used to refer to aspects of the environment that satisfy human needs, directly (e.g. reeds collection) or indirectly (e.g. carbon sequestration).

Regulation functions: this group of functions relates to the capacity of natural and semi-natural ecosystems to regulate essential ecological processes and life support systems through bio-geochemical cycles and other bio-spheric processes. In addition to maintaining ecosystem (and biosphere) health, these regulation functions provide many services that have direct and indirect benefits to humans (such as clean air, water and soil, and biological control services).

Habitat functions: natural ecosystems provide refuge and reproduction habitat to wild plants and animals and thereby contribute to the (in situ) conservation of biological and genetic diversity and evolutionary processes.

Production functions: Photosynthesis and nutrient uptake by autotrophs converts energy, carbon dioxide, water and nutrients into a wide variety of carbohydrate structures which are then used by secondary producers to create an even larger variety of living biomass. This broad diversity in carbohydrate structures provides many ecosystem goods for human consumption, ranging from food and raw materials to energy resources and genetic material.

Information functions: Because most of human evolution took place within the context of undomesticated habitat, natural ecosystems provide an essential 'reference function' and contribute to the maintenance of human health by providing opportunities for reflection, spiritual enrichment, cognitive development, recreation and aesthetic experience.

(2) Millennium Ecosystem Assessment, (2003 and 2005a) uses a single concept of ecosystem service; it defined ecosystem service as the benefit people obtain from the ecosystem. These include;

Regulating services: benefits obtained from regulation of ecosystem processes, examples are climate regulation, disease regulation, water regulation and water purification.

Provisioning services: products obtained from ecosystems such as food, fresh water, fuel-wood, fibre and genetic resources

Cultural services: non-material benefits derived from ecosystems, including spiritual and religious recreation and ecotourism, aesthetic, inspirational, educational, sense of place and cultural heritage.

Supporting services: services necessary for the production of all other ecosystem services, it includes soil formation, nutrient cycling and primary production.

De Groot et al., (2002)	Millennium Ecosystem Assessment (2003)
Production functions	*Provisioning services*
Regulation functions	*Regulation services*
Habitat and some Regulation functions	*Supporting services*
Information functions	*Cultural services*

Table 2 (below) describes different ecosystem services as used by the Millennium Ecosystem Assessment, (2003) and gives examples of each. Ecosystem services provide an empirical basis for classifying the key elements of complex ecological structures and processes. For example, a production function is biomass production in an ecosystem, while the goods and services is the actual food harvested from the ecosystem. For this to happen there is need for nutrient in soil (biotic), temperature (a-biotic) and for humans to work on the farm. This is why the concept of ecosystem service is viewed in itself as "inherently synthetic and trans-disciplinary, bringing together both human and biophysical processes in one common, integrative framework" (Wilson and Christopher, 2004). The process of identifying and classifying ecosystem services require an IEA tool called function analysis.

3.4. Function analysis

Function analysis can be viewed as the process by which wide range of key elements of complex ecological structures and processes are determined and classified into an integrative framework (De Groot, 2006). Thus, the process of identifying and classifying the services provided by the Ga-Mampa wetland is function analysis. This was done with inputs from literature search (especially, Morardet and Darradi, 2006 and Tinguery, 2006), discussions with stakeholders and field observation. Ga-Mampa wetland provides numerous services; and effort was made to identify all. However, the focus of the economic valuation contained in this thesis is limited to the provisioning services of the wetland.

Initially, the scope of goods and services to be covered in this study was based on generally available literature on wetland ecosystem services. With the availability of reports of existing and ongoing research in the study area i.e. (Morardet and Darradi, 2006; Tinguery 2006) and considering available resources and time; further review was made to focus the study only on provisioning services accruing to local stakeholders. In addition to time constraints, restriction of the valuation to provisioning services was motivated by uncertainties and controversies about the extent and scope of especially the regulating services of the wetland. For example, some external stakeholders (MWP) claim the role of the wetland in regulating river flow downstream and supplying water to the Olifants River, hydrologists of the research team (IWMI) express some doubts on the contribution of the wetland itself to the river flow downstream. Such issue needs to be clarified before any economic valuation can be undertaken on this service.

At the commencement of field work, a field reconnaissance survey was conducted by the researcher to confirm existence of these provisioning services. This was followed by a focus group discussion in which the list of services (as obtained from existing studies) was presented to the local stakeholders for discussion and verification. At this stage, the local stakeholders advised that there were no medicinal plant benefits derived from the wetland, and a decision was made to remove questions bothering on this from the questionnaire; however, it was left open for exploration[28]. Based on this procedure, main provisioning services provided by the Ga-Mampa wetland was identified and focused on in the economic analysis aspect of this thesis. The identified services are cropping, livestock grazing, edible plant collection, reed collection, sedge collection, water collection (used for bathing, washing, drinking and other purposes), hunting, fishing, and fuel-wood collection. In addition, some other services not included in the economic analysis were observed and classified accordingly.

With the services and benefits derived from the ecosystem captured (see top part of figure 9), the next stage towards an integrated assessment of ecosystem services is to determine the nature of value to human society. Ecosystems have value because they maintain life on earth and the services to satisfy human material and non material needs. The “value” of ecosystems is viewed and expressed differently by various disciplines, cultural conceptions, philosophical views and schools of thought (Goulder and Kennedy, 1997 cited in Millennium Ecosystem Assessment 2003).

[28] Initial report by Darradi had explained that there could be a secret surrounding this use, probably this was the reason the researcher was told such use does not exist. However, it was later confirmed that this use actually does exist. It was thus regarded as a main use of the wetland, infact if it had not been important they might have nothing to hide about it.

Table 2: Categories and examples of ecosystem services (Adapted from Millennium Ecosystem Assessment, 2005a).

Provisioning services		
	Food	This includes the vast range of food products derived from plants, animals, and microbes.
	Fiber	Materials included here are wood, jute, cotton, hemp, silk, and wool.
	Fuel	Wood, dung, and other biological materials serve as sources of energy.
	Genetic resources	This includes the genes and genetic information used for animal and plant breeding and biotechnology.
	Biochemicals, natural medicines, and pharmaceuticals	Many medicines, biocides, food additives such as alginates, and biological materials are derived from ecosystems.
	Ornamental resources	Animal and plant products, such as skins, shells, and flowers, are used as ornaments, and whole plants are used for landscaping and ornaments.
	Fresh water	People obtain fresh water from ecosystems and thus the supply of fresh water can be considered a provisioning service. Fresh water in rivers is also a source of energy. Because water is required for other life to exist it is also considered a supporting service.
Regulating services		
	Air quality regulation	Ecosystems both contribute chemicals to and extract chemicals from the atmosphere, influencing many aspects of air quality.
	Climate regulation.	Ecosystems influence climate both locally and globally. At a local scale, for example, changes in land cover can affect both temperature and precipitation. At the global scale, ecosystems play an important role in climate by sequestering or emitting greenhouse gases.
	Water regulation	The timing and magnitude of runoff, flooding, and aquifer recharge are influenced by changes in land cover, including changes in the water storage potential of the system.
	Erosion regulation	Vegetative cover plays an important role in soil retention and the prevention of landslides.
	Water purification and waste treatment	Ecosystems can be a source of impurities (for instance, in fresh water) but also can help filter out and decompose organic wastes introduced into inland waters and coastal and marine ecosystems and can assimilate and detoxify compounds through soil and subsoil processes
	Disease regulation	Changes in ecosystems can directly change the abundance of human pathogens, such as cholera, and can alter the abundance of disease vectors, such as mosquitoes.
	Pest regulation.	Ecosystem changes affect the prevalence of crop and livestock pests and diseases.
	Pollination	Ecosystem changes affect the distribution, abundance, and effectiveness of pollinators.
	Natural regulation	The presence of coastal ecosystems such as mangroves and coral reefs can reduce the damage caused by hurricanes and large waves.
Cultural services		
	Cultural diversity	The diversity of ecosystems is one factor influencing the diversity of cultures.
	Spiritual and religious values	Many religions attach spiritual and religious values to ecosystems or their components.
	Knowledge systems (traditional and formal	Ecosystems influence the types of knowledge systems developed by different cultures.
	Educational value	Ecosystems and their components and processes provide the basis for both formal and informal education in many societies.
	Inspiration	Ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture, and advertising
	Aesthetic values	Many people find beauty or aesthetic value in various aspects of ecosystems, as reflected in the support for parks, scenic drives, and the selection of housing locations.
	Social relations	Ecosystems influence the types of social relations that are established in particular cultures. Fishing societies, for example, differ in many respects in their social relations from nomadic herding or agricultural societies.
	Sense of place	Many people value the "sense of place" that is associated with recognized features of their environment, including aspects of the ecosystem.
	Cultural heritage values	Many societies place high value on the maintenance of either historically important landscapes ("cultural landscapes") or culturally significant species.
	Recreation and ecotourism	People often choose where to spend their leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area.
Supporting services		
	Soil formation	Because many provisioning services depend on soil fertility, the rate of soil formation influences human well-being in many ways.
	Photosynthesis	Photosynthesis produces oxygen necessary for most living organisms.
	Primary production	*Primary production.* The assimilation of accumulation of energy and nutrients by organisms.
	Nutrient cycling	Approximately 20 nutrients essential for life, including nitrogen and phosphorous, cycle through ecosystems and are maintained at different concentrations in different parts of ecosystems.
	Water cycling	Water cycles through ecosystems and is essential for living organisms.

3.5. Economic valuation

A common definition of the value nature as found in literature is based on the use of ecological, economic and socio-cultural values, (Farber et al., 2002; Wilson and Howarth, 2002). Ecological values of an ecosystem are those determined by ecological criteria, they are determined by the integrity of the regulation and habitat functions of the ecosystem (De Groot et al., 2002). Socio-cultural values are those based on social values (such as equity) and perception of ecosystem and their importance to humans. Economic value (the basis of the valuation aspect of this study) is an anthropocentric concept based on efficiency and cost effectiveness (De Groot et al., 2002). Apart from this classification of value of nature, the Millennium Ecosystem Assessment framework adopts the concept of utilitarian and non-utilitarian value (Box 2).

Box 2: Utilitarian and non-utilitarian dimensions of value (Millennium Ecosystem Assessment, 2003).

Utilitarian value is based on the fact that human beings derive utility from ecosystem services either directly or indirectly, whether currently or in the future. Two important aspects of the utilitarian paradigm are that (i) individual motivation drives use to which ecosystem is put and (ii) utility cannot be measured directly, hence attempt to measure utility leads to measure of ecosystem service in monetary terms hence economic. The non-utilitarian paradigm unlike the utilitarian paradigm argues that ecosystem have value irrespective of the value attached to them by humans for meeting human welfare needs. This perspective mainly stems from many ethical, religious and cultural points of view. Socio cultural services will be a mid point between utilitarian and non-utilitarian perspectives.

Total economic value of nature (TEV) has been a controversial concept, most especially with the non-utilitarian school of though who believe that nature cannot be valued in monetary terms. Others argue based on the "Paradox of Diamonds and Water" by Adam Smith. The problem Smith posed was that water is very useful and very necessary for life, but water is very cheap. By contrast, diamonds have little utility only useful for adornment and it is possible to live without diamonds entirely, and most people do. Yet, diamonds are very more costly than water. His argument is that if demand depends on the usefulness of the product, then we would expect the more useful product, water, to command the higher price- yet diamonds are more costly. Not only do we know that water is cheaper as a matter of fact, but most people would agree that they would not pay as much for diamonds as for water, however diamonds remain more costly in market. Because of this "paradox", Smith came to the conclusion that willingness to pay is not related to utility. To make sense of this strange result, he distinguished between "value in use" and "value in exchange." Value in exchange, he said, is unrelated to usefulness and must be based on other principles. This study is based wholly on Smiths “value in exchange”. It is thus important in economic valuation to explicitly indicate what is been valued relative to different methods/types of valuation (Table 4, pp29). Irrespective of the wrangling generated by TEV, it remains a widely used framework for looking at the utilitarian value of an ecosystem (Pearce and Warford, 1993) and used in planning and decision making regarding many major world ecosystems. The TEV disaggregates into two categories: use and non-use values (see Figure 9, pp22).

Use values refer to the value of ecosystem services that are used for human consumption or production purposes. It includes tangible and intangible services of ecosystems that are either currently used directly or indirectly or that have a

potential of providing future use values (Millennium Ecosystem Assessment, (2003)

Non-use values are also usually known as existence value (or sometimes, conservation value or passive use values). Human ascribe value to knowing that a resource exists, even if they never use that resource directly. Millennium Ecosystem Assessment, (2003)

Use values can further be divided into three aspects, i.e. direct use values, indirect use values and option values; while non use values is viewed either as existence or bequest value (see Figure 9 pp22). Millennium Ecosystem Assessment, (2003) explains each of these values as follows;

Direct use values

Some ecosystem services are directly used for consumptive (when the quantity of the good available for other users is reduced) or non-consumptive purposes (no reduction in available quantity). Harvesting of food products, timber for fuel or construction, medicinal products, and hunting of animals for consumption from natural or managed ecosystems are all examples of consumptive use. Non-consumptive uses of ecosystem services include enjoying recreational and cultural amenities such as wildlife and bird-watching, water sports, and spiritual and social utilities that do not require a harvesting of products. This category of benefits corresponds broadly to the Millennium Ecosystem Assessment description of provisioning and cultural services. This is regarded as the value with the highest level of confidence interms of economic estimates (Table 3). Most of the services valued in this thesis correspond to direct use values.

Indirect use values

A wide range of ecosystem services are used as intermediate inputs for production of final goods and services to humans, such as water, soil nutrients, and pollination and biological control services for food production. Other ecosystem services contribute indirectly to the enjoyment of other final consumption amenities, such as water purification, waste assimilation, and other regulation services leading to clean air and water supplies and thus reduced health risks. This category of benefits corresponds broadly to the Millennium Ecosystem Assessment notion of regulating and supporting services. Some of the services valued in this thesis fall under this category, however not all services indirectly used in the case of Ga-Mampa wetland are valued (e.g. water purification or water supply for downstream users).

Option values

Despite the fact that people may not currently be deriving any utility from them, many ecosystem services still hold value for preserving the option to use such services in the future either by the individual (option value) or by others or heirs (bequest value). Quasi-option value is a related kind of value: it represents the value of avoiding irreversible decisions until new information reveals whether certain ecosystem services have values that are currently unknown. (Note that some analysts place option value as a subset of non-use value rather than of use value as it is uncertain what or if something will have a potential use) This category of benefits includes provisioning, regulating, and cultural services to the extent that they are not used now but may be used in the future.

Non use or passive values embody the principles of existence and bequest values:

Existence value

Existence value is the value of knowing something exists even if you will never use or see it, for example, many people will never see a panda bear or a tiger, yet they are happy to know that these species exist. Economists use surveys to put a monetary estimate on this value, by asking questions such as how much people are willing to pay to save a particular species from extinction. This measure is controversial as often (see Kopp, 1992; Rosenthal and Nelson, 1992; Quiggin, 1993).

Bequest value

The value of leaving something behind for the next generation or the value of knowing that a species or ecosystem will be there for your children or grandchildren to see or use, is similarly difficult to measure. This kind of value is the hardest, and the most controversial, to estimate resulting in a low confidence in its value estimate.

Table 3: Confidence level of Value estimates (Based on OECD, 2001).

Value	Confidence
Direct use values	High
Indirect use values	Low – Medium
Existence/Option values	Very Low - Medium

Economic valuation is an attempt to assign quantitative (monetary) values to market and non-market goods and services provided by environmental resources (Barbier et al., 1997; Munda, 2000). It has also been described as the process of expressing a value for a particular service in terms of something that can be counted, often money, but also through methods and measures from other disciplines such as sociology and ecology (Millennium Ecosystem Assessment, 2003). Economic valuation is an important instrument implicit to the decision making process; an ingredient for improved management of ecosystems (use and allocation of ecosystem services). This is because most often stakeholders do seek a well-informed decision on the basis of communication from the assessment of the values associated with different services provided by nature areas. Several methodologies developed to quantify the benefits of ecosystem services are available in literature; each of these methods is adept to valuing different types of ecosystem services. However, because of the controversies often surrounding valuation studies many researchers continue to be dedicated to developing valuation methodologies.

Table 4 describes some major valuation method and its types; strengths and weaknesses associated with using it and the last column gives examples of services to which it can be well suited. Masiyandima et al., (2005) provide examples of applications of some of these techniques as applied to wetland valuation in developing countries (see Appendix 3, pp110). Generally speaking, the type of valuation method adopted for an ecosystem service depends on availability or non availability of market price. For example, for services on which market price is available, economic valuation can be more straight forward, however it could be cumbersome for services for which market price is not available, thus requiring the adoption of another valuation technique (see Markandya et al., 2002 for possible economic valuation techniques- Appendix 3, pp111).

Table 4: Monetary valuation methods, constraints and examples (from De Groot et al., 2006).

METHOD		DESCRIPTION	CONSTRAINTS	EXAMPLES
1. Direct market valuation	Market price	The exchange value (based on marginal productivity cost) that ecosystem services have in trade	Market imperfections and policy failures distort market prices.	Mainly applicable to the "goods" (e.g., fish) but also some cultural (e.g., recreation) and regulating services (e.g., pollination)
	Factor income or prod. factor method	Measures effect of ecosystem services on loss (or gains) in earnings and/or productivity	Care needs to be taken not to double count values	Natural water quality improvements which increase commercial fisheries catch and thereby incomes of fishermen
	Public pricing *	Public investments, e.g., land purchase, or monetary incentives (taxes/subsidies) for ecosystem service use or conservation	Property rights sometimes difficult to establish; care must be taken to avoid perverse incentives.	Investments in watershed-protection to provide drinking water, or conservation measures
2. Indirect market valuation	Avoided (damage) cost method	Services that allow society to avoid costs that would have been incurred in the absence of those services	It is assumed that the costs of avoided damage or substitutes match the original benefit. However, this match may not be accurate, which can lead to underestimates as well as overestimates.	The value of the flood control service can be derived from the estimated damage if flooding would occur.
	Replacement cost & substitution cost	Some services could be replaced with human-made systems		The value of groundwater recharge can be estimated from the costs of obtaining water from another source (substitute costs).
	Mitigation or restoration cost	Cost of moderating effects of lost functions (or of their restoration)		Cost of preventive expenditures in absence of wetland service (e.g., flood barriers) or relocation
	Travel cost method	Use of ecosystem services may require travel and the associated costs can be seen as a reflection of the implied value.	Over-estimates are easily made. The technique is data intensive.	Part of the recreational value of a site is reflected in the amount of time and money that people spend while traveling to the site.
	Hedonic pricing method	Reflection of service demand in the prices people pay for associated marketed goods	The method only captures people's willingness to pay for perceived benefits. Very data intensive.	Clean air, presence of water, and aesthetic views will increase the price of surrounding real estate.
3. Surveys	Contingent valuation method (CVM)	This method asks people how much they would be willing to pay (or accept as compensation) for specific services through questionnaires or interviews	There are various sources of bias in the interview techniques. Also there is controversy over whether people would actually pay the amounts they state in the interviews.	It is often the only way to estimate non-use values. For example, a survey questionnaire might ask respondents to express their willingness to increase the level of water quality in a stream, lake or river so that they might enjoy activities like swimming, boating, or fishing.
	Group valuation	Same as Contingent valuation (CV) but as an interactive group process	The bias in a group CV is supposed to be less than in individual CV.	
4. Benefit transfer		Uses results from other, similar area to estimate the value of a given service in the study site	Values are site and context dependent and therefore in principle not transferable.	When time to carry out original research is scarce and/or data is unavailable, Benefit transfers can be used (but with caution)

*strictly speaking, public pricing is not "market based" but is real money involved in transactions related to ecosystem services reflecting the public WTP for their use or conservation.

Direct market valuation

Market price: This is based on market price (Vorhies, 1997). It is the exchange value that ecosystem services have in trade, mainly applicable to provisioning services, but also to some cultural services (e.g. recreation) and regulating services (e.g., water regulation services).

Factor income (FI): Many ecosystem services enhance incomes; an example is natural water quality improvements which increase commercial fisheries catch and thereby the incomes of fishermen.

Public investments: New York City, for example, decided to use natural water regulation services of largely undeveloped watersheds, through purchase or easements (worth ca. 100 million US$/year), to deliver safe water and avoided the construction of a $6 billion water filtration plant. This implies that those watersheds saved New York City an investment of US$ 6 billion and represent a willingness to pay-value of at least 100 million US$/year. Wetlands trading programs allow property owners to capitalize on the demand for wetlands banks, with wetlands being sold in banks for $74,100 to $493,800 per ha (Powicki 1998 cited in De Groot et al., 2006).

Indirect market valuation

When there are no explicit markets for services, it is necessary to resort to more indirect means of assessing values. A variety of valuation techniques can be used to establish the (revealed) willingness to pay (WTP) or willingness to accept compensation (WTA) for the availability or loss of these services. Some those used for indirect market valuation are:

Avoided cost (AC): Services allow society to avoid costs that would have been incurred in the absence of those services. Examples are flood control (which avoids property damages) and waste treatment (which avoids health costs) by wetlands. Thus, the cost that would have been incurred in the absence of the service, is an indication of its economic value.

Replacement cost (RC): Services could be replaced with man-made systems; an example is natural waste treatment by marshes which can be (partly) replaced with costly artificial treatment systems.

Mitigation or restoration cost: The cost of moderating effects of lost functions or of their restoration can be seen as an expression of the economic importance of the original service. For example, the cost of preventive expenditures in the absence of wetland service (e.g. flood barriers) or relocation.

Travel cost (TC): Use of ecosystem services may require travel. The travel costs can be seen as a reflection of the implied value of the service. An example is the amount of money that visitors are willing to pay to travel to a place or an area that they want to visit.

Hedonic pricing (HP): Service demand may be reflected in the prices people will pay for associated goods; an example is that housing prices at beaches usually exceed prices of identical inland homes near less attractive scenery.

The general idea behind this valuation technique is that the monetary cost/value that would have been needed i.e. to avoid, replace or mitigate a service, will serve as an indication of the economic value of that service.

Survey-based valuation

This valuation technique entails asking questions i.e. in the form of a questionnaire survey to people to find out their WTP or WTA. The use of either of these depends on who has the property right. For instance, where the question is addressed to owner of

property right, it is expected to use WTA, since he will need to be compensated (for further discussion see Thampapillai, 2000)

Contingent valuation (CV): Service demand may be elicited by posing hypothetical scenarios that involves the description of alternatives in a social survey questionnaire. For example, a survey questionnaire might ask respondents to express their willingness to pay (i.e., their stated preference as opposed to revealed preference, see above) to increase the level of water quality in a stream, lake or river so that they might enjoy activities like swimming, boating, or fishing (Wilson & Carpenter 2000 cited in De Groot et al., 2006). Lately the related method of contingent choice – asking respondents whether or not they would pay a predetermined amount – has gained popularity, since it eliminates some of the weaknesses of CV.

Group valuation: Another approach to ecosystem service valuation that has gained increasing attention recently involves group deliberation (De Groot et al., 2006). This evolving set of techniques is founded on the assumption that the valuation of ecosystem services should result from a process of open public deliberation, not from the aggregation of separately measured individual preferences. Using this approach, small groups of citizens are brought together in a moderated forum to deliberate about the economic value of ecosystem services. The end result is a deliberative "group" contingent valuation (CV) process. With a group CV, the explicit goal is to derive a monetary value for the ecosystem service in question, through group discussions and consensus building (after Millennium Ecosystem Assessment 2003).

Benefit transfer

In case of human or financial resource constraints, values can sometimes be taken out of previous studies focusing on a different region or time period. This practice of transferring monetary values is called 'benefit transfer'. An example is a case study done on Olango Island in the Philippines (White et al. 2000 cited by De Groot et al., 2006), where the values for fishery, both for the local market and for live fish export, have been obtained from coral reef studies elsewhere in the Philippines. This data was combined with local data on seaweed farming and tourism (Stuip et al., 2002 cited in De Groot et al., 2006)

Costanza et al (1997) compiled based on over 100 literature studies an overview of the link between these major valuation methods and ecosystem services. In the columns, the most used method on which the calculation was based is indicated with +++, the second most with ++, etc.; open circles indicate that that method was not used in the studies analyzed by Costanza et al., (1997) study but could potentially also be applied to that service (Appendix 3).

3.6. Application of economic valuation to Ga-Mampa wetland

As explained earlier, economic valuation is an attempt to assign quantitative values to market and non-market goods and services provided by environmental resources (Barbier et al., 1997). To assign quantitative values to resources harvested from Ga-Mampa wetland a direct market valuation technique was adopted. Choice for direct market valuation is based on the fact that market price does exist for services to be valued. Moreover, this technique is best in achieving the objective of this study, as it fits well into relating value to livelihood of local stakeholders. To attach monetary values to these services, the first step was to quantify the amount of each service harvested from the wetland. This is then related to the existing market price (as prevalent in local market in

Ga-Mampa valley). In reality, market prices vary over space and time; in this case, average prices of services as they exist in Ga-Mampa valley markets during the period 2005/2006 cropping season was used. In the situation where market price is not available, the market price of the closest available substitute suggested by the locals was used. Three indicators are used to express the monetary value of the Ga-Mampa wetland. This include, the Gross Financial Value (GFV) or resources draw (according to Coomes et al, 2004); Net Financial Value (NFV), in which case the cost of producing/harvesting resources from wetland is taken into consideration. Lastly, the economic worth of the quantity of each resource sold, i.e. cash income (referred to as economic reliance in Coomes et al, 2004) was also estimated.

In estimating the economic value of Ga-Mampa wetland, large or minor variations do often exist in the quantity of services harvested in a household each time. For example, a household that harvests a kilogram of edible plant today may harvest 3kg or more the following day or week. It was also not possible to determine the exact number of households in Ga-Mampa valley. This is needed and necessary to extrapolate values at total population level; this was because the entire population was not sampled. Finally, there are temporal price variations, which cannot always be taken into account. Thus, some assumptions need to be made to quantify and estimate the economic worth of human use of the Ga-Mampa wetland. Box 3 describes on a general term, the key terms, assumptions and procedure used to estimate quantity and economic values of Ga-Mampa wetland provisioning services, while Box 4 is an example of valuation applied to edible plant collection.

Box 3: Key terms, assumptions and procedure to estimate quantity and economic values of Ga-Mampa wetland provisioning services.

Key terms and procedure:

Participating Household (PHH): This refers to a household participating in the use of the wetland for a provisioning service, for example participating household in fishing.

Total Quantity Harvested (TQH) or Total Annual Production: Quantity for each provisioning service was estimated for a year**.** Percentage of PHH for each service calculated from the questionnaire survey is applied to the entire population using average household population of 394 to estimate the total proportion of PHH in the whole population. For each service, average annual household collection (HC) per household calculated from the sample is then multiplied by PHH in the entire population to estimate the TQH for the whole population.

$$TQH = \sum HC_1 + HC_2 + HC_3 \ldots\ldots\ldots HC_{66} / 66 * (PHH)$$

Services from the wetland are not measured in same unit, for instance, reeds, sedge and fuel-wood are measured in bundles (about 60cm in diameter), maize in bags, water in kiloliters etc. A uniform unit of measurement understandable by respondents was used, in cases where these units were not standard, there were later converted. For example respondents can best indicate quantity of edible plants collected using farm seed buckets; this was later estimated and translated into standard measurement i.e. grams. For resources with variable size, i.e. size of fish varies; additional question was asked to ascertain if there is great variation.

Quantity Household Use (QHU): This represents proportion of TQH used directly for household subsistence purpose.

Quantity Sold (QSD): Proportion of TQH that was sold for cash within or outside Ga-Mampa, either directly or after making other products from it.

Quantity Gift (QGT): Proportion of TQH that was given for free to members of other households either within or outside Ga-Mampa.

Price (PRC): This represents the average price at which a resource/commodity is sold in Ga-Mampa. In cases where there is no market price within Ga-Mampa, PHH are asked to suggest closest substitute of which price could be used. Justification for using local prices as against a world market price is because benefits are analyzed for contribution to local stakeholders and not to the national economy in which case factors such as government subsidy will be considered.

Box 3 continued.

Gross Financial Value (GFV): This represents the monetary value of TQH: this is total annual production multiplied by average price per unit (TQH * Average price per unit). Because price is often not a static phenomenon (it changes over time) GFV was thus calculated using minimum, average, and maximum prices over this time period a resource is sold in Ga-Mampa valley. [1] Quoted prices are average price for period under consideration September 2005 – October 2006. [GFV does not take into consideration cost of harvesting the product.

Cash Income (CIC): This relates to the monetary value of quantity sold (QSD*Average price per unit)

Cost (CST): Cost could be either fixed or variable; however for most services provided by Ga-Mampa wetland, cost is more variable than fixed. It is estimated based on all monetary inputs going into the harvesting (use) of each provisioning service of the wetland. The main source of cost is that for tools and implement used for harvesting resources. Cost of implements was calculated using straight line depreciation. Cost of an implement at time (year) it was bought was corrected with inflation rate between time of buying and today, average inflation rate value gotten from Statistics South Africa. Estimated value gotten will be cost of implement if bought today (2005/2006) by using a compounding factor- $P*(1+r)^t$

P is cost when bought; 1 is a constant; r is the rate of interest (inflation rate) expressed as a decimal; t is number of years from year bought till today.

This cost is then further divided by average length of use (average length of use for each type of tool and implement was suggested during FGD, i.e. 5 years for hoe, 3 years for cutlass and 10 years for shovel) and number of uses (as indicated by households in survey questionnaire). Note that, cost in this case refer only to those paid for by PHH. Household labor that is not paid for is not regarded as cost in this case. For cropping, because activities (land preparation, weeding and use of tools and implements) for each crop are not separated, it was not possible to decipher which cost was for which crop per season. Hence the total cost (at today) is divided by number of crops cultivated for each season and for each crop. This relates mainly to cost general to all crops, for example, implements or land preparation.

Net Financial Value: Net Financial Value is computed as GFV less total CST, (GFV-CST)

Key assumptions:

In calculating the economic value of each of the wetland services, some assumptions were made; these could lead to a level of uncertainty in the result. They have been attached alphabets

A= Assumptions related to quantity of goods harvested: For most of the resources derived from the wetland, quantity collected by households varies over time; respondents were asked to give the average quantity they collect per time period i.e. week, values given were then extrapolated to the whole period of collection within the year to calculate the Total Quantity Harvested (TQH). However, it is obvious that households do not collect exactly the same quantity every time. This assumption generates more uncertainty with uses that are collected for longer period through the year.

B= Assumptions related to number of households: This is due to lack of exact data on the actual number of households in the study area (see Table 5). TQH is calculated with a total number of households that is not exact. In economic analysis tables presented in this chapter an average number of households (394) is used, but there is as well a minimum (377) and maximum (412) total number of households in the study area. Uncertainty generated by this assumption applies to all wetland uses except cropping for which exact number of Participating Household

To complete the framework in Figure 9, pp 22, it is important to take note of the fact that stakeholders' views and interest need be taken into consideration from the start of the assessment, because it is the stakeholders that determine the services that are important, and this guides the entire process for it to be relevant in decision making needed for planning and management of the resource. The process is cyclic since the management and planning steps taken will have impact on the state of the environment thus the processes and structure of the environment.

Box 4: Valuation example using edible plant collection.

To estimate total quantity of edible plant harvested per household, the average collection per week was extrapolated to the entire year for the period in which the household indicate they do collect edible plants from the wetland. To do this, it was assumed that there are four weeks in all months. For example, the family of Albert Mampa responds to collect averagely about 300g of edible plants per time twice a week, making a total of 600g per week. The period of collecting edible plant from the wetland indicated by this household was April-September (inclusive), based on assumption of four weeks per month; this household will be collecting edible plants for 24 weeks in a year. This value when related to the average quantity collected per week (600g) means that Mr. Albert Mampas household harvested a total of 14,400g of edible plant per annum from the wetland. Applying same calculation to all PHH collecting edible plants from the wetland, it was extrapolated that for respondents a total of 2,559,000g (2,559kg) of edible plant is harvested for the year (Based on Assumption A). Applying assumptions B and C as explained above, using average total number of household in Ga-Mampa (394), TQH of edible plant is 15,273kg. Edible plant is seldom sold in Ga-Mampa valley, when sold price ranged between R1.5 and R2.5, making an average price of R2. Making estimates with average values yield the GFV from edible plants collection as R203, 637. Only about 2.8% of TQH is sold with an estimated CIC of R5, 707.

3.7. Sustainable livelihood analysis framework

In its simplest term livelihood is the way someone earns the money they need to pay for food, a place to live, clothing, etc. Understanding livelihoods of poor rural households could be complex and approached from diverse perspectives. Unravelling these complexities of diversity, change and exclusion is not easy. The livelihood analysis aspect of this thesis draws on the frameworks of livelihood based on resource use dynamics (Coomes et al., 2004) and sustainable livelihood (Carney, 1999; ODI, 2000; IFAD[29]). The use of these frameworks is not in anyway to conduct a detailed livelihood analysis of Ga-Mampa valley households, but rather to give an insight into how livelihoods of Ga-Mampa valley households depend on the wetland to aid poverty alleviation. A livelihood is sustainable when it can cope with and recover from stress shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (Carney, 1999)

The framework by Coomes et al., (2004) draws on insight from some other studies (Coomes et al., 2004). Its aim is to aid effective targeting of conservation-development initiatives by understanding with who (user group) specifically conservation efforts should be focused. To do this, the framework has at its heart the object of study- natural resource use i.e. reeds, sedge, fish, water etc. These services provide benefits that are used directly by households for household consumption, sale, to meet social responsibilities (gift), and often exchanged for other products such as labour. According to Coomes et al., (2004), the two key features of resource use by rural households are draw (volume of extraction) and economic reliance (share of income). With the framework, it is possible to determine to which household type resource use and resource draw are concentrated and if the level of resource draw of households is associated with their levels of economic reliance. The framework was based on the predicate that households are heterogeneous in these societies.

Livelihoods comprise the capabilities, assets, activities and strategies required and pursued by households and individuals for a means of living, it is divided into two key

[29] http://www.ifad.org/governance/index.htm.

components- livelihood assets and livelihood strategies[30]. Livelihood assets define the resources which individual households draw on to build their livelihoods. These assets influences and to a large degree defines the options and constraints available to households and individuals in their livelihood strategies; these are either controlled directly by households/individuals, or include publicly owned assets and more intangible assets related to social and cultural relations. Livelihood assets are defined within five distinct asset categories, these are, physical (housing, equipments), financial (income of household head and other household members, access to credit facilities), human (household demographics), social (family and other social links), and natural (natural resources including access to land). For this study, only aspects of financial, natural and human capital are analyzed[31]. Livelihood Strategies are the behavioral strategies and choices adopted by people to make a living, i.e. how people access food, how they earn income, the way they allocate labor, land and resources, patterns of expenditure, the way in which they manage and preserve assets, and how the respond to shocks and the coping strategies they adopt. Shocks which can influence and can be influenced by household assets include environmental changes, floods, and droughts, changes in household as well as economic and political shocks. In between the assets and strategies are the institutional processes and organizational structures households pass through. This includes formal government structures and also informal structures such as the GCDF and traditional authorities. In Ga-Mampa valley, the effect of governmental structures in resource use is expected to be minimal as it is far from governmental influence and seeming lack of governmental interest in such small wetlands. Combining the assets available at their disposal and taking into account the prevailing vulnerability context supported or obstructed by existing policies, institution and processes, it is expected that households make decision of draw and reliance from the wetland.

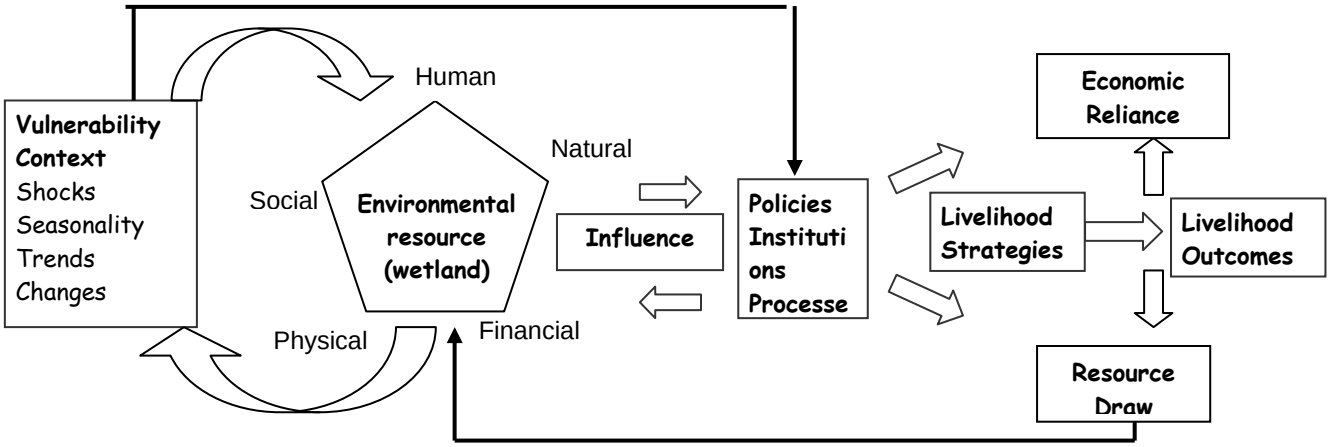


Figure 10: Sustainable livelihood analysis framework (Adapted from (IFAD).

In exploring more deeply the role of environmental resources in the livelihoods of the poor, key questions this thesis wants to address with this framework is to understand how wetland dependants of Ga-Mampa valley meet their needs through feeding their household and earning a living from the wetland services. How does this vary over different household types and what are some of the basic characteristics that define resource use options available to wetland dependent households in Ga-Mampa valley.

[30] http://www.fsausomali.org/200511123506_baseline_analysis.php?open1003=set.
[31] because of the scope of this study, moreover a complete livelihood analysis is being undertaken in parallel to this study.

Livelihood analysis is used in this case to understand how household characteristics (assets) influence value of benefit derived from the wetland. Households were typified into categories based on various assets they posses; such as age, marital status, occupation, sex, and number of education years of household head; location of household settlement, household access of cropping plot in the wetland, and household income. Average value of benefit (GFV (resource draw); NFV and CIC (economic reliance) derived by each household type is compared separately using inferential statistical test by SPSS (t-test and analysis of variation) to discover if there is/are significant differences in benefits (equity). This will also give an insight into resource use decision making by households. Further analysis of livelihood is made using responses of respondents on their perceptions; some of these perceived responses are weighed and compared with empirical estimates to give an insight into perception and reality.

3.8. Uncertainty analysis

Model-based assessments (such as economic valuation models) are often limited by many different types of uncertainties. The available knowledge base often consists of a mixture of partial knowledge, assumptions, ignorance. These could lead to potential errors which could be highly costly (Sluijs et al., 2005). To avoid potential cost and controversies such errors could cause, it is essential to explore and communicate the level of certainty of scientific studies. The method of determining scientific certainty of a result is called uncertainty analysis. This could be done qualitatively or quantitatively. A questionnaire (Appendix 11, pp178 was developed for experts and local stakeholders to acquire a qualitative measure of uncertainty in this study[32]. Attempt was also made at a quantitative uncertainty analysis, for this purpose, results (economic values) are expressed with a margin of the associated mean error. Also, coefficient of variation (CoV) is used to express the depth of uncertainty in value estimates for each service, such that the service estimate with the highest coefficient of variation is regarded as having the highest level of uncertainty.

Combining the knowledge gained from aforementioned frameworks, specific methods and their instruments relevant for the assessment required in this study were adopted. Such useful methods include; function analysis, service valuation and livelihood analysis, while specific instruments such as questionnaire survey and focus group discussions were adopted for data collection. The next section describes technique used for this.

3.9. Methods of data collection

A combination of complementary and supplementary methods was adopted in data gathering, some aspects of the design and use of these methods required specialized techniques to achieve success. Sources of data are primary and secondary; primary sources are data that are not in previous existence but are acquired directly from field. The main methods are;

Questionnaire survey

There are two aspects to this approach, these are designing the questionnaire and conducting the survey. First a topic list covering all aspects of needed information was

[32] Effort made at qualitative measure was not successful because of lack of time to follow up questionnaire distributed after feedback workshop.

developed. With this, a list of questions was developed mainly to elicit quantities of provisioning services harvested, times/period of harvest, the cost of carrying out this activity etc. Four major modifications were made to the initial questionnaire. First modification was after reconnaissance survey, the second was after the first focus group discussion, the third was after a pre-administration test, and finally after administering the first two questionnaires. For example, changes were made to the order of questions, some questions were removed and others (especially follow up questions) were added. As the survey progressed some very minor modifications were made to the questionnaire. There were two sets of questionnaire one for wetland croppers and the other for non wetland croppers[33]. The questionnaire (Appendix 11, pp150 was structured into three sections; the first section captured background/bio-data of respondents, including questions such as household income and household size. Section 2 dealt with general information with regards to access and use of the wetland, includes questions such as "for which service do your household use the wetland". While the third section had nine sub sections; each sub-section deals with each provisioning service under study and aims at capturing quantity of service harvested and cost implication.

Potentially, all households in Ga-Mampa valley fall into the sample frame for this study. This was based on initial assumption that all households in the area use the wetland for one purpose or the other, as it was not possible to ascertain who uses each service at the onset of the fieldwork. Table 5 shows estimated current number of households and population in Ga-Mampa valley based on fieldwork. The headman of Mantlhane provided number of households in Mantlhane main village; however, such detail was not available for Ga-Mampa. Efforts made to get this data proved unsuccessful, the researcher thus resorted to physical counting of the number of households in the sub-villages of Ga-Mampa valley for which number of households could not be fully ascertained. This explains the minimum and maximum values for Ga-Mampa in Table 5. Population was computed using the average household size from questionnaire administration i.e. 7 persons per household (Appendix 4, pp112). The questionnaire was administered to randomly chosen respondents within the Ga-Mampa valley; it was strongly aimed to be administered *face to face* by the researcher to the head of households in the presence of household members[34]. Major advantage of the face-to-face method in this study was that it allows elicitation of more data, which might be respondent specific and was omitted in the questionnaire design; high response rate and ability of the researcher to make side notes while interview is conducted, however it was time consuming, thus limiting number of households that can be sampled. It was clearly explained to respondents that they are answering for the entire household and for the period 2005/2006 cropping season. Also, at least a minimum of a week notice was given to respondents prior to questionnaire survey for their household.

[33] The questionnaire for non-wetland croppers was made-up of the same sets of questions as for wetland croppers, however it does not include questions on cropping activity.

[34] Where wetland cropping plot user is not head of household effort was made to talk to both the plot owner and head of household together. Ordinarily the husbands are regarded as heads of household, however, where husbands are indisposed; wives become the heads of household. Most households in Ga-Mampa are female headed because of high widowhood level. Another reason for de facto female headed household is out migration of males for seeking job in town.

Table 5: Distribution of households in Ga-Mampa valley[35] (From field data 2006).

Main Village	Sub Village	Minimum	Average	Maximum	Average Population	% of total
Mantlhane	Mantlhane	32	32	32	224	8
	Ditabogong	17	17	17	119	4
	Gemini	11	11	11	77	3
Ga-Mampa	Mashushu	40	41	42	287	10
	Mapagane	200	215	230	1505	55
	Marulatchipigh	35	35	35	245	9
	Ga-Moila	42	43	45	301	11
Total		377	394	412	2758	100

The sample frame (all households in Ga-Mampa valley) was clustered into two groups, i.e. wetland cropping households (WCH) and non-wetland cropping households (NCH). WCH are those households with access to a farming plot in the wetland while NCH are those households without access to a cropping land but still utilizing the wetland for other purposes. Using a list[36] of wetland cropping households provided by secretary of GCDF and verified during the first focus group discussion (FGD), a sample frame was developed for WCH. From this list of wetland cropping households, a total of thirty WCH was selected randomly. In the process of the initial survey more croppers were identified and from this list, three other wetland cropping households were selected bringing the total number of wetland cropping households surveyed to 33.

The number of NCH for each sub-village is the total household number less the number of WCH in that sub-village (Table 6). Ten percent of the NCH in each sub-village was selected for sampling. In each village, a systematic random sampling technique was applied to select non-wetland cropping households to be surveyed. For example, in Mapagane, households were picked diagonally, non-wetland cropping households were selected after every ten non-wetland cropping households. In a situation whereby a wetland cropping household comes in between, it was left out and the next non-wetland cropping household will be counted/selected. Same procedure was applied in all the other sub-villages. In total, thirty-three NCH's were selected and surveyed, making a total of sixty-six respondents (about 17% of total population) for this study.

Photo 1: Some responding households during the questionnaire survey.

[35] For Mantlhane, Ditabogong and Gemini values were given by the headman; he has the list of households in his domain. For other villages I counted myself. Sampling size was based on average number of household.

[36] This initial list contained 46 names of only some wetland croppers from Ga-Mampa main village. During the discussion at the first focus group discussion more names were added especially to include wetland croppers from Mantlhane and some others from Ga-Mampa. During interviews and questionnaire administration respondents were sought to help verify the list. This yielded more names and some deletions. For example, in a particular case the name of a mother and daughter was on the list separately as though the household had two wetland plots. Verification of the list was conducted throughout the field study and at the end of it, 99 wetland croppers were identified for the entire Ga-Mampa valley.

