MINISTRY OF AGRICULTURE,

IRRIGATION AND WATER DEVELOPMENT

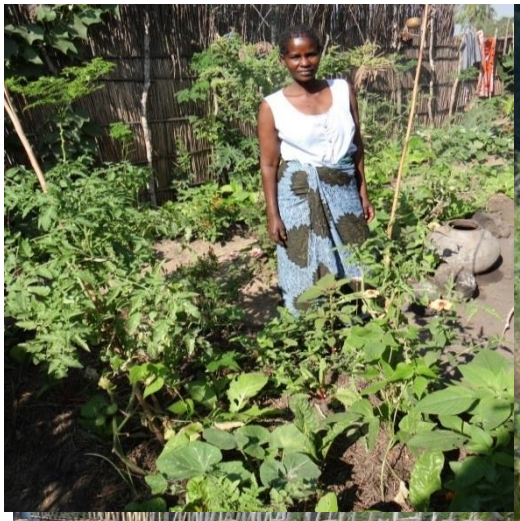
Government of Malawi

We All Need The Shire

MALAWI NATIONAL GUIDELINES: INTEGRATED CATCHMENT MANAGEMENT AND RURAL INFRASTRUCTURE

VOLUME I: Theory and Procedural Catchment Management Guidelines

November 2015






Cover page pictures (left to right, top to bottom):

Source of photos: contributing specialists

1. Maria and her permaculture, Kasankha Bay
2. A successful farm along the North Rukuru River west of Karonga, practising forest protection, conservation agriculture principles and general resource protection
3. Sapling protected of from goats.
4. Fish from the Lake Chilwa
5. Children along the banks of the Shire River in Kasisi
6. Irrigation scheme in Chingale catchment

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List of Acronyms and Abbreviations

ADC	:	Area Development Committee
ADP	:	Area Development Plan
AEC	:	Area Executive Committee
ASWAp	:	Agricultural Sector Wide Approach
AWU	:	Association of Water Users
CBNRM	:	Community Based Natural Resource Management
CBSL	:	Community Based Savings and Loans
CCNRE	:	Cabinet Committee on Natural Resources and Environment
CDC	:	Community Development Committee
CMP	:	Catchment Management Plan
CSO	:	Civil Society Organisation
DAT	:	Development Advisory Team
DC	:	District Council
DEC	:	District Executive Committee
DDC	:	District Development Committee
DDP	:	District Development Plan
DDPS	:	District Development Planning System
DEAP	:	District Environmental Action Plan
DEC	:	District Executive Committee
DESC	:	District Environmental Sub-Committee
DSS	:	Decision Support System
DTT	:	District Training Team
EAP	:	Environmental Action Plan
EC	:	Extension Officer
EIA	:	Environmental Impact Assessment
EMA	:	Environment Management Act, 1996
EMP	:	Environmental Management Plan
FLS	:	Frontline Staff
FRIM	:	Forestry Research Institute of Malawi
GBI	:	Green Belt Initiative
GCM	:	Global Circulation Model
GUI	:	Graphical User Interface
GVH	:	Group Village Head
IC	:	Irrigation Committee

ICM	:	Integrated Catchment Management
IEE	:	Initial Environmental Examination
IFR	:	Instream Flow Requirements
IWRM	:	Integrated Water Resources Management
JICA	:	Japan International Cooperation Agency
LFA	:	Logic Framework Assessment
MASDAP	:	Malawi Spatial Data Access Portal
MGDS	:	Malawi Growth and Development Strategy
MoU	:	Memorandum of Understanding
MSE	:	Micro Scale Enterprise
NEAP	:	National Environmental Action Plan
NEP	:	National Environmental Policy
NGO	:	Non-Governmental Organisation
NIDF	:	National Irrigation Development Fund
NRM	:	Natural Resources Management
NWDP	:	National Water Development Programme
NWRA	:	National Water Resources Authority
PCENR	:	Parliamentary Committee on Environment and Natural Resources
PIC	:	Project Implementation Committees
PM&E	:	Participatory Monitoring and Evaluation
PRA	:	Participatory Rural Appraisal
RAAKS	:	Rapid (Relaxed) Appraisal of Agriculture Knowledge Systems
RCM	:	Regional Climate Model
RCP	:	Relative Concentration Pathways
RRA	:	Rapid Rural Appraisal
SADC	:	Southern African Development Community
SMART	:	Specific, Measurable, Achievable, Realistic, Timely
SOE	:	State of Environment
SOER	:	State of the Environment (and Outlook) Report
SOP	:	Standard Operating Procedures
SRBMP	:	Shire River Basin Management Program
SSEA	:	Strategic Social and Environmental Assessment
STEEP	:	Social, Technological, Economic, Environmental, Political, Legal, Ethical and Demographic
SWAT	:	Soil and Water Assessment Tool
SWOT	:	Strengths, Weaknesses, Opportunities and Threats
TA	:	Traditional Authority
UNDP	:	United Nations Development Programme

VDC	:	Village Development Committee
VHSC	:	Village Health and Sanitation Committees
VLAP	:	Village Level Action Plan
VNRMC	:	Village Natural Resources Management Committees
VSTEEP	:	Values: Social, Technical, Economic, Ecological, Political
WMS	:	Welfare Monitoring Survey
WRA	:	Water Resources Act, 2013
WRIS	:	Water Resources Investment Strategy
WUE	:	Water use efficiency

Glossary of Terms

Agroforestry: the deliberate combination of woody and non-woody species – most commonly trees with crops or grass – for multiple benefits

Base Scenario (Baseline): the current status of a catchment resulting from 'business-as-usual' activities

Biodiversity: the range of living organisms within a given area

Carrying Capacity: the maximum number of individuals that can be supported, fed or are able to survive in any specific habitat or ecosystem without causing the breakdown of the habitat or ecosystem

Catchment: an area from which any rainfall falling on it will drain into a watercourse through surface flow to a common point: sometimes referred to as a watershed. In the Malawian context around 35,000 ha in size (see also **Micro-Catchment**; **Sub-Catchment**; **River Basin**)

Catchment Management Plan: a plan of action to achieve the **catchment vision**

Catchment Vision: the future that a group want to see in their catchment – their goal

Climate Change Adaptation: measures taken to adapt to the impacts of climate change by lessening their impacts and/or reducing risks of extreme events

Climate Change Mitigation: measures to decrease the reduction of greenhouse gasses in the atmosphere through reduced emissions, or by carbon storage (sequestration)

Climate Resilience: the ability of a living system to restore itself to its original condition after being exposed to shocks or disturbance caused by climate

Conservation Agriculture (CA): an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment. CA is characterized by three linked principles, namely:

1. Minimum mechanical soil disturbance.
2. Permanent organic soil cover.
3. Diversification of crop species grown in sequences and/ or associations

Decision Support System (DSS): a system that helps guide people to make choices from a 'menu' of activities based on specific needs and situations

Deforestation: the partial or complete loss of trees within a forest and the associated loss of the forest's ecosystem function and services

Endemic: a plant (or animal) that is originally from and confined to a particular location

Eutrophication: the enrichment of aquatic systems with plant nutrients, mostly nitrates and phosphates, which stimulates growth of algae, and depletes oxygen, killing local plants and fish and thus damaging the indigenous aquatic ecosystem

Fauna: animal **life**

Flora: plant life

Integrated Catchment Management (ICM): the integrated management of all the components that operate within a catchment, as well as the human activities that impact on, and are impacted on, by the different components

Integrated Water Resources Management (IWRM): a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems

Intercropping (or Companion Cropping or Mixed Cropping): a combination of different crops in the same field to provide benefits greater than planting separately but also to reduce risk

Invasive Alien Species: plant species that have been introduced from outside the country (or outside a particular zone) that reproduce rapidly and reduce production of desired species

Land Tenure: the rights to use of land – may be temporary or permanent

Micro-Catchment: See **Catchment**, in the Malawian context around 500 ha in size

Mitigation: the implementation of practical measures to reduce adverse impacts: in the context of climate change see **Climate Change Mitigation** (above)

Modelling: use of computerised mathematical formulae based on available data/ estimates to predict a catchment's reaction to (for example) rainfall or conservation treatments such as afforestation

Participatory Rural Appraisal: a participatory methodology aimed at articulating problems and potentials involving members of the local community and facilitated by a trained 'outsider'. Combines various tools, such as transect walks, historical profiles, participatory mapping, wealth ranking, and ranking/ scoring of different options

Permaculture: a system of 'natural' farming that makes use of a combination of plants, ensuring maximum integration of resources and seeking symbiotic relationships and continuous production. Permaculture is often characterised by a three dimensional geometric design

RAAKS: Rapid Appraisal of Agriculture Knowledge Systems combines elements of PRA (see above) and institutional analysis to create a framework for participatory action research to understand and improve agricultural knowledge systems

Remote Sensing: monitoring from a distance – for example aerial photography or satellite imagery

Reclamation: restoring land from a state of serious erosion, such as a gully, and (at least) stabilising its state

Rehabilitation: the process of bringing natural resources – croplands, rangelands, forests etc. – back to their original state after degradation has taken place

Resilience: the ability of a living system to restore itself to its original condition after being exposed to an outside disturbance

Riparian Buffer Zone: a strip of several metres in width (depending on the size of the river, and its flow regime) alongside a river which is planted to perennial vegetation, including trees, principally to protect the riverbanks from erosion

River Basin: the catchment of a whole river

Runoff: surface flow of non-infiltrated rainfall

Semi-Structured Interview: a participatory methodology tool that is used to gather information in an informal way by constructing a discussion around a small number of key questions (in contrast to a structured questionnaire

Soil Erosion: the detachment and transform of soil particles: i.e. the loss of soil form the original site

Sub-Catchment: See **Catchment**, in the Malawian context around 4 500 ha in size

Sustainability: the ability of a system to survive for some specified (finite) time

SWAT: the Soil and Water Assessment Tool is a model used to predict the effect of management decisions on water, sediment, nutrient and pesticide yields with on large, ungauged river basins

Strengths, Weakness, Opportunities, Threats (SWOT): a participatory exercise used to evaluate a system, activity, project, organisation etc. Usually a SWOT is developed and depicted on a wallchart divided into four sections

Tillage: working the soil by plough or hoe. **Minimum Tillage** implies reducing the amount of tillage as much as possible. **Zero-Tillage or No-till** means no tillage at all

Water Conservation: the sustainable and efficient management of surface and underground water, drinking water, and water in rivers, streams, reservoirs, wells, dams, canals, channels, lakes or wetlands

Water Harvesting: the collection and concentration of rainfall runoff for productive purposes

Water Use Efficiency: maximising productivity in relation to water in a farming system

Wetlands: lands characterised by permanent, shallow water, through which (typically) reeds, grasses and *papyrus* grow

Foreword

The Government of Malawi is working with its development partners to bring about economic growth and to alleviate poverty in the country. One of the recent initiatives is the Shire River Basin Management Program. The program is a flagship World Bank financed activity for Malawi, given the importance of the Shire River Basin in the economy of the country. The overall Development Objective of the Shire River Basin Management Program (SRBMP) 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 will have an initial duration of 15 years.

The first phase project – the Shire River Basin Management Programme Phase-1 Project (SRBMP-1) commenced in 2013, and will last for five and a half years. The Development Objective and the Global Environmental Objective of the SRBMP-1 are: to develop the Shire River Basin planning framework to improve land and water management for ecosystem and livelihood benefits in target areas. The project will address the interlinked challenges of poverty and a deteriorating natural resource base in the Shire River Basin to reduce the process of environmental degradation and to improve the productive potential of the natural resources. SRBMP-1 comprises three components:

a) Shire Basin Planning

b) Catchment Management, and

c) Water Related Infrastructure

As part of the Catchment Management component, one activity has been to develop national integrated catchment management and rural infrastructure Guidelines. These Guidelines have duly been drawn up, and are presented here. They comprise two separate volumes which complement each other as follows:

Volume I	Theory and Procedural Guidelines *The theory of catchment management and higher level planning*
Volume II	Toolbox *Step-by-step technical guidance and village level planning*

The Guidelines were developed in consultation with many different stakeholders - within the Malawi Government, the Shire River Basin Management Program and other stakeholders within Malawi, and international experts. It represents a substantial collaborative effort. I wish to convey my thanks to all those who participated in the consultation processes, and made contributions to the product that you hold in your hands today.

The next step is the implementation of a training program in which the target groups will be coached in the use of the Guidelines. This process, together with 'road-testing' as the Guidelines are put to use will, no doubt, result in further adjustments and fine-tuning, culminating in a more robust and practically useful product.

It gives me great pleasure therefore to introduce you to these National Guidelines for Integrated Catchment Management and Rural Infrastructure Development.

How to Use the Guidelines

The Guidelines comprise two volumes that complement one another. Volume I is intended for office study, while Volume II is basically a field manual. Each is self-standing, with introductory sections and an explanation of the overall catchment management process.

Volume I Theory and Procedural Guidelines

Volume I introduces catchment management principles: it explores the theory of catchment management in the context of Malawi and lays out the need for integrated catchment management– and why strategic catchment planning is required at all levels. It deals with procedures throughout the process, linking national plans with activities on the ground. It is especially targeted at higher level planners and managers. It is recommended that government and project staff study these guidelines: this will help them understand the overall importance of integrated catchment management in terms of the environment and development. It also shows how higher level planning processes tie in to participatory village planning.

Volume II Toolbox

Volume II comprises practical activities targeted at village level. First, the village-level planning process is explained, and how the Village Level Action Plans formed are turned into on-farm and community activities. Step-by-step technical guidance is given for a range of measures, from (for example) conservation agriculture and agroforestry, to gully rehabilitation and forest management. There are line drawings and photographs to illustrate each technology, as well as references and suggestions for further reading. This volume is aimed at 'hands-on' practitioners at the village/ community level.

Overleaf each volume is summarised, by section, with a short explanation of the purpose of each section, and its main content.

These Guidelines are also available at:
http://www.catchmentguidelines.org.mw/

Volume I Theory and Procedures

	Section	Content and Objective
1	Introduction	This section introduces the concepts and context of integrated catchment management (ICM), and catchment management plans (CMPs) as appropriate planning instruments.
2	Key issues in Malawi	A dependency on natural resources leads to degradation and depletion under the pressures of high population growth. Deforestation, land degradation, impacts on water resources (quantity and quality), depleted biodiversity and fish resources, all exacerbate levels of poverty. Climate change is an underlying threat.
3	Catchment management: concepts and principles	The catchment is an integrated management unit defined by hydrology. Sustainability requires integrated land and water management objectives, the participation of stakeholders in planning and decision making, and 'reasonable utilisation'.
4	Legislative and institutional framework	Malawi has a comprehensive suite of institutional structures, backed by the Constitution, including Cabinet and Parliamentary oversight committees, a National Environmental Policy, and an Environmental Management Act. The Forestry Act, the National Water Resources Policy, and institutional structures for Water Resource management are outlined, along with local government structures and functions focusing down to village level.
5	Catchment management planning	This section is the heart of Volume I of the guidelines. The planning commences with initiation, assessment, planning, implementation and ultimately monitoring and review of a CMP. *For more on Village Level Planning refer also to Volume II: Section 3.*
6	Participatory approaches	There are many useful techniques that assist planners in working with communities. Participatory and Rapid Rural Appraisals are described, and methodological techniques are presented as practical guidelines.
7	Modelling	A decision support system is required to support the analysis of different development scenarios. There are many models to choose from, with selection dependent both on purpose and on the availability of data for model configuration. Both hydrological and ecosystems models are offered as useful planning tools.
8	Role of a Catchment Management Committee	Catchment Management Committees are mandated in terms of the National Water Resources Act (2013) as custodians of water resources conservation. They may or may not be established but are the most suitable vehicle for implemented ICM planning.
9	Alternative sources of income to support improved catchment management and protection	Limitations and pressures on natural resources require that additional, alternative, strategies be adopted for both production (agroforestry, and poultry rearing), and demand reduction (energy efficient stoves), with micro-scale enterprises playing a vital role in value addition.

Volume II Toolbox

Chapter		Content and Objective
1	Introduction	The principles of catchment management are introduced. The Guidelines are outlined.
2	Stakeholders and roleplayers	Everyone in the village benefits from sustainable catchment management. However different stakeholders play different roles in the process. The different contributors and participants in village level catchment management are identified and discussed.
3	Village level catchment planning	The purpose of the Village Level Action Plan is explained. The process is laid out in simple stages: villages identify problems and opportunities, and compile a VLAP. Technical measures are selected and guidance is given to communities to manage their own resources. How the VLAP is linked to the overall catchment planning (Vol 1, Ch 5) is described.
4	Budgets, funding and savings clubs	The financial market is seen as playing a vital role in the rural development process. Guidelines outline the process of compiling a budget, a funding application, and organizing and managing a Community Based Savings and Loans group or “Bank Mkhonde”. It lists steps on how to start a CBSL, describes accountability structures, operational rules and linkages with formal banks.
5	Monitoring and Evaluation	Monitoring and evaluation ensuring the village’s plans are implemented correctly and that they achieve their set objectives. This section outlines the key principles that villagers need to be aware of.
6	Tool Box Introduction	A simple decision support system is described to help villagers choose appropriate measures and guidelines. The icons of the tool box guidelines are explained.
A	Sustainable Land Management	The sub-themes that are covered in this section include: Climate-Smart Agriculture, Rangeland Management, Soil Fertility Management, Erosion and Runoff Control Measures, Gully Management, Stream / River Bank Management, and Sediment Trapping. Tips on compost making and fertilizer selection are included. Guidance is provided on restoring eroded land e.g. by reclaiming gullies. There is information on creating buffer zones for rivers and wetlands.
B	Water Harvesting and Storage	The sub-themes that are covered in this section include: Water Use Efficiency, Water Reuse and Recycling, Water Harvesting, Micro Water Storage, Small Dams, Infiltration, and Small-Scale Irrigation. Improving WUE by installing drip irrigation, making use of household “grey water” is highlighted. Instructions are given on harvesting water from roofs and roads for productive purposes.
C	Household Management	The sub-themes that are covered in this section include: Farm Management, Sanitation, Energy and Waste Management. This section also demonstrates how to establish living fences and windbreaks from trees and how to operate a tree nursery. There are instructions on how to maintain borehole pumps, and guidelines for improved grain storage. Sanitation includes construction of a composting toilet, and an “Arborloo” latrine, as well as instructions on how to close a filled pit latrine. A detailed section explains construction and use of devices that utilise alternative sources of energy, e.g. solar, wind and biogas. Waste management looks at how to improve waste management both at the household level and at the market level, and suggests means for recycling and reuse.
D	Natural Resource Management	The six components of this section are: Forestry (woodlot management and natural forests), Fishing (aquaculture), Wetland management (*Dambos*), and Invasive Alien Vegetation Management.
E	Disaster Management	Fire Management, Health and Emergency Response are the three sub-themes dealt with in this section. Planning and practical action are described.
	Annexes	Annexes to *Volume* II give extra, specific information on the following: 1: Standard requirements for accessing donor funding 2: Co-operative Agreements (Forest Reserves) 3: Community Disaster Risk Reduction Response Plans 4: Fire Hazard Assessment and Mitigation 5: Selecting Beneficial Trees 6: Participatory approaches in catchment management planning

1 Introduction

1.1 Context for integrated catchment management

In 1995, in response to Agenda 21, the Malawian Government developed the National Environmental Action Plan (NEAP) as a framework for development that proposed a set of actions that should be taken in order to redress the escalating environmental degradation and facilitate sustainable utilisation and management of natural resources. In this process, nine key environmental issues were identified, namely: soil erosion, deforestation, water resources degradation and depletion, threat to fish resources, threat to biodiversity, human habitat degradation, high population growth, air pollution and climate change. The plan has strategies to address each area of concern. Considerable work has been undertaken in Malawi since then to address these issues, and numerous aid and funding organisations have partnered with the Malawian Government to achieve this. Regrettably, recent studies[1] have confirmed that the key issues raised in the NEAP are still prevalent, and that environmental degradation is still evident. It is apparent that these key issues are all inter-connected and to a large extent can be attributed to poverty and high population.

In managing Malawi's natural resources, including water resources, all of these concerns and aspects as well as others, must be taken into consideration. Integrated catchment management (ICM) as a process of managing natural resources within the catchment/watershed unit, promotes this co-ordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

1.2 Natural resource management

The severity and complexity of natural resource management challenges has led to more integrated approaches to natural resource management. Cairns and Crawford (1991)[2] define integrated natural resource management as a "*Coordinated control, direction or influence of all human activities in a defined environmental system to achieve and balance the broadest possible range of short- and long-term objectives*."

Van Zyl (1995)[3] emphasises that integrated natural resource management must be people centred, but also states that:

"To succeed in managing...managers must be in a position to see the whole picture, understand the resources, the customers, their needs and aspirations and to make wise decisions in the interests of all. This requires a holistic approach to management that integrates skills in engineering, economics, politics, social and environmental management. It involves the bringing together of various disciplines and the compilation and development of multidisciplinary teams of champions. Due to the ...site-specific nature of (water) resources in terms of physical properties, land use and people involved, it is not feasible to manage ...on a national basis without basing it on logical management units."

Examples of integrated approaches include integrated catchment management and are characterised by a proactive, all-inclusive and systems-based approach to natural resource management challenges. In

[1] Government of Malawi (2014). **2014 Millennium Development Goal Report for Malawi**, Government of Malawi, Ministry of Finance, Economic Planning and Development, Lilongwe. URL: http://www.undp.org/content/dam/malawi/docs/general/Malawi_MDG_Report_2014.pdf, Accessed 10 November 2015.

Government of Malawi (2010). **Malawi State of Environment and Outlook Report Environment for Sustainable Economic Growth,** Ministry of Natural Resources, Energy and Environment, Lilongwe, URL: http://www.mw.undp.org/content/dam/malawi/docs/environment/Malawi%20State%20of%20the%20Environemnt%20and%20Outlook%20Report_2010.pdf, Accessed 10 November 2015.

[2] Cairns, J. Jr. and T.V. Crawford. 1991. **Integrated Environmental Management,** 215 pp. Lewis, MI, USA. A handbook for integrated environmental management.

[3] van Zyl, F. C. 1995. **Integrated catchment management: is it wishful thinking or can it succeed?** Water Science and Technology 32:27-35.

many developing countries, governments and development agencies are turning to integrated natural resource management as a means of safeguarding the natural resource base and improving agricultural productivity.

1.3 Institutional aspects of integrated natural resource management

In many cases, community responses to natural resource management challenges are being hampered by the growing compartmentalisation of governments. Most countries have separate laws, institutions and policy objectives to govern sectors such as agriculture, forestry, water, energy and health. The compartmentalisation frequently means that decisions to govern a sector are made without sufficient regard for issues outside the sector's narrow mandate.

The fragmented approach of government departments to natural resource management issues has high administrative costs, e.g. interdepartmental committees or new multi-sector units, and other challenges such as who, which department, is accountable for the budget or funding of these activities and taking the lead to drive the process. By contrast, communities find it relatively easy to think and act holistically. The administrative costs of integrated natural resource management can be reduced by devolving significant management responsibility to community based organisations where possible. The challenge is to effectively connect government departments with each other and with local-level organisations.

Government funding allocated to integrated resource management programmes instead of individual departments will facilitate cross-sector collaboration. The challenges of departmental collaboration should also be easier to overcome through properly established decentralisation. However, this requires adequate capacity and genuine social empowerment through devolution of authority and responsibility. The authority and responsibility for management must be vested together at the lowest appropriate level and only delegated upward where necessary.

1.4 Integrated Catchment Management

1.4.1 Principles and characteristics

The principle of Integrated Catchment Management (ICM) is that the process of developing the strategic approach to integrated resource use should be inclusive and holistic. As water is the common link among resource users in a catchment, it is appropriate that the catchment is used as a planning unit for resource management.

> In its widest possible sense, ICM recognises the need to integrate all environmental, economic and social issues within a river basin (or catchment) into an overall management philosophy, process and strategy or plan.

Thus ICM is aimed at deriving the greatest possible mix of sustainable benefits for future generations and the communities in the area of concern whilst protecting the natural resources upon which these communities rely.

ICM is based on the following principles:

- Land and water resources are parts of natural ecosystems. Management should be based on the catchment as the geographical unit.
- Catchments are continually changing so management must adaptively take into account these changes.
- Management of land and water resources must be coordinated, with decisions based on best available information.
- Resource management can only be achieved by the informed actions of users and managers of these resources, therefore strong need for stakeholder engagement, awareness building and capacity development.
- A sound balance between economic development and environmental protection must be maintained.

In effect, the ICM approach seeks to maintain a balance between the competing pressures exerted by the need to maintain resource integrity in the long-term, against the compelling call for social upliftment and advancement, and the need for continuous economic growth and use of environmental resources.

Six important characteristics have to be borne in mind for the practice of ICM to be truly effective and efficient, namely:

- Effective co-ordination of land and water management may have to extend beyond the normal "physical" boundaries of a single catchment;
- All landowners and other stakeholders can and should play a significant role in ensuring effective resource management;
- The relationships between stakeholders should be based on trust, with long-term commitment to, and continuity of, the catchment management process;
- The definition of catchment boundaries may have to be flexible, depending on the definition of common issues of concern to stakeholders;
- Specific institutional arrangements may have to be flexible and adaptable within different Catchments, to suit the particular circumstances of each situation; and
- Recognition that whilst ICM is a long-term process, realistic short- and medium-term goals are also necessary.

The purpose of ICM is to integrate the management of land, water and related resources to achieve sustainable and balanced use of these resources for sustainable current and future development.

The main goals of ICM should be:

- Increased community awareness, coordination and cooperation;
- Development of common goals and priority actions; and
- Achieving economic and ecological sustainability.

These goals provide a framework for fostering the adoption of sound natural resource management practices and the coordination of both government and non-government planning and action in rural and urban areas.

1.4.2 Catchment related issues

While different problems may have different priorities in an individual catchment, the issues listed in Table 1-1 below appear to be common throughout Malawi, and are closely related to the issues identified by NEAP listed in Chapter 2 Section 2.1.

Table 1-1: Common catchment related issues in Malawi

	Common Issues
1	Impact of land use on water quality
2	Soil erosion and sedimentation of water courses and stability of banks
3	Salinity caused by land clearing
4	Loss of habitat and deforestation
5	Floodplain management (including flood mitigation)

	Common Issues
6	Increased productivity yield demand
7	Competition for resources and water availability

Catchment Management Plans (CMPs) should provide the basis for addressing significant issues in the specific catchments and provide important guidance on the use and management of natural resources.

In particular, the issues that this process should address include *inter alia*:

- Increasing competitive demands on natural resources;
- Rural infrastructure;
- Undesirable off-site effects such as water pollution, induced soil salinity and degradation of groundwater; and
- Loss of essential ecological processes, ecosystems and biodiversity.

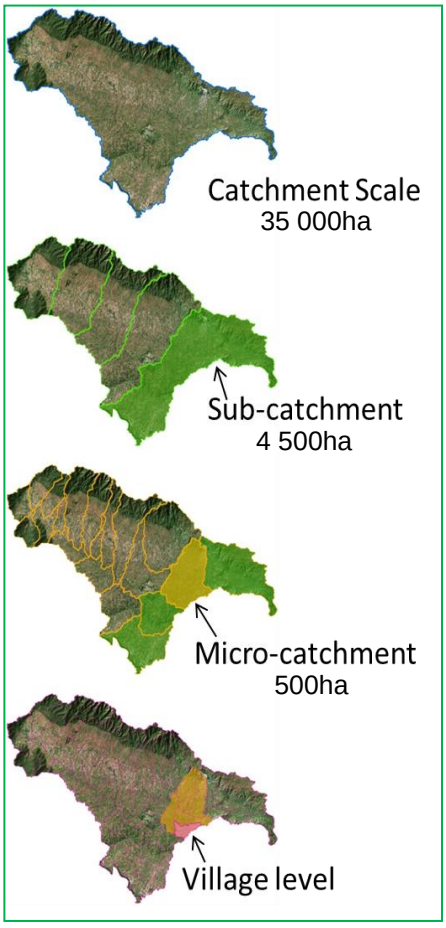


Figure 1-1: Various catchment scales

1.4.3 Levels of catchment management

Catchment management can be difficult to coordinate, because catchments do not respect political or tribal boundaries, and in many instances cross several economic, cultural or even national boundaries. Catchment management planning is therefore carried out at various scales from district level strategy down to village level planning. This has to be integrated so that everyone is aiming and working towards achieving the same goals.

