Enhancing sustainable Agriculture-Wetland Interactions in the small inland wetland systems of Malawi.

A GAWI case study of Simlemba, Malawi.

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Guidelines on Agriculture and Wetland Interactions (GAWI)

MALAWI ANALYSIS AND REPORT

1. Introduction

Increased use of wetlands for agriculture has occurred in most parts of the world over the last 60 years. The pressure to further increase agricultural production from wetlands is only set to increase as the Comprehensive Assessment on Water Management in Agriculture (CA) points out (CA, 2007). In contrast, the Millennium Ecosystems Assessment (MA) identified agriculture as the major cause of wetland degradation and loss, both in the past and at present (MA, 2005). However, increased loss of wetlands will have serious impacts as these areas have critical roles to play in the future with respect to climate change, food production, water storage and biodiversity habitat maintenance.

To help understand this situation in 2005 FAO and Ramsar developed an initiative called GAWI – Guideline on Agriculture and Wetland Interactions. With the support of various other agencies, including the International Water Management Institute, Wetland Action and Wetlands International, this initiative has been analysing agriculture and wetland situation around the world in order to identify ways in which benefits can be maximised and risks of wetland loss and degradation minimised.

In its work GAWI has applied the Millennium Ecosystem Assessment's (MA) ecosystem services (ESS) concept (MA, 2005) which identifies five main groups of services or benefits from wetlands. These are:

- Provisioning – crop production, fish, grazing, domestic water, reeds etc.
- Regulating – flood control, water infiltration, groundwater recharge, etc
- Cultural –religious, recreational, tourism, etc
- Support – soil formation, cycling of nutrients, carbon storage, etc.
- Biodiversity – natural habitats for plants, animals and insects.

The study also applied the DPSIR (Drivers, Pressures, State changes, Impacts and Responses) methodology to try to explore the dynamics of agriculture's interactions with wetlands.

Of particular note in this work has been the understanding from the MA that wetlands are fragile areas which are subject to degradation if misused. The MA shows that over-dependency and over-exploitation of one service – for instance intensive crop cultivation – may easily, and suddenly, lead to an undermining of the wetland ecosystem's capacity to provide other functions / services (e.g. water storage, flood regulation and water supply), as well as to sustain the wetland itself. Ultimately this will lead to the collapse of its capacity to provide for intensive crop cultivation. Hence it is argued that an imbalance in ESS leads to reduced resilience of wetland ecosystems and their ability to function and cope with shocks, such as extreme weather events due to climate change.

However, the MA also points towards a way to address these challenges. It states that a sustainable management and exploitation regime for wetland ecosystems can be

achieved more easily if a balance is maintained amongst the five ecosystem services, and also within services types. This need for a balance in ESS is general guidance and a specific configuration of services is not identified as providing the "perfect balance". Rather, the implication of the MA's statement is that more of a 'balance' in general needs to be sought through practical measures such as the diversification of ESS and the facilitation of multiple ESS exploitation. The precise choice and configuration of ESS in diversification and multiple use is then context specific – both in terms of ecosystem capacity (biophysical resources) and in terms of socio-economic characteristics including society's needs (as revealed in the DPSIR analysis).

While such action will help to maintain the functioning of wetland ESS in the long term, the challenge is to identify how this balance can be achieved. How can diversified ESS be maintained in a wetland, so that it accommodates the multiple demands for, and uses of, the full range of ESS by different interest groups in society but at the same time minimising ecological stresses, and also minimising conflicts?

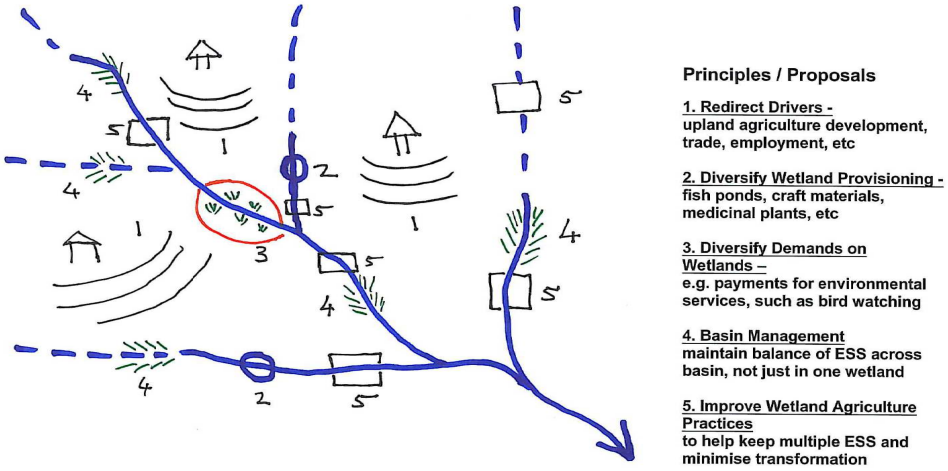
2 GAWI Study

The GAWI study of agriculture in wetlands around the world was undertaken between 2006 and 2008 and explored 92 cases from six continents (FAO 2008). From this analysis it was shown that there has been a growing imbalance in ESS in wetlands as a result of agricultural development in these areas and that in order to sustain the benefits from wetlands a re-balancing of ecosystem services is needed as suggested by the MA. It was recommended that this process should involve putting to fruitful use all of the ESS, provisioning and non-provisioning ones. This rebalancing of ESS may involve a number of interventions which could include:

- redirecting the drivers of change so that the specific needs of society (which lead to drivers) can be met in other ways – through trade, employment, non-wetland farming development, (which do not create imbalances in ESS and negative state changes in wetlands or elsewhere in the river basin system;
- diversifying the wetland provisioning services used - through the addition of fishing, crafts etc, as so as to still meet household needs while reducing the pressures from mono-agriculture upon the wetlands and the negative state changes and impacts due to cultivation,
- diversifying the demands on wetlands so that different ecosystem services can generate income through non-provisioning services, especially through payment for environmental services for regulatory or biodiversity conservation services,
- managing basin level land use in ways to facilitate the maintenance of a balance of ecosystem services overall, with different ESS provided at different points in the river / stream system, including active measures to build "wetness" in some wetlands to enhance the range of ESS which can be provided (see the figures in this paper), and
- improving agricultural practices so that they are more sensitive to other ecosystems services and their requirements and cause less alteration of the wetland ESS, e.g. irrigated rice as opposed to drainage for cultivation of maize.