Table 6: Average number of households and number of respondents (From field data 2006).

	Ga-Mampa				Mantlhane			Total
	Mapagane	Mashushu	Marulatch-ipigh	Ga-Moila	Mantlhane	Ditabogong	Gemini	
No. of Households	215	41	35	43	32	17	11	394
Wetland Croppers	47	2	4	13	22	10	1	99
Wetland Croppers Interviewed	18	1	1	5	4	3	1	33
Non wetland croppers	168	38	31	29	10	7	10	293
Non wetland croppers interviewed[37]	16	3	3	4	2	3	2	33
Total Interviewed	34	4	4	9	6	6	3	66

Focus group discussion (FGD)

Two focus group discussions were held. The first was held at the beginning of the study to provide some more background information and to identify main uses and users of wetland resources and to verify the list of wetland croppers. The second FGD was held at the completion of the questionnaire administration. The purpose of this was to provide some outstanding information. For example, variation in prices, durability of implement (average length of use of tools and implements) and how best to express household labor time was discussed. Also the second focus group discussion served as an avenue to verify some information collected during the questionnaire administration. Six household heads were selected at random for the first FGD, while for the second a member of each user group was selected at random, in all there were eight participants. Although, a question list (Appendix 11, pp176) was developed to guide the focus group discussions it was often the case that discussion does positively digress from these lists of questions.

Photo 2: Participants at the first focus group discussion held at Ga-Mampa valley.

Field observation and measurements

The researcher not only asked the respondents about their activities in the wetland but also frequently visit the wetland (on Sunday mornings spent in the field and evenings on some other days) to observe what actually the people are doing in the wetland. The household in which I was accommodated was also used for an informal case study observation, observing things such as feeding patterns, frequency to wetland etc. Attempts were made to measure several phenomena, such as use of Global Positioning System (GPS) to determine average altitude and distances, using universally understandable units to express quantity of services harvested from the wetland, measure time taken to and from wetland, etc.

Key informant interviews

As the research progressed, some important key informants who could provide further information were identified. Interviews and sometimes informal discussions were held

[37] 10% of non-wetland croppers in each village, for Gemini, Mantlhane and Ditabogong an additional one household was added.

with them to garner more information. Some of the key informants are, the headman of Mantlhane (who provided information such as access to the wetland and number of households in his domain); the chairman and secretary of the GCDF (who gave general information including cultural and historical background); Agricultural extension officer (about activities in the wetland and cropping yield); Ward councilor: Mphofela Sabulone Mabatane (future potential of the wetland for tourism); Mr. Abel Mashabela a farmer who could speak English (cropping activities, sale and use). Towards the end of field work there was opportunity to have information on use of the wetland for medicinal purpose from the wife to one of the traditional users (Mrs. Rosina Mampa). Informal discussions were also held with staff of Mondi Wetland Project, and the progress milling company. Also, discussion was held with some selected members of some user groups.

Pebble distribution method

This was not used as a distinct approach on its own, but was incorporated into questionnaire survey and focus group discussions. Pebble Distribution Method (PDM) also referred to as Bean game (Turpie, 2002) is a described as a method applied to get the perception of respondents. It is a tool in multidisciplinary landscape assessment (MLA)[38]. In this study it has been used both on individual level (during questionnaire survey) and group level (during focus group discussion). Individual respondents were asked to rank their sources of livelihood using four categories, i.e. wetland, dry-land (including irrigation scheme farming), pension and grants and others which include wage, and monetary gift from relatives. Using 4 sticks of different sizes, respondents were asked to indicate the livelihood source they perceive as the most important for their household with the longest stick and the least important source assigned the smallest stick. During the second focus group discussion, participants were asked to together rank each wetland service as they perceive their value. For this purpose, twenty-five tiny stones were used, from these numbers of stones were appropriated to each service based on agreed importance of value assigned after discussion between the participants. Data from MLA was weighed and analyzed, for example, the response from the second FGD was expressed as a percentage and compared with empirical value of each service also expressed as percentage (this procedure is simply referred to in this thesis as weighting).

Market pricing

Since this study adopted a direct market valuation technique, market prices are central to it. Some of the prices were ascertained during discussions and interviews. However, some others could not be known through these methods, for example some do not remember how much they bought some farm implements. A list of unknown prices, most especially those with very high variability, was made and the researcher visited the local market to ascertain them within Ga-Mampa and Mafefe.

Photo 3: Cross-section of participant at feedback workshop to local stakeholders.

Feedback workshop

A feedback workshop was organized for the local stakeholders, it held on 10th November in the Ga-Mampa Development Centre. Participation was open to the entire community; however, only

[38] MLA is an innovative method designed to reveal the relative importance of biodiversity and other attributes of the forest landscape as perceived by local people. (http://www.cifor.cgiar.org/mla/_ref/uptake/index.htm 10-01-07).

respondents were sent formal invitation letters. During this workshop, it was possible to communicate preliminary result to the community. Effort was made to communicate the result in a manner they will act on and useful for local decision making. The time for questions and comments proved to be an avenue to get some further information, for example, some information on pest control in the wetland. Also, after the presentation, a discussion was held with the secretary of the GCDF to get his personal view of the results. Photo 1 is a cross-section of participants at the feedback workshop. A second feedback workshop organized on 17th November to experts from IWMI was also helpful in developing further lines of analysis for the study, as further insights was gained from comments and suggestion received.

Secondary sources

These are data already in existence for which data mining technique was adopted. This includes data collected from existing literature, government agencies, district office, local governments and government ministries. This was used to give more insight into the methodology adopted for this study and as well to provide a background to what already exist about the wetland area. A base topographic map of the area sourced from the National Geographic Institute of South Africa by the International Water Management Institute was used. Literature search using internet resources such as WebSPIRS (CAB Abstract and Web of Science) SCIRUS, IWMI and Wageningen Catalogues, Google scholar were useful for this study.

3.10. Method of data analysis

Although only a fraction of the population, (66 households) were sampled. Data from this sample was aggregated over the entire population and with this, a statistical generalization is made. As questionnaires were being administered in the field, data collected was inputted into an already prepared Microsoft Excel file developed at the beginning of the questionnaire interview but only perfected at the end of the interview. Analysis for communication of results[39] (feedback workshop) in the field was based on this file. After the field work, data was translated from the Excel file into SPSS software file with which final analysis was made. Descriptive statistics such as percentage, means are calculated, while analysis of variation (ANOVA), statistical t-test and correlation analysis are the main inferential statistical analysis employed. These inferential statistical tests are conducted at 0.05 significant levels and for ANOVA post-hoc test LSD (Fisher's Least Significant Difference) was used. A weighing system was conducted to relate some perceptual responses with the empirical estimates. Results of these analyses are presented in tables and graphs.

[39] A feedback workshop was held for the local community on 7th November 2007. Another presentation of initial result was held at IWMI office on 10th November 2007.

4. INVENTORY OF SERVICES PROVIDED BY GA-MAMPA WETLAND

Chapters four, five and six present the results of this study. Chapter four provides an inventory of the services provided by the Ga-Mampa wetland and also explores some perception of the local stakeholders to wetland services. Chapter five presents results and analysis on the quantity and economic value of the provisioning services provided by Ga-Mampa wetland. In chapter six the level of livelihood dependence on the wetland services is explored; this is followed by an analysis of the distribution of benefits over different household types.

4.1. Profile of respondents

The sample frame for this thesis is made up of all households in Ga-Mampa valley. Average number of household was estimated as 394 (Table 5 pp 38). In all, sixty–six households representing 18% of households in Ga-Mampa valley were randomly selected for questionnaire administration. A summary of the profile of respondents in this study (Appendix 4, pp 112) shows that 22.7% of respondents are from Mantlhane main village and 77.3% from Ga-Mampa main village[40]. Of the total, 51.5% are from Mapagane which has about 55% of the entire population of Ga-Mampa valley. Most households in Ga-Mampa are female-headed; this explains why majority of respondents i.e. 69.7% are female. Average age of household heads (respondents[41]) is 55 years, with each having an average of 5 schooling years. Average monthly income is R853[42], majority of which is from government paid pension and child grant scheme[43] since majority of the people in the area do not have paid job income. According to Statistics South Africa (SSA), in this region 31% of households have no source of income, 10.9% of households earn less than R400 per month, and 25% of households earn less than R800. In addition, most of the respondents are native of Ga-Mampa valley; majority was given birth to and grew up in Ga-Mampa valley, average length of residency of respondents in Ga-Mampa valley was estimated as 42 years. This gives a confidence that respondents should be well knowledgeable about the area.

4.2. Important provisioning services provided by the Ga-Mampa wetland

Procedure for identifying main provisioning services of Ga-Mampa wetland was through function analysis (see section 3.4, pp 24). Table 7 adapted from Morardet and Darradi (2006) shows the uses of the wetland based on interview of local stakeholders (15 respondents); external stakeholders (5) and Darradi's visual observation; the final section describes my own experience. While Darradi visually observed the collection of sedge from the wetland, this was not the case during this study; this was probably due to the time period field work was conducted. On the other hand, whereas, there was visual confirmation of the use of the wetland for leisure purpose, collection of fuel-wood and collection of drinking water during this study, Darradi did not observe them.

[40] About 84% of total population of Ga-Mampa valley are from Ga-Mampa main village.
[41] Only 3 respondents were not household head.
[42] South African Rand (R), The rand has the symbol 'R' and is divided into 100 cents, symbol 'C',.
[43] Government provides social welfare scheme for citizens; elders are paid 890R per month while 190R is paid for every child under 14 years.

Interestingly, none of the external stakeholders is aware of the use of the wetland for grazing, bathing, fishing and collection of wild plants; this buttresses the point that the local stakeholders have better direct knowledge of nature around them than external stakeholders.

This list of services was presented to local stakeholders during FGD for verification. As such, the provisioning services to which the wetland is used in support livelihood have been identified through literature, field observation and discussion with the local community. These are its use for crop cultivation, livestock grazing, reed collection (building material), sedge collection (art and craft material), fishing, hunting, fuel-wood collection, edible plant collection, medicinal plant collection and collection of water for drinking, washing and bathing. Other services confirmed/believed to be supported by the wetland, however not included in the economic analysis are provisioning services (sand mining-mainly close to the river bank and collection of medicinal plants); cultural services (sacred place within the wetland); regulation services (micro-climate regulation, ground water recharge, river flow regulation, water quality).

Result shows that, all households in Ga-Mampa valley used the wetland for one purpose or the other in the year under study. Survey data revealed that relative to past years before the 2005/2006 season the use of the wetland by households for all provisioning services is decreasing. For example, all respondents agree to have collected edible plant from the wetland prior to 2005-2006 cropping season, however only about 95% collected during the 2005/2006 session (Figure 11). For uses such as fuel-wood, water collection, fishing and hunting, decisions of households not to participate in the use of these services are voluntary. Reason been that there are alternative locations (within Ga-Mampa valley) to collect these services at levels better than in the wetland. However, for services such as sedge and reed, non participation of most households was due to their inability to find these resources for collection in the wetland. This is probably due to decrease in availability of these services (reeds and sedge) from the wetland. In my view this condition is closely related to the encroachment of agriculture into the wetland, however, about 50% of participating households relate it to the poor rainfall condition in the valley. For cropping, whereas there are demands for cropping plots in the wetland, it is increasingly difficult to find a plot and even if a plot is found access to wetland plots for cropping is no more receiving approval from the headmen. Only about 25% of households in Ga-Mampa valley presently have access to use of the wetland for cropping purpose (Figure 11).

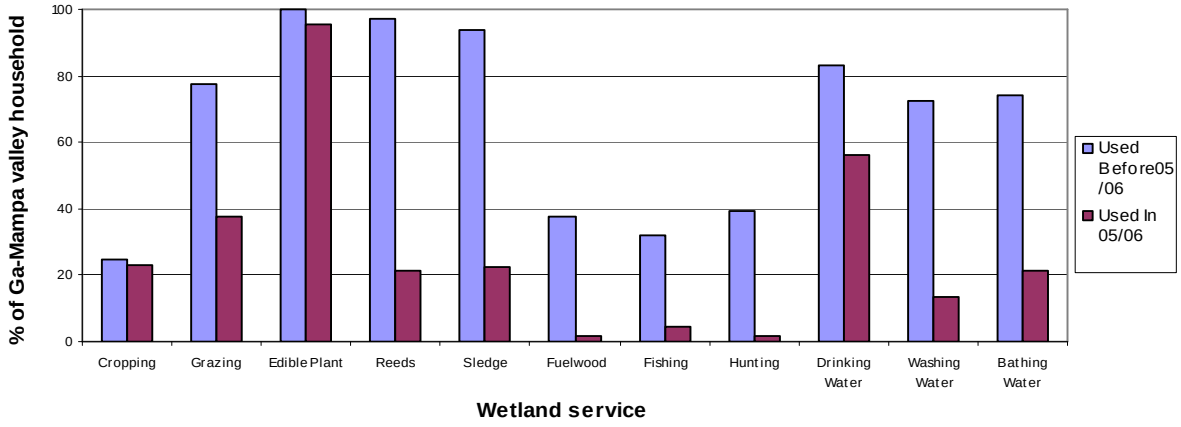


Figure 11: Proportion of households using the wetland before and during 2005/2006 season for each wetland service (from field survey, 2006)

Table 7: Wetland uses according to local & external stakeholders and own observation (Adapted from Morardet and Darradi, 2006).

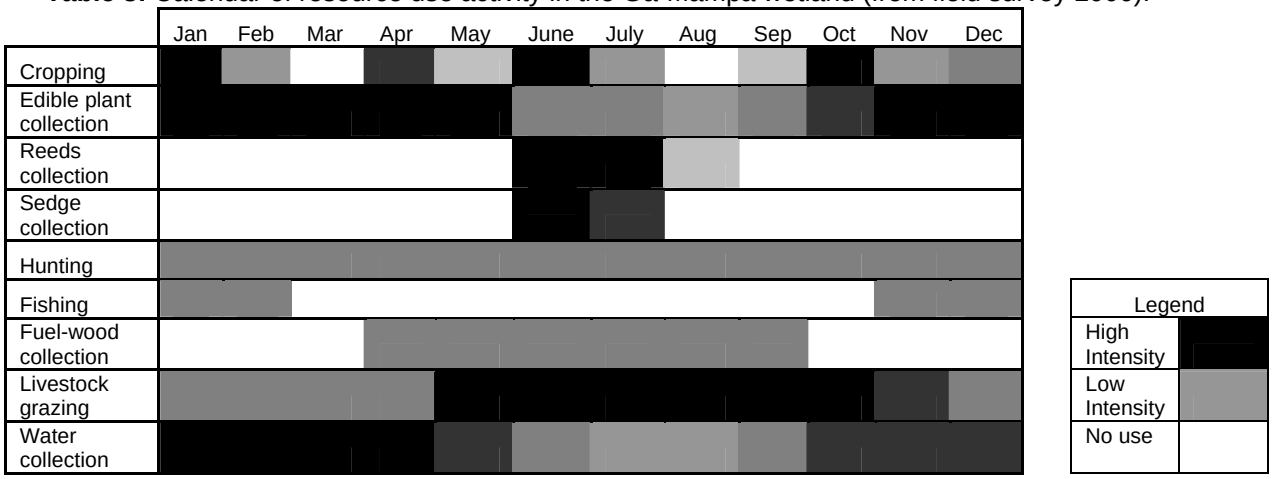
Service typology as used in this study		**Service typology as used by Darradi**	**# 15 Local stakeholders**	**#5 External stakeholder**	**Darradi visual confirmation**	***Visual confirmation**	***Informal discussion**
Cropping		Agriculture	15	All (5)	Yes	Yes	Yes
Livestock Grazing		Livestock watering	9	None	Yes	Yes	Yes
		Livestock grazing	8	CDDA	Yes	Yes	Yes
Material Collection	Edible Plant Collection	Collection of wild plant for food	4	None	Yes	Yes	Yes
	Reeds Collection	Reeds collection	11	EO	Yes	Yes	Yes
	Sedge Collection	Sedge collection	7	EO and NDA	Yes	No	Yes
Water Collection	Washing Water	Water for dish washing	0		No	No	Yes
		Water for laundry	1		Yes	Yes	Yes
	Bathing Water	Water for bathing	1	None	No	No	Yes
	Drinking Water	Water for drinking	3	CDDA	No	Yes	Yes
Others	Fuel-wood Collection	Fuel-wood collection	1		No	Yes	Yes
	Fishing	Fishing	6	None	Yes	Yes	Yes
	Hunting	Hunting	6	EO	No	No	Yes
Not included in this study		Collection of medicinal plant	0		No	No	Yes
		Leisure	2	LPDEAT	No	Yes	Yes
		Tourism	0	LPDEAT and NDA	No	No	Yes

* This is based on my field observation at various times and discussions held with some of the locals.

4.3. Resource use calendar

Resource harvesting in the Ga-Mampa wetland takes place throughout the year; for most uses there are periods of higher intensity in harvesting of wetland resources. Based on response from questionnaire survey, Table 8 presents a calendar of activities in the wetland. For example sedge collection takes place only in the months of June and July. About 80-100% of participating household in sedge collection are found collecting sedge in June, while between 60-80% of them are still involved in sedge harvesting in July. Intensity of cropping activity is highest in January; this corresponds to the weeding period when visit to the wetland is almost daily. Water collection from the wetland is highest between October and April corresponding to wet cropping season when the wetland croppers are present cropping the wetland and lowest in the dry cropping season when most croppers are not present in the wetland. The reason for this is because wetland croppers who collect a substantial quantity of water for drinking, bathing and washing while on farm are absent. For most of the service for which the wetland is used, there are periods whereby intensity of use is reduced (either deliberately or otherwise). Reed and sedge collection is limited to June and July because of the sanction by the headman restricting collection to this period of the year only. Collection of edible plants appear to be of high intensity in the dry season, this is probably because of it non-availability in other locations like the mountains during this period.

Table 8: Calendar of resource use activity in the Ga-Mampa wetland (from field survey 2006).



4.4. Perception of respondents

Some questions dealing with the perception of the respondents about the services provided by the wetland were included in questionnaire. Except for reeds and sedge, there are alternative places (within Ga-Mampa valley) to harvest other resources. Most of the households use the wetland for resource collection because of its richness relative to other ecosystems around the valley. For instance, about 82% of the wetland croppers explain that they crop in the wetland because of the wetness of the soil and availability of water year round, only about 15% say they crop the wetland because it is the only available land to them. For edible plant collection majority of the participating households use the wetland for this service because it is always available (throughout the year) in here and because its quality is better than from other locations. Figure 12 shows observed changes in wetland services as perceived by participating households. Potential for livestock grazing, edible plant collection, reed collection, sedge collection and fishing in the Ga-

Mampa wetland are perceived to be reducing. Only the potential of the wetland to provide cropping benefits was perceived as increasing by some few respondents. Crop yield was used as indicator to perceive changes for cropping, while availability and time taken to find are used as indicators for explaining perceived changes in reed and sedge (see Appendix 5 for further perception of respondents).

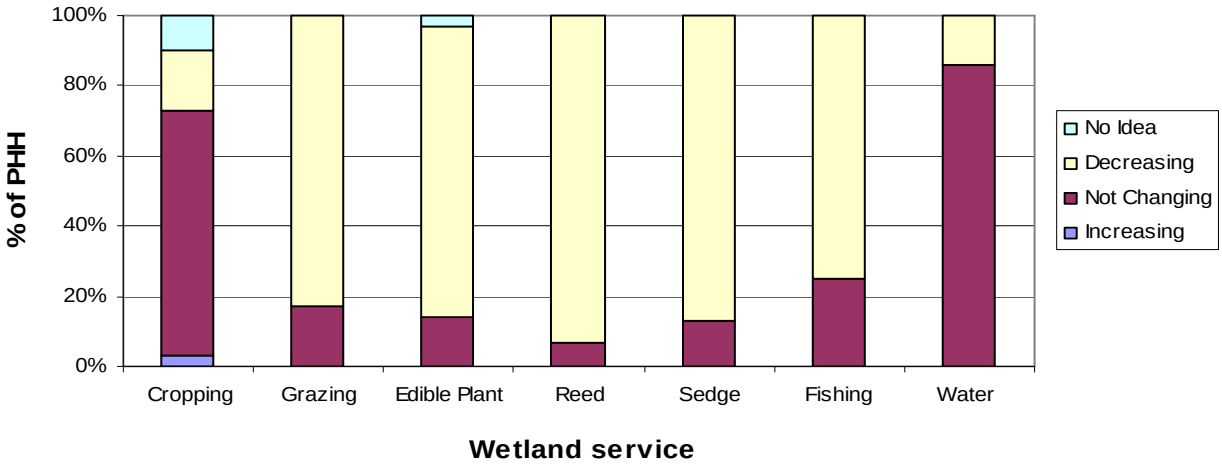


Figure 12: Perception of respondents on observed changes in wetland services (from field survey 2006).
* PHH for fuel-wood collection and hunting are too small to make any conclusion.

These perceived changes appear to have been dictated by reported shortages respondents experienced in wetland services in the past five years. Shortage was experienced by more than 50% of PHH in edible plant, reed and sledge collection, as well as fishing (Figure 13). However, it is only for edible plant collection that there is a positive correlation between households experiencing shortage and the perception of the changes in resources. How then do they cope with shortage in services that are believed to be so important to them? Data shows that coping mechanism depends on wetland service involved. For example participating households are able to easily cope with shortage in edible plant because of availability elsewhere in the valley, however majority of households do not have copping strategy in the absence of reeds and sedge services (Appendix 5), indicating that shortages in these services will have impact on the livelihood of households. In the absence or shortage of edible plants from the wetland these household reported having to pay for the available substitute to the households, which for them is often to buy meat, beans or cabbage.

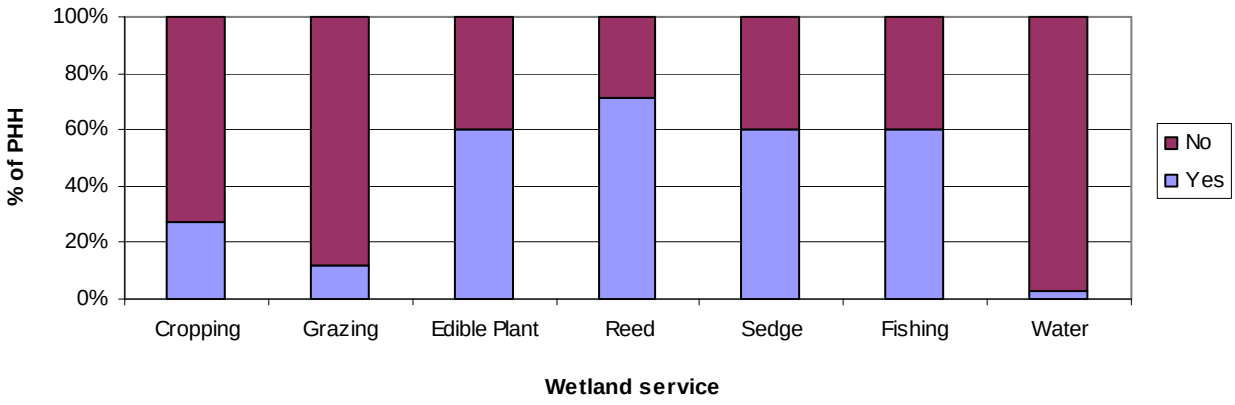


Figure 13: Proportion of respondent experiencing shortage in wetland services (from field survey 2006).
* Respondents in fuel-wood collection and hunting are not enough to make any conclusion.

Apart from cropping, all households in Ga-Mampa valley have equal access to all wetland services. Respondents were asked if they are satisfied with the current level of benefit their household derive from the wetland. About 67% of responding households indicated they are not satisfied with the current level of benefits they derive from the wetland, believing it could be better. 59% of those not satisfied are wetland croppers (WCH). The main reason given for not being satisfied (Figure 14) is the absence of fence to protect their crops from animals especially in the dry season. For non- wetland cropping household (NCH), the major reason for not being satisfied with level of benefit derived from the wetland is their lack of access to cropping plot in the wetland; on the other hand there are as well some households with wetland cropping plots who are not satisfied because of the seemingly small size of their plot. Other reasons given for non-satisfaction of benefits household derive from the wetland are; need of market where produce (mainly crops) can be sold for good profit; distance from settlement to the wetland (mainly households from Mashushu and Ditabogong) and others complain not been able to find what they need, for example their inability to find sedge or reeds for collection. Even though field data reveal that there is substantial loss of crops due to pests and diseases (Appendix 6), none of the wetland-cropping household mentioned this as a reason why they are not satisfied.

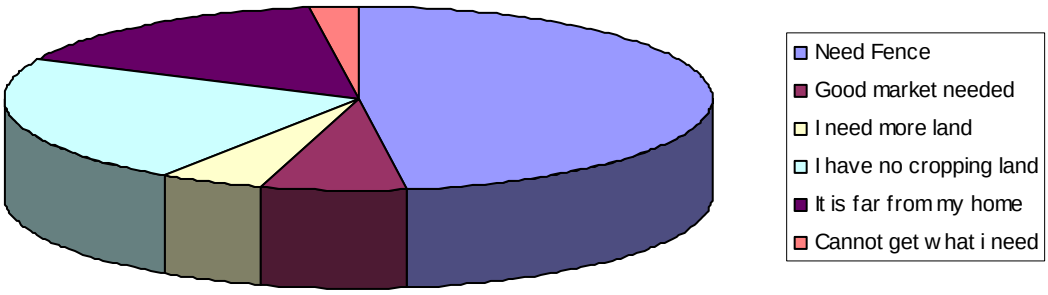


Figure 14: Reason why households are not satisfied with benefits they derive from the wetland (from field survey 2006).

5. USE AND ECONOMIC VALUE OF WETLAND SERVICES

This chapter presents information on the estimated quantity and economic value of services harvested from the Ga-Mampa wetland. Results are presented in tables for each provisioning service analysed; estimated total quantity harvested, use of the harvest, price (average) and economic values indicators in the form of Gross Financial Value (GFV), Net Financial Value (NFV) and Cash Income (CIC) are presented. Values are expressed in South African Rand (R), American Dollars ($) and European Euro (€). Values were expressed by respondents in Rand, conversion was based on average exchange rate between September 2005 and September 2006 at R6.46 = $1 and R8.62 = €1 (Statistics South Africa). The chapter begins by discussing and estimating annual economic value for each wetland service. A summary providing the total economic value of the provisioning services provided by the Ga-Mampa wetland follows. The final section of this chapter is focused on discussing the uncertainty in the economic value estimates.

5.1. Cropping (Go lema)

Cropping is the major service provided by the wetland and the one that raises the most environmental concern for the health of the wetland. According to the chairman of GCDF wetland committee, cropping is the most important use of the wetland in terms of benefits derived by the people. It is believed by the local stakeholders that their fore fathers who first settled in the valley cropped in the wetland. Apart from this assertion, there is no further evidence to suggest cropping in the wetland prior to the 1970s (see Box 5). Cropping activity by the living generation of Ga-Mampa only began at around 1971, with Mr. Adolph Mampa as the first person using the wetland for cultivation. It was not until nine years later that the second person moved to crop in the wetland. However, due to deterioration of hydraulic equipment of the irrigation schemes, combined with massive flood in the area in 1995, some few more farmers abandoned irrigation scheme farming and moved to cultivate in the wetland. Most of the plots occupied by these early wetland farmers are located on the fringes of the wetland, which are its driest parts. A further destruction of the irrigation scheme, especially that of *Fertilis* which served Mapagane (largest village in Ga-Mampa valley) after a second flood in year 2000 and subsequent drought in the area, led to a larger encroachment and conquest of the wetland for agriculture. Mapagane has the most important population in Ga-Mampa valley, the village also has a close proximity to the wetland and while irrigation scheme in Ga-Moila *(Valis)* and Mashushu were rehabilitated after the flood for it to be functional till date, *Fertilis* irrigation scheme was totally destroyed and not rehabilitated. Presently, there are a total of about ninety-nine farmers having access to cropping plot in the wetland, sixty-six of whom are from the main village of Ga-Mampa and the remaining thirty-three from Mantlhane main village (Figure 15).

Photo 4: A farmer and his son ploughing their cropping plot with a donkey.

Box 5: Evidence supporting use of wetland for cropping (Source: Tinguery, 2006).

There isn't an evidence that the tradition of the agricultural use of the wetland is embedded in the past. The white commercial farmers before the years of the Trust were cultivating in the irrigation schemes, and in the areas known as the Heights and the Downs. This last mention is important as most of the farmers in the villages were former workers (exploited labor force) in these commercial farms. Nevertheless, some people are still maintaining that their forefathers before the white farming in the zone (may be in the 19th century) were cultivating the wetland. Despites the lack of clear clues to confirm this from the farmers themselves and from cross checking throughout literature, we may assume it as a plausible situation during past drought years or low rainfall periods in the areas. What was cultivated there was said b y the farmers to b e maize but this was not either clear, regarding the somehow recent introduction of maize in Southern Africa (1905). The cultivation of the wetland in the past may mean that some indigenous knowledge of the wetland was preexisting. This may have encompassed what kinds of crops are adapted to the areas and or technical methods to drain and make the wetland suitable for some crops. And even though this is not back up by any further information from this research, the argument to denies it is also blurred, particularly if we rely on the fact evidenced by historians that still in the 19th century (1850-1910), there was a rise of an African peasantry, and among other characteristics," Spedi were able to continue practicing their traditional agricultural methods and were self sufficient" (Terreblanche, 2002). These traditional agricultural methods may have included cultivating in the wetland.

Mapagane accounts for the largest number of wetland farmers in Ga-Mampa valley, i.e. about 48%. Up till year 2000 only about ten persons were identified to be cropping in the wetland, most of whom cultivated at the fringe of the wetland, meaning that more than about 90% of farmers only started cultivating the wetland after year 2000 (Appendix 6). Average length of time farmers have been cropping in the wetland was estimated as 5 years.

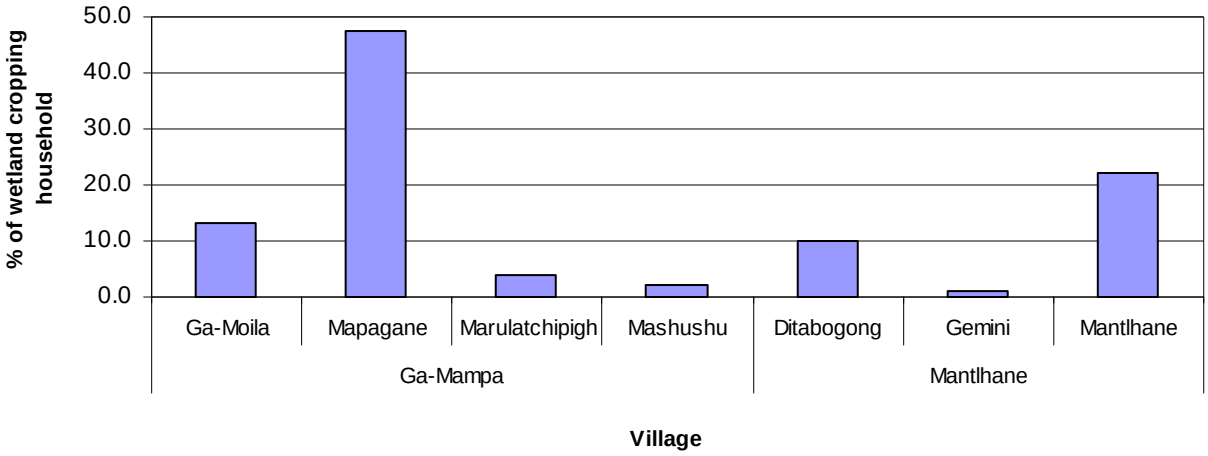


Figure 15: Proportion of wetland croppers from sub-villages (Based on wetland croppers list for the entire population of Ga-Mampa valley compiled during field study).

There are two cropping seasons in the cropping year, i.e. the wet (October–April) and dry (May-September) cropping seasons. Predominant crop cultivated in the wet season is maize *(mabele)* which is often intercropped with vegetables *(morogo)*[44] and groundnut *(dimake)*. Coriander (*mospo*) and beans are popular dry season crops. Sugar-cane *(moba)* and banana are the most common permanent crops in the wetland. Other crops mentioned to be cultivated in the wetland include spinach, cabbage, tomatoes, onions, pumpkins and beet-root; mango was recently introduced by a farmer. Most of the agricultural produce is

[44] The secretary of the community development forum indicated they do this to help preserve soil moisture.

used for subsistence- household consumption; asked why they do not sell the crops for income, major reason given is the poor market price of their produce. This has also contributed to the reduction in number dry season cultivators to about 5% of total wetland croppers[45]. Cultivated maize is used mainly as staple meal called *"pap"* – a meal eaten in most households about five times a week. After harvest, a day is set aside (in consultation with the extension officer) when all farmers (wetland and irrigation scheme farmers) bring their yield (maize) to the extension office for it to be taken for milling/processing by the milling company. The end product is called *mill meal*, usable for making *"pap"*. R100 is paid to the milling company per bag of maize to cater for transportation to and from Ga-Mampa, packaging bag and milling. For every 95kg[46] of maize given to the milling company, an 80kg bag of milled maize is given in exchange. Most households use the milling company located in Mafefe and Lebowakgomo as a sort of food bank. It is possible for instance to give ten bags of maize and not collect all ten at once but in monthly installments. Collection day of milled maize is set to date when pension and child grant is to be paid. Coriander used to be a major cash crop, as it is not a staple as maize is, however; there has been a massive decline in its cultivation in the last year (Box 6). Other wetland products cultivated for cash are beans and groundnut, the rest are mainly for household consumption.

Box 6: Fall in market price of agricultural produce (coriander) Tinguery, 2006.

An explanation to this situation from the extension officer relates to the fact that the farmers by the past were bringing their production of coriander to Agriculture service and the selling was organized from there. In 2002, the prices of coriander dropped and the farmers thought about the extension officer bear somehow a responsibility in it. They then stopped to bring their production and get directly into the market, which situation hampered the possibility for the extension officer to have more valid count of the yield. The decreasing prices over successive years from 2002 brought to the farmers the angle of reflection that the extension officer has no influence on the market. Currently, they are selling the coriander at about 200 Rands the bag at Origstad and Burgersfort. Most of the farmers complain about the transport which is expensive and despites the fact that they try to some extent to group their crops and limit the number of trips; their benefit margin is heavily reduced.

Access to cropping plot in the wetland begins with a person identifying a plot. An authorization of the headmen is then required for using the wetland for cropping (Morardet and Darradi, 2006). In Ga-Mampa some few farmers reported making a once payment of R20 to gain access, but in Mantlhane no payment was made. Access (user-ship) to the wetland can only be transferred with the consent of the headman. Presently, there are no more available plots and even if there are, authorization is no more being given. Based on field study, it was estimated that about 65.65 hectares (ha) (525 *bambas*[47]) of the wetland is under cultivation. Average wetland cropping land ownership is 0.66ha (5.3 *bambas*) per wetland cropping household. Alternative to wetland cropping is the irrigation cropping in the *Mashushu* and *Valis* schemes. Interestingly, field data revealed that 40% of wetland cropping households also own plots in the irrigation scheme. From this data it was estimated that, average land access per wetland cropping household in the irrigation scheme is about 1ha, against 78% of non wetland cropping

[45] It is believed that in the last 2 years the market price of coriander which is the main dry season crop dropped while cost of production has been on the increase. This affects both wetland and irrigation scheme farmers.
[46] This is because after shelling the weight reduce, thus to achieve a standard weight of 80kg per bag.
[47] This is a local unit of land measurement. 8 bambas = 1 hectare.

households with plots in the irrigation scheme with average plot access of 0.6ha per household. This indicates that, though more non wetland croppers have access to the irrigation scheme, however, wetland croppers have larger plots than the non wetland croppers.

Major farm activities are land preparation (LP), sowing (PS), weeding (WD), fertility management (FM), pest control (PC), disease control (DC), harvesting (HV), transportation of harvested produce (TP) and post harvesting activities (PH). Most of the labor used for these activities comes from household labor. Figure 16 depicts average household labor time relative to cost spent on external labor per cropping activity for both wet and dry seasons. For example, land preparation gulps the highest financial cost on external labor but with a very low household labor requirement, on the other hand post harvesting requires a lot of household labor time but less external labor cost. Average household requirement and external labor cost per season is provided in appendix 6, pp 120. No household reported use of pesticide; this is because the use of pesticides in the wetland is forbidden by the GCDF[48]. Any farmer found contravening this rule is reported to the headman for punishment. The farmers only resort to manual method to control pest. This probably explains the reason for high loss due to pest reported by wetland croppers. Up to 40% of actual yield could be lost to pest, while total loss could be up to 50% of total actual yield (see appendix 6). For most households, farm activities are the responsibility of the husband and wife, only for the children to assist at weekends or when on holiday from school activities.

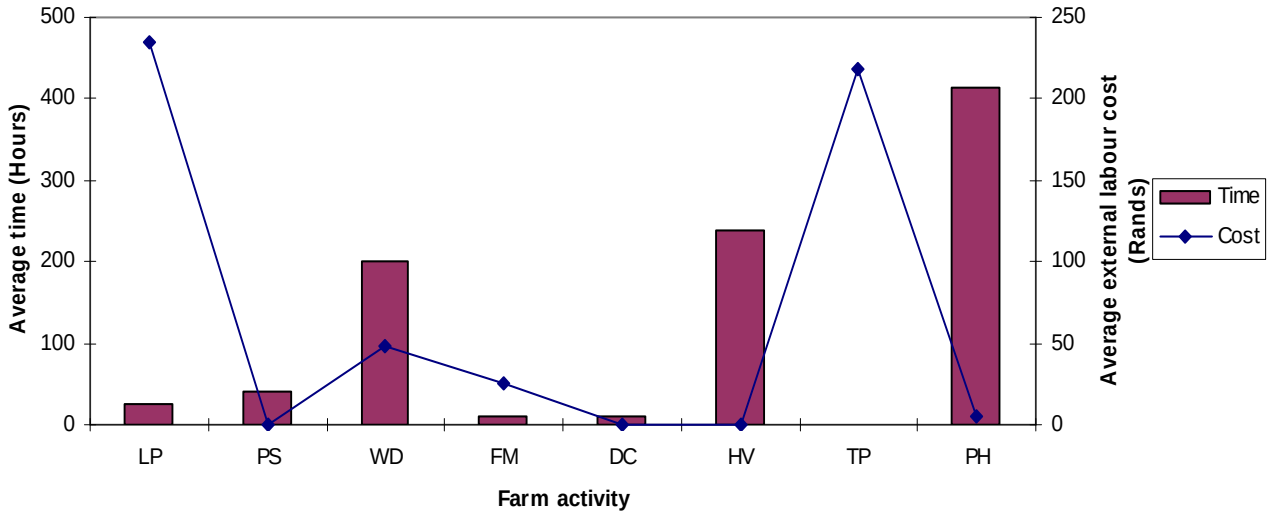


Figure 16: Average time and cost spent by household on each cropping activity for all crops in 2005/2006 cropping season (from field survey 2006).

An estimated 91% of wetland croppers actually cultivated crops in the 2005/2006 cropping year: lack of money and ill health are the reasons given for not cropping. Crops cultivated during wet season are: maize, vegetables and groundnut; and during dry season: coriander, beans and beet root; and permanent crops are sugarcane and banana. Below are estimated economic values of each of these crops, tabular details are presented in Appendix 6, pp120.

[48] It was learnt during feedback workshop on 13-11-2006 that the reason for forbidden use of pesticides is to protect the health of the soil and protect the birds from indiscriminate killings by farmers.

Maize (*Mabele*)

Maize cultivation is the most common in the wetland. In 2003/2004 wet season an estimated 49 ha of the wetland were put to maize cultivation with an average yield of 2.04 tons/ha, in the same season of 2004/2005, 56.25 ha were cultivated with average maize yield of 1.97 ton/ha. In 2005/2006 wet cropping season which is the year under study, an estimated 56.25 ha, representing about 85.7% of total cultivated land in the wetland was used for maize cultivation, yielding about 1,158 bags[49] (110,010kg) of maize. This represents an average yield of 1.96 tons/ha and 1.22 tons/PHH. Of the TQH of maize, 92.7% was used for household subsistence consumption[50], 5.2% was sold, and 1.3% kept as seed for the next cropping year while less than 1% was exchanged for external labor on the farm (see Appendix 6).

Unit price of maize could be highly variable. A bag of un-milled maize sells for between R100 and R150. However, un-milled maize is hardly sold in Ga-Mampa valley because households hardly consume maize until it is milled. Milled maize which is more commonly sold, goes for between R250 and R280/bag. A 95kg bag of un-milled maize is exchanged for an 80kg bag of milled maize; R95 is paid additional to the milling company for transportation, milling and the bag[51]. For the purpose of this study, considering the fact that un-milled maize is hardly sold and it is not too useful to households until it is milled, price used for analysis is deduced from the average price of milled maize and taking into consideration R95 paid to the milling company. Market value of maize is thus deduced to be between R155 and R185 with an average price of R170/bag. At average price gross financial value (GFV) due from maize cultivation in Ga-Mampa wetland was estimated as R196, 860 per annum. With cost incurred mainly from purchase of seed, farm implements, labor and transportation of yield home, net financial value (NFV) was estimated as R165, 936. 5% of maize yield is sold by about 3% of wetland cultivators to give cash income (CIC) of R10, 234.

Groundnut *(Dimake)*

Groundnut is commonly intercropped with maize. It is estimated that about 8 wetland croppers cultivated groundnut in 2005/2006 wet cropping season on a total of about 2.2ha (3.3% of cultivated plots in the wetland). Total yield was about 21.3 bags (1,704kg) of groundnut. A bag of groundnut sells for between R200 and R230. At average price of R215, GFV is estimated as R4, 580, NFV as R4, 266. About 87% of total quantity harvested is sold to give a CIC of R3, 999.

Vegetable *(Morogo)*

It is a common practice for farmers in Ga-Mampa valley to cultivate vegetables together with maize. This is done according to the farmers "to maintain soil moisture". An estimated 63% of farmers planted vegetables yielding a TQH of about 1, 584kg. Price of vegetables range between R1.5 and R2.5 per 150g, thus giving a GFV of R21, 120; taking cost of production into consideration, NFV is estimated as R20, 551. There was no reported case of sale of planted vegetables. Because it is intercropped with maize it is difficult to determine plot size under vegetable cultivation.

[49] Generally, one bag is equivalent to 80kg. However, for un-milled maize it is 95kg.

[50] This includes quantity consumed directly immediately after harvest (1,695kg) and that taken to the milling company in exchange for *milled meal* (100,309kg).

[51] The bag can be re-sold for a price or used for other purposes. In this analysis, it is regarded wholly as a cost.

Coriander *(Mospo)*

Increasing threat from animals and poor market value for coriander limited its cultivation to only about 3% of wetland croppers in the 2005/2006 cropping season. Coriander was cultivated on about 1.9ha (about 2.2%) of cultivated land in the wetland. Total yield was estimated at 2,880kg representing a yield of about 1.5tons/ha. Average price of coriander is R215 per bag resulting in a GFV of R7, 740 and NFV of R7, 426. Of the TQH of coriander, 66.6% was sold to yield a CIC of R5, 160.

Beans *(Dinawa)*

Beans was also cultivated in the dry season, it is at a trial stage as past effort to cultivate beans in the wetland did not yield expected profit. It is estimated that 3 farmers cultivated beans on about 2.3 ha (3.2% of cultivated area in the wetland); with a total yield of about 840kg representing an average yield of about 0.37 tons/ha. Average price of beans is R375 per bag, this result in GFV of R3, 938 and NFV of R2, 866; also of the TQH of beans more than 85% was sold for cash income of R3, 375.

Beetroot *(Petiruti)*

Not many wetland croppers are involved in beetroot cultivation, it is however a popular meal in South Africa. Also, an estimated 3 farmers cultivate beetroot on about 0.75 ha of the wetland. This suggests a yield of about 533 beetroot per ha of the wetland. GFV for beetroot from the Ga-Mampa wetland is estimated as R788 and NFV of R513. About 40% of yield is sold for cash to give estimated annual cash income of R315.

Sugarcane *(Moba)*

Sugarcane is one of the two currently existing permanent crops in the wetland. There are about 6 sugarcane farmers in the wetland cultivating a total of 0.4ha with sugarcane. Total yield for the year was 750 sticks of sugarcane (about 1875 sticks of sugarcane per hectare). Sugar cane is sold for a Rand per stick. This yields a GFV of R750 and NFV of R480.

Banana *(Panana)*

Banana like sugar cane is a permanent crop in the wetland. It is estimated that there are about three farmers who grow banana in the wetland (mainly in permanently water logged portion of the wetland) on about 0.4 hectare. An average bunch with about 15 pieces of banana is used as unit of measurement. Yield was 150 of such bunch. Average yield per hectare will thus be 375 bunches. Average price per bunch is R12.5 yielding a GFV of R1, 875 and NFV of R1, 521.

Summary cropping

In total, cropping in the Ga-Mampa wetland yields an estimated annual gross financial value of R237, 751, net financial value of R203, 559 and cash income of R24, 748 (Table 9, Figure 17). If considered per cropping season, the highest value from the wetland is in the wet cropping season (maize, ground nut and vegetables) contributing 94% of cropping GFV and NFV, but only 57% of CIC per annum.