A catchment can be sub-divided into smaller units for specific purposes, such as management by specific groups or to match other geographic or administrative boundaries. The smallest form of a water catchment is called a micro-catchment. A number of micro-catchments make up a sub-catchment and groupings of sub-catchments make up a larger catchment. The catchment scales are illustrated in Figure 1-1.

While the ICM strategy emphasises community responsibility for management of natural resources, there are a number of activities which can be fostered by government agencies, research organisations and universities as well as professional societies. These include regulation, resource assessment and monitoring, research and development, planning, extension, education and awareness. Therefore catchment management planning needs to be carried out at different water management unit scales such as catchment, sub-catchment, village, as well as involving different stakeholders such as national government institutions, districts, villages, individual landowners.

The area of a catchment depends on topography, rainfall, and the scale at which the catchment is defined. No catchment is the same and so too there are different groups of stakeholders involved at these different scales. For example an individual farmer may have little interest in what is happening in the rest of the basin, but can make a significant contribution within his village and sub-catchment.

The approximate areas of catchments in Malawi are:

- Catchment scale (35 000 ha; District level)
- Sub-catchment scale (4 500 ha)
- Micro-catchment (500 ha; Group Village Headman)
- Village-level (Villages)

The level or detail of catchment plans also varies depending on the scale of the catchment, for example at the village-level, the plan will only include site-specific or very localised but very defined activities (Village Level Action Plan, or VLAP); whereas at the Catchment scale the plan will be much broader in scope and quite comprehensive with sector and scenario analysis (Catchment Management Strategy and Plan, CMS and CMP).

These broader Catchment Management Plans should contribute to informing the type of activities that should be happening at the village level, but the context specific activities are captured in the VLAP. The levels of catchment management strategies and plans are as follows:

1.4.4 Catchment Management Strategies (CMS)

Focused at the broadest catchment scale, catchment management strategies should reflect strategic thinking, such as national strategic objectives, to provide for the management of natural resources of a particular catchment. The CMS should be for a period of not less than 5 years and address issues of strategic importance for the catchment. It should be driven by principles (for example equity and sustainability) and should recognise the major drivers in the catchment (e.g. degradation, soil erosion, economic development opportunities and demographic issues). It should take a systems view and acknowledge the interlinkages at the catchment scale. It should not contain details related to budgets and implementation plans, nor should it identify individuals and institutions directly. The CMS applies to everyone who has a stage or interest in a particular catchment. It provides the opportunity to translate other sectoral and national policies, objectives and activities to the catchment scale.

1.4.5 Catchment Management Plans (CMPs)

These are based on the CMS and are an interpretation of the principles in the CMS into specific management plans. CMPs should address specific areas of strategic importance and provide details related to: how, what, who, when, and why? The CMP contains timeframes as well as issues of cost, and describes how the plan will be implemented. The CMP includes specific issues such as climate adaptation, disaster management, infrastructure development and so on. There is prioritisation of actions related to the most important and pressing issues for the catchment, for example flood management.

1.4.6 Village Level Action Plans (VLAPs)

Village-level action plans (VLAP) are plans for managing the resources and infrastructure at village level. Plans provide for in-field activities, and typically cover a period of five years. One of the most important aspects is for village members to participate in the planning process so that people have both input into and a clear understanding of what their responsibilities are. The focus of village plans is on the maintenance and sustainable utilisation of the ecosystem that provides resources in support of village livelihoods. Part of the plan addresses the rehabilitation or restoration of damaged ecosystem services needed to support the village. Refer to Volume II of the *Guidelines for Integrated Catchment Management and Rural Infrastructure*.

1.5 Objectives of the Guidelines

These *Guidelines for Integrated Catchment Management and Rural Infrastructure* serve as a planning framework for the country with the aim of improving land and water management for ecosystem and livelihood benefits across Malawi. The Guidelines address the interlinked challenges of poverty and a deteriorating natural resource base especially in the southern region and propose measures to reduce the process of environmental degradation in other regions and improve the country's overall productive potential of natural resources. Together Volume I and II are for use by the relevant government departments, their development partners, and other stakeholders and cover multi-sectoral planning and implementation of catchment management at different scales (from basin wide to village level); thereby enhancing harmonised planning, interventions and Monitoring and Evaluation (M&E) for catchment management in Malawi. Specifically Volume I*, Procedural Catchment Management Guidelines*, targets the more technical audience responsible for overall governance of the catchments, as well as technical professionals providing specific consulting services. This Volume ensures that overall strategic catchment management goals are incorporated into smaller scale plans, for example at village level.

2 Key issues in Malawi

In 1995 the Malawian Government undertook the development of a National Environmental Action Plan (NEAP) in pursuit of its responsibilities in terms of the Malawi Constitution, Chapter III, Section 13(d):

To manage the environment responsibly in order to:

- Prevent degradation of the environment
- Provide a healthy living and working environment for the people of Malawi
- Accord full recognition to the rights of future generations by means of environmental protection and sustainable development of natural resources
- Conserve and enhance the biological diversity of Malawi

In the process of developing the NEAP, key environmental issues were identified. These include: soil erosion, deforestation, water resources degradation and depletion, threat to fish resources, threat to biodiversity, human habitat degradation, high population growth, air pollution and climate change. Figure 2-1 illustrates the linkages between these key environmental issues. Integrated Catchment Management seeks to understand the problems holistically and address them in a sustainable and system manner.

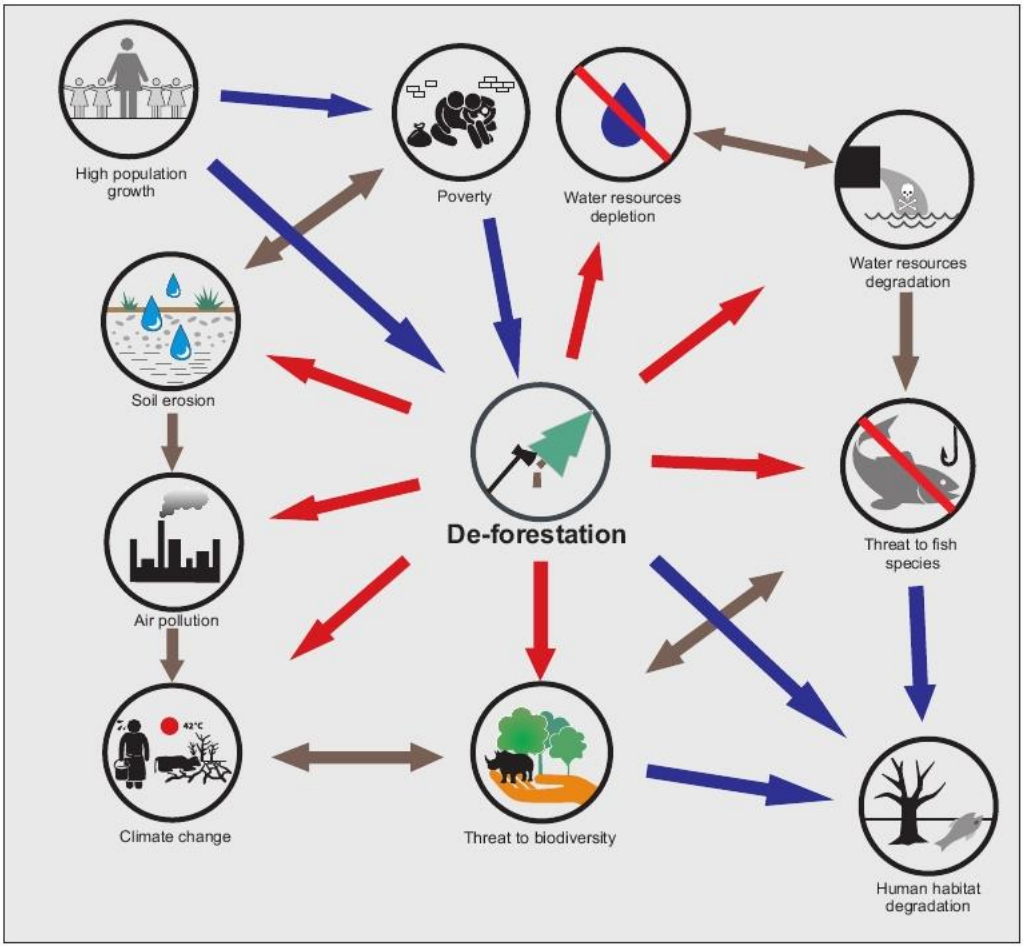


Figure 2-1: Cause and effect linkage of drivers and impacts of environmental degradation

The objective of these two volumes of Guidelines is to provide knowledge and enable communities, Districts and Government Departments to implement integrated Catchment Management. By

implementing catchment management activities will result in healthier catchments (representative of all natural resources) and improve livelihoods, as illustrated in **Figure 2-2**.

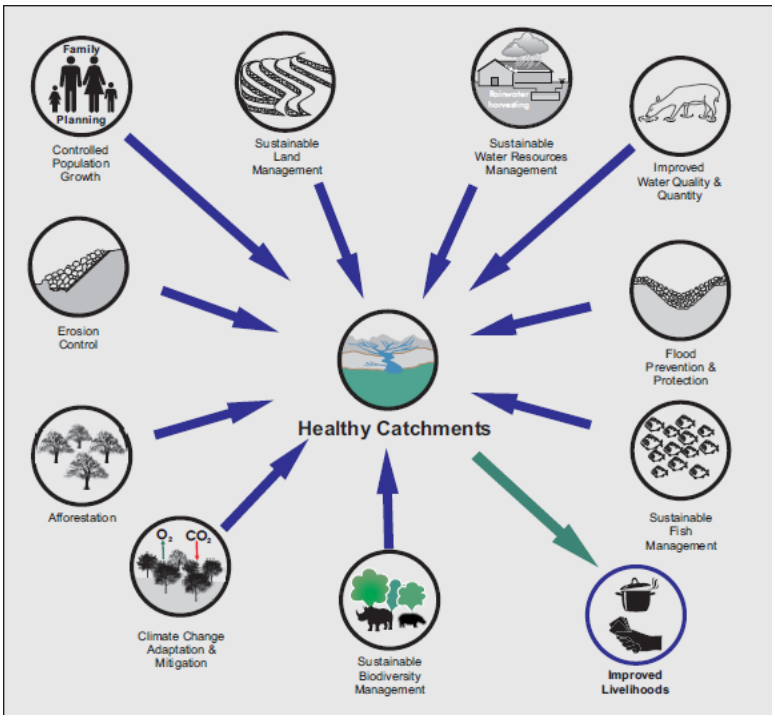


Figure 2-2 The implementation of catchment management activities results in healthy catchments and improved livelihoods.

Since 1995, considerable work has been undertaken in Malawi to address these issues. The partnership and support of funding and aid organisations must be acknowledged. Some of these initiatives are listed below:

Table 2-1: Initiatives to address environmental degradation in Malawi

Initiatives to address environmental degradation
National Forestry Policy in 1996
National Forestry Act 1997
National Forestry Programme in 2000
National Land Resources Management Policy and Strategy in 2000
National Water Development Programme (NWDP I 1995-2004, and NWDP II 2007-2015)
National Water Policy in 2005
Malawi Growth Development Strategy (MGDS I 2006-2011 and MGDS II 2011-2016)
National Sanitation Policy in 2008
National Water Resources Master Plan[4] (1987 – updated 2011-2014)
Water Quality Management Project (2011-2013)
National Irrigation Plan and Infrastructure Framework, 2014
Green Belt Initiative (GBI) 2015-2018
Agricultural Sector Wide Approach (ASWAp)

[4] **Project for National Water Resources Master Plan in the Republic of Malawi.** Undertaken by CTI Engineering International Co., Ltd., Oriental Consultants Co., Ltd and NEWJEC Inc. for the Ministry of Agriculture, Irrigation and Water Development (MoAIWD), Funded by the Japan International Cooperation Agency (JICA).

The key issues raised in the NEAP are still apparent, and environmental degradation is still evident. These are discussed in more detail below.

2.1 High population growth

The most recent population census in Malawi took place in 2008. The country's population had grown from approximately 10 million in the 1998 census, to 13.1 million in 2008. This is an overall growth of more than 30%, with an annual growth rate of 2.8% per annum over the census period. This has resulted in a population density of 139 persons per km^2 in 2008 - one of the highest in the world. Combined with a low rate of literacy, this contributes to high levels of poverty. Many people rely on natural resources for their livelihood, but there is not enough good quality arable land to support such a fast growing population.

The Malawian National Statistical Office has made population projections based on the 2008 Census, published as the "Malawi Population Projection". This estimated that, if current rates of population growth were to be maintained, there would be 14.4 million people in the country in 2011, 22.4 million people in 2025, and 30.3 million people in 2035.

Land, water, and forest cover are threatened by the high demand for resources such as wood for fuel, subsistence agriculture, and the need to generate a basic income from any possible source. The growing population and its reliance on natural resources for survival is reducing both the volume and the yield of natural resources. Soil fertility is systematically reduced together with the carrying capacity of the land to support both livestock and people through food production. The end result is that there are insufficient resources to support the current generation adequately, let alone future generations. From the figures above it is clear that the current population growth rate is unsustainable.

2.2 Poverty

Malawi is among the poorest countries in the world, with about 65% of its population classified as living in poverty, and 29% as living in absolute poverty[5]. In 1968 the average landholding size was 1.5 ha, whereas in 2010 it was estimated to be 0.8 ha[6]. With 84% of the population in Malawi classified as rural by the World Bank in 2013, there is a deep reliance on the land for subsistence living. While there have been improvements in plant and animal genetic stock, along with increased fertiliser use bolstered by 'smart subsidies', that have brought increased productivity[7], these improvements cannot keep pace with continued growth. Rural communities are highly resilient, but part of this resilience comes from finding and exploiting other remaining resources – putting pressure on what little of the natural environment remains. The situation is exacerbated by climate change.

2.3 Land degradation and soil erosion

A recent estimate of the average rate of soil loss in Malawi was 20 tons/ha/year[8]. This is almost double the world soil loss tolerance standard figure of 11.2 t/ha. This soil loss (coupled to a loss in fertility) contributes to a reduction in crop yields of more than four per cent per year[8].

[5] **Malawi National Statistical Office,** 2008.

[6] **Malawi Climate Change Vulnerability Assessment.** Produced for the United States Agency for International Development by Tetra Tech ARD, through a Task Order under the Prosperity, Livelihoods, and Conserving Ecosystems (PLACE) Indefinite Quantity Contract Core Task Order (USAID Contract No. AID-EPP-I-00-06-00008, Order Number AID-OAA-TO-11-00064).

[7] **Towards 'smart' subsidies in agriculture? Lessons in recent experience in Malawi.** Briefing paper: Andrew Doward, Ephraim Chirwa, Duncan Boughton, Eric Crawford, Thom Jayne, Rachel Slater, Valerie Kelly and Maxton Tsoka. ODI Annual Report, 2008.

[8] **Economic Valuation of Sustainable Natural Resource Use in Malawi. Ministry of Finance and Development Planning,** UNDP/UNEP. Authors: Gil Yaron, Ronald Mangani, John Mlava, Patrick Kambewa, Steve Makungwa, Austin Mtethiwa, Spy Munthali, William Mgoola, John Kazembe. (See Section C7, page xv).

In addition to the loss of agricultural production soil erosion causes sedimentation and siltation of rivers and reservoirs, impacting on water quality reducing storage capacities. The deposition of Infertile sand may also reduce the productivity of fertile low-lying alluvial lands in the flood plain.

Since the majority of the population of Malawi rely on subsistence agriculture for their livelihoods, it is vital that every effort is made to employ soil conservation measures and reduce the loss of this essential natural resource.

2.4 Deforestation

Extensive deforestation continues in Malawi. This been as a result of the growing demand for domestic fuel wood for energy, heating and cooking; and also due to clearing of forests to meet the need for agricultural land. Wood is also used for tobacco barns (Burley tobacco) and smoke curing in the tobacco and fish industries, brick burning and beer brewing.

The rate of deforestation for agricultural expansion is declining only because there is so little agriculturally suitable land left to be deforested, rather than as a consequence of sustainable management.

Afforestation programmes are not meeting the increasing demand of fuel wood and communities are forced to make use of the low growth-rate indigenous forests on customary land, even if illegally. There is a demand for charcoal as a cheap energy source, so those needing to supplement their income use this wood to make charcoal – supplying both income needs and energy demands.

In the face of the pressure to provide income, this (often illegal) deforestation continues, contributing to excessive loss of natural forests and even protected areas. Deforestation increases the incidence of soil erosion, and with erosion a reduction in crop yields as discussed in the previous section.

There is also pressure on forests through industries using wood for fuel or infrastructure, for example the tobacco industry. The tobacco sector encourages the establishment of woodlots – with woodlot production intended to meet requirements. This may meet the requirements of tobacco production but does not necessarily compensate for the increasing number of people on the land with their own added demand for wood and energy. This pressure makes it difficult for those responsible to protect and manage customary forests to do so.

2.5 Water resources degradation and depletion

An abundant supply of surface and ground water has, up to 2010, allowed Malawi sufficient water abstraction volumes to meet requirements during average dry seasons, with shortages only occurring during drought dry seasons[9]. This is no longer be the case due to increased water requirements from the growing population, combined with climate variability and the steady degradation of the catchments. At current growth rates, some form of water resource development, such as storage, lake water use, basin transfers, or rain water harvesting (probably all of these) will be needed. The Water Resources Assessment component of the Water Resources Investment Strategy (WRIS)[9] identified three risks to water resource availability, namely:

[9] **Water Resources Investment Strategy Component 1** – Water Resources Assessment, Main Report, April 2011. Undertaken by WS Atkins International Ltd in association with Wellfield Consulting Services for the Government of the Republic of Malawi, Ministry of Irrigation and Water Development, Second National Water Development Project (NWDP II). Funded by the World Bank. World Bank, 2011.

2.5.1 Risk of sediment ingress

The risk of sediment ingress into watercourses was assessed to be relatively high across the whole of Malawi. This affects the availability of water because silted rivers have reduced capacities and are more susceptible to flooding. The silt can bury habitat for fauna and flora, as well has have a negative impact on hydropower generation capability by reducing storage capacity and damaging generators.

2.5.2 Risk of infestation from alien weeds

The risk of infestation by invasive aquatic weeds was found to be medium to very high in most of Malawi's aquatic environments[9]. There are four major invasive aquatic species of concern, namely *Eichhornia crassipes* (water hyacinth), *Pistia stratiotes* (water lettuce), *Salvinia molesta* (giant salvinia, kariba weed), and *Azolla filiculoides* (red waterfern).
These plants form dense mats of floating weeds in nutrient-rich aquatic ecosystems, and threaten biodiversity through altering the microclimate and displacing indigenous aquatic flora and fauna[10]. Invasions of aquatic weeds are associated with a range of impacts on water quality, as listed below:

- Dense mats can impede water flow in rivers and irrigation canals, which increases the rate of siltation in rivers, lakes and reservoirs.
- These mats can also inhibit the diffusion of air into water, resulting in lower dissolved oxygen concentrations.
- This, combined with the increased amounts of organic detritus collecting beneath these floating mats, can increase sediment accumulation rates and accelerate eutrophication processes. Increased eutrophication can be lethal to fish and other aquatic biota.
- Aquatic weeds also increase evapotranspiration from a water surface. Water hyacinth can increase evaporative water losses by at least 40 – 50% through transpiration from its leaves.
- Invasions by aquatic weeds have been linked to increases in water-borne and other water-related diseases. Water hyacinth infestations have been linked to increases in schistosomiasis (bilharzia) and have also been shown to adsorb cholera viruses from contaminated water.
- *Salvinia molesta* provides habitat for mosquitoes, which are vectors for diseases such as dengue fever, elephantiasis, encephalitis and malaria.

Dense floating mats also interfere with water transport especially where it blocks access to the water for fishing vessels and canoes, and clogs commercial harbours (as experienced in Lake Victoria). Aquatic invasives interfere with fishing by entangling fishing lines and nets, and with freshwater supplies by blocking intake points, screens and filtration plants.

Water hyacinth first appeared in the Shire River in the 1960's and by early 2000 has been observed in Lake Malawi and all the major river systems reaching all the way to the Songwe River and Karonga in the north[11]. Water hyacinth is a major concern for hydropower production on the Shire River where it has affected the operations of the barrage at Liwonde and has disrupted hydropower production at the Nkula Falls and Kapichira Falls further downstream.

Lake Chilwa, a Ramsar site that supports important populations of 153 species of resident and 30 species of palearctic (migratory) water birds, is threatened by water hyacinth, *Salvinia*, water lettuce, and red water fern[10]. The massive mats of interlocked plants have changed the water chemistry, impeded light penetration and decimated indigenous flora, negatively affecting fish and invertebrate biodiversity, and overall aquatic ecosystem integrity.

[10] **"National Biodiversity Strategy and Action Plan".** Published by Environmental Affairs Department, Lilongwe, Malawi, 2006.

[11] **"Progress with Biological Control of Water Hyacinth in Malawi".** Proceedings of the Second Meeting of the Global Working Group for the Biological and Integrated Control of Water Hyacinth, Beijing, China, 9–12 October 2000. Phiri, PM, Day, RK, Chimatiro, S, Hill, MP, Cock, MJW, Hill, MG and Nyando, E (2001).

2.5.3 Water quality risks

The quality of both surface and groundwater resources in Malawi was found to be generally tolerable for a wide number of uses[9]. In some areas, however, water quality is often too poor for domestic potable use, or even to enable use for irrigation without additional pre-treatment, adding to the cost of supply. The high sediment loads are likely to cause damage to irrigation equipment. Fortunately the highest sediment loads coincide with the wet season when there is less irrigation required. Additionally, sediments enhance nutrient cycling and may cause negative water quality impacts such as eutrophication.

In 2011, 88.6% of Malawians (66.8% urban and 91.8% rural), were using unimproved pit latrines[12]. The growing population also results in unplanned settlements with improper sanitation and waste disposal. Pit latrines near water sources, livestock and industrial discharge contaminate ground and surface water, resulting in biological contamination. “While the application of agro-chemicals has led to pest control and increased food production, it has equally contributed towards the degradation of water resources”[13]. Chemical contamination through runoff from agriculture containing fertilizers and pesticides and improper disposal of industrial waste promotes eutrophication, damages ecosystem health, causes fish mortality and increases the threat to human health.

The long term prediction from the WRIS[9] was that, if significant water quality protection and catchment management was not introduced in the country, significant deterioration in both the surface and groundwater quality would occur, and as a worst case, the raw water quality could be unsuitable for use in most sectors by 2035. The study further stated that: “Given the nature of the risks highlighted above, the potential pressures on water resources highlighted in this report, and the importance of these resources to the plans for economic growth and poverty alleviation in Malawi, it is difficult to overstate the vital importance of incorporating sustainable land and catchment management practices as an integral part of Malawi’s long-term investment strategy.”

2.6 Threat to fish resources

Threat to fish resources has increased due to degradation of the lakes and rivers through poor agricultural and water management practices. These bring about sedimentation, water pollution and prevention of fish migration due to construction and deposition (shallower water levels). Additionally the introduction of non-indigenous fish and water weeds is an increasing threat.
Furthermore the growing population increases the demand for fish products, which leads to over-fishing, non-compliance with "off-season" regulations and inappropriate and damaging fishing methods. This brings about a decline of populations of endemic anadromous fish, a decline in the genetic structure of the stock, and a decline in catch rates. The situation is further worsened by community expansion into ecological niches, destroying breeding areas – a disastrous feed-forward loop
In the mid-1990s, significant declines in 12 species of fish were recorded in Malawi[6]. In the past three years (212-2014), there seems to be an increase in the overall catch tonnage, with some species increasing (e.g. the sardine-like Usipa or *Ungaulicypris sardella* and Chambo (Oreochromis spp.) but others continuing to decrease[4]. The inability to enforce, inadequate adherence to, and the contradictory nature of the legislation limits sustainable fish stock management.

2.7 Threat to biodiversity

[12] **Welfare Monitoring Survey (WMS),** 2011 conducted by the Malawian Agriculture Statistics Division of the National Statistical Office (NSO) between September 2011 and February 2012.

[13] **NEAP**, 2001.

Threats to biodiversity have increased with the increase in population and the associated need for agricultural land and livestock rangeland. This has forced most natural fauna into national parks, game and forest reserves. These reserves are however, subject to poaching as well as to community encroachment. Some fauna and flora species are found only outside of protected areas and are therefore highly threatened.

Livestock has a high density in rangelands, especially in the northern regions of the country. This is likely to decrease biodiversity through unsustainable overgrazing. Biodiversity is also threatened by human activities and encroachment into habitat areas. Bushfires are a threat to biodiversity as they occur in all areas of the country between April and November annually.

2.8 Human habitat degradation

Human habitat degradation is a consequence of increased population and the associated pressures. Urban areas are overcrowded as a result of high migration and low income levels. The pressure for housing leads to unplanned, unauthorized squatting in areas with no roads, no water supply, and no sewerage disposal. Access to drinking water, particularly clean water, is hampered by significant operational and maintenance problems in both the rural and urban areas, while human wastes and effluent contaminate surface- and ground- water resources through poorly sited and poorly maintained pit latrines, should these exist at all. While homesteads may have pit latrines these are often not available to small-scale miners, charcoal burners, and people working at distance in forest and field.

Solid waste poses a threat to human health if incorrectly managed, or if dumped in unsuitable areas. This can also contribute to the spread of mosquitos and malaria by providing breeding habitat. Mining pollution results in localised and unfilled pits, quarry dust, coal dust, subsidence, dumping of refuse, and potential radiation exposure. Working in these environments poses significant health risks through heightened exposure to toxic materials where ventilation is inadequate, with the inhalation of fine airborne particulates. The frequency of industrial inspections ensuring safe working environments is hampered by lack of adequately trained personnel, and by limited financial resources.

Development in the transport sector contributes to deforestation, with road construction through natural afforested areas and excavation of quarries for sand, stone and gravel for construction and maintenance purposes resulting in clearing of forested areas. This contributes to erosion and siltation due to disturbed soils and increased run-off. As with mining, stagnant water in abandoned pits can become a breeding ground for mosquitos. Deficiency of pollution control is due to the lack of enforcement of legislation, and the lack of specifications and procedures for the disposal of toxic liquid industrial wastes. Urban centres are challenged with inadequate sewerage and solid waste collection, disposal systems and facilities. In some cases these facilities are non-existent.

2.9 Air pollution

Hydropower provides the main industrial and commercial energy source with an installed capacity of 304 MW. This meets 94% if the commercial demand, with the remaining 6% coming from thermal energy. A coal-fired power station of 120 MW is currently in planning. The main contribution to poor air quality in Malawi remains, therefore, the consequence of the burning of trees for charcoal[14]. As agricultural yields fail to keep up with growing requirements for food and income, rural dwellers increasingly turn to charcoal production as an income generating activity – driven by the very high demand for fuel[14].

[14] **"Malawi Climate Change Vulnerability Assessment".** Produced for the United States Agency for International Development by Tetra Tech ARD, through a Task Order under the Prosperity, Livelihoods, and Conserving Ecosystems (PLACE) Indefinite Quantity Contract Core Task Order (USAID Contract No. AID-EPP-I-00-06-00008, Order Number AID-OAA-TO-11-00064).

