THE GOVERNMENT OF THE REPUBLIC OF MALAWI

MINISTRY OF AGRICULTURE IRRIGATION AND WATER DEVELOPMENT

SHIRE RIVER BASIN MANAGEMENT PROGRAMME (PHASE I) PROJECT

# CLIMATE RESILIENT LIVELIHOODS AND SUSTAINABLE NATURAL RESOURCE MANAGEMENT IN THE ELEPHANT MARSH, MALAWI

## Management Report

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MRAG

In Association with:

Southern Waters

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ANCHOR environmental

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# Management Report

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Report Prepared by MRAG Ltd in Association with Southern Water, Anchor Environmental and Streamflow Solutions for the Shire River Basin Management Program and the Ministry of Agriculture, Irrigation and Water Development, Government of Malawi

## Acknowledgements

This report forms part of a larger study on the Elephant Marsh, 'Climate resilient livelihoods and sustainable natural resources management in the Elephant Marsh, Malawi'. This project aims to generate a thorough understanding of the functional ecology of the Elephant Marsh incorporating hydromorphology, ecosystem services, biodiversity, and local livelihoods in order to inform a management plan for the marshes and in order to prepare an application for Ramsar status as a wetland of international importance.

The study falls under the Shire River Basin Management Program (SRBMP), the goal of which is to increase sustainable social, economic and environmental benefits by effectively and collaboratively planning, developing and managing the Shire River Basin's natural resources. The SRBMP (Phase 1) is funded through a loan from the World Bank as well as grants by the International Development Association (IDA) of the World Bank with additional financial support from the Global Environmental Facility (GEF) and the Least Developed Countries Fund (LDCF).

The report synthesises the information from the substudies and is informed by data collected by Southern Waters, MRAG, Anchor Environmental and Streamflow Solutions. The team is grateful for the wide range of people who provided assistance with the study at the national, district and local levels from governments, NGOs, private sector, traditional authorities and villages in and around the Elephant Marsh.

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# Executive Summary

The management report provides a synthesis of the study findings and a draft Elephant Marsh management strategy incorporating key results of all of the sub-studies. As such, it forms part of a larger study on the Elephant Marsh, 'Climate resilient livelihoods and sustainable natural resources management in the Elephant Marsh, Malawi'. The development of the Draft Elephant Marsh Management Strategy involved consultations at national, district and local level in 2015 and 2016 and presentations at the National Biodiversity Committee in 2017. The strategy has been developed in close consultation with national thematic experts within the project Technical Committee, Department of Fisheries, National Ramsar focal point and the project lead partner, the Department of National Parks and Wildlife.

**Site description**

The Elephant Marsh lies on the floodplain of the lower Shire River between the towns of Chikwawa and Chiromo in southern Malawi. The immediate Area of Interest for this study extended from Chikwawa Bridge (upstream) to Chiromo Bridge (downstream). The Marsh's hydromorphology is dependent upon the hydrology of the upstream Shire River Basin, including its source, Lake Malawi, adjacent sub-catchments and the Ruo River. In the north-west, the Marsh is typically a seasonal wetland; centrally, it is semi-permanent marshland, and; in the south, it is characterised by semi-permanent marsh and shallow lakes. The Marsh supports floating mats of vegetation (termed 'sudd') and its margins are lined with palm and fever trees. The Ruo River, the largest tributary of the Shire River, and the southeast boundary with Mozambique, joins the Shire near the village of Chiromo.

**Historical Development**

Published archaeological, geological and historical information and new historical climate chronologies for the region provided good detail of fluctuations during the last six centuries, with available evidence demonstrating that within the last one or two millennia, fluctuations of at least 14 m occurred in the lake. This indicates historically-low lake levels, low enough to terminate outflow to the Shire River, are not infrequent phenomena: four are indicated in the last 900 years, three in the last 470 years and two in the last 200 years; their frequency has increased in more recent times. Land cover changes in the marsh have been extensive since the 1980s, particularly in the upper and western regions where declining flows (and inundation) have presented opportunities for the ingress of people, together with their largely subsistence activities.

**Hydromorphology**

The nature of the Elephant Marsh as a depression provides areas of higher and lower lying land around its edge. The extent to which these areas are inundated by flooding differs and gives rise both to different forms of cultivation and cropping and potentially provides a degree of flexibility for farmers who are able to crop more upland areas in wetter years and lower lying, and more fertile, areas in drier years. Based on a combination of geography, ecology and land/water use, five separate regions of the Elephant Marsh were identified that represent different social-ecological sub-areas

**Biodiversity**

The Elephant Marsh has undergone significant transformation in terms of the extent of cultivation taking place on the floodplains. Hydrologically there have also been some changes with the shifting of the Shire River channel, which have likely led to drying out (and subsequent transformation to agriculture) on the western side of the marsh. Despite natural variation and increasing human impacts, the Elephant Marsh supports populations of birds, insects, reptiles, fish and large mammals. Around 110 waterbird species have been recorded at Elephant

Marsh and 26 of these have been found breeding in the area. The Elephant Marsh supports over 20,000 waterbirds and 1% or more of a delineated population of three waterbird species therefore exceeding the thresholds set by The Ramsar Convention for a wetland to be considered of 'international importance'. In addition to this it also supports populations of hippopotamus, and several species of fish and aquatic invertebrates, including one new sub-species of butterfly.

On the basis of the biodiversity sub-study it appears that the Central sub-area of the Elephant Marsh, which is less accessible, is currently the least impacted, while the Northern and Western sub-areas, where there is extensive agricultural development and roads, have seen a higher degree of modification and losses of natural habitats and biota as a result. Fishing pressure is reasonably high in some parts of the Elephant Marsh, particularly the southern area, while the Northern and Central sub-areas are fished at low intensity due to the nature of the habitat (Northern) and difficulty in access (Central).

**Livelihoods and ecosystem services**

It is estimated that there were around 160,000 people living in and around the Elephant Marsh in 2008 (60,000 in Chikwawa District and 100,000 in Nsanje). Total populations of the two districts (in 2008) were 438,895 (Chikwawa) and 238,089 (Nsanje) and the average rate of population increase was about 3%. The Lower Shire and Elephant Marsh area are important for both agriculture and fisheries production within Malawi. Local populations derive important food and income from wetland farming, casual labour on wetland farms and the harvesting of wetland products (including fishing). This forms a significant part of household livelihoods across the Elephant Marsh. In addition to household subsistence farming there is also intensive commercial cash crop production of sugar cane (primarily at the Illovo sugar cane farms on the western side of the Marsh).

Within the Elephant Marsh the main harvested resources include fish, mammals, birds, papyrus, reeds, thatching grass and water lilies. These are almost exclusively harvested by poorer households on a subsistence basis or to generate some cash income. The fisheries, particularly important in the southern part of the marsh, are estimated to produce around between 2,000 and 12,000 tonnes per annum with an estimated value of between US$1.5 – 8.8 Million per year (productivity is dependent on the flood cycle). Various reptiles, birds and small mammals, or their eggs, are still hunted or collected. Birds are currently hunted both for subsistence and there are some commercial hunters targeting waterfowl in the southern part of the Marsh.

Plants and vegetables are also important sources of materials, food and income. Papyrus, reeds and grasses are widely collected for thatching and mats. Water lilies are abundant throughout the marsh and are harvested for food, in particular during periods when food reserves may be low and/or market prices high.

The Elephant Marsh may provide an important stopover point for African Skimmers. While the Skimmer does not appear to breed within the Elephant Marsh, large flocks have been recorded more frequently in recent years (usually between 280- 600 individuals. African Skimmers are a sought-after sighting for bird enthusiasts and in addition to being globally threatened, these birds are a drawing card for certain tourists, increasing the tourism and biodiversity value of areas like Lengwe National Park.

Beyond provisioning services, the Elephant Marsh also provides important regulating services in the form of flood attenuation, water quality amelioration, sediment retention and carbon sequestration. It was estimated that the Shire River peak flows would increase by approximately 20% if there was no Elephant Marsh. The Shire River carries high sediment loads into the top of the Elephant Marsh from the heavily deforested and degraded catchment. It was estimated that the average rates of sediment deposition has increased in the last 50

years to between 10 and 34 mm per year in the lower Elephant Marsh. Considering above and below ground biomass, peat accumulation, and the extent of undisturbed natural vegetation, the estimated standing stock of carbon in the major vegetation groups within the Elephant Marsh is approximately 0.6 million tonnes of carbon.

The total annual provisioning value was estimated to be approximately US$5-12million per annum. Most of this value is from harvesting fish and thatching grass. Annual value of the regulating services offered by the Elephant Marsh was estimated between US$3 and 255 million. The total tourism/recreation value is currently quite low at approximately US$17,500 per annum. These give a total value between US$8.5 million and US$268 million. Comparison to other Malawian wetlands in which ecosystem services have been evaluated indicate that the Elephant Marsh is not markedly different from Lake Chilwa or Lake Chiuta in its provisioning services, with fishing being the main economic activity.

Income sources for households were similar in all areas around the Elephant Marsh but the relative importance of activities differed by location (e.g. fishing and wild food collection more important in the south) and particularly by wealth group. The relative importance of different sources varies from year to year depending upon the flood cycle as this affects the areas that can be cultivated, the crops that are planted, yields (and hence produce available for sale), fishing and labouring opportunities. Household expenditure differs with wealth groups. For poorer households up to 60% of expenditure may be on food items with health and education as the other key expenses.

Along the Shire River and its adjacent marshes, high rates of human-wildlife conflict are reported. The occurrence of these incidents stems from the large populations surrounds the waterways, and the high level of reliance on the river and marshes for fresh water and livelihoods. The two main problem causing animals along the Shire River and wetlands are crocodile and hippopotamus. Crocodiles have been known to take humans as they fish, wash clothes, bathe, fetch water or travel by canoe. They also destroy fishing gear and attack livestock. Hippopotamus graze on crops and can also cause harm to people as they try to protect their crops.

In addition to effects on crops and livestock, people living in the Elephant Marsh are also vulnerable to water-borne diseases, in particular malaria, bilharzia, filaria, cholera and diarrhoea. Many of these diseases seem to be somewhat connected with receding floodwaters in the marsh, as well as other artificial water bodies such as irrigation ponds and ditches.

Adaptation is a key requirement of livelihoods within dynamic systems such as the Elephant Marsh. Modifying agricultural practices, including location planted, crop varieties and planting dates was a key adaptation strategy for all agricultural households. The village headman and TA can play a role in land provision where necessary and people are able to seek casual labour opportunities locally on small holdings or further afield on commercial agricultural lands (e.g. Illovo sugar cane and Thyolo tea plantations). Fishers by contrast, particularly in the southern area, are more able to move in response to the flood cycle and local productivity. Fishers will move from one landing site to another and even across the border into Mozambique. In doing so the local institutional structure of the BVC and the positions of the BVC Chair and village headman play important roles in facilitating access to resources.

Markets also play an important role in household adaptation strategies. Purchasing food was identified as important by the majority of respondents and a key strategy to generate income to pay for food, particularly by the rural poor is casual labour. Other options include selling livestock and there are well established markets farm and wild (e.g. reed, grass and charcoal) products. Wealthier households in particular may also be able to engage in petty trade and take advantage of new opportunities. Other responses include the use of food banks, selling livestock to pay for staples, use of wild foods, such as water lily root. Support is also provided by the government, by NGOs, CSOs and religious groups in the form of food, agricultural

inputs and clothes. Villages and households will also provide support, e.g. shelter during flooding and sharing food. Based on these adaptation strategies and the role of key institutions, interventions were identified for each area of the Elephant Marsh that focus on enhancing the contribution of food and income generating activities and minimising the negative impacts of the Elephant Marsh environment on their individual and collective wellbeing.

**Ecosystem Functional Model**

The information generated in the sub-studies to construct a DRIFT Decision Support System (DSS) that could be used to assess likely responses of the Elephant Marsh ecosystem to scenarios of change in flow, sediment and livelihood pressures. The Elephant Marsh assessment considered a series of 21 scenarios against a 2014 baseline. The conclusions from the analysis of the potential effects of alternative future scenarios of flow and/or management on the ecological condition of the Elephant Marsh are as follows:

- The Marsh is fairly resilient to flow and sediment changes, having endured significant fluctuations in both in its history.
- Development and climate change as assessed in this report do not represent a significant threat to the long-term integrity and sustainability of the Elephant Marshes, but may represent a threat in the short term if overlain on dry periods such as those known to have occurred 1991-2002.
- The most immediate and significant threat to the integrity and sustainability of the Elephant Marshes is pressure from commercial and subsistence users, including clearing of marsh areas for cultivation, abstraction and discharge and potential over-harvesting a wide range of resources.

**Draft Management Plan**

The growing human population and commercial agriculture development, not only directly surrounding the marsh but within the catchment and Malawi as a whole have been identified as presenting a threat. This threat manifests in numerous ways, the most immediate of which are:

- removal of wetland vegetation and land conversion to agriculture;
- water abstraction for cultivation;
- increased sediment supply from denuded catchments;
- exotic species;
- low agricultural productivity
- over-harvesting of resources;
- increased incidence and severity of fire; and
- the incidence of human disease and wildlife interactions.

On the basis of the analysis conducted these threats are likely to give rise to a number of changes within the Elephant Marsh that are expected to include, but are not limited to:

- Changes in the extent of the seasonally-inundated grassland habitat that characterises the less-saturate portions of the Marsh to cultivated fields; coupled with the harvesting pressure on vegetation, fish and other resources these are likely to have seriously reduced the abundance of natural flora and fauna, and reduced biodiversity in the Marsh;
- Further loss of megafauna, especially hippopotamus (*Hippopotamus amphibius*), interactions with the environment that are essential for maintaining fish populations (e.g., Mosopele et al. 2009). Movement of these animals creates incised, vegetation-free pathways through which water can flow during flooding, diverting water and

sediment into adjacent areas. These channels may become major river channels when the old channels fill with sand and avulse (McCarthy et al. 1998). These ever-changing channels and lagoons created by the actions of large mammals are major habitats for fish;
- Incision of the Shire River channel feeding into the Marsh, and build-up of the adjacent floodplain areas, leading (very slowly) to less flooding of adjacent areas;
- Changes in the extent of Lake Bangula, Lake Tomoninjobi and other lakes in the southern part of the Marsh linked to construction, and subsequent breaches and repairs, of the railway embankment; and
- Changes in the extent of papyrus and reed beds in the southern part of the Marsh linked to construction and subsequent breaches and repairs of the railway embankment.

To address these potential changes to the structure and functioning of the marsh, there is a need to focus activities in different areas Adopting a 'people-centred' approach to management planning, the aim of the management plan, based on the project ToRs and refined through consultation with stakeholders at the national, district and local levels, is to ensure that:

*The integrity of the Elephant Marsh is maintained and enhanced, together with the natural functions that these wetlands perform and the benefits that they supply, including the sustainable utilisation of wetland resources, without undermining future adaptive capacity.*

Reflecting the people-centred approach, the main focus of the management strategy for the Elephant Marsh that has been developed to address the identified threats includes:

- Conservation and maintenance of wetland function within the Elephant Marsh, including measures to restore or rehabilitate some areas that have been identified in the surveys as degraded.
- Enhancing the productivity of ecosystem services, including increasing yields, quality and value as appropriate and reducing inputs and post-harvest losses.

Four key objectives have been identified to help achieve this aim that include cross-cutting objectives recognise the need to develop capacity to manage and to strengthen the knowledge basis underpinning decision-making:

Objective 1: Develop and promote cooperative conservation of the hydrology, flora and fauna of the Elephant Marsh taking into account the full variety of wetland uses.

Objective 2: Develop and promote the sustainable and wise use of wetland resources while minimising impacts by enhancing the productivity of resource utilisation.

Objective 3: Strengthen policies and institutional capacities for the effective management of the Elephant Marsh.

Objective 4: Strengthen the knowledge base to support conservation, management, planning and restoration efforts and raise awareness of the important role of wetlands, their ecosystem functions and livelihood values.

Current status and relevant activities are proposed for each of these objectives. A monitoring framework is proposed that supports the four objectives and is intended to capture changes in the health of the Elephant Marsh and the benefits derived from it. Indicators have been suggested for each of the objectives. In developing the monitoring framework a landscape-scale perspective was used so that biotic, abiotic and human factors are all captured. The framework should be developed further in consultation with local stakeholders to incorporate additional locally-relevant indicators to provide an agreed set of indicators across scales that

can form the basis for the long-term assessment of the health of the wetland as well as a means to evaluate the effectiveness of management and local management strategies.

The institutional context of the Elephant Marsh and the nature of the activities to be initiated under the draft management plan highlight roles for a range of actors and agencies at scales from national to local. Initial suggestions of these actors and agencies are provided that should be engaged from the outset in further developing and implementing the management plan.

At the national level it is expected that the DNPW would assume the responsibility of lead agency and principal coordinator for the management plan. The Ramsar focal point would be responsible for taking forward the proposal to establish the Elephant Marsh as the second Ramsar site in Malawi. To implement the plan, the DNPW will need to coordinate at national with the Ministry of Ministry of Agriculture and Food Security, Irrigation and Water Development, Ministry of Natural Resources, Energy, and Environment and Ministry of Health. At the national and sub-national levels this will also include the Department of Fisheries, Department of Agriculture, Forestry Department, Environmental Affairs Department, Department of Disaster Management Affairs and Department of Education. This coordination can ensure that the plan is reflecting and contributing to wider national aims and objectives.