Table 9: Summary Estimated Economic Value of Cropping from Ga-Mampa Wetland (from field survey 2006).

Crop	GFV (Rands)	NFV (Rands)	CIC (Rands)
Maize	196,860	165,936	10,234
Ground Nut	4,580	4,266	3,999
Vegetable	21,120	20,551	0
Coriander	7,740	7,426	5,160
Beans	3,938	2,866	3,375
Sugarcane	750	480	540
Banana	1,875	1,521	1,125
Beetroot	787.5	513	315
Total	237,651	203,559	24,748

Although maize cultivation yields the highest value (gross, net and cash), it is the major proportion of yield from groundnut, coriander, beans, beetroot, sugarcane and banana that is sold for cash contributing to cropping CIC (see Figure 17).

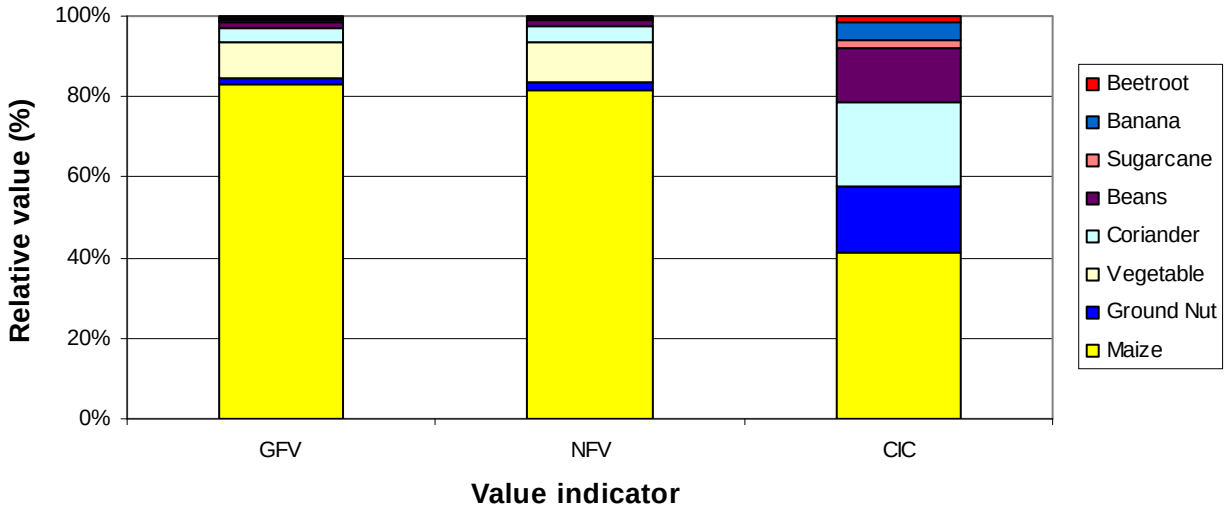


Figure 17: Percentage contribution of each crop to value of cropping in Ga-Mampa wetland (from field survey 2006).

On the other hand analysis reveals that coriander and banana yields highest economic values per hectare of cultivated plot (Table 10). Ordinarily, one could suggest putting the wetland to cultivation of either crop. However, while it could be possible to encourage coriander cultivation with availability of profitable market, it might not be possible to use most of the wetland for banana cultivation because most part of it is dry during the year. Albeit, time spent will be important in making such suggestion; this might be considered not important in the case of Ga-Mampa, because this study also finds out that opportunity cost for time is very low.

Table 10: Estimated per ha yield and economic value of cropping from Ga-Mampa wetland (from field survey 2006).

Crop	Cultivated land area (ha**)	Yield per ha**	NFV / ha (R)	CIC/ ha (R)
Maize	56.25	1.96 tons/ha	2,950	182
Ground Nut	2.2	0.8 ton/ha	1,939	1,818
Vegetable	56.25*	0.03 ton/ha	365	0
Coriander	1.90	1.50 tons /ha	3,908	2,716
Beans	2.30	0.37 ton /ha	1,246	1,467
Sugarcane	0.40	1875 sticks /ha	1,200	1,350
Banana	0.40	375 bunches/ha	3,803	2,813
Beetroot	0.75	533 pieces /ha	684	420

*cultivated together with maize (could not indicate actual area).

** Based on actual area cultivated.

5.2. Livestock grazing (Mafulo a mehlape)

Livestock grazing is the most visible use of the wetland today. During field study, animals were seen grazing in the wetland daily, most especially in the Mantlhane part of the wetland (portion 3, Appendix 1, pp104). This is probably due to lack of fence in this portion of the wetland close to the settlement. Although it is possible to see hens and dogs scouting for food in the wetland, the main domestic livestock types predominant and grazing in the wetland are donkeys, cattle and goats. Grazing in the wetland is believed to have taken place in the recent past, even before colonization of the wetland by cropping; but not at a scale comparable to today. Prior to the 2000 flood, livestocks were allowed to graze mainly in the mountain for fear of been stuck in the muddy waters of the wetland (Morardet and Darradi, 2006). However, with the current situation (drying up of part of the wetland), this has changed and more grazing is now taking place in the wetland. It is also possible that with the ongoing fencing round the irrigation scheme, access of livestock to the wetland will be reduced drastically in the coming years.

It is estimated that approximately, 70% of households in Ga-Mampa valley own at least one type of livestock. Average livestock ownership per household is estimated as 9 cows, 2 donkeys and 7 goats. This adds up to an estimated 174 donkeys, 1288 cattle and 2115 goats[52] in Ga-Mampa valley. However, only an estimated 46% (38% of entire households in Ga-Mampa valley) of these households could ascertain that their livestock does depend on the wetland for forage. This estimate suggests that at least, about 84 donkeys, 618 cattle and 1115 goats depend on the wetland for forage. On the other hand it is possible that all livestock in the Ga-Mampa valley depend on the wetland. Field observation reveals that most households do not confine their livestock and might not even know where they graze, since most livestock owners do not deliberately take their animals to the wetland to graze and neither take forage home to feed them, they are not aware whether the livestock go to the wetland to graze when they roam around the valley. During the field study it was only observed once that someone leads his livestock to and from the wetland. Also, a census of livestock taken over a week period in some part of the wetland reveals an average of 27 donkeys, 34 cattle and 38 goats in the wetland per day.

[52] During questionnaire administration, 46 respondents (representing about 70 of population) agree to owning livestock. However, of these 46 respondents, only 25 respondents (38% of population) agree that their animals depend on the wetland for forage. However, not all households have all types of animals; hence, estimated value was estimated by aggregating average number of each animal per household owning them to the entire population.

Generally, data on grazing benefit from the wetland was difficult to acquire, due to the fact that people pay less direct attention to the activities of their livestock. Some other benefits are derived from the livestock: goats and cattle provide milk which is used for household consumption, donkeys are used for transportation and drought power, and manure from the animals is used in irrigation scheme farming and as a substitute to cement in building[53]. Alternative to wetland grazing is grazing in the mountains. This (grazing in mountain area) is presently also being used as all respondents with livestock agree their animals graze in the mountains. Efforts made to explore the existence of conflict between croppers and grazers reveal that, though wetland croppers complain of crop loss due to activities of livestock, this is not regarded as issue for conflict since most of the wetland croppers also own grazing livestock[54].

The daily forage demand differs for different kinds of livestock based on their type, size and age, physiological needs, and management objectives. Also, forage quality varies markedly throughout the year and it affects forage intake (White and Troxel, 1995). This study have adapted to estimate the economic value of Ga-Mampa wetland by using an average forage intake by livestock as against other possible methods[55] as a basis for determine the economic value of livestock grazing in the Ga-Mampa wetland. Some household are able to indicate quantity of forage collected per time from the wetland for their livestock, whereas some other could not, but were able to give periods in which their animals feed in the wetland. Thus, in cases whereby respondents are not able to give quantity of forage collected from wetland for their livestock an average intake per animal per day (Animal Unit Day) has been determined as 5kg of dry matter per day for cattle, 1kg for goats and 3kg for donkeys (Tardese, 1995)[56] (Appendix 7, pp126).

Based on the foregoing about 150 households are using the Ga-Mampa wetland for livestock grazing. Meaning that on average, about 84 Donkeys, 618 cows and 1,115 goats depend annually on the wetland for their forage. There was no reported sale of grazing forage in Ga-Mampa. In separate discussion held with three wetland grazers, focus group discussion and interview with extension officer, it was indicated that R20 will be acceptable price for a bag full of forage (this is half of cost of similar feed in Mafefe, according to extension officer). Annual GFV from grazing is estimated as R488, 295, the main cost involved in grazing is due to use of cutlass or sickle to collect forage, in most cases no direct cost is involved as animals are only led to wetland, left there and led back in the evening. Few household employ external labor to take their animals for grazing while for most households it is the responsibility of the young boys. NFV of grazing in the Ga-Mampa wetland is thus estimated as R488, 057 (Table 11)

[53] It is a common practice in this part of South Africa to use animal excreta (cow dung) to plaster floor and walls in substitute for cement. This the researcher found interesting, and explored if it has any cultural route, but found out it does not.

[54] According to secretary of GCDF up to 90% of livestock, owners are also wetland croppers. However, survey data suggest about 40% are wetland croppers. This low figure may be because most households are not aware their animals graze in the wetland.

[55] It was possible to use the value of products such as manure, milk, and drought power derived from livestock to estimate value of grazing in the wetland. Also possible is the use of the actual market price of the animals. For the former, there was inadequate data; also, these methods were not used because they assume the wetland as the only input to the value of the animals.

[56] Note that these values are for grazing in Ethiopia, which may differ slightly from South Africa. However, variation is expected to be minimal.

Table 11: Estimated Harvest and Economic Value of Grazing from Ga-Mampa Wetland (from field survey 2006).

Livestock grazing (Mafulo a mehlape)								
	Total Harvested	Household Use	Gift	Sold	Price (R)	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	10,791					2,698	2,696	0
Per average HH	4,957					1,239	1,239	0
Bags	24,415	24,415	0	0	20			
R						488,295	488,057	0
$						75,587	75,551	0
€						56,647	56,619	0

5.3. Edible plant collection (Morogo)

Edible plant collection is the service with the highest number of users. It is estimated that at least between 95.5% to the entire households of Ga-Mampa valley collect edible plant from the wetland. This is the most open and general use of the wetland; collection is free and unrestricted, in fact it is possible to collect edible plants from farm plot when not under cultivation. There are about 24 different types of edible vegetable plants collected from the wetland and used to diversify diet, major types are *Moshwe, Leshashe, Mshigi, Morotse and Bolotse.* Collection takes place all year round with highest collection intensity between November and March (Table 8, pp45). Some households collect excess of these plants in the wet season and sundry them for use in the dry season when available quantity in the wetland would have reduced. Edible plants occur and are available for collection generally across the wetland; collection is the responsibility of the women and children. Collection is done with the hands, into small farm seed buckets[57]. There are other possible locations to collect edible plants outside the wetland i.e. the mountains and dry-land. When asked why they choose the wetland as the place for collecting edible plants, majority of respondents indicated that it is not always available from other sources, and might not be as good as that from the wetland. In the case of shortage they either buy meat, beans or cabbages which are substitute to edible plants to diversify their diet.

Questionnaire survey show that 95.5% of households harvested edible plant from the wetland, this results in a TQH of edible plant of 15, 273kg. Edible plant is seldom sold in Ga-Mampa valley, when sold, price ranged between R1.5 and R2.5, making an average price of R2. Thus average annual GFV from edible plants collection from the Ga-Mampa wetland is R203, 637. Because cost of collection is due only to the farm seed bucket whose cost is regarded as negligible NFV for edible plant was estimated to be same as GFV. Only about 2.8% of TQH is sold with an estimated CIC of R5, 707 accruing mainly to 5% of households (Table 12). 86% of harvested edible plant is used for direct household consumption by PHH. Some 11% is used to meet social responsibilities through gift giving to elderly neighbors and relatives. Average household collection per week is 1,530g requiring about 1.7 hours walking to and from the wetland and another 1.7 hours for collection. Taking household labor time into consideration, about 1 hour of household labor time is required to collect 450g of edible plant, meaning averagely R6 is benefited for every hour spent collecting edible plant in an area where average standard hourly wage is R8.

[57] During survey, the buckets were used as unit of measurement since it was easier for respondents to estimate quantity using this unit. A 2*kg* bucket was estimated to contain about 300g of edible plant, analysis was based on this conversion.

Table 12: Estimated Harvest and Economic Value of Edible Plant from Ga-Mampa Wetland (from field survey 2006).

Edible Plant collection (Morogo)								
	Total Harvested (kg)	Household Use (kg)	Gift (kg)	Sold (kg)	Price	Gross Financial Value	Net Financial Value*	Cash Income
Per PHH	41					542	542	15
Per average HH	39					517	517	14
Total	15,273	13,211	1,634	428	2 R/ 150g			
%	100.0	86.5	10.7	2.8				
R						203,637	203,637	5,707
$						31,523	31,523	883
€						23,624	23,624	662

* In this case NFV = GFV because cost is only due to farm seed bucket for which cost is highly negligible.

5.4. Reed collection (Lehlakha)

One of the main benefits local people of Africa derive from wetlands is the ability to collect materials for roofing their homes. Reeds *(phragmites australis)* are the materials harvested from the Ga-Mampa wetland and used in building homes- it is used as materials for roofing in buildings. Often used together with grasses (*Bjang*) collected from the mountains, reeds are used in roofs as insulators underneath the grasses. It is believed that use of reeds in buildings is gradually on the decline in Ga-Mampa valley, a condition blamed on decreasing quantity of reeds in the wetland coupled with modernization leading to taste for zinc roofing. Approximately, about 50% of buildings in Ga-Mampa are roofed with reeds believed to have come from the wetland. In the year under study (2005/2006 cropping year), reeds were collected in the wetland by an estimated 21.3% of total households in Ga-Mampa valley. Up to 97% of households have been involved in reeds collection in the past and possibly majority are still potential users of these service, however not all are able to find reeds during this period. There exists a sort of community management around reeds harvesting from the wetland as period to collect reeds is sanctioned by the headman. It is usually between June and July (Table 8, pp45) annually. It is an offence to collect reeds without the headmen's permission when they have not yet declared time for reed collection.

Because of restriction on harvesting period, it was much easier and reliable to determine the total TQH per PHH. At average values, based on assumption B and C, total annual harvest of reeds from the Ga-Mampa wetland is estimated as 2, 512 bundles[58]. Of this about 71.7% is used directly by households for roofing their own house, while 9.5% is used as gift mainly to neighbors and relatives who could not find any, another 18.8% is sold both in Ga-Mampa and neighboring settlement of Kappa. A bundle of reeds costs R20 in Ga-Mampa throughout the year. Average GFV from reed collection in the Ga-Mampa wetland is R50, 520. Cost involved in the use of reeds is due mainly to the use of implement (cutlass) for collecting reeds, hence average annual NFV for reeds is estimated at R50,355 (Table 13). About 19% of total quantity collected is sold by 36% of PHH to yield a CIC of R9, 480. Average household collection per year is 30 bundles requiring about 2.8 hours walking to and from the wetland and another 38.2 hours for collection. In

[58] Reed and Sedge are harvested in bundles. A bundle is about 60cm in diameter and could weight between 5-10kg

total about 41 hours of household labor time is required to collect the average quantity of reeds which is worth R600 meaning averagely R14.6 is benefited for every hour spent collecting reeds, as against R8 which is average standard hourly wage.

Table 13: Estimated Harvest and Economic Value of Reeds from Ga-Mampa Wetland (from field survey 2006).

Reed collection (Lehlakha)								
	Total Harvested (bundles)	Household Use (bundles)	Gift (bundles)	Sold (bundles)	Price	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	30					601	599	113
Per average HH	6					128	128	24
Total	2,526	1,812	240	474	20 R			
%	100.0	71.7	9.5	18.8				
R						50,520	50,355	9,480
$						7,820	7,795	1,467
€						5,861	5,842	1,100

5.5. Sedge collection (Lethlaka)

Photo 5: A respondent displaying mats made from sedge.

Sedge *(Cyperus papyrus)* is important wetland resources in Africa (Turpie, 2000) and they are important to the people of Ga-Mampa valley. It was reported that sedge are used for making different art and craft materials such as baskets and mats. It is the reduction in quantity of sedges and reeds that seems to give the locals the most concern as to the health of the wetland. An estimated 22.8% of households collected sedge from the wetland during the 2005/2006 cropping year. Up to 93% of total households in Ga-Mampa valley are potentially engaged in sedge collection, this includes households that have collected sedge from the wetland in the past and those who wanted to collect in the last year but could not find any. Sedge collection has same management procedure as reeds with regards to period of collection. Unlike reeds, sedge is not used directly by households; it only becomes useful and beneficial to them after making craft materials, mainly mats (*legoga)* from it. Though there are other craft items such as baskets that could be made from sedge, none of respondents reported making this. Sedge is hardly sold until *legoga* is made from it. In household organization, the parents collect sedge.

An estimated 756 bundles of sedge is harvested from the wetland annually. A bundle of sedge like reeds is sold for R20. Of the TQH 74.6% (564 bundles) is used in making mats

and the remaining 25.4% (192 bundles) is sold[59], mainly to households within Ga-Mampa. Averagely, one mat is made from 0.75 bundle of sedge, meaning in total, about 750 mats were made annually. Of this total mats made, 76.8% is sold to customers from Ga-Mampa, Kappa and Mafefe. The remaining is used as gift and for personal use. Combining worth of quantity sold directly in bundles at R20 per bundles, and number of mats made at a standard price of R80, average annual GFV derived from sedge harvesting from the Ga-Mampa wetland is estimated as R63,840. Cost involved in use of sedge from the wetland is due to (i) cutlass used for harvesting (ii) thread and needle used in making mats (iii) cost of building a locally made knitting machine and (iv) cost of transportation to and from market. Taking these monetary costs into consideration, average annual NFV was estimated as R51, 148. A total of R49, 920 is also generated as cash income i.e. value realized from the sale of bundles of sedge and mats. 70% of PHH are involved either in the sale sedge in bundles or mat making.

It takes about twenty hours (3 hours for walking to and from wetland and seventeen hours for harvesting) of household labor to collect average quantity of sedge (8.4 bundles), in addition, it requires about 7.2 hours to make 1 mat. With this, an average PHH requires about eighty household labor hours to harvest sedge and make mats per year. This means that for R640 worth of household labor hour devoted to sedge collection from the Ga-Mampa wetland, it could get R709 in return.

Because the main reasons for collecting sedge is mat making for profit, 93% of respondents believe there is no substitute for sedge to them, only 7% who mainly collect sedge to make mats for household use say they will make wooden bed as a substitute. In the respondents perception with regards to observed changes in quantity of sedge during the past five years, indicators used and causes of changes are similar to those of reed; this could be because people closely relate reeds and sedge.

Table 14: Estimated Harvest and Economic Value of Sedge from Ga-Mampa Wetland (from field survey 2006).

	Sedge collection (Lethlaka)									
	Total Harvested (bundles)	Sold directly (bundles)	Total for Mats (bundles)	Mats Made	HH Use Mats	Sold Mats	Price (R)	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	8.4						20/	709	568	555
Per aver. HH	2						bundle	162	130	127
Total	756	192	564	750	174	576				
%	100	25.4	74.6	100.0	23.2	76.8	80/ mat			
R								63,840	51,148	49,920
$								9,882	7,918	7,728
€								7,406	5,934	5,791

5.6. Fuel-wood collection (Dikgong tsa mollo)

Relative to earlier discussed services derived from the Ga-Mampa wetland, the use of the wetland for fuel-wood collection is minimal. This is probably due to the wetness of fuel-

[59] It could have been assumed that they were used for making mats, however because this was not investigated during the field work, this assumption has not been considered in this calculation.

wood from the wetland and the availability of drier once in the mountains[60] and other parts of the Ga-Mampa valley. Reported cases of fuel-wood collection from the wetland were only in the dry season. Main reason given by PHH for using the wetland as a source of fuel-wood was proximity to settlement. Up to 38% of households agreed to have collected fuel-wood from the wetland in the past. However, an estimated 1.5% of households in the valley collect fuel-wood from the wetland in the period under study. Fuel-wood is a major source of cooking energy. For PHH, it is the responsibility of the young ladies and the mother to collect fuel-wood. Fuel-wood is collected and divided into bundles; a bundle of fuel-wood could measure up to 70cm in diameter and about 200cm long with an approximate weight of 10-15kg.

An estimated annual harvest of 1,296 bundles of fuel wood is reportedly collected from the Ga-Mampa wetland. Though no data exist on sale of fuel-wood from the wetland, standard price for fuel-wood (collected from other sources i.e. the mountains) in Ga-Mampa valley for this period was R20 per bundle. Thus GFV for fuel-wood is estimated as R25, 920. When cost of an axe (implement used for fuel-wood collection) is considered, fuel-wood harvesting from the wetland gave an estimated NFV of R25, 860. It takes about 4.5 hours for a household to collect average weekly requirement (9 bundles) of fuel wood.

Table 15: Estimated Harvest and Economic Value of Fuel-wood from Ga-Mampa Wetland (from field survey 2006).

Fuel-Wood collection (Dikgong tsa mollo)								
	Total Harvested (bundles)	Household Use (bundles)	Gift (bundles)	Sold (bundles)	Price	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	216					4,320	4,310	0
Per average HH	3					66	66	0
Total	1,296	1,296	0	0	20			
R						25,920	25,860	0
$						4,012	4,003	0
€						3,007	3,000	0

5.7. Fishing (Go thea dihlapi)

In this study the Mohlapitsi River was delineated and not considered as part of the wetland, hence fishing activities going on in the river was not regarded as wetland activity; as such fishing from the river was clearly distinguished from fishing in the wetland. Fishing in the river is more frequent than that taking place in some identified ponds within the wetland. An estimated 31.8% of Ga-Mampa valley households have collected fish from the wetland in the past. In the period 2005/2006, 4.5% of Ga-Mampa valley has collected fish from the wetland (majority of these are those with cropping plots in the wetland). It is mostly the responsibility of young males to go fishing for the household. All fishing is done with the use of fishing hook using worms found in the wetland as a feed trap to lure the fish. It was not possible during this study to determine the different species of fish available in the wetland.

[60] Most fuel-wood cutting takes place along the slopes of the mountains, a situation which could accelerate rate of erosion and rock falls in the valley.

An average sized fish of about 100g weight is worth between R2 and R2.5. Estimates reveal that a total annual harvest of 708 averagely sized fish is caught from the Ga-Mampa wetland annually. Average annual collection per PHH is about 39 pieces. Annual gross financial value due to fishing is estimated as R1, 593, cost is associated with buying hooks and thread giving an annual NFV of R1, 425 for fishing in the Ga-Mampa wetland. Also fishes collected were used for household consumption.

Table 16: Estimated Harvest and Economic Value of Fishing from Ga-Mampa Wetland (from field survey 2006).

Fishing (Go thea dihlapi)								
	Total Harvested (Pieces)	Household Use (Pieces)	Gift (Pieces)	Sold (Pieces)	Price	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	39					89	79	0
Per average HH	2					4	4	0
Total	708	708	0	0	2.25			
R						1,593	1,425	0
$						247	221	0
€						185	165	0

5.8. Hunting (Go tsoma)

There is verbal confirmation to suggest hunting activities at a large scale in the wetland in the past, however, presently, hunting is not regarded as a major use of the wetland. An estimated 39% of Ga-Mampa households have benefited from the wetland through hunting in the past, however with the clearing of the wetland and reduction in vegetation which support games, ability to hunt and find games in the wetland have drastically reduced. In the year under study only an estimated 1.5% of households agree to collecting game from the wetland. This seems to be a collection by chance and not a deliberate action. On the other hand most households deliberately go hunting in the mountains. This is the responsibility of the young males in the household, and they mainly use dogs for this purpose.

1.5% of households in Ga-Mampa valley hunt games[61] from the wetland collecting averagely about ten pieces of game per PHH. In total, about 60 averagely sized games are hunted in the wetland annually. There is no market for game in Ga-Mampa valley, PHH and members of focus group discussion suggest chicken as the closest substitute for the game. It is believed that an averagely weight game of about 3kg is worth about R31.5 (average price). Annual GFV of hunting in the Ga-Mampa wetland was estimated to be R25, 920. Game was collected using dogs to hunt them down, cost was thus considered insignificant as such GFV=NFV. It takes about 10 hours to hunt average quantity per PHH.

[61] As I did not observe the games myself, it was not possible to describe its type or give its scientific or English name. it is called Lehudi in the local language.

Table 17: Estimated Harvest and Economic Value of Hunting from Ga-Mampa Wetland (from field survey 2006).

Hunting (Go tsoma)								
	Total Harvested (Pieces)	Household Use (Pieces)	Gift (Pieces)	Sold (Pieces)	Price	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	10					315	315	0
Per average HH	0.2					5	5	0
Total	60	60	0	0	31.5			
R						1,890	1,890	0
$						293	293	0
€						219	219	0

5.9. Water collection (Go gelela meets)

The three major uses of wetland water identified are its use for washing, bathing and drinking (Morardet and Darradi, 2006). Wetland water was also discovered to be essential for other purposes such as for domestic animals and for building purpose. The presence of water is a major feature of wetlands important for societies around arid zones like Ga-Mampa valley. The presence of a wetland is important for the provisioning of water needed for domestic uses. Because of its location and geology, there are a number of springs and rivers from where most households collect their daily water requirement. This is mainly because the springs and rivers are closer to the settlement than the wetland. 75% of responding households from Mantlhane sub-village agree to the wetland as their main source of water for drinking, washing and bathing and other uses. Reason for this is because the wetland is closer to the people at this village. For households in this village they deliberately go to the wetland to collect water, whereas for households from other settlements water collection in the wetland is associated with other activities, i.e. during farming activity or edible plant collection. An estimated close to 90% of households is presently collecting water from the wetland for one purpose or the other. This is 56% for drinking; 14% for washing and 21% for bathing. Virtually the entire population has collected water from the wetland in the past. Water collection is done by all household members except the men.

In all it is estimated that about 6,329,061 liters (6,329 kl[62]) of water is collected annually from the wetland. This represents about 418kl for bathing; 186kl for washing; 5, 82kl for drinking; 100kl for other purposes and about 5, 040kl consumed by animals (Table 18). Valuing the monetary benefit from water collection in Ga-Mampa valley presents two main difficulties, (i) there is no market price for water in South Africa, at least the law stipulates household water is free to rural households (DWAF, 2006) (ii) even in the absence of this price, substitutes are available to wetland water and these alternatives require even less travel time (except for Mantlhane). Despites these difficulties, price of bulk water supplied to municipalities gotten from Department of Water Affairs and Forestry in Tzaneen (closest settlement to Ga-Mampa where price exists) at R3.44 per kl is used. Based on this, gross financial value of water collection from the wetland is estimated as R4, 251. About 6 households reportedly experienced Bhilarzia as a result of drinking water from the wetland, costing an average R1800 on medical expenses. With this NFV of water is estimated as R2, 451 (Table 19) Time spent collecting water from the wetland was considered as negligible, because water collection from the wetland is

[62] Kilo litres

mostly associated with other activities in the wetland, for example farming or edible plant collection.

Table 18: Estimated harvest and economic value of water collection (per use type) from Ga-Mampa Wetland (from field survey 2006).

	Bathing		Washing		Drinking			Animal		Other Purpose		
	Total	GFV	Total	GFV	Total	GFV	NFV	Total	GFV	Total	GFV	Price
Per user HH	5	17	3	12	3	9	-8	28	96	17	58	
Per average HH	1	4	0.5	2	1	5	-5	13	44	0.3	1	
Total	418		186		583			5,041		101		3.44
R		1,438		641		2,005	-1,877		17,340		347	
$		223		99		310	-291		2,684		54	
€		167		74		233	-218		2,012		40	

Whereas, table 18 presents results for each water use the wetland is put to. This showed that in terms of NFV, participating households are at a loss. Table 19 is the general result for water collection from the Ga-Mampa wetland.

Table 19: Estimated economic value of water collection (general) from Ga-Mampa Wetland (from field survey 2006).

Water (Go gelela meets)							
	Total Harvested (kl)	Household Use (liters)	Sold	Price	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	16	16	0		56	51	0
Per average HH	16	16	0	3.44	55	50	0
Total	6,329	6,329	0				
R					21,772	19,895	0
$					3,370	3,080	0
€					2,526	2,308	0

5.10. Medicinal plant collection (Dihlare tsa setso)

Not much is known about the use of the Ga-Mampa wetland for medicinal plants. This is probably due to "secrecy" in the community about its use (Morardet and Darradi, 2006). In the course of this research, there was initial resistance to speak. However, through persistence and extra assurance and confidence building by researcher- that information given will be used only for research purpose, one of the households using the wetland for this purpose agreed to be interviewed. It was established that there are actually three[63] traditional healers in Ga-Mampa valley, who are in the first case potential users of the wetland for medicinal purposes (there could be other individuals using the wetland for this purpose). Three types of medicinal plants collected from the wetland were mentioned: these are *Mupurogu, Mutusa, Masheo Mabe* (could not determine botanical name). *Mupurogu*, is used for prevention of all forms of sickness, it is claimed to be able to "prevent any type of disease, no matter how bad it could be", provided it is taken before sickness occurs. It is tree and is left out to dry for some days after which it will be burnt into ashes, it is the ashes from this plant that serves as the medicine. About 750 gram of ash could be gotten from a log weighing about 5kg. Procedure for use is that

[63] Of these three, one was interviewed another claimed not to collect medicinal plant from the wetland, while the third person declined interview.

people who need it pay R10 for a taste of the medicine a 750g could last about 4 months. The other medicinal plants from the wetland are *Mutusa* and *Masheo Mabe* used together with other plants collected from elsewhere (mountain) for local male fertility drug. A mixture of this drug is worth about R20 per bottle. The informant believes these plants are abundantly available in the wetland but not aware of any deliberate effort to conserve them.

Because of the seeming secret surrounding its use it was not possible to express and include in the economic value of medicinal plant in this study, though it was still regarded as a main service provided by the Ga-Mampa wetland. This is based on the premise that if it had not been important, probably, the people will have nothing to hide about it.

5.11. Total economic value of Ga-Mampa wetland provisioning services

From the foregoing estimation of the economic value of each provisioning services of Ga-Mampa wetland, the total economic value of the provisioning services provided by Ga-Mampa wetland was estimated (Table 20). Based on this estimation, livestock grazing contribute the highest value to the GFV (about 47%) and NFV (about 45%) of the Ga-Mampa wetland. Sedge collection account for about 56% of the total cash income generated from the Ga-Mampa wetland (Figure 22).

Table 20: Total economic value (GFV, NFV and CIC) of each wetland services (from field survey 2006).

Wetland service	Average GFV ($)	Average NFV ($)	Average CIC ($)
Cropping	36,788	31,511	3,831
Grazing	75,587	75,551	0
Edible Plant	31,523	31,523	883
Reed	7,820	7,795	1,467
Sedge	9,882	7,918	7,728
Fuel-wood	4,012	4,003	0
Hunting	293	293	0
Fishing	247	221	0
Water Use	3,370	3,080	0
Total ($)	169,523	161,893	13,909

Combining estimated average annual value of the main provisioning services provided by Ga-Mampa wetland gives the total economic value (of main provisioning services) of the wetland. At average value it has been estimated that the annual total economic value of Ga-Mampa wetland is worth $169,523 at gross financial value. If the cost (excluding household labor time) of harvesting each of the service is taken into consideration, annual net financial value of Ga-Mampa wetland is estimated at $161, 893. Annual cash income of the Ga-Mampa wetland was estimated as $13,909. No one household in Ga-Mampa valley uses the wetland for all services. From survey data, the household with the highest estimated annual benefit of $3, 769 (GFV) uses the wetland for all services except for fishing and hunting. On the other hand, household with the least benefit use the wetland only for edible plant collection having an annual GFV of $17. This figures suggest a high variation in value of benefit between households, further analysis is conducted and reported in chapter six to establish these variation. However, assuming benefit from the provisioning services of the Ga-Mampa wetland is shared equally among households in

the Ga-Mampa valley, it is able to contribute $430 in gross financial value (about 26% of average household cash income), $411 in net financial value and $35 in cash income to each household in the Ga-Mampa valley (Table 24, pp74). However, are the resources shared equally among households?

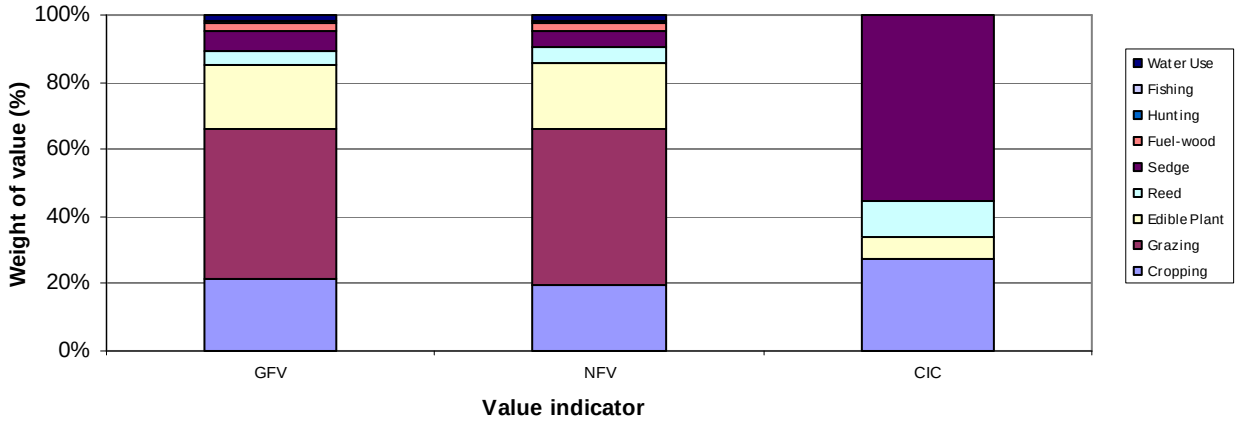


Figure 18: Total economic value of Ga-Mampa wetland provisioning services.

However, in reality based on a number of uncertain factors and assumptions (Box 3, pp32) it is extremely difficult to estimate an exact economic value for wetland service, average value was used for simplicity. A range of values is more logical, for this study range of possible values for each service have been estimated based on combination of all assumptions at minimum level and combination of all assumptions at maximum level. This yields the range of values presented in table 21 below.

Table 21: Estimated Economic Value of All Services Giving Minimum, Average and Maximum Estimates (from field survey 2006).

	Gross financial value ($)			Net financial value ($)			Cash income ($)		
	Minimum Value	Average Value	Maximum Value	Minimum Value	Average Value	Maximum Value	Minimum Value	Average Value	Maximum Value
Cropping	33033	36788	40543	27755	31511	35266	3516	3831	4146
Grazing	71411	75587	78928	71376	75551	78890	0	0	0
Edible Plant	22636	31523	41290	22636	31523	41290	634	883	1151
Reeds	7448	7820	8100	7424	7795	8073	1398	1467	1520
Sedge	9443	9882	10322	7566	7918	8270	7384	7728	8071
Fuel-wood	4012	4012	4012	4003	4003	4003	0	0	0
Hunting	260	293	325	260	293	325	0	0	0
Fishing	233	247	260	208	221	233	0	0	0
Water Use	3225	3370	3519	2946	3080	3215	0	0	0
Total	151701	169523	187300	144174	161893	179565	12932	13909	14889

Respondents (members of second FGD) were asked to rank the value of wetland services, using a PDM. They were to assign they were to assign appropriate number of stones to each service based on their perceived importance. This was weighed (as a percentage) and is used as perceptual value. Comparing the weight of empirically estimated average values of each wetland service with weight of perceptual value put on them by respondents (Figure 19) reveals some disparity suggesting that households do have a different perception of value of services relative to empirically determined estimates. While empirical estimates suggest livestock grazing as having the highest value, respondents perceive cropping as having the highest value, in fact grazing (highest

empirical value) was perceived as having only the fourth highest value after cropping, edible plant collection, sedge and reeds collection. However, respondents perceived position of the contribution of fishing and hunting fits with empirical finding.

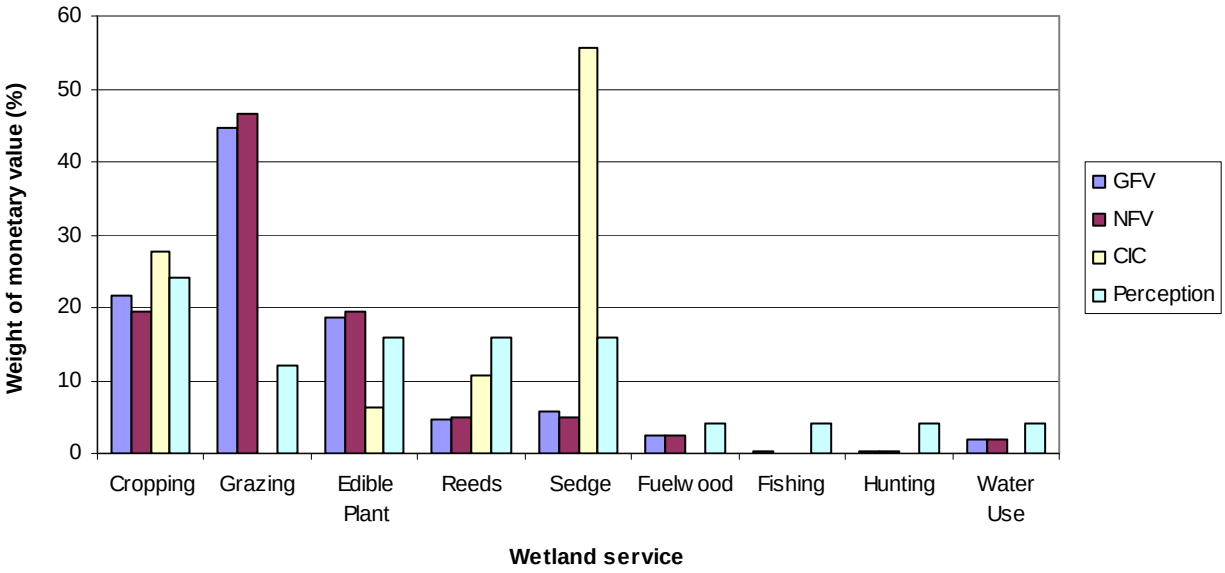


Figure 19: Estimated proportional value of wetland services (GFV, NFV and CIC) compared with their relative value as perceived by stakeholders (from field survey 2006).

All estimations of NFV indicated for the main economic analysis, as depicted from the foregoing sections of this report does not consider labour time spent by households in the process of using a wetland service as a cost of production (this will be known as -time). Further analysis, is made to explore the estimation of value (NFV) of wetland services, taking household labour time spent in wetland activities as a factor (this will be known as + time). In Ga-Mampa valley, based on focus group and informal discussions, it was estimated that average labour cost is about R8[64] per hour. Table 22 shows the relative net financial value of Ga-Mampa wetland services with and without household labour taken into consideration as a cost. Value of water collection is not included, because it is often not a deliberate activity often associated with trips to the wetland for other purposes, thus, expected difference is minimal and negligible.

Table 22: Net annual financial value of wetland services with and without household labour as cost (from field survey 2006).

Wetland service	- time ($)	+ time ($)
Cropping	31,511	-54,936
Grazing	75,551	38,938
Edible Plant	31,523	-10,740
Reeds	7,795	3,789
Sedge	7,918	908
Fuel-wood	4,003	3,446
Fishing	221	-20
Hunting	2,92	269
Total	158,814	-18,348

[64] Average wage to a hired labour per day is R70; this is approved by the GCDF. After putting it to discussant at second focus group discussion, it was suggested that using the R70 per day is better.

As will be expected the value estimate +time is less, it is interesting to see how the value of each service changed. The value of copping changed significantly from being the second highest contributor (when considered –time) to having the greatest deficit, meaning that if time is taken into consideration, cropping households are loosing rather than gaining. Reason for this situation is considering the high unemployment rate in Ga-Mampa valley, the opportunity cost of labor for most households is expected to be less than the average value of labor time.

5.12. Uncertainty Analysis

Values discussed above are at average estimate, however as earlier indicated in chapter 3 of this report (Box 3, pp32), a number of assumptions were adopted. This leads to varying estimates in ranges. In reality values of the wetland are estimates and could be in ranges (Table 18) depending on how much information is available to estimate each wetland service. Standard deviation and mean error can give insight into uncertainty related to an estimate. Table 23 shows the error from mean value, indicating that TEV estimate of GFV and NFV is accurate to ten of a thousand dollars, while CIC is to 600 dollars. In addition, coefficient of variation (CoV) is employed in this case to suggest relative uncertainty related to each wetland service, in this case it is assumed that the service with the highest CoV posses the highest uncertainty.

Table 23: Uncertainty Associated with estimated Economic Value (from field survey 2006).

	Gross Financial Value		Net Financial Value		Cash Income	
	Value (Mean ± MD)	CoV	Value (Mean ± MD)	CoV	Value (Mean ± MD)	CoV
Cropping	36788 ± 2168	10.21	31511 ± 2168	11.92	3831 ± 182	8.23
Grazing	75587 ± 2174	5.00	75551 ± 2174	5.00	0	0.00
Edible Plant	31523 ± 5387	29.33	31523 ± 5387	29.33	883 ± 149	29.06
Reeds	7820 ± 189	4.20	7795 ± 188	4.20	1467 ± 35	4.20
Sedge	9882 ± 254	4.44	7918 ± 203	4.44	7728 ± 198	4.44
Fuel-wood	4012	0.00	4003	0.00	0	0.00
Hunting	293 ± 19	11.11	293 ± 19	11.11	0	0.00
Fishing	247 ± 8	5.56	221 ± 7	5.56	0	0.00
Water Use	3370 ± 85	4.37	3080 ± 78	4.37	0	0.00
Total USD	169523 ± 10276	10.50	161893 ± 10216	10.93	13909 ± 565	7.03

Figure 20 shows the relative measure of uncertainty in estimates for the wetland services valued. Estimated values of edible plants have the highest uncertainty for all three measures (GFV, NFV and CIC). Uncertainty in value estimates for fuel-wood collection is the least. A visual representation of the extent for each service is presented in Appendix 8. Since grazing is the highest contributor to the total value of the wetland, the TEV will tend to be more sensitive to this, though also with some level of uncertainty it is minimal. Most services are not sold for CIC resulting in null uncertainty in cash income of some services (hunting, fishing and water use).

Although, effort at qualitative uncertainty analysis through experts was not successful, it was possible to get an idea of this from the local stakeholders. In discussion with secretary of GCDF immediately after feedback workshop to the local stakeholders (on 10th November 2006) he indicated agreement with the empirical values even though it is higher than his perceptual estimate.

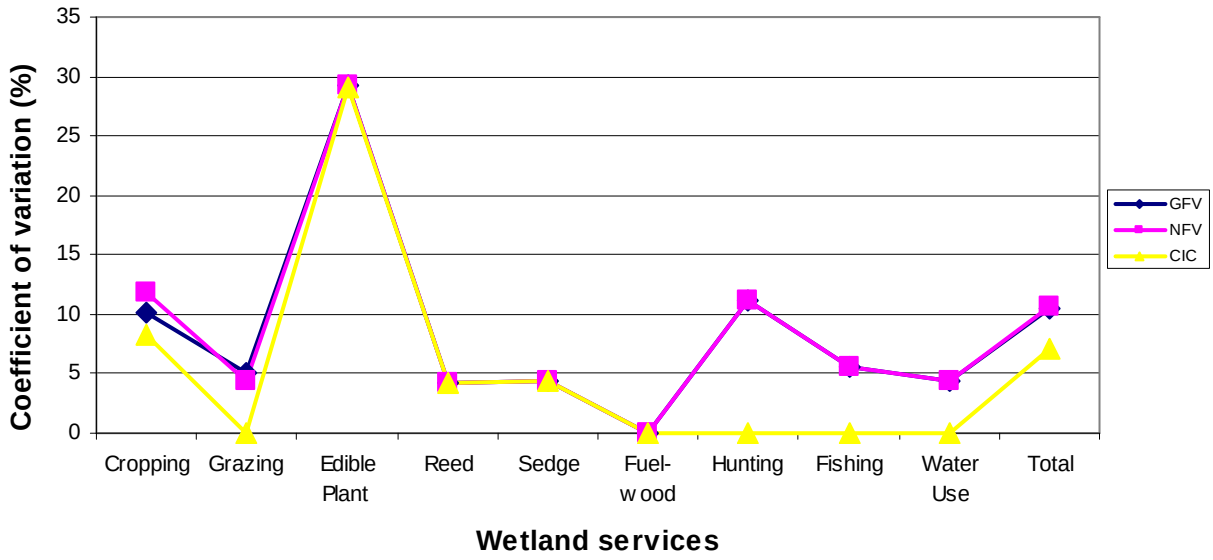


Figure 20: Uncertainty analysis for estimated value of each service (from field survey 2006).

5.13. Other services provided by Ga-Mampa wetland

The above estimated values of provisioning services are only part of the total economic value of the Ga-Mampa wetland. There are other services supported by the Ga-Mampa wetland, all of which are beyond the scope of this study and will need the commissioning of a separate study to estimate their economic values. Some of these were identified and include the following;

Provisioning services

Other provisioning service identified to be supported by the wetland is sand mining. Sand is collected from the wetland and used for building also there is sand mining going on in the wetland close to the river bank. Children were also seen collecting worms for fishing in the river from the wetland. These other services are considered low in intensity.