Additional contributions to air pollution include emissions from industries and cars, and the burning of waste (including tyres) in urban areas. The burning of vegetation (both through wildfires and controlled burning), particularly between May and November, also pollute the air, but fire is also an important part of vegetation management. Quarrying and mining activities are increasing in scope, increasing levels of air pollution.

Malawi is highly suited to the development of renewable energy sources (notably solar power and solar water heaters) and should see this as an important solution both to energy supply and air pollution problems.

2.10 Climate change

Climate change

Climate change is altering atmospheric characteristics and dynamics on a global scale, and every management strategy should take account of the current and future impact of these changes. While Malawi makes its contribution to global warming and climate change, and must play its part in reducing fuel emissions, the main issue in the country is that deforestation and environmental degradation leave it ever less resilient to the impacts of that climate change. Generally warmer temperatures and more frequent heat waves are expected. Rainfall patterns are becoming more erratic, meaning more floods and more frequent droughts. Changing rainfall onset and cessation dates will have a particular impact on farm crop selection and planting regimes. Altered rainfall and evapotranspiration rates will impact on the flora, with an increased pressure on marginal species. Ultimately biological diversity is reduced. These changes also have societal impacts through crop yields, as well as on the forestry and fishing industries. Climate changes may alter human health and settlement distribution with disease vectors changing in response to temperature and moisture availability. Several assessments have been undertaken to determine the effect of climate change on Malawi, as listed below:

- United Nations Development Programme (UNDP): General Circulation Model (GCM) - country report for Malawi4;
- Malawi Climate Change Vulnerability Assessment[6];
- Climate change components in the WRIS[9]; and
- The most recent National Water Resources Master Plan in the Republic of Malawi[4].

Studies show uncertainty in the severity of the likely changes to occur in the near future but they do agree on the direction of change from the present mean climate experienced in Malawi. These changes are warmer day and night-time temperatures with more frequent and intense heat waves of longer duration[6]. The rainfall will increase in amount and intensity during the wet season of November to April, and will diminish during the dry season of May to October, although total annual rainfall may be similar to the present. With more rain falling as heavy storm events it will be less effective, and there will be increased erosion, an increased risk of flooding, and greater environmental degradation. Higher evaporative demand will offset any benefits should rainfall possibly increase, also resulting in less effective rainfall. The impact of changes in rainfall patterns to the flow dynamics of the catchment make proper sustained catchment management implementation ever more essential.

These projections for Malawi are made through the detailed analysis of the output from the General Circulation Model, the Regional Climate Model, and downscaled models initialised with the foreseeable global thermal pathways. These data provide a robust description of the near future (2050) and far future (2085) climate characteristics. Refer to Chapter 7 for more detail on modelling.

2.11 Conclusion

The above description of the key environmental issues in Malawi shows strong linkages, as illustrated in Figure 2-1. The high population growth, together with poverty, is a cause and not an effect of environmental degradation. Similarly all the environmental issues have an impact on human habitat.

It is clear that there is a need to intervene and reverse the degradation of the environment in order to improve the lives of the majority of the people of Malawi. These guidelines are aimed at working with

those that are most vulnerable to the effects of environmental degradation in order to reverse the trend and improve the livelihoods of those who depend on the land to sustain them. Much can be achieved with the right attitude and approaches.

3 Catchment Management: concepts and principles

Land and water degradation, together with their impacts on water resources and subsequent impacts on users and other resources, cannot easily be separated or managed independently of one another, Figure 3-1. This implies that a co-ordinated and integrated planning approach, and consequent action, is required. This applies for all scales of catchment management and through all levels of institutions from individual land users, through Traditional Structures to District and National Ministries.

The left side in Figure 3-1 illustrates the good state of both land and water resources, whereas the right hand side illustrates the situation with these resources in a poor state. Land and water resources should be managed for sustainability and utilised in an integrated manner, in order to keep the catchment as close to the 'left-hand' condition as possible.

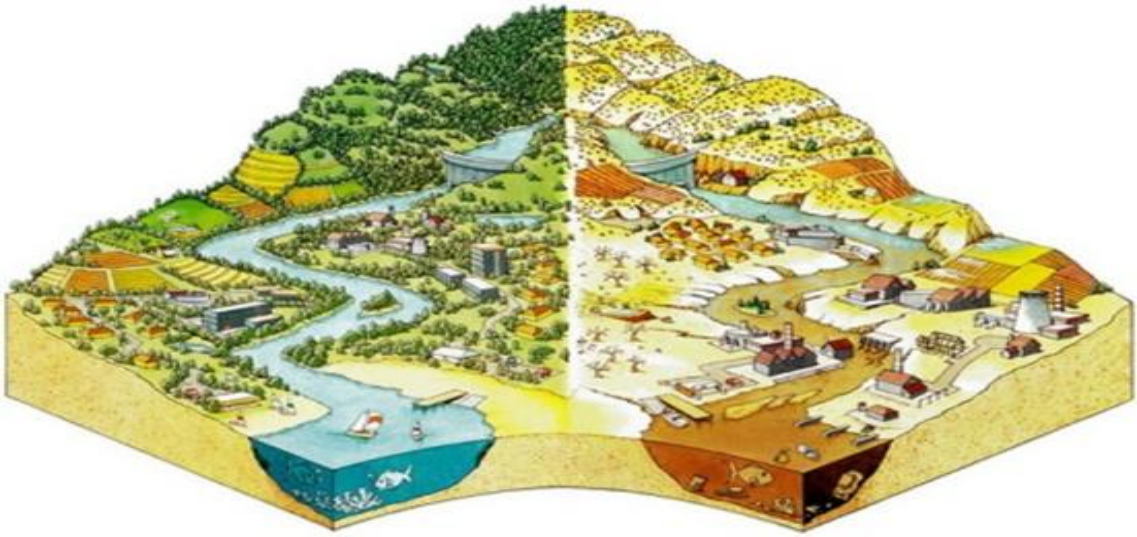


Figure 3-1: Illustration of good and poor state of both land and water resources in a catchment (Source: Waterwatch Queensland)

In its widest possible sense, Integrated Catchment Management (ICM) recognises the need to integrate all environmental, economic and social issues within a catchment (at all scales) into an overall management philosophy, process, strategy and plan. Thus ICM is aimed at deriving the best possible outcome of sustainable benefits for local communities and future generations, whilst protecting the natural resources upon which communities rely. Integrated Catchment Management is equivalent to the World Bank concept of a 'Landscape Approach'[15], with ICM favoured in Malawi in order to strengthen the sense of management within a catchment framework.

Often, water resource management approaches assume that sustainability of water resources can be achieved merely through focused efforts to control water use and protect the integrity of water resources within a catchment context. However, it is now acknowledged that this approach ignores the complex issues of land use patterns and the varied roles played by stakeholders, which impact on the water use and water resource. A more integrated and coordinated approach across all aspects of natural resources management and land use is thus needed, hence Integrated Catchment Management.

In order to achieve ICM and derive the best outcome of benefits, while protecting resources, requires careful consideration and planning. A catchment management plan also requires both the physical implementation of activities in day-to-day practices and livelihoods, as well as a strong legislative, regulatory and institutional framework to support the planning process and implementation.

[15] **Moving toward a sustainable landscape approach to development.** 2014, by Treguer, David; Pehu, Eija. Agriculture and environmental services note ; no. 12. Washington, DC ; World Bank Group. Accessed at: http://documents.worldbank.org/curated/en/2014/06/19607203/moving-toward-sustainable-landscape-approach-development.

3.1 Concepts and principles

There are a number of concepts and principles of importance to catchment management. These are discussed further in this section.

3.1.1 Catchment and river basin scale

The water resource, as determined at a particular location, is the product of runoff or groundwater recharge that originates in a geographically defined drainage area known as a catchment ("local scale") or basin (large scale, multiple catchments). The way human beings use and abuse land inside the catchment has a decisive impact on the quantity and quality of the water resource and on the health of the aquatic ecosystems reliant on that resource. In this way the management and use of the land, the hydrological cycle, and functioning of the aquatic ecosystem form a continuum bounded by the extremities of the catchment. This calls for recognition that naturally occurring water can usually be effectively and efficiently managed only within river basin (regional scale management) or catchment (local scale management) boundaries, because of the need to technically account for all aspects of the hydrological cycle, including the way human beings change aspects of the cycle through their use of the land. Figure 3-2 illustrates the type of water and land use activities that could occur within a catchment or river basin

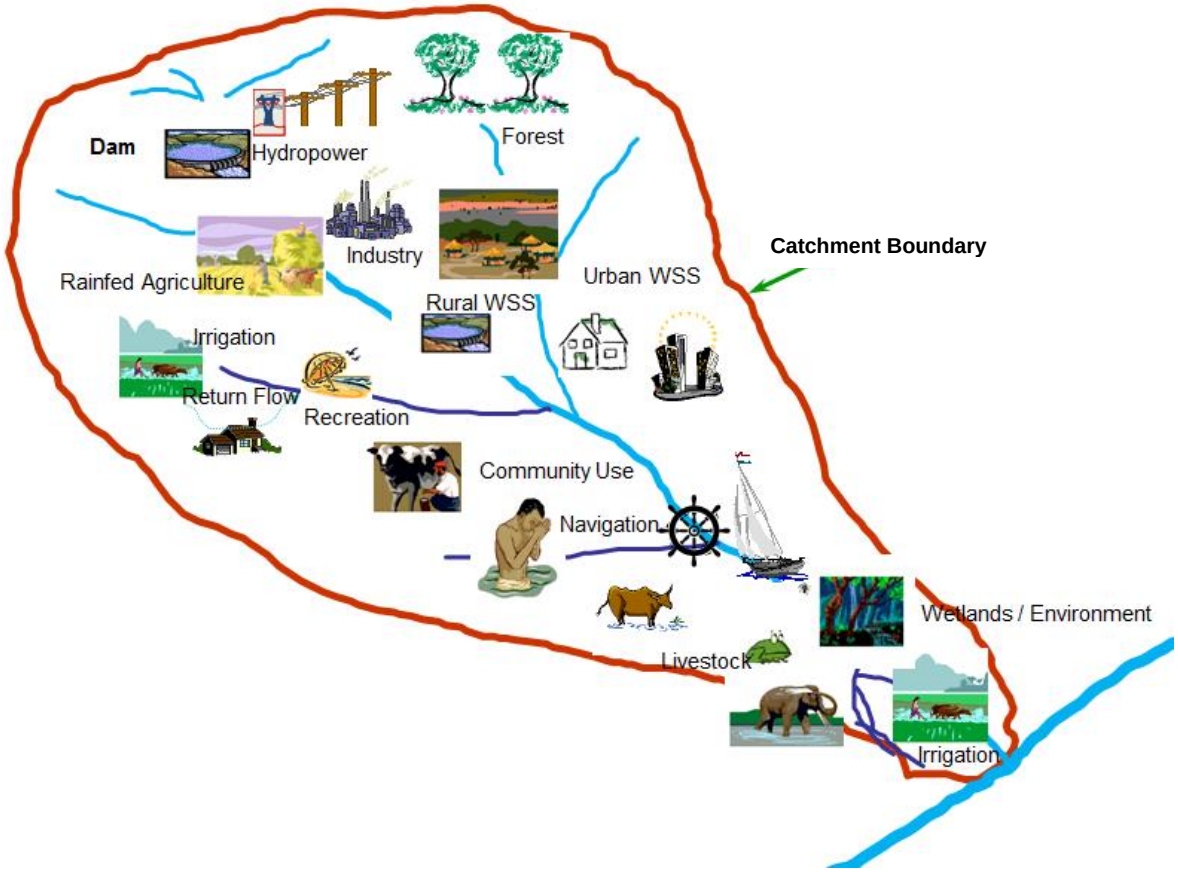


Figure 3-2: Illustration of water and land use activities within a catchment or river basin

Difficulties do arise through the use of 'catchment' as a management unit. Firstly, people are not settled according to catchment boundaries. Secondly, more than one Tribal Authority or District Council may fall within or across a single catchment area, and conversely, one Tribal Authority or District Council's administrative area may cover more than one catchment area.

3.1.2 Integrated Catchment Management

Catchment management is a philosophy, a process, and an implementation strategy with a set of actions to achieve a sustainable balance between utilisation and protection of land and water resources in a catchment. Catchment management recognises the interdependence of livelihoods on land-use, water and the environment, and aims to manage these components in an integrated manner in order to ensure the sustainable utilisation of environmental resources and the protection of such resources.

3.1.3 Sustainability

Sustainability in the use and development of natural resource systems means that the system has a high level of resilience, i.e. can cope with and recover from stresses and shocks, and maintain or enhance its capability and assets, both now and in the future, while not undermining the natural resource base.

Sustainable use of resources must therefore deliver basic environmental, social and economic services to all residents of a community without threatening the viability of the natural, built and social systems upon which the delivery of these systems depends. The key to achieving sustainability is adopting a long-term and forward-looking approach to improving the quality of life of human beings while maintaining the integrity of ecosystem functions and services. This ensures that future and cumulative impacts of development activities are anticipated and managed for continued resource productivity.

It is essential that water and land resources be developed in a viable manner to accommodate future generations and to meet their resource needs. It is generally accepted that sustainable development requires a process, and ultimately consensus building, among all stakeholders. This must be inclusive of all role-players, government institutions, stakeholders, non-governmental organisations and community based organisations as partners who together define the problems, design possible solutions, collaborate to implement them, obtain specific products, and monitor and evaluate the outcome.

3.1.4 Reasonable utilisation

Reasonable utilisation can be defined as “A sustainable balance, where use provides for the needs of people without destroying or depleting the resource”. If the level of utilisation cannot be held at a reasonable rate then the land must either be required to hold fewer people or those demands must change. Technology can help in reducing and mitigating demands, as shown throughout this guideline, but it must be recognised that resources remain finite.

Reasonable utilisation also depends on the nature of demands or requirements of people living within the catchment. High population demands can place unsustainable pressure on resources – as is happening across much of southern Malawi; by contrast the reduced demand on resources in the northern region are evident by the state of forests and lower occurrence of land degradation.

4 Legislative and institutional framework

4.1 Introduction

The activities of catchment management, and the implementation of catchment management plans, cannot be the responsibility of any one institution. Catchment management cuts across many sectors, geographic areas and political/administrative jurisdictions; the functions and responsibilities of catchment management are inevitably spread across several institutional structures. This section briefly outlines the legislation and key role-players in catchment management planning and implementation. Donor agencies, NGOs, and the private sector are important stakeholders, and will be identified with the catchment management planning process. This section focuses on government and legislated institutions.

4.2 Constitutional framework

The Constitution of the Republic of Malawi, 1995, has defined the role of the State and lays a strong foundation for policy and legal reform in environmental governance. Section 13(d) declares that:

"*The State shall actively promote the welfare and development of the people of Malawi by progressively adopting and implementing policies and legislation aimed at achieving the following goals*:

Section 13(d) To manage the environment responsibly in order to:

i) Prevent the degradation of the environment;

ii) Provide a healthy living and working environment for the people of Malawi;

iii) Accord full recognition to the rights of future generations by means of environmental protection and sustainable development of natural resources; and

iv) Conserve and enhance the biological diversity of Malawi"

The constitution therefore sets, as a guiding principle, the integration of environmental sustainability alongside social and economic sustainability considerations in national and sectoral policy discourse and in planning towards sustainable development of the country.

In 1998 Malawi adopted a shared vision for the long-term development of the country in its Vision 2020. It is apparent that in this vision the main rallying point was the need for sustainable development that does not compromise the ability of the natural resources base to provide for future generations. The Vision 2020 challenges Malawians to aspire to a nation which is: "God-fearing, secure, democratically mature, environmentally sustainable, self-reliant with equal opportunities for and active participation by all, having social services, vibrant cultural and religious values and being a technologically-driven, middle income economy by the year 2020"

Elaborating on its aspirations and options for environment and natural resources management, the vision dwells on addressing environmental challenges identified in the National Environmental Action Plan (NEAP) such as controlling water, forestry, land degradation, arresting deforestation, prevention of degradation and depletion of water resources, developing fisheries, restoring and conserving biodiversity, developing human settlement, controlling air pollution and managing climate change issues, eradicating poverty and managing population growth, and political advocacy for proper management of natural resources and the environment.

4.3 Environment

As an umbrella policy, the National Environmental Policy (NEP) adopted in 1996 and revised in 2004, aims at ensuring that all sector policies embrace the principles of sustainable development. As a framework instrument, the NEP guides different lead agencies in so far as their activities affect the environment and natural resources management, including how to minimize the impacts of environmental

degradation. It's aspirations for different sectors are considered relevant to enhance ideals of sustainable water, forestry, and land management. These are summarized in the overall goal: "The overall policy goal is the promotion of sustainable social and economic development through the sound management of the environment and natural resources". Specific objectives are:

- Ensuring that national and district development plans integrate environmental concerns, in order to improve environmental management and ensure sensitivity to local concerns and needs
- Increased public and political awareness, and understanding of the need for sustainable environmental protection, conservation and management
- Involvement of local communities in environmental planning and actions at all levels and empowering them to protect, conserve and sustainably manage and utilise the nation's natural resources
- Managing, conserving and utilizing the country's biological diversity, (ecosystem, genetic resources and species) sustainably for the preservation of national heritage
- Promoting the sustainable use of water, forestry, and land resources, primarily, but not exclusively, for agricultural purposes - by strengthening and clearly defining security of tenure over these resources

The 2004 revision of the National Environment Policy prescribes the policy and institutional arrangements necessary for effective delivery of the sustainability agenda and provides the basis for Environmental Impact Assessment (EIA) and Environmental Management Plans (EMPs).

The Environment Management Act (EMA, 1996) gives strength to the principles outlined in the NEP 2004 to the extent that wherever sectoral legislation conflicts with the EMA, the latter shall take precedence. It provides for the creation of regulations on aspects of environmental management, so that gaps or inconsistencies in sectoral legislation may be easily rectified. It created, for the first time, a firm legal framework for environmental impact assessment (EIA) and environmental auditing. Following this, national and sector specific EIA Guidelines were developed and approved. These formed the main instruments for ensuring that interventions are environmentally and socially sustainable, whilst also economically sound.

Most importantly, the 1996 EMA established a National Council for the Environment with considerable powers to mediate in situations of conflict. It accorded to the Environmental Affairs Department responsibility for the co-ordination of environmental monitoring interventions and investments in the environment/natural resources sectors. The EMA also provided an environmental framework for policy development across many sectors and a legal framework for the development of new sectoral legislation.

Among the main innovations in the 2004 revision of the NEP was the establishment of the National Environment Protection Agency with greater powers as an independent national environmental watchdog. This necessitated the review of the 1996 EMA, which has been reviewed but has remained in draft form for over six years.

The Cabinet Committee on Natural Resources and Environment (CCNRE) is the highest environmental policy and decision-making body. Its objective is to advise Cabinet on the protection, conservation and sustainable utilisation of renewable and non-renewable natural resources and the environment - to ensure equitable utilisation and enhance socio-economic development of the people of Malawi. In relation to decentralization, the CCNRE specifically advises Cabinet on institutional strengthening for decentralized environmental and natural resources management.

The Parliamentary Committee on Environment and Natural Resources (PCENR) is a forum for discussing environmental issues at the legislative level. Its role in decentralized natural resources management is to promote the participation of local communities, especially women and youth, in the management and conservation of natural resources and the environment, based on the principle of democracy and good governance.

4.4 Forestry

The Forestry Act, 1997 provides for the management of trees and forests within forest reserves and protected forest areas, and also for areas under customary land ownership outside these areas. It provides for establishment of Forest Management Agreements between communities and the Department of Forestry that enhance co-management of forest resources. Forest Management Agreements lay the foundation for sustainable forest management. The Act also provides for penalties for forest offences as well as seizure of forest products by forestry officers and police officers. The excessive deforestation that has occurred in Malawi is a serious risk to both biodiversity and the state of the catchments. Section 32 of the Forest Act provides for the management of forests on customary land.

"32.(1) The Minister may make rules which shall apply all customary land outside forest reserves and protected forest areas.

(2) In particular and without prejudice to the generality of the foregoing power, such rules may –

(a) provide for the protection of water catchment and fragile areas, rehabilitation of degraded areas and any other activity which would be conducive to good land husbandry;

(b) facilitate the establishment and management of forest by village natural resources management committees for the benefit of local communities;

(c) encourage District Councils, non-governmental organizations and the private sector to contribute towards the provision of forestry extension services, as well as the establishment and management of plantations in accordance with guidelines provided by the Department of Forestry;

(d) provide for the establishment and maintenance of nurseries to provide seedlings for tree planting programmes;

(e) authorise the payment of grants or bonuses out of public funds for the encouragement of forestry;

(f) provide for the declaration of endangered or essential tree species and their management;

(g) prescribe a mechanism for sharing costs and benefits between the Department of Forestry and village natural resources management committees in regard to forest produce confiscated from customary land forests.

33. Any rules made by village natural resources management committees (VNRMC) shall be approved by the Minister.

34. (1) Any person who or community which protects a tree or Right to forest, whether planted or naturally growing in any land which naturally that person or community is entitled to use, shall acquire and growing trees retain the ownership of the tree and forest with the right to sustainable harvest and disposal of the produce

(2) Any tree or forest owner under subsection (1) may seek the advice of the Director of Forestry on the management and utilization of his tree or forest."

In particular, section 32(2)(a) provides for the essential practices of catchment management. The agent for implementing this section of the legislation is the Village Natural Resource Management Committee.

Table 4-1: Forestry Organisations and Responsibilities in Catchment Management

Roleplayer	Level	Appointed / Elected	Mandate	Reports to	Function / Responsibility	Role in Catchment Management
Village Natural Resources Management Committees (VNRMC)	Village	Elected by village	Forestry Act 1997	VDC	• Committee responsible for sustainable forest management including the protection of water catchments and fragile areas as well as rehabilitation of degraded areas • Empowered to seek technical and financial assistance from external sectors	Key roleplayer of catchment management planning at the village level if already established (Refer to Volume II)
District Extension Officers	District	Appointed	Forestry Act 1997	District Forest Office	• Extension officers responsible for forest management • Development orientated	Key roleplayer and driver of catchment management planning at the village level (Refer to Volume II)

4.5 Water resources

The overall goal of the 2005 National Water Resources Policy is to ensure sustainable management and utilisation of water resources. This is in order to provide water of sufficient quantity and acceptable quality, to ensure the availability of efficient and effective water sanitation services that satisfy the basic requirements of every Malawian, and to enhance the country's natural ecosystems. The policy aims to address all aspects of water including resource management, development, and service delivery. It recognises that quality and quantity of water is much affected by human activities in catchment areas.

The National Water Resources policy addresses issues of sustainable management through catchment protection but leaves the responsibility to relevant sectors such as the Departments of Water, Forestry, and Land Resources Conservation to implement such initiatives. This gives the impression that the policy does not consider natural resources management as a core business of the Water Department, which is required only to provide a conducive policy environment in which other sectors can play their roles.

The National Water Resources Act, 2013 provides for the establishment of National Water Authority to replace the National Water Resource Board and Catchment Management Committees. The Act also paves the way for the establishment of River Basin Authorities. The strength of this for natural resources management is that a River Basin Authority would have the powers to enforce planning and management requirements for sustainable utilisation of resources in the river basin. Nanthambwe (2013)[16] argues that there is a good case for a River Basin Authority that would coordinate activities by different players in all districts in the Shire River Basin.

Table 4-2: Water Resource Organisations and Responsibilities in Catchment Management

Roleplayer	Level	Appointed / Elected	Mandate	Reports to	Function / Responsibility	Role in Catchment Management
Catchment Management Committee (CMC)	Two or more sub-catchments	Appointed	Water Resources Act 2013	National Water Resources Authority	• Broad scale institutional arrangement • Water resources conservation, use and allocation • Water resources conservation activities and works	Key roleplayer if established; could also be established to drive this process

[16] **Policy Sector Review for Incorporating Sustainable Land Management in the Shire River Basin and Development of an Institutional Framework for Sustainable Land Management**. Environment Affairs Department. Nanthambwe, Stephen, 2013.

Roleplayer	Level	Appointed / Elected	Mandate	Reports to	Function / Responsibility	Role in Catchment Management
Association of Water Users (AWU)	Water resource point e.g. River, Village, Sub-catchment; Irrigation project	Members	Water Resources Act, 2013	CMC	• Manage, distribute and conserve water from a source used jointly by the members of the association • Acquire and operate an abstraction license or a discharge permit under the Act • Collect water user charges and fees on behalf of the Authority • Several irrigation schemes around Malawi are registered as an AWU	Roleplayer to provide input, if established

4.6 Irrigation

Irrigation is limited in extent, but is of growing importance in Malawi as a mitigation activity against drought and climate change. Potentially irrigable land is estimated at ~0.5 million ha but the actual area irrigated is less than 20% of this - primarily through small schemes, with water diverted directly from rivers. Treadle Pumps have been introduced but have a major negative environmental and gender impact by encouraging farming within riparian zones which is contrary to law, and left to women to operate.

The Irrigation Act, 2001 makes provision for the sustainable development and management of irrigation, protection of the environment from irrigation related degradation, establishment of the National Irrigation Board, the Irrigation Fund and other matters related to irrigation development in Malawi.

The Irrigation Act mandates farmers to maintain irrigation canals, drains and other associated infrastructure in their holdings and prohibits people from engaging in practices that are destructive or potentially destructive to the catchment area of a river that provides water for irrigation. It prohibits livestock grazing, and setting or causing to set fire on irrigation schemes or farms. Recognizing the destructive effect of fire, the Act puts the responsibility for averting, fighting or extinguishing fire on irrigation schemes. It prohibits any actions that are destructive to the catchment.

Several irrigation schemes in Malawi are registered as Associations of Water Users (AWUs).

4.7 Lands

The Land Act (amendment 2003) and Land Policy (approved by Cabinet in 2002) make provision for various matters relating to customary land, private land and public land and powers of the Minister in respect of access, use and marketing of land (and soils). The Act consists of a number of sections that address issues related to Private Land, Customary Land, Land Use, Trespass and encroachment or unlawful occupation of land. The Act reinforces the aspirations that are outlined in the National Land Policy.

The relevant legislation for Watershed Planning and Management is under the customary and public land stipulations which are vested in the President and that the Minister administers and controls all customary land and mineral rights thereof on behalf of the people of Malawi. Customary land may be acquired for public purposes under the law with laid down procedures and instruments. The Act further defines the powers of the Minister to regulate, manage or control the user of land.

The Land legislation is currently at an advanced stage of review and there are several amendments that are planned for enactment during this session of Parliament. [17]

[17] Please note, that there are 11 land related Bills including the Land Act which are planned for tabling in November 2015 meeting of Parliament

4.7.1 Customary Land

The Land Act (2003) defines customary land as "all land which is held, occupied or used under Customary Law but does not include any public land."

Section 25 of the Land Act instructs that "all customary land is declared to be the lawful and undoubted property of the people of Malawi and is vested in perpetuity (permanence) in the President for the purpose of the Act.[18]" The President is a trustee as far as matters concerning customary land are concerned. At a local level, traditional authorities represent the President. Traditional authorities act as custodians of the cultural and traditional values of the community. They have the control of customary land ensuring that authority over land is passed in succession from one generation to another in a clan (family). Village heads also perform a semi-judicial function of settling customary disputes over land. On the development front, they lead development initiatives and act as chairpersons of Area Development Committees (ADCs) as provided in the Local Government Act, and mobilize people to participate in the developmental activities. For watershed planning and management, the entry point is the traditional authorities who would bring the matter into the ambit of ADCs meetings to garner support from his subjects.