Beyond the government agencies, resources for the plan can also be mobilised through engagement with donors, NGOs and the private sector. The lead agency should also take advantage of existing coordinating bodies to raise awareness of the management plan and planned activities, ensure the complementarity of key activities with existing plans and strategies (e.g. the Malawi Agricultural Sector Wide Approach) and mobilise resources in support of the plan.

Activities will be implemented at the local level and it is therefore critical also that effective partnerships are created at the District and sub-district levels across the Elephant Marsh. This is reflected in the objectives of the management plan. As the Elephant Marsh is largely customary land, held, occupied, or used by community members under customary law and under the jurisdiction of traditional authorities (TAs), the involvement of these traditional authorities in the planning process is important. Commercial agriculture and livestock raising are important actors in the Elephant Marsh and their activities also have the potential to impact on the Marsh environment and ecosystem. Engaging with these private sector organisations will therefore be important and key commercial operators such as Illovo and Presscane should therefore be engaged from the outset.

**Implementation and adaptive management**

Because of the nature of the institutional arrangements and land tenure, the draft management plan is based on an approach that encourages local government staff to work together with other sectors and with local people on concrete activities at the local level and to enable local people to work with others around the Elephant Marsh. The local level therefore represents an important level for effective and sustainable management of the Elephant Marsh. Weakness in the current local government structures mean that the sectoral committees and CBOs that operate at the community level represent a key entry point. These community-level organisations can, and already do, manage and play an important role in regulating use of natural resources. For example, the Beach Village Sub-Committees enacting and enforcing by-laws, for example banning use of certain fishing gears and methods. An approach is proposed based on adaptive management whereby activities are implemented and monitored in order to identify what works in an iterative manner through collaborative workshops to generate a series of local level plans to develop pilot conservation, productivity enhancement and income generating pilot activities.

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# Acronyms

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| AA | Administrative Authority |
| ADC | Area Development Committees |
| BVC | Beach Village Committee |
| DC | District Council |
| DRIFT | Downstream Response to Imposed Flow Transformation |
| DSS | Decision Support System |
| GoM | Government of Malawi |
| IDA | International Development Agency |
| MA | Millennium Ecosystem Assessment |
| MP | Member of Parliament |
| NGO | Non-Governmental Organisation |
| RIS | Ramsar Information Sheet |
| SRBMP | Shire River Basin Management Program |
| VDC | Village Development Committee |

# 1 Background and purpose

The Government of Malawi received a credit and a grant from the International Development Agency (IDA – World Bank Group) to finance the implementation of the Shire River Basin Management Program (Phase I) Project (SRBMP). The overall objective of the program is to increase sustainable social, economic and environmental benefits by effectively and collaboratively planning, developing and managing the Shire River Basin's natural resources. The 'Climate resilient livelihoods and sustainable natural resources management in the Elephant Marsh' project falls under the umbrella of the SRBMP, and itself has three key objectives:

- To improve understanding of the functional ecology of the Elephant Marsh;
- To assess the feasibility of designating the Elephant Marsh as a community-managed protected area and a Ramsar site; and
- To identify strategies and development options that would build the resilience of local communities to environmental change.

Development of the draft management plan involved socio-economic, hydromorphological and ecological studies on the Elephant Marsh by international specialists. The sub-studies provide a solid scientific basis for the development of the strategy, incorporating lessons from other wetlands in southern Africa and beyond in order to address the threats facing the Elephant Marsh and enhance its contribution to local livelihoods. The way in which the management planning component draws upon the hydromorphology, ecosystem services, biodiversity, and livelihoods sub-studies, to contribute to the management planning as shown in Figure 1.

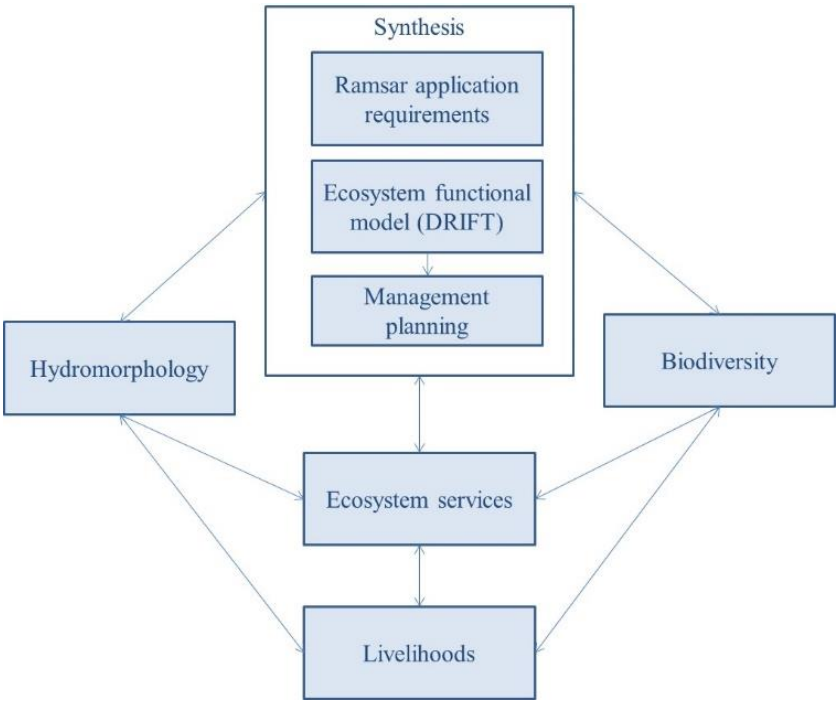


**Figure 1: Relationship between the sub-studies and the three elements of the synthesis.**

In terms of the scheduling of activities, the development of the Draft Elephant Marsh Management Strategy involved consultations at national, district and local level in 2015 and 2016 and presentations at the National Biodiversity Committee in 2017. The strategy has been developed in close consultation with national thematic experts within the project Technical Committee, Department of Fisheries, National Ramsar focal point and the project lead partner, the Department of National Parks and Wildlife.

## 1.1 Report structure

The report provides details of the suggested management plan for the Elephant Marsh, incorporating key results of all of the sub-studies. The management plan is intended to provide a sustainable basis for adaptive management for the benefit of livelihoods and biodiversity while maintaining the integrity of the Marsh ecosystem. The report begins with a short description of the site, including hydromorphology, biodiversity, livelihoods and ecosystem services. The report then outlines the approach to the development of the management plan, key threats to the Elephant Marsh and the strategies that have been identified to address these together with the monitoring and evaluation requirements. The final sections of the report highlight the institutional structures and processes that need to be built on and developed and how this can contribute to adaptive management of the site.

## 1.2 Site description and map

The Elephant Marsh,[1] one of Malawi's first wildlife protection areas (Jawali, 2015), lies on the floodplain of the lower Shire (or Tchiri) River between the towns of Chikwawa and Chiromo in southern Malawi (Figure 2**Error! Reference source not found.**). The immediate Area of Interest for this study extended from Chikwawa Bridge (upstream) to Chiromo Bridge (downstream) (Figure 2), largely determined by the location of hydrometric stations. The Marsh's hydromorphology is dependent upon the hydrology of the upstream Shire River Basin, including its source, Lake Malawi, adjacent sub-catchments and the Ruo River.

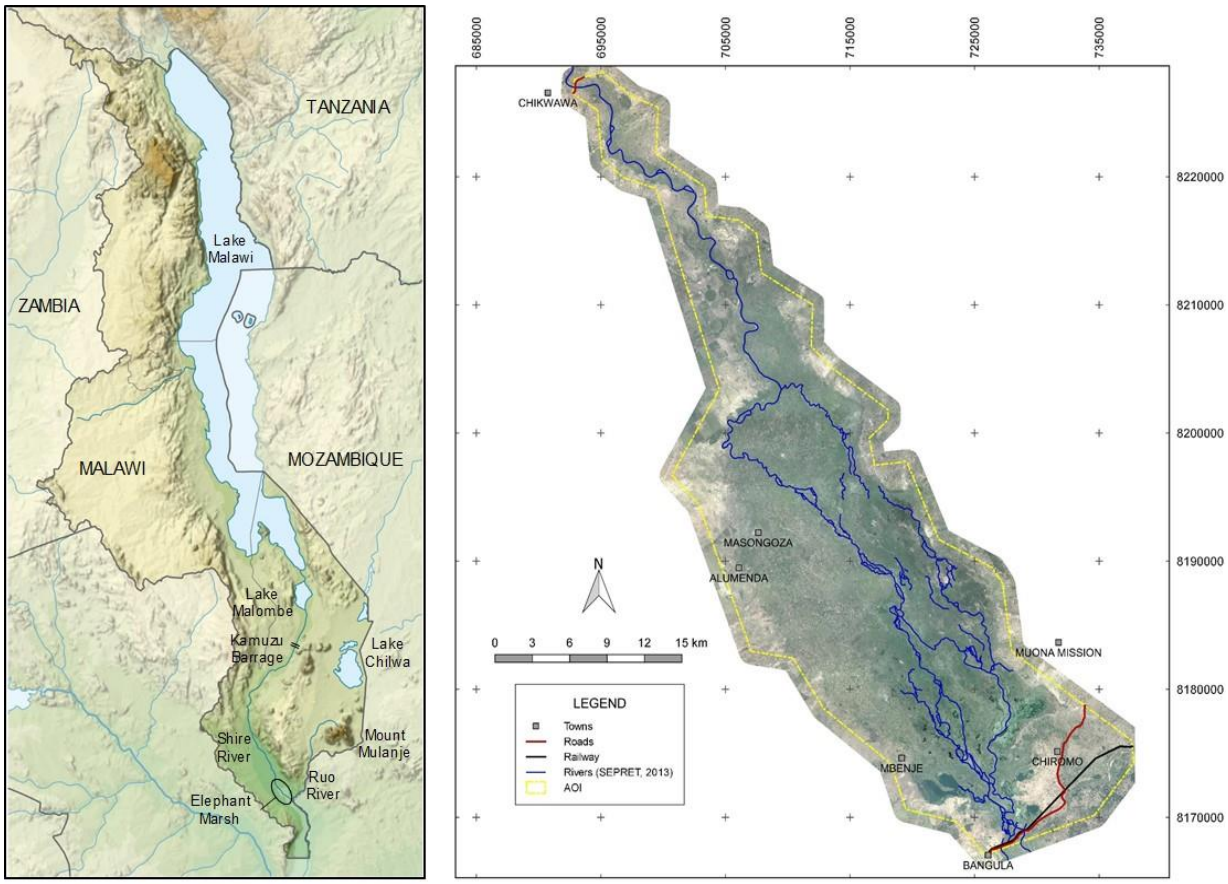


**Figure 2: Location of the Elephant Marsh and Area of Interest for the study**

[1] also known as the 'Dabanyi Marsh' (Mandala, 1984, as cited by Jawali, 2015)

In the north-west, the Marsh is typically a seasonal wetland; centrally, it is semi-permanent marshland, and; in the south, it is characterised by semi-permanent marsh and shallow lakes.[2] The Marsh supports floating mats of vegetation (termed 'sudd') and its margins are lined with palm and fever trees. The Ruo River, the largest tributary of the Shire River, and the southeast boundary with Mozambique, joins the Shire near the village of Chiromo.[3] The Lake Malawi-Shire River hydrological system represents Malawi's single most important natural resource, providing water for various anthropogenic uses, including: hydropower; agriculture; fisheries; transport; tourism, and; urban and rural users (World Bank, 2012). The river flows for 520 km through the southern region of Malawi and is joined by numerous tributaries along its length before discharging into the Zambezi River near the town of Caia in Mozambique.

Downstream of Lake Malawi, between Lake Malombe and the Kamuzu Barrage at Liwonde (**Error! Reference source not found.**) the river flows at a gentle gradient. The barrage was constructed in 1965[4] to partially control both the upstream water-level, which backs-up through Lake Malombe to Lake Malawi,[5] and the downstream discharge of the Shire River to support hydropower. From Liwonde, the Shire falls only seven metres over 50 km, but thereafter drops a further 360 m over ~70 km through a series of rapids and falls where three hydropower plants (HPPs), developed between 1966 and 2014, are located: Nkula (**Error! Reference source not found.**), Tedzani, and Kapichira (**Error! Reference source not found.**). The total installed capacity is 346.3 MW[6] and accounts for 98% of Malawi's grid-based electricity. The three HPPs are often referred to as 'run-of-river',[7] since their reservoir storage capacities are limited. Their capacities have reduced further due to sedimentation: the Nkula and Kapichira Reservoir's had only 30% of their live storage in 1996 and 2003, respectively (Kaunda and Mtalo, 2013).[8] Since storage is limited, power generation largely depends on flows from upstream. Daily water-level fluctuations are evident in the observed hydrometric record at Chikwawa,[9] but not at Chiromo, as by then they have been attenuated by the Marsh's hydrodynamics.

The Lower Shire emerges from the Kapichira Falls and enters a floodplain system with a progressively decreasing longitudinal gradient to the river's confluence with the Zambezi, ~320 km further downstream (at an elevation of ~30 m amsl). The wetlands associated with these floodplains are considered to play an important role in reducing downstream sediment and flooding. The lower Shire Floodplain system hosts large areas of traditional and commercial[10] agriculture, and more than half a million people live in areas adjacent to the river that are susceptible to flooding, and includes the Elephant Marsh, which supports extensive cultivation, high biodiversity and a productive fishery (World Bank, 2012).

### 1.2.1 Historical development

Appreciation of the long-term changes in lake levels, Shire River flows and underlying climate change is fundamental to developing an understanding of historical changes in the Marsh. This, in turn, provides a sound basis for assessing its capacity for resilience in the future.

[2] refers to recent (decadal) characteristics
[3] The Ruo River changed its recent historical (at least 150-year) low-flow course during the extreme floods of January 2015, and now flows directly into the Marsh. This is discussed in various sections of this report.
[4] After more than 50 years of operation, the Kamuzu Barrage is currently being upgraded with funds allocated from Phase 1 of the SRBMP.
[5] effectively, the available or live storage for downstream use
[6] http://www.escom.mw/generation.php (accessed 18 August 2016)
[7] Although this description is at odds with a recent World Bank Group definition of run-of-river, which is: hydropower plants that release downstream into the same river, with a short or no diversion, have ≤ 48-hour dry-season storage and do not make peaking-power releases (World Bank Group, 2016).
[8] Dredging operations have been carried out to recover storage capacities - refer to **Error! Reference source not found.**.
[9] up to half a metre or so
[10] mainly sugar cane

Nicholson (1998) also provided a 1,200-year chronology based on a synthesis of published archaeological, geological and historical information and new historical climate chronologies for the region (refer to Brikhead et al. 2016). The record provided good detail of fluctuations during the last six centuries, with available evidence demonstrating that within the last one or two millennia, fluctuations of at least 14 m occurred in the lake. Extending this to the lake history, Delvaux (1995) cites fluctuations as much as 250 to 400 m - this being consequence of, *inter alia,* natural climate change.

Nicholson's (1998) study raises a number of relevant points for this study, namely: historically-low lake levels, low enough to terminate outflow to the Shire River, are not infrequent phenomena: four are indicated in the last 900 years, three in the last 470 years and two in the last 200 years; their frequency has increased in more recent times; whilst three have similar minima, the penultimate occurrence in the 1700/1800s, for which there is "*unquestionable*" evidence,[11] was substantially lower and of longer duration.[12]

## 1.3 Hydromorphology

in January 2015, devastating floods hit the lower Shire; the temporary (Mtayamoyo) bridge and the sections of repaired embankment were washed away, and; the Ruo River changed its course and confluence with the Shire River (refer to **Error! Reference source not found.** and **Error! Reference source not found.**). The Ruo breached it banks, but unlike after previous recent large floods (e.g., 2001), flow did not return to its pre-flood (low flow) channel. The river, which was the Malawi-Mozambique border (which follows the Ruo's old course), now flows in a north-westerly direction directly into the Marsh through Lake Tomaninjobi. The town of Chiromo has become isolated by rivers, and the informal ferrying of people and their goods across the Shire River.

The Chiromo Bridge and its damaged embankments are current concerns for several reasons: there are transport difficulties across the Shire River; Chiromo Village is now separated from the rest of Malawi by the Ruo and Shire Rivers with no bridge crossings, and the breached embankments and altered course of the Ruo have potentially major consequences for the hydromorphology of the Elephant Marsh. South of the Elephant Marsh, the Shire flows through the Ndindi Marsh before joining the Zambezi River in Mozambique.