Figure 1 provides a schematic example of where these interventions may fit in a river basin system with its wetlands.

Figure 1: GAWI Principles applied across a River System



From this work it has become clear that across the globe there is the need for a change of thinking about wetlands. This should involve a move from a situation of competition amongst stakeholders who each seek to achieve mono-ESS use of wetlands to meet their own specific interest, to a situation where stakeholders work together to achieve a mix of ESS in wetlands with mutually advantageous multiple benefits which are sustainable in the long term. This will require the setting of priorities for the different ESS to be developed / maintained in different parts of a wetland or along a stream valley wetland system, so as to help accommodate the multiple demands made on wetland ecosystems. The DPSIR analysis helps achieve this by mapping out the socio-economic demands for specific ESS and the state changes and impacts which result from the development these ESS, along with their consequences for the balance of services in a wetland system. Overall a congruent / harmonious and functional management strategy must be developed that links each demand to a specific ecosystem service to be attained but also maintains the balance of ESS overall.

Building on the GAWI Report (FAO, 2008), it was decided to undertake a series of case studies in different countries to test if the methodology developed can help bring stakeholders together to engage in a mutually supportive and consensual way to achieve a balance of ESS in wetlands. This report records the analysis of one type of wetland situation in Malawi – dambo and stream valley seasonal wetlands, and the subsequent discussions from a round table stakeholder workshop held in Kasungu on 11th and 12th November 2010.

3. Malawi Context

The majority of the population in Malawi live in the rural areas on very low incomes. Drought and food shortage in the 1990s and again in three of first six years of 21st century have led to great concern over food security. The Malawi Growth and Development Strategy (MGDS) 2006-2011, revised in 2009, focuses on poverty reduction through sustainable economic growth and infrastructure development (MG, 2009). It identifies nine key priority areas which the country intends to address in order to achieve its goals. Of these three clearly relate to wetland issues, namely: agriculture and food security; green belt irrigation (of one million hectares) and water development; and climate change, natural resources and environmental management.

Wetlands are diverse in Malawi. At least four major groups can be identified:

- Lake Malawi margin wetlands – where several irrigation schemes have been developed and more are planned, especially through the Green Belt initiative;
- Lake Chilwa, a very shallow, but extensive lake (683 sq km), and a Ramsar site of international importance for migratory birds, important for fishing and irrigation activities, and also affected by catchment degradation;
- Lower Shire floodplain where recent in-migration has seen a major expansion in cultivation;
- Dambo and stream valley seasonal wetlands, where some government irrigation schemes have been developed, but also much small scale to micro scale irrigation has been development by individuals and communities. (Note: Dambos are streamless valleys or depressions which are seasonally flooded.)

There are a number of recent policy initiatives which relate to the role of wetlands in Malawi's development. Of particular note is the recent Draft Irrigation Policy (MG, 2010) which stresses the important role which irrigation has to play in a number of development areas including:

- the "socio-economic advancement of the population",
- enhancing of agricultural production and extending cropping opportunities,
- diversifying cropping,
- improving the nutritional status of the population, especially vulnerable groups, and
- promoting a business culture.

This policy is important because of the recognition it also gives to catchment linkages for irrigation and the need to ensure that all environmental factors and natural resource management issues are taken into consideration in irrigation development. Especially noteworthy for this GAWI initiative are the ideas of river basin coordination and the linkages with other ministries. It also stresses the need for a mutually supporting and coherent policy framework based on the linkages with other government agencies.

With respect to the case study in this paper, the draft policy specifically recognises the smallholders undertaking micro-scale irrigation on an informal / self-help basis and the need to review policy about dambo use, which at present officially prevents cultivation of these areas.

The 2005 Water Policy is also important because of its emphasis upon participatory and integrated approaches, recognition of the impact of environmental degradation on water supplies and on how river systems fail to cope with flooding due to catchment degradation (MG, 2005). The policy is also important because it points out the conflicts which exist amongst some natural resource management legislation and the need for these to be resolved. Overall the emphasis is upon Integrated Water Resource Management and the way in which an understanding of the country's ecosystems must inform water development. There is however one major area of conflict created because of the regulation which prevents development, including agriculture, taking place below the 100 year flood level, without special permission. This would effectively require much of the irrigation development, formal or informal, which has occurred to date to seek this permission or else be abandoned.

What these policies and other recent development measures show is that in Malawi there is growing recognition of the link between development and the environment, the need to give due consideration to the functioning of ecosystems, and the importance of coordinating policies. The GAWI approach is one analytical and practical method which can help achieve this with special reference to wetlands and their catchments.

4. Simlemba Case Study

4.1 Setting and Origins

The GAWI case study in Malawi was undertaken in Simlemba TA in the central part of the country, some 180km north of Lilongwe. As a result it focuses on the situation in seasonal wetlands found in the dambos and stream valleys, where wet season flooding may exceed 1m, while in the dry season the water table may be up to 4m below the surface. There is a long history of traditional use of dimba gardens in these dambos and stream valleys for supplementary farming, especially after poor rainfed harvests, while these wetlands also provide a range of other ESS benefits for the communities, including grazing for livestock, domestic water, wild plants for medicinal, craft, relish and thatching use, and limited supplies of fish.

In the 1990s, increased use of these areas began in response to food shortages following poor upland harvests. This has accelerated since 2000, especially with the introduction of treadle pumps which has replaced bucket or can irrigation from shallow wells for some farmers. There is plenty of evidence of the success of these developments and the growing importance of seasonal wetlands for food production and income generation. One example is the mounds of vegetables for sale by the roadside from July onwards, and especially in September and October.

The case study is based on five years of work undertaken in collaboration with MALEZA, a Malawian NGO which has been working in the Simlemba area since 2003. That work has focused on improving food security in general and building up community institutions to engage in development initiatives. Specifically work on wetlands was developed in response to community requests to improve the use of these areas and the concern of MALEZA to ensure this was done in a sustainable manner (Wood, 2005; Kotze, 2008).