Cultural services

In the Mafefe area, Ga-Mampa has been designated as a tourist zone by the municipal authority. This is because of the presence of the sacred places believed to be within the wetland. Potentially, there are two of such. These are the invisible tree and invincible river; both are believed to be within the wetland and could not be seen with the ordinary eyes except when accompanied by the village head. The people of Ga-Mampa hold these sacred places very important to them and their culture. It is reported that some tourists do visit these sites on regular basis. Also in the course of this study a number of people were seen relaxing and using the wetland for leisure purpose, though the people do not regard this as an important use of the wetland.

Regulating services

Because of its size, it is not straight forward to establish how much the wetland contributes in the regulation of ecosystem processes. Morardet and Darradi (2006) reported that external stakeholders hold a belief that the Ga-Mampa wetland is important for regulating the quantity of water in the Olifants River. However, scientific experts have expressed some doubts about the real role of the wetland itself. Contribution of the Mohlapitsi River to the Olifants which is true might originate more from groundwater dynamics in the whole catchment rather than from the wetland itself (Troy et al. 2006). It

is also believed that the wetland contributes to the regulation of the micro-climatic condition in the valley, this was the only other benefit identified by one of the respondents during questionnaire survey; however, because of the size of the wetland potential for this service is regarded as low.

Supporting services

Ga-Mampa wetland is located in a valley hence it serves as a floodplain serves for sediment retention: it serves as a deposit for alluvium moved from higher altitude through agents of denudation.

6. CONTRIBUTION TO LIVELIHOOD AND DISTRIBUTION OF BENEFITS OVER HOUSEHOLDS

Having discovered the economic value of Ga-Mampa wetland, this chapter starts by examining how households feed and earn a living from wetland resources (contribution to livelihoods). The second section will examine how benefit distribution vary over different household types and what are some of the basic characteristics that define resource use options available to wetland dependent households in Ga-Mampa valley. Finally, the chapter ends with an examination of current management and sustainability issues facing wetlands in South Africa, with specific focus on Ga-Mampa wetland.

6.1. Contribution of Ga-Mampa wetland to household livelihood

It is believed that the dependence and use of the Ga-Mampa wetland in support of household livelihood by the inhabitants of Ga-Mampa valley had increased after apartheid when most homelands[65] gained considerable control over their lands and resources (Ferrand, 2004). Prior to this period, the people mainly serve as laborers on white controlled farms. Ga-Mampa valley is located in one of these poorest regions of South Africa (Gyekye & Akinboade, 2001) where 31 % of households have no source of income, 10.9% of households earn less than R400 per month, 25% of households earn less than R800, and about 65% of households live below poverty line (Statistics South Africa).

For most households with monthly income, the main source is from the social welfare which is a policy of the South African government. Close to 90% of the welfare budget in South Africa is allocated to this social welfare, in the form of old age pensions, pensions for the disabled, child and family benefits (maintenance grants), and social relief. Very few households have other sources of income apart from this. Going by the proportion of households in Ga-Mampa valley depending on the wetland for services, it is obvious that what the people collect from the wetland is vital to their daily survival. If not important, probably fewer households will depend on it, but with entire population depending on at least one service provided by the wetland shows its importance to livelihood in the Ga-Mampa valley.

Figure 21 depicts how crop yields from the Ga-Mampa wetland is used by households. More than 20% of total yield of each crop is consumed directly for household subsistence. This is even higher (over 80%) for maize (main staple meal in Ga-Mampa valley) and edible plants (source of nutrient diversification). From this, it is adequate to deduce that Ga-Mampa wetland is a source of food security for the inhabitants of the Ga-Mampa valley. The provision of crops from the wetland is very essential to food production contributing significantly needed nutrition for households. Food crops cultivated in the wetland supply households a wide range of nutrients, also supporting the cultivation of crops which ordinarily would not have been able to be cultivated outside the wetland for example banana. Pap made from maize is the most common meal in South Africa – in Ga-Mampa most households eat pap averagely 5 days a week. For

[65] Also derogatorily called Native areas, they were territories delineated according to ethnic, geographical and economic criteria, and formed “reserves” for black people (from the South African Natives Land Act of 1913).

cropping households' maize for this purpose is provided from the wetland. In the absence of the cropping in the wetland, assuming these households will be left to purchase maize in the market most certainly will not have the means to afford it. With the wetland these households are secured of available pap for many months. Average annual maize yield per participating household is 13 bags; this is believed to be adequate for an average household as most households interviewed reported having left-over[66] maize bags with the milling company. It is deduced that an average household require approximately a bag of milled maize per month. Apart from use for household consumption some quantities is sold for cash[67], some other are kept to be used as farm seed for the next cropping season, while also a part is given in exchange for farm labor. Interestingly, no household reported giving part of their maize yield for gift.

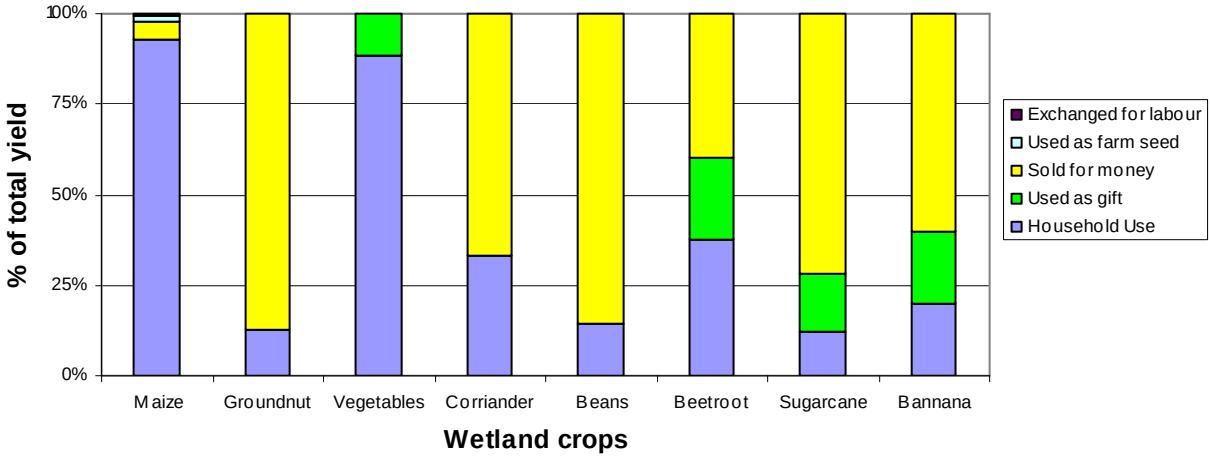


Figure 21: Use of yield of wetland crops by cropping households (from field survey 2006).

Apart from serving as a buffer for soil moisture, cultivated vegetable in the wetland is important to household food supply. Over 80% of cultivated vegetables are used directly for household consumption, serving the purpose as edible plants collected from the wetland; the remainder is given out as gift. Substantial part of other crops cultivated in the wetland is sold for cash, generating household income: some necessary money needed to meet other household requirements. Parts are also used as gift to neighbors and relatives. Also important to note from this result is the fact that no part of "main" crops cultivated (coriander, groundnut, beans and maize) is used as gift.

Figure 22 depicts destination/use of other wetland services by households. All quantities of benefits derived from livestock grazing, fuel wood, fishing, hunting and water collection are used directly in households to support their livelihoods. It is believed that because most households in the Ga-Mampa valley cannot afford frequent buying and consumption of meat, they resort to using edible plants to diversity their meal. Thus, to meet the requirement and the feeling they would have derived from eating meat, edible plants from the Ga-Mampa wetland have been so important. Based on discussion and field observation[68] edible plants are consumed in meals at least four days a week, most of which are collected from the wetland. Some portions of harvested edible plants are used as gift to neighbours and elderly relatives. Reed collection is equally important and is useful both as a source of income and as source of material for building/roofing their

[66] After giving un-milled maize to milling company, the milled maize bags is given to households on request, most households collect a bag per month, and most do have left over bags with the milling company at the end of the year.
[67] Most part was sold to milling company.
[68] Household in whose compound I was accommodated.

homes. To underscore the importance of reeds to the people, it is expected that in the absence of reeds from its only source in the Ga-Mampa valley (the wetland), households will resort to buying roofing zincs, which most of these poor households might not be able to afford. Moreover, the roofing zinc will also not provide them the coolness they derive from using reeds. It is only for sedge collection that more than 50% of quantities collected are sold to generate household income. This is mainly due to its use in mat making which is a significant income generating activity from the Ga-Mampa wetland. Livestock grazing in the Ga-Mampa wetland is important to sustain through feeding and provision of water for animals. In Ga-Mampa valley, loverstocks are kept to support household livelihood. Most end up been sold or consumed during festivities or celebrations. Livestock's are not only important when they are consumed but also provide products such as milk (mostly consumed directly in households, most households do not produce milk on commercial scale) and manure used on farm and as substitute to cement; and as means of transportation and drought power. Through the provision of forage and water, the Ga-Mampa wetland supports the sustenance of these animals which in-turn enabling them to continually provide products which are important for the people.

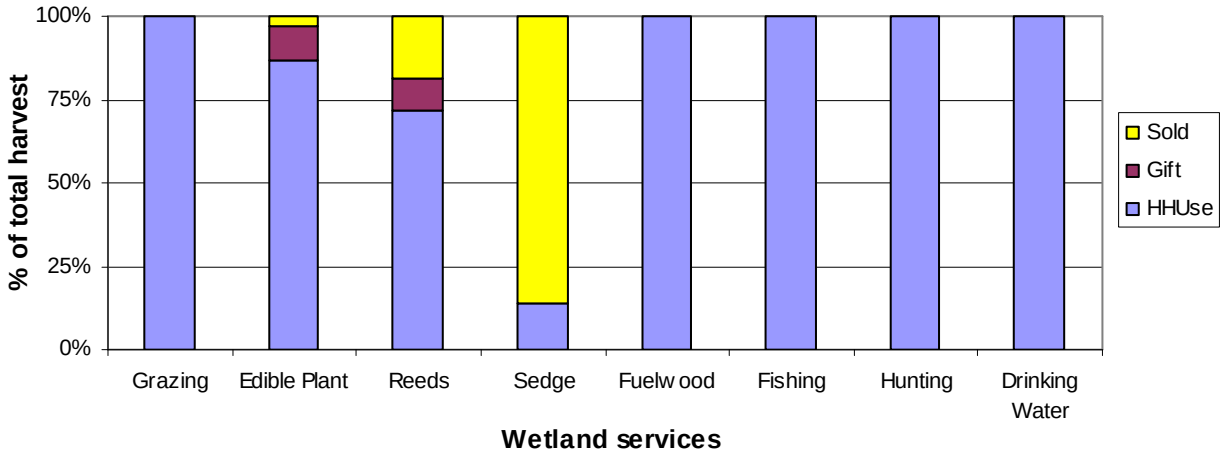


Figure 22: Destination of wetland resources harvested by households (from field survey 2006).

Whereas, there could be alternative locations outside the wetland to conduct activities such as cropping, livestock grazing, fuel-wood collection, fishing and water collection, there are no alternative locations for sedge and reed collection outside the wetland. This means a problem for households depending on reeds and sedge. For example, households using reeds for building their homes will have to seek substitute in buying roofing zincs from the market; while those selling reeds and/or making mats from sedge will inevitably be loosing a major source of cash income. This means that households in Ga-Mampa could be vulnerable to changes in availability of wetland resources, most especially those for which they do not have an alternative location for collection around them. Field data reveal that most of these households have no copping strategy to adjust to changes (reduction) in services, there is possibility this can make them even more vulnerable to poverty.

If benefits derived from the wetland are shared equally among all households, the Ga-Mampa wetland is able to support an equivalent of about 26% of household cash income, this is based on average household cash income of R853 per month estimated from this study (most of which are from social welfare grants), this is an average annual gross financial value per Ga-Mampa household of about $430 (Table 24).

Table 24: Wetland value per household and per hectare and per year (from field survey 2006).

	GFV ($)			NFV ($)			CIC ($)		
	Total	Per HH	Per ha*	Total	Per HH	Per ha*	Total	Per HH	Per ha*
Cropping	36,800	93	307	31,500	80	263	3,800	10	32
Grazing	75,600	192	630	75,600	192	630	0	0	0
Edible Plant	31,500	80	263	31,500	80	263	900	2	7
Reeds	7,800	20	65	7,800	20	65	1,500	4	12
Sedge	9,900	25	82	7,900	20	66	7,700	20	64
Fuel-wood	4,012	10	33	4,000	10	33	0	0	0
Hunting	300	1	2	300	1	2	0	0	0
Fishing	300	1	2	200	1	2	0	0	0
Water Use	3,400	9	28	3,100	8	26	0	0	0
Total	170,000	430	1,413	162,000	411	1,349	14,000	35	116

*Based on total area of the wetland. It was not possible during this field work for this study to determine total area used for collection of each service.

It was also interesting to see how respondents perceive the importance of wetland to their household livelihood. Respondents ranked the importance of wetland on a continuum of 1 to 5, 1 meant, not important to 5 which meant extremely important. A weighting system was applied and figure 23 represents the perceived importance of the wetland to their household livelihood. For an estimated about 50% the wetland is extremely important, only about 2% of the population says the wetland is fairly important and none says the wetland is not important to their household.

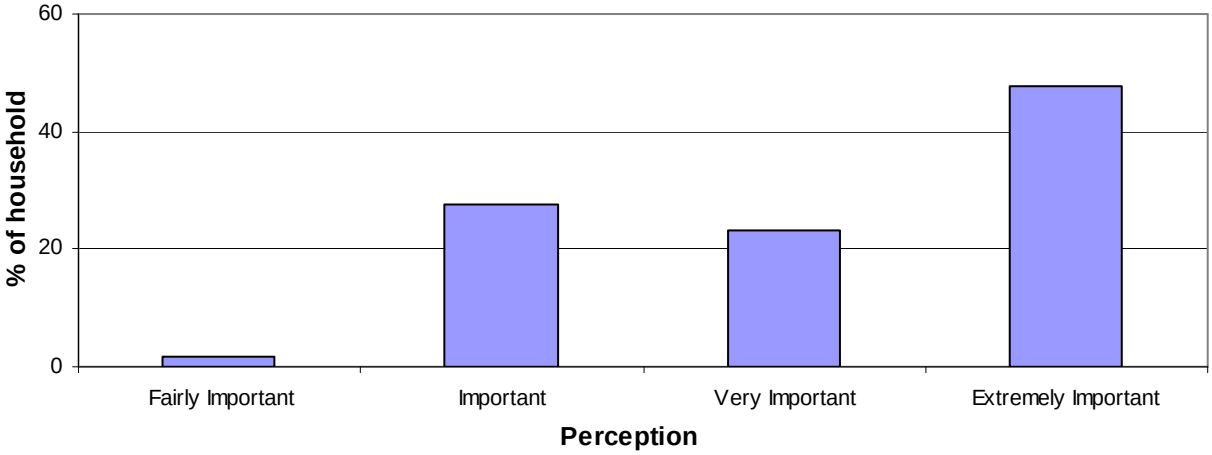


Figure 23: Perceived importance of wetland to households (from field survey 2006).

Apart from the wetland there are other sources of livelihood available to Ga-Mampa valley households. Relative to other sources of livelihood available to households i.e. pension/grant, dry-land activities and others (paid job income etc), the wetland as a source of livelihood weight almost 25% of livelihood source, second only to pension and grant. Interestingly this fits with estimated contribution of wetland to household average income (Figure 24).

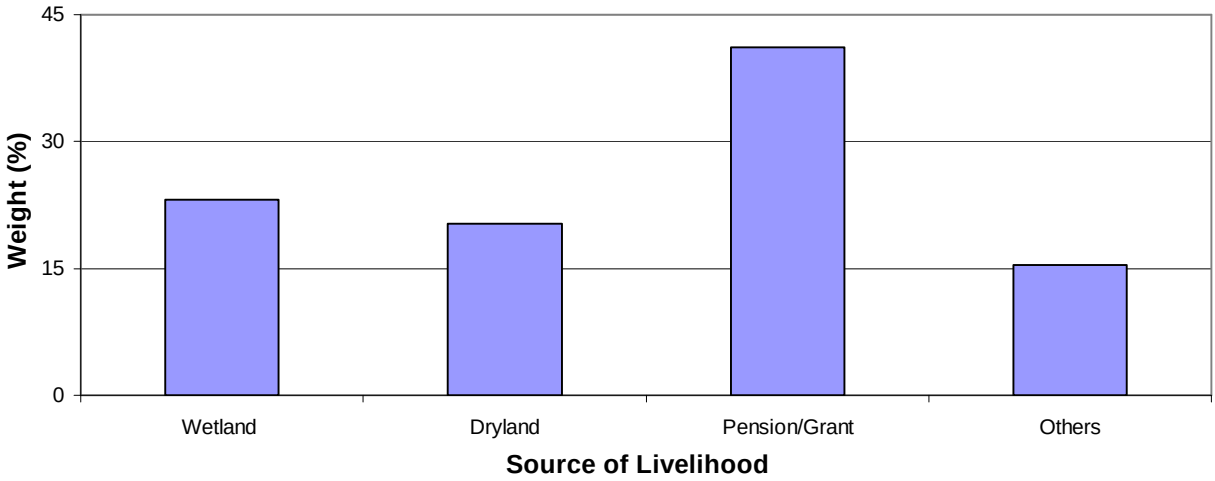


Figure 24: Relative importance of the wetland as a source of livelihood (from field survey 2006).

6.2. Distribution of benefits over households

Equity and fair distribution of resource is seen as an essential principle of ecosystem management (a key principle of IEA) and for sustainable management of environmental resources. Noting that households are most often not homogeneous, it is essential for sustainable management that benefits from resources are seen to be equally distributed among beneficiaries. Household types have been distinguished based on age, marital status, occupation, sex, and number of education years of household head; location of household settlement, household ownership of cropping plot in the wetland, and household income.

For this purpose wetland services have been grouped into five, i.e. cropping; grazing (forage and water for livestock); material collection (sedge, reed and edible plant collection) water collection (collection of water for drinking, bathing, washing and for other purposes) and others (fishing, hunting and fuel-wood collection). Statistical t-test and analysis of variation (ANOVA)[69] was conducted to see if there is any significant difference in benefits (GFV, NFV and CIC) derived by different household types. For this analysis, all hypothesis has been set as null (Ho). That is that there is no significant difference in benefits derived between different household types. Table showing results of these analysis is presented in Appendix 9 and 10.

Age

Significant difference was observed in the average value of benefits gotten by households based on age grouping. This disparity is associated with cash income generated from material collection (sedge, reed and edible plant collection). Households having household heads with an age in the range of 71-90 are having significantly higher benefit than households having heads with an age in the range of 31-50. The implication of this is that even though no significant differences exist in quantity of materials collected from the wetland, households with household head whose age is between 71-90 are more involved in sale of wetland materials. This might be due to the possibility that, the older generation posses the skill in mat making (which is a major source of cash income) and probably, the younger are not interested in this activity.

[69] For t-test, each phenomenon was grouped into 2 classes, while for ANOVA more groupings were used to discover any inter- group variation.

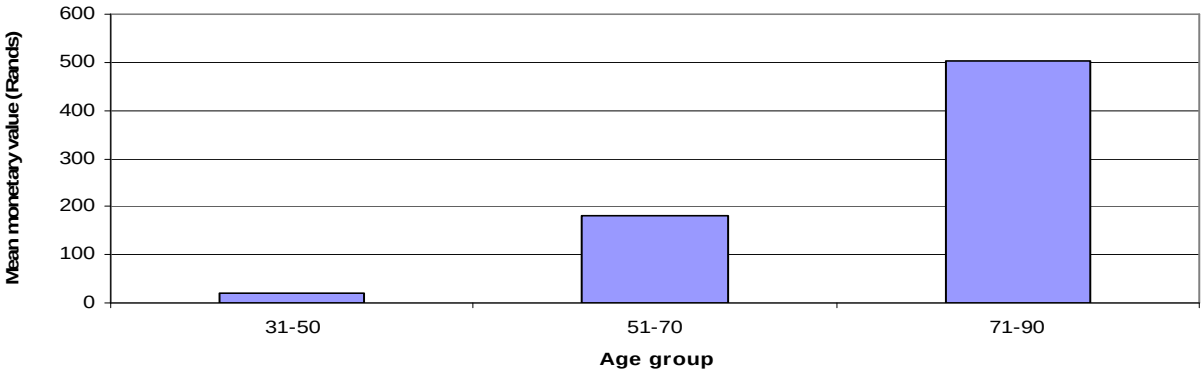


Figure 25: Mean distribution of material collection CIC over different household types based on age group[70] of head of household (from field survey 2006).

Occupation

Occupation of head of household was grouped into farmers and non farmers (note this is based on response of respondents as to their occupation, some WCH do not regard themselves as farmers and vice versa). With this a test of significance of mean benefit was conducted between both household types based on occupation. The results of this analysis reveal a significant difference in benefit from cropping. Meaning that as will be expected, farmer households have significantly higher gross and net benefit than non farmers. Suggesting that, probably farmers utilize the wetland more than those involved in other occupation.

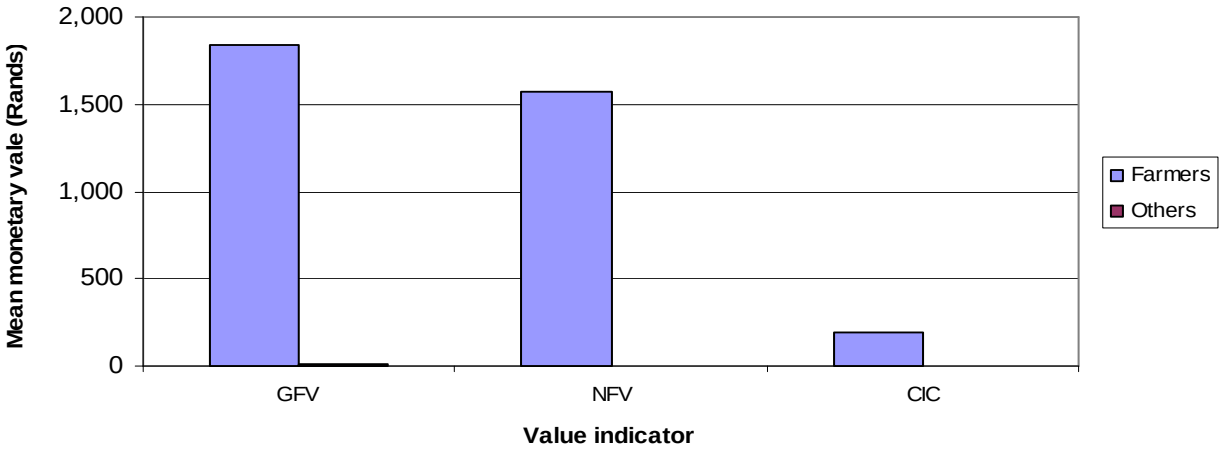


Figure 26: Mean distribution of cropping value over different household types based on occupation of head of household (from field survey 2006)

Household location

Analysis of variation was conducted to determine if a significant difference do exist in mean benefit between household from the various sub-villages within Ga-Mampa valley. The main difference between sub-villages is in gross financial value of water collection, gross financial value, and net financial value of livestock grazing. Post-hoc test using LSD (Fisher's Least Significant Difference) reveals that the variation exists between some villages (Figure 27) this figure shows that households in Mantlhane sub-village collect the most water from the wetland. The reason for this is the proximity of the wetland to the settlement and longer distance to river and springs. Field data also reveal that about 75%

[70] Age group was determined by the researcher, using a different age grouping might yield different result.

of households in Mantlhane sub-village depend on the wetland for their main source of water, against none from the other settlements. Further analysis with t-test, using the main villages of Ga-Mampa and Mantlhane, shows that there is significant difference in benefits derived between the main villages in gross value in water collection. Average collection in Mantlhane main village is almost eight times average collection in Mantlhane.

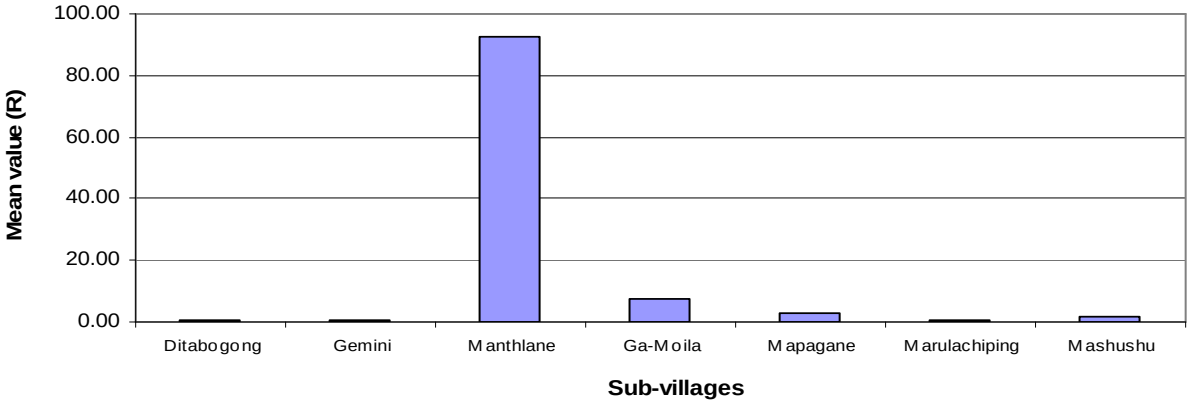


Figure 27: Mean distribution of water collection value over different household types based on settlement location (sub-villages) (from field survey 2006).

Furthermore, mean benefits in grazing is highest for Mantlhane and Ga-Moila (Figure 28) relative to other sub-villages. This might not also be unconnected to proximity of settlement.

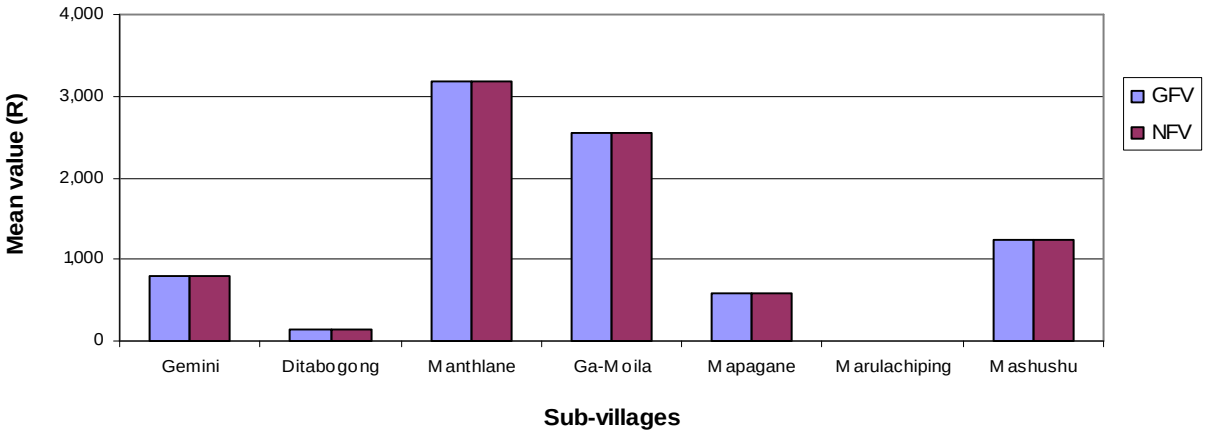


Figure 28: Mean distribution of grazing value over different household types based on settlement location (sub-villages) (from field survey 2006).

Plot access

Not all households have access to cropping plots in the wetland. Analysis reveals that significant difference exists in mean benefit gotten from the wetland between WCH and NCH. Not surprisingly there is significant difference in GFV, NFV and CIC for cropping. More important is the significant difference mean value of total benefit of all services from the wetland between both household types- in favor of WCH (Figure 29). This situation exists because over 20% of total value of the wetland is from cropping, all of which accrue only to households with access to wetland plot (WCH).

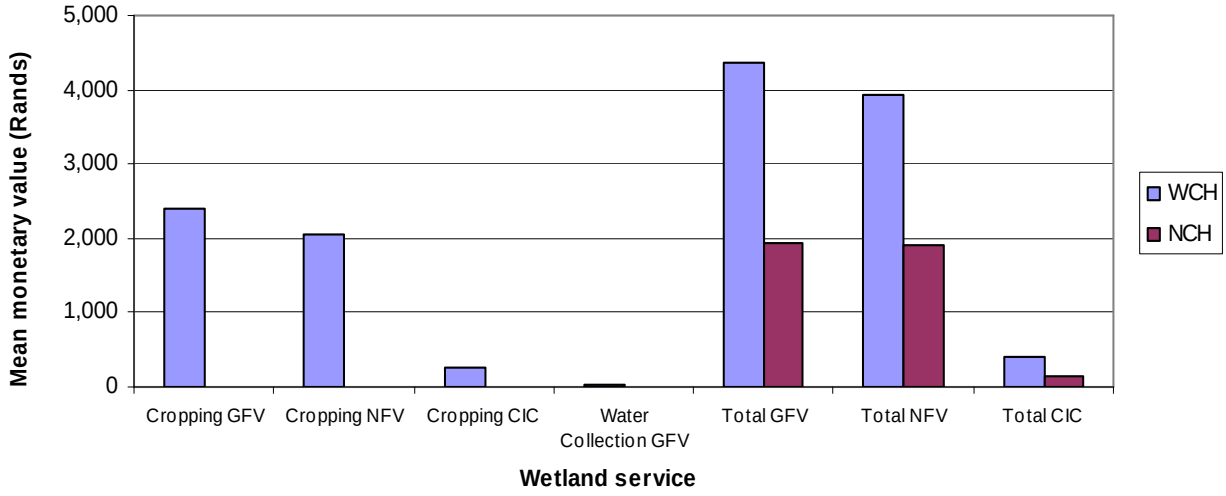


Figure 29: Mean distribution of cropping value and total value over different household types based on household access to wetland cropping plot (from field survey 2006).

From discussions held in the field the feeling was that the seeming disparity between those with access to wetland plot and those without is a potential conflict point. This is because most households without access to cropping plot in the wetland (NCH) feel disenfranchised; some of whom openly expressed their displeasure to this researcher. A further analysis is made to explore the existence of significant difference in benefits between both households if household labor time is taken into consideration (see table 22, pp67). Result (Figure 30) from this reveals that there is yet significant difference in mean benefit between both household types (WCH and NCH), but in this case, the difference is in favor of the NCH (this is interesting as similar test using (NFV-time) reveals an exactly opposite result). This is because of the low opportunity cost of time in the valley, most WCH spend a lot of time harvesting wetland resources. Because there is no significant difference for other services will indicate that households in Ga-Mampa valley spend almost commensurate household labor time using the wetland for all services except cropping.

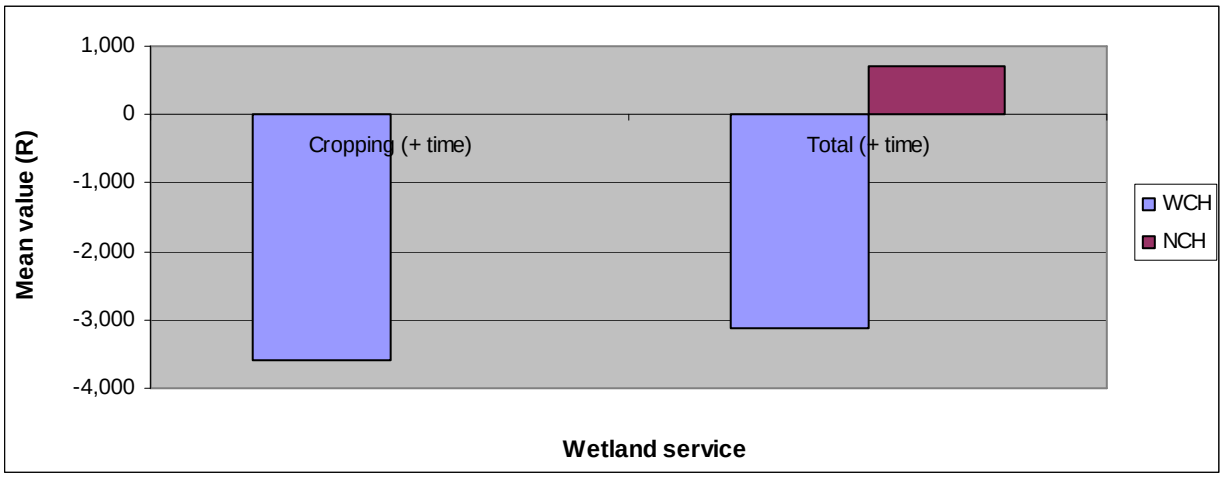


Figure 30: Mean distribution of cropping + time and total value + time over different household types based on access to wetland plot (from field survey 2006).

Household size

ANOVA reveals that there is significant difference in GFV, NFV and CIC from material collection based on household size (Figure 31). Post-hoc test reveals that these variations arise from higher benefit derived by household with size between 11-15 and lower benefit

by households with other household types most especially household with between 1-5 persons. Reason for this is because these larger households have more manpower available for collection of wetland resources.

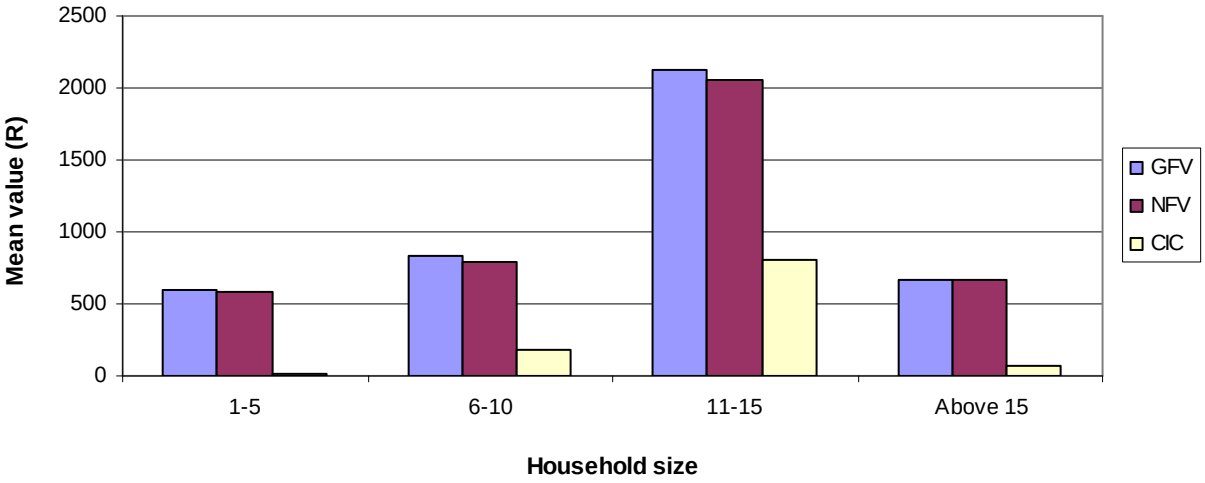


Figure 31: Mean distribution of material collection value over different household types based on household size (from field survey 2006).

Sex, Education and Income

Analysis does not reveal any significant difference in mean benefit between different household types based on sex and number of educational years of head of household and average household income. This means that across all household types distinguishable based on sex, education and income, benefits derived from the Ga-Mampa wetland is equally distributed.

In addition, correlation between number of uses households use the wetland for and household characteristics follow result from the tests of significance. For example, WCH use the wetland for more uses than non wetland cropping households. The implication of the foregoing test of significant shows that the distribution of benefit derived from the Ga-Mampa wetland is a function of age and occupation of head of household, household location, access to wetland plot and household size. However, overall benefit is only a function of access to wetland cropping plot. This analysis could be used to identify target group to focus management issues on (Coomes et al., 2004), i.e. if it is assumed that groups with significantly higher benefits (especially GFV) have more impact on the service. In this case argument could be made to focus on wetland croppers if cropping is regarded the major management issue or on households from Mantlhane is water collection is the major management issue. It is important to quickly point out that in Ga-Mampa valley; cases of difference inequality in resource distribution are by no means deliberate act. In fact, the wetland is run as an open access resource and every individual and household have access to the wetland as do others. The only use of the wetland with property right assigned is plot for cropping; else all other uses are open.

In most African wetlands, cases of conflict are often reported between croppers and grazers, however in Ga-Mampa, this is not an obvious reason of conflict, rather the imbalanced distribution of benefits between households with and without access to wetland cropping plot could be the most potent cause of conflict. In relative terms the benefit of households from Mantlhane is higher than that of households from Mapagane.

Whereas, while not considering household labor time, average value from the wetland is significantly higher among wetland croppers, a situation which is interpreted to have caused non satisfaction with benefits derived from the wetland among non wetland croppers. However, if households were to take household labor time spent into consideration, the non wetland croppers have significantly higher value than the wetland croppers. These facts suggest that households in Ga-Mampa rather do not regard household labor time in valuing resources because the opportunity cost of time is very low.

6.3. Management and sustainability

In general, there are a number of documents and policies aimed at wetland management in South Africa. Prominent are those that restrict wetland uses (National Water Act (NWA -Act 36 of 1998), National Environmental Management Act (NEMA- Act 107 of 1998), Environmental Conservation Act (ECA- Act 73 of 1989)); foster and control the wise use of wetlands (National Environmental Management: Biodiversity Act of 2004- NEMBA) or regulate aspects of the use like wetland cultivation and the issue of erosion (Conservation of Agricultural Resources Act (CARA- 1983) (Tinguery, 2005). These policies are distinct and cross cut lines of jurisdiction of Departments of Agriculture (DoA), the Department of Water Affairs and Forestry (DWAF) and the Department of Environmental Affairs and Tourism (DEAT) often leading to fragmentation and redundancy. This is a challenge for co-operative governance in wetland management (integrated management rather than sectoral management) in South Africa and to reduce the lack of cohesion in policy formulation and implementation[71].

It is often assumed that small wetlands have minimal overall impact both on environment and livelihoods, infact some have argued of the difficulty in integrating conservation of small wetland with poverty reduction. However, from the foregoing results; it is obvious that the absence of the wetland will definitely create a livelihood vacuum that will exacerbate poverty. This study argues that with proper policies (i.e adopting an ecosystem approach) and cooperation on the part of local stakeholders, it will be possible to properly integrate conservation with poverty reduction startegies. The case of Ga-Mampa wetland underscores the need to give smaller wetlands prominent place in wetland policies, in the South Africa policy documents. At present most policies are focused on large wetlands, especially those with an international importance like Ramsar sites. There are no strong policies that lay much focus on use and management of smaller wetlands like Ga-Mampa wetland. Not only because of the importance of these smaller wetlands to supporting livelihood but because there is a dare ecological need for it, most especially in a country losing wetland area in excess of 50% (Kotze et al., 1995).

Inhabitants of Ga-Mampa valley exhibit a strong readiness and willingness to co-operate and organize to manage the Ga-Mampa wetland in a sustainable way if aided by governmental and non-governmental organizations- a situation often lacking in most resource rich areas. This is made possible through the pivotal role played by the GCDF. The role of this forum is important in Ga-Mampa valley as it serves as a watchdog for the sustainable development of the valley; this forum is found to be important in creating and raising environmental interests of the community. Presently, there exists some local and traditional management in the wetland. For example, reed and sedge harvesting are

[71] This insight was gained from a workshop organized by the Institute of Soil, Climate and Water of the Agricultural Research Council,, South Africa on 16-11-2006

restricted to only two months in a year. Also the use of pesticides is prohibited in the wetland; defaulters are either fined or punished. Even though there are those farmers who object to this stance, but cannot do otherwise. It is expected that governmental and non-governmental organizations should capitalize on this enthusiasm to promote the wise use of the wetland. Need to educate the people on the importance and role of the wetland is essential, field data reveals that these wetland dependents have little knowledge of the ecological contributions of the wetland. Only one respondent was able to mention another benefit (service), apart from those studied derived from this or other wetlands. The fact that all of the respondents have never received any training on how to manage the wetland sustainably might be a reason for this seeming lack of knowledge. And also the fact that the massive use of wetland for cropping is relatively recent and there was not adequate time for the wetland croppers to build their own knowledge on wetland cultivation before embarking on it.

After a recent disagreement between the MWP and LPDEAT against the community (especially farmers) most of the farmers are scared they may be forced out of the wetland, an action which will no doubt affect their livelihood. I believe such an action is uncalled for as there are other better means (if need be) to stop cultivation in the wetland. It is important to integrate the local community into wetland management decision making process, doing otherwise will lead to suspicion and lack of support from the locals. Participatory and dialogue with local community as Ga-Mampa will most certainly yield progressive result rather than autocratic enforcement or rules. While it is important to manage the Ga-Mampa wetland sustainability at optimal level, this is often difficult to determine what optimal level of resource harvesting adequate for sustainability is.

Restricting household access to wetland services will obviously not be an efficient decision in Ga-Mampa valley. If this is done households will have to seek alternative and may be forced to cultivate and harvest more resources along mountain slopes. With Ga-Mampa valley prone to high rate of erosion, doing so may lead to dare consequences for lives and property and prove even much more costly. In managing the wetland, there is need to create better working and access to irrigation scheme, this is necessary in order to dissuade continuous conversion of the wetland for cropping. There is strong optimism in the community that if the irrigation scheme is rehabilitated, most farmers can be convinced to move out of the wetland to crop in the irrigation scheme, however, they argue they will resort to use the wetland for cropping in years of dare drought, a position supported by the chairman and secretary of the GCDF.

In fact there are indications that with the development in the Ga-Mampa valley area (construction of access road) which might open up the settlement; creating other sources of income and encourage out-migration of youth. This might lead to activities and specifically cropping in the wetland to reduce. However, this might create new threat as demand for land for settlement might increase.

7. DISCUSSION

In the preceding chapters, this study showed the economic value of the Ga-Mampa wetland and its contributions to household livelihood. However, there are some issues that need to be discussed further, especially regarding the methods and result of the study. The estimates presented in this report must be interpreted with caution; they are at best indicative of the value of the provisioning services of the Ga-Mampa wetland. At the same time uncertainty analysis showed the robustness of estimate of each service. Therefore, the values presented are believed to provide a reasonable indication of the total value of the wetland. This chapter is structured into two sections. The first discusses the implications of methods adopted in this study while the second section focuses on the results in the light of other existing empirical studies. Each section discusses their strengths and weaknesses.

7.1. Discussion of methods

Economic valuation

Economic valuation studies are fraught with uncertainties which often results in value estimates that are crude and inexact. Combining the analytical complexity involved in the valuation process with the complexity caused by the involvement of different stakeholders from varying institutional scale in decision-making processes, clarifies why a comprehensive, complete and undisputed valuation is virtually impossible to achieve. This study was no exception of the foregoing. It is argued in this study that economic valuation is useful and "failure to quantify ecosystem values in commensurate terms with opportunity costs often results in an implicit value of zero being placed on ecosystem services" (Loomis et al., 2000). Moreover, it is better with whatever partial information is available or affordable to take forward processes of multi-objective decision-making. In practice, it may be better to reach an agreement based on imperfect value estimates rather than continuing theoretical disputes over the "real" value of environmental resources. Rather economic valuation should be viewed in a broader perspective, not solely as an objective or neutral means to place a quantitative value on resources, but also as a means to decision making. It makes an important contribution to wetland resources management by offering a structured and transparent mechanism that supports a multi-stakeholder dialogue, helping stakeholders to express their values and to reach jointly a certain level of agreement on the use and management of resources[72] (Hermans et al., 2006).

Economic valuation technique

There are different environmental valuation methodologies discussed in literature (Costanza et al., 1997; De Groot et al., 2002). For this study, direct market valuation technique was used. It is possible that the use of other techniques (for example contingent valuation or benefit transfer) will result in slightly different results. Since market price exists for most services in this study, the use of direct market value is able to ensure the best value estimate (OECD, 2001), which will be less controversial among stakeholders and best suited to the purpose of this study (Turpie, 2002). Using contingent valuation might result in speculative value estimates which might suffer from income constraints expected in such poor society. However, whereas contingent valuation would have estimated both use and non use values of these services, direct market valuation is

[72] Two of the outside stakeholders mentioned in Darradi, (2005) contacted by this researcher seem to be in agreement with the outcome of this research.

believed to only fully capture their use values. One interesting aspect, though beyond the scope of this study which contingent valuation might be best able to capture is to assess the value external stakeholders place on these provisioning services. However, the problem that will arise from this is how to aggregate this value to that from direct valuation from local stakeholders.

Monetary value for water use stated in this study best relates to the value of bulk water to municipalities, infact value of water to the local community (in terms of market price) tend to zero[73]. Using travel cost method could have elicited a better estimate, however, in this case in which water use is associated with cropping activity makes its (travel cost method) use of not much good. The other alternative is to adopt a contingent valuation technique, this was not done because of reasons stated above and its complexity coupled with lack of time. It remains a challenge for valuation studies to device the best methodology to adopt under such circumstance. Valuing the direct benefit from livestock grazing in the wetland was constrained by available time. It was possible to use the value of products such as manure, milk, and drought power derived from livestock to estimate value of grazing in the wetland. Also possible is the use of the actual market price of the animals. For the former, there was inadequate data (owing to time needed to collect such data); also, these methods were not used because they assume the wetland as the only input to the value of the animals (in reality there are other inputs such as grazing in mountains etc). While values from these services should be treated with some caution, they remain the best available estimates.