Note that the incorporation of trust has very important development significance. It gives powers to the Government to deal with customary land as well as control it. This is done through Ministry of Lands and Housing or Ministry of Agriculture, Water Development and Irrigation. It should be noted that, under customary law, land could not be permanently alienated, although under Section 27, Land Act (2003) the Minister may declare that any customary land becomes public land by an order published in the Gazette. But this can also revert to customary status under Section 29 when such land is no longer required for public purposes.

In practice, Government may convert customary land to public land for public utilities such as schools, hospitals, public demonstration agricultural gardens, and woodlots etc. which are for the benefit of the community or public. The conversion of land is undertaken in consultation with Traditional Authorities. At times, the Government controls the use of customary land by making control orders. Provision may be made regulating and controlling the use of the land, the method of cultivation and growing of crops and keeping of livestock, and the general good management and conservation of natural resources. Conservation agriculture methods, afforestation, fishing and any other environmental programmes are guided by this provision. The Land Policy of 2002 advocates that:

"Land use planning will be extended to all rural and urban land, including freehold, leasehold and customary estates. However, the declaration of a planning area will not automatically require the conversion of all customary land to public land, as has been the practice prior to this Land Policy. Instead, all landowners in such planning areas will be required to comply with approved planning and development regulations."[19]

The Land Policy makes provision for land to be turned into a planning area. There is a Physical Planning Bill which makes provision for this. Currently there is only the Town and Country Planning Act which makes provision for towns and cities as planning areas. Catchment planning and management plans should therefore be vigorously be advocated at all levels from the onset. This will ensure compliance with the Land Use Planning Policy and legislation. In fact many orders have been made under section 27 and are in force within many parts of the country, covering various schemes and projects. Watershed planning and management shall therefore use this provision (Section 27, Land Act 2003) to protect the water sources that are under customary land. Customary land forms the largest bulk of the land in Malawi (over 80%).

4.7.2 Public Land

Public land is defined by the Land Act as all land which is occupied, used, or acquired by the Government and any other land that is not customary land or private land. It generally includes:

[18] This position will change and vest land in the Republic when the Land Bills are enacted (to be tabled in November 2015 parliament session).

[19] Government of the Republic of Malawi: Malawi National Land Policy; Ministry of Lands and Housing. January, 2002

- any land which reverts to the Government on the termination, surrender, or falling-in of any freehold or leasehold title under which it is held; and
- any land which was, immediately before the coming into operation of the Act, public land within the meaning of earlier legislation.

Land in Malawi may become public land under the following situations:

i) the acquisition of customary land;

ii) applying the Acquisition of Land for Public Purposes Act that empowers the minister to acquire any lands required for any public purpose (subject to payment of compensation) such as roads, airport, national parks, forest reserves etc., and

iii) through powers of re-entry where the minister has powers to re-enter any private land on the breach or non-observance by a lessee of any of the covenants or conditions contained or implied in his lease and falling-in of a lease.

Public land in Malawi includes land declared as such for uses as National parks, Conservation, Historical, Military, etc. The Shire River Basin Programme would use some of the provisions in Land Act to access public land for watershed management activities.

4.7.3 Private Land

Private Land is defined by the Land Act as all land which is owned, held, or occupied under a freehold title, a leasehold title, or a certificate of claim or which is registered as private land under the Registered Land Act.

The National Land Policy states that:

"All land deemed necessary for national development purposes in Malawi shall be acquired and vested in the State as government land to be managed on behalf of the nation by the Minister responsible for lands, or by other designated agents of the government. Any private land (including customary estates) acquired to be used for the benefit of the general public or for national development purposes will be valued and compensation based on the open market value paid to the owner for both the land and improvements."

There will be instances where the catchment area is located in a private land. For example, Shire River Basin as a programme would be able to use this provision to acquire the private land "in the interest of the general public". Compensation for such acquisition shall be effected by the Shire River Basin Programme. The Minister of Agriculture may facilitate the acquisition of this land. Furthermore land legislation is being amended to reflect the provisions of the Land Policy in the Land Acquisition Bill, 2015.

4.7.4 Communal Land

Another important piece of land that is common in rural areas is the "Communal Land". The National Land Policy (2002) clearly states that in the case of customary land managed by Traditional Authorities, common access land reserved as riverbanks/shores (dambos), community woodlots, etc., will be classified as public land exclusive to members of the Traditional Authority. It further states that to ensure cultural cohesiveness, and to make titles more certain (secure) and more static, a deliberate course of action will be taken to demarcate and formally register all customary land interests of Traditional Authorities in recognition of communal land areas. The Policy explains that "communal land rights" in Malawi are closely connected to ethnic identity and Traditional Authorities (TA's) which creates a powerful system of land allocation regimes and a tenure system designed to preserve the asset base of the community for current and future generations. In practice these are animal grazing areas, grave yards, woodlots, preserved areas for cultural events (such as dambe for the Chewa tribe or Jando for Yaos), the shrines (for spiritual occasions) whose use of the land is done in a controlled manner by the community. Ironically, these communal land/areas are well covered by forest and are generally watershed areas (e.g. TA Nthache's Shrine in Mwanza and Chewa Shrine in Malingunde) in most parts of Malawi. The

catchment planning and management initiative should therefore take deliberate effort to target these "communal areas".

Table 4-3 Land Resource roleplayers and responsibilities in Catchment Management

Roleplayer	Level	Appointed / Elected	Mandate	Reports to	Function / Responsibility	Role in VLAP Process
Traditional Authorities (TA)	Traditional land management area	Hereditary	N/A	N/A	• Traditional or cultural head of an area • Community leader responsible for supervising a cluster or number of GHV	• Key roleplayer and driver of catchment management planning at the village level (Refer to Volume II)

4.8 Local government

The Local Government Act, 1998 supports the implementation of decentralisation by giving powers to local authorities for the planning and development of areas under their jurisdiction. It devolves authority and relocates capacities from a central administration authority to District Councils[20]. The District Councils have responsibility to ensure sustainable management of natural resources within their jurisdiction. However, devolution of authority has been slow and implementation of programmes is constrained by human and financial resources limitations.

The Local Government Act, 2009 (amended), provides for the formulation of development plans for local authorities including environmental development. The Act further provides for local governance structures through which these guidelines should be implemented. Local government administrative areas are established, such as district, town, municipality and city assemblies.

The Act mandates the District Council to undertake environmental protection services. It also provides for the establishment of committees and sub-committees (see Section 15(I)) at district and sub-district levels. Those of particular importance to the implementation of these guidelines are discussed further.

4.8.1 District Executive Committee

The District Executive Committee (DEC) is the technical arm of the District Council, comprising representatives from all government ministries and departments, NGOs represented within the district, and co-opted members. The DEC is responsible for implementation of all aspects of the District Development Planning System (DDPS). The District Commissioner, or in his absence the Director of Planning and Development, chairs this committee.

The functions of DECs are to:

- Provide technical advice to the District Council on the Socio-Economic Profile (SEP) development of the district;
- Facilitate the mobilization of resources for social-economic development;
- Appraise community project proposals;
- Monitor and co-ordinate the implementation of community projects;
- Produce the Social Economic Profile for the district, including a State of Environment Report;
- Prepare a District Development Plan with integral Environment Action Plans; and
- Build awareness on development issues at both district and community levels.

Specific activities for catchment management, especially from the Catchment Management Plan should be incorporated into the District Development Plan.

[20] Cities, Municipalities and Towns are considered "districts in their own right".

4.8.2 District Environment Sub-Committee

The District Environment Sub-Committee (DESC) is the DEC focal point on issues of the environment. It acts as a multi-disciplinary forum for environmental management and comprises environmental and natural resource management (NRM) sector district officers. The Director of Planning and Development chairs the DESC, with secretarial services provided by the Environmental District Officer. The functions of DESC are as follows:

- Assess and analyse the status of the environment and produce State of the Environment and Outlook Reports (SOERs) and District Environmental Action Plans (DEAPs) for the District Council;
- Provide technical advice to the District Council on issues of the environment and natural resources;
- Appraise micro-projects and facilitate their development;
- Conduct awareness campaigns on environmental and natural resources management; and
- Develop capacity in sustainable environmental management at community level so that issues of environment are integrated into decision-making processes and planning systems.

The DESC should drive the process for the development of sub-catchment and micro-catchment plans.

4.8.3 Area Development Committee

Area Development Committees (ADCs) under the current institutional structure, are decision-making institutions located at area level (i.e. at the levels of the Traditional Authority). Development decision-making bodies comprise the ADC.

The composition of ADC includes:

- Traditional Authority (TA);
- Group Village Headmen (*this should also include the Village Head as well as the land owners*);
- Sub Traditional Authority;
- Members of Parliament;
- Councillors; and
- District Council representatives.

The ADC has the following environmental management tasks:

- Responsibility for State of Environment and Outlook Report (SOER) and Environmental Action Plan (EAP) processes at area level;
- Identification and prioritization of environmental issues that need immediate mitigation actions;
- Development of Environmental Action Plans (at TA level) and subsequent micro-projects;
- Facilitate formation of Village Development Committee (VDC) Environmental working groups;
- Collate and approve VDC EAPs;
- Mobilize community resources and solicit funds; and
- Monitor SOE and implementation of EAPs.

The ADC must be involved in the development of the sub-catchment, micro-catchment and village action plans, as these plans will require their input, and they will be responsible for some of the activities identified within the plans. The relevant ADC actions identified in the catchment plans will need to be incorporated into the Environmental Action Plans.

4.8.4 Village Development Committee/Community Development Committees

Village Development Committees (VDCs) are at village level (i.e. at the level of the Group Village Headman). The advisory executives are the front line staff at VDC level. The VDC has the following environmental management tasks:

- Organize Natural Resources Management (NRM) meetings in the villages;
- Lead the EAP process at village level;
- Co-ordinate Community Based Natural Resources Management (CBNRM) activities with the ADC and communicate feedback from ADC; formulation of micro-projects addressing environmental issues and solicit funding for such activities through the DDPS (District Development Planning System);
- Facilitate the mobilization of community resources for CBNRM self-help projects; and
- Supervise and monitor SOE and implementation of NRM micro-projects at VDC level.

In cities and municipalities the functions undertaken by VDCs are done by Community Development Committees (CDCs) under one neighbourhood led by an elected chairperson.

The VDC / CDC are important stakeholders in the development of the micro-catchment and village action plans. Refer to Volume II, Section 2 for further information on their role in these processes. They will also be responsible for coordinating the implementation of village-specific activities identified from the catchment management planning process.

4.8.5 Area Executive Committee

The Area Executive Committee (AEC) is the technical body of the ADC. It comprises frontline staff (FLS) and plays the advisory role to the ADC. As executive body, it is responsible for day-to-day technical advice on projects within the area, and further down to the VDC.

The AEC has the following environmental management tasks:

- Facilitate the SOER and EAP processes at area level;
- Facilitate the process to develop micro-projects.

The AEC will be involved in the development and implementation of catchment management plans.

Table 4-4: Local Government Organisations and Responsibilities in Catchment Management

Roleplayer	Level	Appointed / Elected	Mandate	Reports to	Function / Responsibility	Role in Catchment Management
Village Development Committee (VDC)	Village	Elected by village	Local Government Act, 2010 (Amended) Decentralisation Policy 1998 (not formally prescribed by legislation or policy)	ADC	• Existing committee mandated by the village • Lead and manage NRM and CBNRM activities and projects in the village • Lead the process of developing Environmental Action Plans (EAPs)	Key roleplayer and driver of catchment management planning at the village level (Refer to Volume II)
District Council (DC)	District	Elected and appointed	Local Government Act 2010 (Amended) Decentralisation Policy 1998	Ministry of Local Government and Rural Development and relevant line Ministries	• Decentralised government responsible for administering overall development of their area.	Roleplayer to provide input
District Executive Committee (DEC)	District	Portfolio from DEC	Local Government Act, 2010 (Amended) Decentralisation Policy 1998	DC	• Technical and advisory arm of the DC • Provide technical advice on socio-economic and community development in the District and facilitate	Roleplayer to provide input

Roleplayer	Level	Appointed / Elected	Mandate	Reports to	Function / Responsibility	Role in Catchment Management
					projects • Responsible for the District Development Plan (DDP).	
District Environmental Sub-Committee (DESC)	District	(multi-disciplinary forum)	Local Government Act, 2010 (Amended) Decentralisation Policy 1998	DEC	• Provides technical advice to the DC on issues of the environment and natural resources • Facilitates micro-projects, awareness campaigns and capacity development on environmental projects • Develops District Environmental Action Plan (DEAP)	Roleplayer to provide input. Incorporate VLAPs into DEAEP, ADP and VDP
Area Development Committee (ADC)	Traditional land manage-ment area	Elected	Local Government Act, 2010 (Amended) Decentralisation Policy 1998 (not formally prescribed by legislation or policy)	TA DEC	• Representative all VDCs working within a TA area • Assist in the identification, prioritisation and preparation of community needs, which encompasses more than one VDC • Responsible for environmental issues, projects and the Environmental Action Plans (EAPs)	Roleplayer to provide input Incorporate VLAPs into DEAEP, ADP and VDP
Area Executive Committee (AEC)	Traditional land manage-ment area	Assigned	Local Government Act, 2010 (Amended) Decentralisation Policy 1998 (not formally prescribed by legislation or policy)	ADC DEC	• A representative body of all extension workers of government ministries, NGOs and Statutory Corporations working within a Traditional Authority area • Responsible for advising the ADC on all aspects of needs assessment, project identification and project proposal preparation.	Roleplayer to provide input

Table 4-5: Traditional Leadership Responsibilities in Catchment Management

Roleplayer	Level	Appointed / Elected	Mandate	Reports to	Function / Responsibility	Role in Catchment Management
Village Headman (VH)	Village	Appointed by TA	Chiefs Act 1967	GVH TA	• Existing traditional leader of the village	Roleplayer at the village level (Refer to Volume II)
Group Village Headman (GVH)	Five or more villages	Elected by village headmen / Appointed by TA	Chiefs Act 1967	TA	• Existing traditional leader of a group of villages	Roleplayer at the village level (Refer to Volume II)
Traditional Authorities (TA)	Traditional land manage-ment area (a number of villages)	Hereditary	N/A	N/A	• Traditional or cultural head of an area • Community leader responsible for supervising a cluster or number of GHV	Roleplayer at the village level (Refer to Volume II)

4.8.6 Linkage between District Environmental Sub-Committee and environmental planning at local level

The District Environmental Sub-Committee (DESC) provides guidance for all sectors such as water, forestry, agriculture, health, education, fisheries, industry and civil society in preparing the integrated District Environmental Action Plan (DEAP). These are further developed into Area Development Plans (ADPs) and Village Development Plans (VDPs) as illustrated in Figure 4-1.

The catchment management planning process, whether at catchment-wide scale or at Village Level Action Plan, must be brought into the Village and Area Development Plans. Specific activities requiring implementation within the village or district must be included into the Village and Area Development Plans in order to ensure integration of the planning processes. This will also help in securing resources for the implementation of these activities.

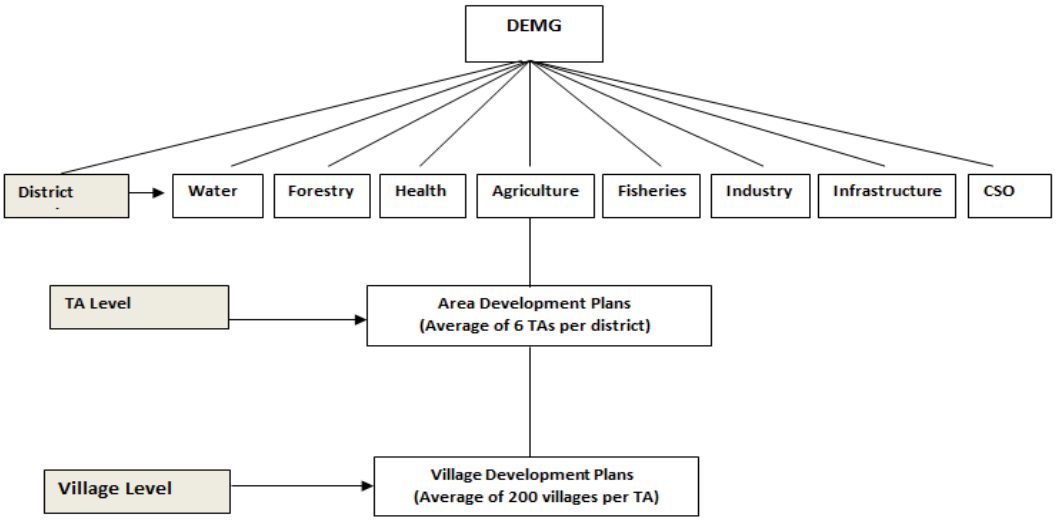


Figure 4-1: How DESC is aligned to DEAP and area and village development plans

4.9 Summary

The multi-disciplinary nature of catchment management planning has resulted in a host of different institutional entities with responsibilities mandated in terms of Malawi's legal framework. As an emerging discipline, the boundaries and overlaps of these related sectors are not often clear and this is one of the challenges in initiating and implementing catchment management in Malawi. Section 5 provides information relating to the practicalities of the process from planning through to implementation and monitoring. Section 6 details participatory approaches which can be applied to ensure that consultation is inclusive, and the process is enhanced through the various sector-specific inputs of the roleplayers discussed above.

5 Catchment Management Planning

5.1 Introduction

The process of developing strategies and plans to govern natural resources within a catchment is known as catchment management planning. The principles of integrated catchment management planning have been presented in Section 1 'Introduction' and can be applied to the different scales of catchment units, namely catchment, sub-catchment, micro-catchment and village-level.

The Catchment Management Plan (CMP), the subject of this section, is the main output of the catchment management planning process at the broadest scale. The CMP records a vision for the catchment and formalises the current and future trends of the various resources such as water, land and social economic factors in terms of that vision. This is captured in the form of a Catchment Management Strategy (CMS). The CMP then provides additional details with regard to the specific implementation of options for improved catchment management and the development of the main natural resources of a catchment that is the land and water. The CMP states how issues and concerns will be addressed through agreed management strategies within a specified time period, and outlines an associated legislative, procedural and technical framework for implementation. The plan reflects national policies as well as stakeholder commitments. It needs to be granted legal status, either as a contract or as a legal proclamation, if it is to be implemented. In this regards the CMP typically includes a detailed implementation plan (IP) and a Monitoring and Evaluation Plan (MEP). The IP allocates responsibility for implementation and is used to inform the development of sub-catchment plans, the District Level Action Plan (DLAP) and individual Village Level Action Plans (VLAP) that can be implemented with support from the relevant catchment management committee (CMC), various national and local level government organizations including the District Environmental Sub-committee (DESC) and relevant NGOs and CBOs in the catchment.

An indicative outline of a CMP report is given in Table 5-1:

Table 5-1: Indicative outline of a CMP

Draft outline for a Catchment Management Plan (CMP) Report	
1	**Introduction** a. Objectives and purpose of the CMP b. Policy and legal context
2	**Description of the catchment** a. Natural resources b. People, economic activities, important social aspects c. Present development and use of water
3	**Situation Assessment** a. Issues, vulnerabilities and threats in the catchment b. Sector assessments c. Potential mitigation measures
4	**Water resources assessment** a. Rainfall, evaporation, runoff and streamflow b. Groundwater – occurrence, recharge, characteristics c. Flood risk, historical occurrence and impacts d. Drought – historical occurrence and impacts
5	**Water Demand and Water Balance** a. Present water use and infrastructure b. Projections of future water demand c. Water balance – issues
6	**Alternative catchment scenarios** a. Vision and Planning objectives b. Development options

Draft outline for a Catchment Management Plan (CMP) Report	
	i. Modifications of existing water infrastructure and use ii. Investment in new infrastructure or rehabilitation iii. Mitigation of adverse impacts of development iv. Catchment protection and water conservation v. Water management options, operating rules vi. Multi-criteria evaluation of alternative plans
7	**The Catchment Management Strategy** a. Vision and Mission Statement b. High Level Strategy c. Key Strategic Objectives (KSO) d. Strategic Themes and Implementation Options e. Priority options for implementation and further studies
8	**Implementation Plan** a. Implementation Plan b. Roles and responsibilities c. Financing Strategy d. Information management e. Capacity building
9	**Monitoring and Evaluation Plan** a. Indicators b. Reporting Requirements

5.2 The catchment management planning process

The catchment management planning process is set out in Figure 5-1 below. Note that the planning steps imply a certain chronology, but an overlap and iteration between steps is inevitable to accommodate feed-back between tasks and steps. The catchment management process is, by its very nature, continuous, iterative, and perpetual. This figure is representative of all levels of catchment management planning.

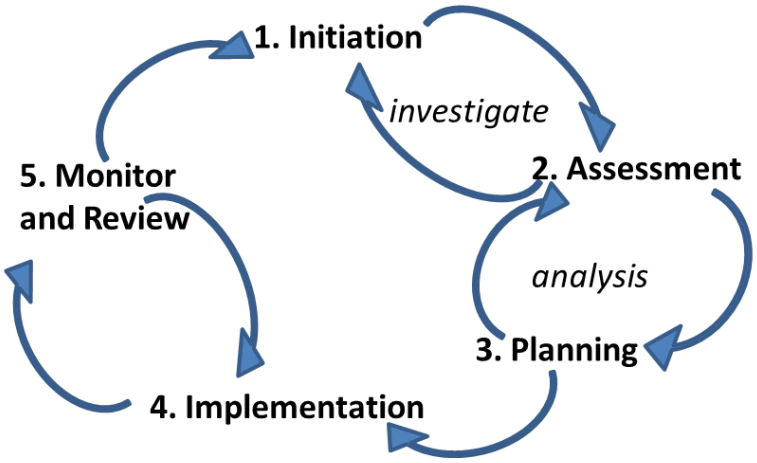
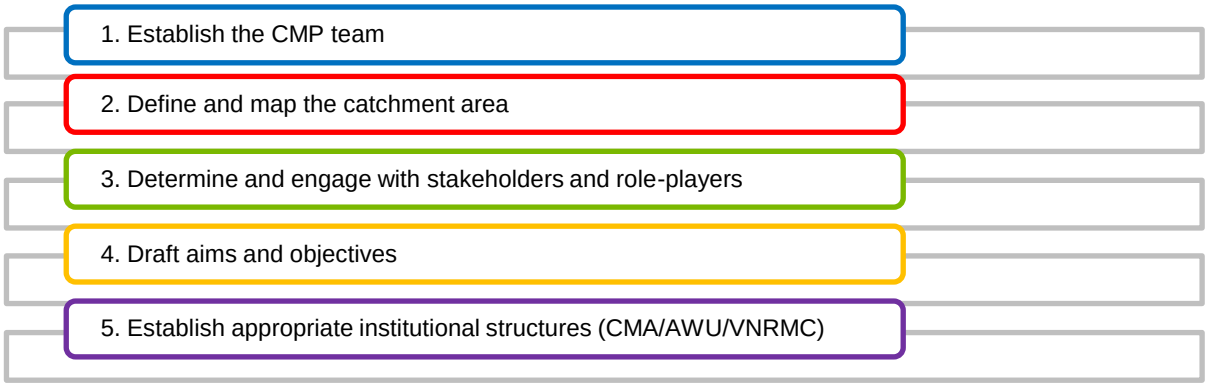


Figure 5-1: Steps of the Catchment management planning process

	Step 1: Initiation	
1	Establish the CMP team	Establish multi-disciplinary team
2	Define and map the catchment area	Define the study area and include key features

5.3 Step 1: Initiation

A Catchment Management Plan (CMP) may be triggered by a process such as the establishment of a Catchment Management Committee (CMC), or by an issue such as water supply shortage increased sedimentation or uncontrolled deforestation and loss of biodiversity. Ideally however a CMP should be undertaken pro-actively as part of the normal development planning process in order to pre-empt and where possible mitigate these potential future risks and to address any issues of potential conflict with sufficient time for them to be managed and resolved before becoming a crisis or resulting in a state from which recovery is not possible. The Initiation Step gets the ball rolling. Activities include:



A toolbox providing step-by-step guidance on practical methods to apply in the field, and with more detail on Village Level Action Planning appears as Volume II of these guidelines.

Output

The output from Step 1 is an *Inception Report* documenting the aims and objectives for the development of the CMP, the confirmation of the geographic scope, the summary of identified key stakeholders and role-players as well as an initial assessment of the critical data required and its availability.

5.3.1 The catchment management planning team

Depending on how the development of the CMP has been initiated, i.e. by the water users or by the Department of Water, the CMP team should include people with the requisite knowledge and experience (‘specialists’ or ‘experts’) to support both the plan and the resolution of technical issues. Additional skills can be brought in as needed. Composition of the core CMP team typically includes people with expertise in:

- Soil Conservation
- Forestry/Agroforestry
- Agronomy (Plant Management, Integrated Pest Management)
- Water Harvesting /Irrigation / Stormwater
- Food Security (Economist/Socio-economist/Agro-economist)

The CMP team is tasked with managing the development of the CMP and is most likely to be representative of the final composition of the catchment management committee (CMC) (refer Chapter 8 Roles of the CMC). Ideally the CMC should have already been established and would therefore constitute the core of the CMP team as this would ensure continuity with implementation of the CMP. In situations, were the CMC has not been established then the relevant ministry should put together representatives of the various organisations at national and district level who are likely to constitute the CMC to provide as much continuity as possible.

5.3.2 Define the catchment area and aims and objectives for the CMP

Mapping the catchment area is critical in terms of identifying potential stakeholders and in particular for determining the individual districts, villages, etc. that will be impacted by the CMP. During the course of developing the CMP, further details can be added to the map, including issues, resources, features, etc.

Mapping the catchment can be done in two ways:

1. Where GIS data is available (automated), use stream order to delineate the boundaries of catchments based on topography.
2. Where GIS data is not available (manual method).Using a topographic map (typically at a scale of 1: 50 000), and with the collective knowledge of stakeholders, mark the drainage area of the catchment. If a formal map is not available, then draw a new map of the area and catchment as best possible. Indicate features on the map such as meeting places, villages, large trees, streams and rivers, roads, rocky areas, etc. such that all stakeholders can share in, and improve, the visualisation. The catchment drainage area may not include an entire village or district, in which case stakeholders should choose whether to include the rest of the village into one plan, rather than split it across catchment areas. Keeping the village unified will help with resource allocation and implementation of the CMP later on. The map indicates the area to which the plan is applicable.

In addition to defining the physical scope of the intended CMP, it is also necessary to clearly define the aims and objectives of the catchment management planning process. This will assist in the identification of key stakeholders, the focusing of data collection and assessment of alternative future scenarios, as well as in forming the basis for the development of a catchment vision and finalising the aims and objectives of the final CMP. During this phase it is also critical to understand the requirements of key ministries or representatives of the catchment management planning team for the CMS and the final CMP.

5.3.3 Identify and engage with stakeholders and role-players

Participatory planning and stakeholder engagement

Catchment planning, at all levels, must take a participatory approach, drawing on input from all the stakeholders. Participatory approaches and techniques are detailed in Section 6 of this Guideline (Volume I).

The identification of catchment stakeholders must be carefully approached. As catchment management includes a broad range of activities, this can be an extensive process. Mapping and assessing the various organisations and structures (refer section 5.3.3 Institutional Assessment) will lead to identification and prioritisation of the main stakeholders in the catchment. It is also important to work out whether the organisation or individual is a stakeholder that is directly affected, or an interested party; i.e. does the stakeholder need to be directly engaged in participatory activities or only informed and given opportunity for input. This helps to determine suitable methods for engagement and participation.

Stakeholders will include a number of different groupings, all with their own interests and concerns. The stakeholder list should be maintained as a living document, i.e. it should be updated regularly in recognition that new entities and people may engage with catchment interventions.

- Governmental groups will include central government, local (district) government and parastatal entities like the agricultural marketing board. Traditional leadership, although civil, is appointed through state institutions.
- Non-governmental groups will include the private (commercial) sector and local industry associations, civil society groups, research bodies, local communities within and downstream of the target area, NGOs, and the general public.