The valleys originally had a mix of wetland vegetation, sedges and reeds and bulrushes, around permanent ponds, but also some upland/dryland vegetation, even trees, in the drier areas. While the stream at Malawila flows all year, the Mthabua river and the dambos studied have only seasonal flows and limited stream channels. Flooding in the rains can reach between one and 1.5m above the surface of these valleys/ dambos, while in the dry season the water table can be up to four metres below the surface. The Mthabua valley has a few small permanent wetland patches in the form of ponds, while the Malawila stream had an extensive core of reeds before cultivation developed. The dambos are natural grassland areas with variations in the grass reflecting water availability. In a few places there are the remains of reed beds.

The catchments of these wetlands also vary physically and this is reflected in the variable occurrence of gravel deposits in the wetlands as a result of upland erosion, and also the availability of water storage in the sediments and seepage supplies of water from the uplands. In most parts of these valleys the catchments are degraded and as a result there appears to have been a reduction in water infiltration and water storage in the catchment. This seriously reduces the dry season recharge of the wetland water table. The wetlands also vary in terms of their development potential depending on their location relative to markets and transport facilities.

4.2 GAWI Analysis of the Present Situation

The GAWI project has developed a dedicated analytical framework which combines the MA ecosystem services (ESS) framework with the driver-pressure-state-impact-response (DPSIR) framework. This was applied to the seasonal wetlands in the Simlemba area with the following findings.

4.2.1 Drivers

Drivers are in essence society's articulation of socio-economic needs in the form of demands for deriving benefits from ESS. Traditionally these are strongly geared towards reaping the benefits of provisioning services.

In the case study, the drivers identified are:

a) Seasonal food shortages related to rainfall variability and land shortages / land degradation in the uplands.

b) Population pressure on land and water resources due to in-migration from neighbouring districts.

c) Local and wider markets for vegetables and food staples (green maize).

d) Government policies and measures in support of wetland cultivation have included subsidies for "winter" farming and projects by NGOs and government agencies, including subsidised treadle pumps.

4.2.2 Pressures

Pressures are the means by which ecosystem services (ESS) are exploited and through which the needs and demands from the drivers are satisfied – e.g. irrigation, crop intensification, aquaculture, water extraction, tourism, gazetting of a protected area. Pressures identified in the Simlemba seasonal wetlands are:

a) Dry season agriculture, using residual moisture and irrigation.

b) Clearance of natural vegetation in the wetlands to create gardens, thereby removing the plant cover which protects the soil from erosion.

c) Soil disturbance for cultivation which damages the soil structure and increases the risks of erosion during the annual flood.

d) Wells in the centre of the valley which can become potential focal points for erosion and gulley formation.

e) Reduced water infiltration/ seepage in the dry season due to upslope catchment degradation which leads to less water storage in the catchment.

f) Planting of moisture loving plants, such as eucalyptus and sugar cane, along edges of the valleys and within the wetland in the case of sugar cane.

g) Grazing of goats and cattle in wetland sites (and uplands) which leads to reduction in the vegetation cover and may cause soil compaction.

4.2.3 State Changes

The state of the ecosystem is defined in terms of the MA ESS framework, using three constituent levels of analysis:

(i) The overall state or 'balance' of the five ESS groups.

(ii) The balance of the sub-types of ESS, within the main ESS groups, that are being utilized – e.g. irrigated vegetables, fisheries, wild plant collection and domestic water supply, within provisioning services; water retention and flood protection within regulating services, etc.

(iii) The overall situation of how the pressures interact upon the biophysical resources/ processes that constitute the ecosystem and so change the biophysical state of the wetland. This includes various feedback mechanisms as outline in Table 1.

In the study area the situation is as follows:

i) The overall balance of ESS shows a bias towards provisioning services, with a reduction in regulating and biodiversity services.

ii) Agricultural provisioning is becoming dominant with other provisioning services reduced – notably domestic water at the end of the dry season and wild plants and craft materials,

iii) Wetlands are changing in terms of their physical characteristics, becoming drier and having less natural vegetation with gulley formation occurring in places, especially in the larger ones where the overland flow in the wet season is faster.

Specific state changes in these seasonal wetlands are:

a. Loss of biodiversity due to wetland vegetation removal and with this loss of any functions by the vegetation to slow the flood and maintain the wetland habitat. Water now flows faster down the valleys, so farmers say.

b. Soil compaction by grazing cattle compacts soils and may reduce water infiltration and encourage runoff and erosion both in the uplands and in the wetlands.

c. Soil structure damage due to cultivation, especially when this is prolonged and intensified, with the result that the likelihood of erosion is increased.

d. Gulley formation in centre of wetlands due to increased runoff from the catchments, less natural vegetation in the wetlands to stabilise the soil and slow the flood, with more centrally located wells acting as turbulence points.

e. Dessication of the valley/dambo floor, with the water table in sediments going down more quickly and to a lower level due to treadle pump extraction, less recharge from seepage due to catchment degradation and possibly reduced infiltration of water into the sediments during the flood.

f. Sediment deposition along edge of wetlands from upslope erosion on farm land leading to poorer quality farming land in the wetland.

4.2.4 Socio-Economic Impacts

Impacts describe the ways in which state changes affect human well-being. Here, the emphasis is on the socio-economic characteristics of society in terms of:

(i) who derives which benefits from which ESS; and
(ii) whose / which benefits (whether private or public) are affected through the ensuing state (changes) of the ecosystem.

In Simlemba, the main impacts identified are:

a. Food security is improved directly for producers and indirectly for many others through local sales – vegetables and maize. (Baseline data show that the intensive users of wetlands for cultivation are concentrated most amongst poorer female headed households - for domestic food security, and the richest male headed households - for market sales) (Msukwa, 2007).

b. Inequality / differentiation is increased with some households benefiting more than others due to differential access to stream valley / dambo land, and to the resources needed to use these areas (labour, cans and pumps).

c. Increased tensions within and between communities, with the potential for conflict growing as interest in formerly open access wetland sites develops and competition occurs between households and communities for land and water in the wetlands. This can cause increased difficulties in coordinating land use within a community and also between communities on either side of a stream valley.

d. Dependence on wetlands increased with growing involvement by communities in using these areas leading to wetlands becoming a critical element in the livelihood strategies of some/many households.