Method of data collection

Apart from the methodological approach adopted in valuation studies, collection of data goes a long way to dictate the level of reliability and validity of results. The major approach to data collection adopted for this study is the questionnaire survey. In addition, focus group discussion, field observation and measurements, key informant interviews, market pricing, and pebble distribution method were also used to complement and supplement data. Time was a major limiting factor in this research, especially for data collection, there was only about six months for the entire study, of which less than three months was spent on actual field to collect data. A research with field work covering a longer period allowing for monitoring of respondent will no doubt provide better estimates and allow more data collection. For example, time was not enough to collect adequate data on size of the wetland used for each service. Interviews were often long, averagely about 1.5 hours taking a toll on respondents. This was not always a problem because respondents were informed more than a week before they are scheduled to be interviewed, for some others interviews were split into two sessions. The economic nature of questions which dealt with personal circumstances of the respondents was another limiting factor; this made some respondents uncomfortable to respond to some questions– assuring respondents of solely academic use and promise of a feedback workshop helped to gain their co-operation. Techniques such as, including follow up questions and questions to cross-check responses were also adopted to improve data gathered. Despite efforts made to value benefits derived from the use of the wetland for medicinal plant, this was not successful because there is a seeming secret (cultural based) surrounding the use of the wetland for it. It was interesting to discover that despite efforts by Darradi (see Morardet and Darradi, 2006) and me to establish this use, users remain adamant. Although, it is believed with more time and persuasion, more details could be garnered on this use. Majority of respondents cannot communicate in English, introducing a language

[73] In South Africa households do not pay for water use, see section 5.9 pp 63

barrier. A field interpreter with good knowledge in English and the local dialect *Spedi* was employed; it is however possible that difficulty of interpretation means information is often lost in the process. The fact that field data was collected personally by the researcher was very helpful, as it allowed for more probing questions not originally on questionnaire to be collected. In addition, the good welcome, conducive working environment and co-operation received from the community through the Ga-Mampa Community Development Forum (GCDF) which aided the field work was important in the data collection process.

Although, some steps were taken to alleviate the effect of some of the constraints described above on the validity and reliability of the data collected, the use of a mix of data collection methods was equally very useful. The use of research triangulation was found to be essential for valuation studies; it was very helpful in offsetting some of the limitations discussed above, by providing complementary and supplementary information. Triangulation is the application and combination of several research methodologies in the study of the same phenomenon[74]. Same data was colleced from different sources, for example some values given in households were cross checked with extension officer and often with secretary of the GCDF. Also, multiple methods were used to collect data from respondents, for example the combination of questionnaire survey with focus group discussion, informal discussion and interviews helped in providing much extra information that one method alone might not be able to offer. The iterative nature of the study left some flexibility to the study and was essential in positively modifying (when new and important information become available) the study as it progressed. This is also a key to a successful valuation study. These facts are in line with suggestions for an integrated wetland research framework (Turner et al 2000).

Method of data analysis

Data was analyzed by aggregating data collected from sampled household (66 households representing about 17% of total households) to the entire population, this is statistically valid. The study thus estimated the annual total economic value of important provisioning services of the Ga-Mampa wetland as GFV $170, 000 ± $10, 000; NFV of $162, 000 ± $10, 000 and CIC $14, 000 ± $600. These values are however based on some assumptions (see Box 3, pp32). Whereas, with availability of adequate data from local authorities the effect of assumption B can be eliminated, those introduced by assumption A, C and D are often inevitable in valuation studies. This makes an expression of uncertainty and sensitivity of results paramount. Estimate for livestock grazing can further be affected by the fact the Animal Unit Day used is not from South Africa, however, it is believed that livestock feeding in these regions are comparable. Economic value estimates were computed from an annual data and could be generalized to other years, however, it is important to note that measured phenomenon such as quantity of services harvested are dynamic, hence it will be important to take note of inter-annual variations. This will mean collecting data over different years. In as much as this is important, often wetland decision making need to be made urgently and might not allow for this, in such situations, estimates from such annual studies are most useful.

7.2. Discussion of results: Comparism with literature

There are only a few economic valuation studies of African wetlands compared to the number of studies conducted on other continents (Schuyt, 2005). Yet, this study did find

[74] http://www.tele.sunyit.edu/traingulation.htm

other empirical studies against which the results generated by this thesis research can be compared. Most existing studies are conducted in years preceding 2006 as such for values to be comparable they are corrected (compounding) to 2006 value at an annual inflation rate of 3%[75]. Turpie et al., (1999), conducted a valuation study of the Zambezi basin wetlands (Barotse Floodplain (Zambia); Chobe-Caprivi (Namibia and Zambia); Lower Shire wetlands (Malawi and Mozambique) and Zambezi Delta (Mozambique)). Turpie's 2000 study was on Rufiji floodplain and delta in Tanzania. Emerton et al., (1999) study of Nakivubo urban wetland in Uganda was also used.

This study like most economic valuation studies underscore the fact that provisioning services provided by wetlands, contribute a great deal to the sustenance of the livelihoods of local stakeholders depending on them. However, no two wetland systems are similar, as such; all wetlands cannot have the same economic value/contribution to household livelihood. For instance, in the economic valuation study of four wetlands using same methods by Turpie et al., (1999), there are some marked differences and similarities in value estimates generated even by these wetlands. However, it is essential for empirical purposes to understand how wetland values vary over different wetlands.

In this study sedge collection contribute the highest economic value to household income; this is a divergence from empirical findings in Turpie et al., (1999); Schuyt (1999) and Turpie (2000) in which fishing was the most significant wetland service contributor to household income. In fact, in Ga-Mampa wetland, fishing contributes the least value per household: a meager $1 as against up to $224 per household in Turpie et al., (1999). This variation is most probably due to the strict distinction of the boundary of what constitutes the wetland in this study- the fact that fish caught from the adjacent Mohlapitsi River is not regarded as a value of the wetland. Also, the variation could be due to the nature/type of wetland under study. Turpie et al., 1999 study includes large lakes and floodplain of large rivers with a high potential in fish production, this is obviously not the case of the Mohlapitse River. In Ga-Mampa, most part of the wetland is not flooded throughout the year.

In most of the studies reviewed cropping contributes significantly to total value of wetlands, this is also true for this study. The value of cropping ranged from between $3 per household for Nakivubo urban wetland, Uganda (Emerton et al., 1998) to $109 per household in Barotse; $363 in Lower Shire (Turpie et al., 1999), the value of cropping per household is estimated as $93 for the Ga-Mampa wetland. Low value from Nakivubo could be due to the fact that less than 2% of households were involved in cropping against about 25% in Ga-Mampa valley. In Ga-Mampa wetland, grazing contributes the highest economic value to the total GFV and NFV of the wetland, it contributes about $192 per household, this as well falls within the range calculated for the Zambezi Basin, which ranges from $38 in Lower Shire to $519 in Chobe-Caprivi. Net value for material collection per household (edible plants, reeds and sedge) in Zambezi basin ranged between $23 and $159 against and average net value of $120 in Ga-Mampa. The contribution of sedge per household in Ga-Mampa is much higher than that available for households in Nakivubo, i.e. $25 against $0.5. When values per household from Ga-Mampa wetland is compared with a similarly smaller wetland such as the Nakivubo (529ha), Ga-Mampa community are having much relative benefits due to the population density per wetland area. In Ga-Mampa valley, total contribution of the main provisioning services provided by the Ga-Mampa wetland per household is estimated at $430 in GFV;

[75] Most economic commentary suggest the use of rate between 2 and 5%, I decided to use 3%, average of this range.

$411 in NFV and $35 in CIC. These values are 35%, 28% and 93% less than values estimated for the Rufiji floodplain and Delta (Turpie, 2000). This is most probably a consequence of the more provisioning services supported by this wetland probably due to the types of wetlands involved. When compared per hectare, value estimates of services in the Ga-Mampa wetland study yields higher value relative to other studies. For example, net value of cropping per hectare per year in Ga-Mampa is $263 relative to about $128 in Nakivobo Urban Wetland in Uganda. However, benefits of fishing per hectare is least for Ga-Mampa, suggesting that because of the extent of flooding, Ga-Mampa wetland produces less value on services that are water dependents. All values from this study fall well within the range of suggested values in De Groot et al., (2002).

Many studies have stressed the role of local stakeholders in wetland management (De Groot et al 2002; Tinguery, 2006). This study also establish the role a local community organization like the GCDF can play in ensuring and enforcing the tenets of wise use by promoting environmental awareness of the people. The presence of such in African wetlands can prove important for community management of wetlands. Strengthening these organizations ought to be the focus of those interested in community driven conservation and development efforts.

8. CONCLUSIONS AND RECOMMENDATIONS

In this chapter conclusions and recommendations are made on the basis of the findings of this research that has been based on empirical work and literature study. The answers to the research questions are summarized below. It is on the basis of the foregoing discussion section, conclusions and recommendations are drawn. Firstly, recommendations are made for further research and on the methodology for economic valuation studies. Secondly, some management recommendations are made to local and external stakeholders to the Ga-Mampa wetland. The final section provides policy recommendation.

8.1. Conclusion

This study adopted an integrated environmental assessment conceptual and methodological framework to assess the economic value of services derived from the Ga-Mampa wetland. It has been shown that, although this wetland is relatively small (about 120ha) it is very important to the livelihood of local stakeholders. To conclude, each of the research questions posted in section 1.6, pp7 is now provided answers.

Q1: What are the main provisioning services provided by Ga-Mampa wetland?

Ga-Mampa wetland provides a variety of services including supporting, regulation, cultural and provisioning services. The main provisioning services provided by the Ga-Mampa wetland are its use for crop production, livestock grazing, edible plant collection, fishing, hunting, fuel-wood collection, water collection (use for bathing, washing, drinking and for other purposes such as building etc) and its use for medicinal plant collection.

Q2: What proportion of the households in Ga-Mampa valley depends on the wetland for supply of each provisioning services?

The Ga-Mampa wetland is important to the people and all households collect/harvest at least one type of provisioning service from the wetland. Variable proportion is involved in each service use. Edible plant collection presents the highest proportion of households using the wetland for any provisioning service –96% of households collect edible plants from the Ga-Mampa wetland annually. Access to cropping plot is available only to about 25% of the population; as such these are the only ones using the wetland for cropping, however not all with access to wetland cropping plot use it annually, 23% of households use the wetland for cropping annually. Sedge collection and reed collection are important services of the Ga-Mampa wetland in which 93 to 97% of the households want to participate in but are often not able to find any of these services, probably because of their recent decrease. Whereas 21.3% of households are able to find and harvest/collect reeds annually, it is 22.8% of households for sedge collection. Annual dependence on the wetland for fuel-wood collection and hunting are the least important service as only 2% of the population collect this material from the wetland annually, this is despite about 39% who have collected these resources in the past. 5% of households fish annually from the wetland as against, 32% who have done so in the past. All households have collected water from the wetland in the past; however annual rate of collection is 56% of households for drinking; 14% for washing water and 21% for bathing water. It was estimated that up to 77% of Ga-Mampa households have used the wetland for grazing in

the past (prior to 2005/2006 cropping season), however at present only about 38% of households annually use the wetland for grazing.

Q3: What quantity of provisioning services is harvested from the wetland annually?

Just as the number of dependants varies, so also does the quantity of each service harvested from the wetland. Services are expressed in various units understandable to the people of Ga-Mampa, for example, maize in bags, sedge, reeds and fuel wood in bundles. Annual quantity of each of these services harvested was estimated. Annual quantities of crops harvested from the wetland are estimated a s follows; 110,010kg of maize; 1,704 kg of groundnut; 1,584 kg of vegetables; 2,880 kg of coriander; 840kg of beans; 450 beetroot, 750 sticks and 150 bunches of banana. For other services harvested in the wetland, annual quantities harvested are as follows; 15, 273 kg of edible plants; 2526 bundles of reeds; 756 bundles of sedge; 1296 bundles of fuel-wood; 708 pieces of medium sized fish; 60 pieces of games and about 6329kl of water.

Q4: How are these services used by participating households?

Maize cultivation is the most common crop cultivated in the Ga-Mampa wetland, more than 90% of its yield is used for household consumption (in making pap), and same goes for vegetables cultivated in the wetland. More than 50% of yield from groundnut, coriander beans, sugar cane and banana cultivation are sold for generating household income. As well portion of yield from vegetables, beetroot sugarcane and banana are used as gift to neighbor and relatives. Total benefits derived for grazing, fuel wood collection, fishing, hunting, and water collection are used directly for household use. Apart from using most quantity directly in households, some minor portion of benefits derived from reeds and edible plant collection is sold for income and some others as gift. Major part of (more than 80%) sedge harvested is sold to generate household income.

Q5: What is the annual economic value of the main provisioning services provided by the Ga-Mampa wetland?

The annual economic value of the main provisioning services provided by Ga-Mampa wetland yield a gross financial value of $170, 000 ± $10, 000; NFV of $162, 000 ± $10, 000 and CIC $14, 000 ± $600. At average value and in absolute terms, livestock grazing contributes the highest to the economic value of the Ga-Mampa wetland (GFV and NFV of $76, 000 ± $2000) while fishing is the least contributor (GFV of $250 ± $10; NFV of $220 ± $10). Others are, edible plant collection (GFV and NFV of $32, 000 ± $5000; CIC of 900 ± 200); reed collection GFV and NFV of $7, 800 ± $200; NFV CIC of 1, 470 ± 40); sedge collection (GFV of $9, 900 ± $300; NFV of $7, 900 ± $200; CIC of 7, 700 ± 200); fuel wood collection (GFV of $ 4, 012; NFV of $4,033); hunting (GFV and NFV of $300 ± $20) fishing (GFV of $250 ± $10; NFV of $220 ± $10; CIC of 0) and water use (GFV of $3,370 ± $90; NFV of $3, 080 ± $80; CIC of 0) In terms of cash income generated, sedge collection is the highest contributor with about 56% of the total cash income generated from the wetland. Assuming benefit from the provisioning services of the Ga-Mampa wetland is shared equally among households in the Ga-Mampa valley, it is able to contribute $430 in gross financial value, $411 in net financial value and $35 in cash income to each household in the Ga-Mampa valley.

Q6: How are the benefits of wetland services distributed among different household types in the Ga-Mampa valley?

The wetland is seen as an open resource, disparity exists in distribution of resources both within and between sub villages. The most prominent is the significant difference in water

use of the wetland between sub-villages, but the most prominent able to course conflict and which needs to be addressed is the significant difference in benefits between wetland croppers and non wetland croppers. If there will be any conflict at all in this wetland, this will be the most potent cause of conflict among wetland dependants of Ga-Mampa, the fact that cropping benefit from the wetland is not equally distributed among households. Access to the wetland for cropping services is no distribution of benefits. This study also concludes that benefit derived from the Ga-Mampa wetland is influenced by the age and occupation of head of household, household location, access to wetland plot and household size, whereas, the total economic value of the main provisioning services provided by the Ga-Mampa wetland is a function of access to wetland cropping plot.

Apart from giving an indication of the economic value of the Ga-Mampa wetland, the results of this study could be used as a basis for a tradeoff analysis between different uses of the wetland. For example, one interesting option for the wetland will be to devote it to sedge harvesting (since it generates a very high household income and I believe it is easier to conduct sedge collection sustainably) or to livestock grazing (with highest net economic value, but could be more devastating for the environment) or even to coriander or banana cultivation. Making, a decision for any will require further studies. Although, this study did not determine what optimal level of harvesting in the wetland is or should be: there is need to use the wetland optimally. The good news is that, the Ga-Mampa valley community is very willing to co-operate and work with willing organization (governmental and non-governmental) that will teach them how to use the wetland in a sustainable manner.

Schuyt (2005) had called for an increase in economic valuation studies of wetlands in the African continent. This study is hoped to be a useful contribution in this regard. Experience and expertise gained in the conduct of this study has been immense, the use of a mix of methods proved interesting and useful. It is hoped that this thesis has produced information to support knowledge that can aid the enhancement of the livelihood of the wetland dependents of Ga-Mampa area, South Africa. Specifically this thesis has/will be useful

- to generate information which will contribute to an understanding of the local value of the Ga-Mampa wetland to the local inhabitants, traditional rulers, government officials, non governmental organizations, researchers and decision and policy makers.
- to complement and integrate with the already conducted and ongoing research effort of IWMI in the Ga-Mampa wetland and contribute to its trade-off analysis and subsequent development of a management plan for the Ga-Mampa wetland.
- to serve as a methodological and economic bases for future studies especially in the Southern Africa sub region.

8.2. Recommendations

From the results and conclusion drawn from this study, the following recommendations are put forward;

Research recommendations

- This study adds to the growing list of economic valuation studies of African wetlands. Probably because of the stronger dependence on direct benefits of wetlands in Africa, most studies tend to be more focused and concentrated on

direct use values of wetland. There is needed to as well start initiating many more studies focusing on the indirect use values of African wetland ecosystems.

- The use of triangulation of methods and sources is recommended as essential for such studies most especially where time is a limitation. As well, valuation studies should be made as iterative as possible.

- This study has only focused on the provisioning services provided by the Ga-Mampa wetland, it is expedient to as well study the value of other services (supporting, regulation and cultural) provided by the wetland.

- Sedge and reed harvesting from the wetland contribute a substantial amount to household income, further study be conducted on the cost and benefit of converting the wetland for reed and sedge harvesting as against traditional agriculture-livestock grazing scenario.

- Substantial proportion of yield is lost to pest, presently nothing is being done, there is need to study what sustainable pest control techniques can be available and applicable in Ga-Mampa.

- An important issue arising from such studies is to determine if the wetland is being used optimally, this is difficult as it is often difficult to say what an optimal use level is For example what is the optimal in wetland use what quantity i.e. how many animals should graze on wetland to achieve ecological and economic optimality. A study could be focused in this direction to give an insight into what optimal harvesting level of resources could be in African wetlands or wetlands in general.

- Though this study and some others before have provided good insight into the Ga-Mampa valley ecosystem, further research is needed to collect data over a long period of time in order to fully understand the inter-annual dynamics in benefits derived from the Ga-Mampa wetland. For example, to reduce assumptions and some uncertainties due to price and fluctuations in quantity harvested.

<u>Management recommendations</u>

- The co-operation received in Ga-Mampa valley by external organizations and researchers is highly commendable. The role of the GCDF is pivotal; it is recommended that such forums be encouraged in wetland areas. This willingness however seems to stem from existing support received from organizations like the International Water Management Institute and other development organizations which suggests that such support given to local communities goes a long way in encouraging local community driven development, such manner of support is recommended and be encouraged by other organizations.

- The Ga-Mampa valley community through the Ga-Mampa development forum should use the outcome of this thesis to initiate the writing of a “wetland brochure” in the local spedi language. This brochure should be used as an educational material made available to school children and even adults so that they can better understand the value of the wetland to them. In this regard the support and assistance of governmental and non governmental organization might be

required most especially in funding the production of the brochure which is expected to educate the people to promote sustainable management of the Ga-Mampa wetland.

- Even though some specific wetland legislations exist in South Africa, most of the people of Ga-Mampa know nothing of this. The usefulness of legislation goes beyond the letters but making people aware of it and its content. Relevant governmental organizations should make time to educate the people on the existing legislation and how they are expected to manage the wetland. Other organizations such as the International Water Management Institute, can participate in this by organizing wetland management training sessions and workshops for the Ga-Mampa valley inhabitants.

- The Ga-Mampa community through the GCDF with the assistance of governmental organizations should lobby the milling company to establish a milling centre in Ga-Mampa valley. This will reduce the cost households incur for transportation and milling of cultivated maize (from both wetland and irrigation scheme) and increase the benefit derived from the wetland. There is also the need to local agriculture office to look into the possibility of creating viable market for agricultural produce; a suggestion could be to subsidy transportation of produce to the market.

- Government organization should work to rehabilitate the dilapidated irrigation schemes in Ga-Mampa and if possible work to make them functional. If this is done, it is possible to encourage most of the wetland croppers to farm in the irrigation scheme while the wetland is been reclaimed leaving an option for wetland to be used for cropping only in years of serious drought. The community supports this view point.

- To reduce dependence on wetlands and improve the livelihood conditions of Ga-Mampa valley households, there is need for governmental and non governmental organizations to support efforts aimed at building the capacity of local stakeholders to identify and explore other means of livelihood, such as establishment of small and medium scale enterprise in the valley.

- There is need for relevant wetland management organizations in South Africa to develop a holistic approach to wetland management involving and taking into account the views and interests of the local stakeholders. There is need for these governmental organizations to be more involved in the management of small wetlands like the Ga-Mampa wetland.

<u>Policy recommendation</u>

The bottom-line of this study is for the Ga-Mampa wetland to continually provide needed benefits for the sustenance of livelihood of local stakeholders, while not putting the overall health of the ecosystem in jeopardy. This makes the need for developing an integrated approach to the management of the Ga-Mampa wetland important. To achieve this, all stakeholders: local community (GCDF), governmental organizations (LDEAP) and non-governmental organizations (IWMI, MWP) must be fully involved. The CBD Ecosystem Approach is suggested as a guiding principle in any management plan for the Ga-Mampa wetland, this approach will help achieve a balance of three objectives:

conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilization of the wetland.

The folowing actions are important;

- A stakeholder forum be conveyed to ensure confidence building among stakeholders and to alley any fears or misunderstanding. Also, this can be a forum to identify further the conservation-development interests of all stakeholders.
- The irrigation scheme should be rehabilitated and farmers relocated, while the wetland is left for some years to be restored. To achieve this, government might need to provide alternative source of income for households or pay them for services so lost.
- Funding for the restoration effort should be championed by the government.

Progress of this policy step should be evident with a cordial and understanding relationship among stakeholders. Increase in the extent of the wetland should asv well be a monitoring indicator.

REFERENCES

Acharya, G., Barbier, E., 2000. Valuing groundwater recharge through agricultural production in the Hadejia-Nguru wetlands in northern Nigeria. Agricultural Economics. 22, 247-259.

Agricultural Research Council (ARC) - Institute for Soil, Climate and Water 2003. Limpopo basin profile. ARC, Pretoria South Africa.

Bell, F. W., 1997. The economic valuation of saltwater marsh supporting marine recreational fishing in the southeastern United States. Ecological-Economics. 21, 243-254.

Balmford, A., Bruner, A., Cooper, P., Costanza, R., Farber, S., Green, R., Jenkins, M., Jefferiss, P., Jessamy, V., Madden, J., Munro, K., Myers, N., Naeem, S., Paavola, J., Rayment, M.,Rosendo, S., Roughgarden, J., Trumper, K., Turner, K., 2002. Economic reasons for conserving wild nature. Science Compass Review. 297, 950-953.

Barbier, E.B., Adams, W.M. and Kimmage, K. 1993. An economic valuation of wetland benefits. In: Hollis, G.E., Adams, W.M. and Aminu-Kano, M. (eds). The Hadejia-Nguru Wetlands – environment, economics and sustainable development of a Sahelian floodplain. IUCN, Gland, Switzerland.

Barbier, E. B., Acreman, M., Knowler, D., 1997. Economic valuation of wetlands: A guide for policy makers and planners. Ramsar Convention Bureau, Gland, Switzerland.

Barrow, C. J., 1991. Land degradation. Cambridge University Press, Cambridge United Kingdom.

Born, W., Rauschmayer, F., Brauer, I., 2005. Economic evaluation of biological invasions- A survey. Ecological Economics. 55, 321-336.

Carney, D., 1999. Approaches to sustainable livelihoods for the rural poor. ODI Poverty Briefing 2. London, United Kingdom.

Chiron, D., 2005. Impact of the small-scale irrigated sector on household revenues of the black community of Ga-Mampa valley: Contribution to the irrigation management transfer study of the small-scale irrigation schemes. Limpopo province - South Africa. Master of Science Thesis in Social Management of the Water and Tropical Agricultural Development. Centre National d'Etudes Agronomiques en Régions Chaudes. France.

Chopra, K., Adhikari, S. K., 2004. Environment development linkages: modelling a wetland system for ecological and economic value. Environment and Development Economics. 9, 19-45.

Cleland, D. I., 1998. (ed), Field guide to project management, John Wiley and Sons. New York, United States of America.

Coomes, T. O., Barham, L. B., Takasaki, Y., 2004. Targeting conservation-development initiatives in tropical forests: insights from analysis of rain forest use and economic reliance among Amazonian peasants Ecological Economic. 51 47-64.

Costanza, R., D'arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'neill, R., Paruelo, J., Raskin, R., Sutton, P., Van Den Belt, M., 1997. The value of the world's ecosystem services and natural capital. Nature. 387, 253-260.

Cowardin, L.M., Carter, V., Golet, F.C. & LaRoe, E.T. 1979. Classification of wetlands and deepwater habitats of the United States. Cited in Dini, J., Cowan, G., Goodman, P., 1998. Proposed wetland classification system for South Africa. http://www.ngo.grida.no/soesa/nsoer/resource/wetland/inventory_classif.htm#introduction.

De Groot, R., 1992. Functions of nature: Evaluation of nature in environmental planning, management and decision making. Wolters-Noordhoff, The Netherlands.

De Groot, R., Wilson, M. A., and Boumans, M. J., 2002. A typology for the classification, description and valuation of ecosystem function, goods and services. Ecological Economics. 41, 393-408.

De Groot, R., 2006. Function analysis and valuation as a tool to asses land use conflicts in planning for sustainable, multi functional landscapes. Landscape and Urban Planning. 75, 175-186.

De Groot, R., Stuip, M., Finlayson, M., Davidson, N., 2006 Valuing wetlands: Guidance for valuing the benefits derived from wetland ecosystem services. Ramsar Technical Report 3 Gland Switzerland.

Department of Water Affairs and Forestry., 2006. Water resource management charges: Simplified guide Pretoria, South Africa.

Department for International Development (DFID) 1999. Sustainable Livelihoods Guidance Sheets, Department for International Development (www.livelihoods.org).

Dini, J., Cowan, G., Goodman, P., 1998. Proposed wetland classification system for SouthAfrica.ww.ngo.grida.no/soesa/nsoer/resource/wetland/inventory_classif.htm#introduction.

Dubgaard, A., 2004. Cost-benefit analysis of wetland restoration. Journal-of-Water and Land Development. 8, 87-102.

Emerton, L., Iyango, L., Luwun, P., Malinga, A., 1999. The present economic value of Nakivubo urban wetland, Uganda. IUCN: Biodiversity Economics for Eastern Africa and National Wetlands: Conservation & Management Programme.

Emerton, L., Kekulandala, L., 2003. Assessment of the economic value of Muthurajawela wetland. Occasional paper. IUCN, Sri Lanka.

Farber, S. C.; R. Costanza and M. A. Wilson 2002. Economic and ecological concepts for valuing ecosystem services. Ecological Economics 41, 375-392.

Ferrand, P., 2004. Participatory diagnosis about farming systems and social management of water in the small scale irrigation scheme of the Mashushu community, Limpopo Province South Africa. Master of Science thesis in Social Management of the Water and Tropical Agricultural Development. Centre National d'Etudes Agronomiques en Régions Chaudes. France.

Findeisen, W., Quade, E., 1997. The Methodology of systems analysis: An introduction and overview. In, Quade, E. S., Miser, H. J., 1997. Handbook of systems analysis: Overview of uses, procedures, applications and practice (Vol. 1) Chichester.

Garrod, G., and Willis, G., 1999. Economic valuation of the environment: Methods and case studies. Edgar Elgar, Cheltenham.

Goulder, L., and D. Kennedy., 1997. Valuing ecosystem services: Philosophical bases and empirical methods. In: Nature's Services: Societal Dependence on Natural Ecosystems, G.C. Daily (ed.), Island Press, Washington, DC. Cited in, Millennium Ecosystem Assessment, 2003. Ecosystems and human well-being: A framework for assessment. http://www.millenniumassessment.org.

Gyekye, A. B., Akinboade, A. O., 2001. Analysis of poverty in the northern Province of South Africa: Implications for empowerment policy. Paper presented at the 75th Anniversary Conference of the Economic Society of South Africa at Glenburg Lodge, Johannesburg on 13 September 2001.

IUCN- The World Conservation Union, 1997. The Hadejia-Nguru wetlands booklet. Kano Nigeria. IUCN, Gland, Switzerland.

Hein, L., van Koppen, K., de Groot, R. S., van Ierland, E. C., 2006. Spatial scales, stakeholders and the valuation of ecosystem services. Ecological Economics. 57, 209-228.

Hermans, L., Renault, D., Emerton, L., Perrot-Maître, D., Nguyen-Khoa, S., Smith, L., 2006. Stakeholder-oriented valuation to support water resources management processes: Confronting concepts with local Practice. Food and Agriculture Organization of the United Nations, Rome.

Jogo, W., 2006. Draft literature review on economic valuation of wetland goods and services. PhD proposal University of Pretoria, South Africa.

Kopp, R. J., 1992. Why existence value should be used in cost benefit analysis. Journal of policy analysis and management 11 123-130.

Kotze, D. C., Breen, C. M., Quinn, N., 1995. Wetland losses in South Africa. In: GI Cowan, Wetlands of South Africa. Department of Environmental Affairs and Tourism, Pretoria. 263 - 272.

Kotze, D. C., 2005. An ecological assessment of the health of the Mohlapitsi wetland, Limpopo Province, South Africa. Project report. IWMI, Silverton, South Africa.

Leemans R., 2000 Modeling of global land use: connections, causal chains and integration. Inaugural Lecture, Department of Plant Production Systems Wageningen University Wageningen, The Netherlands. 85pp. Cited in Hein, L., van Koppen, K., de Groot, R. S., van Ierland, E. C., 2006. Spatial scales, stakeholders and the valuation of ecosystem services. Ecological Economics. 57, 209-228.

Loomis, J., Kent, P., Strange, L., Fausch, K., Covich, A., 2000. Measuring the total economic value of restoring ecosystem services in an impaired river basin: results from a contingent valuation survey. Ecol. Econ. 33, 103–117.

Markandya, A., Harou, P., Bellu, L. G., Cistulli, V., 2002. Environmental economics for sustainable growth: A handbook for practitioners. Edward Elgar, Cheltenham, United Kingdom.

Masiyandima, M., Morardet, S., Rollin, D., Nyagwanbo, L., Jayasinghe, G., Thenkabail, P., 2005. Assessing trade-offs in wetland utilization in Limpopo River Basin: a research framework Communication to The CGIAR Challenge Program on Water and Food International workshop on "Enhancing human and ecological well-being in Africa through sustainable increases in water productivity", November 28 – December 1, 2005, Entebbe, Uganda.

Millennium Ecosystem Assessment, 2003. Ecosystems and human well-being: A framework for assessment. http://www.millenniumassessment.org.

Millennium Ecosystem Assessment, 2005a. Ecosystem and human well-being: synthesis Island press, Washington DC.

Millennium Ecosystem Assessment, 2005b. Ecosystems and human well-being: Wetlands and water (synthesis). World Resource Institute, Washington DC.

Mitch, W. J., Gosselink, J. G., 1993. Wetlands, 2nd ed. Van Nostrand Reinhold, New York. Cited in Turner, R., Jeroen, C., Soderqvist, T., Barendregt, A., Straaten, J., Maltby, E., Ierland, E., (2000). The values of wetlands: Landscape and institutional perspective: Ecological economic analysis of wetlands: scientific integration for management and policy. Ecological Economics, 35, 7-23.

Mmopelwa, G., 2005 Economic and financial analysis of harvesting and utilization of river reed in the Okavango Delta, Botswana. Journal of Environmental Management, 79, 329-335.

Morardet, S., Koukou-Tchamba, A, 2004. Assessing trades-offs between agricultural production and wetlands preservation in Limpopo river basin: a participatory framework. IWMI. Communication to the International workshop on Water Resource Management for Local Development: Governance, Institutions and Policies, Cirad, Department of Water Affairs and Forestry, Water Research Commission, French Embassy in South Africa, Loskop Dam, 8-11 November 2004 (available on CD and website <http://wrm2004.cirad.fr/>).

Morardet, S., and Darradi, Y., 2006. Translation of extracts from Younes Darradi master thesis report (analyse de la perception des porteurs d'enjeux. le cas de la zone humide du bassin versant de la mohlapitse river, province du limpopo, afrique du sud. MSc Thesis Ecole Nationale D'ingénieurs Des Travaux Agricoles De Bordeaux.

Munda, G., 2000. Conceptualising and responding to complexity. Environmental Valuation in Europe (EVE), Policy Research Brief No. 2, Cambridge Research for the Environment, UK.

Niemeijer, D., De Groot, R. S., 2006. Framing environmental indicators: Moving from causal chains to causal networks. Environment, Development and Sustainability. Original paper.

OECD (Organization for Economic Co-Operation and Development) 2001. Valuation of Biodiversity Benefits: Selected Studies, OECD: Paris, France.

Overseas Development Institute, 2000. Understanding livelihoods in rural India: Diversity, change and exclusion. ODI, London, United Kingdom.

Oglethorpe, D. R., Miliadou, D., 2000. Economic valuation of the non-use attributes of a wetland: a case-study for Lake Kerkini. Journal of Environmental Planning and Management. 43, 755-767.

Pearce, D.W., Warford J.W., 1993. World without end: Economics, Environment and Sustainable Development. Oxford University Press, Oxford, United Kingdom.

Perret, S., Morardet, S., Jourdain, D., Masiyandima, M., Pollard, S., Fritsch, J., 2004. Research Proposal (Synopsis) Wetlands based livelihoods in the Limpopo basin: balancing social welfare and environmental security. IWMI, Silverton, South Africa.

Powicki, C.R., 1998. The value of ecological resources EPRI Journal 23, July-August. Palo Alto, California. Cited in, De Groot, R. S., Stuip, M., Finlayson, M., Davidson, N., 2006 Valuing wetlands: Guidance for valuing the benefits derived from wetland ecosystem services. Ramsar Technical Report 3 Gland Switzerland.

Quade, E. S., Miser, H. J., 1997. The context, nature and use of systems analysis. In, Quade, E. S., Miser, H. J., 1997. Handbook of systems analysis: Overview of uses, procedures, applications and practice (Vol 1) Chichester.

Quiggin, J., 1993. Existence valua dn benefit-cost analysis: A third view. Journal of policy analysis and management 12 195-199.

Ramsar Convention Bureau, 2000. Ramsar handbook for the wise use of wetlands. The Ramsar Convention Bureau, Gland, Switzerland.

Ramsar Convention Bureau, 2002. Ramsar COP8 DOC. 15: Cultural aspects of wetland, presented at 8th Meeting of the Conference of the Contracting Parties to the Convention on Wetlands (Ramsar, Iran, 1971) Valencia, Spain, 18-26 November 2002 The Ramsar Convention Bureau, Gland, Switzerland. (http://www.ramsar.org/cop8/cop8_doc_15_e.htm)

Rosenthal, D. H., and Nelson, R. H., 1992. Existence value should not be used in cost-benefit analysis. Journal of policy analysis and management 11 116-122.

Rotmans, J., 1998. Methods for IA: The challenges and opportunities ahead. Paper presented at the EFIEA workshop on challenges and opportunities for integrated environmental assessment, Amsterdam. Cited in Toth and Hizsnyik 1998. Integrated environmental assessment methods Evolution and applications. Env. Modelling & Assessment, 3, 193-207.

Sarron, C., 2005. Effects of wetland degradation on the hydrological regime of a quaternary catchment. Mohlapitse River, Ga-Mampa valley, Limpopo Province, South Africa. MSc thesis. ENSAR: Ecole Nationale Supérieure Agronomique de Rennes.

Schulze, R.E., Maharaj, M., Lynch, S.D., Howe, B.J. and Melvil-Thomson, B. 1997. South African atlas for agro-hydrology and climatology. University of Natal, Pietermaritzburg. Cited in, Chiron, D., 2005. Impact of the small-scale irrigated sector on household revenues of the black community of Ga-Mampa valley: Contribution to the irrigation management transfer study of the small-scale irrigation schemes. Limpopo province - South Africa. Master of Science Thesis in Social Management of the Water and Tropical Agricultural Development. Centre National d'Etudes Agronomiques en Régions Chaudes. France.

Schuyt, K. D., 1999 Economic Valuation of the Lake Chilwa wetland – Report for the lake Chilwa Wetland and Catchment Management project, May, Zambia.

Schuyt, K.D., 2005. Economic consequences of wetland degradation for local populations in Africa. Ecological Economics, 53, 177-190.

Sluijs, J., Craye, M., Funtowicz, S., Kloprogge, P., Ravetz J., Risbey, J., 2005. Combining quantitative and qualitative measures of uncertainty in model based environmental assessment: the NUSAP system. Risk Analysis, 25, 481-492.

Smeets, E., and Weterings, R., 1999. Environmental indicators: typology and overview. Technical report 25, European Environmental Agency, Copenhagen Denmark 1-19.

Stuip, M.A.M., Baker,C.J., Oosterberg, W., 2002. The socio-economics of wetlands. Wetlands International and RIZA, Wageningen, The Netherlands. 35pp. Cited in, Groot, R. S., Stuip, M., Finlayson, M., Davidson, N., 2006 Valuing wetlands: Guidance for valuing the benefits derived from wetland ecosystem services. Ramsar Technical Report 3 Gland Switzerland.

Taddese, G., 1995. Increasing water productivity: livestock for food security and poverty alleviation. International Livestock Research Institute (ILRI) Ethiopia. www.iwmi.cgiar.org/assessment/files/pdf/publications/WorkingPapers/INCREASINGWater_Girma.pdf.

Thampapillai, D. J., 2000. Willingness to pay and willingness to accept: A simple conceptual exposition. Applied Economics Letters, 7, 509-511.

Tinguery, N., (2006). The interface between the local community based wetland resource and the formal wetland policies, laws and institutions case studies in South Africa and Zambia. MSc thesis Brandeis University.

Toth, F.L., Hizsnyik, E., 1998. Integrated environmental assessment methods evolution and applications. Environmental Modelling & Assessment, 3, 193-207.

Troy, B., Sarron, C., Fritsch, J. M., Rollin, D., 2006. Assessment of the impacts of land-use change on the hydrological regime of a small rural catchment in South Africa. Draft IWMI working paper. IWMI, Silverton, South Africa.

Turpie, J. K., Smith, B., Emerton, L., Barnes, J., 1999. Economic value of the Zambezi Basin wetlands. Harare: Report to IUCN ROSA.

Turpie, J. K. 2000. The use and value of natural resources of the Rufiji floodplain and delta, Tanzania. Cape Town, South Africa:Rufiji Environmental Management Project; IUCN - Eastern Africa Regional Office; Fitzpatrick Institute, University of Capetown.

Turpie, J. K., 2003. The valuation of riparian fisheries in Southern and Eastern Africa Report to ICLARM www.iwmi.cgiar.org/Assessment/files_new/research_projects/Paper_Turpie_ICLARM.pdf -.

Turpie, J. K., Heydwnrych, B., Lamberth, S., 2003. Economic value of terrestrial and marine biodiversity in the Cape Floristic region: Implications for defining effective and socially optimal conservation strategies. Biological Conservation, 112, 233-251.

Turner, R., Jeroen, C., Soderqvist, T., Barendregt, A., Straaten, J., Maltby, E., Ierland, E., 2000. The values of wetlands: Landscape and institutional perspective: Ecological economic analysis of wetlands: scientific integration for management and policy. Ecological Economics, 35, 7-23.

Turner, R. K., Paavola, J., Cooper, P., Farber, S., Jessamy, V., Georgiou, S., 2003. Valuing nature: Lessons learned and future research directions. Ecological Economics, 46, 493-510.

Vorhies, F., 1997. Environmental economics explained: Part 1: How economic valuation can help pay for conservation. www.earthmind.net/marine/docs/economic-valuation-conservation.pdf.

Wetland International, 2005. Wetland international strategic intent 2005-2014. Strategy paper. http://www.wetlands.org/publication.aspx?id=4df50486-ea97-4707-86a0-200507672aa8. Wageningen, The Netherlands.

White, A.T., Ross M., Flores, M., 2000. Benefits and costs of coral reef and wetland management in De Groot, R. S., Stuip, M., Finlayson, M., Davidson, N., 2006 Valuing wetlands: Guidance for valuing the benefits derived from wetland ecosystem services. Ramsar Technical Report 3 Gland Switzerland.

White, L. D., Troxel, T. R., 1995 Balancing forage demand with forage supply. Texas Agricultural Extension Service, The Texas A&M University system. texnat.tamu.edu/publications/B-1606.pdf.

Wilson, M.A., Carpenter, S.R., 2000. Economic valuation of freshwater ecosystems services in the United States in De Groot, R. S., Stuip, M., Finlayson, M., Davidson, N., 2006 Valuing wetlands: Guidance for valuing the benefits derived from wetland ecosystem services. Ramsar Technical Report 3 Gland Switzerland.

Wilson, M.A., Howarth, R. B., 2002. Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. Ecological Economics. 41, 431–443.

Wilson, M., Christopher, T., 2004. Understanding and accounting for the spatial geography of ecosystem goods and services: An example from the national science foundation Baltimore ecosystem project, http://ecovalue.uvm.edu/evp/doc accessed 28-05-2006.

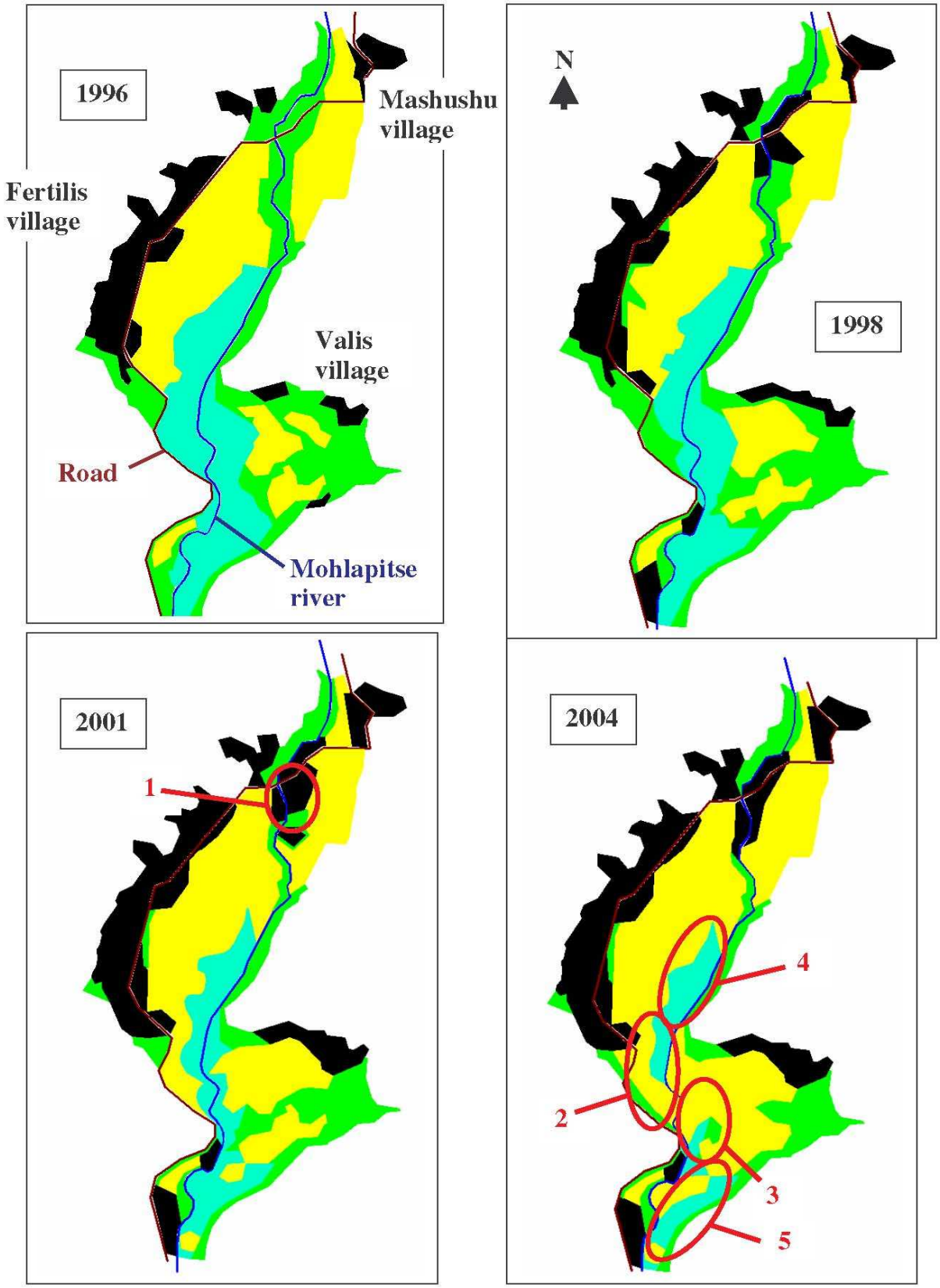
Woodward, T., Wui, Y., 2001. The economic value of wetland services: A meta-analysis. Ecological Economic, 37, 257-270.