The nature of the Elephant Marsh as a depression provides areas of higher and lower lying land around its edge. The extent to which these areas are inundated by flooding differs and gives rise both to different forms of cultivation and cropping and potentially provides a degree of flexibility for farmers who are able to crop more upland areas in wetter years and lower lying, and more fertile, areas in drier years. Land cover changes in the marsh have been extensive since the 1980s, particularly in the upper and western regions where declining flows (and inundation) have presented opportunities for the ingress of people, together with their largely subsistence activities. Based on a combination of geography, ecology and land/water use, five separate regions of the Elephant Marsh were identified (see Birkhead et al. 2016; Brown et al. 2016; Arthur and Hara 2016) that represent different social-ecological sub-areas (Figure 3):

**Northern** ~81.8 $km^2$; characterised by the Shire River flowing into the marsh;

**Western** ~208.2 $km^2$; characterised by cultivated fields;

**Eastern** ~128.2 $km^2$; characterised by anastomosing and distributary channels;

[11] Nicholson, 1998
[12] many decades

**Central** ~108.9 km$^2$; characterised by distributary channels through predominantly indigenous marsh vegetation[13] but including some cultivated fields primarily along channel margins, and;

**Southern** ~56.7 km$^2$; characterised by open water lakes, marsh vegetation and some cultivated fields.

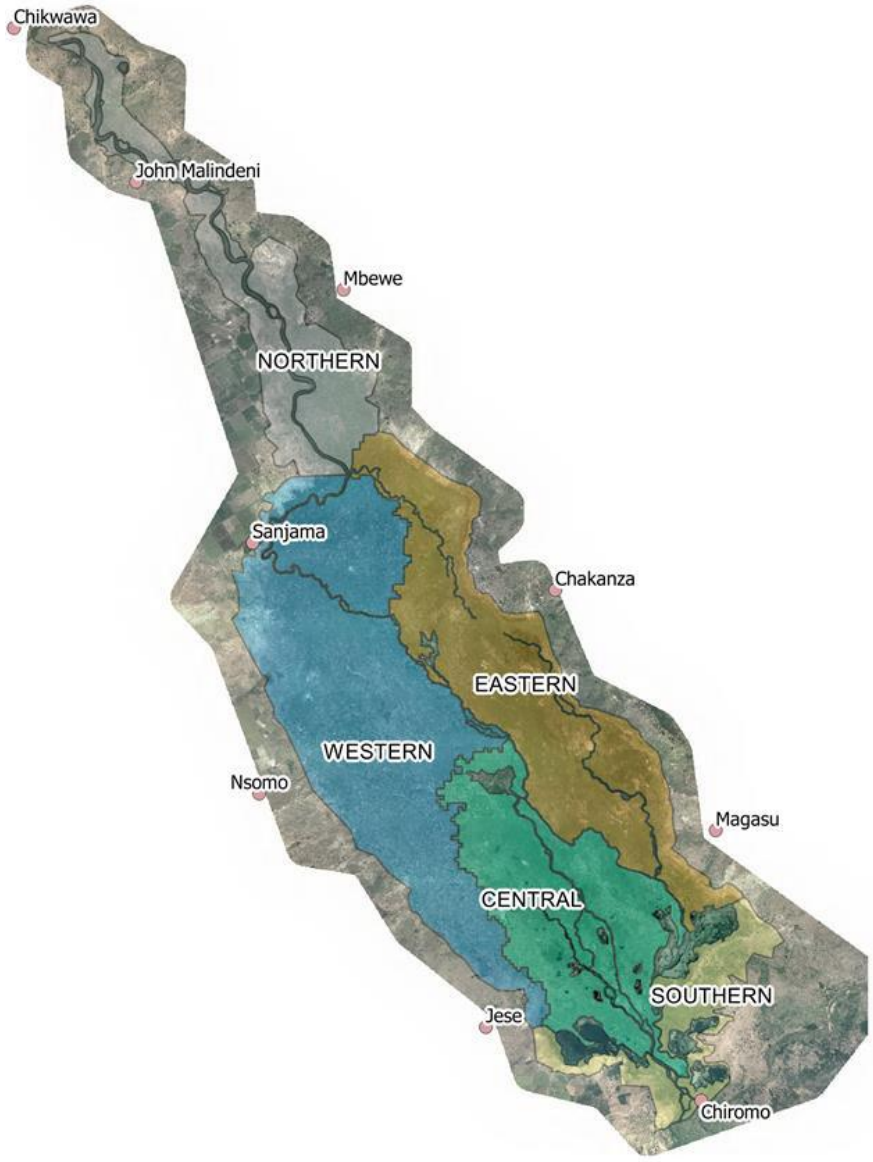


**Figure 3: Social-ecological sub-areas within the Elephant Marsh identified based on vegetation types, hydromorphological influences and stages of transformation for cultivation (from Brown et al. 2016).**

On the basis of the work done, these sub-areas provide a practical basis on which to develop management actions that can help maintain the ecological character of the Elephant Marsh.

## 1.4 Biodiversity

[13] Marsh vegetation is found in perennial- or seasonally-inundated areas with slow flow that are well vegetated (Turpie et al. 2016).

The biodiversity sub-study (Turpie et al. 2016) provides a summary of the biodiversity of the Elephant Marsh and summarises the Baseline Ecological Status (BES)[14] of the Elephant Marsh as at 2014. Overall, the Elephant Marsh supports populations of birds, insects, reptiles, fish and large mammals. Around 110 waterbird species have been recorded at Elephant Marsh and 26 of these have been found breeding in the area. The Elephant Marsh supports over 20,000 waterbirds and 1% or more of a delineated population of three waterbird species therefore exceeding the thresholds set by The Ramsar Convention for a wetland to be considered of 'international importance'. In addition to this it also supports populations of hippopotamus, and several species of fish and aquatic invertebrates, including one new sub-species of butterfly. The Baseline Ecological Status for key biodiversity components whole Marsh (WM) and the individual sub-areas are summarised in Table 1 and below.

**Table 1: BES of the sub-areas and the whole Elephant Marsh as at 2014. WM = Whole Marsh.**

| Discipline | | North | West | East | Centre | South | WM |
|---|---|---|---|---|---|---|---|
| Vegetation | Sub-area score | E | E | B | B | C | D |
| Aquatic invertebrates | Sub-area score | C | C | C | B | B | C |
| Fish | Sub-area score | D | D | C | B | C | C |
| Herpetofauna | Sub-area score | D | D | B | B | B | C |
| Mammals | Sub-area score | E | E | E | D | D | E |
| Birds | Sub-area score | Not assessed at sub-area level | | | | | B |
| Overall BES | Sub-area score | D | D | C | C | C/D | D |

### 1.4.1 Vegetation

The Elephant Marsh has undergone significant transformation in terms of the extent of cultivation taking place on the floodplains. Hydrologically there have also been some changes with the shifting of the Shire River channel, which have likely led to drying out (and subsequent transformation to agriculture) on the western side of the marsh. Despite these changes, the two most common marsh species, *Phragmites australis* and *Cyperus papyrus,* are extremely resilient to clearing and sprout rapidly and more densely in response to being cut (Figure 4).

[14] Definitions for the ecological categories are: A = Unmodified. Still in a natural condition; B = Slightly modified. A small change in natural habitats and biota has taken place but the ecosystem functions are essentially unchanged; C = Moderately modified. Loss and change of natural habitat and biota has occurred, but the basic ecosystem functions are still predominantly unchanged; D = Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred; E = Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive; F = Critically / Extremely modified. The system has been critically modified with an almost complete loss of natural habitat and biota. In the worst instances, basic ecosystem functions have been changed and the changes are irreversible.

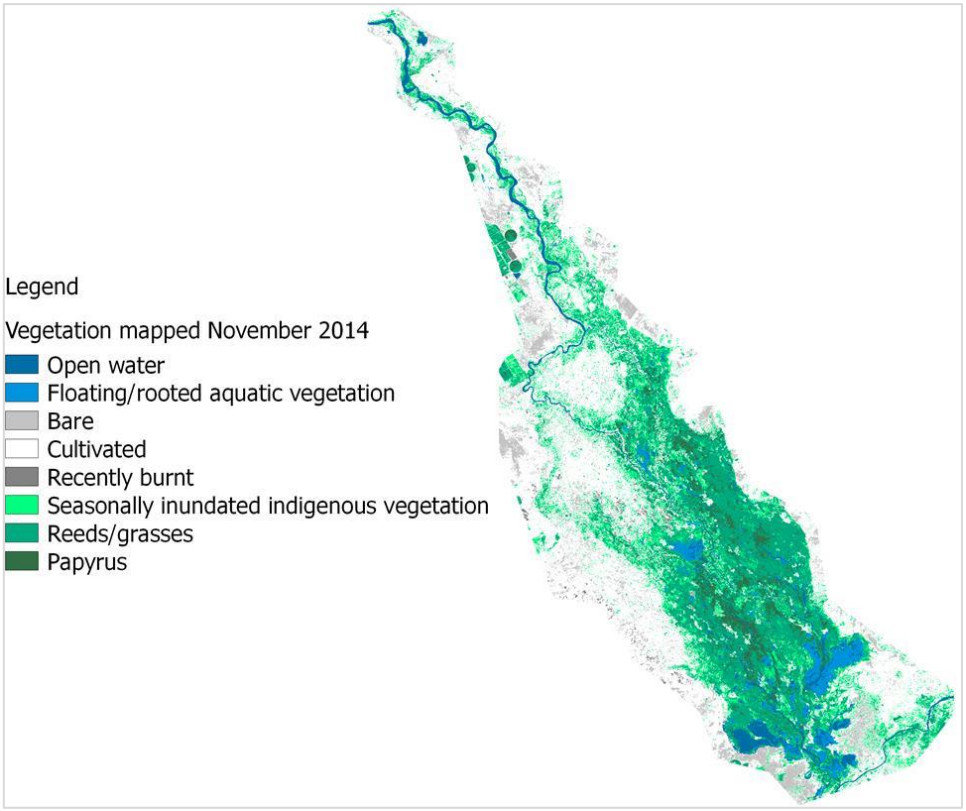


**Figure 4: Vegetation types of the Elephant Marsh as at November 2014**

The biggest changes over the past century would have been in the loss of riparian woody vegetation along the main river banks. It is likely these large woody species would have been removed to allow for agriculture or used for building materials and charcoal production. The BES of the marsh vegetation was estimated to be a D category, where the system is largely modified from its historical condition and/or associated with a large loss of habitat, biota and basic ecosystem functioning.

### 1.4.2 Aquatic invertebrates

Based on the low abundance of flow- and habitat-sensitive taxa and the high diversity and abundance of flow- and pollution-tolerant taxa, the BES of the marsh invertebrates was determined to be a C. The condition of the westward-flowing tributaries, however are considered as severely modified, with little resemblance to their original state.

### 1.4.3 Fish

The fish population in the Elephant Marsh is similar to the Zambezi and while the majority of fish are considered to be Least Concern as assessed by the IUCN Red List, the Sanjika (*Opsaridium microcephalum)* is considered Vulnerable and is endemic in the area. Two other fish species, the African mottled eel (*Anguilla bengalensis labiate)* and the Mozambique tilapia (*Oreochromis mossambicus)*, are also considered to be Near Threatened. Whilst not considered threatened, the lungfish (*Protopterus annectens)* is restricted to seasonal pools, which are susceptible to land use change and drainage, and so might be at risk locally.

Overall, the current fish biodiversity is probably significantly modified from pristine conditions due to fishing pressure and major changes in riverine habitat over the past 100 years or more. The loss of seasonal floodplain habitat to cultivation throughout the marsh is likely to have

reduced the extent of available breeding and feeding habitat for many species, and therefore their overall abundance in the Elephant Marsh. However, this change has probably not led to the local extinction of any species, at least in recent decades, as considerable seasonal floodplain habitat still exists. Similarly, the extensive loss of tall and dense riparian woodland along the river banks has reduced available habitat for dense vegetation specialists (e.g. some small cyprinids), although these species appear to have persisted in the marsh.

Fishing pressure is reasonably high in some parts of the Elephant Marsh (conversely, some areas are probably fished at low intensity due to difficulty in access) and the abundance of some species may be locally suppressed in these areas. Fishing effort would have to be very high throughout the Elephant Marsh as a whole to have driven any species to local extinction, and therefore this is unlikely to have occurred for any resident species. The BES of the marsh fish was estimated to be in a C category, where moderate modification of natural habitat and biota has occurred, but the basic ecosystem functions are still unchanged.

### 1.4.4 Herpetofauna

Prior to human impact the Elephant Marsh would have had more extensive marshy areas, particularly in the surrounding area currently under cultivation. In addition there would have been far more tree cover in the marsh itself and the entire area surrounding the marsh would have comprised tall woodland providing a greater diversity of habitats for reptilian and amphibian fauna. Despite these dramatic habitat changes it is likely that amphibian diversity and populations numbers today still reflect what originally existed in the Marsh. There are on the other hand probably fewer species of arboreal snakes, larger terrestrial reptiles, and specialised aquatic amphibians, and those that remain do so at a lower abundance than would be natural. The BES of the marsh herpetofauna was estimated to be in a C category, moderately modified from natural due to loss and change of natural habitat and biota but with basic ecosystem functions predominantly unchanged.

### 1.4.5 Mammals

Most medium and large sized mammals only occur in fenced and protected areas today. There is a low diversity of small mostly generalist mammals that persist in the marsh. The numbers of hippopotamus have declined drastically; high numbers were recorded up to 1990, now there are only a few sightings and it is estimated that there are currently fewer than 100 hippopotamus remaining. The BES of the marsh mammals was estimated to be an E category, far from the natural / historical, condition and bearing little resemblance to the historical state.

### 1.4.6 Birds

Eight of the waterbird species that have been recorded at Elephant Marsh (either in the March survey or during the African Waterbird Census) are formally considered globally threatened including; Madagascar Squacco Heron, Lesser Flamingo, Wattled Crane, Southern Crowned Crane, Great Snipe, Bar-tailed Godwit, Curlew Sandpiper and African Skimmer. Of these species the Elephant Marsh is a significant locality for the African Skimmer.

Under natural conditions, there would have been a greater extent of undisturbed marsh vegetation of all types providing a rich tapestry for bird life. There were also riparian trees along the inflowing tributaries and the Shire River, and the drier areas surrounding the Elephant Marsh would have comprised woodland. In addition, there were fewer people and thus less harvesting of birds for food. The BES for marsh birds was determined to be 61-89%, i.e. somewhere between “B - largely natural” and “C - significant modifications to biodiversity”. A small number of species have either disappeared from the system or are greatly reduced in number.

On the basis of this assessment the Central sub-area of the Elephant Marsh, which is less accessible, is currently the least impacted, while the Northern and Western sub-areas, where there is extensive agricultural development and roads, have seen a higher degree of modification and losses of natural habitats and biota as a result. Fishing pressure is reasonably high in some parts of the Elephant Marsh, particularly the southern area, while the Northern and Central sub-areas are fished at low intensity due to the nature of the habitat (Northern) and difficulty in access (Central).

## 1.5 Livelihoods and ecosystem services

It is estimated that there were around 160,000 people living in and around the Elephant Marsh in 2008 (60,000 in Chikwawa District and 100,000 in Nsanje). Total populations of the two districts (in 2008) were 438,895 (Chikwawa) and 238,089 (Nsanje) and the average rate of population increase was about 3%. The Lower Shire and Elephant Marsh area are important for both agriculture and fisheries production within Malawi. Local populations derive important food and income from wetland farming, casual labour on wetland farms and the harvesting of wetland products (including fishing). This forms a significant part of household livelihoods across the Elephant Marsh.

### 1.5.1 Agriculture

Agriculture is the main livelihood activity for the majority of households and agriculture occurs all around the Elephant Marsh (see Figure 4). The two agricultural seasons are summer (rainy season) and winter (dry season). In and around the Elephant Marsh it is the lowland winter production based on residual soil moisture that is most important. Typically households in and around the Elephant Marsh would have access to both upland and lowland (*dimba*) land, cultivating upland areas for the summer crop and lowland for the winter. In cases where there is increased flooding, upland areas may be used for the winter crop as well.

Agriculture is largely based on staple crops such as maize, sorghum, millet, rice, beans, cassava and sweet potatoes with some cash crops (e.g. cotton). Most of the food grown is for subsistence though surplus (especially rice) is sold. Rice is mainly grown on the east bank where there are greater areas of marsh that retain residual moisture. Beans are mainly grown during the dry season using irrigation.

Crop production is supplemented by livestock rearing and households in the area depend on the wetlands to provide food for goats and cattle that represent a source of monetary income and make significant contributions to national meat production. The Elephant Marsh provides grazing land and watering points that are particularly important during the dry season. In addition to agriculture local people are engaged in fishing and hunting activities (e.g. for wild birds). Depending on the flooding and local productivity, fishers may move around from one site to another. This is especially true in the more productive south where there are more full-time fishers and who may even migrate into Mozambique. The fisheries are estimated to produce around between 2,000 and 12,000 tonnes per annum (productivity is dependent on the flood cycle). In addition to household subsistence farming there is also intensive commercial cash crop production of sugar cane (primarily at the Illovo sugar cane farms on the western side of the Marsh).

### 1.5.2 Natural resources

Ecosystems provide a number of living resources which are harvested for raw materials, food and medicine. Within the Elephant Marsh these resources are almost exclusively harvested by poorer households on a subsistence basis or to generate some cash income. The main harvested resources include fish, mammals, birds, papyrus, reeds, thatching grass and water lilies.

Fishing is the third most important economic activity in the Elephant Marsh after crop production and Livestock rearing and occurs throughout the Elephant Marsh, but is a particularly important livelihood activity in the eastern and southern areas (Figure 5). Fish landings vary annually with the flood cycle, and are estimated to range between 2,000 and 12,000 tonnes per year with an estimated value of between US$1.5 – 8.8 Million per year.