4.2.5 Responses

Responses refer to the actions already being undertaken to achieve desirable changes in the socio-economic impacts and the state (changes) of the ecosystem. In the Simlemba area responses identified included:

a. Communities have some recognition of the changes in wetlands- especially the increased aridity in wetlands during the dry season and the threats from gulley formation, but have not identified agreed responses, except for controlling the use of treadle pumps at the height of the dry season.

b. Government support for winter farming and dambo use continues, although there are growing concerns amongst government staff about the need to control erosion, and the importance of organic manure developing, but no development of a response to concerns about increased aridity in the wetlands and no active support for controlling gulleys.

c. NGO discussions with communities identified issues to address, notably coordination of communities to address natural resource management issues related to catchments and wetlands.

d. NGO Project to explore technological and institution responses, especially in the form of community land management coordination and byelaws, as well as discussions with the District Development Committee to support the development of guidance.

4.2.6 Overview of Present State

Clearly agriculture is the major pressure in both the uplands and the stream valleys / dambos, and this has negative effects on many ESS. Overall, the most critical state change is the loss of regulating services in the wetlands which greatly diminishes their capacity to retain and regulate the water resources – both in the wet, and in particular, the dry season. As a result, the wetlands are progressively 'loosing' their wetland, or 'wetness', characteristics. This not only negatively affects their ecological state, leading to a general loss in biodiversity, but it also threatens to undermine their capacity to support the present provisioning services which depend on the water retention and water regulation services. The services under threat include dry season cultivation, harvesting of wild plants for food relish and craft use, dry season grazing, water - for domestic use and livestock, and fishing.

The regulating services of the wetlands are being reduced by a number of interrelated processes which are created by the agricultural pressures. The main ones are:

- land degradation in the catchments which reduces infiltration within the catchment thereby diminishing 'delayed' ground water re-charge and seepage inflow;
- increased surface water runoff from the catchments – due to land degradation, which leads to greater peak rain storm surface flows which in turn increase erosion in the wetlands; and
- erosion and gully formation within the wetlands, which undermine their water retention and regulation capacity.

The overall result is that less water is retained within the wetland for shorter periods of time and there is less recharge of wetland as a result of seepage from the catchment. This situation is further aggravated by an increased use of groundwater in the dry season for irrigated agriculture and domestic water supply, which leads to a further drying out of the wetland during the dry season.

The present agricultural provisioning services in the catchments and wetlands in Simlemba are creating a web of negative consequences upon the state of these areas and the ESS provided by them. The situation in the wetland is especially complex with many process of state change and feedback linkages. Table 1 identifies the major mechanisms of state change and the ESS which are affected, while Table 2 identifies how the resulting changes in ESS have further feedback effects.

Table 1: Direct Consequences of Ecosystem Service Development in Catchment and Wetlands upon State Changes and Ecosystem Services in Wetlands

Provisioning Services	**State Change Processes / Mechanisms**	**ESS Affected**
Catchment Rainfed Agriculture.		
	-- soil erosion	Regulating & Supporting
	-- increased runoff	Regulating
	@ low yields and increased pressures on dambo, including dambo erosion	Provisioning, Impact, Regulating
Intensive Grazing in Catchment		
	-- soil compaction	Supporting
	-- increased runoff	Regulating
	@ increased pressure on dambo grazing	
	-- loss of dambo vegetation	BioDiversity
	-- dambo erosion	Regulating
Dambo Irrigated Agriculture		
	-- water depletion	Regulating
	@ depleted water supply	Provisioning
	-- drainage	Regulating
	@ dry season desiccation of wetland vegetation	BioDiversity Supporting
Water Extraction		
	-- water depletion	Regulating
Dambo Cultivation (Sugar Cane & Eucalyptus		
	-- dry season water depletion	Regulating
	? possible increased water retention	
Overall Socio-Economic Impacts of the State Changes from Provisioning Service Development	increased competition for dwindling wetland & (dry season) water resources, with poorer households suffering growing water shortages due to the increased use of treadle pumps by the better-off.	

Note: @ = leading to

Table 2: Indirect / Feedback Consequences of Ecosystem Service Development in Catchment and Wetlands upon State Changes and other Ecosysetm Services in Wetlands

State Change Effects on Other ESS	State Change Processes / Mechanisms	ESS Affected
Regulating Services		
	----- reduced water retention	BD & Provisioning
	----- water infiltration (catchment)	BD & Provisioning
	--- ground water recharge	BD & Provisioning
Supporting Services		
	reduced soil nutrients & fertility	Provisioning
	reduced soil moisture holding capacity	Provisioning & Regulating
BioDiversity & Ecological State		
	less wetland vegetation & BioDiversity	Cultural
	less provisioning services: fish/fowl gathering	Provisioning
Cultural Services		
	Less resources and site for traditional ceremonies for some ethnic groups	

4.3 Key Elements of a Desired Future State – Reduced Erosion leading to Improved Water Retention / Storage

4.3.1 Desired Future State

The above analysis of the way the presently developed ecosystem provisioning services impact upon other ESS, along with the DPSIR analysis of the situation in Simlemba, show that the situation is not sustainable. There is a negative progression in terms of both ecological conditions and also the ESS which are provided, including provisioning services. It is also clear, from the DPSIR analysis, that agriculture cannot be removed from either the catchments or the wetlands. The desired future that needs to have productive provisioning services in the wetlands and the catchments. Hence, rather than removing agriculture, there is a need to undertake agriculture in a different way. This should involve reducing the present negative effects upon state changes and ESS – especially in the wetlands, and, where possible, developing positive state changes which will improve the mix and balance of ESS available.

Recognising this situation, the key requirement is to enhance and foster the water regulating services as this will not only restore and secure the seasonal wetness in the dambos and stream valleys, but will also improve their capacity to provide water for provisioning services, and the support services which are necessary to maintain them. This requires responses on multiple fronts, in both catchments and wetlands, specifically targeted at addressing the pressures, state change mechanisms and feedback linkages outlined in Tables 1 and 2 that at present cause the ESS to

deteriorate. In particular, the following state changes are needed to redress the situation:

- enhance regulating services through -
    - increasing and fostering the water infiltration capacity of the catchments (with reduced runoff and enhance groundwater recharge and sub-surface recharge of wetlands);
    - increase water storage capacity in the wetlands; and
- reduce land degradation through -
    - reducing catchment soil erosion and wetland sedimentation;
    - halting wetland erosion.