It is also important to record the responsibilities of the various identified stakeholders as this will help with the allocation of responsibilities for activities in implementation planning as part of the CMP.

Recording the activities (projects, programmes etc.) of the identified stakeholders in the catchment area is also important particularly with regard to the evaluation of current situation and in the identification of potential opportunities for improved catchment management and resource protection.

5.3.4 Data collection and information management

All readily available and relevant information should be collected for each catchment. Much of this information will come from existing data sources including the Malawi Spatial Data Access Portal (MASDAP), and other studies. Where possible this information must be captured in a spatial database for the catchment, with associated metadata. Non-spatial data and information should also be kept and managed in an inventoried database. The spatial knowledge base enables the user to integrate, analyse and visualise all applicable spatial data and streamline the creation of relevant knowledge products required for sector assessments, state of catchment reports, vision development, scenario development and supporting relevant modelling and Decision Support System (DSS) tools. Where critical data is missing efforts should be made to collect this data, or alternatively to be included it in the recommendations for improved monitoring in the final CMP.

Data to be captured includes, but is not limited to, the types listed in Table 5-2 below:

Table 5-2: Types of data to be collected during the ICM process

Types of Data
The Natural Environment • Topography • Soils information • Climate information (temperature, precipitation, etc.) • Biodiversity • Protected areas
Socio-Economic Conditions • Demography • Settlements • Health • Education • Gender and poverty • Main economic activities and growth projections • Current and future land use • Infrastructure • Sector/Area development plans and options
Water Resources Management • Institutional and legal arrangements • Water resources information (meteorology, surface and groundwater) • Existing hydro-meteorological network and data • Current and future water demand estimates and allocations • Existing hydraulic structures / bulk water storage and supply • Water quality and sediment transport data

In addition to the collection of spatial data, information on previous studies and reports relating to the development of natural resources and the state of the catchment should also be collected.

5.4 Step 2: Assessment

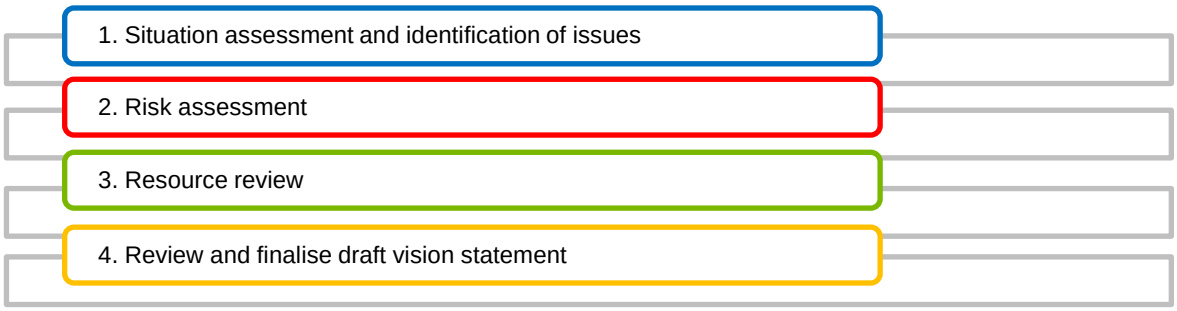
The objective of the assessment phase is to gain an understanding of the *status quo* and identify critical issues in the catchment and potential risks and opportunities that will be evaluated during the planning phase (Step 3). This is achieved through a process of data collection, stakeholder engagements, and a basin tour and field visit by key specialists and the CMP team to identify critical issues, evaluate possible risks, and to witness potential case studies of good practice in the catchment. The stakeholder engagements should include meetings with village Development Committees (VDCs) to engage with Village Level Action Plans that have been developed or being developed.

Stakeholder engagement is an on-going activity throughout the CMP development process. Intensive community mobilisation and sensitisation campaign is needed – at District, Group Village, and Village

levels. This will bring with it relevant local knowledge and experience, inputs on current constraints and opportunities, and insights in support of the catchment vision. Refer also to Section 0, Based on the monitoring and evaluation of the implementation of the CMP, the plan may need to be adapted or updated to reflect changes in the environment, priorities, etc. It is advised that CMPs be reviewed and revised every five years in order to ensure the plan is still relevant, and to revise the plan, as activities are implemented, new activities may be required.

Participatory approaches in catchment management planning.

The several themes and topics set out in this section all need to be assessed in order to establish a baseline on which to build the CMP. The collected information helps the users to understand the *status quo* of the catchment, as well as the drivers, issues and impacts affecting it. Activities for this Step include:



Output

The output from Step 2 is a report on the baseline status quo of the catchment and sub-catchments, describing and illustrating the existing situation as well as identifying key issues and opportunities for improved catchment management and the development of natural resources.

5.4.1 Individual sector assessments

A catchment plan requires input and buy-in from all sectors that impact on, or are impacted by, water resources development and management.

The objective of individual sector assessments is to determine the current status of each sector in the catchment, including the current and future water demands, and their impacts on the environment and the water resources e.g. flow rates, effluent discharge and the quality of water in return flows.

The current status of the relevant sectors need to be reviewed. The individual sector assessments are also critical in determining the current and future water demands for the sector and the final water balance for the catchment under different scenarios. The following sectors, *inter alia*, should be considered:

- Water – surface water and groundwater supply and availability, water use requirements, water quality, flood risks, and storage potential;
- Environment - including protected areas, sensitive areas, areas under threat;
- Agriculture – existing and potential irrigation schemes, dryland agriculture, livestock, etc.;
- Forestry – natural, community and plantation;
- Energy;
- Fisheries;
- Tourism;
- Transport - includes navigation;
- Land use practice and management; and
- Mining.

For each of the identified sectors or activities, the assessment will need to describe and quantify the characteristics of activities in these sectors as they relate to water quantity, quality and ecosystems both at present and in the future.

Climate change impacts also need to be assessed as these cut across all of the above mentioned sectors and are particulary important to Malawi. These should be addresed in the risk assesment phase (see Chapter 7 Modelling).

Since agriculture is almost always the largest user of water, agricultural water use strategies are critical and need to be linked to broader agricultural initiatives. However, there is the danger that planning processes may be treated simply as opportunities for advocacy, where water agendas are promoted without linkages to other sectors and priorities. Therefore water resource planning, especially at the catchment scale, must be linked to the country's overall sustainable development strategy and public administration framework.

The information compiled from the sector assessments will inform the scenario development described Section 5.5.2. As part of the sector assessments the social, economic and environmental impacts and implications of the proposed sector developments must be reviewed. This impact review can be done by desktop evaluation rather than in-depth Strategic Social and Environmental Assessment (SSEA). However, the final proposed developments (i.e. in the Plan) will be subject to an in-depth SSEA or Initial Environmental Examination (IEE) as part of their authorising processes and implementation.

A sector assessment is done at the catchment scale, however, the information and proposed actions will need to be disaggregated to the Village Level Action Plans, especially in areas where specific programmes, projects and activities are required. Refer to Section 1.4.

The CMP needs to comply with the objectives of the National Water Resources Master Plan (NWRMP). These must be taken into consideration during the preparation of the catchment scenarios and the draft CMP. It is also important that the final CMP is integrated with, links to, and builds on other national plans and strategies – including poverty reduction strategies, national strategies to meet the Sustainable Development Goals, strategies required by key environmental conventions e.g. National Biodiversity Strategy and Action Plan, National Plan to Combat Desertification and Ramsar requirements.

5.4.2 Institutional assessment

Building on the individual sector assessment, the analysis of policies and institutional arrangements need to be conducted from a catchment-wide perspective with a view towards alignment with national and regional level policy and strategy as well as IWRM principles. This will focus on the status at:

- Regional / trans-boundary level, linked to water (or other) agreements between Malawi and its neighbours, particularly under the auspices of the Zambezi Basin Commission and state practice;
- National level, particularly within the water and related sectors; and
- Catchment level, through initiatives and bodies operating within the catchment.

In particular, for catchments in Malawi, consideration should be given to:

- The SADC Regional Water Policy and Strategy, SADC Protocol on Shared Watercourses (where applicable), the Southern Africa Vision for Water, Life and the Environment, as well as international treaties or conventions ratified by Malawi;
- National water, agriculture, forestry, economic and environmental policies and legislation, and the institutional arrangements established in the catchment to implement these; and
- The water authorisation systems and mechanisms for water allocation, water management and water infrastructure development.

The institutional mapping will have the following components:

a) Description of the policy-legal-institutional environment in the catchment.

b) Identification of the actors and the rules of engagement and arrangements between them.

c) Identification of key institutional barriers and enablers of good water and natural resource governance in the catchment.

d) It will represent a key element in the chain of relationships to be developed.

5.4.2.1 Environmental assessment

Environmental assessment includes the following process:

a) Identification of issues and impacts (refer to the lists below for suggestions);

b) Assessment to prioritise the most significant issues;

c) Identify strategies for avoidance or mitigation; and

d) Develop an Environmental Management Plan to include those issues that cannot be avoided, and which should be managed and monitored on an ongoing basis.

Typical catchment issues to consider in the environmental assessment include:

Key ecological drivers:

- Water quantity and flow regime – including surface and groundwater sources;
- Water quality;
- Geomorphological processes (erosion and sedimentation);
- Biological processes, affecting biotope quality and availability (e.g. algal abundance); and
- Upstream / catchment processes.

Key challenges affecting management:

- Maintenance of hydrological regimes and the implementation of effective Instream Flow Requirements (IFR) for river systems (i.e. keeping enough water in the river – high flows, low flows and average flows).
- Maintenance of natural or near-natural water quality, and improvement of water quality in degraded systems.
- Maintenance of natural (or sustainable, in an altered environment) erosion and sedimentation processes.
- Maintenance of biological and hydrological linkages throughout the catchment, and seasonal or permanent links with groundwater and wetlands.
- Maintenance of specific habitat quality and availability
- Maintenance of genetic integrity (including biodiversity)
- Co-ordination of management interventions at a catchment scale so as to maximise the potential for achieving and sustaining all of the above objectives.
- Integration of ecological and social objectives, so that the improvement in one sphere is not at the expense of the other.

Some of the key issues, vulnerabilities and threats associated with catchment management and the sustainability of natural resources are detailed in Table 5-3:

Table 5-3: Key issues, vulnerabilities and threats associated with catchment management

Impact	Vulnerability / Threat
Catchment permeability and reduced infiltration	Surface hardening as a result of land degradation (e.g. erosion) and development - including roof and road surfaces resulting in loss of wetlands and natural drainage patterns; loss of natural habitat at a catchment level leading to increased runoff volume and rate.
Fragmentation	Loss of biological corridors and natural connectivity through diversion, in-filling and the farming of riverine strips and wetlands. Ecological linkages between systems are lost - through deforestation, through massive erosion gullies, and roads.
Direct loss of aquatic habitats	Encroaching land uses resulting in the loss of floodplains impairs the functionality of river banks, and causes erosion and sedimentation. Farming of riparian zones and wetlands, and canalisation all destroy aquatic habitats.
Over-abstraction from surface and groundwater	Leads to low flows and the desiccation of river edge plants, which reduces natural flood protection and increases the risk of erosion.
Impoundments (dams)	In addition to losses to the riverbed, riparian fields and biodiversity, dams impact on both high and low flow regimes. The biggest impact of dams lies in their command areas (for the area opened for irrigation), resulting in changed land uses.
Introduction of: • Terrestrial alien and invasive vegetation • Aquatic alien vegetation • Alien fish and other animals	Impacts on ecological functioning of river systems: can increase organic content and turbidity of water and reduce ecological carrying capacity of species important for livelihood support.
Pollution (point and non-point sources). Key sources of pollution • Road surfaces • Industrial processes and spills • Waste water treatment works and pit latrines • Construction and demolition activities • Corrosion of materials • Litter and dumping • Erosion	Pollution affects water quality, which in turn affects its usability and increases the cost of purification. It will also affect the ability of water bodies to support ecological functioning.
Removal of vegetation (deforestation and land clearing)	Increases open surfaces which will increase erosion, reduce the quality of water, increase runoff and reduce the buffering of flood events.
Interbasin transfers (IBTs)	Transfer of water out of the system reduces its overall resilience through, for example, less water for dilution.

All issues, when identified, should be assessed to rank their importance and to identify actions that would reduce the significance of any environmental impact. This is often achieved by undertaking a risk assessment, either a descriptive risk assessment or a risk ranking (described in Chapter 7).

5.4.2.2 Land resources assessment

Planning and implementation requires a thorough understanding of catchment management and the linkages to poverty and land degradation. Maintaining productive and stable farming systems – in the face of soil exhaustion and erosion from non-sustainable agricultural practices – presents a particular challenge. Whilst the economy is growing in the short-term, farmers are at risk from potential longer-term decline in land productivity as the natural resource base becomes degraded and loses its ability to recover. Without urgent remedial measures (e.g. soil conservation techniques), soil degradation is likely to escalate.

The CMP team must undertake the following:

a) Work with community and farmers organisations to verify and understand the following:

   i) agriculture / agronomy of the catchments (land use, crops grown, productivity, livestock production and farmers preferences);

   ii) verification of soils information - including soil fertility and observed changes in productivity; and

   iii) land degradation through deforestation, soil erosion, plant invasions, and extractive farming;

b) Identify and assess agricultural or other opportunities; and

c) Identify and capture information on planned projects.

Understanding land use change is central to understanding drivers of land degradation. The land use assessment must capture the condition of the land and the relationship between land use practices, sustainable land use and the economy both at farm / household level and for the catchment as a whole so that remedial actions can be designed. Again, all issues, when identified, should be assessed to rank their importance and to identify actions that would reduce the significance of any land degradation.

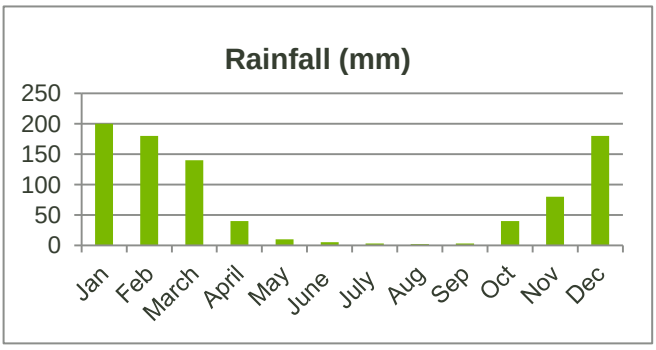
A useful analytical tool to assist in the land resources situation assessment is the mapping of appropriate land use activities based on an assessment of the land capability particularly with regard to the erosion and sedimentation risks under natural, current and potential future land use scenarios. Such a map will assist in identifying key areas where intervention is required to address inappropriate land use (e.g. cultivation on slopes with a high erosion risk) or that should be protected through the prevention of deforestation and the use of appropriate sustainable land management (SLM) practices. The modelling of current and future erosion risks can also be used to evaluate the sediment loads in rivers that highlight the risks to planned infrastructure developments and increase the motivation for improved catchment management.

5.4.2.3 Water resources assessment

A water resources assessment is used to determine water quantity available water for urban, rural domestic, and agricultural users (and the corresponding water requirement), water quality, pollution sources and threats, environmental flow requirements, and water use efficiencies. The assessment should also quantify the potential water resources available for new irrigation development or improvements to existing systems, and for meeting the future needs of domestic and industrial users.

Sources of available hydro-meteorological information may include:

- Flow data - daily or monthly, from dams and gauging stations;
- Groundwater monitoring, infiltration capacity, and soil water recharge rates;
- Rainfall (daily and hourly, if available) for daily and seasonal summaries, intensity estimates, etc.;
- Temperature (daily maximum, minimum and average);
- Evaporation (pan or other direct measurement);
- Wind, relative humidity and dew point for theoretical estimates of evaporation, if necessary;
- Suspended sediment concentration records; and
- Environmental flow requirements (including seasonal variations for spawning and migration).



A useful tool for assisting the water resources assessment is the development of a watershed model. Using watershed modelling methods will be vital for data poor areas where empirically generated data is scarce. Refer to Section 7 ‘Modelling’ for further details on modelling. This section is presented independently, due to the amount of information and importance of modelling in the Catchment

Management Planning process. The watershed model will also assist in the evaluation of alternative catchment scenarios.

The level of detail required in the watershed model will however depend on the nature and scale of the CMP being developed. For larger catchments with multiple opportunities for the development of significant water supply infrastructure (i.e. dams and irrigation schemes) it may be necessary to develop a complex water resources model using one of a multiple set of software tools available such as Mike Hydro Basin, WEAP or HEC-HMS. For smaller catchments, with only limited infrastructure potential, a simple conceptually based water balance model would be sufficient, and most decision-making is based on best practices and does not typically involve significant trade-offs between competing demands as in larger catchments.

5.4.2.4 Water infrastructure assessment

This assessment comprises the following:

a) A review of existing water infrastructure within the catchment: dams, canals and pipe distribution networks, treatment plants, roads, small bridges, small hydropower installations, major gully control works, irrigation schemes, etc. Develop an asset register if this is not already in place.

b) An assessment of system performance, e.g. water services to people (supply and sanitation), water losses, water use efficiency, and productivity in the use of water for irrigation schemes.

c) An assessment of operations and maintenance schedules (O&M). Determine the funding available for O&M over the short, medium, and long term.

d) Evaluate the rehabilitation needs of existing infrastructure.

e) Identification of additional infrastructure necessary for expanding and developing new areas. This would include suitable areas for new dams and irrigation schemes. Criteria to screen and prioritize potential interventions are water and land availability, cost, previous development in the area and farmers' interest and demand. Map the identified development opportunities.

f) Identify and map rivers, gauging stations, rain gauges, abstraction weirs and dams, as well as existing sector activities (e.g. mines, irrigation schemes), villages, environmentally sensitive and protected areas, current and future land use type and soils information in terms of agricultural potential. This information is critical in applying water resources planning tools used to assess the impacts of future development options.

Field visits and stakeholder meetings are critical in the formulation of appropriate and cost effective solutions, since it is during this stage that the concepts will be formulated. The consultation process with farmers and communities e.g. VNRMC, will also highlight the opportunities and constraints to development. These may include water availability, water loss/inefficiency, land and soils, land tenure issues, equity of water distribution, rehabilitation/expansion plans, potential for increasing gross margins, availability of inputs, availability of construction materials, environmental concerns, strength of village and farmers' organisationS, labour availability, initiative and technical knowledge. The assessment should consider the following:

- Asset register (inventory of assets, age, condition and functionality);
- Inventory of asset rehabilitation requirements;
- Operations and maintenance register and schedule; and
- Database of potential projects and sites for new water-related infrastructure.

5.4.2.5 Economic assessment

The economic component should include the following:

a) An assessment of the contributions (costs and benefits) of the major sectors like forestry, tobacco, and subsistence farming. Consider also other opportunities, a

valuation of natural resources and the situation vis-à-vis jobs, migration, poverty and sustainability.

b) Identify and evaluate key income generators in the catchment, what threats there are to this, and what other potential income generating activities exist within the catchment.

c) Identify funding agencies and funding sources.

d) Include a consideration of value chain opportunities taking account of agricultural systems, soils, climate, transport, population centres, comparative advantages, specific market opportunities and potential for contract farming or similar market-driven production arrangements. Value chain activities that promote alternative income generation (rather than reliance on sale of charcoal) can be proposed as part of the catchment management plans. For more Refer to Section 9, Alternative sources of income to support improved catchment management and protection. One important consideration is the question of cold chains (i.e. meat, fruit, vegetables) – and how this may be hindered by the availability of power for refrigeration.

5.4.2.6 Social assessment

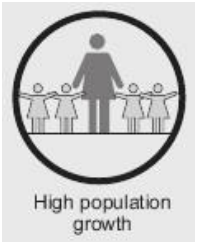
A social assessment is carried out to identify positive and negative impacts of proposed catchment management activities on the environmental and social fabric of the catchment. This can be done by:

a) Compiling village/micro-catchment profiles, including demographics, gender, age, health, income generators and land-use.

b) Assessing characteristics of household food insecurity and resilience.

c) Mapping community natural resource assets.

d) Through these assessments, identify the positive and negative impacts of proposed catchment management activities with regard to environmental and social sub-sectors.



e) Establish the level of awareness and capacity on social and environmental issues at community and district level to identify capacity building needs for effective implementation of environmental and social issues.

5.4.3 Basin visit and stakeholder engagements

5.4.3.1 Basin visit

Reconnaissance level basin visits must be conducted by the CMP team to verify the available information and develop the team's understanding of the situation in the catchments as assessed above. These site visits will need to complete a thorough evaluation of water, land and environmental resources, water infrastructure, as well as institutional, social, agro-economic and other livelihood factors, and to have detailed consultations with the stakeholders at district and village levels e.g. VNRMC and VDC. Transects walks (refer to Section 6.7) are a useful tool.

Issues identification is relevant to all scales of catchment management planning, but not necessarily to the same level of detail. Mark all issues on the map, including importance, extent, magnitude, impact and duration. Seek to identify the cause of the issue and activities that could remedy or prevent it. Basin visits are also useful to inform various stakeholders of the objectives of the development of the CMP and to identify potential opportunities for improved catchment management and resource development that can be showcased to other stakeholders in the catchment.

Table 5-4 provides an example of an Issues Identification Table.

Table 5-4: Example of an Issues Identification Table

Issue	Impacts	Extent / spatial influence	Magnitude	Duration	Source of the issue	Potential remedies
Erosion donga on farm x	• Loss of soil • Loss of land to farm Flooding of adjacent field	Farm specific	Natural processes Farming activities	Ongoing	Stormwater from the road	• Manage upstream sources of water by encouraging infiltration Divert the stormwater from the road

5.4.3.2 Stakeholder engagements

The engagement of key stakeholders is critical in the development of a sustainable CMP. Stakeholders can be engaged in a number of ways including informal meetings, basin visits and formal stakeholder workshops (refer to section 6 for more detail). The primary purpose of these engagements is for the CMP team to raise awareness with stakeholders about the CMP process as well as to assist in the situation assessment and identification of key issues and opportunities. These engagements also provide opportunity to identify issues identify at small catchment scales such as Village Level and provide bottom up inputs into the planning process.

5.4.4 Key issues, risk ranking and overall situation assessment

Having undertaken the situation assessment and data collection for the catchment, it is necessary to identify critical issues to be addressed through the development of the CMP and to undertake an overall assessment of the current situation in the catchment. These are necessary for determining the overall catchment vision and for the identification and prioritisation of options for implementation to address these key issues.

As part of the overall assessment it is important to undertake a risk ranking, particularly with regard to the identification of threats and opportunities. A risk ranking evaluates the likelihood, consequence and potential mitigation of potential risks. The catchment risks can be issues identified in the various assessments or potential developments, or catchment management activities. The level of detail for the risk ranking should be based on the relative size of the catchment and the potential for current and future development opportunities. Refer to Section 7 for more detail on risk ranking methodology

The overall situation assessment should make use of simple analytical tools such as SWOT (Strengths, Weaknesses, Opportunities and Threats); STEEPLED (examining the Social, Technological, Economic, Environmental, Political, Legal, Ethical and Demographic factors); or VSTEEP (Values: Social, Technical, Economic, Ecological, Political) to scan components of strategic management and assist in identifying the government and stakeholders' key objectives for catchment management. The opportunities, issues and constraints relevant to achieving those objectives, need to be identified.

A STEEP analysis can include the analysis of available land, agricultural yield, availability of water (includes access and quality), sensitive areas, erosion, flood risk, drought risk, health, population density, capacity, capability, etc.

Details and examples of a SWOT analysis can be found in Volume I, Section 3.

5.5 Step 3: Planning

Scenario planning and strategy development are the next steps in the planning process. This phase results in the identification of key opportunities and requirements for implementation that are formalised in an implementation plan for improved catchment management. These represent Step 3 in Figure 5-1.

Using the information and understanding of the catchment garnered in the assessment phase, the task is now to develop and analyse scenarios for development and management of the catchment as a whole. These are then translated into strategies and actions and ultimately detailed design and implementation planning.

Activities include:

1. Development of a catchment vision
2. Strategic themes and implementation options
3. Development of future catchment scenarios
4. Development of analytical tools
5. Analysis of future scenarios
6. Preparation of the Catchment Management Plan
7. Preparation of the Implementation Plan
8. Preparation of the Monitoring and Evaluation Plan

Output

Catchment wide and sub-catchment Catchment Management Strategy (CMS) and Plan (CMP).

5.5.1 Catchment vision, aims and objectives

A **vision** outlines what the CMP wants to achieve, or how it sets the context in which it will operate. It is a long-term view and concentrates on the future. It can be emotive and a source of inspiration.

Objectives indicate the steps to be taken in achieving the vision by identifying the key areas and actions that must be addressed. As one further unpacks the necessary steps and actions needed to achieve the vision, the base of contributing elements increases, as illustrated in Figure 5-2.

Figure 5-2: The broadening base of strategic planning

Stakeholders draft the vision together as a group. The vision sets the scope of the catchment management plan, i.e. what the plan seeks to achieve. It may be a simple statement or catchphrase but should give direction towards a future desired state. The vision is a “destination” and the catchment management plan is the “roadmap” to get there.

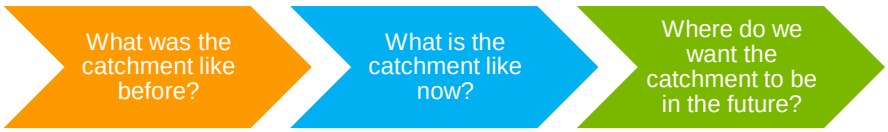
To develop the vision, start by identifying….

The **situation** (*e.g. state of environment, livelihoods, resources etc*) → The desired **goal** or **end point** → **Actions** required to get there

The vision may only be finalised further along in the CMP development process, but a first draft is needed to help "steer" or guide this. A vision is appropriate at all catchment scales (and is also discussed in Volume II, Section 3).

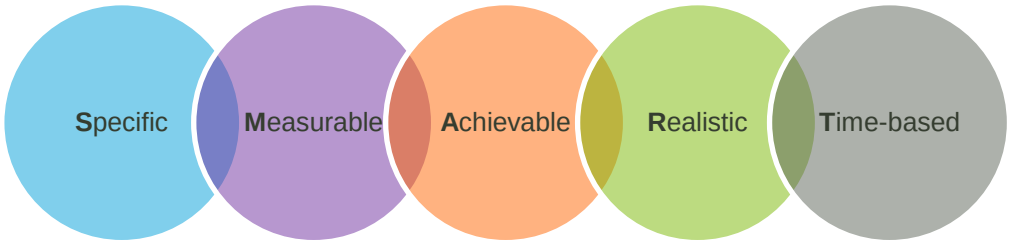
The vision should be drafted by the stakeholders together as a group. The vision sets the scope of the CMP, i.e. what the plan seeks to achieve. It may be a simple statement or catchphrase but should give direction towards a future desired state. The vision is a "destination" and the catchment management plan is the "roadmap" to get there.

To determine the vision, the stakeholders should ask the following questions:



From a practical perspective, the **vision** is broken into different goals; each **goal** is for a different aspect of catchment management. Example goals could include support for social and economic development, provision of water for drinking, erosion rehabilitation, prevention or improved soil fertility, protection of critical resources and the maintenance of functioning stream ecosystems. Under each of these goals specific **activities** are identified that can help achieve the goals. Achieving the goals then achieves the vision.

The aims and objectives in support of the vision should be Specific, Measurable, Achievable, Realistic, and Time-based – these are thus known as SMART goals. These goals then direct the development of the various sub-strategies and activities for implementation.



The vision is a general statement of a desired future state, usually captured as a catchphrase. The vision is the link between the status quo of the catchment and the strategies aimed at managing and improving the natural resources in the catchment to support human welfare, environmental sustainability and economic activities. For example, Malawi's National Water and Sanitation sector vision is "*Water and Sanitation for All, Always*".