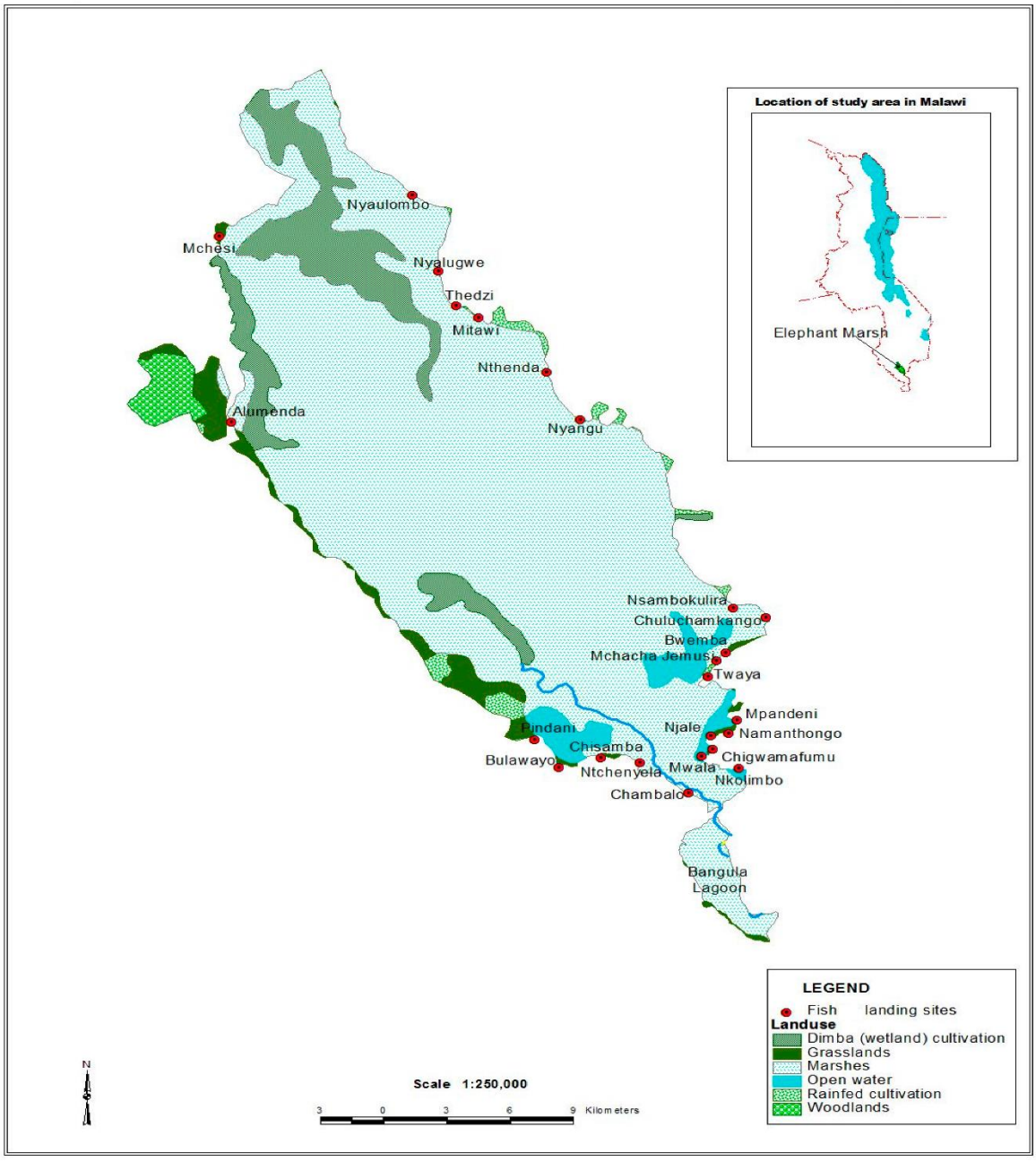


**Figure 5: Location of main fishing villages around the Elephant Marsh (source: Kosamu, 2014)**

Large mammals, including hippos, are now rare in the wetland and little hunting of these animals occurs. However various reptiles, birds and small mammals, or their eggs, are still hunted or collected. Bird populations are still relatively healthy, and the sustainable yield is estimated to be in the order of 400 waterfowl per year (at a rate of 10% harvest), which would be worth about US$970 per annum. Birds are currently hunted both for subsistence and there are some commercial hunters targeting waterfowl in the southern part of the Marsh. The Elephant Marsh may provide an important stopover point for African Skimmers. While the

Skimmer does not appear to breed within the Elephant Marsh, large flocks have been recorded more frequently in recent years (usually between 280- 600 individuals; see Turpie et al. (2016) for more details). African Skimmers are a sought-after sighting for bird enthusiasts and in addition to being globally threatened, these birds are a drawing card for certain tourists, increasing the tourism and biodiversity value of areas like Lengwe National Park.

As well as animals, harvests of plants and vegetables are also important sources of materials, food and income. Papyrus, reeds and grasses are widely collected for thatching and mats. There is approximately 32.2 $km^2$ of papyrus and 166.2 $km^2$ of reeds within the Elephant Marsh and, given that parts of the Marsh are inaccessible, only a fraction of this is currently harvested. Grasses are found within cultivated areas and in the 87 $km^2$ of uncultivated floodplains of the Elephant Marsh and are widely collected. Water lilies are abundant throughout the marsh and are harvested for food, in particular during periods when food reserves may be low and/or market prices high.

### 1.5.3 Wetland regulating services

Beyond provisioning services, the Elephant Marsh also provides important regulating services in the form of flood attenuation, water quality amelioration, sediment retention and carbon sequestration.

It was estimated that the Shire River peak flows would increase by approximately 20% if there was no Elephant Marsh. This would be the equivalent of a water level rise at the Shire/Ruo River confluence of between 0.5 and 0.75 m at peak flows of ~1000 to 2000 $m^3s^{-1}$. This would have a significant effect on flood risk, as a rise in water level of 0.5 m in a village near the confluence would change the effect of a 1 in 5 year flood to that of a 1 in 10 year flood, and a 1 in 10 year flood to that of a one in 50 year flood. Recognising that the data is limited and the modelling (and hence estimates) therefore uncertain, the available data suggest that the the annual value of the Marsh in attenuation and flood damage avoidance for 1 in 5 and 1 in 10 year floods is approximately US$3.3 million.

The Shire River carries high sediment loads into the top of the Elephant Marsh from the heavily deforested and degraded catchment. It was estimated that the average rates of sediment deposition has increased in the last 50 years to between 10 and 34 mm per year in the lower Elephant Marsh, while in the upper marsh was closer to 1 mm per year. The current level of sedimentation equates to between approximately 144 $kgm^{-2}$ per year being deposited across the Elephant Marsh.

Wetlands, and in particular papyrus wetlands, can have very high levels of primary production and potentially represent some of the most productive biological systems in the world. Considering above and below ground biomass, peat accumulation, and the extent of undisturbed natural vegetation, the estimated standing stock of carbon in the major vegetation groups within the Elephant Marsh is approximately 0.6 million tonnes of carbon. Using the social cost of carbon which is equal to the damage avoided by not releasing the tonne of carbon into the atmosphere, we estimate that while the loss of the Elephant Marsh could generate global damages worth US$20 million.

### 1.5.4 Value of the Elephant Marsh in relation to other wetlands

The total annual provisioning value was estimated to be approximately US$5-12million per annum. Most of this value is from harvesting fish and thatching grass. Annual value of the regulating services offered by the Elephant Marsh was estimated between US$3 and 255 million. The high values, assume that this service will be demanded by the Shire Zambezi Waterway Project. The total tourism/recreation value is currently quite low at approximately US$17,500 per annum. These give a total value between US$8.5 million and US$268 million.

Previous estimates of the total value of the Elephant Marsh or Lower Shire wetlands were between US$3-98 million per year. The current figures are therefore only estimates, and only include the value of the Elephant Marsh provisioning services and eco-tourism, not regulating services. Comparison to other Malawian wetlands in which ecosystem services have been evaluated indicate that the Elephant Marsh is not markedly different from Lake Chilwa or Lake Chiuta in its provisioning services, with fishing being the main economic activity. Within the Zambezi Basin, however there are a number of larger wetlands that appear to provide a higher value of ecosystem services than the Elephant Marsh such as the Barotse and Liuwa plain wetlands as well as the Kafue flats.

### 1.5.5 Livelihoods constraints and strategies

Agriculture and fishing are not uniformly distributed within the marsh area. The northern and western sub-areas of the Elephant Marsh have areas of both extensive and intensive agricultural activity. The main livelihood activity for households living in and around the Elephant Marshes is rain-fed agriculture over two seasons as only about 15 to 20% farm families have access to irrigation. Average size of land for irrigation is about 0.2 hectares. Land holding was reported to be similar across households regardless of wealth, although poorer households may not be able to fully utilise their land. Low rainfall and low yielding nature of the staple food crops (maize, millet and sorghum) can mean that there is not enough food for the whole year for an average farm family.

Toward the southern end of the marsh the aquatic habitats become more complex and there are larger areas of open water and increased fishing activity based around a number of fish landing sites. Along both sides of the marsh there is evidence of small scale sand extraction in a number of the river beds. Brick making is also common in many villages. Along the road around the marsh there are a number of markets and trading centres that are important for local people and to which traders will come from Blantyre to attend (and buy goods for resale in Blantyre).

Income sources for households were similar in all areas around the Elephant Marsh but the relative importance of activities differed by location (e.g. fishing and wild food collection more important in the south) and particularly by wealth group. The relative importance of different sources varies from year to year depending upon the flood cycle as this affects the areas that can be cultivated, the crops that are planted, yields (and hence produce available for sale), fishing and labouring opportunities.

Household expenditure differs with wealth groups. For poorer households up to 60% of expenditure may be on food items with health and education as the other key expenses. The main sources of energy for households are firewood (collected or bought), charcoal and reeds. For households near the sugar plantations condemned sugarcane is sometimes available and can be used for fuel. Village banks are operating in some villages. Households make contributions to the grain banks after the harvest and this is sold to those members who need food.

Along the Shire River and its adjacent marshes, high rates of human-wildlife conflict are reported. The occurrence of these incidents stems from the large populations surrounds the waterways, and the high level of reliance on the river and marshes for fresh water and livelihoods. The two main problem causing animals along the Shire River and wetlands are crocodile and hippopotamus. Crocodiles have been known to take humans as they fish, wash clothes, bathe, fetch water or travel by canoe. They also destroy fishing gear and attack livestock. Hippopotamus graze on crops and can also cause harm to people as they try to protect their crops.

In addition to effects on crops and livestock, people living in the Elephant Marsh are also vulnerable to water-borne diseases, in particular malaria, bilharzia, filaria, cholera and

diarrhoea. Many of these diseases seem to be somewhat connected with receding floodwaters in the marsh, as well as other artificial water bodies such as irrigation ponds and ditches. Improved sanitation, prevention and treatment could vastly decrease the prevalence of the diseases in and around the Elephant Marsh.

Adaptation is a key requirement of livelihoods within dynamic systems such as the Elephant Marsh. In response to the situation and issues faced, people are able to adopt strategies that enable them to cope or adapt. These strategies draw upon individual capabilities, household assets and the formal and informal institutions that govern behaviour at the local level. Households within and around the Elephant Marsh are not homogeneous so the types of strategies and responses available, and the outcomes, are also variable. Key to the conservation of the marsh and sustainability of local livelihoods is considering how the complementarity of these two elements can be achieved. In order to contribute to this we consider the nature of the strategies that are employed by households around and within the Elephant Marsh.

For agriculture, availability and access to land with sufficient soil moisture is critical. Modifying agricultural practices, including location planted, crop varieties and planting dates was a key adaptation strategy for all agricultural households. In drier years during the dry season farmers will crop lands further into the Marshes where the soil is more productive and there is residual moisture. This strategy does however bring with it the potential of increased risk of wildlife interaction and waterborne diseases. The village headman and TA can play a role in land provision where necessary and people are able to seek casual labour opportunities locally on small holdings or further afield on commercial agricultural lands (e.g. Illovo sugar cane and Thyolo tea plantations). Fishers by contrast, particularly in the southern area, are more able to move in response to the flood cycle and local productivity. Fishers will move from one landing site to another and even across the border into Mozambique. In doing so the local institutional structure of the BVC and the positions of the BVC Chair and village headman play important roles in facilitating access to resources. The Elephant Marsh also plays an important role in livestock management. The edges of the marsh produces a lot of grass that is available at important times.

Markets play an important role in household adaptation strategies. Purchasing food was identified as important by the majority of respondents and a key strategy to generate income to pay for food, particularly by the rural poor is casual labour. Other options include selling livestock and there are well established markets farm and wild (e.g. reed, grass and charcoal) products. Wealthier households in particular may also be able to engage in petty trade and take advantage of new opportunities. During 2015 for example, households moved well into the Elephant Marsh to plant crops. This created opportunities for petty traders to sell food and drinks to farmers working in these areas and bicycle transport to move crops and crop inputs.

Other responses include the use of food banks, selling livestock to pay for staples, use of wild foods, such as water lily root. Support is also provided by the government, by NGOs, CSOs and religious groups in the form of food, agricultural inputs and clothes. Villages and households will also provide support, e.g. shelter during flooding and sharing food.

Based on the main livelihood activities across the areas of the Elephant Marsh and the types of interactions and adaptation strategies, a number of key areas for intervention to improve wellbeing and enhance climate resilience were identified (Table 2). These focus on enhancing the contribution of food and income generating activities and minimising the negative impacts of the Elephant Marsh environment on their individual and collective wellbeing.

**Table 2: Examples of climate adaptation strategies identified as important across the whole Elephant Marsh and additional sub-area specific strategies.**

| Elephant Marsh Sub-area | Strategies identified as sub-area priorities |
|---|---|
| Whole Marsh | Agricultural support and technology experimentation including access to improved seeds, introducing some diversity to crops and intercropping long season pigeonpea. Studies should explore drivers of agricultural production (e.g. subsidies that incentivise monocropping).<br>Reducing wildlife interactions, in particular crocodile attacks and hippos destroying crops. |
| Northern | Drought resistant crops,<br>Improving sanitation and access to water |
| Western | Managing livestock. Improving access to water.<br>Improving sanitation and access to water |
| Eastern | Managing water and erosion |
| Central | Priority for the area is to enhance protection and reduce access. On the basis of the scenario assessment this is likely to have the greatest benefit for the Elephant Marsh biodiversity in the face of identified climate and development change. |
| Southern | Improving communication links<br>Supporting BVC management of local fisheries. Studies should assess changes in fish species abundance. |

## 1.6 Ecosystem Functional Model (DRIFT)

The objective of the Ecosystem Functional Model (DRIFT) was to use the information generated in the sub-studies to construct a DRIFT Decision Support System (DSS) that could be used to assess likely responses of the Elephant Marsh ecosystem to scenarios of change in flow, sediment and livelihood pressures.

DRIFT (Brown *et al.* 2013) has been specifically developed for use in studies involving planning, development or management of inland aquatic ecosystems (e.g., King and Brown 2009). In the DRIFT-DSS a network of indicators is used to describe the aquatic ecosystem and its human users. Arrows that link indicators show the flow of cause-and-effect. In essence, the lines are the processes and the indicators represent the outcomes of the processes, with the network as a whole representing a simplified ecosystem model (**Error! Reference source not found.**).

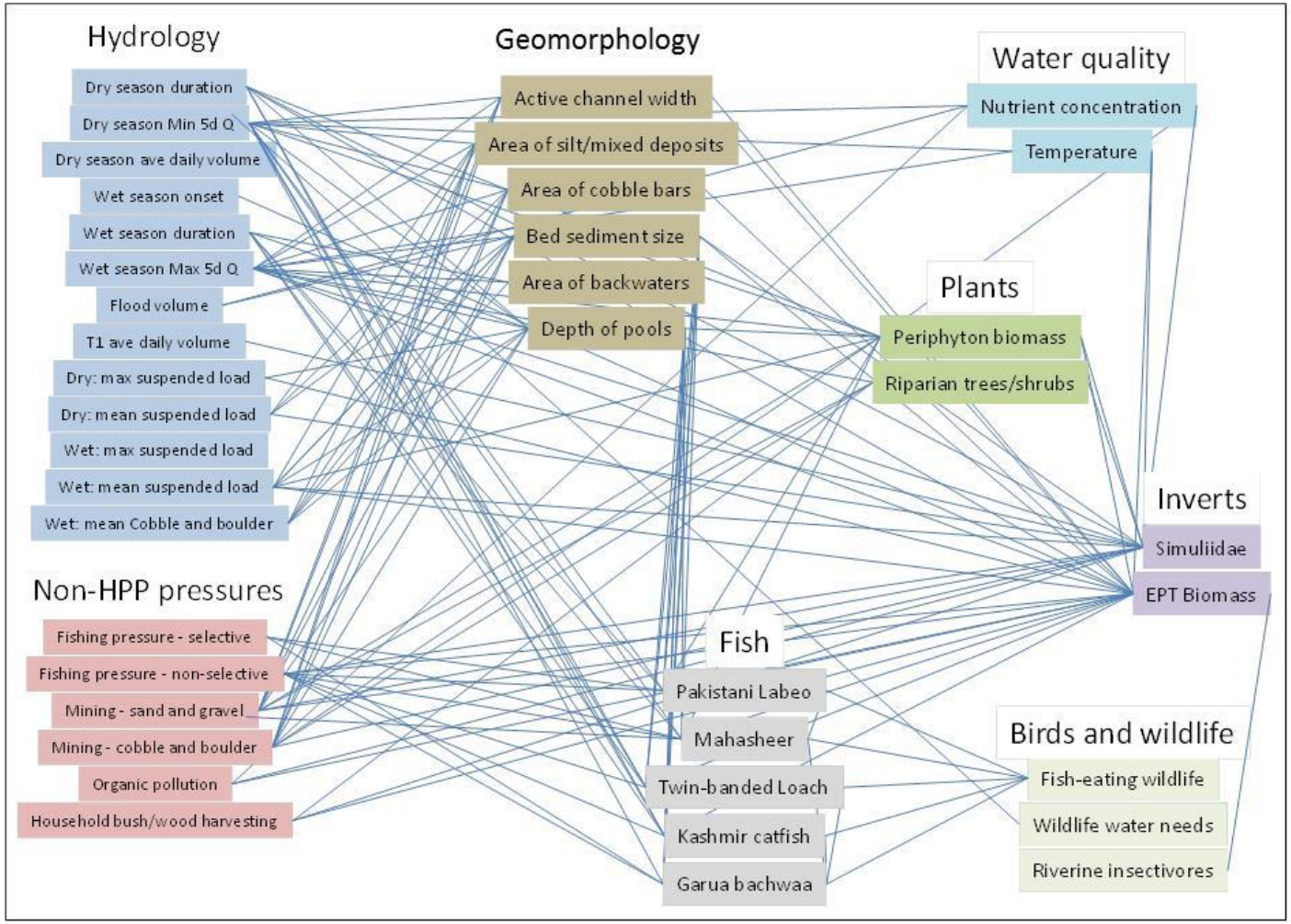


**Figure 6: A typical DRIFT network of linked indicators (from Poonch River EFlows Assessment, Kashmir; Brown *et al*. 2017)**

The indicators are used to describe:

- some aspect of the physical drivers of the ecosystem, such as water or sediment flow;
- a range of ecosystem attributes, and;
- a range of ecosystem-linked social attributes and pressures.