4.3.2 Specific Measures in a Multiple Response Strategy

These desirable state changes may be achieved through a number of interventions. These should be seen as linked elements of a functional landscape planning approach which tries to improve the way the wetlands and catchments function together and enhance the ESS they provide (Wood, 2008).

The measures proposed here are based on extensive field discussions with communities in Simlemba through transect walks and focus group meetings, a workshop with several communities and government field staff, and a review of the MA and the GAWI global study. Field testing of these measures has been on-going for up to four years in three sites in Simlemba, and that experience was discussed at the roundtable workshop in Kasungu. However, these measures should be seen as only partially tested proposals and in plans to scale up this work they should be used initially as a basis for discussion and consideration by communities.

a) Catchment: Understanding of the functional system of wetlands must start with the catchment from where much of the water present in a wetland is derived. Hence, the key is to improve infiltration so that more water is available through seepage into the wetland over the year. Improved catchment management which should benefit wetlands can include a wide range of measures including:

- **conservation farming and land husbandry measures**, such as soil and water conservation measures, use of cover crops, organic manure and agro-forestry:
- **crop diversification and intercropping,** to increase food security and possibly add some higher value crops – such as paprika, which will increase income from new markets;
- **afforestation of non-farmland**, especially hills, and
- **development of a cordon of natural vegetation on the lower slopes**, around the wetland edge.

Overall these measures will improve the regulatory services in the catchment – through reduced runoff, improved infiltration and water retention / storage. This will benefit the wetlands through prolonged and increased groundwater recharge, as well as by reducing the potential for gulley erosion in these areas initiated by flash flooding. Improved infiltration in the catchment and changes in crops in the catchment will lead to better harvests, and improved food security which should encourage further improved land management in these areas. There should also be positive impacts, or socio-economic benefits, while improved upland farming should reduce demand to expand cultivation in the wetlands. Soil and nutrient conservation

in the catchment, as a result of improved land management and maintenance of natural vegetation, will also lead to better ecosystem support services which may benefit the wetlands through the reduced deposition of coarse material in those areas, as well as through increased infiltration of water for seepage recharge of the wetlands.

b) Wetland: Within the wetlands specific measures can be identified to help achieve the key goals of maximising water storage and reducing wetland erosion, while at the same time helping ensure that the diversity of ESS is maintained and sustainable use of the wetlands is facilitated. The following measures will help achieve this:

- **maintaining natural vegetation in the centre of the wetland**, and around any streams and water bodies;
- **locating hand dug wells away from the centre of wetlands;**
- **maintaining and enhancing ponds and reed beds** in the centre of dambos and stream valleys to store water;
- **enhancing provisioning services in wetlands by developing fish ponds / micro dams,**
- **using areas of natural vegetation in wetlands** to provide opportunities for generating other benefits related to biodiversity conservation which could generate **payments for environmental (conservation) services** from nature conservation groups or provide benefits in terms of integrated pest management when habitats of pest predators are maintained. Such sites may also provide a cultural service for some communities.

In the wetlands these measures can be seen as also contributing towards a functional landscape approach by creating a pattern of land use and natural vegetation in the wetland which maximizes the surface and sub-surface water storage capacity in and along the stream valleys and dambos. The measures above will help to slow floods, reduce the risk of erosion, prevent wells becoming sources of turbulence and gulley formation, and enhance both regulating and provisioning services through fishing and reeds for crafts people, as well as water for livestock. These measures not only have the potential to improve food security and generate income but can also help enhance the water storage in the wetland, maintain the micro-environment, and thereby build nature, especially regulatory services and biodiversity. All these measures are in line with the functional priority service assigned to the wetlands of water retention.

c) Wetland Farming: At the micro-scale the functional landscape approach for maintaining ESS can be applied to wetland farming so that the state changes caused are minimised and the cultivation “goes with nature”, rather than against it. Specific measures for this wetland agriculture might include:

- **avoiding drainage and the loss of water**, by creating raised beds, rather than drains, to make land suitable for cultivation in the wetter areas and after the annual flood;
- **controlling water extraction** for both domestic consumption and crop irrigation;
- **restricting cultivation to limited plots outside the core of the wetland** where water storage and flood regulation are the prioritised ESS;
- **minimising the disturbance of the soil** through minimum tillage in the cultivated sites;

- using organic manure and mulches where appropriate to help to **maintain the soil structure**;
- improving the quality of the produce and diversifying crops towards higher value crops to improve the income from using these areas; and
- **minimising the areas where natural vegetation is removed** for cultivation;

The agricultural activities foreseen within the dambo land use plan, and in alignment with the water regulating services, are two-fold:

1. Irrigated cultivation of vegetable and green maize on dedicated plots that lie outside the demarcated water retention areas in the core of the wetland, and are supplied with water from the seasonally retained water stored in ponds or the wetland groundwater.
2. Flood retention / draw down agriculture of green maize, fodder, or short leafy vegetables, along the outer edges of the water retention area, along strips of land subject to seasonal water recession (e.g. using residual soil moisture for cultivation, supplemented with capillary groundwater).

As a result of these measures wetland agriculture can be practised in ways which ensure that water retention is increased in the wetland, and the water table retained at a level in the dry season that does not impact on provisioning or biodiversity ESS. Further soil disturbance and the risks of erosion are minimised, with cultivation kept to small areas and removed from the centre of the wetland. Critically these practices do not diminish the capacity for the peak/flood water retention capacity, while they avoid drainage.

d) Grazing: Given that uncontrolled grazing can have negative effects on land degradation and soil erosion. Specific measures geared towards reducing the negative consequences of grazing may need to be considered. These could include optimizing fodder cultivation and grazing management through controlled grazing and the development of pasture areas along the dambo edges, supported by seasonal flooding for water and nutrient replenishment. This can be expanded by broader agro-forestry measures.