Referred Websites

www.anc.org.za/lists/maplist.html
http://www.cifor.cgiar.org/mla/ accessed 09-07-06
(http://www.cifor.cgiar.org/mla/_ref/uptake/index.htm 10-01-07)
http://cnx.org/content/m12170/latest/
http://www.ceroi.net/reports/arendal/dpsir.htm
http://www.dwaf.gov.za/Projects/WARMS/Revenue/charges1.asp
www.ecosystemvaluation.org/
http://www.fsausomali.org/200511123506_baseline_analysis.php?open1003=set
http://maps.grida.no/go/graphic/dpsir_framework_for_state_of_environment_reporting
www.ifad.org/
http://www.indexmundi.com/zp/sf/1460.htm
http://www.iucn.org/themes/CEM/ourwork/ecapproach/index.html
http://www.iwmi.cgiar.org/ (06-07-06)
http://www.limpopo.gov.za/about_otp/location.asp
www.livelihoods.org
http://www.maweb.org/en/Framework.aspx
http://www.maplandia.com/south-africa/northern-province/pietersburg/ga-mampa/(15-01-07)
http://www.maweb.org/en/Framework.aspx
chm.moew.government.bg/nnps/upload/Common/Costs_and_Benefits.ppt
http://www.ngo.grida.no/soesa/nsoer/resource/wetland/inventory_classif.htm#introductin
www.naturevaluation.org
http://www.places.co.za/html/wolkbergwa.html
http://www.ramsar.org/cop8/cop8_doc_15_e.htm
www.waterandfood.org/ accessed 26-05-2006
http://william-king.www.drexel.edu/top/prin/txt/MUch/Eco412.html
http://www.weathersa.co.za (15-01-07)
http://en.wikipedia.org/wiki/Limpopo_River (30-10-06)
(http://www.wetland.org/za 10-02-07)
www.waterandfood.org (06-07-06)
http://www.statssa.gov.za/publications/StatslnBrief2006.pdf (16-11-06)

APPENDIXES

Appendix 1: Land use change in Ga-Mampa valley and map of Limpopo Basin



Land-use change in Ga-Mampa wetland (Sarron, 2005).
***The light green portion indicate area covered by wetland.**

Land-use evolution and trend in the Ga-Mampa Valley from 1996 – 2004 (Sarron, 2005).

Land Use	1996	1998	2001	2004	Trend 1996-2004
Wetlands (km^2)	0.90	0.82	0.66	0.43	- 52%
Agriculture (km^2)	1.82	1.87	2.16	2.51	+ 38%
Urban/Bare (km^2)	0.95	1.13	1.36	1.36	+ 43%
Woodland/Uncultivated (km^2)	1.43	1.28	0.92	0.80	- 44%
Total (km^2)	5.10	5.10	5.10	5.10	

Appendix 2: Study area

Country Statistics of Limpopo Basin (ARC, 2003).

	Total area (km^2)	Area of country within basin (km^2)	As % of total area of the basin	As % of total area of the country	Population in country in 1998 (million)	Population in basin (million)	As % country population
Botswana	581,730	80,118	19	14	2	1	59
Mozambique	801,590	84,981	21	11	17	1	7
South Africa	1,221,040	185,298	45	15	42	11	24
Zimbabwe	390,760	62,541	15	16	11	1	9
Total		**412,938**			**72**	**14**	

Predominant vegetation in Ga-Mampa wetland (Kotze, 2005).

Vegetation type	Predominant species	Structure	Site characteristics	Natural extent
Phragmites Marsh	Predominantly Phragmites mauritianus but also with P. australis,	Very tall (> 3m) uniform stands	Permanently wet areas on the valley floor and in the river channel and its margin	Very extensive
Cladiumma riscus marsh	Cladium mariscus	Very dense uniform stands (2m)	Permanently wet areas on the valley floor	Limited
Mix ed marsh	Pycreus mundii, Thelypterus cf. interrupta, Leersia hexandra, P mauritianus	Variable (0.5-2 m)	Permanently wet areas on the v alley floor	Moderately extensive
Typha capensis Marsh	Typha capensis	Uniform stands (2-3 m)	Primarily within the river channel in permanently inundated sites	Limited primarily to within the main stream channel
Miscanthis junceus meadow	Miscanthis junceus	Dense clumps (2 m) interspersed with short	On the valley floor in areas with seasonal wetness	Extensive
Mesic grassland	C ynodon dactylon, P .mauritianus	Short (mainly < 0.5 m)	On the valley floor in areas with sandy, moderately well drained soils	Limited
Hygrophilo us grassland	Paspalumdilitatum, Pycreus mundtii,P . mauritianus,Imperata cylindrica	Short (mainly < 0.5 m)	On the v alley floor in areas with somewhat poorly drained soils (temporarily saturated)	Extensive, particularly along the margins
Riparian forest	Sysigiumcordatum, Rauvolfia caffra, Ficus sycomorus	Generally closed canopy, > 5m	Adjacent to the river channel or at the transition from steep hillslope to valley floor where shallow, surface water is readily available to the trees	Moderately extensive

Appendix 3: The ecosystem functions and services and monetary valuation techniques

The relationship between ecosystem functions and services and monetary valuation technique (source: de Groot et al. 2006).

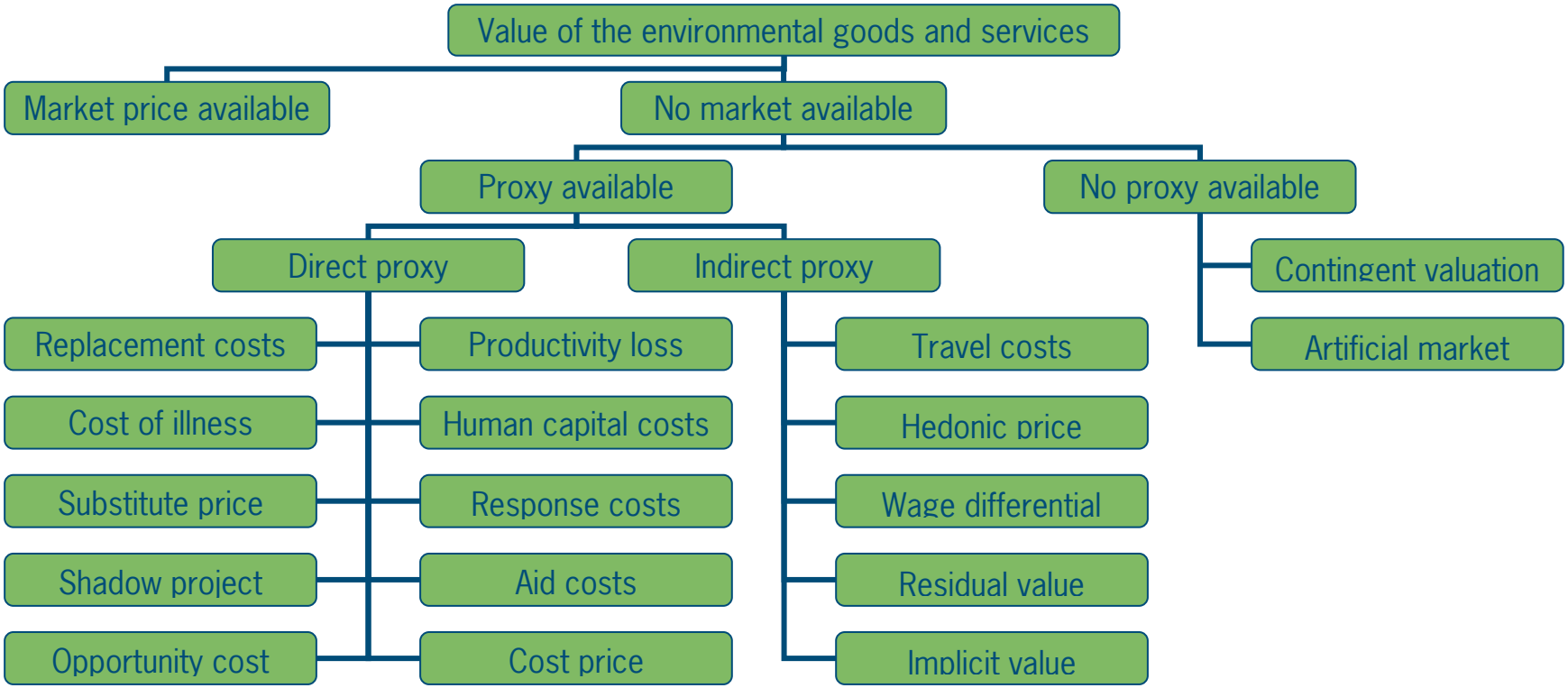
Ecosystem functions (and associated services)	Maximum monetary values (US$/ha Year) 1	Direct Market Pricing2	Indirect Market Pricing					
			Avoided Cost	Replacement cost	Factor Income	Travel cost	Hedonic Pricing	Contingent Valuation	Group Valuation
Regulating service									
Gas regulation	265		+++	O	o			o	o
Climate regulation	223		+++	O	o		o	o	o
Disturbance regulation	7,240		+++	++	o		o	+	o
Water regulation	5,445	+	++	O	+++		o	o	o
Water supply	7,600	+++	o	++	o	o	o	o	o
Soil retention	245		+++	++	o		o	o	o
Waste treatment	6,696		o	+++	o		o	++	o
Pollination	25	o	+	+++	++			o	o
Biological control	78	+	o	+++	++			o	o
Supporting services									
Refugium function	1,523	+++		O	o		o	++	o
Nursery function	195	+++	o	O	o		o	o	o
Soil formation	10		+++	O	o			o	o
Nutrient cycling	21,100		o	+++	o			o	o
Provisioning services									
Food	2,761	+++		O	++			+	o
Raw materials	1,014	+++		O	++			+	o
Genetic resources	112	+++		O	++			o	o
Medicinal resources		+++	o	O	++			o	o
Ornamental resources	145	+++		O	++		o	o	o
Cultural services									
Aesthetic information	1,760			O		O	+++	o	o
Recreation & tourism	6,000	+++		O	++	++	+	+++	
Cultural & artistic		o			o	O	o	+++	o
Spiritual & historic	25					O	o	+++	o
Science & education		+++			o	O		o	o

1 Dollar values are based on Costanza *et al*. (1997) and apply to different ecosystems (e.g., waste treatment is mainly provided by coastal wetlands and recreational benefits are, on a per hectare basis, highest in coral reefs). These monetary values are examples for illustrative purposes only: actual values will vary from location to location, depending on ecological, biogeographic and socio-economic conditions.

2 Based on added value only (i.e., market price minus capital and labour costs, typically about 80%).

Wetland functions, associated wetland goods and services, valuation techniques and example from developing countries (Masiyandima et al., 2005).

Wetland function	Wetland goods and services	Valuation technique	Example
Production function			
Biomass production and export (both plant and animal)	Production of valuable food and fiber for harvest (crops, grazing, wood, fish, wild animals, wild plants for food, craft and medicine)	Net factor income	Rufiji floodplain and delta (Turpie 2000) Hadejia-Jama'are, Nigeria (Barbier 1994) coastal wetland of Campeche, Mexico (Barbier and Strand 1998)
Regulation functions			
Recharge of groundwater	Increased water supply	Net factor income or replacement cost	Hadejia-Nguru wetlands in Northern Nigeria (Acharya and Barbier 2000; Acharya 2000) Zambezi basin wetlands, (Turpie *et al.* 1999)
Discharge of groundwater	Increased productivity of downstream fisheries	Net factor income, replacement cost or travel cost	
Retention, removal and transformation of nutrients	Reduced costs of water purification	Net factor income or replacement cost	Nvibuko urban wetland in Uganda (Emerton *et al.* 1999) Zambezi basin wetlands, (Turpie *et al*., 1999)
Flood control and storm buffering	Reduced damage due to flooding and severe storms	Net factor income or replacement cost	Zambezi basin wetlands, (Turpie *et al*., 1999)
Stabilization of sediment	Erosion reduction	Net factor income or replacement cost	mangrove Indonesia 1994) in Bituni Bay, (Ruitenbeek
Habitat functions			
Habitat for aquatic species	Improvements in commercial and/or recreational fisheries either on or offsite. Non-use appreciation of the species	Net factor income, replacement cost, travel cost or contingent valuation	mangrove in Bituni Bay, Indonesia (Ruitenbeek 1994)
Habitat for terrestrial and avian species	Recreational observation and hunting of wildlife. Non-use appreciation of the species	Travel cost or contingent valuation	
Information function			
Aesthetic information	Amenity values provided by proximity to the environment	Hedonic pricing	



Possible taxonomy of economic valuation techniques (Markandya, et al., 2002).

Appendix 4: Respondents profile

Summary of respondents profile, N=66 (From field survey 2006).

Particulars		Percentage	Remarks (Average)
Sub-Village	Ga-Moila	13.6	
	Mapagane	51.5	
	Marulatchipigh	6.1	
	Mashushu	6.1	
	Gemini	4.5	
	Ditabogong	9.1	
	Mantlhane	9.1	
Sex	Female	69.7	
	Male	30.3	
Marital Status	Married	53	
	Widowed	30.3	
	Single	15.2	
	Living Together	1.5	
Occupation	Farmer	65.2	
	Trader	3	
	Craft Maker	1.5	
	Pensioner	15.2	
	Housewife	4.5	
	Builder	1.5	
	Helper	1.5	
	None	7.6	
Age Group (Years)	31-50	42.4	
	51-70	47	54.5
	71-90	10.6	
Education (Years)	None	30.3	
	1 -5	28.8	
	6-10	28.8	4.9
	11-15	10.6	
	Above 15	1.5	
Household size	1 -5	33.3	
	6-10	59.1	
	11-15	4.5	6.8
	Above 15	3	
Household Income (Rands)	0-100	1.5	
	101-500	22.7	
	501-1000	56.1	853.2
	Above 1000	19.7	
Period Residence in Ga-Mampa Valley (Years)	1-20	12.1	
	21-40	28.8	
	41-60	45.5	42.1
	61-80	12.1	
	Above 80	1.5	

Appendix 5: Perception of respondents on selected wetland services

Respondents perception on cropping (N=30).

1. Why do you farm in the wetland?	
Reason	*%*
Wetness of the soil	81.8
Only available land	15.2
High yield	3.0
2. Availability (for household) of other location to crop?	
Response	*%*
No	51.5
Yes	48.5
3. If yes (to 2), where is the alternative?	
Location	%
Irrigation scheme	100.0
Others	0
4. Can you do the type of cropping you do in wetland elsewhere?	
Response	*%*
No	100.0
Yes	0
5. In the absence of wetland, what will you do?	
Response	*%*
Farm dry-land	48.4
Nothing to do	35.5
Farm in my compound	3.2
Look for land	12.9
6. Have you experienced shortage in crop yield in the past?	
Response	*%*
No	71.9
Yes	28.1
7. What was reason for the shortage?	
Reason	%
Weather	71.4
Animals	14.3
Bad soil	14.3
8. How did you adjust to this shortage?	
Response	%
Nothing	83.3
Something	16.7

Respondent perception on reed collection (N= 14).

1. Do you have substitute to what you use reeds for?	
Response	*%*
No	50.0
Yes	50.0
2. In the absence of wetland to collect reeds, what will you do?	
Response	*%*
Nothing	35.7
Buy reeds from other settlements	50.0
Use other materials	14.3
3. Have you ever experienced reeds shortage from the wetland?	
Response	*Valid Percent*
No	28.6
Yes	71.4
4. What did you do to adjust to this shortage?	
Response	*%*
Nothing	80.0
Buy	20.0
5. How do you describe changes in reeds from the wetland?	
Response	*%*
Decreasing	92.9
Not changing	7.1
6. What Indicator did you use for this description?	
Response	*%*
Availability in wetland	85.7
Time taken	14.3
7. What reason can you give for this change?	
Response	*%*
Poor weather (lack of rainfall)	46.2
Farming activity (colonization of wetland)	53.8

Respondents perception on sedge collection (N=15).

1. Do you have substitute to what you use sedge for?	
Response	*%*
No	93.3
Yes	6.7
2. In the absence of wetland to collect sedge, what will you do?	
Response	*%*
Nothing	100
3. Have you ever experienced sedge shortage from the wetland?	
Response	*%*
No	40
Yes	60
4. What did you do to adjust to this shortage?	
Response	*%*
Sold other things	40
Nothing	60
Total	100
5. How do you describe changes in sedge from the wetland?	
Response	*%*
Decreasing	86.7
Not changing	13.3
6. What Indicator did you use for this description?	
Response	*%*
Availability	80
Time taken	20
7. What reason can you give for this change?	
Response	%
Weather	60
Farming	40

Respondents perception on edible plant collection (N= 63).

1. Apart from in the wetland, are there other locations for you to collect edible plant?	
Response	*%*
No	6.3
Yes	93.7
2. If yes, describe these other location (s)	
Response	%
Mountain	79.7
Farm (by cultivating it, including home garden)	6.8
Dryland	13.6
3. Do you collect edible plants from these other locations?	
Response	%
No	45.8
Yes	54.2
4. If you do not collect from these sources, why?	
Response	%
Difficult to find	44.4
Not available	25.9
Not good	29.6
5. Do you have substitute to what you use edible plants for?	
Response	*%*
Yes	100.0
6. Describe the substitute	
Response	*%*
Meat	74.6
Cabbage	6.4
Meat and Cabbage	12.7
Meat/Cabbage/Beans	6.3
7. Why do you choose the wetland as the place to collect edible plant?	
Response	*%*
Always available there	88.1
It is best there	11.9
8. In absence of edible plant from the wetland what will you do?	
Response	*%*
Buy meat	83.8
Buy cabbage	3.2
Collect from garden	4.8
Mountain	6.5
Hunting	1.6
9. Have you experienced shortage of edible plants from the wetland?	
Response	*%*
No	39.7
Yes	60.3
10. What did you do to adjust to this shortage?	
Response	*%*
Buy meat	37.1
Buy cabbage	7.9
Go to mountain	23.7
Collect from garden	13.2
Nothing	7.9
11. How do you describe changes in edible plants in the wetland?	
Response	*%*
Decreasing	82.5

Not changing	14.3
I don’t know	3.2
Response	%
12. What Indicator did you use for this description?	
Response	*%*
Availability	90.2
Time taken	8.2
Difficulty to collect	1.6
13. What reason can you give for this change?	
Response	*%*
Poor rainfall	96.2
Population increase	3.8

Appendix 6: Cropping activity-tables

Average time and yield/time spent by wetland cropping households for each cropping season in the Ga-Mampa wetland.

Activity	Wet season		Dry season		Both seasons	
	Average time (Hours)	Average household labor cost (Rands)	Average time (Hours)	Average household labor cost (Rands)	Average time (Hours)	Average household labor cost (Rands)
Land preparation	12.5	159.4	13.0	75.0	25.5	234.4
Planting and sowing	15.0	0.0	26.0	0.0	41.0	0.0
Weeding	145.3	48.0	56.0	0.0	201.3	48.0
Fertility management	11.0	25.0	0.0	0.0	11.0	25.0
Disease control	10.0	0.0	0.0	0.0	10.0	0.0
Harvesting	112.2	0.0	127.0	0.0	239.2	0.0
Transportation		88.0	0.0	130.0	0.0	218.0
Post harvesting	294.3	5.7	120.0	0.0	414.3	5.7

Estimated crop loss before harvest by farmers in the Ga-Mampa wetland.

Reason for lost	***Quantity***	***Maize (bags)***	***Vegetable (kg)***	***Groundnut (bags)***	***Coriander (bags)***	***Beans (bags)***
Lost to pest	No	142	828.7	8.3	4.5	1.5
	% of yield	12.3	7.1	39.1	12.5	14.3
Lost to crop	No	68.3	1820.1	2.5	3	0
disease	% of yield	5.9	15.6	11.7	8.3	0
Other loss	No	126.2	431.9	0	3	1.5
	% of yield	10.9	3.7	0	8.3	14.3
Total loss	No	335.8	4621	10.84	10.5	3
	% of yield	29	26.4	51.6	29.2	28.6

Estimated harvest and economic value of maize from Ga-Mampa wetland.

	Maize *(Mabele)*								
	Total Harvested	Household Use	Exchanged	Sold	Next year	Price	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	13						2,187	1,844	114
Per average HH	3						500	421	26
Total in (Bags)	1,158	1073.8	9	60.2	15	170			
Total (kg)	110,010	102,004	855	5,721	1430				
%	100	93	0.8	5	1.3				
R							196,860	165,936	10,234
$[76]							30,474	25,687	1,584
€[77]							22,838	19,250	1,187

[76] Based on average exchange rate between September 2005 and September 2006 at R6.46= $1 (Statistics South Africa)
[77] Based on average exchange rate between September 2005 and September 2006 at R8.62= €1 (Statistics South Africa)

Estimated Harvest and Economic Value of Groundnut from Ga-Mampa Wetland.

Ground Nut							
	Total Harvested	Household Use	Sold	Price	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	2.7				572.4	533.3	499.9
Per average HH	0.1				11.6	10.8	10.1
Total (bags)	21.3	2.7	18.6				
Total (kg)	1,704	216	1,488	215			
%	100	12.5	87.5				
R					4,580	4,266	3,999
$					708.9	660.4	619.0
€					531.3	494.9	463.9

Estimated Harvest and Economic Value of Cultivated Vegetables from Ga-Mampa Wetland.

Vegetable								
	Total Harvested (kg)	Household Use (kg)	Gift (kg)	Sold (kg)	Price R/150g)	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	28					371	361	0
Per average HH	4				2	54	52	0
Total	1,584	1403	181	0				
%	100	88.6	11.4	0				
R						21,120	20,551	0
$						3,269	3,181	0
€						2450	2384	0

Estimated Harvest and Economic Value of Cultivated Coriander from Ga-Mampa Wetland.

Coriander								
	Total Harvested	Household Use	Exchanged	Sold	Price/ bag	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	960					2,580	2,475	1,720
Per average HH	7					20	19	13
Total (bags)	36	12	0	24	215			
Total (kg)	2,880	962	0	1918				
%	100	33.4	0	66.6				
R						7,740	7,426	5,160
$						1,198	1,150	799
€						898	861	599

Estimated Harvest and Economic Value of Cultivated Beans from Ga-Mampa Wetland.

Beans								
	Total Harvested	Household Use	Exchanged	Sold	Price (R)	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	3.5					1,313	955	1,125
Per average HH	0.03					10	7	9
Total (bags)	10.5	1.5	0	9	375			
Total (kg)	840	120	0	720				
%	100	14.3	0	85.7				
R						3,938	2,866	3,375
$						610	444	522
€						457	332	392

Estimated Harvest and Economic Value of Beetroot from Ga-Mampa Wetland.

Beetroot								
	Total Harvested	Household Use	Gift	Sold	Price	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	150					263	171	105
Per average HH	1.1					2.0	1.3	0.8
Total	450	170	100	180	1.75			
%	100	37.8	22.2	40				
R						787.5	513	315
$						122	79	49
€						91	60	37

Estimated Harvest and Economic Value of Cultivated Sugarcane from Ga-Mampa Wetland.

Sugarcane								
	Total Harvested	Household Use	Gift	Sold	Price	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	125					125	80	90
Per average HH	2					1.9	1.2	1.4
Total	750	90	120	540	1			
%	100	12	16	72				
R						750	480	540
$						116	74	84
€						87	56	63

Estimated Harvest and Economic Value of Cultivated Banana from Ga-Mampa Wetland.

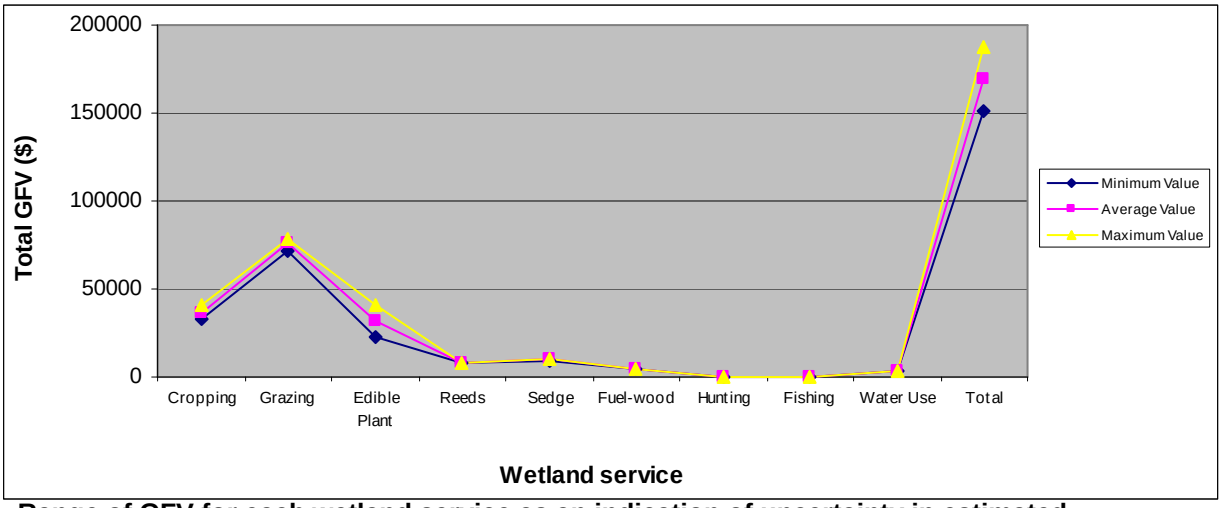
	Banana							
	Total Harvested	Household Use	Gift	Sold	Price	Gross Financial Value	Net Financial Value	Cash Income
Per user HH	50					625	507	375
Per average HH	0.4					4.8	3.9	2.9
Total	150	30	30	90	12.5			
%	100	20	20	60				
R						1,875	1,521	1,125
$						290	235	174
€						218	176	131

Appendix 7: Estimated forage and water intake by livestock under an African condition

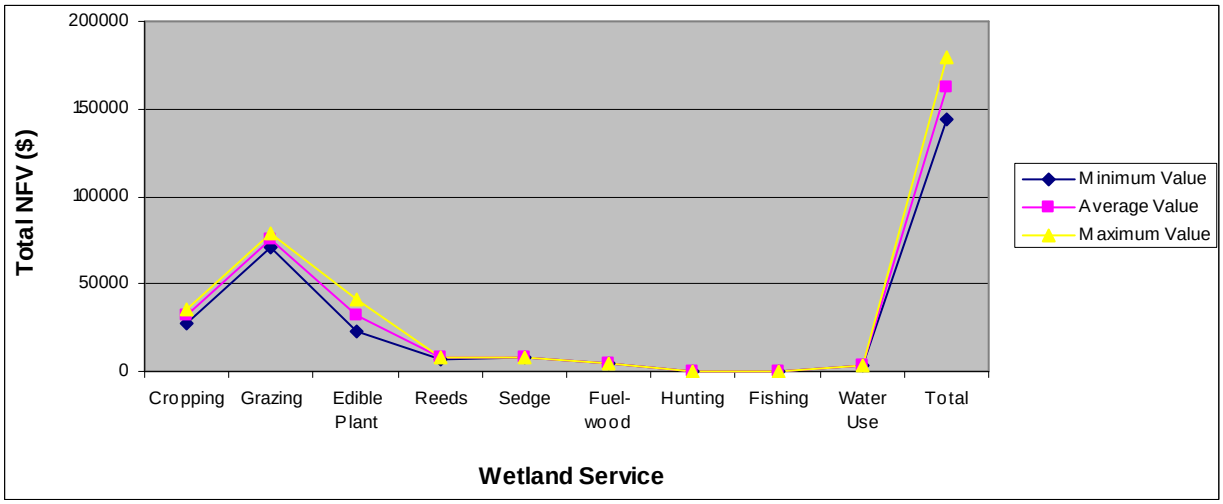
Estimated Water and Forage Intake by Livestock under African Conditions (Source Tardese, 1995).

	Tropical	Mean	Daily dry	Wet season Air temp 27℃		Dry cold Season Air temp from 15-21		Dry hot season Air temp 27℃	
Animal	Livestock Units (TLU)	Live-weight in kg	Matter intake in kg	Total water req. in l/day	Voluntary water intake in l/day	Total water req. in l/day	Voluntary water intake in l/day	Total water req. in l/day	Voluntary water intake in l/day
Camels	1.6	410	9	50	15	37	35	50	50
Cattle	0.7	180	5	27	10	20	19	27	27
Sheep	0.1	25	1	5	2	4	4	5	5
Goats	0.1	25	1	5	2	4	4	5	5
Donkeys	0.4	105	3	16	5	12	11	16	16

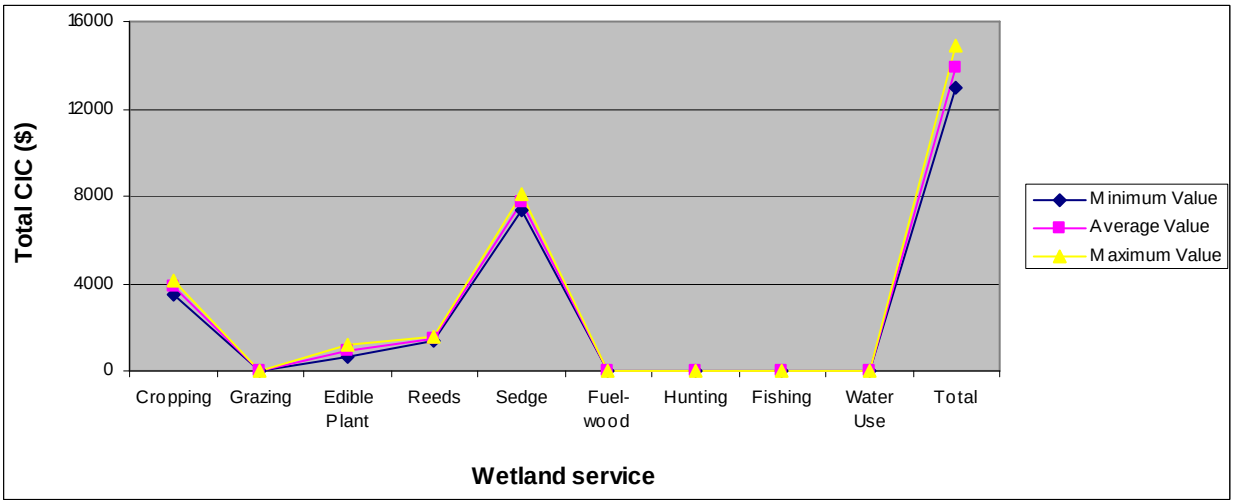
Appendix 8: Uncertainty analysis figures



Range of GFV for each wetland service as an indication of uncertainty in estimated monetary value of Ga-Mampa wetland services.

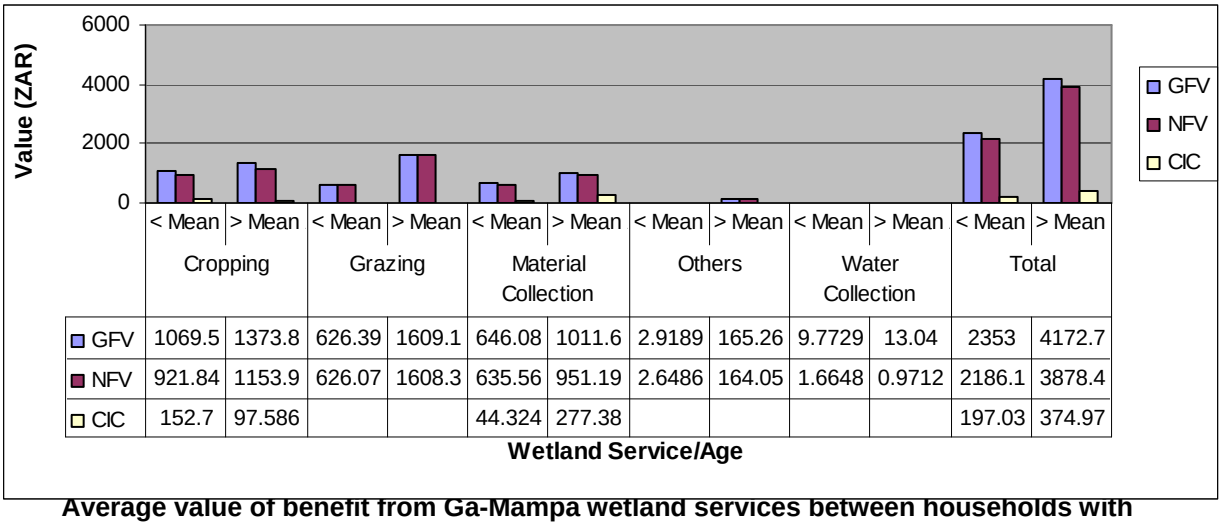


Range of NFV for each wetland service as an indication of uncertainty in estimated monetary value of Ga-Mampa wetland services



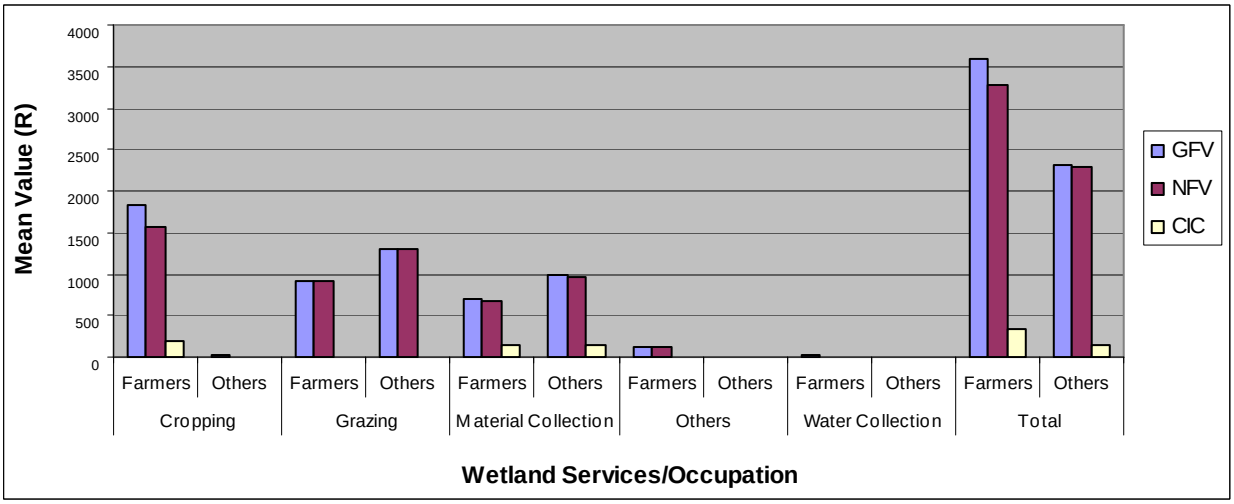
Range of CIC for each wetland service as an indication of uncertainty in estimated monetary value of Ga-Mampa wetland services.

Appendix 9: Charts showing mean distribution of values over different household types

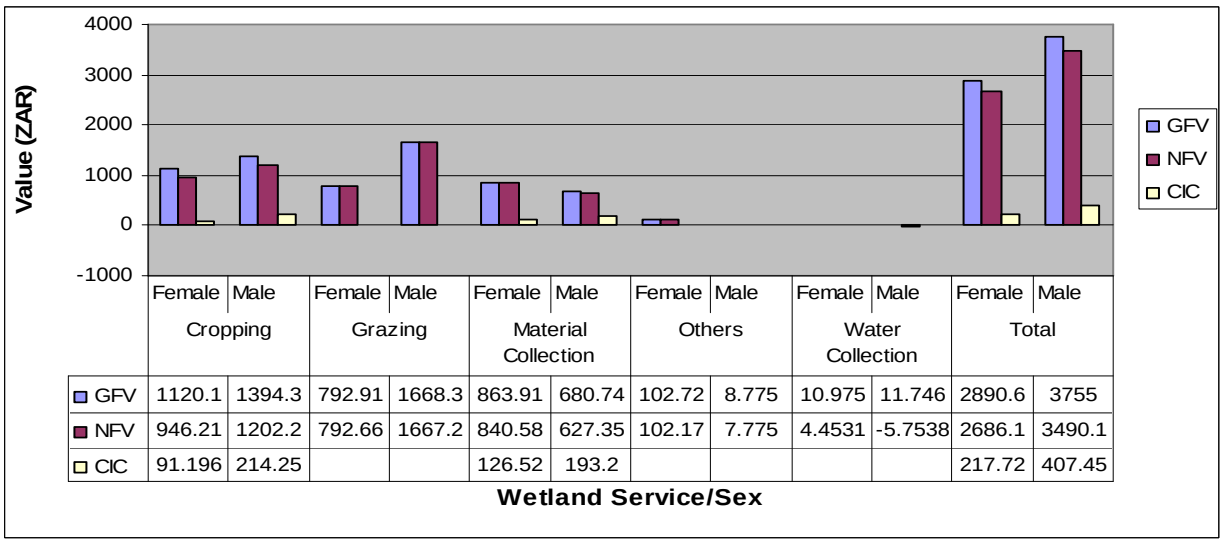


	< Mean	> Mean	< Mean	> Mean	< Mean	> Mean	< Mean	> Mean	< Mean	> Mean	< Mean	> Mean
	Cropping		Grazing		Material Collection		Others		Water Collection		Total	
GFV	1069.5	1373.8	626.39	1609.1	646.08	1011.6	2.9189	165.26	9.7729	13.04	2353	4172.7
NFV	921.84	1153.9	626.07	1608.3	635.56	951.19	2.6486	164.05	1.6648	0.9712	2186.1	3878.4
CIC	152.7	97.586			44.324	277.38					197.03	374.97

Average value of benefit from Ga-Mampa wetland services between households with household heads age < and > average age.

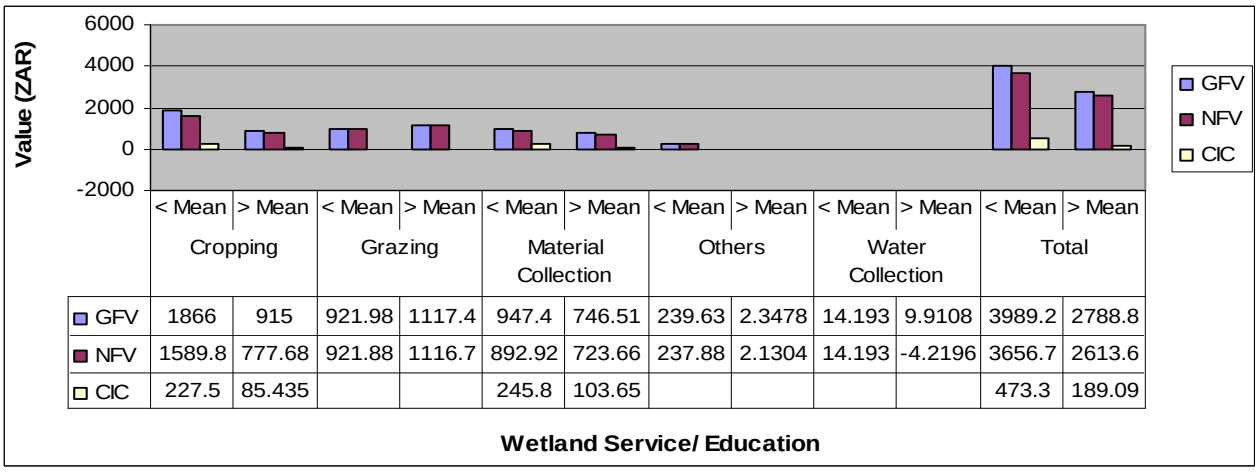


Average value of benefit from Ga-Mampa wetland services between households with household heads occupation.



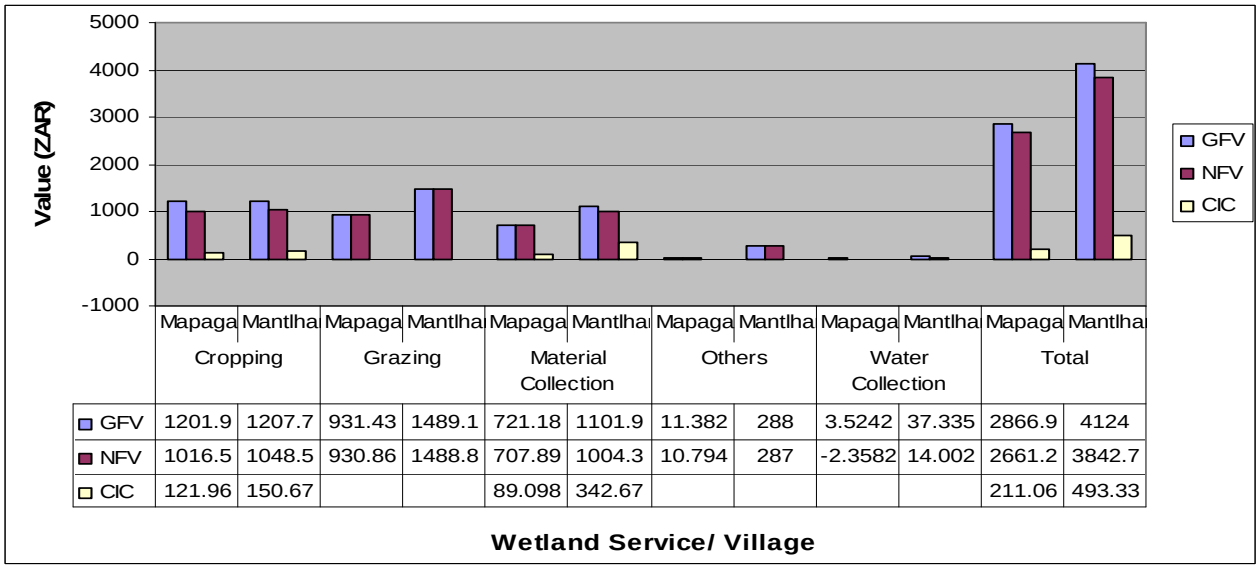
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
	Cropping		Grazing		Material Collection		Others		Water Collection		Total	
GFV	1120.1	1394.3	792.91	1668.3	863.91	680.74	102.72	8.775	10.975	11.746	2890.6	3755
NFV	946.21	1202.2	792.66	1667.2	840.58	627.35	102.17	7.775	4.4531	-5.7538	2686.1	3490.1
CIC	91.196	214.25			126.52	193.2					217.72	407.45

Average value of benefit from Ga-Mampa wetland services between male and female headed households.



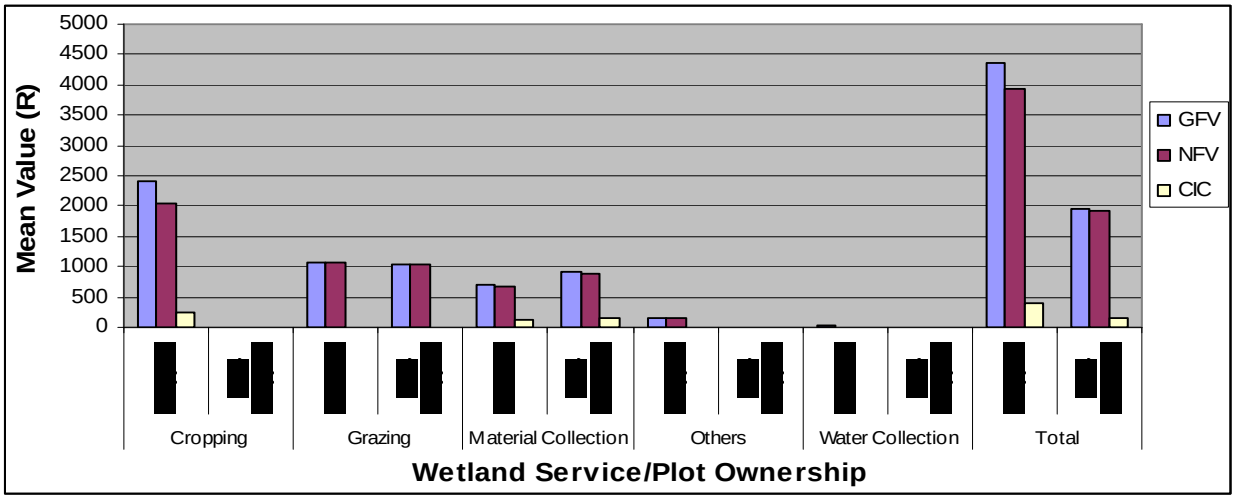
	Cropping		Grazing		Material Collection		Others		Water Collection		Total	
	< Mean	> Mean	< Mean	> Mean	< Mean	> Mean	< Mean	> Mean	< Mean	> Mean	< Mean	> Mean
GFV	1866	915	921.98	1117.4	947.4	746.51	239.63	2.3478	14.193	9.9108	3989.2	2788.8
NFV	1589.8	777.68	921.88	1116.7	892.92	723.66	237.88	2.1304	14.193	-4.2196	3656.7	2613.6
CIC	227.5	85.435			245.8	103.65					473.3	189.09

Average value of benefit from Ga-Mampa wetland services between households with household heads education years < and > average.