The goals and objectives are more specific and can even be prioritised in order to achieve the vision effectively. Ultimately the vision and objectives are a summary of the component parts of the strategic plan. Refer to Volume II, Section 3 for information to assist in developing a vision

Once the vision has been determined, the driving forces for scenario development can be discussed.

5.5.2 Strategic themes and development options

A Strategy is essentially the set of options determined to be the best measures for addressing the issues affecting water resources development and management in the particular catchment. Given the multiple sectors impacted by improved catchment management and the many issues that need to be addressed, it is useful to capture the vision in terms of a number of key themes under which specific opportunities can be identified and assigned with specific roles and responsibilities. These key themes will start emerging from stakeholder engagement, catchment assessments, and scenario development.

Typical key themes would be, for example:

- **Creating an enabling environment (institutional):** addressing capacity building, financial support, governance accountability, institutional structures, knowledge growth and training, legislative frameworks, stakeholder participation and water resources management.

- **Catchment water management:** addressing, *inter alia*, water availability, regional cooperation and water resources management.
- **Water supply and sanitation:** addressing the needs of future generations, improved sanitation, poverty reduction and water supply.
- **Livelihoods and socio-economic development:** addressing equitable and reasonable utilisation of water resources, future generations, improved livelihoods, poverty reduction, sustainable social and economic development and water resources management.
- **Environmental protection, land and disaster management:** addressing adaptation to climate variability and climate change, environmental and water resource protection and environmental rehabilitation.
- **Capacity Building and training**: addressing training and building capacity and capability in catchment management and planning, as well as specific activities identified within the catchment management plan.

The strategic objectives start to flesh out the catchment vision according to the themes identified, i.e. what needs to be achieved in terms of each theme. Each theme may have one or more strategies, each leading to a set of specific opportunities for implementation, an example is depicted in Table 5-5.

Table 5-5: Example of a theme and associated objectives and strategies

Theme	Strategic objective	Strategies
Water supply and sanitation	The strategic objective is: "*Provide adequate access for various water uses and acceptable sanitation facilities*"	The strategies to achieve this objective are: 1. Improve access to a sustainable water supply of sufficient quantity and quality from appropriate and sustainable sources. 2. Provide improved sanitation facilities. 3. Ensure effective water supply and sanitation asset management. 4. Ensure wastewater treatment in urban areas and industries.

During the situation assessment phase a number of opportunities for improved catchment management and the development of natural resources should be identified through stakeholder engagements and with inputs from individual specialists as part of the CMP team. These can then be grouped in terms of the individual themes and complied into a "long list" of potential options. Out of the long list, individual actions can be prioritised based on some level of analysis and possible consideration of alternative development scenarios.

Provisional themes for describing strategic planning and implementation options in the catchment include:

- The need for increased water storage; the proposed locations of dams; the requirements for development and mitigation of negative impacts, and ensuring safety and sustainability.
- The likely areas for future development in the energy and mining sector and requirements for resources allocation, pollution control and mitigation measures to protect natural resources.
- Resource requirements for agriculture, fisheries and forestry - and recommendations for mitigating potential negative impacts of these on both the system and other resource users.
- Opportunities for the development of water infrastructure in support of transport and navigation.
- The requirements for flood and drought management including institutional measures (e.g. insurance, demarcation of flood lines and early warning systems), soft measures (e.g. catchment management, maintenance of wetlands and riparian buffers), and hard measures (e.g. increased storage capacity, berms and flood control levees).
- The prioritisation of areas for interventions in catchment management and land use planning and outlining the necessary steps and support required for this process as well as the mutual benefits that can be obtained for other sectors including water storage and carbon sequestration.

- Priority areas for wetland management and appropriate steps in the rehabilitation and management of wetlands in support of sustainable water resources and rural livelihoods.
- Interpretation of national guidelines for riparian zone management and the benefits in terms of water resources management, flood mitigation and pollution control, and recommendations for different management processes in different areas based on the current situation and pressures.
- Identification of protected areas, and areas of critical biodiversity, and an assessment of the potential impacts of alternative development scenarios and water resource infrastructure. Recommendations for mitigation measures or management options to improve sustainability.
- Identification of the importance and requirements for environmental flows and recommendations for how to quantify these in the individual catchments and the requirements for implementation through, for example, changes to water related infrastructure design and operating rules.
- Future requirements for water supply and sanitation and the necessary physical infrastructure development, institutional arrangements, operations and maintenance.
- Highlighting of key water quality and pollution management concerns in each catchment and recommendations for ways to improve the situation through, for example, improved monitoring and enforcement, provision of basic sanitation services, upgrades to treatment plants, changes in agricultural practices and the use of riparian buffers and natural and artificial wetlands.
- Sedimentation concerns with respect to water quality impacts, reduced storage capacity in dams, and in particular the impacts on Lake Malawi, and describe potential development, institutional and land use changes that could improve or manage the situation.
- Potential climate change impacts and appropriate adaptation measures.

5.5.3 Catchment scenarios

Given that the benefits and costs of water management and distribution are often far-reaching and are not limited to a single sector, water infrastructure planning demands a broad-based, long-term approach that weighs investments in terms of economic efficiency, social equity and environmental sustainability (the principles of IWRM). Scenario planning is a mechanism for assessing these cross-sectoral interactions.

Scenario planning is a forecasting approach that can help to highlight priorities for action and resource allocation as well as identify potential impacts or constraints. Scenarios also provide a framework within which trade-offs can – if necessary – be made between objectives. Further, if infrastructure development proposals are to be effective and not simply a competition for resources, they should not be treated only in terms of a financial allocation process.

Scenario development helps in unpacking the possible consequences of high impact but unpredictable occurrence of certain future events. Predictable driving forces e.g. population growth and climate change will appear in all scenarios because there is no need to speculate on their likelihood. Varying the state of the driving forces highlights different development strategies. It is the development strategies that then inform the required development programmes, projects, and implementation activities to support the selected strategies and the preferred scenario.

The framework for scenario planning charts the following steps:

i) Define the driving forces for change/assumptions;

ii) Bring drivers together into a viable framework;

iii) Produce 7-9 initial mini-scenarios including a base scenario;

iv) Reduce to 2-3 scenarios;

v) Draft the scenarios; and

vi) Identify the issues arising and actions needed to achieve the desired outcome.

Note: Most existing sector reports and development plans for Malawi, including the Water Resources Investment Strategy, have already carried out scenario development to compile specific development plans. These existing scenarios should be used in step (iii) above to inform the 'mini-scenarios'. This will also facilitate integration of the catchment plans with the existing national and sector development plans.

The base scenario is the projected future with the state of the current driving forces remaining unchanged.

At stakeholder workshops it will be necessary for the stakeholders and CMP team to select the driving forces to use in the scenarios. Prospective driving forces could include:

- Environmental degradation (includes sediment ingress and aquatic alien infestation);
- Agricultural development to support development of an export market; and
- Infrastructure development (irrigation, hydropower and storage).

The resultant impacts of these driving forces form the basis on which to select the most appropriate scenarios e.g. impact on water availability (in terms of quantity and quality), impacts on environment, economic benefits (productivity, costs) and social impacts (upliftment, employment).

Climate change will impact most countries, principally through water resources. Water resources management structures must be able to cope with the pressures that will be brought to bear. Climate change should be identified as a certainty variable like population growth and not as a driving force between scenario characteristics. The existing climate change scenarios will need to be accommodated into the scenario development, e.g. Climate Change and agriculture scenarios for Malawi[21].

Figure 5-3 illustrates the differences between four alternative development scenarios discussed in the Climate Change and Agriculture Scenarios for Malawi[21]. These or other future scenarios already developed for Malawi inform choices with regard to the development of catchment plans.

Figure 5-3: Illustrative scenarios developed for assessing the potential impacts of climate change on the agricultural sector in Malawi[22]

[21] Food and Agriculture Organisation of the United Nations (FAO-EC), 2013

[22] Food and Agriculture Organisation of the United Nations (FAO-EC), 2013

Sectors to be considered for translating the vision into specific **development scenarios** include:

- **Social**: future population growth and spatial distribution (i.e. urban or rural migrations, population density)
- **Environmental:** biodiversity (including loss of bees), land use change, deforestation, streamflow impacts, climate change impacts, etc.
- **Economic:** economic growth projections, mining and hydropower opportunities, biofuels, etc. Sub sectors to be considered include mining, agriculture, manufacturing, power and industry.
- **Infrastructure:** likely or planned developments in terms of new dams, treatment plants, irrigation schemes or other infrastructure development necessary to support the identified catchment vision.

When considering future development scenarios it is also important to identify the potential for management decision making that could influence these future scenarios. This will assist in linking the analysis of future development scenarios with specific decision making process within the catchment.

At the catchment-wide scale, scenarios can guide development and investment strategies, particularly with regard to key management decision and water infrastructure. However, scenario planning is not applicable at village level. The outcomes of scenario planning at the catchment scale should disaggregate down to the village level, especially with regard to applicable specific programmes, projects or specific activities.

5.5.4 Analytical tools

A number of analytical and modelling tools are available to assist in the analysis of alternative catchment scenarios and to provide support in terms of decision making and the prioritization of implementation options as part of the CMP. These range from simple qualitative tools for the prioritisation of options based on stakeholder consultation, to highly developed computation models that can be used for detailed water resources planning and decision making. The level of modelling required depends on the objectives of the level of detail required in the CMP and the associated complexity and risk of future development options.

A description of some of the analytical tools and models available are given in Section 7 on Modelling.

In general the type of analytical tools that should be considered include:

- A tool to assist in the evaluation and prioritisation of options – this could be based on a qualitative and/or semi-quantitative multi-criteria decision analysis (MCDA) tool based on the available information and possible outputs from more detailed models as well as input from stakeholders.
- A water balance model for the catchment used to evaluate the potential benefits and impacts of current or proposed infrastructure options and management decisions that could also include potential for modelling water quality as well as water quantity impacts.
- A land use model for identifying critical risk areas, particularly in regard to soil erosion and potential for increased sedimentation, and to determine appropriate land use in the catchment.
- A selection of models ranging in complexity from simple empirical relationships to highly complex ecological, social and economic models for evaluating the social, economic and environmental impacts of alternative development scenarios and management decisions for the catchment.

A critical consideration is the choice of appropriate models to use, as the development of highly complex models may not be appropriate for specific decision making context or in situations where the specific benefits of individual implementation options are hard to quantify and evaluate, or where there is limited data available critical to the validation of these models. Refer to Chapter 7: Modelling for a detailed look at modelling and different types of models.

5.5.5 Scenario analysis

A number of alternative development scenarios will be identified through the individual sector assessment and the catchment visioning process. The potential impacts of these alternative development scenarios

can be simulated by identifying the critical "levers" in the individual simulation models. By changing these levers (e.g. by increasing the number of dams, or through improved catchment management practices), the alternative development scenarios can be modelled to investigate how these might meet the competing demands of current and future generations in each catchment based on a number of specific indicators.

The indicators used in the evaluation of scenarios can be quantitative (measurable) or qualitative (statement). These indicators should also be grouped according to general goals or development objectives. An example of possible indicators are given in Table 5-6 below. These indicators must be limited in number to faciliate easy interpretation of the results and must be agreed upon with the stakeholders in advance of the development of the analytical tools as these tools will be developed to report on the identified indicators.

Table 5-6: Criteria and indicators for comparison of scenarios

Goals	Criteria	Possible (measurable) indicators
Economic Development	Sustainable economic growth Increased farm income Increased energy production Poverty alleviation	Agricultural benefits (yield) Hydropower benefits (output) Increased income generation Reliability of water supply
Social Development	Water supply and sanitation Reduced threat of water borne disease Increased employment opportunities Minimize resettlement	Water supply and sanitation Health (reduced child mortality rate) Potential for job creation Number of people impacted and potentily requiring resettlement
Environmental Sustainability	Minimize adverse project impacts Minimum flow provision Biodiversity protection	Sensitive areas impacted Minimum stream flows Benefits to sensitive habitats
Implementation	Financial Feasibility or Risk Economic Feasibility or Risk Public acceptability	Financial Requirements Economic rate of return Stakeholder views and acceptability

Not all alternative development scenarios can be modelled due to the limitations of the models, and given the limits of time and budget, only a small selection of alternative development scenarios can normally be considered. The modelling of too many alternative scenarios is also confusing to the end user. For this reason it is recommended to limit the number of alternative development scenarios to a maximum of five with the possible consideration of alternative climate change scenarios (e.g. a wet and a dry scenario). The models are used to model the future water resources situation out to 15 to 40 years in future depending on the required planning horizon for the development of the CMP. The results of the different development scenarios are then evaluated through the development of the visualisation and reporting tools.

The analysis of the potential development scenarios informs the development of the CMP. The outcome of this process will be to develop a strategy for the catchment under review. The next step is to translate this strategy into priority actions and compile the CMP by assigning roles and responsibilities for implementation.

5.5.6 Catchment Management Plan

A CMP is neither a conventional investment plan nor a list of capital investments aimed at meeting water requirements. A CMP should rather outline the changes that are required and the benefits of those changes towards ensuring appropriate and sustainable development. An IWRM-based CMP provides an integrated strategy for the sustainable water resource management in the catchment while considering all the sectors that rely on or impact water resources, social and economic requirements. Refer to Table 5-7 for the contents of the final CMP:

Table 5-7: Contents of a CMP

1	A summary of the Situation Assessment
2	An outline of the Catchment Management Strategy (CMS) giving the catchment vision, high level strategy, aims and objectives for improved catchment management and resource development
3	A summary of priority interventions and recommendations for further studies
4	A detailed Implementation Plan
5	A Monitoring And Evaluation Plan

A typical table of contents for a final CMP is given in the Introduction to this Section in Table 5-1.

One of the key criteria when drafting a CMP is to develop it in such a way that is easily translatable into action plans that can be pursued in parallel. Strategic plans address high level initiatives and overarching goals, but don't get translated into day-to-day projects and tasks that will be required in order to achieve the plan. Therefore, the detailed plan task requires identifying specific activities and actions that are needed in order to achieve the strategic objectives and catchment vision. This provides the opportunity to identify actions that can be translated down to village level for inclusion in the Village Level Action Plans (VLAP), and likewise, top pull key actions or issues identified in the VLAP process up to a broader catchment scale implementation.

When identifying specific activities, check whether other actions are needed to take place in order for the activity to occur. Examples would be the need for additional community or high-level political approval, or making sure that funds are available. Look out also for ‘assumptions’ that could invalidate the whole project, or this particular task. Once the list of activities for each strategy has been identified, the CMP team can then group similar or related activities, coordinate activities that are reliant on other actions, and prioritise the activities. Identify if the activities are part of a bigger project or programme, and group them as such.

5.5.6.1 Prioritisation of activities

Criteria for prioritisation of activities must be agreed upon during stakeholder engagement. Prioritisation should be based on available data and an understanding of the needs of the catchment. For example:

- Extent of resource requirements
- Available capacity and capability
- Contribution to improved yield
- Contribution to poverty reduction
- Contribution to health
- Contribution to improved environmental health

The prioritisation methodology should be defensible and based on objectively measurable criteria.

The prioritisation would make maximum use of maps and ranking tables that enable an interactive discussion and comparison of sub-catchments. Information available spatially, such as the spatial extent of erosion classes, catchment water flow, available soil moisture and agricultural potential, population density, community flood vulnerability, infrastructure, land use change, and aquatic plant population densities are examples of factors that may be presented spatially.

High priority activities should include a few “low hanging fruit” activities to build confidence in the plan, i.e. activities that will bear quick rewards with little effort or resources. In terms of sequencing, some activities may need to be implemented first, prior to other activities, and several activities may occur simultaneously. This may also influence the ranking or prioritisation of activities.

Example criteria and scoring for the prioritisation of identified options are given in Table 5-8. These criteria include social, economic and environmental costs and benefits as well as the potential for opportunity costs, the ease of implementation and the capacity and availability of resources for implementation.

Table 5-8: Criteria for evaluation and scoring of implementation options and/or themes for the CMP

Criterion for Evaluation	Impact Scoring
Overall impact of option	Addresses one issue (1) More than one issue (3) Resolves several issues (5)
Importance of issue(s) addressed	Low (1) Medium (3) High (5)
Social Benefit	Low (1) Medium (3) High (5)
Economic benefit	Low (1) Medium (3) High (5)
Environmental cost (-ve)	Strong negative (-5) Negative (-3) No impact (0)
Environmental benefit (+ve)	No impact (0) Positive (3) Strong positive (2)
Opportunity costs (if any) (i.e. loss of opportunity to others as consequence of the development)	Very high (-3) High (-2) Limited (-1) None (0)
Ease of implementation (physical feasibility)	Very difficult (-3) Difficult (-2) Feasible / possible (2) Very feasible (3)
Cost / affordability	Prohibitive (-5) Very expensive (-3) Expensive (-1) Possible (1) Money could be found (3) Possible within budget (5)
Capacity to implement	None / inadequate (-3) Weak (-2) Capacity would need to be built / recruited (-1) Limited capacity (1) Good – available (3)
Consequences of failure to implement (reflect urgency of action)	None. Issue(s) will resolve naturally over time (-3) Issue(s) increase but remain at same relative scale (0) Escalation of issue(s) (3)
Sustainability	Definite long-term sustainability (5) Sustainable (3) Uncertain - it depends … (0) Short-term only (-3) Most unlikely (-5)

In development planning it is important to recognise that there are many cross-cutting issues and mutually supportive or alternatively contradictory impacts. These need to be pointed out and incorporated as part of the analysis of alternative development scenarios and the overall CMP.

The strategic implementation plan describes the potential timing of development options in order to identify priority actions, and to facilitate financing and the long term planning required for some interventions such as the design and construction of a dam, or a water supply system, or irrigation scheme.

The implementation plan for a catchment-wide management plan can include broader strategic activities, as well as site-specific localised activities including rehabilitation activities, infrastructure development, etc. These site specific activities can be included into the VLAPs of the applicable villages if the activities become the responsibility of the village to implement., However if the responsibility for implementation still rests with the District, CMC or other Departments, then the activities are only included in the CMP for the broad-scale catchment, with engagement with the affected village.

The CMP and sub-catchment plans should be integrated with the Area Development Plans.

5.5.6.2 Micro-catchment plans

Micro-Catchment Plans are sub-sets of the Catchment and Sub-Catchment Plans. The Catchment and Sub-Catchment Plans delineate the wider land use zones. Overlaid on topographic maps, the micro-catchment plan identifies areas that should remain under forest cover; steep areas not suitable for farming; stream/river sources and banks that need to be placed under protection; cultivable areas to be subject of conservation agriculture, irrigation farming and aquaculture, and other land use types.

The objective of Micro-Catchment Plans is to “stratify the area under each Group Village Head into agreeable land use categories” that will be mapped, zoned and accepted to be maintained through legally binding arrangements in conformity with the Land Bill (2013).

The Micro-Catchment Plans represent broad integrated land use plans that will be agreed upon by Group Village Heads/Village Heads and key village representatives (Indunas). Technical input of various sectors present in the area must be sought. If not available, arrangements should be made to bring in such expertise. Micro-Catchment Plans are essentially the grouping of VLAPs within the micro-catchment area. Actions of Micro-catchment plans should be incorporated into Area Development Plans.

Such land use planning must be in support of the provision of goods required by villagers for their daily livelihoods (timber, fuel – wood and charcoal, food crops, etc.). The planning must also provide for regulating services – climate control, water quality control, disaster control and, where feasible, wildlife habitat regulation. Cultural aspects of land use must be accorded its rightful pace in the integrated land use plan. Envisaged land use categories/zones include the following:

- Agricultural land (where soil and water conservation land husbandry practices will be instituted – contour bunding, box ridging, agroforestry, conservation agriculture, fish farming);
- Permanent forest-cover areas (land which would be identified and agreed upon by villagers as marginally suitable/not suitable for crop production). Participatory Forest Management plans to be prepared for conservation and sustainable utilization of such forest land;
- Riverine/stream conservation strips (which may be developed through engineering works to support irrigation farming and fish farming);
- Grazing land (marginal areas that can be developed to provide grazing for livestock); and
- Wetlands – management of wetlands as sources of water and associated biodiversity conservation activities.

Consideration will also be made to set aside adequate land for current and future needs of infrastructure development including school blocks, health units, community centres roads and bridges and other social facilities. It is not for the CMP to invest in such construction, however, such plans need to be integrated with the local District Councils as input into their planning and programming of development activities.

For the micro-catchment plans to be sustainable, they will need to be integrated into the overall District Development Planning system. This will allow local communities to develop by-laws which enforce the micro-catchment management and land use plans. Further, the priorities of each land use plan must be integrated into the VLAPs, which will be costed to become a Village Investment Plan (VIPs). Development

of VLAPs and VIPs is a strategic activity to ensure that such priorities are integrated into the District Development Plan (DDPs) and the District Investment Plan, which directly increases sustainability as such plans access funds from the District Development Fund and other financing mechanisms such as the Local Development Fund (LDF) and the Constituency Development Fund (CDF).

5.5.7 Implementation Plan

The Implementation Plan is the ultimate deliverable from the CMP process. This is the roadmap that contains all the actions and activities, projects and programmes that have been identified in order to achieve the strategic objectives and the catchment-specific vision. The Implementation plan can be compiled according to each scale of catchment or its components, i.e. from Village-level action plan to micro-catchment, to sub-catchment to catchment/Water Resource area.

Working with the prioritised list of actions and activities further details are captured. Usually a table format is the simplest to work with. The implementation plan must be a realistic plan that includes a clear definition of roles and responsibilities, a sound financing strategy, provision for capacity-building, and systems to monitor progress and make adjustments as needed. For each action, identify who is responsible for the action; identify potential source of funding for the activity. Also think about the scale of the activities, are they relevant in a particular village/field or community, a particular area, or are they applicable to the catchment as a whole? Identify what indicators could be used to monitor progress of achieving the activity.

5.5.7.1 Elements of the Implementation Plan

The Implementation Plan is presented in table format, according to the strategic theme that support the catchment vision. Each strategy under the strategic themes is then expanded as follows:

a) **Targets** - what are the specific activity/ies aiming to achieve;

b) **Activities** (implementation actions);

c) **Indicators** (Monitoring and Evaluation), to measure outcomes of Activities,

d) **Timeframes**: Short (6 months), Medium (1-2 years) or Long (3-5 years) for implementation of Activities;

e) **Responsibility**, at Catchment /WRA scale, micro-catchment scale, village scale and Other Stakeholders for implementation of the Plan;

f) **Costing / Funding Source**, per Activity.

This is illustrated in an example in Table 5-9.

Note, that the activities identified are not limited to jurisdiction of the catchment. Some activities identified may require legislative or national policy adjustment.

Table 5-9: Example of an Implementation Plan

Strategic Option 5: Increased Environment Protection, Land and Disaster Management								
Strategic Objective: ***To increase the resilience of the Catchment and its people to natural and human pressures through sound land and environmental management practices***								
Strategy 5.6: Climate change adaptation and preparedness								
Target	**Activities**	**Indicators (M&E)**	**Time-frame**	**Responsibility**				**Costing & Funding Sources**
				Catchment Scale	**Micro-catchment Scale**	**Village Scale**	**Other Stakeholders**	
a) Improved flood management	• Determine flood lines for populated areas - rural, urban and industrial areas. • Provide floodplain development protocols (i.e. suitability of land uses in floodplains). • Review role of infrastructure in flood management and the expected role of currently proposed infrastructure. • Develop flood management plan for each watershed.	• Flood lines defined. • Floodplain development protocol developed, implemented and regulated. • Flood management plans (flood mitigation and adaptation strategy) developed. • Catchment flood management councils /committees established.	Short/ Medium	• CMC to facilitate the identification of flood prone areas in the catchment. • To facilitate the development of strategies and guidelines for flood management at catchment scale.	• Districts to map out flood prone areas at sub-catchment level. • To develop sub-catchment flood management strategies and guidelines.	• Districts, to map out micro flood prone areas. • To develop and implement flood management strategies at micro levels.	• NGO, Private Sector, water users. Donors, academic institutions, etc., to support the identification and development of flood management strategies through information provision, research and funding.	• Annual Budget • Donor funding • Private Sector • Service Fees
b) Develop Drought management plans	• Develop Sub-catchment Drought Management Plans. • Develop Catchment-wide drought management Plan.	• Sub-catchment requirements for UN Convention to combat desertification are met.	Short	• CMC to coordinate the development of Catchment-wide drought preparedness plans.	Districts to develop and implement sub-catchment drought management plans in line with the catchment wide plan.	• Districts etc. to develop and implement micro drought management plans in line with sub-catchment and catchment wide plans.	• NGO, private sector, water users, donors, etc., to support micro, sub-catchment and catchment wide drought management plans including provision of information.	• Annual Budget • Donor funding • Private Sector • Service Fees

5.5.8 Monitoring and Evaluation Plan

The development of a Monitoring and Evaluation Plan (M&E Plan) is an important component of the CMP as it is necessary to ensure that the intended objectives of the CMP are met and maintained. Continuous monitoring is also critical in order to allow for adaptation to changing conditions. The details of an M&E plan are outline in Step 5: Monitoring and Evaluation.

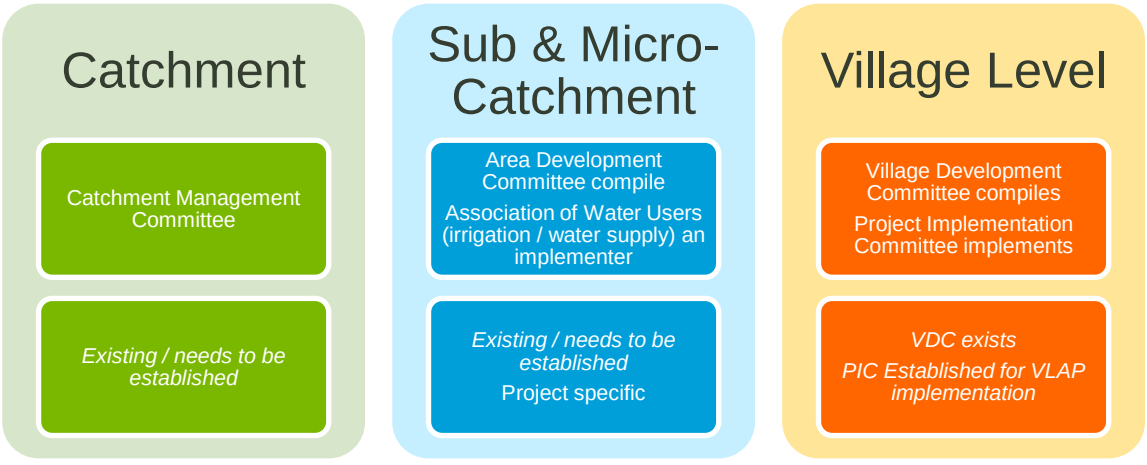
5.6 Step 4: Implementation

This step aims provides the processes necessary to ensure that projects are implemented successfully, as required in Step 4 in Figure 5-1. The responsible parties identified in the implementation plan are tasked with implementing the activities identified. This may require including the activities into the business plans of government organisations, work plans of district and local institutions, or mobilising communities, villages and farmers. The CMC is tasked with monitoring the implementation of the catchment management plan; similarly the ADC or PIC is tasked with monitoring implementation at the smaller catchment component levels.

Activities include:

5.6.1 Establishment of a Catchment Management Committee

The planning team is discussed in Section 5.3.1 and details on Roles of a Catchment Management Committee (CMC) are set out in Section 8. The body that will be responsible for administering the CMP should be identified, and/or established, early on in the process. In the case of a Catchment Management Committee (CMC), membership may be drawn from, but need not be the same as, those members of the team compiling the CMP.