Once constructed the DSS can be used to describe how the ecosystem attributes would change under different climate or development related flow and sediment regimes and/or levels of human disturbance. The analysis is based on a simplified ecosystem model, which focusses on those aspects of an aquatic ecosystem that are expected to be vulnerable to change in flow or water supply. The broad conceptual framework used in this assessment is depicted in Figure 7.

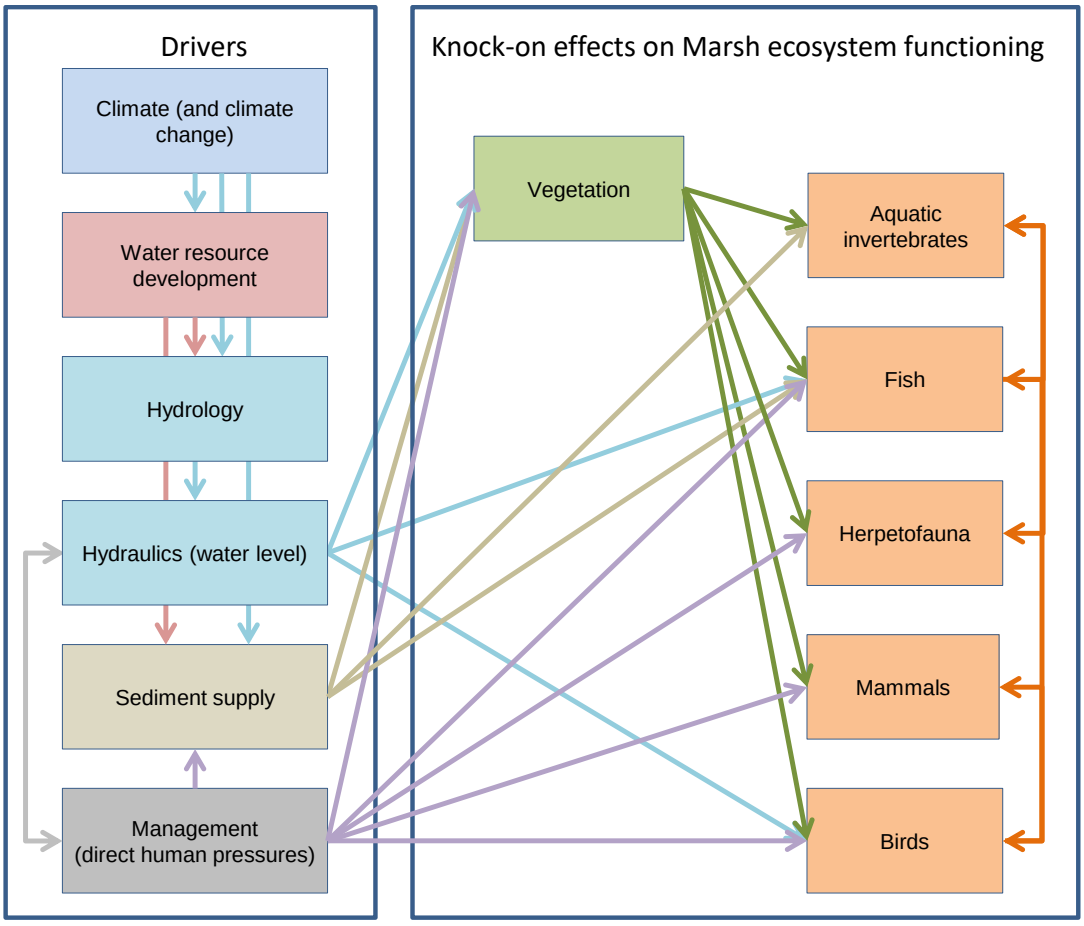


**Figure 7: A simplified schematic of the links between the abiotic drivers (climate, hydraulics, geomorphology and management) and the knock-on links to biota, which comprise the Elephant Marsh conceptual model.**

The Elephant Marsh assessment comprises consideration of a series of scenarios against a 2014 baseline, which represents the Marsh under conditions that have prevailed for about the last 10 years or so, but excludes some of the most recent changes brought about by the 2014 flood. In particular, baseline excludes the influence of the Ruo River, which changed its course during those floods and now discharges directly into Tomoninjobi Lake rather than having a confluence with the Shire River downstream of Chimromo Bridge. Ultimately 21 different scenarios were modelled that included differences in population, climate change effects,

sediment load, water resource development and access to the Elephant Marsh (see XXXX et al. 2016 for details).

### 1.6.1 Changes to the Elephant Marsh under future climate and development scenarios

Changing the amount of sediment load coming into the marsh had little effect on the delivery of ecosystem services. Restricting access to combination of central, eastern and southern parts yielded the greatest increases in ecosystem service delivery. Increases in population had severely negative impacts on almost all of the ecosystem services. The maximum development and climate change scenarios in conjunction with different levels of protection had little effect, or a positive effect on most services. Water lilies however, seem to be negatively affected by maximum development and climate change. This is potentially to do with their reliance on certain aquatic habitats that may be limited under these scenarios. Human-wildlife conflict increased under most scenarios, possibly as a result of protection on increasing numbers of problem causing animals. Some indicators, such as the hydraulic and vegetation indicators, show different vulnerabilities to changes in the pattern and volume of water and sediment entering the Marsh for the different focus areas. For instance:

- the Northern and Western Areas are more vulnerable to decreases in water flows than are the other areas, particularly given the human pressures in these areas and that any marsh that dries out sufficiently is converted to crops;
- the Central and Eastern Areas are less vulnerable to decreases in water flows than the Western and Northern Areas (mainly because they are considerably wetter and thus require greater level of change before they are vulnerable to conversion to crops) but fairly vulnerable to removal of channelisation.
- the Southern Area is particularly vulnerable to change as a result of an increase in the lateral supply of sediments, e.g., from the Ruo River.

The conclusions from the analysis of the potential effects of alternative future scenarios of flow and/or management on the ecological condition of the Elephant Marsh are as follows:

- The Marsh is fairly resilient to flow and sediment changes, having endured significant fluctuations in both in its history.
- Development and climate change as assessed in this report do not represent a significant threat to the long-term integrity and sustainability of the Elephant Marshes, but may represent a threat in the short term if overlain on dry periods such as those known to have occurred 1991-2002.
- The most immediate and significant threat to the integrity and sustainability of the Elephant Marshes is pressure from commercial and subsistence users, including clearing of marsh areas for cultivation, abstraction and discharge and potential over-harvesting a wide range of resources.

By far the most effective measure for improving ecosystem condition, and thus ensure sustainability of the Elephant Marsh is to impose some access restrictions on one or more areas of the Marsh.

# 2 The draft management plan

The following sections provide a description of some of the key threats that have been identified through the sub-studies (Section 2.1). These, and opportunities to enhance livelihoods, form the basis for a people-centred approach to management (Section 2.2) based around four key objectives (Section 2.3). The implementation of the draft plan is intended to provide adaptive management that fits with the local institutional arrangements and ensure also that activities at the local level within and across the Elephant Marsh contribute to District and national planning and resource management (Sections 2.5 and 2.6). Finally a monitoring framework is proposed that can support the implementation and evaluation of the management plan and provide information on the health of the Elephant Marsh and wellbeing of local people living in and around the wetland (Section 2.4).

## 2.1 Key threats and resultant changes

It is important to understand the historical processes that have affected the nature and functioning of this landscape. These are summarised in Brown et al. (2016) and include:

- Periodic, and presumably natural, cessations of flows from Lake Malawi into the Shire River;
- Order of magnitude increases in sediment supply to the Elephant Marsh as a result of population pressures and severe land degradation in the Shire River Basin;
- The decimation of the large animal populations, such a hippos and elephants, from the Elephant Marsh, and;
- Intense pressure on the natural resources as a result of a c. 3% per annum increase in people living adjacent to the Elephant Marsh (Kosamu et al. 2012). This has resulted in increased water abstraction, conversion of natural vegetation, sediment input, movement and deposition, as well as biodiversity losses. The resultant high turbidity also reduces the productivity of the littoral zone, smothers substrates, and reduces food source availability and fish visibility (which can affect hunting for many species; Turpie et al. 2016).
- Development of commercial agriculture (in particular sugarcane) and livestock ranching.

In particular the growing human population and commercial agriculture development, not only directly surrounding the marsh but within the catchment and Malawi as a whole have been identified as presenting a threat. This threat manifests in numerous ways, the most immediate of which are:

- removal of wetland vegetation and land conversion to agriculture;
- water abstraction for cultivation;
- increased sediment supply from denuded catchments;
- exotic species;
- low agricultural productivity
- over-harvesting of resources;
- increased incidence and severity of fire; and
- the incidence of human disease and wildlife interactions.

On the basis of the analysis conducted (see Brown et al., 2016), these threats are likely to give rise to a number of changes within the Elephant Marsh that are expected to include, but are not limited to:

- Changes in the extent of the seasonally-inundated grassland habitat that characterises the less-saturate portions of the Marsh to cultivated fields; coupled with the harvesting

pressure on vegetation, fish and other resources these are likely to have seriously reduced the abundance of natural flora and fauna, and reduced biodiversity in the Marsh;
- Further loss of megafauna, especially hippopotamus (*Hippopotamus amphibius*), interactions with the environment that are essential for maintaining fish populations (e.g., Mosopele et al. 2009). Movement of these animals creates incised, vegetation-free pathways through which water can flow during flooding, diverting water and sediment into adjacent areas. These channels may become major river channels when the old channels fill with sand and avulse (McCarthy et al. 1998). These ever-changing channels and lagoons created by the actions of large mammals are major habitats for fish;
- Incision of the Shire River channel feeding into the Marsh, and build-up of the adjacent floodplain areas, leading (very slowly) to less flooding of adjacent areas;
- Changes in the extent of Lake Bangula, Lake Tomoninjobi and other lakes in the southern part of the Marsh linked to construction, and subsequent breaches and repairs, of the railway embankment; and
- Changes in the extent of papyrus and reed beds in the southern part of the Marsh linked to construction and subsequent breaches and repairs of the railway embankment.

Short-term (33 year) development and climate change effects do not represent a significant threat to the long-term integrity and sustainability of the Elephant Marsh, but may represent a threat in the longer term if they coincide with, and exacerbate, particularly dry periods, which as are known to have occurred in the past. The most immediate and significant threat to the integrity and sustainability of the Elephant Marshes is increasing human pressure from including clearing of marsh areas for cultivation, over-harvesting resources and human pressure in more upstream areas.

The scenario analysis (Brown et al., 2016) suggests that the different sub-areas identified within the Elephant Marsh show different vulnerabilities to changes in the pattern and volume of water and sediment entering the marsh:

- The Northern and Western sub-areas are more vulnerable to decreases in water flows than are the other areas, particularly given the human pressures in these areas and that any marsh that dries out sufficiently is converted to crops;
- The Central and Eastern sub-areas are less vulnerable to decreases in water flows than the Western and Northern sub-areas (mainly because they are considerably wetter and thus require greater level of change before they are vulnerable to conversion to crops) but fairly vulnerable to removal of channelisation;
- The Southern sub-area is particularly vulnerable to change as a result of an increase in the lateral supply of sediments, e.g., from the Ruo River.

To address these potential changes to the structure and functioning of the marsh, there is a need to focus activities in different areas and develop a set of tailored but inter-related plans. The scenario analysis indicated that the Elephant Marsh is currently, and is likely to remain, fairly resilient to short-term flow and sediment changes, having endured significant fluctuations in both in its history. However, the Elephant Marsh is susceptible to longer term climatic cycles and sudden and catastrophic changes in channel planform geometry resulting from excessive sediment loads combined with flooding (as occurred in 2015).

The following section lays out a proposed response to the situational analysis provided by the sub-study reports. In particular elaborating a people-centred approach to managing the Elephant Marsh that can enhance biodiversity conservation and livelihood climate change resilience and the aims, objectives, activities and indicators that support this.

## 2.2 A people-centred approach to management planning

The Elephant Marsh and the ecosystem functions it provides make important contributions to the livelihoods of people settled in and around it (Arthur and Hara, 2016; Forsythe and Turpie, 2016). If the Elephant Marsh is to continue to provide important services and functions local people will need to be engaged and involved as co-managers of the resource. Such a 'people-centred' approach to management planning would have the following aim:

*The integrity of the Elephant Marsh is maintained and enhanced, together with the natural functions that these wetlands perform and the benefits that they supply, including the sustainable utilisation of wetland resources, without undermining future adaptive capacity.*

This approach rests on three key principles that inform the objectives and the selection of options that contribute to meeting them:

1) **1 Wetlands as dynamic systems:** The Elephant Marsh includes both terrestrial and aquatic systems that change with the annual flood cycle. Wetlands typically have high biodiversity as they contain both aquatic and terrestrial species, many adapted to the specific conditions of wetlands. Relative abundance can change with the changing flood cycle and management options need to consider the dynamic nature of wetlands and the importance of the annual flood cycle in sustaining ecosystem nature and function. It is important that the management options are revisited periodically to accommodate new understanding and knowledge and to determine the extent to which they are contributing to attaining the objectives in practice. Supporting this aspect should be a monitoring and evaluation (M&E) component that cross-cuts the management plan and provides the means to measure and assess performance and adapt it.
2) **2. Stakeholder participation:** The Ramsar Convention recognises as essential stakeholder participation in wetland management and decision-making[15]. People should therefore be at the heart of the management planning for the Elephant Marsh given that the Elephant Marsh makes important contributions to local livelihoods in and around the wetland. People can also contribute knowledge about the wetland and how it responds to change that can assist in the selection of management options in a complex and dynamic wetland with multiple drivers and effects occurring across different scales (Birkhead et al., 2016) means that it will continue to be difficult to predict the nature and magnitude of services (and dis-services) that it provides
3) **3 Wise use and equitable distribution of benefits:** Sustainable management and conservation of the Elephant Marsh should avoid presenting local people dependent on the marsh as the main agents of its destruction and degradation and focus on conservation alone. The marsh provides important provisioning services, including agricultural crops, livestock, fisheries and reeds (Forsythe and Turpie, 2016). In addition the Elephant Marsh supports other important environmental functions, including flood control and biodiversity. Agriculture has taken place in and around the Elephant Marsh for many years (Birkhead et al. 2016) and cultivation within the marsh has had impacts across the wetland. Local communities are likely to continue practicing varying levels of agriculture in the marsh in the future. A long-term perspective is required that conserves biodiversity and enhances human wellbeing through consideration of the ecosystem services provided by the wetlands, and the processes that underpin these. The interests of different resource users need to be balanced. Options for managing the Elephant Marsh need to consider potential impacts on biodiversity and ecosystem function and on users, individually and collectively.

[15] e.g. Recommendation 6.3 of Ramsar COP6 (1996).

## 2.3 Management objectives and options to address the identified threats

The aim of the management plan, based on the project ToRs and refined through consultation with stakeholders at the national, district and local levels, is to ensure that:

*The integrity of the Elephant Marsh is maintained and enhanced, together with the natural functions that these wetlands perform and the benefits that they supply, including the sustainable utilisation of wetland resources, without undermining future adaptive capacity.*

Reflecting the people-centred approach, the main focus of the management strategy for the Elephant Marsh that has been developed to address the identified threats includes:

- Conservation and maintenance of wetland function within the Elephant Marsh, including measures to restore or rehabilitate some areas that have been identified in the surveys as degraded.
- Enhancing the productivity of ecosystem services, including increasing yields, quality and value as appropriate and reducing inputs and post-harvest losses.

Four key objectives have been identified to help achieve this aim that include cross-cutting objectives recognise the need to develop capacity to manage and to strengthen the knowledge basis underpinning decision-making:

Objective 1: Develop and promote cooperative conservation of the hydrology, flora and fauna of the Elephant Marsh taking into account the full variety of wetland uses.

Objective 2: Develop and promote the sustainable and wise use of wetland resources while minimising impacts by enhancing the productivity of resource utilisation.

Objective 3: Strengthen policies and institutional capacities for the effective management of the Elephant Marsh.

Objective 4: Strengthen the knowledge base to support conservation, management, planning and restoration efforts and raise awareness of the important role of wetlands, their ecosystem functions and livelihood values.

Each of these objectives are discussed in turn, emphasising the way in which the studies suggest the identified threats could be addressed and potential contributions to livelihoods realised. The activities are identified on the assumption that DNPW will be the lead agency with responsibility for the management plan. Some initial activities are suggested against each of the four objectives.

### 2.3.1 Objective 1: Develop and promote cooperative conservation of the hydrology, flora and fauna of the Elephant Marsh taking into account the full variety of wetland uses.