This would support the positive effects on ESS in similar ways to other measures outlined above with increased infiltration, improving regulatory services and reduced erosion leading to improved soil and nutrient conservation and so enhanced ecosystem support services.

4.4 Implementing the Measures to Achieve the Desired Future State

The technical measures discussed in the previous section have sought to address the negative state changes in the wetlands brought about by the pressures from agriculture in the wetlands and the catchments. However, for these measures to be implemented successfully it is necessary to ensure there is a supportive economic, institutional and policy/ regulatory environment at the community and national levels. This means exploring the DPSIR analysis further to identify current negative drivers of change which need to be reduced or redirected, and interrogating the technical proposals from the perspective of the farmers to identify economic and institutional constraints which need to be addressed

With respect to the technical measures, while they may be desirable in order to sustain a balance in the ESS of the wetlands, they need to be economically attractive for farmers. One way in which this may be achieved is through the development of improved market linkages and value chains, putting producers in contact with specific buyers so that farmers develop their production for these opportunities. The production of good quality produce for high value markets should increase the income received and so more than compensate for additional efforts involved with these innovations. This improved income from provisioning services should also enhance the value of wetlands to farmers and thereby improve their motivation to manage these areas sustainably.

The linkages between catchments and wetlands are recognised in the functional landscape approach which is proposed as the framework for the technical measures outlined above. In particular it is clear that the planning of land use needs to be coordinated amongst farmers and natural resource users not just in the village lands, but also across the stream or river valley in other wetlands and the catchments which comprise the functioning landscape unit. As a result attention needs to be given to the development of community level institutions and inter-community institutions to address these issues and coordination.

To some extent these responsibilities for controlling natural resource management are already located with the Village Development Committee and the Village Headman. However, these responsibilities are often not well developed, nor are measures firmly applied. Hence it appears necessary to build on these local organisations through the development of sub-committees to undertake actions, such as coordinating land and water use. In the Simlemba area, Village Natural Resource Management Committees (VNRMC) have been established in the last few years as advisory groups to Village Headmen and the Village Development Committees and they have the responsibilities for the pilot land management measures introduced by MALEZA in three catchment and wetland sites (Dixon, 2008). These institutions face a number of challenges, not least exploring how reductions in the presence of water loving plants – sugar cane and eucalyptus, in and around wetlands can be achieved. This will require a major awareness raising programme so that the majority of the community become aware of the way these crops appropriate a large share of the water resources.

The responsibility of these institutions are not just to restore and optimise the ESS in the wetlands but also to address socio-economic issues such as access to wetlands, thereby ensuring that these areas remain an effective safety net for society at large and not just the lucky few who appropriate them. Such institutional development is also needed at a higher level, the Traditional Authority, to coordinate natural resource management over all the villages in the TA so that whole stream valley and their catchments can benefit from the functional landscape approach.

From the DPSIR analysis, it is clear that there are national level drivers of wetland degradation which also need to be addressed through policy measures, rather than the land management techniques outlined above. In particular, there is a need for development policies to be coordinated amongst the different agencies so that the view is inculcated that wetlands should be developed for multiple ESS uses creating symbiotic and mutually beneficial linkages. Through coordination of the goals of the various agencies involved their policies should move to recognise the value of

working towards a common goal of maintaining multiple ESS in wetlands and thereby increasing the sustainability and value of wetland benefits. Another related issues is the need to further strengthen the recognition in development policies of the links between uplands and catchments, and particularly support measures, such as conservation farming, which have wide reaching ecological benefits, including ones which benefit wetlands through enhanced infiltration.

With the policy framework fine-tuned to recognise the landscape linkages in development, it will be possible for a coordinated approach to be made which will create cumulative socio-economic and ecological benefits, which will see wetlands recover their role as a key landscape feature and source of a full range of ESS.

4.5 Overall Results of the Multiple Response

The overall results of these proposals may be seen in Figure 2 for a single wetland and catchment. When applied more extensively down a valley Figure 3 provides an indication of what might be achieved showing how the development of ESS at different points along the wetland valley system may create a pattern of development with enhanced ESS which meet more needs and is more sustainable.

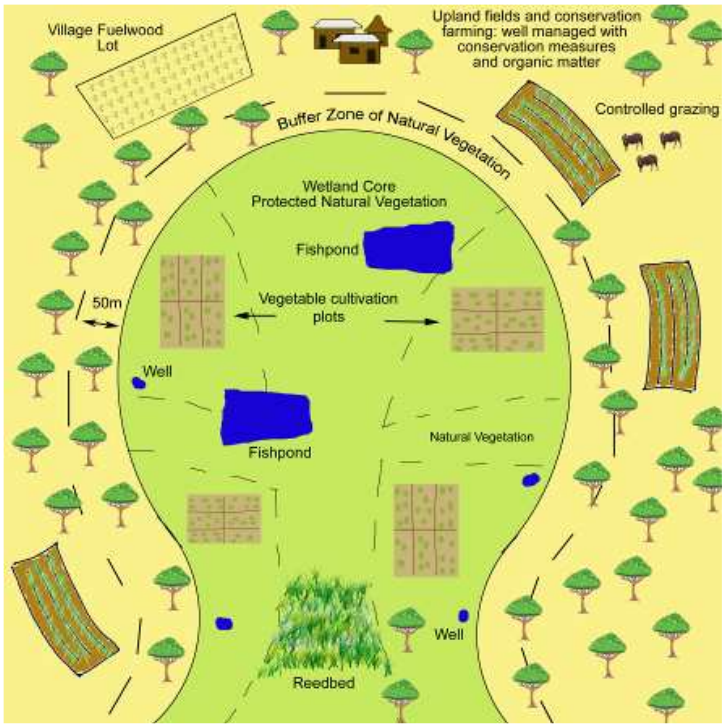
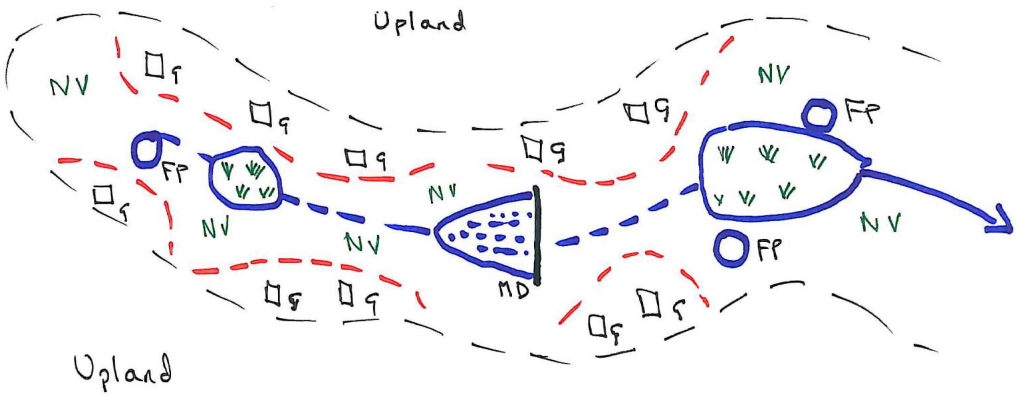