All catchment and sub-catchment institutions will have been identified as part of the stakeholder identification process (Section 5.3.2). IWRM principles advocate that major river systems are best managed by adopting the hydrological river catchment as the management unit. However, as the political/ administrative boundaries do not necessarily align with the hydrological boundaries, existing institutional arrangements may need to be adapted or modified. Revised boundaries can have profound impacts upon the gathering, management and communication of information as the reporting area now differs.

The establishment of catchment management institutional bodies will go some way to addressing this disconnect in boundaries. New, or additional, organisational structures can also lead to conflict. The Catchment Management Committee (CMC), as mandated by the National Water Resources Act, 2013, will manage catchment management within the hydrological catchment, but the members of the committee should include District representatives to integrate with the existing political administrative aspects.

At the catchment scale the CMP will be administered by the CMC. The CMC includes representation by Associations of Water Users (AWUs). AWUs currently tend to represent specific projects, such as an irrigation or a water supply scheme. AWUs can and should also be established for overall water resource management and catchment management for sub- and micro-catchments, not just specific projects. At the micro-catchment and village level, the Village Development Committee (VDC) which should already be in place, is responsible for village level planning and implementation can be registered as an AWU. Further, village catchment management activities should be implemented by the Project Implementation Committee (PIC) (for Village Level Action Planning, refer to Volume II).

If no institutional structure is in place, then one of the components of the plan will need to be the establishment of an appropriate structure. If the plan is for the broader catchment such as a Water Resource Area, then a CMC should be established. See Chapter 8 and Section 5.3.1 for more information on this process. If the process is being driven at a village level, then this would be the establishment of a VDC, refer to Volume II.

5.6.2 Further analysis and feasibility studies

During the development of the CMP it is likely that insufficient information will be available to make final decisions on particular options identified for potential implementation. This is particularly true for large scale infrastructure investments that could potentially have very significant social, ecological and economic implications, or potentially result in a trade-off between competing uses of the available natural resources (i.e. land and water). These requirements for further analysis and feasibility studies for specific intervention should be addressed as soon as possible, as they are likely to significantly impact the potential for future development. Although these studies can be relatively expensive they are of critical importance to ensure the expenditure of much large sums of money, in particular for large infrastructure projects, are not waste on unsustainable projects or results in much greater social and economic costs.

Typical feasibility studies would include:

- The mapping of appropriate land use categories and identifying high risk areas with regard to inappropriate land use or in critical need of rehabilitation or protection.
- Determining the critical thresholds of social and ecological systems in the catchment, particularly those dependent on the maintenance of sufficient streamflow to maintain river health or critical inflows to receiving environments such as lakes, wetlands and estuaries.
- The detailed evaluation of specific development opportunities at greater detail, and as a critical requirement before undertaking detailed design and project implementation.
- A study to identify alternative income generating activities to reduce the pressure on natural resources as a driver of continued catchment degradation.

These follow-up studies should be supported at national level and could make use of donor funding.

5.6.3 Technical designs

After completion of the preparatory activities for infrastructure projects, the preliminary design (or conceptual design) and detailed design of the proposed structure should be compiled. The detailed design must include the preparation of specifications, a bill of quantities, and bidding documents where necessary.

5.6.4 Environmental Impact Assessment

An Environmental Impact Assessment (EIA) focuses on investments proposed as part of the intervention targeting process. The assessment needs to be undertaken with due regard to the requirements for Environmental Impact Assessment in Malawi, as set by the Environmental Management Act of 1996, and the 1997 Malawi EIA Guidelines. The objective of conducting an environmental assessment is to ensure that any potential adverse environmental impacts are identified early, and proposed mitigation measures are put forward, thus enhancing sustainability of the proposed investments. All activities must comply with the EIA legislation and requirements, where applicable.

5.6.5 Procurement facilitation

In the catchment, the facilitation of procurement will focus on the necessary inputs to implement the catchment, micro-catchment and village plans. Procurement may include consultancy services, purchasing of equipment, or materials. The procurement policy of the Government of Malawi (or donor agency if applicable) should be followed when making procurements.

5.6.6 Capacity building and training

On-going capacity building and training are important to ensure the successful implementation of the CMPs, and to ensure that there is knowledge transfer through the generations and succession of implementers. Capacity building and training should not be limited to the various technical topics in the implementation plan, but should also include the operational, institutional and administrative activities of developing, implementing, monitoring and revising the catchment management plans.

5.7 Step 5: Monitor and review

Monitoring and evaluation (M&E) is essential to:

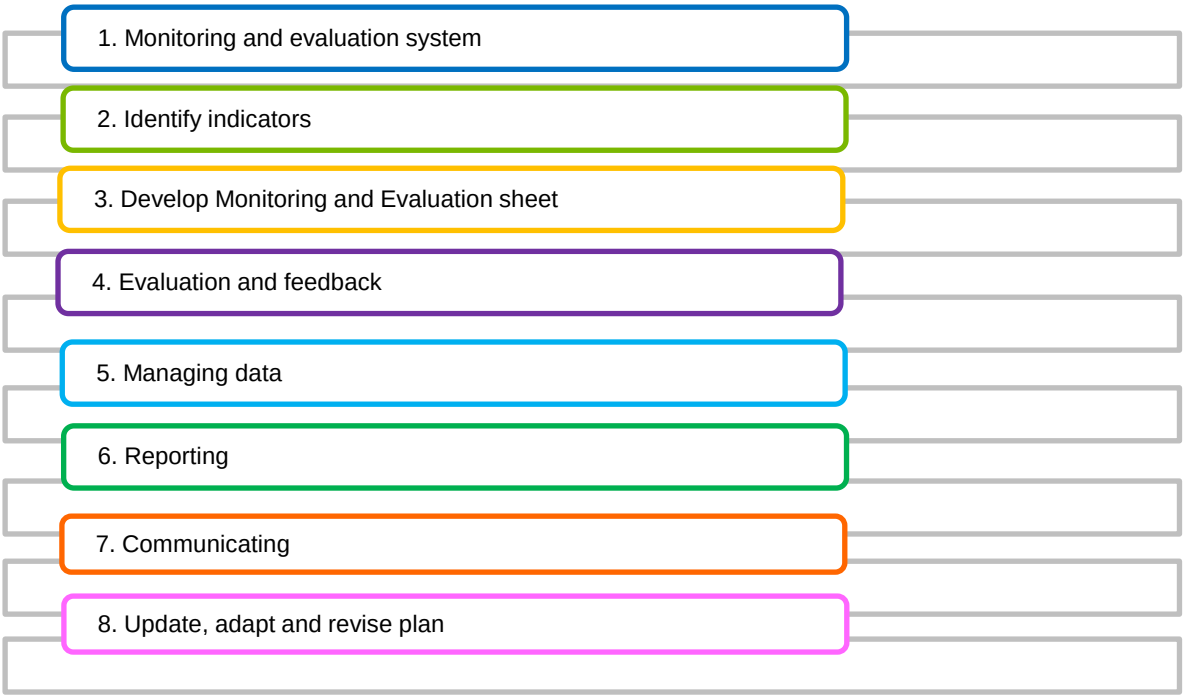
(i) ensure that implementation is on track;

(ii) measure short and long term impacts; and

(iii) evaluate the impacts in order to modify the plan or its implementation (as necessary).

The M&E process will be guided by the specific result-based indicators described in the Implementation Plan and the M&E Plan contained in the final CMP. For individual projects/programmes, this will include M&E of progress in terms of implementation programmes and actual against planned expenditure, among others. More detailed step-wise M&E indicators should be identified for each project/ programme so that progress can be adequately tracked and evaluated.

The reporting system, to be implemented by the CMC, needs to be designed in such a way that progress with the individual activities of the CMP can be tracked. Problems encountered, and the measures taken to address the problems, should be reported on a quarterly and annual basis. In addition, systematic periodic evaluation and objective assessment of the progress made towards the achievement of the overall goal of the CMP should be done. Activities include:



5.7.1 Monitoring and evaluation system

Key components of the monitoring and evaluation (M&E) system should be the selection of the indicators and ensuring feedback of the results into the decision-making and implementation processes. In simple terms, M&E is necessary to ensure that implementation takes place with the intended results and impacts. A proper M&E system, whose results are shared among stakeholders, also fosters accountability and transparency, and is likely to generate broad-based support for the plan implementation. It is essential that there is consistency between the goals, objectives, strategies, activities and the chosen indicators.

M&E systems can be costly[23] and demanding of resources - human, data and financial. It is therefore necessary to develop an efficient, effective and sustainable system, which can be implemented within resource limits and line functions. The data and its interpretation should be rigorous and robust; it is important to measure what is valued, not value what is being measured e.g. availability of water at boreholes, rather than number of boreholes drilled.

Strategies and plans must be monitored and evaluated on a regular basis. How often, and when, monitoring is carried out will be dictated by what is being measured – environmental improvements will have different timescales to budget expenditure. Stakeholders need to know whether progress is being made and what the achievements have been at any given time. A good M&E process will also provide indications of where delays or diversions are being experienced, so these can be addressed. Monitoring also provides an evidence base to:

(i) Show funders that their money is being used effectively;

(ii) Identify where more funding is required to tackle new issues; and

(iii) Suggest new actions where stubborn problems remain.

Strategies and plans are “living documents” and should be adapted as circumstances change. M&E informs timely adjustments and/or updates. Ideally the Catchment Management Plan, including its Implementation Plan as developed in Section 5.5, should be reviewed and updated at least once every five years with the results of monitoring critical to revising the plan.

[23] The costs of no M & E may be considerably higher when plan implementation is ineffective and inefficient.

5.7.2 Indicators

The next step is therefore to identify targets and indicators in order to measure progress, Good targets and indicators, stakeholder participation in monitoring process, as well as good feedback mechanisms are essential for effective M&E.

An indicator is a “pointer” that helps to measure progress towards achieving results. There are two types of indicators: quantitative indicators (measurable) and qualitative indicators (statement).

An indicator, quantitative or qualitative, provides a simple and reliable means to measure or reflect the changes connected to catchment management interventions. An indicator helps to isolate a result or change. Indicators are not important on their own but they are important at pointing or signalling the change that is a result of planned interventions derived from the implementation plan. The indicator is not the change but signals the change. Indicators should be used for establishing a baseline for an intervention within the catchment area. The baseline values are used to track progress of a catchment intervention or lack thereof and to monitor whether it achieves the objectives set out.

When selecting an indicator it is important to look at the following:

- Validity: Does the indicator allow you to be precise in measuring the results (quantity, quality, time-bound) that conforms to the needs and priorities set out in the CMP.
- Reliability: Do the indicators measure trends over time (for example: the absenteeism rate of children in primary school may vary according to the time of the year, in relation with the calendar of agricultural activities)? To be reliable, the information must normally be collected at the same time period.
- Representivity: Do the indicators provide disaggregated information (by sex, age group, etc.)?
- Simplicity: Is the information available and will it be feasible to collect and analyse it?
- Affordability: Can one afford to collect and analyse this information?

5.7.3 Monitoring and evaluation sheet

Once indicators have been identified, an M&E sheet should be developed to structure the way in which information is collected. The format of an M&E sheet will be fairly similar to the Implementation Plan table (Table 5-9 above), i.e. the columns of targets, activities, indicators, but with a scoring column, notes/progress column, date column, and a column for responsibility. This is then used as a scorecard, and can be kept as a record to follow progress. It would be useful to arrange the activities into order of timeframes as well: i.e. short, medium and long, so it is easy to follow what should be done immediately.

A scoring matrix will be needed, so that the same rating can be used in the future and not be subjective. Possible scoring types could include:

- Measurement against set targets, for example, expressed as % or numbers achieved;
- Fixed measurement, for example, hectares or number of schemes; and
- Qualitative / subjective evaluation, which could for example be on a scale from 1 to 5.

An M&E example from the Implementation Plan is shown in Table 5-10 below and an associated M&E example sheet is shown in Table 5-11.

Table 5-10: M&E example from an Implementation Plan

Strategic Option 4: Improved Livelihoods and Socio-economic development					
Strategic Objective: *To develop and manage water resources to serve social and economic development in the catchment.*					
Strategy 4.1: Water demand of intensified, agricultural and aquaculture developments					
Target	**Indicators (M&E)**	**Timeframe**	**Responsibility**		
			Catchment Scale	**Micro-catchment Scale**	**Village Scale**
c) Increase area of irrigation and drainage	• Irrigation development plan (Catchment master plan) in place • Area under irrigation in ha • Efficiency of water use • New irrigation projects implemented	Quarterly data and annual evaluation	CMC – evaluation, assessment and feedback	Data management and evaluation	Provide information

Table 5-11: M&E example sheet

Strategic Option 4: Improved Livelihoods and Socio-economic development						
Strategic Objective: *To develop and manage water resources to serve social and economic development in the catchment.*						
Strategy 4.1: Water demand of intensified, agricultural and aquaculture developments						
Target	**Activities**	**Indicators (M&E)**	**Scoring**	**Notes/ progress**	**Date**	**Assessed by**
c) Increase area of irrigation and drainage	Develop the catchment's irrigation master plan in which lands best suited to irrigation are defined and a long term irrigation development plan put forward for discussion with stakeholders. Opportunity to be linked to needs.	Irrigation development plan (Catchment master plan) in place	Yes/no	Note progress on development of irrigation master plan.	Capture date	Institution responsible for monitoring assessment
c) Increase area of irrigation and drainage	Existing irrigation schemes evaluated and indicated improvements implemented.	Current area under type of irrigation in ha	Measure in ha		Date of measure	Institution responsible for monitoring assessment
c) Increase area of irrigation and drainage	(or alt. number of improvements)	X hectares	Notes on improvements for existing irrigation schemes	Capture date	Institution responsible for monitoring assessment	
c) Increase area of irrigation and drainage	Plan for the expansion of irrigation within the limitations of catchment water access.	Studies completed	No of studies	Notes on irrigation expansion	Capture date	Institution responsible for monitoring assessment

Strategic Option 4: Improved Livelihoods and Socio-economic development						
Strategic Objective: ***To develop and manage water resources to serve social and economic development in the catchment.***						
Strategy 4.1: Water demand of intensified, agricultural and aquaculture developments						
c) Increase area of irrigation and drainage	Seek optimal use of irrigation water through crop selection, improved irrigation methods and WC/WDM	Efficiency of water use	Scale from 1 to 5. 1 = none 5 = full WC/WDM	Notes on efficiency improvements achieved	Capture date	Institution responsible for monitoring assessment

There are many data collection methods and their choice will depend mostly on their simplicity and cost. The data collection methods can also be classified into quantitative and qualitative methods.

For quantitative methods, the structured questionnaire is the most used and this will collect data on frequencies, numbers and quantities. This is called Participatory Monitoring and Evaluation (PM&E).

For qualitative data collection a number of methods are used and these include:

- Participatory Rural Appraisal (PRA);
- Participatory Learning and Action (PLA);
- Self-assessment;
- Testimonials;
- Focus groups;
- Participant observation;
- Case studies;
- Individual and group interviews; and
- Documentary content analysis, etc.

The principles of some of these methods are described in further detail in Chapter 6.

Surveys are usually used to collect both qualitative and quantitative data.

5.7.4 Evaluation and feedback

The monitoring results need to be evaluated annually. Data analysis or interpretation means making sense of the data that you have collected – it is a collection of methods used to derive useful information from collections of data. Data analysis is used in any field that collects data and needs to have useful information. In the context of catchment management monitoring and evaluation, data analysis is supposed to be an integral part of the operations to decipher meaning and isolate results that are being generated by the programme.

The findings should be discussed in the CMC and the implementing institutions need to ensure that implementation remains on schedule and yield good results. The findings of the evaluation need to be incorporated into Malawi's development planning cycle (mid-term review and national and district development plans) and in the plans of major stakeholders. Evaluation will normally lead to modification of the CMP or its implementation.

5.7.5 Managing data

As reporting on indicators will be carried out by different institutions, it is important to ensure the data collected are managed and stored in an accessible format and place. Information Management, as

discussed under Section 5.3 Step 1: Initiation, should also accommodate the information collected in terms of M&E.

5.7.6 Reporting

Reporting takes two forms. The first relates to reporting on progress on the Implementation Plan as a whole. This should be undertaken by a task team that meets every 6 months. The second relates to the reporting on the achievement of the specific actions and targets. It is important to report on progress of the activities and targets using the indicators. The timeframe for carrying out assessments must be realistic, i.e. it must provide time for projects to be implemented and take effect. A standard reporting timeframe is 2-3 years, depending on the targets and the longevity of the Implementation Plan. It is important to note that the institutions that were tasked specific activities are responsible for reporting on the activity-specific indicators. This may result in several institutions reporting on the same target.

5.7.7 Communicating

It is essential to ensure that the effective communication of progress against the targets, to all stakeholders involved, as well as to the general public, is carried out in order to build trust in the Catchment Management Plan. Communication can take the form of newspaper articles, updated progress chart on a webpage, in a regular newsletter or even through the radio.

When reporting, the message should be clear and unambiguous for specific audiences e.g. VDC, ADC, DDC or donor. The results should be clear and make sense to the target audience. There should be an agreed frequency for reporting. The information should be timely, and any delays should be explained for credibility. Keep it simple and focused.

Presentation and format determines how well the information is actually received by the targeted audience. The results should be presented in such a way that the target audience will relate to them and understand the results. It is recommended to write a report in a predetermined format. Within the format the information or results should be presented in a compelling manner, for example by using pictures graphs, tables and summaries.

5.7.8 Update, adapt and revise plan

Based on the monitoring and evaluation of the implementation of the CMP, the plan may need to be adapted or updated to reflect changes in the environment, priorities, etc. It is advised that CMPs be reviewed and revised every five years in order to ensure the plan is still relevant, and to revise the plan, as activities are implemented, new activities may be required.

6 Participatory approaches in catchment management planning

6.1 Introduction

Community Participation is accepted as essential in planning and decision-making – and is both expected and demanded by communities. The greater the degree of participation the more likely final decisions and outcomes are to be blessed with cooperation and success. It must be recognised that good participation takes time – both from practitioner and community – sometimes leading to "participation fatigue". Nevertheless, as a rule of thumb, the deeper the level of participation that can be achieved, the better.

Participation is not simply consultation….

Talking to, telling, and advising a community does not bring community buy-in, and this short-cut invariably leads to alienation of community from the process and eventual project failure. In all development it is absolutely vital to move away from the old top-down approaches so prevalent in the past, to shared approaches that draw on the power of community to take full ownership of both planning and implementation. There has been a radical shift in the understanding of the value and need for participatory decision-making, and participatory approaches have become mainstream over the past 25 years.

There are a number of different participatory approaches – developed for particular circumstances and needs - and there are a number of participatory methods or techniques used by all or some of these styles of participation. Methods may be adopted and used as circumstances require and permit. There are no hard and fast rules as to what techniques to utilise – but the basic rules in applying these methods (see below) must always be adhered to.

Participatory techniques were first formalised as a way of giving voice to the "poorest of the poor". It is important to ensure that even the most humble and quiet of voices are heard and that these are not drowned out by those who are strident or happen to hold the most power. The secrets to a good plan often lie in the voices of those who do not speak easily.

This section outlines the most commonly used approaches for participatory planning in the catchment context, and methodologies used by these approaches. The CMP team or project team should select the approach that most suits their needs or type of information they require. Participatory work is a skill that comes naturally to some, but not to all. Training in these skills is recommended and until or unless the CMP Team has these skills, it is important that professional experience be drawn into the process.

Participatory approaches include:

- Rapid Rural Appraisal (RRA)
- Participatory Rural Appraisal (PRA). (This is the most inclusive approach and is the main methodology used in planning)
- Rapid Appraisal of Agriculture Knowledge Systems (RAAKS)
- Participatory Monitoring and Evaluation (M&E)

Methods or techniques used by these participatory approaches are listed in Table 6-1. These techniques can be used singly or in conjunction with each other.

Table 6-1: Participatory Methods or Techniques

	Participatory Methods or Techniques
1	Village meetings
2	Visual mapping
3	Semi-structured interviews
4	One-to-one interview
5	Transect walks
6	Time lines
7	Historical (and other) matrices
8	Ranking, rating and sorting (e.g. three pile sort)
9	Problem trees
10	Venn diagrams
11	Group work (focus groups)
12	Action research

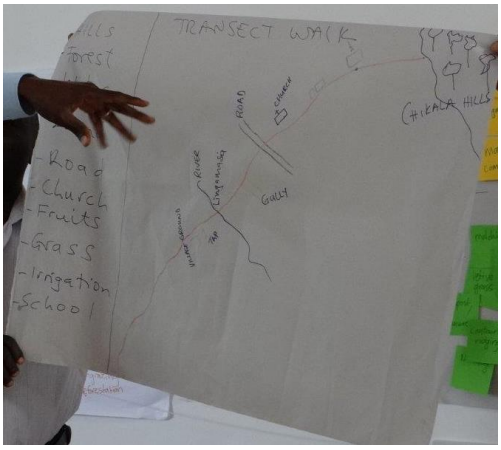


Figure 6-1: Example of a transect walk (Source: S. Braid)

There is excellent detail on all of these and other methods published on the internet.

6.1.1 Concepts in participatory practice

All participatory practice entails the following:

- Reverse the conventional direction learning: Gain social, physical and technical knowledge from and with people face-to-face. Facilitate analysis by letting people use maps, diagrams, explanation, planning, monitoring and evaluation. Figure 6-2 below shows resource mapping in action.

Figure 6-2: Resource mapping in Dedza. The seeds, leaves and sticks represent various village assets. (Source: C. Blanché)

- Understand the power of the practitioner's role: Denying your power as a practitioner simply confuses people – it works better to discuss with stakeholders how you can use your power effectively.
- Work as a team: A balanced team represents environmental, socio-economic and cultural perspectives. The team should include local stakeholders who know the area, as well as people with the required skills and knowledge.
- Share knowledge: Share knowledge and experience willingly and openly, allowing for self-critical appraisal and learning from others. Local people should share knowledge amongst themselves and with outsiders. Practitioners should share their findings with each other and with the local people.
- Use non-authoritarian approaches: Listen rather than lecture, be relaxed and unhurried, probe and explore instead of rushing to the next topic, don't dominate or control, learn about the community's concerns and priorities. Enable the people to do their own research and analysis and state their own priorities.
- Make trade-offs: Balance the costs of different ways of learning against usefulness of the information. Make trade-offs between quantity, relevance, accuracy and timeliness of different approaches to learning.
- Triangulate: Use a range of methods, investigators and disciplines to crosscheck information. PRA recommends that you draw on at least three sources of information to make the necessary recommendations and decisions.
- Seek diversity: Deliberately look for contradictions and differences rather than simply working with averages.

6.1.2 Rules to remember

There are a number of important basic rules to adhere to in all the approaches:

- Respect stakeholders, learn with them and learn from them;

- Be patient and courteous – don't undermine, intimidate, exclude or label people;
- Try not to interrupt speakers; control domineering participants; and let everyone feel comfortable to contribute;
- Find ways to help people to express and analyse their knowledge;
- Resist the temptation to impose your ideas and values;
- Be aware of your body language during the meeting, be respectful;
- Be approachable;
- Be interested;
- Turn your mobile phone off, don't text or take calls during the participatory approach, unless it is a dire emergency;
- Follow protocol, where applicable, both cultural and political; and
- If you record, photograph or film any of the participation sessions, be sure to ask permission from the participants first.

6.1.3 Facilitation

Participation is a skill and participatory methodologies require the inclusion of experienced facilitation. A team undertaking a participatory exercise should ideally comprise of a lead facilitator, an observer, and a recorder. The observer watches the process and the reactions of the participants, guiding the facilitator as required. Typically the observer notes when people are showing signs of feeling alienated, or seeks ways of distracting dominant voices or powerful figures in order to give others the space needed.

The key to facilitation is empathy. People must feel that they are being heard. It is also vital that

Many NGOs have experience in Participatory Exercises facilitation.

people are heard and that opinions are accommodated or sensitively dealt with. Whilst not everyone can facilitate, these are skills that can be learned, and training is recommended for all team participants so that they can fully understand and support the process.

6.2 Rapid Rural Appraisal (RRA)

This input on Rapid Rural Appraisal (RRA) has been adapted from the website for '*Community Adaptation and Sustainable Livelihoods*' (CASL)[24].

RRA consists of a series of techniques that can generate results of less apparent precision, but greater evidential value, than classic quantitative survey techniques. The method does not need to be exclusively rural nor rapid, but it is economical of the researcher's time. It is essentially extractive as a process: the agenda is still that of the outside researcher.

RRA emerged in the 1970s as a more efficient and cost-effective way of learning by outsiders, particularly about agricultural systems, than was possible by large-scale social surveys or brief rural visits by urban professionals. It emphasises the importance and relevance of situational local knowledge, and the importance of getting the big things broadly right rather than achieving unauthentic statistical accuracy. It developed a style of listening research, and a creative combination of iterative methods and verification, including "triangulation" of data from different sources - using two

[24] **Participatory research for sustainable livelihoods: A guide for field projects on adaptive strategies.** https://www.iisd.org/casl/CASLGuide/guidebook-home.htm

different methods to view the same information. Both primary[25] and secondary[26] data pertaining to the community is collected. RRA is usually conducted by a multi-disciplinary team, and the chief techniques are set out in Table 6-2 below.

Table 6-2: Chief techniques used in RRA

	RRA Techniques
1	Review of secondary sources, including aerial photos, even brief aerial observation
2	Direct observation, foot transects, familiarisation, participation in activities
3	Interviews with key informants, group interviews, workshops
4	Mapping, diagramming
5	Biographies, local histories, case studies
6	Ranking and scoring
7	Time lines
8	Short simple questionnaires, towards end of process
9	Rapid report writing in the field

RRA remains fundamentally an extractive, externally-driven process. A note on this point is that materials developed by the community, whatever the methodology employed, should always be left behind with the community, enhancing ownership of both process and outcome.

6.3 Participatory Rural Appraisal (PRA)

This section has been adapted from the website for '*Community Adaptation and Sustainable Livelihoods'* (CASL)[24].

Emerging in the 1980s, Participatory Rural Appraisal (PRA) builds on RRA but goes much further. PRA involves local people carrying out their own appraisal, analysis and actions, with facilitation as outlined above. PRA is distinguished by the use of local graphic representations created by the community that legitimise local knowledge and promote empowerment.

PRA uses group exercises and interactive visual tools to facilitate information sharing and analysis. PRA encourages shared learning and gives people the freedom to try and fail, or succeed. It views mistakes as learning opportunities and chances for constructive criticism. In this way the people own the decisions and are committed to the work.

PRA adds some more radical activist perspectives to RRA, including those of (i) Empowerment – where knowledge is power and shared knowledge is shared power (ii) Respect – where the researchers are the learners and the community are the teachers: (iii) Localisation – on-site engagement with on-site materials and representations (iv) Enjoyment – PRA as fun, with an emphasis on the process and not on time taken (v) Inclusiveness – where everyone is included.

[25] Primary sources are namely 'raw data' or first-hand accounts of the subject that is being researched, and in this context, are collected specifically in relation to the study. For example, primary sources include observations, interviews and surveys that would be undertaken by the planning team.

[26] Secondary sources are generally sources of information that have been collected and documented by a third party that provide context and background to the subject that is being researched. These could include maps, documents, and biographies that were documented by another party.

Figure 6-3: PRA in Dedza (Source: C. Blanché)

Note that at the broader catchment scale, it is recommended to carry out several PRA workshops throughout the catchment, rather than attempt to cover the whole catchment in one PRA. (At the village catchment scale, one PRA workshop is suitable.)

A risk to be guarded against with all methodologies, and all development interaction, is the possible build-up of unrealistic expectations.

PRA is the fundamental methodology that should be adopted at all levels of catchment planning although it can be said that provided participatory approaches are adopted and community knowledge is respected, it matters little what label the technique is given and practitioners can mix and match methodologies as best appropriate.