**Current status:**

Based on the modelling, far the most effective measure for improving ecosystem condition and enhancing ecosystem services was to impose some access restrictions on one or more sub-area of the Marsh. Of the options for access restrictions modelled, the best outcome, and one that returns an improvement in baseline marsh conditions, is achieved by restricting human access to the core Central sub-area of the Elephant Marsh and reducing access to the Eastern and Southern sub-areas. Realising this requires supporting processes in both Chikwawa and Nsanje as the central sub-area that is identified as a priority for access restriction straddles both districts (Figure 8). However, the scenario analysis (Brown et al.

2016) identified that gains made through restrictions could be undermined if there are significant reductions in the flows entering the Elephant Marsh.

While agricultural development is a concern from a conservation perspective, it is important to recognise that agriculture is also a key element of the livelihoods of people living in and around the Elephant Marsh (Arthur and Hara, 2016). The management plan should therefore include elements that aim to ensure that agriculture (commercial, smallholder and subsistence) minimises the effect on the Elephant Marsh (in terms of land conversion, vegetation loss, water abstraction and impacts on water quality).

While the approach does not necessarily increase biodiversity, conservation agriculture can represent a low-cost approach, locally-adapted and low external input farming approach that can be adopted even by the poorest households. Elements of the approach include addressing soil health and moisture through the addition of organic matter and mulching (which was observed in some areas of the marsh), maintaining buffer strips of natural vegetation and measures to control water flow to optimise soil moisture and reduce erosion, for example growing reeds as well as crops. In the context of Malawi there have been doubts about uptake where people believe that enhancing production requires additional fertiliser (e.g. Chinsinga et al., 2012). However, within the Elephant Marsh, where soil fertility in the lowland areas can be high, this potentially becomes less of a constraint.

The cutting of reeds and rushes, especially when done by hand and not concentrated in a single area, tends to have less impact on wetlands than cultivation because there is minimal disturbance to the soil and the plants rapidly re-grow. These plants are adapted to variable wetland conditions and appropriate levels of cutting can even have a positive effect on the wetland. However, if harvesting occurs at rates above the capacity to renew, the vegetation will be degraded, with loss of benefits to the users of these resources. In addition, harvesting should ideally be limited at the time when birds and insects are breeding.

Communal woodlots can be an affordable way for villages to establish over time wood supplies that can at least satisfy their household needs and encourage more diverse habitats, although it requires labour for nursery management and woodlot establishment. There are examples within communities inside the Elephant Marsh of successfully managed community woodlots. These could provide a model for other communities within and around the Elephant Marsh.

Climate change is expected to result in longer dry periods and more intense floods in the Elephant Marsh, but will also alter the nature of agriculture at the marsh edge. Both of these will affect the marsh that is defined by, *inter alia*, its relationship to the flow of water and sediments entering it. Water flows from Lake Malawi into the Shire River have ceased in the past, even for prolonged periods (Birkhead et al., 2016) and are likely to do so again in the future. Any reduction in flow, whether through climate related changes or abstraction, will lead to drying out of areas of the marsh and an increase in cultivation and encroachment further into the Elephant Marsh. Conversely, wetter periods will result in a reduction in cultivation, or possibly a change in crop selection.

Planned development of irrigation abstraction will affect the Elephant Marsh, particularly in relation to reduced dry season flows. The modelling has indicated that, combined with projected climate change, the effect will likely be a reduction in ecosystem services across the Elephant Marsh. To compensate, it may be the case that people move further into the marsh to undertake recession farming. This will contribute to land conversion and loss of natural vegetation and may facilitate other resource use. Restricting access to part or all of the central area can help mitigate some of the impacts. In addition it will be important to maintain connectivity across the Elephant Marsh. Water abstraction, land conversion siltation and floating vegetation can all contribute to reducing connectivity and it will be important to monitor connectivity. Hippopotamus can also play an important role in keeping channels open and

maintaining and enhancing connectivity. It will be important to ensure that the population of hippopotamus in the Elephant Marsh is not reduced.

Addressing the increased sediment supply from denuded catchments requires management interventions at a range of scales, including areas outside and upstream of the Elephant Marsh (see also Objective 3 below). Results from the project sub-studies have been shared with other components of the wider Shire River Basin Management Programme in order to ensure that impacts on the Marsh arising from changes in hydrology and land use in upstream areas can be assessed and, where necessary, mitigated.

Water hyacinth (*Eichhornia crassipies*) water lettuce (*Pistia stratiotes*) and water fern (*Azolla filliculoides*) are all abundant across the Elephant Marsh, sometimes forming large mats that almost completely cover smaller lake. These plants impact human use of the wetland, for example making travel by boat more difficult and affecting fishing opportunities. They may also impact on the functioning and economic potential of the Elephant Marsh. This is more of a problem in the southern part of the marsh where there are larger areas of open water.

**Proposed activities:**

1.1. Work with local communities adjacent to the central area to establish a protected area with restricted access or no-take designation within the central area of the Elephant Marsh that protects an area with high habitat diversity and biodiversity.

1.2. Work with local village committees (e.g. the BVC) to establish locally managed conservation areas, channel vegetation buffers and dry season refuges that will improve wetland protection and provide critical habitats.

1.3. Work with the ADD and sub-district agriculture extension officers to promote conservation agriculture practices that maintain and enhance ecosystem services, including improving soil fertility and avoiding soil loss, maintaining strips of natural vegetation between crop patches, to reduce the risks of crop or soil loss and maintaining natural vegetation buffers along channels.

1.4. Working with commercial, smallholder and subsistence farmers, introduce measures to minimise the use of pesticides and artificial fertilisers, thereby reducing the impact on water quality.

1.5. Ensure that flows (in and out of the Elephant Marsh) and sediments are monitored (including community-based monitoring), particularly from the Ruo entering the lagoons in the southern part of the Elephant Marsh and that information about sediments and the impact of sedimentation is shared with the Shire River Basin Authority.

1.6. Opportunities for clearing of alien plants should explored based on the national alien plant strategy.

1.7 Host workshops and develop materials to share techniques and identified ‘best practices’ that can conserve biodiversity and maintain ecosystem services with government agencies, NGOs, consultants, international fora (e.g. Ramsar, CBD COP) and interested stakeholders

### 2.3.2 Objective 2: Develop and promote the sustainable and wise use of wetland resources while minimising impacts by enhancing the productivity of resource utilisation.

**Current status:**

A critical challenge will be to identify how and where agriculture fits within the wetland management plan. This is made more complex because many farmers are in a situation where

they are unable to reliably feed their families each year and their priority is a secure food supply. Farming in and around the Elephant Marsh is focused on staple crops, of which maize is a central component, and one requiring a minimum threshold of soil moisture for successful cropping. Individual areas for cultivation are typically small and households often face food shortages over the course of the year. Changing cropping patterns, managing water and soil moisture and fertility through conservation agriculture has the potential to increase yields and contribute to managing environmental impacts at low cost to farmers.

Conservation agriculture, aimed at improving the management of agro-ecosystems to achieve higher productivity and increased food security while enhancing the environment is widely promoted. In addition to conservation measures that can reduce erosion and increase soil moisture and fertility (see Objective 1) crop rotation (e.g. maize and groundnut) and intercropping (e.g. maize with pigeonpea) are measures that can improve yields and reduce risk. Increasing the productivity of existing lands, particularly with regard to recession farming, will be important in reducing the incentive to extend farmlands into the Elephant Marsh.

Over harvesting of wild resources was also identified as a potential threat and a conservation concern. In the case of the Elephant Marsh, this includes plant harvesting, fuel wood collection, overgrazing, overfishing and excess hunting pressure. An obvious response to the threat of overharvesting is to introduce legislation to prohibit or limit the harvest. However nature of overharvesting and drivers are often complex and care has to be taken to ensure that pursuing a legislative solution will not simply change the nature of the problem, displace it or even exacerbate it (e.g. Claridge and O'Callaghan, 1997).

In the case of the Elephant Marsh, historical patterns of exploitation, including the dependence on wild resources by refugees and the combination of commercial and subsistence exploitation (e.g. livestock and hunting) can complicate control. For example, commercial grazing may in practice reduce the amount of wetland vegetation that can be harvested. It is important in such situations that care is taken to identify the drivers for overharvesting (e.g. commercial or subsistence use) so that actions are addressing causes rather than symptoms and, secondly, that restrictions are proportional to the impact. Local people may not have many options regarding resource use, particularly in times of drought or flood and inappropriate regulation can make things worse. Other issues are that the institutional framework for biodiversity conservation and sustainable use is fairly weak in practice, due to uncoordinated sectoral approaches to wetland planning (including different administrative units) and the fact that responsibility for the Elephant Marsh is split between Nsanje and Chikwawa. This could be addressed to some extent by focusing interventions and pursuing coordination at the local level.

There is evidence from interviews that BVCs can and do regulate some aspects of fishing activities (see also Kosamu et al., 2016). This again can represent an opportunity to build on successful initiatives. This can include facilitating information sharing but also helping the BVCs address issues that they are currently unable to control, for example in the Southern area establish mechanisms for the Fisheries Department in Nsanje to support local BVCs in addressing illegal gear use.

The frequency of fires during dry periods in the marsh and surrounding areas is also believed to have increased with population increase and encroachment into the marsh in dry years. Fire is used to facilitate the establishment of new cultivated fields at these times. However, burning also dries papyrus marsh and it has caused extensive habitat loss and modification. This threatens mammal, reptile and amphibian populations, especially those that are not able to vacate quickly enough to escape the fire. It is important therefore that burning complies with the best practice to limit potentially harmful practices

People living in the Elephant Marsh are vulnerable to water-borne diseases, in particular malaria, bilharzia, cholera and diarrhoea. These are reported to be correlated with areas of

stagnant water that form following inundation. Malaria transmission is perennial, with seasonal increases after rains during November–April (Bennett et al. 2013). Cholera and diarrhoea are related to poor access to clean water and sanitation that is attributable to limited maintenance of existing water facilities and spatial coverage of permanent latrines combined with flooding and siltation, theft and vandalism of water facility infrastructure and equipment. In addition to more acute illness there are high morbidity and mortality rates due to Tuberculosis and malnutrition and a high prevalence of HIV/AIDS and orphanhood.

Crocodile (and to some extent hippopotamus) attacks on people are said to be common as the fishers and farmers make use of the marsh for livelihood and basic life (washing, collecting water) activities. Crocodiles are particularly problematic as these can destroy fishing gears and attack people. The protection of hippos in the Elephant Marsh is a serious concern. Their damage-causing behaviour, threat to the local people, and the fact that they provide a large amount of meat and fat make the hippo a target species. The main problem with hippo is that they require inundated areas during the day, but often travel large distances at night to graze dry land. While there are plenty inundated channels for them to seek refuge during the day, they are severely limited in areas where they may graze safely, such as un-cultivated floodplain areas. Local people have tried various means to address the issue of wildlife interactions (e.g. scarecrows and guards for hippos and fences for crocodiles) with varying degrees of success.

While wildlife is often viewed as a resource or problem, given the proximity of Lengwe and Majete and the alternative forms of wildlife available in the Elephant Marsh it may be possible to develop the potential of the Elephant Marsh as a tourist site and as a source of benefits to local communities. Birdlife is plentiful and offers potential for some bird-watching based tourism. In order to maximise the value of this ecosystem service, tourism access to the marsh would need to be improved. These opportunities should be explored and pilot activities trialled.

**Proposed activities:**

2.1. Work with the ADD and sub-district line agency extension workers to extend conservation agriculture and natural resource management practices that can enhance productivity. This includes measures such as adding mulch to reduce soil organic matter depletion and erosion, staggering the cultivation of crops to avoid extensive bare ground, which can represent an erosion hazard and promotion of sustainable harvesting practices (fish, birds and reeds).

2.2 sustainable enhance productivity and market value of natural resources (fish, reeds etc) through enhanced management measures for both commercial and subsistence harvesting to increase livelihoods benefits.

2.3. Working with the communities around the central area, identify potential sites for tourist visits and potential mechanisms for benefit sharing (e.g. local guides) and initiate some pilot tourism activities.

2.4. Ensure that burning within the Elephant Marsh complies with the Best Management Practices in order to minimise burning practices that are potentially harmful.

2.5. Measures to enhance water availability and improve sanitation were important in all areas. Coordinate with District Councils to provide clean water and sanitation to villages and schools.

2.6. A combination of increasing the effectiveness of the problem animal measures by DNPW and action research with local communities to pilot measures to combat problematic wildlife interactions should be undertaken.

2.7. Host workshops and develop materials to share techniques and identified ‘best practices’ that can enhance productivity and ecosystem services with government agencies, NGOs, consultants, international fora (e.g. Ramsar, CBD COP) and interested stakeholders

### 2.3.3 Objective 3: Strengthen policies and institutional capacities for the effective management of the Elephant Marsh.

**Current status:**

In order for the management plan to be effective it is critical that the importance of the Elephant Marsh is recognised. Establishing the Elephant Marsh as an internationally recognised wetland (e.g. Ramsar) should achieve this and provide a focus for policy and a means to leverage resources to support the management plan.

Currently there are many activities affecting the Elephant Marsh that are occurring independently at the local level. While the District Council provides an important coordinating mechanism, it is also important to consider the opportunities for networking amongst groups with similar interests (e.g. agricultural producers, BVCs). Similarly, given the importance and impacts of activities upstream of the Elephant Marsh (including Shire, Ruo and Mwanza rivers) it is important to consider initiatives within the Elephant Marsh in the context of wider Shire River developments. In particular it should be recognised that land use changes and infrastructure development, for example related to hydropower and irrigated agriculture, are likely to affect the natural flow regime and potentially threaten The Elephant Marsh. As such, an integrated basin-scale perspective is also required. It is therefore important that institutional linkages are created or enhanced within the Elephant Marsh and with outside interests so that information from the Elephant Marsh, in particular related to developmental impacts, can inform basin and national policies.

The management plan requires a variety of technical skills to support its implementation. These already exist to some degree within the line agencies, NGOs and communities. However, the studies have indicated that there are weaknesses at the local, sub-district level. Within the fisheries and agriculture departments there is an emphasis on data collection as opposed to extension. Data collection is also currently limited to production and there is a need to develop planning, analytical and monitoring skills to include wider issues such as biodiversity assessment, water quality, vegetation monitoring and GIS as well as the ability to incorporate forecasting (e.g. short-term meteorological and longer-term climate change predictions) into planning processes. Furthermore, there is a need to develop data collection capabilities beyond line agencies. Private sector, NGOs and local communities can all play a role in identifying appropriate indicators and collecting relevant data to support adaptive management.

Planning, monitoring and evaluation skills will be important together with the ability to organise and present information effectively. Furthermore, there are key sets of skills that need to be developed relating to working with communities, other line agencies and private sector interests to support local management. This will be important, e.g. for community fisheries management, management of local conservation areas, managing water quality etc. Skills in facilitation, problem identification and problem solving and conflict resolution will be important in this respect. In addition to piloting activities and extending best practice, there is much that can be learned from what people already do. Staff working at the local level should therefore have good communication skills and be able to encourage the participation of relevant stakeholder groups and key individuals and be able to support the development of networks and information-sharing events. A draft monitoring framework is proposed (see Section X) that incorporates key themes related to the objectives including physical processes and connectivity, biodiversity, land use, ecosystem services and livelihoods benefits and partnerships and management effectiveness.

Existing technical, institutional, and financial resources to implement the draft management plan are currently lacking at the local level and limited at best at the district and national level. As part of the management plan it is recommended that sources of funding and expertise are

sought and potential public-private partnerships are explored, for example with commercial agriculture operations and/or tourism operators.

**Proposed activities:**

3.1 DNPW to expedite the declaration of Elephant Marsh as an internationally important wetland in accordance with Ramsar.

3.2 Identify Focal Points at the National, District and sub-district levels who shall have a key role in coordinating activities and ensuring the efficient and effective implementation of the management plan.

3.3 Initiate and formally develop the formation of partnerships with a) relevant commercial landowners and cooperatives as a basis for implementing agriculture, grazing and land use best practice guidelines and b) upstream actors for conservation of the catchment areas upstream of the Elephant Marsh to support collaboration and information sharing, including between private and public sectors and c) education providers to assist with needs assessments and the development of management and technical skills.

3.4 Formalise relations with the communities in and around the Elephant Marsh through links with village sub-committees (e.g. BVCs), village heads and Group Village Heads and the establishment of associations of village sub-committees within each of the Elephant Marsh sub-areas to promote communications, coordination and peer-to-peer learning.

3.5 Develop forecasting techniques and links to meteorological and climate change data to inform District Councils and communities of likely climate and flood characteristics in advance to enhance adaption. Develop an outreach strategy to share with people and key agencies the result of conservation and livelihoods activities and local assessments of the likely impacts of forecasted change on the Elephant Marsh.

3.6 Ensure alignment with the District Council local development strategies and ensure monitoring data contributes to local state of the environment reports.

3.7 Initiate discussions with private sector and donor agencies to expand support for wetland conservation projects, including private sector support, to increase funding leverage.

3.8 Hold training workshops to develop data collection, monitoring and assessment capacity amongst technical staff, educators, and local communities

3.9. Provide support and resources for citizen science and community wetland monitoring and small-scale pilot community conservation and livelihoods projects.

3.10 Seek to develop national and international partnerships to research the drivers and dynamics of change within the Elephant Marsh.

### 2.3.4 Objective 4: Strengthen the knowledge base to support conservation, management, planning and restoration efforts and raise awareness of the important role of wetlands, their ecosystem functions and livelihood values.