Figure 2: A functional landscape approach to wetland and catchment management for sustaining multiple ecosystem services

These two diagrams show the potential for enhancing and sustaining ESS in wetlands in situations such as Simlemba, especially when the wetlands and catchments are managed together as a functional landscape. In particular, the diagrams show that multiple ESS can be developed in wetlands and that they can be mutually supporting, rather than in conflict. Developing such a balance and mix of ESS in turn can enhance

resilience and improve sustainability of these services, and so improve livelihoods and well-being of communities.

Figure 3: Applying GAWI Principles to enhance ESS in a Dambo/Stream Valley



FP = Fish Ponds G = Garden / Small Field MD = Micro Dam NV = Natural Vegetation

Swamp areas and natural vegetation – contribute to all ESS through flood control, ground water recharge, craft materials, biodiversity refuges, water storage and support to integrated pest management

5. Ways Ahead

5.1 Relevance of GAWI for Malawi

Building on the workshop deliberations, the field experience in Simlemba, and other discussions, key ways in which the GAWI work has relevance for Malawi have been identified. They are seen as the following:

- Applying ESS and DPSIR concepts into wetland management and thereby giving Integrated Water Resource Management a more detailed functional perspective of wetlands and their catchments,
- Using a functional landscape approach to explore the relationship of catchments and wetlands in a linked management process which can enhance and sustain ESS in wetlands,
- Recognising the need to maintain a mix of ESS in a wetland in order to ensure sustainability and understanding the value / role of different ecosystem services and their inter-relations as the basis for wetland sustainability,
- Enhancing the “wetness” of wetlands through additional water retention / storage, so as to increase the range of wetland ESS and benefits that can be developed / obtained, as well as improving the sustainability of these wetland systems – singly or as part of a stream / river system,

- Using the DPSIR framework in order to identify drivers of change and also points for intervention in order to address negative developments reducing the sustainability of wetland and the benefits from them,
- Exploring the ways to achieve mutually supportive rather than competitive approaches to wetland management amongst different agencies as a basis for improved coordination of agencies at different levels from policy to the field,
- Identifying key elements of the desirable future environmental state for sustainable wetland management – with reduced erosion and degradation and enhanced water storage in these areas.

5.2 Areas of Proposed Action

Several areas for immediate action were identified from the deliberations. They are discussed under the following headings: awareness, demonstration, policy and regulation development, planning and technical measures and institutional capacity.

5.2.1. Awareness and Dissemination

In the first instance it is clear that understanding of the GAWI ideas need to be made accessible to a wider audience in the policy making and planning circles in Malawi, both at national and local levels.

This should be done through the development of a policy briefing note which will be circulated by FAO as a follow up to the Kasungu workshop. To ensure that these ideas are picked up and applied where relevant, specific follow up measures are needed, especially through within agency discussions on the value of the approach to each organisation and field demonstration activities (see 5.2.2 and 5.2.3).

5.2.2. Demonstration of the Value of the GAWI Analysis

The GAWI analysis would benefit from application in other wetland situations, besides Simlemba, in order to confirm its relevance and utility.

The Simlemba analysis covers the small upper valley wetlands with seasonal flooding and mostly seasonal streams. Lake Chilwa is suggested as a case study of a large lake wetland, while the Chia Lagoon is proposed as a large, lakeside lagoon which would be particularly relevant to the Green Belt Initiative. In addition, a stream / river valley with an irrigation scheme should be analysed. Such cases study analyses could be undertaken as a capacity building process to raise awareness of the ESS and DPSIR concepts as applied by GAWI. These case studies could also be a means of developing inter-institution cooperation at national and regional / district levels. The studies could be developed through guided field exercises led by the Department for Environmental Affairs (DEA) as the agency with overall responsibility for environmental matters, including wetlands

5.2.3 Pilot Implementation in Simlemba

Field implementation of the GAWI multiple response strategy, based on the analysis paper presented at Kasungu, should be scaled-up in Simlemba Traditional Authority (TA) to cover the whole TA. This would help confirm the cumulative benefits of the multiple response strategy measures once applied at a landscape scale.

This work should be led by MALEZA, the NGO which has led the work to date, but there should be closer coordination with government agencies. In particular, at the

Traditional Authority level the Area Development Committee (ADC), made up of the group village headpersons, is the body through which field actions should be coordinated. The Area Executive Committee, made up of the government and NGO extension workers, should provide technical advice for the fieldwork through its guidance provided to the ADC.

As well, at the TA level there should be good coordination of the pilot action between the political decision making groups and the technical advisory ones. Respectively these are the Village Development Committee and the Village Natural Resource Management Committee at the village level, and the District Development Committee and the District Executive Committee. Hence a more strategic and joint NGO / GO approach should be explored with active coordination through the various existing institutional arrangements.

Specific funding should be sought by MALEZA and its international partners for this work.