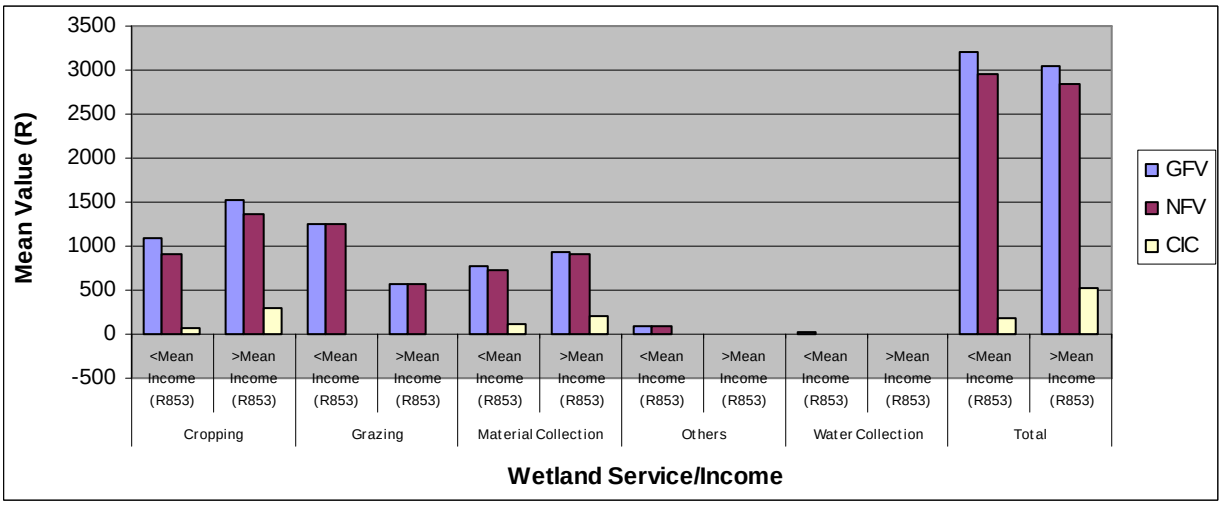


	Cropping		Grazing		Material Collection		Others		Water Collection		Total	
	Mapaga	Mantlha	Mapaga	Mantlha	Mapaga	Mantlha	Mapaga	Mantlha	Mapaga	Mantlha	Mapaga	Mantlha
GFV	1201.9	1207.7	931.43	1489.1	721.18	1101.9	11.382	288	3.5242	37.335	2866.9	4124
NFV	1016.5	1048.5	930.86	1488.8	707.89	1004.3	10.794	287	-2.3582	14.002	2661.2	3842.7
CIC	121.96	150.67			89.098	342.67					211.06	493.33

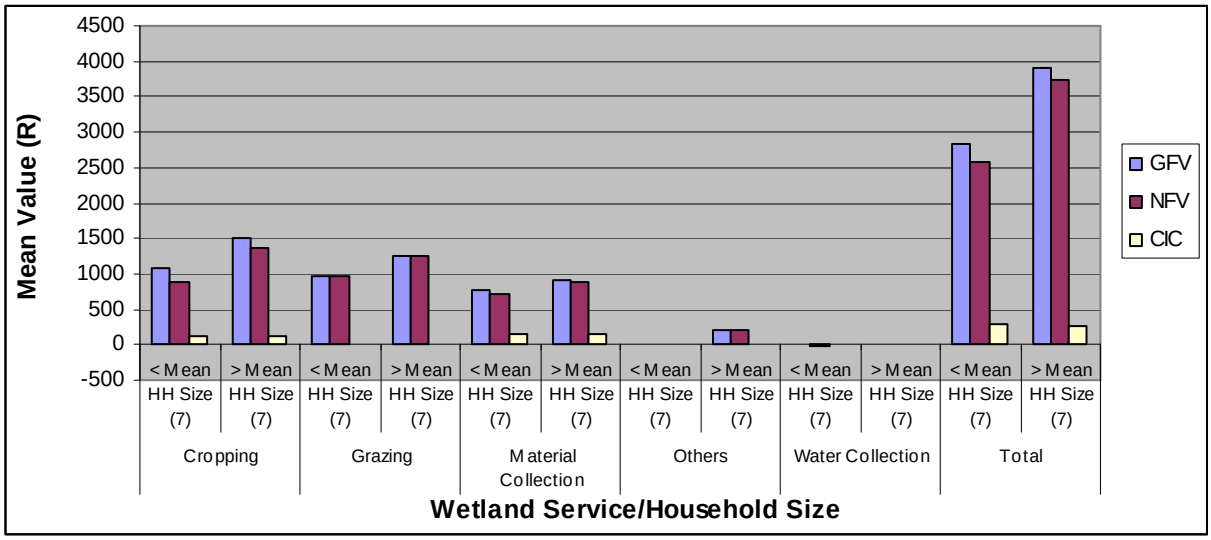
Average value of benefit from Ga-Mampa wetland services between households in Ga-Mampa and Mantlhane main villages.



Average value of benefit from Ga-Mampa wetland services between households by access to cropping.



Average value of benefit from Ga-Mampa wetland services between households in over income group.



Average value of benefit from Ga-Mampa wetland services between by household size.

Appendix 10: Analysis of variation and t-test[78]

[78] Results are presented for means with significant difference at 95% and also for grand total of benefits. Note that all monetary values are in Rands.

Analysis of variation (ANOVA) of wetland services for household location (7 sub-villages).

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Grazing GFV	Mapagane	34	579.97	1,135.736	194.777	183.69	976.24	0	4,618
	Ga-Moila	9	2,540.57	4,334.369	1,444.790	-791.12	5,872.26	0	13,019
	Mantlhane	6	3,189.39	3,440.087	1,404.409	-420.76	6,799.53	0	7,426
	Marulatchipigh	4	0.00	0.000	0.000	0.00	0.00	0	0
	Mashushu	4	1,229.68	1,419.965	709.983	-1,029.80	3,489.16	0	2,474
	Ditabogong	6	133.33	326.599	133.333	-209.41	476.08	0	800
	Gemini	3	800.00	1,385.641	800.000	-2,642.12	4,242.12	0	2,400
	Total	66	1,058.17	2,243.581	276.166	506.63	1,609.71	0	13,019
Grazing NFV	Mapagane	34	579.36	1,134.979	194.647	183.34	975.37	0	4,617
	Ga-Moila	9	2,539.64	4,333.844	1,444.615	-791.65	5,870.93	0	13,018
	Mantlhane	6	3,189.39	3,440.087	1,404.409	-420.76	6,799.53	0	7,426
	Marulatchipigh	4	0.00	0.000	0.000	0.00	0.00	0	0
	Mashushu	4	1,229.68	1,419.965	709.983	-1,029.80	3,489.16	0	2,474
	Ditabogong	6	133.05	325.905	133.050	-208.97	475.07	0	798
	Gemini	3	799.33	1,384.486	799.333	-2,639.92	4,238.59	0	2,398
	Total	66	1,057.67	2,243.228	276.122	506.22	1,609.12	0	13,018
Water Collection GFV	Mapagane	34	3.06	4.579	0.785	1.46	4.65	0	14
	Ga-Moila	9	7.41	10.226	3.409	-0.45	15.27	0	23
	Manthlane	6	92.60	94.387	38.533	-6.45	191.66	0	227
	Marulachiping	4	0.55	1.101	0.550	-1.20	2.30	0	2
	Mashushu	4	1.72	3.440	1.720	-3.75	7.19	0	7
	Ditabogong	6	0.37	0.899	0.367	-0.58	1.31	0	2
	Gemini	3	0.73	1.271	0.734	-2.42	3.89	0	2
	Total	66	11.21	37.233	4.583	2.06	20.36	0	227
Grand Total Gross Benefit	Mapagane	34	2,779.13	2,217.001	380.212	2,005.58	3,552.67	192	7,546
	Ga-Moila	9	4,378.21	4,291.528	1,430.509	1,079.45	7,676.97	384	14,019
	Manthlane	6	6,737.82	9,318.821	3,804.393	-3,041.68	16,517.33	192	24,350
	Marulachiping	4	1,335.55	1,356.827	678.413	-823.46	3,494.56	112	2,974
	Mashushu	4	1,743.40	1,688.683	844.341	-943.67	4,430.47	256	3,674
	Ditabogong	6	2,391.03	1,718.066	701.398	588.03	4,194.03	560	5,192
	Gemini	3	2,362.07	1,545.717	892.420	-1,477.71	6,201.84	846	3,936
	Total	66	3,152.56	3,719.475	457.836	2,238.20	4,066.93	112	24,350
Grand Total Net Benefit	Mapagane	34	2,546.83	2,067.296	354.538	1,825.52	3,268.15	192	7,167
	Ga-Moila	9	4,138.14	4,370.046	1,456.682	779.03	7,497.26	384	13,996
	Manthlane	6	6,355.53	8,914.700	3,639.411	-2,999.87	15,710.94	192	23,112
	Marulachiping	4	1,254.22	1,229.647	614.824	-702.43	3,210.86	112	2,649
	Mashushu	4	1,717.10	1,681.162	840.581	-958.00	4,392.20	256	3,619
	Ditabogong	6	2,205.21	1,523.057	621.786	606.86	3,803.56	560	4,635
	Gemini	3	2,091.90	1,722.699	994.601	-2,187.52	6,371.32	521	3,934
	Total	66	2,929.71	3,579.063	440.552	2,049.87	3,809.56	112	23,112
Grand Total Cash Income	Mapagane	34	284.53	834.985	143.199	-6.81	575.87	0	3,520
	Ga-Moila	9	47.78	143.333	47.778	-62.40	157.95	0	430
	Manthlane	6	556.67	929.896	379.628	-419.20	1,532.53	0	2,220
	Marulachiping	4	25.00	50.000	25.000	-54.56	104.56	0	100
	Mashushu	4	140.00	280.000	140.000	-305.54	585.54	0	560
	Ditabogong	6	356.67	620.247	253.215	-294.24	1,007.58	0	1,600
	Gemini	3	640.00	1,108.513	640.000	-2,113.70	3,393.70	0	1,920
	Total	66	275.21	721.384	88.796	97.87	452.55	0	3,520

ANOVA (see descriptives above)

		Sum of Squares	df	Mean Square	F	Sig.
Grazing GFV	Between Groups	64,733,692.773	6	10,788,948.796	2.425	0.037
	Within Groups	262,453,872.355	59	4,448,370.718		
	Total	327,187,565.128	65			
Grazing NFV	Between Groups	64,732,768.953	6	10,788,794.826	2.426	0.037
	Within Groups	262,352,041.397	59	4,446,644.769		
	Total	327,084,810.350	65			
Water Collection GFV	Between Groups	43,989.995	6	7,331.666	9.379	0.000
	Within Groups	46,119.052	59	781.679		
	Total	90,109.047	65			
Grand Total Gross Benefit	Between Groups	121,889,211.122	6	20,314,868.520	1.542	0.181
	Within Groups	777,352,985.283	59	13,175,474.327		
	Total	899,242,196.405	65			
Grand Total Net Benefit	Between Groups	110,910,482.910	6	18,485,080.485	1.511	0.190
	Within Groups	721,719,271.093	59	12,232,530.019		
	Total	832,629,754.003	65			
Grand Total Cash Income	Between Groups	1,706,362.337	6	284,393.723	0.522	0.789
	Within Groups	32,119,298.693	59	544,394.893		
	Total	33,825,661.030	65			

T-test of economic values of wetland services based on household location (2 sub-villages).

Group Statistics

	Main villages	N	Mean	Std. Deviation	Std. Error Mean
Water Collection GFV	Mapagane	51	3.52	5.932	0.831
	Mantlhane	15	37.34	73.241	18.911
Water Collection NFV	Mapagane	51	-2.36	41.008	5.742
	Mantlhane	15	14.00	101.181	26.125
TOTAL GFV	Mapagane	51	2,866.86	2,679.034	375.140
	Mantlhane	15	4,123.96	6,106.578	1,576.712
TOTAL NFV	Mapagane	51	2,661.19	2,601.486	364.281
	Mantlhane	15	3,842.68	5,843.576	1,508.805
TOTAL CIC	Mapagane	51	211.06	692.774	97.008
	Mantlhane	15	493.33	797.556	205.928

		Levene's Test for Equality of Variances		T-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Water Collection GFV	Equal variances assumed	57.862	0.000	-3.322	64	0.001	-33.811	10.179	-54.146	-13.477
	Equal variances not assumed			-1.786	14.054	0.096	-33.811	18.929	-74.395	6.772
TOTAL GFV	Equal variances assumed	4.790	0.032	-1.154	64	0.253	-1,257.095	1,089.735	-3,434.090	919.901
	Equal variances not assumed			-0.776	15.616	0.450	-1,257.095	1,620.725	-4,699.759	2,185.570
TOTAL NFV	Equal variances assumed	4.595	0.036	-1.126	64	0.264	-1,181.485	1,049.098	-3,277.299	914.329
	Equal variances not assumed			-0.761	15.665	0.458	-1,181.485	1,552.157	-4,477.643	2,114.673
TOTAL CIC	Equal variances assumed	3.403	0.070	-1.340	64	0.185	-282.275	210.602	-703.001	138.452
	Equal variances not assumed			-1.240	20.619	0.229	-282.275	227.633	-756.197	191.648

Analysis of variation (ANOVA) of economic value of wetland services based on household income group (4 grouping).

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
TOTAL GFV	0-100	1	2,277.93	.	.	.	.	2,278	2,278
	101-500	15	2,708.47	2,296.599	592.979	1,436.66	3,980.29	336	8,660
	501-1000	37	3,399.42	4,483.221	737.037	1,904.64	4,894.20	192	24,350
	Above 1000	13	3,029.67	2,823.314	783.046	1,323.56	4,735.78	112	7,546
	Total	66	3,152.56	3,719.475	457.836	2,238.20	4,066.93	112	24,350
TOTAL NFV	0-100	1	1,697.43	.	.	.	.	1,697	1,697
	101-500	15	2,415.18	2,193.163	566.272	1,200.65	3,629.72	336	8,492
	501-1000	37	3,199.72	4,319.775	710.167	1,759.43	4,640.00	192	23,112
	Above 1000	13	2,849.72	2,665.267	739.212	1,239.11	4,460.32	112	7,167
	Total	66	2,929.71	3,579.063	440.552	2,049.87	3,809.56	112	23,112
TOTAL CIC	0-100	1	0.00	.	.	.	.	0	0
	101-500	15	49.47	120.457	31.102	-17.24	116.17	0	430
	501-1000	37	297.92	688.578	113.202	68.34	527.50	0	2,700
	Above 1000	13	492.23	1,121.085	310.933	-185.23	1,169.70	0	3,520
	Total	66	275.21	721.384	88.796	97.87	452.55	0	3,520

ANOVA (see descriptives above)

		Sum of Squares	df	Mean Square	F	Sig.
TOTAL GFV	Between Groups	6,174,232.160	3	2,058,077.387	0.143	0.934
	Within Groups	893,067,964.246	62	14,404,322.004		
	Total	899,242,196.405	65			
TOTAL NFV	Between Groups	8,270,238.983	3	2,756,746.328	0.207	0.891
	Within Groups	824,359,515.020	62	13,296,121.210		
	Total	832,629,754.003	65			
TOTAL CIC	Between Groups	1,471,496.233	3	490,498.744	0.940	0.427
	Within Groups	32,354,164.798	62	521,841.368		
	Total	33,825,661.030	65			

T-test of wetland services for household income groups (more than and less than mean household income from this study).

Group Statistics					
	Income group	N	Mean	Std. Deviation	Std. Error Mean
TOTAL GFV	0-853	48	3,196.55	4,090.762	590.451
	Above 853	18	3,035.28	2,571.197	606.037
TOTAL NFV	0-853	48	2,962.09	3,951.176	570.303
	Above 853	18	2,843.38	2,409.429	567.908
TOTAL CIC	0-853	48	186.19	497.400	71.793
	Above 853	18	512.61	1,106.204	260.735

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
TOTAL GFV	Equal variances assumed	0.183	0.670	0.156	64	0.877	161.264	1,035.813	-1,908.010	2,230.537
	Equal variances not assumed			0.191	48.715	0.850	161.264	846.116	-1,539.322	1,861.850
TOTAL NFV	Equal variances assumed	0.217	0.643	0.119	64	0.906	118.709	996.788	-1,872.604	2,110.023
	Equal variances not assumed			0.147	50.134	0.883	118.709	804.839	-1,497.749	1,735.168
TOTAL CIC	Equal variances assumed	11.754	0.001	-1.659	64	0.102	-326.424	196.745	-719.467	66.620
	Equal variances not assumed			-1.207	19.635	0.242	-326.424	270.438	-891.222	238.375

T-test of economic value of wetland services based on sex of household head.

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
TOTAL GFV	Male	20	3,755.02	3,205.412	716.752
	Female	46	2,890.63	3,926.005	578.858
TOTAL NFV	Male	20	3,490.10	3,187.437	712.733
	Female	46	2,686.07	3,743.389	551.933
TOTAL CIC	Male	20	407.45	880.704	196.931
	Female	46	217.72	642.680	94.758

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
TOTAL GFV	Equal variances assumed	0.001	0.981	0.866	64	0.390	864.397	998.152	-1,129.641	2,858.435
	Equal variances not assumed			0.938	43.970	0.353	864.397	921.309	-992.415	2,721.208
TOTAL NFV	Equal variances assumed	0.001	0.971	0.837	64	0.406	804.026	960.840	-1,115.473	2,723.524
	Equal variances not assumed			0.892	42.211	0.377	804.026	901.453	-1,014.910	2,622.961
TOTAL CIC	Equal variances assumed	1.698	0.197	0.982	64	0.330	189.733	193.271	-196.370	575.835
	Equal variances not assumed			0.868	28.179	0.393	189.733	218.543	-257.805	637.270

Analysis of variation (ANOVA) of economic value of wetland services based on household size .

Descriptives

	Household size	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Material Collection GFV	1-5	22	592.00	527.474	112.458	358.13	825.87	0	1,920
	6-10	39	831.90	681.029	109.052	611.13	1,052.66	112	2,568
	11-15	3	2,128.00	3,278.907	1,893.078	-6,017.26	10,273.26	0	5,904
	Above 15	2	664.00	124.451	88.000	-454.15	1,782.15	576	752
	Total	66	805.76	888.406	109.355	587.36	1,024.15	0	5,904
Material Collection NFV	1-5	22	584.11	526.051	112.155	350.88	817.35	0	1,920
	6-10	39	786.87	619.830	99.252	585.95	987.80	112	2,565
	11-15	3	2,060.17	3,161.743	1,825.433	-5,794.04	9,914.37	0	5,701
	Above 15	2	660.20	119.077	84.200	-409.66	1,730.06	576	744
	Total	66	773.32	843.128	103.782	566.06	980.59	0	5,701
TOTAL GFV	1-5	22	1,995.76	1,650.152	351.814	1,264.12	2,727.40	192	6,155
	6-10	39	3,725.23	4,501.173	720.765	2,266.12	5,184.34	112	24,350
	11-15	3	2,946.47	2,816.826	1,626.295	-4,050.91	9,943.85	295	5,904
	Above 15	2	5,019.56	2,638.156	1,865.458	-18,683.32	28,722.45	3,154	6,885
	Total	66	3,152.56	3,719.475	457.836	2,238.20	4,066.93	112	24,350
TOTAL NFV	1-5	22	1,755.84	1,484.973	316.597	1,097.44	2,414.24	192	5,280
	6-10	39	3,502.57	4,343.092	695.451	2,094.70	4,910.44	112	23,112
	11-15	3	2,876.97	2,710.656	1,564.998	-3,856.67	9,610.61	295	5,701
	Above 15	2	4,750.74	2,257.980	1,596.633	-15,536.40	25,037.88	3,154	6,347
	Total	66	2,929.71	3,579.063	440.552	2,049.87	3,809.56	112	23,112
TOTAL CIC	1-5	22	31.59	104.835	22.351	-14.89	78.07	0	455
	6-10	39	382.69	844.166	135.175	109.05	656.34	0	3,520
	11-15	3	800.00	1,385.641	800.000	-2,642.12	4,242.12	0	2,400
	Above 15	2	72.00	101.823	72.000	-842.85	986.85	0	144
	Total	66	275.21	721.384	88.796	97.87	452.55	0	3,520

Sum of Squares			df	Mean Square	F	Sig.
Material Collection GFV	Between Groups	6,317,044.531	3	2,105,681.510	2.902	0.042
	Within Groups	44,985,167.590	62	725,567.219		
	Total	51,302,212.121	65			
Material Collection NFV	Between Groups	5,788,257.653	3	1,929,419.218	2.960	0.039
	Within Groups	40,417,928.888	62	651,902.079		
	Total	46,206,186.541	65			
Material Collection CIC	Between Groups	1,732,848.503	3	577,616.168	3.089	0.033
	Within Groups	11,592,308.587	62	186,972.719		
	Total	13,325,157.091	65			
TOTAL GFV	Between Groups	49,329,007.896	3	16,443,002.632	1.199	0.317
	Within Groups	849,913,188.509	62	13,708,277.234		
	Total	899,242,196.405	65			
TOTAL NFV	Between Groups	49,754,816.866	3	16,584,938.955	1.313	0.278
	Within Groups	782,874,937.137	62	12,627,015.115		
	Total	832,629,754.003	65			
TOTAL CIC	Between Groups	2,665,053.404	3	888,351.135	1.768	0.163
	Within Groups	31,160,607.626	62	502,590.446		
	Total	33,825,661.030	65			

T-test of economic value of wetland services based household size group (more than and less than mean household size).

Group Statistics					
TOTAL GFV	1-7	46	2,825.87	2,723.278	401.526
	Above 7	20	3,903.97	5,376.897	1,202.311
TOTAL NFV	1-7	46	2,576.50	2,649.925	390.710
	Above 7	20	3,742.10	5,118.062	1,144.434
TOTAL CIC	1-7	46	276.96	734.294	108.266
	Above 7	20	271.20	709.401	158.627

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
TOTAL GFV	Equal variances assumed	2.310	0.133	-1.084	64	0.283	-1,078.099
	Equal variances not assumed			-0.851	23.352	0.404	-1,078.099
TOTAL NFV	Equal variances assumed	2.202	0.143	-1.220	64	0.227	-1,165.598
	Equal variances not assumed			-0.964	23.552	0.345	-1,165.598
TOTAL CIC	Equal variances assumed	0.003	0.957	0.030	64	0.977	5.757
	Equal variances not assumed			0.030	37.398	0.976	5.757

Analysis of variation (ANOVA) of economic value of wetland services based on age of household group.

Descriptive

	Age of household head	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
TOTAL GFV	31-50	28	2,241.11	2,510.110	474.366	1,267.79	3,214.43	112	9,155
	51-70	31	4,190.17	4,652.823	835.672	2,483.50	5,896.84	256	24,350
	71-90	7	2,203.26	1,669.186	630.893	659.52	3,747.00	192	5,192
	Total	66	3,152.56	3,719.475	457.836	2,238.20	4,066.93	112	24,350
TOTAL NFV	31-50	28	2,087.83	2,468.314	466.467	1,130.72	3,044.95	112	9,094
	51-70	31	3,887.99	4,475.026	803.738	2,246.54	5,529.45	256	23,112
	71-90	7	2,053.43	1,509.236	570.437	657.62	3,449.24	192	4,635
	Total	66	2,929.71	3,579.063	440.552	2,049.87	3,809.56	112	23,112
TOTAL CIC	31-50	28	159.64	666.225	125.905	-98.69	417.98	0	3,520
	51-70	31	328.19	742.551	133.366	55.82	600.56	0	2,700
	71-90	7	502.86	863.746	326.465	-295.97	1,301.69	0	1,920
	Total	66	275.21	721.384	88.796	97.87	452.55	0	3,520
Material Collection CIC	31-50	28	19.29	65.655	12.408	-6.17	44.74	0	320
	51-70	31	181.42	495.061	88.916	-0.17	363.01	0	2,400
	71-90	7	502.86	863.746	326.465	-295.97	1,301.69	0	1,920
	Total	66	146.73	452.772	55.732	35.42	258.03	0	2,400

		Sum of Squares	df	Mean Square	F	Sig.
TOTAL GFV	Between Groups	62,944,825.167	2	31,472,412.584	2.371	0.102
	Within Groups	836,297,371.238	63	13,274,561.448		
	Total	899,242,196.405	65			
TOTAL NFV	Between Groups	53,687,699.922	2	26,843,849.961	2.171	0.123
	Within Groups	778,942,054.081	63	12,364,159.589		
	Total	832,629,754.003	65			
TOTAL CIC	Between Groups	823,748.906	2	411,874.453	0.786	0.460
	Within Groups	33,001,912.124	63	523,839.875		
	Total	33,825,661.030	65			
Material Collection CIC	Between Groups	1,379,866.971	2	689,933.486	3.639	0.032
	Within Groups	11,945,290.120	63	189,607.780		
	Total	13,325,157.091	65			

T-test of economic value of wetland services based on age of household (more than and less than mean age).

Group Statistics					
	Age group	N	Mean	Std. Deviation	Std. Error Mean
TOTAL GFV	0-54.5	35	2,360.74	2,416.845	408.521
	Above 54.5	31	4,046.56	4,668.773	838.536
TOTAL NFV	0-54.5	35	2,191.59	2,345.993	396.545
	Above 54.5	31	3,763.08	4,490.382	806.496
TOTAL CIC	0-54.5	35	208.29	737.318	124.630
	Above 54.5	31	350.77	707.300	127.035

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
TOTAL GFV	Equal variances assumed	2.182	0.145	-1.873	64	0.066	-1,685.812	900.160	-3,484.089	112.465
	Equal variances not assumed			-1.807	43.756	0.078	-1,685.812	932.756	-3,565.954	194.329
TOTAL NFV	Equal variances assumed	1.969	0.165	-1.811	64	0.075	-1,571.494	867.637	-3,304.799	161.811
	Equal variances not assumed			-1.749	43.990	0.087	-1,571.494	898.713	-3,382.742	239.754
TOTAL CIC	Equal variances assumed	1.169	0.284	-0.799	64	0.427	-142.488	178.417	-498.918	213.941
	Equal variances not assumed			-0.801	63.575	0.426	-142.488	177.962	-498.054	213.077

Analysis of variation (ANOVA) of economic value of wetland services based number of education years of household head.

	Education years	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
TOTAL GFV	0	20	3,989.19	5,190.249	1,160.575	1,560.08	6,418.31	192	24,350
	1-5	19	3,113.62	3,205.286	735.343	1,568.72	4,658.52	256	14,019
	6-10	19	2,353.17	2,502.495	574.112	1,147.01	3,559.34	194	9,155
	11-15	7	3,110.42	3,248.385	1,227.774	106.16	6,114.67	112	8,660
	Above 15	1	2,643.47	.	.	.	.	2,643	2,643
	Total	66	3,152.56	3,719.475	457.836	2,238.20	4,066.93	112	24,350
TOTAL NFV	0	20	3,656.70	4,914.754	1,098.973	1,356.52	5,956.87	192	23,112
	1-5	19	2,883.99	3,208.196	736.011	1,337.69	4,430.29	256	13,996
	6-10	19	2,210.31	2,443.537	560.586	1,032.56	3,388.06	194	9,094
	11-15	7	2,970.28	3,173.081	1,199.312	35.67	5,904.89	112	8,492
	Above 15	1	2,643.47	.	.	.	.	2,643	2,643
	Total	66	2,929.71	3,579.063	440.552	2,049.87	3,809.56	112	23,112
TOTAL CIC	0	20	473.30	867.649	194.012	67.23	879.37	0	2,700
	1-5	19	244.11	595.890	136.706	-43.10	531.31	0	2,400
	6-10	19	213.68	804.489	184.562	-174.07	601.44	0	3,520
	11-15	7	0.00	0.000	0.000	0.00	0.00	0	0
	Above 15	1	0.00	.	.	.	.	0	0
	Total	66	275.21	721.384	88.796	97.87	452.55	0	3,520

		Sum of Squares	df	Mean Square	F	Sig.
TOTAL GFV	Between Groups	26,440,979.633	4	6,610,244.908	0.462	0.763
	Within Groups	872,801,216.772	61	14,308,216.668		
	Total	899,242,196.405	65			
TOTAL NFV	Between Groups	20,536,561.450	4	5,134,140.362	0.386	0.818
	Within Groups	812,093,192.553	61	13,313,003.157		
	Total	832,629,754.003	65			
TOTAL CIC	Between Groups	1,481,022.936	4	370,255.734	0.698	0.596
	Within Groups	32,344,638.095	61	530,239.969		
	Total	33,825,661.030	65			

T-test of economic value of wetland services based on educational years of household head (more than and less than average educational years).

Group Statistics

	Education years	N	Mean	Std. Deviation	Std. Error Mean
Material Collection GFV	0-5	39	930.67	1,039.690	166.484
	Above 5	27	625.33	579.739	111.571
Material Collection NFV	0-5	39	881.75	982.825	157.378
	Above 5	27	616.71	567.707	109.255
Material Collection CIC	0-5	39	233.95	573.088	91.767
	Above 5	27	20.74	67.819	13.052
TOTAL GFV	0-5	39	3,562.63	4,304.937	689.342
	Above 5	27	2,560.25	2,623.688	504.929
TOTAL NFV	0-5	39	3,280.25	4,135.929	662.279
	Above 5	27	2,423.38	2,563.734	493.391
TOTAL CIC	0-5	39	361.64	747.044	119.623
	Above 5	27	150.37	676.720	130.235

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Material Collection CIC	Equal variances assumed	15.378	0.000	1.919	64	0.059	213.208	111.084	-8.708	435.124
	Equal variances not assumed			2.300	39.529	0.027	213.208	92.691	25.803	400.613
TOTAL GFV	Equal variances assumed	0.609	0.438	1.078	64	0.285	1,002.386	930.037	-855.576	2,860.349
	Equal variances not assumed			1.173	63.147	0.245	1,002.386	854.485	-705.088	2,709.861
TOTAL NFV	Equal variances assumed	0.554	0.460	0.956	64	0.343	856.868	896.638	-934.372	2,648.108
	Equal variances not assumed			1.038	63.361	0.303	856.868	825.862	-793.301	2,507.037
TOTAL CIC	Equal variances assumed	3.294	0.074	1.173	64	0.245	211.271	180.082	-148.485	571.026
	Equal variances not assumed			1.195	59.433	0.237	211.271	176.835	-142.522	565.063

T-test of economic value of wetland services based on occupation of household head (farmer and others).

Group Statistics					
	Occupation	N	Mean	Std. Deviation	Std. Error Mean
Cropping GFV	Farmers	43	1,838.84	2,181.215	332.632
	Others	23	14.78	70.895	14.783
Cropping NFV	Farmers	43	1,571.06	1,982.646	302.351
	Others	23	0.63	3.023	0.630
Cropping CIC	Farmers	43	197.21	653.923	99.722
	Others	23	0.00	0.000	0.000
TOTAL GFV	Farmers	43	3,602.28	3,984.558	607.639
	Others	23	2,311.80	3,070.875	640.322
TOTAL NFV	Farmers	43	3,275.67	3,816.395	581.995
	Others	23	2,282.93	3,061.023	638.267
TOTAL CIC	Farmers	43	345.86	809.880	123.506
	Others	23	143.13	507.299	105.779

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Cropping GFV	Equal variances assumed	20.213	0.000	3.995	64	0.000	1,824.055	456.591	911.910	2,736.199
	Equal variances not assumed			5.478	42.166	0.000	1,824.055	332.960	1,152.191	2,495.918
Cropping NFV	Equal variances assumed	21.825	0.000	3.785	64	0.000	1,570.432	414.910	741.554	2,399.310
	Equal variances not assumed			5.194	42.000	0.000	1,570.432	302.351	960.262	2,180.601
Cropping CIC	Equal variances assumed	8.177	0.006	1.441	64	0.154	197.209	136.847	-76.174	470.592
	Equal variances not assumed			1.978	42.000	0.055	197.209	99.722	-4.038	398.457
TOTAL GFV	Equal variances assumed	0.232	0.632	1.352	64	0.181	1,290.478	954.797	-616.948	3,197.903
	Equal variances not assumed			1.462	55.773	0.149	1,290.478	882.744	-478.031	3,058.986
TOTAL NFV	Equal variances assumed	0.134	0.715	1.075	64	0.286	992.743	923.472	-852.105	2,837.590
	Equal variances not assumed			1.149	54.175	0.255	992.743	863.773	-738.889	2,724.375
TOTAL CIC	Equal variances assumed	3.778	0.056	1.089	64	0.280	202.730	186.087	-169.022	574.482
	Equal variances not assumed			1.247	62.260	0.217	202.730	162.613	-122.301	527.761

T-test of economic value of wetland services based on access to wetland plot for cropping.

Group Statistics

	Access	N	Mean	Std. Deviation	Std. Error Mean
Cropping GFV	WCH	33	2,406.36	2,195.495	382.187
	NCH	33	0.00	0.000	0.000
Cropping NFV	WCH	33	2,047.58	2,037.739	354.725
	NCH	33	0.00	0.000	0.000
Cropping CIC	WCH	33	256.97	738.517	128.559
	NCH	33	0.00	0.000	0.000
Water Collection GFV	WCH	33	20.87	50.539	8.798
	NCH	33	1.55	8.321	1.449
TOTAL GFV	WCH	33	4,360.40	4,236.453	737.472
	NCH	33	1,944.73	2,672.988	465.307
TOTAL NFV	WCH	33	3,941.44	4,104.292	714.465
	NCH	33	1,917.98	2,657.687	462.644
TOTAL CIC	WCH	33	392.48	864.613	150.510
	NCH	33	157.94	530.217	92.299

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Cropping GFV	Equal variances assumed	24.734	0.000	6.296	64	0.000	2,406.364	382.187	1,642.858	3,169.869
	Equal variances not assumed			6.296	32.000	0.000	2,406.364	382.187	1,627.875	3,184.852
Cropping NFV	Equal variances assumed	28.010	0.000	5.772	64	0.000	2,047.581	354.725	1,338.937	2,756.226
	Equal variances not assumed			5.772	32.000	0.000	2,047.581	354.725	1,325.030	2,770.132
Cropping CIC	Equal variances assumed	15.673	0.000	1.999	64	0.050	256.970	128.559	0.143	513.797
	Equal variances not assumed			1.999	32.000	0.054	256.970	128.559	-4.897	518.837
Water Collection GFV	Equal variances assumed	10.565	0.002	2.167	64	0.034	19.322	8.916	1.510	37.134
	Equal variances not assumed			2.167	33.734	0.037	19.322	8.916	1.197	37.447
TOTAL GFV	Equal variances assumed	1.621	0.208	2.770	64	0.007	2,415.673	871.995	673.662	4,157.684
	Equal variances not assumed			2.770	53.993	0.008	2,415.673	871.995	667.423	4,163.924
TOTAL NFV	Equal variances assumed	1.434	0.235	2.377	64	0.020	2,023.459	851.176	323.040	3,723.879
	Equal variances not assumed			2.377	54.823	0.021	2,023.459	851.176	317.541	3,729.378
TOTAL CIC	Equal variances assumed	4.532	0.037	1.328	64	0.189	234.545	176.557	-118.167	587.258
	Equal variances not assumed			1.328	53.086	0.190	234.545	176.557	-119.569	588.660

T-test of economic value of wetland services based on access to wetland plot for cropping taking household labor time into consideration.

	Access to plot	N	Mean	Std. Deviation	Std. Error Mean
Cropping +Time	WCH	33	-3,584.7421	4,272.05890	743.67000
	NCH	33	0.0000	0.00000	0.00000
Total	WCH	33	-3,117.8193649	3,457.54695588	601.88166944
	NCH	33	703.2947701	1,901.36183453	330.98461128

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
CRNFV	Equal variances assumed	33.169	0.000	-4.820	64	0.000	-3,584.74210	743.67000	-5,070.39371	-2,099.09049
	Equal variances not assumed			-4.820	32.000	0.000	-3,584.74210	743.67000	-5,099.54832	-2,069.93588
Total	Equal variances assumed	11.495	0.001	-5.563	64	0.000	-3,821.11413504	686.88598538	-5,193.32663716	-2,448.90163292
	Equal variances not assumed			-5.563	49.732	0.000	-3,821.11413504	686.88598538	-5,200.94914904	-2,441.27912104

Appendix 11: Questionnaires and outline of focus group discussion

Economic Valuation Questionnaire

I am a MSc students in Environmental Sciences, Wageningen University and Research Centre (The Netherlands) carrying out a study about benefits from Ga-Mampa wetland goods and services in conjunction with The International Water Management Institute. The outcome of this research will aid the development of the wetland management plan in your community.

I would appreciate it very much if you could help me in answering the following questions as best as you can. Your response will assist me to fill out this questionnaire. This interview will take approximately one hour thirty minutes; most of the questions will cast your mind back to the last two cropping seasons and require response for your entire household (including yourself). If you feel uncomfortable or do not understand any question, please inform me and feel free to ask questions. All information shall be treated in confidence and will be only used for academic purpose. A feedback workshop (tentatively set for the beginning of November) will be organised with the community at the end of this activity.

Thank you

ADEKOLA, Olalekan

Section 1

Interview No: _____

Name of Respondent: _____

Sex: **Male [ ]** **Female [ ]**

Age/ Year of Birth: _____

Marital Status: **Married [ ] Single [ ] Divorced [ ] Widowed [ ] Living together**

Educational Level: _____

Main Occupation: _____

Number in Household: _____

Monthly Household Income _____

Position in Household: _____
(In relation to head of household)

Name of Village: _____

Date/ Time Begin: _____

Section 2

1. How long have you been staying in this village? From Birth [ ] Years [ ]
2. Do you derive any benefits from the wetland? Yes [ ] No [ ]
3. Do you own a plot in the wetland? Yes [ ] No [ ]
4. Which of the following activities have you ever used the wetland for in the past?
   - [ ] Cropping
   - [ ] Grazing
   - [ ] Edible plant collection
   - [ ] Building material collection
   - [ ] Arts and craft materials collection
   - [ ] Fuel wood collection
   - [ ] Fishing
   - [ ] Hunting
   - [ ] Drinking water
   - [ ] Water for washing
   - [ ] Water for bathing
   - [ ] Others (Specify)_____
5. Which of these have you used the wetland for in the last one year?
   - [ ] Cropping
   - [ ] Grazing
   - [ ] Edible plant collection
   - [ ] Building material collection
   - [ ] Arts and craft materials collection
   - [ ] Fuel wood collection
   - [ ] Fishing
   - [ ] Hunting
   - [ ] Drinking water
   - [ ] Water for washing
   - [ ] Water for bathing
   - [ ] Others (Specify)_____
6. Did you give out your plot (all or part) to another person to use either for cropping or grazing in the last year? Yes [ ] No [ ]
7. If yes for what purpose? _____
8. How much/ what did you collect in exchange? _____

If yes to any in 5 above, then please go to the relevant section in Appendix.

9. Which other benefit(s) (apart from those listed above) do you derive from the wetland?

REGULATION	SUPPORTING	CULTURAL

10. Which benefits apart from those listed above are you aware of?

REGULATION	SUPPORTING	CULTURAL

11. Apart from livelihood resource generated from wetland use, what other sources of income do you have? (List)

LIVELIHOOD RESOURCE SOURCE	IMPORTANCE	LIVELIHOOD RESOURCE SOURCE	IMPORTANCE

12. From list above indicate importance in terms of contribution to household resources with asterisk (pebbles or beans)

13. Are you satisfied with the current benefits you derive from the wetland? Yes [ ] No[ ]
14. Please explain your answer_____
_____
_____
15. Have you received information on how to use the wetland so you can derive **better** benefits?
Yes[ ] No [ ]
16. If yes, who provided the information? _____
17. Through which medium? _____
18. Have you received any training on how to best use the wetland to benefit you? Yes [ ] No [ ]
19. If yes, explain _____
20. Overall, how important is the wetland to you?
[ ] Extremely Important (5)
[ ] Very Important (4)
[ ] Important (3)
[ ] Fairly Important (2)
[ ] Not Important (1)
21. Please, can you kindly provide name(s) of other person(s) known to you using the wetland for the following purpose(s).
[ ] Cropping _____
[ ] Grazing _____
[ ] Wild plant collection _____
[ ] Building material collection _____
[ ] Arts and craft materials collection _____
[ ] Fuel wood collection _____
[ ] Fishing _____
[ ] Hunting _____
[ ] Drinking water _____
[ ] Water for washing _____
[ ] Water for bathing
[ ] Others (Specify)_____

20. Time End _____

Section 3

A. Cropping

1. How long have you been involved in cropping activity in the wetland? _____ Years
2. How many households do you know to be involved in cropping activity in the wetland in?

Mashushu ____, Mapagane ____, Mantlane ____, Moila ____, General ____

3. What is the size of the land you use for cropping?
   Wetland _____ *Bambas*
   Others (Specify) _____ *Bambas*
4. Has your wetland farmland size changed in the last two cropping seasons? Yes [ ] No [ ]
5. Did the size of your farmland in the wetland change in the last five Years? Yes [ ] No [ ]
6. Locate on a map where your farmland(s) is/are presently located in the wetland?
7. How do you get there (wetland cropping land from home)?

[ ] Walking, [ ] Cycle, [ ] Personal Transport, [ ] Public Transport

8. How long does it take to the farm from your home? _____(Hours)
9. Is cropping your main occupation? Yes [ ] No [ ]
10. Why do you crop in the wetland? _____
11. Are there other locations available for you to crop besides the wetland area? Yes [ ] No [
12. If yes, what is what/where is this alternative? (describe) _____
13. How accessible is this alternative to you? Free [ ] I pay [ ] _____ (ZAR)
14. Do you have possibility to do what you do in the wetland elsewhere? Yes [ ] No [ ]
15. If yes, what is what/where is this alternative? (describe) _____
16. How accessible/available is this alternative? Free [ ] I pay [ ] _(ZAR)
17. In the absence of the wetland, how will you meet the cropping contribution of the wetland to your household?_____
18. In the past years have you ever experienced crop shortage in the wetland? Yes [ ] No [ ]
19. If yes, when was this and how did you adjust, what did you do?_____
20. Which crops did you cultivate in the last 3 years per farming seasons?

YEAR 1 (2003/2004)		**YEAR 2 (**2004/2005)		**YEAR 3** (2005/2006)	
WET SEASON	**DRY SEASON**	**WET SEASON**	**DRY SEASON**	**WET SEASON**	**DRY SEASON**

21. What was your yield for these crops?

CROP	**YEAR 1 (**2003/2004)		**YEAR 2 (**2004/2005)		**YEAR 3** (2005/2006)	
	WET SEASON	**DRY SEASON**	**WET SEASON**	**DRY SEASON**	**WET SEASON**	**DRY SEASON**

22. How much are you willing to be paid to in *lieu* of your cropping right in the wetland
23. Once payment _____ (ZAR)
24. Over a period of time (indicate below)

YEAR					
AMOUNT					

Repeat this sheet for each plot/crop for each cropping season in the last year.

Crop type: **Size of plot used** **Cropping season:**

1. How did you prepare the land for the season?
Tractor ☐ donkey ☐ hoe ☐ did not cultivate ☐

2. Which seed did you use?
Farm seed ☐ bought normal seeds ☐ bought improved variety ☐

3. Did you do weeding? Yes ☐ No ☐

4. How did you do the weeding? Manual ☐ Chemical ☐

5. Did you use fertilizers? Yes ☐ No ☐

6. If yes which type? Mineral ☐ Organic ☐ Both ☐

7. Did you experience any problems of pests? Yes ☐ No ☐

8. If Yes, please state the type of pests and how you did control them

Type of pest	**Crop affected**	**Method of control used**	**Estimated cost of control**	**Severity of problem** *1.very severe, 2.moderate, 3.not severe*

9. Did you experience any problems of crop diseases? Yes ☐ No ☐

10. If yes state the type of diseases and how you did control them

Type of disease	**Crop affected**	**Method of control used**	**Estimated cost of control**	**Severity of problem** *1.very severe, 2.moderate, 3.not severe*

11. Input used [use one row for each type of input]

Input category [use key 2]	Input name	Quantity used for the total area	Unit	Price / unit	Source [use key 3]

Key 2: 1.seeds or seedlings; 2. mineral fertilizers; 3. organic fertilizers; 4. pesticides; 5. containers; 6. packaging; 7.transport; 8. Others
Key 3: 1. farm production; 2. purchase; 3. gift from family or neighbor; 4. gift from government, NGOs

12. Implement used [use one row for each type of input]

Implement category [use key 4]	Input name	Quantity used for the total area	Source [use key 5]	Price / unit	Length of Use	Estimated Life length of Implement

Key 4: 1.Tractors; 2. Hoes; 3. Cutlass; 4. Wheel Barrow: 5. Spade: 6. others ;

Key 5: 1. Farm production; 2. Purchase; 3. Gift from family or neighbor; 4. Gift from government,

5. NGOs, 6. Hire (from who? _____) 7 Borrow

13. Labor use

Task	Period operation was done	How many family members	Who in the family? [use key 1]	How many days per family member?	How many hired laborers?	How many days per hired laborer?	Cost of labor
Land preparation							
Planting, sowing							
Weeding [*]							
Fertility management [*]							
Pest control [*]							
Disease Control							
Harvest [*]							
Transport of Harvest							
Post harvest processing, shelling, threshing							
Other (specify)							

Key 1 1.Head of household; 2.Spouse; 3.Child; 4. Grandchild; 5.Parents; 6.Siblings; 7.Farm laborer; 8.Other members (includes household helpers)

[*] if several operations of the same type indicate the total number of days

14. Can you indicate average time you personally spend on your farm in the following months?

OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEPT

TIME PER PERSON

AVERAGE NUMBER OF PERSONS

15. Did you loose any part of your yield to flood, thieves etc before harvesting? Yes [ ] No[]

16. If yes, what quantity?

CROP (TYPE)	REASON FOR LOST	QUANTITY LOST

17. What was the total yield for this crop? (specify the unit)

CROP (TYPE)	SIZE OF PLOT USED	QUANTITY OF YIELD

18. Did you loose any part of your yield after harvesting? Yes [ ] No [ ]
19. If yes, what quantity?

CROP (TYPE)	REASON FOR LOST	QUANTITY LOST

20. What quantity of this yield did you use for household consumption?

CROP TYPE	QUANTITY

21. What quantity did you give out?

CROP TYPE	QUANTITY

22. What quantity did you retain for next planting season?

CROP TYPE	QUANTITY

23. What quantity did you exchange?

CROP TYPE	QUANTITY EXCHANGED	EXCHANGED FOR

24. With whom did you exchange? _____
25. Did you pay any other cost for this exchange? Yes [ ] No [ ]
26. If yes how much and for what? _____
27. What quantity did you sell?