**Current status:**

The studies that were undertaken sought to address in the short term an issue of insufficient and fragmented data and information. In order to develop a knowledge base and guide the sustainable utilisation of the Elephant Marsh and conservation and planning processes, regular monitoring of the Elephant Marsh will be necessary. Management planning is an ongoing process, and needs to be based on up-to-date information from long-term monitoring

schemes combined with accurate short and long-term forecasts of change within the area. Protocols should be developed to support the generation of long-term data sets that are adequately resourced. These protocols should be reviewed regularly as part of the adaptive management. Objective 3 above has highlighted issues and activities to strengthen capacity to develop the knowledge base, the activities listed here focus on the actual knowledge that will be required and activities to generate it.

In addition to generating information, it is important that it is shared to inform the management planning process and also make it available to external stakeholders. Communication activities that can synthesise data and lessons learned and identify opportunities for sharing to improve local, national and international planning can help highlight the threats, impacts and opportunities to improve wetland planning and the contributions of healthy wetlands to local livelihoods.

**Proposed activities:**

4.1 Implement a series of communications (workshops, policy briefs and presentations) to educate District Councils, line agencies, NGOs and donors of the status, importance and contributions of the Elephant Marsh to livelihoods, role of ecosystem services in the local economy, key threats and responses.

4.2 Develop sampling and monitoring protocols for wetland monitoring and assessment for the Elephant Marsh, including ecosystem processes (e.g. flow, water quality, sedimentation), biodiversity (e.g. birds, fish and other critical species and groups) and livelihoods (e.g. land use, extent of conservation agriculture practices). Seek to include the use of novel forms of monitoring (e.g. drones) as well as community-based monitoring.

4.3 Collate establishment of conservation areas, conservation agriculture, refuge creation (Activities under Objectives 1 & 2) into an overall Elephant Marsh conservation and restoration strategy that can be monitored and regularly updated.

4.4 Establish and update regularly a wetland inventory and database to support the Elephant Marsh conservation and restoration strategy including land use, vegetation and biodiversity.

4.5 Ensure wetland management and planning is evidence-based by contributing to National Wetlands policies and guidelines through Biodiversity and Wetlands committees and contributions to national reporting commitments, e.g. under Ramsar and CBD.

4.6 Make monitoring and assessment information (objective 3) available, e.g. for tourism operators, NGOs etc. in a variety of ways, including public-friendly materials.

## 2.4 Monitoring framework

This monitoring framework is intended to capture changes in the health of the Elephant Marsh and the benefits derived from it. Indicators have been suggested for each of the objectives. In developing the monitoring framework a landscape-scale perspective was used so that biotic, abiotic and human factors are all captured. The framework should be developed further in consultation with local stakeholders to incorporate additional locally-relevant indicators to provide an agreed set of indicators across scales that can form the basis for the long-term assessment of the health of the wetland as well as a means to evaluate the effectiveness of management and local management strategies. Frequency of monitoring/sampling will depend on the resources available and the extent to which the responsibility can be shared (e.g. village monitoring of rainfall, government monitoring of flows and water quality). Opportunities to use cost-effective methods such as mobile phones and drones should be explored.

### Cooperative conservation of the hydrology, flora and fauna of the Elephant Marsh

Hydrological conditions shape the habitats within the Elephant Marsh and fluctuate within and between years with the flood cycle. Conditions both determine land use (e.g. subsistence and smallholder agriculture) and are shaped by it (e.g. catchment deforestation and commercial agriculture). Monitoring of rainfall, water flow and water levels are important for adaptive management and can be combined with basin-scale monitoring and forecasting. It is expected that flooding and drought will both be affected by changing climates and how soil, hydrology and land use are affected should be monitored to identify adaptive strategies and avoid maladaptive when floods and droughts occur.

Biodiversity represents a key indicator of wetland health and ecosystem function. Both species and habitats should be monitored to give a full representation of the state of the wetland. Species such as the hippopotamus that are important for the function of the wetland and African Skimmer that make the Elephant Marsh a nationally important wetland should be surveyed regularly. Invasive non-native species can impact on wetland hydrology and ecology so should also be monitored. Some of the monitoring can be combined with ongoing monitoring, e.g. Fisheries catch surveys and bird census.

Connectivity between habitats within the landscape are important, particularly for species moving within the wetland, for example butterflies and fish. Indicators of structural connectivity can provide an indication of physical connections between habitats and how easy it is for species to move through the wetland between patches.

**Table 3: Indicators for regular monitoring of conservation status**

| Thematic area | Suggested indicators | Activities | Method |
|---|---|---|---|
| Hydromorphology | Water quality (DO, nitrates, pesticides) across the Elephant Marsh | 1.4 | Assess parameters monthly at key locations across the Marsh. |
| | Water clarity and suspended sediments | 1.5 | Secchi disc and water quality assessment at key locations. |
| | Flows into the Elephant Marsh (e.g. Shire, Ruo and Mwanza) and out of the Marsh | 1.5 | Water levels should be monitored on channels entering the Elephant Marsh and at key points across the site. |
| | Annual flood cycle (Period and duration of flooding, flood extent and maximum water height) | 1.5 | Combine water level data with data collected by either by directly surveying areas during flood events or gathering telemetry data and aerial photos from partner organisations. |
| | Rainfall | 1.5 | If possible rain gauges should be installed across the wetland. If this is not possible data should be obtained from local weather stations. |

| Thematic area | Suggested indicators | Activities | Method |
|---|---|---|---|
| Biodiversity | Numbers of key species (birds hippopotamus, crocodiles and fish) | 1.1, 1.2, 1.3 | e.g. annual wetland bird survey, aerial surveys, DFO catch survey. |
| | Sampling of locally important invertebrates (butterflies, dragonflies) | 1.1, 1.2, 1.3 | Dependent on species being surveyed. |
| | Extent and coverage of non-native plant species | 1.1, 1.2, 1.3 1.6 | Annual monitoring of the distribution of plants in wet and dry seasons and information from village committees. |
| Habitats and connectivity | Ecological status of Elephant Marsh subareas | 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 3.1 | Aggregate assessment using land use and biodiversity information to identify habitats, habitat status and vulnerable areas. |
| | Areas of species-rich habitats within the Elephant Marsh | 1.1, 1.2, 1.3, 1.4, 1.5, 1.6 | Condition surveys and information from local partners, companies and line agencies. |
| | Area of wetland habitats identified as conservation areas | 1.1, 1.2, 3.1 | Data from village committees, District Councils, companies and line agencies on number, location and extent of conservation areas. |
| | Extent and composition of bankside and aquatic vegetation | 1.2, 1.3, 1.6 | Data for this indicator can be collected as part of other habitat surveys. |
| | Extent of buffers, channels and buffer width near channels and cultivated land | 1.3 | Data for this indicator can be collected as part of other habitat surveys. |

**Sustainable and wise use of wetland resources enhancing the productivity of resource utilisation.**

Given that wetlands are important for people as well as wildlife, monitoring land use and harvesting of natural resources across the wetland provides an aggregated view of change at the landscape scale and the potential to assess the contribution to ecosystem health of local level conservation and management strategies. The extent to which the opportunities for livelihoods, tourism and income generating activities are realised should also be reflected in the monitoring framework.

| Thematic area | Suggested indicators | Activities | Method |
|---|---|---|---|
| Land use | Area of wetland being used for grazing, agriculture, fishing, harvesting of natural resources and other activities. | 2.1, 2.2, 2.3 | Aerial surveys, data from village committees, District Councils and line agencies supplemented with walk over surveys at key points in the year |
| | Number/proportion farmers and provided with and adopting conservation agriculture practices | 2.1, 2.4 | Village committees, District Councils and line agency records confirmed by walk over surveys. |
| | Proportion of agricultural area under conservation agriculture practices | 2.1, 2.4 | Village committees, District Councils and line agency records supplemented by aerial surveys |
| | Number/proportion fishers regulated by Beach Village Committees | 2.2, 3.4 | Village committees, District Councils and line agency records supplemented by interviews. |
| Ecosystem services | Measures implemented to improve availability and quality of clean water and sanitation in villages and schools | 2.5 | Village committees, District Councils, NGO and line agency records of boreholes, pumps and latrines provided supplemented by interviews. |
| | Measures implemented to reduce 'problem animal' impacts | 2.6 | DNPW records supplemented by interviews with local communities. |
| | Area used for grazing | 2.1 | Information from local partners, companies and line agencies. Aerial surveys during wet and dry seasons. |
| | Amount of plants harvested and areas used for harvesting | 2.1, 2.2 | Information from local partners, companies and line agencies. Monthly market surveys and aerial surveys during wet and dry seasons. |
| | Quantity of animals harvested (fish, birds and mammals) | 2.1, 2.2 | Information from local partners, companies and line agencies. Monthly market surveys. |

| Thematic area | Suggested indicators | Activities | Method |
|---|---|---|---|
| | Number of tourists using the Elephant Mash and tourist spend | 2.3 | Information from local partners, companies and line agencies. |
| Wellbeing and resilience | Dependence on food aid and work for food | 2.1, 2.2, 2.3 | Line agency, NGO and District Council data supplemented by stratified beneficiary surveys in each sub-area. |
| | Production volumes of key resources (reeds, fish, crops, livestock etc.) | 2.1, 2.2 | Fishing and hunting permits allocated; Quarterly and annual production data from relevant line agencies |
| | Market prices for key resources | 2.1, 2.2 | Monthly market surveys |
| | Perceptions of positive change in income, food, health and opportunities to support livelihoods. | 2.1, 2.2, 2.3, 2.4, 2.5 | Annual stratified beneficiary surveys in each sub-area. |
| | Health (e.g. cholera, malaria, dysentery and animal attack) | 2.4, 2.5 | Quarterly and annual data from relevant line agencies. |

**Strengthen policies and institutional capacities**

In addition to monitoring the outcomes of management and the use of the Elephant Marsh, it is also important to assess the process of managing the site and the extent of engagement with management planning. Wetlands often have a number of stakeholders that need to work together to ensure the management objectives of the area are met. Monitoring of policies and institutional capacities and the effectiveness of partnerships at the local level focuses on identifying the extent of engagement with the process and the changes in behaviours (individually and collectively) that can be identifies as a result.

| Thematic area | Suggested indicators | Activities | Method |
|---|---|---|---|
| Policies | Information/evidence from the Elephant Marsh presented and used in District Council, Shire River Basin and National policies | 1.7, 2.6, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7 | Review District Council, SRBA and national policies and plans. Ramsar reports. |
| | Value of aggregate ecosystem services from the Elephant Marsh | 3.6 | Aggregated information from relevant line agencies. |
| | Number of government and multi-agency initiatives to address conservation and | 3.3, 3.4, 3.5 | Annually collate information on collaborative projects and activities |

| Thematic area | Suggested indicators | Activities | Method |
|---|---|---|---|
| | livelihoods within the Elephant Marsh | | |
| Institutional capacity | Line agency and district staff educational qualifications | 3.3 | Annually collate information on staff qualifications |
| | Number of research projects and educational events focused on the Elephant Marsh | 3.8, 3.9, 3.10 | Annually collate information from national science council, line agencies and NGOs on research and educational initiatives in the Elephant Marsh |
| | Level of investment in the Elephant Marsh from government, NGO, donor and private sector sources | 3.6, 3.7, 3.8, 3.9, 3.10 | Annually collate details on income available to finance management activities in the Elephant Marsh from donors, NGOs, private sector and government (national and sub-national) |
| | Number of planning and training events held with multi-stakeholder participation | 3.8 | Collate data from line agencies, District Councils, NGOs and village committees on training events and participants |
| | Number of local people and organisations contributing to management of the Elephant Marsh | 3.4, 3.8, 3.9 | Annually collate data on membership of local organisations (e.g. CBOs) and village committees linked to the management of the wetland |
| | Stakeholder self-assessments of knowledge, attitudes and practices | 3.8, 3.9 | Annual stratified stakeholder surveys |

**Strengthen knowledge base and raise awareness of the important role of wetlands, their ecosystem functions and livelihood values.**

It is important that the success (or otherwise) of activities implemented in the Elephant Marsh are shared. Furthermore, the health and status of the Elephant Marsh has national and international implications. It is therefore important to assess the extent to which information is being managed and shared.

| Thematic area | Suggested indicators | Activities | Method |
|---|---|---|---|
| Strengthening knowledge base | Development of database for knowledge management | 4.2, 4.4 | Document development and use of the Elephant Marsh Database |

| Thematic area | Suggested indicators | Activities | Method |
|---|---|---|---|
| | Number of publications/reports | 4.3, 4.5 | Quarterly updates to bibliography on the Elephant Marsh |
| | Number of knowledge products for wider stakeholders (websites, news articles, leaflets etc) | 4.6 | Collate information from NGOs, private sector District Councils and line agencies on knowledge products produced and shared, including metrics such as number produced, website hits, mailing lists etc. |

## 2.5 Institutional arrangements, roles and responsibilities

The institutional context of the Elephant Marsh and the nature of the activities to be initiated under the draft management plan outlined above highlight roles for a range of actors and agencies at scales from national to local. In this section we provide some initial suggestions of these actors and agencies that should be engaged from the outset in further developing and implementing the management plan.

### 2.5.1 National level

At the national level it is expected that the DNPW would assume the responsibility of lead agency and principal coordinator for the management plan. The Ramsar focal point would be responsible for taking forward the proposal to establish the Elephant Marsh as the second Ramsar site in Malawi. To implement the plan, the DNPW will need to coordinate at national with the Ministry of Ministry of Agriculture and Food Security, Irrigation and Water Development, Ministry of Natural Resources, Energy, and Environment and Ministry of Health. At the national and sub-national levels this will also include the Department of Fisheries, Department of Agriculture, Forestry Department, Environmental Affairs Department, Department of Disaster Management Affairs and Department of Education. This coordination can ensure that the plan is reflecting and contributing to wider national aims and objectives.

Beyond the government agencies, resources for the plan can also be mobilised through engagement with donors, NGOs and the private sector. Key donors include the EU (currently working with smallholder agriculture and rural infrastructure development in and around the Elephant Marsh), USAID, DFID, the GEF, UNEP and the Malawi National Environment Endowment Trust. These stakeholders can potentially play an important role in providing financial resources to support the plan.

The lead agency should take advantage of existing coordinating bodies to raise awareness of the management plan and planned activities, ensure the complementarity of key activities with existing plans and strategies (e.g. the Malawi Agricultural Sector Wide Approach) and mobilise resources in support of the plan. Examples of coordinating bodies include the National Wetlands Committee, National Committee on the Environment, National Committee on Climate Change and National Biodiversity Committee. Through these committees it should be possible to engage with wider stakeholders from NGO and academic fields with relevant expertise and resources to support the management plan. This includes the Wildlife Environmental Society of Malawi, National Herbarium, Chancellor College, Mzuzu University, Malawi Polytechnic and the Shire River Basin Authority.

### 2.5.2 District and local level

Activities will be implemented at the local level and it is therefore critical also that effective partnerships are created at the District and sub-district levels across the Elephant Marsh. This is reflected in the objectives of the management plan.

Under the national decentralisation policy and the subsequent Local Government Act Government of Malawi, administration and development responsibilities were transferred from central government to District Councils (DCs). In addition, the Malawi Growth and Development Strategy (MGDS) recommended decentralisation as a means for consolidating democracy and achieving the country's poverty reduction goal. Under this process Village Development Committees (VDCs) (at village level, headed by the village headperson) are intended to oversee planning, supervision and implementation of developmental activities at the grassroots level (DLG 2001). The VDCs are supposed to report to Area Development Committees (ADCs) (at Traditional Authority level, headed by the TA of the area), which in turn report to the relevant District Council (Nsanje and Chikwawa in the case of the Elephant Marsh – see Figure 8). Traditional Authority boundaries as they relate to the social-ecological sub-areas identified are shown below in Figure 8. The District Council (DC) is supposed to be a body comprising of elected ward councillors, Members of Parliament (MPs), Traditional Authorities (TAs) and five representatives of interest groups (for Nsanje these are youths, women, faith community, business and livestock owners). This structure represents one channel through which local needs and aspirations can be identified, prioritised and addressed. In addition to the decentralised local planning process, line agencies also have their own decentralised structures. For the Elephant Marsh there are three key agencies related to natural resources: agriculture, fisheries and parks and wildlife.

**Agriculture**: The Elephant Marsh fall under the Shire Valley Agricultural Development Division (ADD) in Ngabu. The ADD is further organised into Extension Planning Areas (EPAs) which are further organised into sections. Each EPA is headed by a Chief Technical Officer (CTO) while each section is headed by a Technical Officer (TO). EPAs tend to extend from upland down into the Elephant Marsh.

**Fisheries**: The northern part of the Elephant Marsh falls under Chikwawa District fisheries administrative area (under the Chikwawa District Fisheries Officer based at Kasinthula) while the southern end falls under the Nsanje District fisheries administrative area (under the Nsanje District Fisheries Officer based at Nsanje boma). For monitoring purposes the Elephant Marsh is divided into four minor strata that each contain a number of beaches where catches are sampled. Each minor stratum is supposed to have a fisheries extension officer (responsible for extension activities in his or her area) and a fish scout (responsible for data collection). For management purposes the Fisheries Department has created Beach Village Committees (BVCs). There are about 20 BVCs on the Elephant Marsh (Kosamu et al., 2012).

**Parks and National Wildlife**: The national park at Lengwe, adjacent to the Elephant Marsh manages officers who are on call to deal with problem animals (hippos, crocodiles and monkeys). The Department has an interest in supporting conservation and developing ecotourism within the Elephant Marsh to complement activities at Lengwe and is the national Ramsar focal agency.