5.2.4. Harmonisation of Policies, Regulations and Technical Guidance

As pointed out above, there are several areas where policy harmonisation is needed to ensure that the policy environment supports ecologically sustainable wetland management, while meeting livelihood needs. Four specific areas have been identified where the GAWI work could be informative and supportive.

a) Wetland Regulations

At present a draft of the Wetland Regulations under the Environmental Management Act has been produced. These are being developed with specific inputs from the Land Resources Conservation Department of the Ministry of Agriculture and Food Security. Ideas from GAWI should be incorporated into these regulations, especially the measures identified in the multiple response strategy and the role which maintaining and enhancing a mix of ESS can play in ensuring sustainable use of these areas. As a result additions to these regulations may be identified, adding a new approach and dimension to wetland management.

b) Water Policy and Wildlife

While the Water Policy was enacted in 2005, much remains to be done to implement this legislation, especially its focus on Integrated Water Resource Management. In particular, it has been noted that there is a need to review where this policy interacts with others agencies, specifically with respect to the regulation which does not allow the use of land below the 100 year flood level without specific permission.

The priority concern of the Department of Water Resources is that wetlands and floodplains must continue to store water and that this capacity should be enhanced, and never reduced. This is similar to the interests of the Department of National Parks about restricting development in wetlands and flood plains. However, these views are not in line with the Department of Irrigation and the Malawi Growth and Development Strategy which both seek secure increased food through irrigation in these areas.

In addressing this “debate” the GAWI work may offer way for working together through the multiple land use regime which it recommends should be maintained

within a wetland or a river system to support sustainable use and to enhance ESS which are under particular pressure, such as regulatory services (see Figures 2 and 3). This land use plan provides the basis for a discussion of "trade offs" between the different viewpoints, especially if there is exploration of how to enhance water storage in wetlands / flood plains with micro dams and fish ponds and areas of natural vegetation to diversify and increase the range and quality of ESS available.

c) Decentralised Environmental Management Guidelines for Districts -
At present there is on-going work to develop decentralised environmental management guidelines for use at the district level by the Ministry of Local Government with support from UNDP. The district level is where development interventions are coordinated and where environmental management guidance is applied through the DEC and DDC to coordinate different agencies.

The landscape perspective in GAWI, which goes beyond the wetlands and takes a holistic view of wetlands and their catchments, is an important concept which could be relevant in these guidelines, especially as a framework for considering how to further develop and apply the IWRM approach under conditions of increasing water shortage and rainfall variability. A specific unit / module based on GAWI might be developed for use either in these guidelines or to inform their development.

d) Draft Irrigation Policy and Landscape Water Storage
The new draft Irrigation Policy seeks to support the development of private initiatives in this area, rather than have the state continue to build irrigation schemes. This policy also recognises the role of small-scale informal irrigation.

In all types or irrigation, sustainability will be enhanced if the GAWI principles are applied so that regulatory services, especially water storage and flood control, are enhanced within catchments and wetlands. In particular, an improvement in the functioning of catchments for water storage will improve and stabilise river flow, reduce the need for dams and for flood control measures, and thereby reduce maintenance and operating costs of irrigation activities.

The system-wide multiple ESS perspective which GAWI stresses as being vital for sustainability has the potential to provide a technical addition into this policy and the regulations which are subsequently developed.

5.2.5. Coordination of Different Agencies
A specific characteristic of wetland issues is the way in which they are multi-sectoral. This makes the issue of coordination vital.

Coordination of field activities of the different agencies is achieved in practice through the District Development Committee of councillors, with advice from the technical departments in the District Executive Committee (DEC) and its environmental sub-committee. Ensuring that all DDCs and DECs understand the GAWI principles would be a major step in getting improved coordination and progress towards more sustainable use of wetlands. At the Traditional Authority level the equivalent are the Area Development Committees which coordinate field staff while at the community level there are Village Natural Resource Management

Committees which report to the Village Development Committees and the village headmen.

Piloting the use of GAWI analysis and principles to inform such coordination should be explored in the development of pilot implementation of the multiple response strategy in Simlemba.

5.2.6 Technical Coordination

One area of particular concern where coordination is needed is where land management measures have hydrological benefits which can impact in multiple ways on water storage, flood control, irrigation, domestic water supply, natural vegetation and wildlife. Hence there is a special need for coordination between the Land Resources Conservation Department and other agencies involved in wetlands. All of these interested departments should realise the very critical need for the development of economically attractive conservation agriculture and soil and water conservation measures which farmers will adopt spontaneously as these measures will improve water infiltration and regulatory ESS. The GAWI understanding of the links between different ESS in a river system and between a catchment and wetland are important for helping make clear the need for such measures.

5.2.7 Redirecting of Drivers through Development Approaches

The DPSIR analysis also helps identify how specific drivers are encouraging over-development of the agricultural provisioning services in Malawi's wetlands. In the Simlemba case, and most cases in Malawi, the key driver is the search for increased food production and food security. Given the danger that over-development of agriculture in wetlands can lead to increased risks of ecological collapse in wetlands, including provisioning services such as agriculture, it is important that alternative ways are found to achieve these development goals. Various improvements in upland farming to improve security of harvests have been suggested, as mentioned above. However, more radical ideas related to changes in development strategy and support for urban employment development might be proposed. Hence, one of the element of the GAWI multiple response strategy should be to raise questions about development approaches and policies at a high level so as to facilitate a more ecologically sound balance in the country's development strategies.

6. Conclusions

Given the importance of wetlands in Malawi, it is important to ensure that these resources are used sustainably and that they contribute in increasing ways to the welfare of communities and the development of the nation. In many cases a negative scenario is developing at present where land degradation in the uplands and poor management of wetlands is reducing the mix of ESS which these areas provide, especially reducing regulatory services overall and threatening provisioning services in the wetlands. The GAWI analysis in Simlemba has identified these trends clearly, and this is not a unique part of the country. A multiple response strategy has been developed and proposals made about how to apply this, and so turn this negative scenario into a positive one. It is suggested that a win-win situation can be achieved whereby increased ecosystem benefits are obtained from wetlands through maintaining a balance of ESS which will help ensure the sustainability of these areas. However, this will require increased cooperation and coordination amongst the various stakeholders, as well as policy, governance and technical developments. Specific initial measures to bring about these changes have been proposed and it is hoped that the GAWI initiative can be brought into use in Malawi to support such developments.

Certainly Malawi needs to ensure that its wetlands continue to function and enhance the ESS in these areas. In this way they can continue and increase their contribution to the country's development so as to reduce poverty, support sustainable economic growth, and also address the challenge of climate change. The alternative of degraded wetlands and loss of critical resources for the country's development is not conscionable.

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