CROP TYPE	QUANTITY	PRICE PER UNIT

28. To whom did you sell? _____
29. Where did you sell it (i.e. local market, outside market)?
30. Did you transport to the market? Yes [ ] No [ ]
31. If yes, how much did the transport cost? _____
32. In the last one year what is the highest and lowest price you sold this crop

CROP TYPE	HIGHEST PRICE	WHEN (PERIOD)	LOWEST PRICE	WHEN (PERIOD)

33. Can you provide price you sold this crop in the last five years?.

PERIOD	PRICE	PERIOD	PRICE

34. What other products did you make from your crops? (list)[79]

PRODUCT	PRODUCT	PRODUCT

35. What else do you do with part of your yield? _____

General Questions

1. How will you describe benefits from cropping in the wetland in the past five years?
[ ] Increasing, [ ] Decreasing, [ ] Not changing, [ ] No Idea
2. What (indicator) did you use to suggest this change? (explain) _____
3. Are you aware of impacts your cropping activity is having on the wetland? Yes [ ] No [ ]
4. If yes, please explain_____
5. In the last 2 years (and maybe years prior) have you done anything to ameliorate this impact(s)? Yes [ ] No [ ]
6. If yes what action have you taken (personally) to reduce impact so you could continue to have these benefits? _____
7. What did you do? _____
8. How much did the action cost you? _____
9. In the last 2 years has the community taken any action to ameliorate this impact? Yes [] No []
10. If yes what has been done to reduce impact so you could continue to have this benefit? _____
11. How much did this activity cost the community? _____
12. In the last 2 years has any **external organization** taken any action to ameliorate these impacts? Yes[ ] No[ ]
13. Which organization? _____
14. What did they do? _____
15. How much did it cost them? _____

[79] If any ascertain cost and amount made from this.

B. Collection of Edible Plants

1. How long have you been involved in collection of edible plants from the wetland? _____
2. How many households do you know to be involved in this activity in the wetland?
3. Mashushu ____, Mapagane ____, Mantlane ____, Moila ____, General ____, I don't know __
4. Which type of plants do you collect from the wetland? (List)

PLANT TYPE	PLANT TYPE	PLANT TYPE

5. How often do you collect this type of plant in a month/year? _____
6. How many people involved in the collection per month for your household? _____
7. How long do each spend? _____
8. What is the total quantity you collect a month/year?_____
9. How long does it take to collect this quantity? _____persons/month
10. In the last one year what quantity of each of these plants did you collect? (Optional)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
FREQ. OF COLLECTION												
QUANTITY COLLECTED												

11. Describe availability of each type of plant in the wetland relation to farming seasons (for each plant)?

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
AVAILABILITY												
HARVESTING PERIOD												

12. Which part of the wetland do you get these plants? Show it on the map for each type.
13. How long is it from your homestead to the place of collection? _____ (time)
14. How do you transport from the homestead to and from the place of collection
[ ] Walking, [ ] Cycle, [ ] Private car, [ ] Public transport
15. Why do you choose the wetland as a place to collect wild plants? _____
16. Is/are these plants available in other places outside the wetland? Yes [ ] No [ ]
17. If yes, where are they located? (describe or show on map._____
18. Do you also get these plants from this source(s)? Yes [ ] No [ ]
19. How accessible (right) is this source to you? _____
20. Is collection of wild plant your main occupation? _____
21. Which of these sources do you use the most? _____
22. How many people collect wild plant for your household? _____
23. Who are they? _____
24. Do you hire external labor to collect wild plant? Yes [ ] No [ ]
25. If yes, how many per collection _____
26. Do you pay for the right to collect wild plant? Yes [ ] No [ ]
27. If yes how much do you pay to collect these materials?
28. Do you use specific tools for collection of plants? Yes [ ] No [ ]
29. If yes, fill table below

TYPE OF TOOL	NUMBER	SOURCE (RENT, GIFT, INHERITANCE ETC.)	WHEN DID YOU ACQUIRE IT	AVERAGELY HOW LONG DOES IT WORK	HOW MUCH DO YOU PAY FOR IT

30. What quantity (of each type of plant) do you use personally? (Per time month)

TYPE (PLANT)	QUANTITY	PRICE

31. What quantity did you give out? (Per time month)

TYPE (PLANT)	QUANTITY	PRICE

32. What quantity did you give out in exchange? (Per time month)

TYPE (PLANT)	QUANTITY	EXCHANGE FOR

33. What quantity did you sell? (Per month)

TYPE (PLANT)	QUANTITY	PRICE

34. Where did you sell them? _____
35. To whom did you sell them? _____
36. Did you incur transport cost to sell? Yes [ ] No [ ]
37. If yes, how much? _____
38. In the last one year what is the highest and lowest price you sold wild plants

TYPE	HIGHEST PRICE	WHEN (PERIOD)	LOWEST PRICE	WHEN (PERIOD)

39. Can you provide price you sold this wild plants in the last five years?.

PERIOD	PRICE	PERIOD	PRICE

40. Do you make other product from wild plants? Yes [ ] No [ ]
41. If yes, what other products do you make from wild plants? (List)

PRODUCT	PRODUCT

42. In the last one year what is the highest and lowest price you sold these products?

TYPE	HIGHEST PRICE	WHEN	LOWEST PRICE	WHEN

43. What else do you use collected wild plants for?_____
44. How will you describe possibility to collect wild plant in the wetlands in the past five years? [ ] Increasing, [ ] Decreasing, [ ] Not changing, [ ] No Idea
45. Are you aware of impacts your plant collection activity is having on the wetland? Yes [ ] No [ ]
46. If yes list/explain _____
47. In the last 2 years (and maybe years prior) have you done anything to ameliorate this impact(s)? Yes [ ] No [ ]
48. If yes what action have you taken (personally) to reduce impact so you could continue to have these benefits? _____
49. What did u do?_____
50. How much did the action cost you? _____
51. In the last 2 years has the community taken any action to ameliorate this impact? Yes [ ] No []
52. If yes what has been done to reduce impact so you could continue to have this benefit? _____
53. In the last 2 years has any **external organization** taken any action to ameliorate these impacts? Yes[ ] No[ ] I don't know [ ]
54. Which organization? _____
55. What did they do? _____

C. Collection of Building Material

1. How long have you been involved in collection of building materials from the wetland? _____
2. How many households do you know to be involved in this activity in the wetland?
Mashushu ____, Mapagane ____, Mantlane ____, Moila ____, General ____, I don't know ____
3. Which type of building materials do you collect from the wetland? (List)

PLANT TYPE	PLANT TYPE	PLANT TYPE

4. Have you collected these materials in the last one year? Yes [ ] No [ ]
5. How often do you collect each of these materials in a month/year? _____
6. How many people involved in the collection per month for your household? _____
7. How long do each spend? _____
8. What quantity do you collect a month/year? _____
9. How long does it take to collect this quantity? _____persons/month
10. In the last one year what quantity of each of these materials did you collect? (Optional)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
FREQ. OF COLLECTION												
QUANTITY COLLECTED												

11. Can you describe availability of each material in relation to farming seasons (for each plant)?

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
AVAILABILITY												
HARVESTING PERIOD												

12. Which part of the wetland do you get these building materials? Show it on the map for each.
13. How long is it from your homestead to the place of collection? _____ (time)
14. How do you transport from the homestead to and from the place of collection
[ ] Walking, [ ] Cycle, [ ] Private car, [ ] Public transport
15. Why do you choose the wetland as a place to collect building materials? _____
16. Is/are these materials available in other places outside the wetland? Yes [ ] No [ ]
17. If yes, where are they located? (describe or show on map._____
18. Do you also get these materials from this source(s)? Yes [ ] No [ ]
19. How accessible is this source to you? _____
20. Which of these sources do you use the most? _____
20. Is collection of building material your main occupation? _____
21. How many people collect building material for you? _____
22. Who are they? _____
23. Do you hire external labor to collect building material? Yes [ ] No [ ]
24. If yes, how many per collection _____
25. Do you pay to collect building materials? Yes [ ] No [ ]
26. If yes how much do you pay to collect these materials?
27. Do you use specific tools for collection of building materials? Yes [ ] No [ ]
28. If yes, fill table below

TYPE OF TOOL	NUMBER	SOURCE (RENT, GIFT, INHERITANCE ETC.)	WHEN DID YOU ACQUIRE IT	AVERAGELY HOW LONG DOES IT WORK	HOW MUCH DO YOU PAY FOR IT

29. What quantity (of each type of material) do you use personally? (Per time month)

TYPE (PLANT)	QUANTITY	PRICE

30. What quantity did you give out? (Per time month)

TYPE (PLANT)	QUANTITY	PRICE

31. What quantity did you give out in exchange? (Per time month)

TYPE (PLANT)	QUANTITY	EXCHANGE FOR

32. What quantity did you sell? (Per month)

TYPE (PLANT)	QUANTITY	PRICE

33. Where did you sell them? _____

34. To whom did you sell them? _____

35. Did you incur transport cost? Yes [ ] No [ ]

36. If yes, how much? _____

37. In the last one year what is the highest and lowest price you sold building materials

TYPE	HIGHEST PRICE	WHEN (PERIOD)	LOWEST PRICE	WHEN (PERIOD)

38. Can you provide price you sold this building materials in the last five years?.

PERIOD	PRICE	PERIOD	PRICE

39. Do you make other product from collected materials? Yes [ ] No [ ]

40. If yes, what other products? (List)

PRODUCT	PRODUCT

41. In the last one year what is the highest and lowest price you sold these products?[l]

TYPE	HIGHEST PRICE	WHEN	LOWEST PRICE	WHEN

42. What else do you use collected materials for?

43. How will you describe possibility to collect building materials in the wetlands in the past five years? [ ] Increasing, [ ] Decreasing, [ ] Not changing, [ ] No Idea

44. Are you aware of impacts your collection activity is having on the wetland? Yes [ ] No [ ]

45. If yes list/explain _____

46. In the last 2 years (and maybe years prior) have you done anything to ameliorate this impact(s)? Yes [ ]No

47. If yes what action have you taken (personally) to reduce impact so you could continue to have these benefits? _____

48. What did you do?_____

49. How much did the action cost you? _____

50. In the last 2 years has the community taken any action to ameliorate this impact? Yes [ ] No []

51. If yes what has been done to reduce impact so you could continue to have this benefit?

_____

52. In the last 2 years has any **external organization** taken any action to ameliorate these impacts? Yes[ ] No[ ] I don't know [ ]

53. Which organization? _____

54. What did they do?_____

D. Arts and Craft Material Collection

1. How long have you been involved in collection of craft materials from the wetland? _____
2. How many households do you know to be involved in this activity in the wetland?

Mashushu ____, Mapagane ____, Mantlane ____, Moila ____, General ____, I don't know __

3. Which type of art and craft materials do you collect from the wetland? (List)

PLANT TYPE	PLANT TYPE	PLANT TYPE

4. How often do you collect each of these materials in a month/year? _____
5. How many people involved in the collection per month for you? _____
6. How long do each spend? _____
7. What quantity do you collect a month/year? _____
8. How long does it take to collect this quantity? _____persons/month
9. In the last one year what quantity of each of these materials did you collect? (Optional)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
FREQ. OF COLLECTION												
QUANTITY COLLECTED												

10. Can you describe availability of each material in relation to farming seasons (for each)?

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
AVAILABILITY												
HARVESTING PERIOD												

11. Which part of the wetland do you get these art and craft materials? Show it on the map for each type.
12. How long is it from your homestead to the place of collection? _____ (time)
13. How do you transport from the homestead to and from the place of collection

[ ] Walking, [ ] Cycle, [ ] Private car, [ ] Public transport

14. Why do you choose the wetland as a place to collect art and craft materials? _____
15. Is/are these materials available in other places outside the wetland? Yes [ ] No [ ]
16. If yes, where are they located? (describe or show on map._____
17. Do you also get these materials from this source(s)? Yes [ ] No [ ]
18. How accessible is this source to you?_____
19. Which of these sources do you use the most (rank)_____
20. Is collection of art and craft material your main occupation? _____
21. How many people collect art and craft material for you? _____
22. Who are they? _____
23. Do you hire external labor to collect material? Yes [ ] No [ ]
24. If yes, how many per collection _____
25. Do you pay to collect art and craft materials? Yes [ ] No [ ]
26. If yes how much do you pay to collect these materials?
27. Do you use specific tools for collection of art and craft materials? Yes [ ] No [ ]
28. If yes, fill table below

TYPE OF TOOL	NUMBER	SOURCE (RENT, GIFT, INHERITANCE ETC.)	WHEN DID YOU ACQUIRE IT	AVERAGELY HOW LONG DOES IT WORK	HOW MUCH DO YOU PAY FOR IT

29. What quantity (of each type of material) do you use personally? (Per time month)

TYPE (PLANT)	QUANTITY	PRICE

30. What quantity did you give out? (Per time month)

TYPE (PLANT)	QUANTITY	PRICE

31. What quantity did you give out in exchange? (Per time month)

TYPE (PLANT)	QUANTITY	EXCHANGE FOR

32. What quantity did you sell? (Per month)

TYPE (PLANT)	QUANTITY	PRICE

33. Where did you sell them? _____
34. To whom did you sell them? _____
35. Did you incur transport cost to sell? Yes [ ] No [ ]
36. If yes, how much? _____
37. In the last one year what is the highest and lowest price you sold art and craft materials

TYPE	HIGHEST PRICE	WHEN (PERIOD)	LOWEST PRICE	WHEN (PERIOD)

38. Can you provide price you sold these materials in the last five years?

PERIOD	PRICE	PERIOD	PRICE

39. Do you make other product from collected materials? Yes [ ] No [ ]
40. If yes, what other products? (List)

PRODUCT	PRODUCT

41. In the last one year what is the highest and lowest price you sold these products?[ii]

TYPE	HIGHEST PRICE	WHEN	LOWEST PRICE	WHEN

42. What else do you use collected materials for?
43. How will you describe possibility to collect art materials in the wetlands in the past five years?

[ ] Increasing, [ ] Decreasing, [ ] Not changing, [ ] No Idea

44. Are you aware of impacts your collection activity is having on the wetland? Yes [ ] No [ ]
45. If yes list/explain _____
46. In the last 2 years (and maybe years prior) have you done anything to ameliorate this impact(s)? Yes [ ] No [ ]
47. If yes what action have you taken (personally) to reduce impact so you could continue to have these benefits? _____
48. What did u do? _____
49. How much did the action cost you? _____
50. In the last 2 years has the community taken any action to ameliorate this impact? Yes [ ] No []
51. If yes what has been done to reduce impact so you could continue to have this benefit? _____
52. In the last 2 years has any **external organization** taken any action to ameliorate these impacts? Yes[ ] No[ ] I don't know [ ]
53. Which organization? _____
54. What did they do?_____

E. Fuel Wood Collection

1. How long have you been involved in collection of fuel wood from the wetland? _____

How many households do you know to be involved in this activity in the wetland?

2. Mashushu ____, Mapagane ____, Mantlane ____, Moila ____, General ____, I don't know __
3. Which type of fuel wood materials do you collect from the wetland? (List)

PLANT TYPE	PLANT TYPE	PLANT TYPE

4. How often do you collect each of these materials in a month/year? _____
5. How many people involved in the collection per month for your household? _____
6. How long do each spend? _____
7. What quantity do you collect a month/year? _____
8. How long does it take to collect this quantity? _____ Hours
9. In the last one year what quantity of each of these materials did you collect? (Optional)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
FREQ. OF COLLECTION												
QUANTITY COLLECTED												

10. Can you describe availability of each material in relation to farming seasons (for each plant)?

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
AVAILABILITY												
HARVESTING PERIOD												

11. Which part of the wetland do you get these fuel woods? Show it on the map for each type.
12. How long is it from your homestead to the place of collection? _____
13. How do you transport from the homestead to and from the place of collection

[ ] Walking, [ ] Cycle, [ ] Private car, [ ] Public transport

14. Why do you choose the wetland as a place to collect fuel wood? _____
15. Is/are these materials available in other places outside the wetland? Yes [ ] No [ ]
16. If yes, where are they located? (describe or show on map._____
17. Do you also get these materials from this source(s)? Yes [ ] No [ ]
18. How accessible is this source to you? _____
19. Which of these sources do you use the most (rank)_____
20. Is collection of fuel wood your main occupation? _____
21. How many people collect fuel wood for you? _____
22. Who are they? _____
23. Do you hire external labor to collect fuel wood? Yes [ ] No [ ]
24. If yes, how many per collection _____
25. Do you pay to collect fuel wood? Yes [ ] No [ ]
26. If yes how much do you pay to collect these materials?
27. Do you use specific tools for collection of fuel wood? Yes [ ] No [ ]
28. If yes, fill table below

TYPE OF TOOL	NUMBER	SOURCE (RENT, GIFT, INHERITANCE ETC.)	WHEN DID YOU ACQUIRE IT	AVERAGELY HOW LONG DOES IT WORK	HOW MUCH DO YOU PAY FOR IT

29. What quantity (of each type of material) do you use personally? (Per time month)

TYPE (PLANT)	QUANTITY	PRICE

30. What quantity did you give out? (Per time month)

TYPE (PLANT)	QUANTITY	PRICE

31. What quantity did you give out in exchange? (Per time month)

TYPE (PLANT)	QUANTITY	EXCHANGE FOR

32. What quantity did you sell? (Per month)

TYPE (PLANT)	QUANTITY	PRICE

33. Where did you sell them? _____
34. To whom did you sell them? _____
35. Did you incur transport cost? Yes [ ] No [ ]
36. If yes, how much? _____
37. In the last one year what is the highest and lowest price you sold fuel wood?

TYPE	HIGHEST PRICE	WHEN (PERIOD)	LOWEST PRICE	WHEN (PERIOD)

38. Can you provide price you sold fuel wood in the last five years?.

PERIOD	PRICE	PERIOD	PRICE

39. Do you make other product from collected materials? Yes [ ] No [ ]
40. If yes, what other products? (List)

PRODUCT	PRODUCT

41. In the last one year what is the highest and lowest price you sold these products?[III]

TYPE	HIGHEST PRICE	WHEN	LOWEST PRICE	WHEN

42. What else do you use collected materials for?
43. How will you describe possibility to collect fuel wood in the wetlands in the past five years? [ ] Increasing, [ ] Decreasing, [ ] Not changing, [ ] No Idea
44. Are you aware of impacts your collection activity is having on the wetland? Yes [ ] No [ ]
45. If yes list/explain _____
46. In the last 2 years (and maybe years prior) have you done anything to ameliorate this impact(s)? Yes [ ] No [ ]
47. If yes what action have you taken (personally) to reduce impact so you could continue to have these benefits? _____
48. What did you do? _____
49. How much did the action cost you? _____
50. In the last 2 years has the community taken any action to ameliorate this impact? Yes [ ] No []
51. If yes what has been done to reduce impact so you could continue to have this benefit? _____
52. In the last 2 years has any **external organization** taken any action to ameliorate these impacts? Yes[ ] No[ ] I don't know [ ]
53. Which organization? _____
54. What did they do? _____

F. Fishing (only relevant if actual fishing is done in the wetland)

1. How long have you been involved in fishing from the wetland? _____
2. How many households do you know to be involved in this activity in the wetland?

Mashushu ____, Mapagane ____, Mantlane ____, Moila ____, General ____, I don't know __

3. Which type of fish do you collect from the wetland? (List)

PLANT TYPE	PLANT TYPE	PLANT TYPE

4. How often do you fish in a month/year? _____
5. How many people involved in fishing per month for your household? _____
6. How long do each spend? _____
7. What quantity do you collect a month/year? _____
8. How long does it take to collect this quantity? _____ persons/week
9. In the last one year what quantity of each fish type did you collect? (Optional)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
FREQ. OF COLLECTION												
QUANTITY COLLECTED												

10. Can you describe availability of fish in relation to farming seasons (for each plant)?

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
AVAILABILITY												
HARVESTING PERIOD												

11. Which part of the wetland do you get these fishes? Show it on the map for each type.
12. How long is it from your homestead to the place of fishing? _____
13. How do you transport from the homestead to and from this place?

[ ] Walking, [ ] Cycle, [ ] Private car, [ ] Public transport

14. Why do you choose the wetland as a place to fish? _____
15. Is/are there alternative places outside the wetland you can fish? Yes [ ] No [ ]
16. If yes, where are they located? (describe or show on map._____
17. Do you also get fish from this source(s)? Yes [ ] No [ ]
18. How accessible is this source to you? _____
19. Which of these sources do you use the most (rank)_____
20. Is fishing your main occupation? _____
21. How many people fish for you? _____
22. Who are they? _____
23. Do you hire external labor to fish for you? Yes [ ] No [ ]
24. If yes, how many per collection _____
25. Do you pay to fish in the wetland? Yes [ ] No [ ]
26. If yes how much do you pay?
27. Do you use specific tools for fishing in the wetland? Yes [ ] No [ ]
28. If yes, fill table below

TYPE OF TOOL	NUMBER	SOURCE (RENT, GIFT, INHERITANCE ETC.)	WHEN DID YOU ACQUIRE IT	AVERAGELY HOW LONG DOES IT WORK	HOW MUCH DO YOU PAY FOR IT

29. What quantity (of each type of material) do you use personally? (Per time month)

TYPE (FISH)	QUANTITY	PRICE

30. What quantity did you give out? (Per time month)

TYPE (FISH)	QUANTITY	PRICE

31. What quantity did you give out in exchange? (Per time month)

TYPE (FISH)	QUANTITY	EXCHANGE FOR

32. What quantity did you sell? (Per month)

TYPE (FISH)	QUANTITY	PRICE

33. Where did you sell them? _____
34. To whom did you sell them? _____
35. Did you incur transport cost? Yes [ ] No [ ]
36. If yes, how much? _____
37. In the last one year what is the highest and lowest price you sold fishes?

TYPE	HIGHEST PRICE	WHEN (PERIOD)	LOWEST PRICE	WHEN (PERIOD)

38. Can you provide price you sold fish in the last five years?.

PERIOD	PRICE	PERIOD	PRICE

39. Do you make other product from fish? Yes [ ] No [ ]
40. If yes, what other products? (List)

PRODUCT	PRODUCT

41. In the last one year what is the highest and lowest price you sold these products?[iv]

TYPE	HIGHEST PRICE	WHEN	LOWEST PRICE	WHEN

42. What else do you use fish for?
43. How will you describe possibility to fish in the wetlands in the past five years?
[ ] Increasing, [ ] Decreasing, [ ] Not changing, [ ] No Idea
44. Are you aware of impacts your fishing is having on the wetland? Yes [ ] No [ ]
45. If yes list/explain _____
46. In the last 2 years (and maybe years prior) have you done anything to ameliorate this impact(s)? Yes [ ] No [ ]
47. If yes what action have you taken (personally) to reduce impact so you could continue to have these benefits? _____
48. What did u do? _____
49. How much did the action cost you? _____
50. In the last 2 years has the community taken any action to ameliorate this impact? Yes [ ] No []
51. If yes what has been done to reduce impact so you could continue to have this benefit? _____
52. In the last 2 years has any **external organization** taken any action to ameliorate these impacts? Yes[ ] No[ ] I don't know [ ]
53. Which organization? _____
54. What did they do? _____

G. Hunting

1. How long have you been involved in hunting from the wetland? _____
2. How many households do you know to be involved in this activity in the wetland?
Mashushu ____, Mapagane ____, Mantlane ____, Moila ____, General ____, I don't know ____
3. Which type of games do you collect from the wetland? (List)

PLANT TYPE	PLANT TYPE	PLANT TYPE

5. How often do you hunt in a month/year? _____
6. How many people involved in hunting for you per month? _____
7. How long do each spend? _____
8. What quantity do you collect a month/year? _____
9. How long does it take to collect this quantity? _____ Hours
10. In the last one year what quantity of each game type did you collect? (Optional)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
FREQ. OF COLLECTION												
QUANTITY COLLECTED												

11. Can you describe availability of games in relation to farming seasons (for each plant)?

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
AVAILABILITY												
HARVESTING PERIOD												

12. Which part of the wetland do you get these games? Show it on the map for each type.
13. How long is it from your homestead to the place of hunting? _____
14. How do you transport from the homestead to and from this place?
[ ] Walking, [ ] Cycle, [ ] Private car, [ ] Public transport
15. Why do you choose the wetland as a place to hunt? _____
16. Is/are there alternative places outside the wetland you can hunt? Yes [ ] No [ ]
17. If yes, where are they located? (describe or show on map._____
18. Do you also get hunt from this source(s)? Yes [ ] No [ ]
19. How accessible is this source to you? _____
20. Which of these sources do you use the most (rank)_____
20. Is hunting your main occupation? _____
21. How many people hunt for you? _____
22. Who are they? _____
23. Do you hire external labor to hunt for you? Yes [ ] No [ ]
24. If yes, how many per collection _____
25. Do you pay to hunt in the wetland? Yes [ ] No [ ]
26. If yes how much do you pay?
27. Do you use specific tools for hunting in the wetland? Yes [ ] No [ ]
28. If yes, fill table below

TYPE OF TOOL	NUMBER	SOURCE (RENT, GIFT, INHERITANCE ETC.)	WHEN DID YOU ACQUIRE IT	AVERAGELY HOW LONG DOES IT WORK	HOW MUCH DO YOU PAY FOR IT

29. What quantity (of each type of material) do you use personally? (Per time month)

TYPE (GAME)	QUANTITY	PRICE

30. What quantity did you give out? (Per time month)

TYPE (GAME)	QUANTITY	PRICE

31. What quantity did you give out in exchange? (Per time month)

TYPE (GAME)	QUANTITY	EXCHANGE FOR

32. What quantity did you sell? (Per month)

TYPE (FISH)	QUANTITY	PRICE

33. Where did you sell them? _____

34. To whom did you sell them? _____

35. Did you incur transport cost? Yes [ ] No [ ]

36. If yes, how much? _____

37. In the last one year what is the highest and lowest price you sold games?

TYPE	HIGHEST PRICE	WHEN (PERIOD)	LOWEST PRICE	WHEN (PERIOD)

38. Can you provide price you sold game in the last five years?.

PERIOD	PRICE	PERIOD	PRICE

39. Do you make other product from games? Yes [ ] No [ ]

40. If yes, what other products? (List)

PRODUCT	PRODUCT

41. In the last one year what is the highest and lowest price you sold these products?[v]

TYPE	HIGHEST PRICE	WHEN	LOWEST PRICE	WHEN

42. What else do you use games for?

43. How will you describe possibility to games in the wetlands in the past five years?
[ ] Increasing, [ ] Decreasing, [ ] Not changing, [ ] No Idea

44. Are you aware of impacts your hunting is having on the wetland? Yes [ ] No [ ]

45. If yes list/explain _____

46. In the last 2 years (and maybe years prior) have you done anything to ameliorate this impact(s)? Yes [ ] No [ ]

47. If yes what action have you taken (personally) to reduce impact so you could continue to have these benefits? _____

48. What did you do? _____

49. How much did the action cost you? _____

50. In the last 2 years has the community taken any action to ameliorate this impact? Yes [ ] No []

51. If yes what has been done to reduce impact so you could continue to have this benefit?
_____

52. In the last 2 years has any **external organization** taken any action to ameliorate these impacts? Yes[ ] No[ ] I don't know [ ]

53. Which organization? _____

54. What did they do? _____

H. Water

1. How long have you been collecting water from the wetland? _____
2. How many households do you know to be involved in this activity in the wetland?
Mashushu ____, Mapagane ____, Mantlane ____, Moila ____, General ____, I don't know ____
3. Which quantity of water for the following activities do you collect from the wetland during the week?

Water for	Source	Location on the map	Quantity Collected per day	Frequency of collection	Length of time using wetland for this purpose	Number of households
Drinking and cooking						
Washing clothes						
Bathing						
Building purposes						
Watering of small livestock(eg rabbits)						
Watering gardens						
Other specify						

4. Why do you collect water from the wetlands? _____
5. Do you have alternative to this? _____
6. If yes, do you also use this source(s)
7. How accessible is this alternative source to you? _____
8. Which of these sources do you use most (rank) _____
8. How many people collect water for your household? _____
9. Who are they? _____
10. Do you hire external labor to collect water? Yes [ ] No [ ]
11. If yes, how many per collection _____
12. How much do you pay them? _____
13. Do you pay to collect water? Yes [ ] No [ ]
14. If yes how much do you pay to collect water?
15. Do you use specific tools for collecting water? Yes [ ] No [ ]
16. If yes, fill table below

TYPE OF TOOL	**NUMBER**	**SOURCE**	**WHEN DID YOU ACQUIRE IT**	**AVERAGELY HOW LONG DOES IT WORK**	**HOW MUCH DO YOU PAY FOR IT**

17. How do you transport to and from the place of collection
[ ] Walking, [ ] Cycle, [ ] Private car, [ ] Public transport
18. What quantity of water collected do you use personally? (Per time mentioned above)
19. What quantity do you give out?
20. What quantity do you sell?
21. What else do you use collected water for?
22. How will you describe possibility to collect water in the wetlands in the past five years?
[ ] Increasing, [ ] Decreasing, [ ] Not changing, [ ] I don't know
23. Are you aware of impacts your water collection activity is having on the wetland?
Yes [ ] No [ ]
24. If yes list/explain _____
25. In the last 2 years (and maybe years prior) have you done anything to ameliorate this impact(s)? Yes [ ] No [ ]
26. If yes what action have you taken (personally) to reduce impact so you could continue to have these benefits? _____
27. What did you do? _____

28. How much did the action cost you? _____
29. In the last 2 years has the community taken any action to ameliorate this impact? Yes [ ] No [ ]
30. If yes what has been done to reduce impact so you could continue to have this benefit?
_____
31. In the last 2 years has any **external organization** taken any action to ameliorate these impacts? Yes[ ] No[ ] I don't know [ ]
32. Which organization? _____
33. What did they do? _____
34. Did you experience any water related disease in the last year?
35. If yes, explain (ascertain cost of treatment)

I. Livestock

1. How long have you been involved in livestock grazing activity in the wetland area? _____
2. How many households are do you know to be involved in livestock grazing?
Mashushu ____, Mapagane ____, Mantlane ____, Moila ____, General ____, I don't know ____
3. Is livestock rearing your main occupation? Yes [ ] No [ ]
4. Fill for each season (last two seasons)

Livestock categories	How many the season	How many born?	How many dead?	How many purchased?	How many sold?	How many used for own consumption?	How many do you give out as gift?	How many exchanged? (+/-)	How many today?
Cattle/ Cow									
Donkeys									
Sheep									
Goats									
Poultry									
Rabbits									
Pigs									

Milk production

5. How many cows or goats that produce milk do you have in the season? Cows ____ Goats____
6. How much milk do each produce per week? Cows _____, Goats _____
7. What quantity of milk do you use for household consumption per week? _____
8. What do you do with the rest? _____

Draught power

9. Did you use some of your livestock for plowing or transport in cropping season? Yes ☐ No ☐
10. If yes, how many animals and of which type did you use for this?

Type of animals	Number	Use [plowing, transport]
Cows		
Donkeys		

11. How many days did you use them last cropping season for your own needs and what area did you plow with your own animals?

Type of animals	Days used for transport	Plowing	
		days	Area
Cows			
Donkey			

(Specify unit_____)

12. Did you rent or lend your animal for plowing or transport last cropping season? Yes ☐ No ☐
13. If yes specify how many days and the area plowed?

Type of animals	Days used for transport	Plowing	
		days	area
Cows			
Donkey			

14. What did you receive in exchange?

Cash ☐ How much for one day?
Labour ☐ How many man-days for one day of work?
other ☐ specify

Manure production

15. Did you collect the manure produced by your animals for fertilizing your plots last cropping season?

Yes ☐ No ☐

16. If yes, from which animals and how did you collect it? (for example, collect manure produced at night in the kraal)

Cattle
Goats/sheep
Donkeys
Pigs
Poultry

17. How many carts (or other mean of measure) of manure did you collect in cropping season?
18. Did you exchange or give away manure to your relatives or neighbors? Yes ☐ No ☐
19. If yes, how many carts?
20. What did you receive in exchange?

Cash ☐ How much for one cart?
Labour ☐ How many man-days for one cart?
other ☐ specify

Other livestock products

21. Did you get other animal product in the copping season? Yes ☐ No ☐
22. If yes, specify,

Which product?
From which animal?
The quantity produced?
For which use (sale, own consumption, exchange),
If sold or exchanged specify price or against what?

Source of feed / grazing

23. Do you let your livestock graze in the wetlands? Yes ☐ No ☐
24. If yes, indicate the periods when you let your livestock graze/browse in the wetlands?

	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept
Cattle												
Donkeys												
Goats												
Sheep												

25. Indicate on the map which part of the wetland you use for livestock grazing?
26. If no, why?
27. Which other grazing area do you use for your livestock? (locate them on the map)
28. Indicate the periods when you let your livestock graze/browse in this area?

	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept
Cattle												
Donkeys												
Goats												
Sheep												

29. Did you cut grasses or bushes to feed your livestock last month? Yes ☐ No ☐
30. If yes specify

Which plants,
Where did you collect them? (dryland, wetland, irrigation scheme; if wetland locate on a map)
For which and how many animals?
What quantity did you collect?
How much time did you spent in collection?
Who in the household did it?

31. Do you cultivate forage to feed your livestock? Yes ☐ No ☐

32. If yes what quantity
33. For which and how many animals is the forage used?
34. What is the mode of distribution? (free grazing, in the kraal…)
35. Do you use crop residue for feeding your livestock? Yes ☐ No ☐
36. If yes specify
    From which crops,
    On which plot? (dryland, wetland, irrigation scheme; locate on a map)
    For which and how many animals?
    What is the mode of distribution? (free grazing, in the kraal…)
    What quantity did you use?
    How much time did you spent in collection?
    Who in the household did it?

Livestock production costs

37. Did you buy any feed for your livestock last cropping season? (Including complement, salt…)

What do you buy?	For which animals?	When?	Quantity	Price	To whom?

38. How much did spend last farming season on veterinary expenses?

	Dry season	Wet season	Total
Cattle			
Donkeys			
Goats			
Sheep			

39. Did you do any work on fences last farming season?

Type of work	Cost of implement	Number of days of family labour	Number of days of hired labour	Cost per day
Build a new fence				
Repair a fence				

40. Did you spend anything else for your livestock in cropping season?
41. How many people take your livestock for grazing for you? _____
42. Who are they? _____
43. Do you hire external labor to take your livestock for grazing? Yes [ ] No [ ]
44. If yes, how many per time _____
45. Do you pay to graze your livestock? Yes [ ] No [ ]
46. If yes how much do you pay?
47. Do your livestock drink from the wetland? Yes [ ] No [ ]
48. If yes, what quantity/how often, for how long? _____
49. What other sources of water do you have for your livestock? (List)
50. Do you take water from the wetland for your livestock? Yes [ ] No [ ]
51. What quantity? _____
52. Locate on the map where you get water for your livestock.
53. What other wetland products do your livestock feed on? (List)
54. How will you describe grazing potential in the wetland area in the past five years?
[ ] Increasing, [ ] Decreasing, [ ] Not changing, [ ] I don't know
55. Why do you graze your livestock's in the wetland?_____
56. Is/are these plants available in other places outside the wetland? Yes [ ] No [ ]

57. If yes, where are they located?_____
58. Do you also get from this source? _____
59. How accessible is it to you? _____
60. If you do not have access anymore to graze in the wetland, what alternative do you have?

Thank you!!!!.

Schedule for Focus Group Discussion at Ga-Mampa

Date: Thursday 14th September, 2006

Time: 9am

Venue: Community Centre

- **Welcome**: Explain purpose of the discussion and expected result. Encourage openness; indicate time to be taken and possibility to clarify issues.

- Present uses of the wetland as described by Nathalie and Darradi and seek correctness and any further input.

- Which products do you make from these?

- Present to them access and ownership according to existing knowledge and seek clarity.

- Describe labor needs, inputs, equipment use and durability.

- Describe price of all products directly or made from wetland.

- For each use mention all people you know or have ever seen or heard use the wetland for this purpose.

- Go through list with them to ascertain that all farmers/ other known users are on list.

- Thank them and tell them of final presentation and possibility they could still be met for further information.

- Refreshments!!!!!

Second Focus Group Discussion, 18th October, 2006.

Introduction

Explain the purpose of the meeting, duration, availability of break time, questions if any, expected outcome, openness encouraged, and presentation scheduled for first week of November. Explain procedure of the discussion, especially the in group discussion during PDM.

Cropping

Present major crop you discover they plant and initiate a brief discussion
Present them with up to date list of croppers and ask them to verify.
Find out period of each activity in a year (to compare with response from questionnaire)
Average time spent on each activity, cost of each activity.
How should household labor time be valued, what is their suggestion and seek prices of unknown commodities?
Discuss with them average price of farm produce
Discuss average life span of all implements
Period spent on farm using calendar

General for all services

What are the different types of each group
Discuss quantities, especially for edible plant
Discuss average prices for services
How long it takes to collect unit quantity
Periodicity and seasonality, use calendar
Alternatives / substitute
Do they know changes?
Shortages
Adaptations
Indicator

Other questions

Why were they not using the wetland before the flood?
Have they received information?
Other benefits from the wetland
How much they are willing to pay

PDM

List all services (not including medicinal plant) ask them to assign pebbles

Questionnaire prepared for experts to explore uncertainty in result.

Table A: Matrix for Entire Research

Proxy	Score	Empirical	Score	Method	Score	Validation	Score
exact measure	4	large sample, direct measurement	4	best available practice	4	comparable with independent measurements of same variable	4
good fit or measure	3	small sample direct measurement	3	reliable method commonly accepted	3	comparable with independent measures of closely related variable	3
well correlated	2	Modeled derived data	2	accepted method limited consensus on reliability	2	comparable with measures not independent	2
weak correlation	1	educated guess/rule of thumb estimate	1	preliminary methods unknown reliability	1	weak/indirect validation	1
Not clearly correlated	0	crude speculation	0	no discernable rigor	0	no validation	0

Assumption (1)_____

_____

_

_____

Table B1: Matrix for assumptions

	Score			
Criterion	2	1	0	Score
Plausibility	Plausible	acceptable	fictive and speculative	
Inter-subjectivity	many would make same assumption	several will make same assumption	few will make same assumption	
Choice Space	hardly any alternative assumption available	limited choice from alternative assumption	ample choice from alternative assumption when no limitation	
Influence situational limitations (time, money etc)	choice assumptions hardly influenced	choice assumption moderately influenced	totally different assumption when no limitation	
Sensitivity	Choice assumption hardly sensitive	choice assumption moderately sensitive	choice assumption sensitive	
Influence on result	only local influence	greatly determines the results of link in chain	greatly determines the result of the indicator	

Assumption (2)_____

_____

Table B2: Matrix for assumptions

Criterion	Score 2	1	0	Score
Plausibility	Plausible	acceptable	fictive and speculative	
Inter-subjectivity	many would make same assumption	several will make same assumption	few will make same assumption	
Choice Space	hardly any alternative assumption available	limited choice from alternative assumption	ample choice from alternative assumption when no limitation	
Influence situational limitations (time, money etc)	choice assumptions hardly influenced	choice assumption moderately influenced	totally different assumption when no limitation	
Sensitivity	choice assumption hardly sensitive	choice assumption moderately sensitive	choice assumption sensitive	
Influence on result	only local influence	greatly determines the results of link in chain	greatly determines the result of the indicator	

Assumption (3)_____

_____

_____

Table B3: Matrix for assumptions

Criterion	Score 2	1	0	Score
Plausibility	Plausible	acceptable	fictive and speculative	
Intersubjectivity	many would make same assumption	several will make same assumption	few will make same assumption	
Choice Space	hardly any alternative assumption available	limited choice from alternative assumption	ample choice from alternative assumption when no limitation	
Influence situational limitations (time, money etc)	choice assumptions hardly influenced	choice assumption moderately influenced	totally different assumption when no limitation	
Sensitivity	choice assumption hardly sensitive	choice assumption moderately sensitive	choice assumption sensitive	
Influence on result	only local influence	greatly determines the results of link in chain	greatly determines the result of the indicator	

Appendix 12: Respondents

Random order list of Sampled Wetland Croppers.

S /N	Name	Settlement	Size of Plot	Location of Plot	
1	Samuel Mampa	Mapagane			
2	Abram Mahlatlole	Ga-Moila			
3	Daniel Mohlatjie	Mapagane			
4	Luther Mushitoa	Ga-Moila			
5	Rosina M Mampa	Ditabogong			
6	Maria Madire Motebajene	Ditabogong			
7	Rachael Sefala	Mapagane			
8	Rejina Mohlathole	Mapagane			
9	Magedelina Malesa	Mapagane			
10	Elizabeth Mohlatlole	Mapagane			
11	Leah Sefala	Mantlhane			
12	Adolf Mampa	Mapagane			
13	Josephine Selane	Mapagane			
14	Anah Mashabela	Mapagane			
15	Albert Mampa	Mapagane			
16	Angelina Mampa	Mapagane			
17	Angelina Ramogale	Mapagane			
18	Anah Letsaolo	Mapagane			
19	Mokgehle Mammila	Mantlhane			
20	Thomas Tomula Malesa	Mapagane			
21	Magedelina Mampa	Mapagane			
22	Flora Letswaolo	Mapagane			
23	Blomina Mahlatji	Mapagane			
24	Mampuru Nelson Mampa	Mapagane			
25	Maseye Makoti	Ditabogong			
26	Maria Mohaltlole	Ga-Moila			
27	Phylia Mashitoa	Ga-Moila			
28	Mabule Mamilla	Mantlhane			
29	Moses Mohlatlole	Mashushu			
30	Monyanya Sefala	Marulachpigh			
31	Samuel Mashitoa	Ga-Moila			
32	Mporomane Manthatha	Mantlhane			
33	Elizabeth Sabetha Mampa	Gemini			

Random Order List of Non Wetland Croppers Sampled.

S/N	Name	Sub-Village
1	Grace Mampa	Mapagane
2	Ramadimetje Mampa	Mapagane
3	Maria Mampa	Mapagane
4	Thabitha Rapulana	Mapagane
5	Maseabi Malesa	Mapagane
6	Sehlagamele Mampa	Mapagane
7	Rosina Motebejane	Mapagane
8	Martha Makgati Monnye	Mapagane
9	Noria Monnye	Mapagane
10	Irin Mampa	Mapagane
11	Samuel Sefolane Mampa	Mapagane
12	Piet Thobejane	Ga-Moila
13	Sam Matsimela	Ga-Moila
14	Julia Thobejane	Ga-Moila
15	Enelinah Raesibe Mampa	Ga-Moila
16	Helen Seleme	Marulatshiping
17	William Rapulana	Mashushu
18	Sophia Mashabela	Marulatshiping
19	Rachael Sethe	Marulatshiping
20	Rax Mainetsa	Mashushu
21	Patrick Mampa	Mashushu
22	Ditabe Johannes Mampa	Mantlhane
23	Ramatsimela Moela	Mantlhane
24	Lydia Tsoane	Ditabogong
25	Sarah Nkosi	Ditabogong
26	Flora Makoti	Ditabogong
27	Linah Hlongwane	Gemini
28	Mpoke Mampa	Gemini
29	Makgati Mampa	Mapagane
30	Rosina Lemao	Mapagane
31	Catherine Manthatha	Mapagane
32	Raisebe Motebejane	Mapagane
33	Thabitha Rachidi	Mapagane

List of Key Informants

S/N	Name	Capacity	Location
1	Rosina Mampa	Medicinal Plant User	Mapagane
2	Zachariah Mampa	Chairman Wetland Committee	Mapagane
3	Frank Mampa	Secretary, Development Forum	Mapagane
4	Mr. Makoti	Headman Mantlhane (Induna)	Mantlhane
5	Philip Mosima	Extension Officer	Limpopo Department of Agriculture
6	Abel Mashabela	Farmer	Mapagane
7	Mr. Zebulon	Ward Councilor	Ward 24 Mafefe
8	Frank Sefala	Chairman Development Forum	Mantlhane

Participant at Initial Result Presentation at IWMI office South Africa

S/N	Name	Capacity
1	Dr. Barbara Van Koppen	IWMI South Africa
2	Dr. Hilmy Sally	IWMI South Africa
3	Dr. Sylvie Morardet	IWMI South Africa
4	Dr. Everisto Mapedza	IWMI South Africa
5	Dr. Mutsa Masiyandima	IWMI South Africa
6	Mr. Tulani Magagula	IWMI South Africa
7	Mr Wellignton Jogo	IWMI South Africa/ University of Pretoria
8	Ms Elanda Botes	HELP 2007
9	Mr Darion Walters	Mondi Wetland Project

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