These agencies are able to extend support to the local level through 'community-based organisations' (CBOs) or sectoral management committees at the village level as a means to identify local priorities and allocate and channel resource. CBOs and sectoral management committees (including Beach Village Committees, Agriculture Farmers Clubs, Forestry Management Committees, etc.) are supposed to function under VDCs, thereby proving the link between local level sectoral natural resource management and administrative

decentralisation. However, at least for both fisheries and agriculture, while there is a decentralised structure, several of the posts at the local level are vacant. This means that effectively there are weaker links between the central government and fishers and farmers and technical capacity to support local communities to manage resources and to develop networks is limited. It is therefore critical that in implementing the plan that there is attention paid to the relationship between village committees and local governments and on working together to identify, implement and/or enforce local management strategies (see Section 2.6.1).

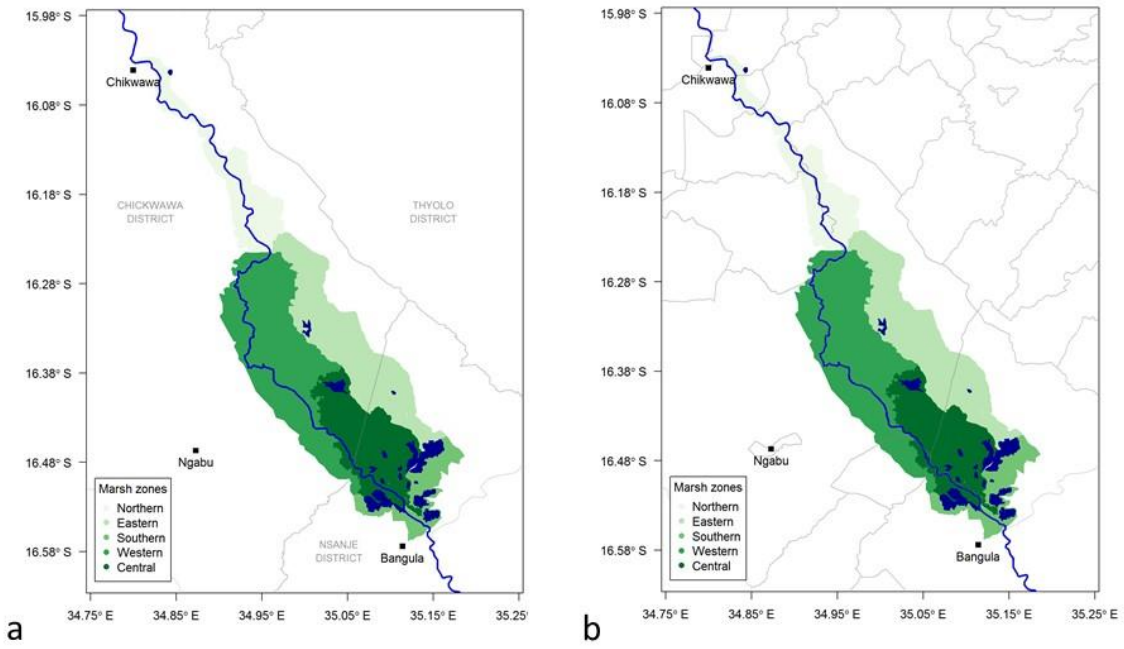


**Figure 8: Location of the Elephant Marsh and the social-ecological sub-areas within it in relation to a) district boundaries and b) Traditional Authority boundaries.**

As the Elephant Marsh is largely customary land, held, occupied, or used by community members under customary law and under the jurisdiction of traditional authorities (TAs), the involvement of these traditional authorities in the planning process is important. Under the Traditional Authority system, the Elephant Marsh falls under TAs Lundu, Ngowe and Ngabu on the west bank in Chikwawa District; TAs Makhuwira, Maseya and Katunga on the east bank in Chikwawa District; TA Mbenje on the west bank in Nsanje District; and TA Mlolo on the east bank in Nsanje District (Figure 8).

Commercial agriculture and livestock raising are important actors in the Elephant Marsh and their activities also have the potential to impact on the Marsh environment and ecosystem. Engaging with these private sector organisations will therefore be important and key commercial operators such as Illovo and Presscane should therefore be engaged from the outset to identify what they can contribute to the management plans in terms of land management, abstraction and discharge from and into the Marsh, establishing conservation areas and buffers and supporting other elements of the plan through financial and in-kind contributions. Other commercial operators, such as tourism agencies should also be engaged early on to identify the kinds of activities and experiences visitors might be interested in from the Elephant Marsh, what the demand might be and how best this could be catered for. This would provide a useful basis for developing the tourism potential of the site.

The following section describes a process by which the key institutional actors could be engaged in order to focus on the development and implementation of conservation and livelihoods activities at the local level to achieve the aims and objectives of the management plan.

## 2.6 Implementation and adaptive management

A key issue in natural resource management that needs to be addressed therefore is communication, collaboration and trust (e.g. Borrini-Feyerabend et al., 2004). Because of the nature of the institutional arrangements and land tenure, the draft management plan is based on an approach that encourages local government staff to work together with other sectors and with local people on concrete activities at the local level and to enable local people to work with others around the Elephant Marsh. The activities identified in Section 2.3 represent priority issues to address at the whole marsh and sub-area scales that should form the basis for working together at the local level and for developing activities with local institutions and communities.

In the case of the Marsh, it is proposed that responsibility and authority for management is shared between communities dependent upon the Elephant Marsh and government. One of the main aspects of this recommended process is an emphasis on developing capacity at the local level to enhance the climate resilience of the Marsh landscape and the communities that depend thereon. This can be achieved through explicit consideration of the needs, aspirations and wellbeing of the communities and the implementation of interventions that provide local communities with opportunities to inform and influence the planning process.

The focus of management planning should be to support existing institutions (outlined above) in this role, enhancing individual and collective adaptive capacity. Recognising that the performance of these local institutions varies (e.g. Kosamu et al., 2016), mechanisms should be identified that will help them to improve their performance and accountability. A key step in doing so could be to develop networks that also extend to include the private sector, whereby experiences and emerging best practice can be shared and coordination between upstream and downstream areas achieved. These networks can also provide opportunities for local institutions to present progress, discuss priorities with the government agencies at regular meetings, and develop regular joint action plans that play to the strengths of each (e.g. Armitage et al. 2010; Garaway and Arthur, 2004). Whilst it might be highly desirable, it will not be logistically possible for all villagers to be involved in this process. Instead, traditional methods for them to express their views (via the village sub-committees) should be used but with additional checks in place to ensure that their needs are being considered (see Section **Error! Reference source not found.**).

The majority of land, natural resources and water management decisions are made and enforced at the local level. The local level therefore represents an important entry point for effective and sustainable management of the Elephant Marsh. Weakness in the current local government structures mean that the sectoral committees and CBOs that operate at the community level represent a key entry point. These community-level organisations can, and already do, manage and play an important role in regulating use of natural resources. For example, the Beach Village Sub-Committees enacting and enforcing by-laws, for example banning use of certain fishing gears and methods.

The next section provides suggestions for how partnerships and effective working arrangements could be developed between relevant institutions in order to implement that activities identified in Section 1.7.

### 2.6.1 The adaptive management process

The approach is based on adaptive management whereby activities are implemented and monitored in order to identify what works in an iterative manner. In a dynamic system like the Elephant Marsh where there is a great deal of variation, identifying land use and conservation options that are appropriate for different conditions is important. Thus planting strategies for drier years or wetter years can be identified and contribute to an emerging set of best practice for the site. Figure 9 below illustrates the process that can be implemented and the roles of the line agencies and village level committees. This is explained further in the following sections.

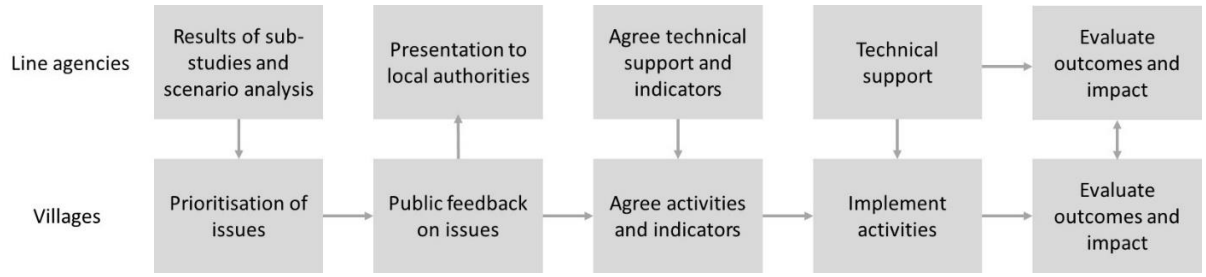


**Figure 9: Process of agreeing and implementing local activities.**

#### 1. Prioritising conservation and livelihoods issues

The first step is to use the outputs from the sub-studies and proposed activities to undertake a series of community and district level workshops around the Elephant Marsh to share the results and discuss the issues and management priorities:

a) Community-level: Using the TAs as an administrative unit. DNPW will convene the workshops and they should involve key village institutional representatives from a number of villages within the TAs together with relevant line agency representation (agriculture, fisheries and health). The relevant sub-area results of the sub-studies and identified priorities (Section 2.3 and Table 2) should be presented and discussed with community-level representatives.

In addition to presenting the results, these workshops would allow people to discuss what they currently do - and why - and the drivers of their actions. This can lead on to exploring how they understand degradation and a ranking of the constraints they face to responding adaptively to change and when adapting shifts to coping or maladaptive strategies (see Arthur and Hara, 2016). This discussion will be the basis for identifying priority issues, broad response strategies (as above) and the local institutions (e.g. Farmers' Club, BVC etc.) and individuals, e.g. village chiefs and committee chairs that might have a role related to them. This will also document the spatial and social boundaries of influence of these institutions. These workshops will help to identify the scale and level at which the issue needs to be addressed and what roles different stakeholders can play in addressing it. The ADCs have assessments of local priorities that are fed into district planning processes and these, together with the priorities identified through the sub-studies can form the basis for coordinated conservation and livelihoods plans.

b) District-level: Alongside the community-level workshops, the maps, results of the studies and priority activities discussed at the workshops should be presented to local authorities to obtain any necessary authorisation for the development of technical support. Other stakeholders, for example the Illovo sugar plantation, should also be informed and made aware of the process and priorities. They may be able to provide additional feedback and support. Training will be provided to district level staff on key skills that they will require

including: participatory approaches and PRA tools; methods for conflict resolution and communications.

Through the workshops held at the two levels, an initial common understanding of the issues and agreement that the actors will collaborate to address them will be established in each district and sub-area. The common understanding can also provide the basis for identifying local priorities and potential solutions. Scenario analysis, such as the one done here for the Elephant Marshes using DRIFT, are intended to provide the information needed for and support discussion and negotiation between all the stakeholders through examination of the implications of alternative actions. On the basis of the outcomes of the workshops, further scenarios could be developed to explore other issues or look in more detail at particular areas.

**2) Public feedback**

Following the workshops, those attending will be required to present the outcomes of the workshop to local people and discuss and agree the local priorities. Attendees will be required to describe the consultation process, who was involved and document the priorities that were discussed and any changes made to those identified in Stage 1.

At the same time as public support for the identified priorities is sought through the village administrations, these same priorities should be the basis of an assessment of existing technical and institutional solutions, and the potential benefits that can be realised from addressing them. This will include reaching out to other relevant departments and NGOs to identify support for elements such as sanitation and provision of boreholes.

Existing best practice should be identified and catalogued in a searchable database based on the priorities, for example the different elements of conservation agriculture, water and sanitation, options for managing fishing effort and approaches to minimise negative interactions with wildlife. These should then form the basis for collating (where they exist), or developing, a series of Technical Support sheets that summarise the issue, the nature of the response and how it can be implemented (e.g. minimising the incidence of cholera). These in turn can be used to develop accessible communications products for these technical options that can be used by extension workers and villagers.[16] This activity should be coordinated with some of the other components of the SRBMP that have been addressing livelihoods issues. It is important in the context of the Elephant Marsh that the identified practices should address the issue (e.g. run-off) rather than directing or shifting the issue downstream.

**3) Agree activities and indicators**

A second series of workshops should be held to agree management actions across the sub-areas. This will be a smaller set of workshops with village and TA representatives held at District level to feedback the support for different priorities and actions. Bringing stakeholders from different sub-areas and from relevant private sector actors such as Illovo together provides an opportunity to initiate communication across the sub-areas and between relevant TAs. These discussions are aimed at finalising the priorities and encouraging stakeholders from different sub-areas to appreciate the nature of the issues in other sub-areas. Some of these will be common while others may be more specific (see Table 2). The larger-scale discussion enables ideas to be shared between areas and upstream/downstream impacts to be considered.

For some of the priority issues (e.g. wildlife interactions) it will be the case that there is either uncertainty about the effectiveness of what is identified as best practice in the context of the Elephant Marsh, or there may currently be no effective, low cost solution. In this case it may be possible to identify or elicit from participants ideas for how to address the issue that can be

[16] http://award.wordpress.hupu-labs.biz/wp-content/uploads/sites/2/2015/11/WR-02C-d024.pdf

tested through a process of local action research and learning. Stakeholders will discuss and agree the strategies and the support that will be provided as well as the way the initiative will need to be monitored to be able to assess the benefits. Criteria for selecting which issues to address and which strategies to adopt will include the likely benefits and uptake potential, long-term benefit against short-term risks and costs, the institutional capacity to support the different strategies and the availability of appropriate sites/willing participants. Once the strategies are selected, criteria for evaluating the implementation process and outcomes in the light of stakeholder objectives will be agreed and responsibility for data collection identified. Finally an initial implementation timetable will be developed with participants.

The discussions are a basis for agreeing actions and responsibilities; it should be stressed that this stage represents the agreement between local management institutions and the line agencies. The agreements should make clear the roles and responsibilities of each, for example the technical and enforcement support to be provided on the one hand, and the monitoring that is expected on the other.

The final set of agreed issues from both District-level workshops will form the basis for action. These will be documented and the representatives will present the agreed actions at community level. It will also be the basis for identifying information sharing and networking opportunities for community institutions addressing similar issues, for example BVCs addressing the issue of gear theft, and the basis for comparing different strategies.

**4. Implement activities**

Drawing on the Technical Support sheets, local government staff will assist and set-up activities in each sub-area according to the District agreement and timetable. Mechanisms for regular communication and support between government staff and user communities will be established and technical support will be provided through the relevant line agencies to local groups. Community members will have responsibility for monitoring implementation, with support from the line agencies. Overall coordination will be provided by the DNPW.

**5. Evaluate outcomes and impact**

Monitoring and evaluation (M&E) are important aspects of any management plan but become critical in an adaptive management plan where it is vital that change is detected so that responsive strategies can be developed and/or implemented and so that the effectiveness of proposed measures can be assessed and modified if necessary. Section 2.4 provides a draft monitoring framework. This is intended to capture information related to the four objectives and can be modified to include more specific and local monitoring of alternative conservation agriculture and fisheries strategies. Where possible, the process will make use of data collection systems that are already in place and innovative and cost-. They may need to be adjusted in order to ensure all the data that is required is included but they have the advantage of being familiar and are likely to be cost effective (e.g. Garaway and Arthur, 2004).

The analysis of the effectiveness of the strategies tested will provide an important basis for assessing the contribution to livelihoods and the conservation of the Elephant Marsh. Where possible local government staff will be involved in assisting with the analysis to help develop their capacity and knowledge. Successful strategies will form the basis for local promotion, including through government extension materials, facilitating study tours where relevant and peer-to-peer learning through local-level networks. Where strategies have been less successful the constraints will be identified and for the basis for possible refinement of the strategy or form the basis for future research.

In addition to the individual strategies, direct observation of the implementation process will help to identify where there are issues of accountability and areas where the process could be improved. Issues that will be a focus for this type of evaluation include communication

(levels and ease), degree of participation at each stage, logistical and financial difficulties caused by need to co-ordinate a large number of people from different areas, occurrence and resolution of conflict. The evaluation will form the basis for recommendations for a next round of innovation and development.

# 3 Conclusions

Through the hydromorphology, ecosystem services, biodiversity, and livelihoods sub-studies and the modelling of past, present, and future scenarios, it has been possible to generate a more thorough understanding of the functional ecology of the Elephant Marsh.

The sub-studies provided the data needed to assess the feasibility of designating the Elephant Marsh as a wetland of international importance under the Ramsar Convention. Based on the criteria provided by Ramsar, the conclusion was that the Marsh did meet the criteria, particularly with respect to birds, and a Ramsar Information Sheet (RIS) and supporting documentation was prepared and submitted for review by the national Ramsar focal point.

The sub-studies were also used to identify objectives, strategies, development options and a monitoring framework to build the resilience of local communities to environmental and developmental changes expected in the Elephant Marsh. Using information on the tenure systems and local planning processes recommendations have been made for an integrated management planning and action-research programme, which could be implemented across the Marsh to address livelihoods and conservation priorities and support community-based management in the Marsh.

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## Categories for Baseline Ecological Status (after Kleynhans 1996)

| Ecological category | Description of the habitat condition |
|---|---|
| A | Unmodified. Still in a natural condition. |
| B | Slightly modified. A small change in natural habitats and biota has taken place but the ecosystem functions are essentially unchanged. |
| C | Moderately modified. Loss and change of natural habitat and biota has occurred, but the basic ecosystem functions are still predominantly unchanged. |
| D | Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred. |
| E | Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive. |
| F | Critically / Extremely modified. The system has been critically modified with an almost complete loss of natural habitat and biota. In the worst instances, basic ecosystem functions have been changed and the changes are irreversible. |