6.4 Rapid (Relaxed) Appraisal of Agriculture Knowledge Systems (RAAKS)

RAAKS is an action-orientated method for stakeholder analysis and problem solving, with a focus on the social organisation of innovation. The method enables stakeholders to gain an overview rather than see the situation from one perspective. RAAKS uses systems thinking, multiple perspectives, action orientation, and participatory and joint learning. It is a way of systematically monitoring and improving stakeholder performance in use of the land.

This technique can be useful in catchment scale and sub-catchment planning. At village level the method to use in information gathering and sharing remains PRA.

6.5 Village meetings as participatory practice

Village meetings bring different groups of people together to discuss the project, gain information and get feedback. The way you conduct the first village meeting is critical as it sets the tone for your future relationship with the people in the area. At the first meeting give a full account of:

- Who you are;
- Where you are from;
- What organisation you are working for;

- Who is funding the project;
- Why you are there;
- What you plan to do;
- What you expect of the stakeholders;
- What they can expect from you;
- The expected time period of the project; and
- An outline of other projects.

Do not raise unrealistic expectations by agreeing to things that the project may not be able to achieve or deliver. Be positive; make it clear from the beginning the limits of what the project can achieve. Agree on a course of action only if you are quite certain that it can go forward. If you are not sure about a suggestion, keep the possibility open. Be attentive. Listen; listening in itself encourages people to come up with practical ideas that may have seemed impossible before.

At the end of a village meeting, express appreciation for the stakeholder's time. Highlight the important features of the meeting. Arrange times and venues for activities that were agreed upon in the meeting.

Be cautious not to create false expectations or bad attitudes. Catchment management is important for everyone. It is not for practitioners to "pay" stakeholders to carry out good catchment practices. Be cautious about creating this expectation.

6.6 Visual mapping

Visual mapping is the collective act of drawing a map. It builds rapport among the people making the drawing, and generates lively discussions about the environmental, economic and social aspects in the catchment. The map can later be used to plan, implement and evaluate IWRM activities. Two common maps used in IWRM are:

- Social maps, which show a village, including households, gardens, beehives, schools, roads, streams and rivers.
- Resource maps, which show land-use patterns, trees, rivers, ponds, and soil types, problem areas.

Figure 6-4: Resource mapping in Zomba (Source: S. Braid)

Mapping helps participating stakeholders describe locations, land tenure patterns and the condition of the land. It gives people a clearer spatial understanding of the upstream and downstream effects of IWRM.

First plan a rough layout of the map. Participants need to agree on the type of map (social map, resource map, or a combination), the categories of information to include, the physical area that will be mapped, the format (size and shape of the paper), and the orientation (where to position north and south). Where paper isn't available, drawing in the sand, or on the side of a building is also fine.

Stakeholders then use coloured pens (markers) to show different features and how they experience the catchment and river (not simply just a drawing of the river and its physical features). The practitioner and project team should not interfere in this part of the exercise in terms of correcting the drawing, but can guide the stakeholders about types of detail to include e.g. areas of erosion or flooding. When the drawing is complete, the practitioner can hold a semi-structured interview. People may then decide to add

new information, such as number of schoolchildren, beehives, crop yields and size of pastures.

Questions to stimulate a resource map:

- What crops are planted, where?
- How is the farm managed?
- Where does the farm get its water from?
- Where are key linkages or access points, e.g. pathways, roads, market area?
- What farming systems are applied?
- What is the yield of the farm?
- Where are areas of erosion?
- Which areas are affected by floods?

This technique can be carried at for all the various scales of catchment planning. At the broader scale, the participants can be grouped, and several visual maps for the different parts of the catchment created.

Information in the map can be verified with a transect walk as described below.

The visual map can also be used in developing a vision. First let the participants create a map of their "catchment" showing the present day. Then add/delete from the map what they would like for their future. These maps are key in both planning and in monitoring and evaluating progress – which should also be undertaken in participatory conjunction with the community.

6.7 Transect walks

In a transect walk, stakeholders identify and discuss different aspects of the catchment as they walk through part of the catchment. They walk along a chosen route, talking among themselves and with the practitioner about things that they notice, and things that impact on water resources: such as soil conditions, erosion, land use patterns, location of- /state of water collection points, irrigation, landslides and gullies, ground cover, etc. Group discussions around overgrazing, deforestation, soil conditions, pasture conditions, farming systems applied, are useful topics for discussion and understanding the level of awareness of catchment issues.

Make sure not to walk too fast on a transect walk. Be observant and ask questions, "Why?", "what do you think?" Encourage participants to ask their own questions and share their knowledge about the use of local resources.

- Wear suitable shoes (hat, water, etc. may also be appropriate)
- Plan the route with the stakeholders (identify what needs to be seen).
- Take notes, photos. Mark on the route map points of interest and discussion.
- If the walk focuses on a specific aspect, make sure the participants have the necessary background knowledge.

Transect walks are appropriate for village scale and micro-scale catchment planning. A transect walk may also be carried out where specific issues have been identified in the broader catchment planning process, as means to gather more information about the issue.

6.8 Semi-structured interviews

A semi-structured (conversational) interview is one with a loose structure that responds to the person or group being interviewed. The interview is highly adaptive to the situation. Many participatory techniques, such as mapping, transect walks, etc. use this tool to gain more insight into relevant issues or topics. For example, after a group of stakeholders has drawn a visual map, you can use a semi-structured interview to enable them to share their knowledge, experiences, perceptions and understanding of the map.

A semi-structured interview allows a free flow of conversation so that participating stakeholders can introduce whatever topics they feel are important. One-to-one interviews are better when the issues being discussed are specific or sensitive, but a semi-structured group interview also works when a topic is applicable to many people. Be aware of one or two strong participants hijacking the conversation. Be sure to enable everyone to participate and contribute their own views in the discussion.

Semi-structured interviews can be carried out at all scales of catchment planning. With larger groups of stakeholders, break into smaller groups to facilitate more discussion and inputs from the participants. A small group (±10 people or less) is more personalised than a large group (30 people and more). Consider the type of information you would to gain from the conservation, and arrange your groups accordingly. For example, if you want to raise women's role in water management, then have a group of only women, don't group the women with the men.

Figure 6-5: Semi- structured interviews being undertaken in Dedza (Source: S Braid)

Start with your own set of thoughts about what you want to discuss – but remember that this is not a questionnaire. Allow a free flowing conversion and use this only to ensure that important issues are not forgotten

6.9 One-to-one Interview

Gently guide and balance the interview to ensure that the person remains focused on the task. Don't be rude or forceful. Use a mental (or written) list of questions to make sure you achieve the aims of the interview, but always remain open to exploring new or unexpected issues that the interview raises. Start with open-ended questions, then look into specific issues. Use both visual and verbal methods to probe. A useful strategy is to apply the 'but-why?' method to get to the deeper causes. Accurately record and date the information from the interviews. You can synthesise your own notes, but keep an accurate reflection of the interview. Give copies of the interview reports to the stakeholders. If you record the interview, be sure to ask permission from the interviewee first.

Note how this differs from a semi-structured interview. It is an in-depth interview – but scripted in a way that is not obvious.

6.10 Group work (focus groups)

Group work is a most useful way of injecting energy into meetings and especially in allowing the silent voices to be heard. There are a number of different ways of undertaking group work: Reflection, Buzz Groups, Rounds, Brainstorming, etc. The most common of these is "buzz groups" where participants are simply asked to discuss an issue with an immediate neighbour (or neighbours) in the group. It is remarkable how stimulating this can be.

Small group techniques are useful in workshops with a large number of participants. They give quiet, less dominant members a chance to express their views. There are many different small group methods, including problem census and brainstorming.

Practitioners need to clearly explain the purpose of a group exercise to all participants. Once in their small groups participants discuss the task and carry out the exercise. Then the whole (plenary) group comes back together to reflect on each small group's findings and explore the issue further.

In the catchment context issues that may be discussed could include:

- Extent of land cultivated
- Extent of erosion, and causes of erosion
- Availability of water, or problems with access to water
- Farming practices used (rotation, mono-cropping), etc.
- Extent of pastures
- Extent of forests, or threats to forests
- Number of cattle, sheep, goats, pigs, chickens, donkeys

Group work is appropriate for broad scale planning. Where detailed more specific information is required, then the small scale approaches such as village meetings, visual mapping and PRA can be used in conjunction with group work.

6.11 Action Research

Action Research is a method of getting diverse social groups to work together in ways that consciously build their relationship. By working towards a common purpose, the groups begin to understand the social, economic, historical and political forces that influence them and others, and that they have on each other (upstream – downstream).

The Action Research process is a series of structured interactions. First, the problem is defined. Then the action is planned. Then the action is carried out. Finally the action is observed and reflected upon. The problem is then redefined (or next problem identified), further action is planned, and another cycle of action research takes place. Action Research can be described as a spiral of events in which action and relationships evolve as the cycle goes forward. Refer to Figure 6-6 below.

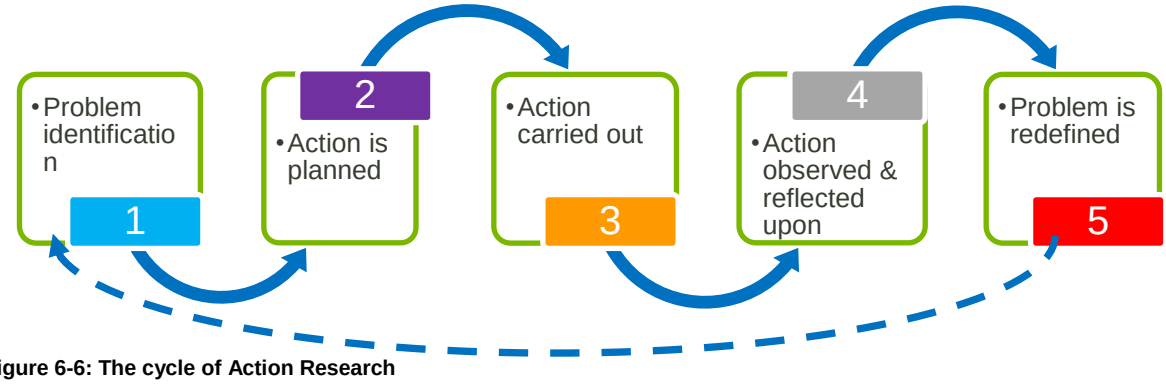


Figure 6-6: The cycle of Action Research

Action Research is a process of learning by doing, and learning with others. It helps participants learn about their practices, languages, modes of work and power relationships. They examine how their skills and values shape their identity and the socio-political structures around them, and how social structures may be limiting their growth. All parties gain a broad perspective on new possibilities to make decisions about the structures and interventions they need. The method is a good way to challenge unjust and unproductive systems of working. It helps people look critically at how oppressive and destructive situations are created and maintained. It helps upstream and downstream participants understand each other's contexts.

This technique is appropriate for catchment-wide planning.

6.12 Conclusion

Participatory skills are vital to any planning team. Where these skills are lacking it is necessary that these be imported into the group. Without community participation there will be no ownership of the plan, and without ownership of the plan there will be no support from the community in implementation. Top down approaches almost invariably result in the community being obstructionist rather than supportive. It is so easy, through good practice, to turn this situation around. Refer to the Lingoni Watershed Project case study as an example of a successful catchment:

A Success Story – The Lingoni Watershed Project

The Lingoni Watershed Project is located in Machinga District, Traditional Authority Chamba at Mitawa Village in Zomba. The Project was developed by Emmanuel International through Wellness and Agriculture for Life Advancement program (WALA). The project took well over 5 years from 2009 to 2014, and received funding from USAID. The goal of the Project was to regenerate and strengthen the natural resource bases of production (soil, water and vegetation), thereby reducing the effect of climate change, and meeting and improving the means of attaining basic livelihood needs and development.

Mitawa Village is the epitome of a very successful Catchment Management Project. The project has the potential of irrigating 1,994 hectares (ha). Some of the interventions and achievements are as follows:

- Excavation of 5,440 water absorption trenches (WATs) - WATs are trenches dug to trap water from run-off, so that it soaks into the ground. This allows for recharge of the groundwater and a continuous supply of water at the borehole. The trenches also prevent and retain silt from running off into rivers.
- Excavation of 861 continuous contour trenches (CCTs) – CCTs are long trenches dug in the field along the contours to also trap run-off. Although CCTs are not as deep, they also trap water which then soaks into the ground creating fertile soil in the process and reducing the loss of soil from the fields.
- Construction of 500 check dams and numerous stone bunds in gullies to reclaim the lost land and prevent further loss of fertile soil.
- Construction of a night storage dam and integrated fish ponds to store water.
- Planting of Vetiver grass along the contours to control erosion in addition to afforestation with the planting of two agroforestry species, 2,577 *Faidherbia alba* (Msangu) and 980 *Gliricidia sepium*.
- Construction of a water intake weir on the Lingoni River and 3km channel with a number of irrigation channels leading off to various parts of the village. The canal water has the potential to irrigate a total of 135 ha. Over 25 ha of land is under irrigation and is being implemented by 64 farming households.
- Practicing the three steps of conservation agriculture with mulching; minimum tillage; and crop rotation and intercropping.
- Protection of the forest in the catchment under the Village Natural Resource Management Committee who control access to the forest and protect it from fires, poaching, charcoal production and encroachment from adjacent land uses.
- Beekeeping to raise funds used to enhance the value of the forest and water resources.
- Creation of a village savings club, whereby community members have contributed their own savings to a club which can be borrowed for projects or small businesses.

7 Modelling

7.1 Introduction

When management decisions are made about water resources systems, decision-makers do so in the belief, or hope, that the predicted changes will be realised as a result of implementing remedial actions. These predictions are often qualitative and based on the knowledge and experience of the decision maker, or in part based on quantitative information provided by mathematical or computer-based models (Loucks and van Beek, 2005)[27].

A model is a simplification of the real world and reflects the knowledge of how natural and man-made water resource systems interact. Because it is a simplification, it can help decision makers identify which catchment processes needs to be controlled to meet the management objectives, i.e. where should management efforts be focussed. It also helps to identify the spatial and temporal scale of catchment processes and the scale at which interventions should be implemented. Lastly, it helps decision makers to identify and priorities interventions to manage problems in the catchment by simulating the possible outcomes beforehand.

Ongely and Booty (1999)[28] made a strong case for utilising local knowledge to support decision making in situations where there is a low to moderate level of expertise to run conventional models, or where there are too little data to run conventional models. Mathematical modelling to support IWRM was the usual method of choice in data-rich developed countries and it required substantial investment in reliable data, scientific capacity and a sophisticated management culture. These were generally not found in developing countries. They found that in developing countries modelling was expensive, posed numerous technical problems, required a high degree of input by foreign experts, and rarely left residual capacity in the developing country. They argued for the development of decision support systems which combines simpler or scoping level models with local expertise to address complex environmental decisions. In their paper they distinguished between conventional mathematical modelling and knowledge-based approaches.

In this section both conventional modelling approaches and knowledge-based approaches are described, and how the two approaches can be integrated in developing countries. The section also describes how the impacts of climate change on water resources systems can be accommodated in water resources planning and management. The section concludes with risk ranking, i.e. considering the likelihood, significance, and consequence of risks occurring, as identified through the situation assessment process (refer to Chapter 5, Section 5.4, Step 2).

7.2 Conventional modelling techniques

Catchment modelling is just one of the links in a larger process of managing catchments. It generally follows a multistep process (Chapra, 1997)[29] for selecting and applying an appropriate catchment model (Figure 7-1).

- The modelling process starts with defining the problem and the outcomes that the manager wants to achieve. Two information sources feeds into this step, the first being the management objectives, options and constraints. The second relates to existing data and information about the catchment being investigated. If data is very sparse some preliminary data collection is appropriate. At the end of this step the modelling team should have a good understanding of the temporal,

[27] Loucks, DP and van Beek, E. 2005. W**ater Resources Systems Planning and Management: An Introduction to Methods, Models and Applications**. UNESCO Publishing. Paris.

[28] Ongley, ED and Booty, WG. 1999. P**ollution remediation planning in developing countries: Conventional modelling versus Knowledge-based prediction**. Water International, 24(1): 31-38.

[29] Chapra, SC. 1997. **Surface water quality modelling**. The McGraw-Hill Companies, Inc., New York.

spatial and kinetic resolution that is compatible with the catchment characteristics and the management objectives.

- The next step is to select an appropriate catchment model. The advantage of selecting an existing software package that is widely used is that the model has credibility in the eyes of other decision makers and water resource scientists.
- This is followed by the preliminary application of the model. This entails configuring the model for the catchment and processes being simulated, preparing the model input files, and running the first simulations. Preliminary application is useful to identify any data deficiencies, designing field studies to fill the data gaps, and to identify which model parameters have the greatest impact of model predictions.
- The catchment model needs to be calibrated or "tuned" to fit an observed data set. This consists of varying the model parameters to obtain an optimal agreement between the model simulation and the observed data set. At the end of this step the modelling team knows that model works and fits a single data set.
- Before the model can be used with confidence, it needs to be confirmed or validated. The calibrated model should now be run with a new data set or several data sets without changing the parameters. If the new simulations match the new data, the model is confirmed as an effective predictive tool.
- The model can now be used to predict the outcome of different management interventions or scenarios from which remedial actions can be formulated.
- After implementation of the remedial actions a check or post-audit can be made to learn whether the model predictions were valid. If there are major discrepancies between the modelled outcome and the actual outcome of remediation measures, these often provide useful clues about missing mechanisms and information. This can be used to improve the robustness of the model.

These conventional modelling steps are unpacked in more detail in the sections that follow.

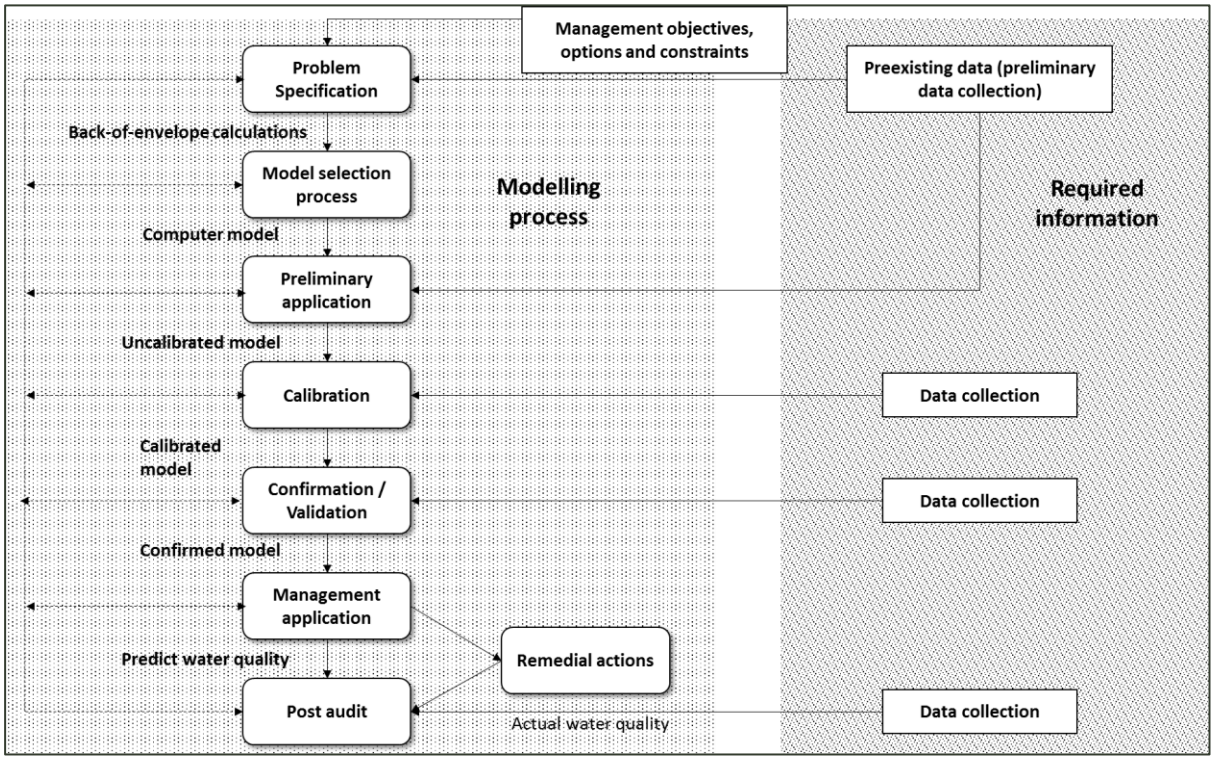


Figure 7-1: Simplified flow diagram of a modelling process and the information needed to support it (from Chapra, 1997)[29]

7.2.1 Establishment of analytical tools and simulation models

Water resources decision-making is a multi-stakeholder negotiation process, which is well served by analytical tools and simulation models. In such a process, the decision for selecting among a set of possible catchment development and management options has to take into account the priorities and preferences of a range of stakeholders and decision-makers (in a multi-jurisdiction context). In catchment planning and management, models enable the evaluation of impacts and benefits of alternative water resources development and catchment management plans in order to inform scenario development and analysis.

The following sub-tasks are employed to implement and apply the analytical tools and simulation models used in catchment management:

- Formulation of an integrated modelling framework as a decision support system (DSS);
- Selection of the most appropriate catchment component models (e.g. aquifer models, rainfall-runoff models, or hydrodynamic channel flow models);
- Configuration of individual baseline catchment or component models;
- Validation of individual catchment or component models; and
- Simulation of alternative development scenarios.

7.2.2 Formulation of an integrated modelling framework as a decision support system (DSS)

A decision support system (DSS) is normally computer based, it plays a supportive role in the decision making process, it generates information via models to support decisions, and it is highly adaptive and flexible to accommodate the needs of a wide range of stakeholders.

The design of the DSS must be focused on the need to support the analysis of alternative development scenarios or components of the scenarios in line with the catchment vision. This requires the identification and assessment of the most appropriate analytical tool or model to address each of the requirements of the scenarios. The latter process informs the formulation of an integrated framework of tools and simulation models, i.e. the DSS, to quantify potential impacts and benefits of alternative development scenarios. The core of these models is usually a water resources simulation model, but other components of an integrated modelling framework could include, but are not limited to, the components listed in Table 7-1 below.

Table 7-1: Potential model components

Model components	Summary
Rainfall/Runoff model	Converts rainfall into catchment run-off at a given time interval.
Land use change model	Evaluate impacts of land use change in terms of catchment runoff, natural capital and resource development, and carbon sequestration.
Irrigation and crop model	Determine the potential for agricultural development including suitable crops and potential yields as well as irrigation demand requirements.
Erosion and sedimentation models	Potential impacts of land use change and management development options on erosion and sediment production.
Water quality model	Impacts of alternative development options on water quality
Groundwater model	Models the potential for groundwater development and impacts.
Hydropower model	Determine hydropower potential under alternative development, operational, and climate change scenarios.
Ecosystem model	Model potential impacts of alternative catchment management processes on natural ecosystems including nutrient dynamics of soils, water resources impacts, soil productivity and carbon budgets.
Economic (Cost/Benefit) model	Evaluate the potential impact of alternative development options in terms of job creation, income and contribution to economic growth in order to do

Model components	Summary
	a simple cost/benefit of alternative development scenarios.
Rainfall/Runoff model	Converts rainfall into catchment run-off at a given time interval.

Choosing the appropriate scale (spatial and temporal) and the level of complexity of the individual component models is critical. This will be informed partly by the requirements of the DSS, but will also be influenced by the availability of data for calibration and validation of the individual models so as to avoid over precision. The final selection of scale should be made early in the CMP development in consultation with the stakeholders.

Spatially, it is likely that each catchment will be divided into five to ten sub-catchments that will be defined by the major rivers and the location of streamflow gauges and potential development options.

Temporally, the time step and simulation period will also be informed by the availability of data and the requirements of the DSS. For example monthly simulations are suitable for water resources assessments and can be run over longer time periods of up to 100 years (depending on the availability of historical data), while water quality, sedimentation and flooding models require shorter time steps (daily or sub-daily) to investigate impacts of pollution or flooding.

7.2.3 Selection of the most appropriate simulation models

The selection of the most relevant and appropriate models should be guided by a sound understanding of the purpose of the modelling, the type, reliability and precision of required model output, spatial and temporal requirements for model configuration, the availability of relevant and reliable input data which are required to configure the model and the availability and quality of observed data to be employed in model calibration and validation. Table 7-2 provides examples of readily available models and analytical tools appropriate to support integrated catchment management.

Table 7-2: Examples of readily available models and analytical tools appropriate to support Integrated Catchment Management

Model	Summary description	Primary functionality								Reference
		Rainfall-runoff	Channel flow, flooding & sediment	Aquifer dynamics	Infrastructure operations	System optimisation	Water quality	Environmental flows or land management impacts	Multi-criteria	
SWAT	SWAT is a catchment-scale, continuous daily simulation model, designed to predict the impact of land management on water, sediment, and agricultural chemical yields in ungauged catchments. Major model components include weather, hydrology, soil temperature and properties, plant growth, nutrients, pesticides, bacteria and pathogens, and land management. An ideal model for consideration of rainfall-runoff, land use change, sediment, erosion and water quality simulations.									http://swat.tamu.edu/software/swat-model
WEAP	WEAP provides a flexible and user-friendly framework for planning and policy analysis. It places demand-side issues such as water use patterns, equipment efficiencies, re-use strategies, costs, and water allocation schemes on an equal footing with supply-side topics such as streamflow, groundwater, reservoirs and water transfers. WEAP is simulates both the natural (e.g. evapotranspiration demands, runoff and baseflow) and engineered components (e.g., reservoirs, groundwater pumping and hydropower) of water resource systems.									www.weap21.org
Mike Basin	This is a comprehensive river system model that operates at any time-step and simulates both the natural (e.g. evapotranspiration demands, runoff and baseflow) and engineered components (e.g., reservoirs, groundwater pumping) of water resource systems. It has an									www.mikebydhi.com

Model	Summary description	Primary functionality								Reference
		Rainfall-runoff	Channel flow, flooding & sediment	Aquifer dynamics	Infrastructure operations	System optimisation	Water quality	Environmental flows or land management impacts	Multi-criteria	
	advanced GUI and is geared for water resources system optimisation.									
HEC-HMS	This is a user-friendly short time-step model designed for flood hydrograph generation and routing through river and reservoir systems.									www.hec.usace.army.mil
HEC-RAS	This is a hydrodynamic channel flow model with a user-friendly GIS-based GUI that allows analysis of flood water levels and lateral extent of inundation and sediment transport under flood conditions. The water level impacts of hydraulic structures in river channels can also be simulated.									www.hec.usace.army.mil
MIKE11	This is a hydrodynamic channel flow model with a user-friendly GIS-based GUI that allows analysis of flood water levels and lateral extent of inundation and sediment transport under flood conditions. The water level impacts of hydraulic structures in river channels can also be simulated.									www.mikebydhi.com
Qual-2K	This is a hydrodynamic channel flow model designed for steady-state analysis of water quality dynamics in river systems. The model simulates both conservative and non-conservative water quality mechanisms and constituents and is particularly useful for assessing nutrient and sediment dynamics and related algal blooms and the latter's impacts on dissolved oxygen.									www.epa.gov/OST/QUAL2E_WINDOWS
DRIFT	This is a multi-component DSS for assessment of environmental water									www.southernwaters.co.za

Model	Summary description	Primary functionality								Reference
		Rainfall-runoff	Channel flow, flooding & sediment	Aquifer dynamics	Infrastructure operations	System optimisation	Water quality	Environmental flows or land management impacts	Multi-criteria	
	requirements in rivers, wetlands and estuaries. It integrates information on streamflows, channel hydraulics, all relevant aquatic and riparian ecosystems and the level of development of the catchment in a multi-criteria framework.									
eWater Toolkit	The Toolkit is a source of software tools and information related to the daily modelling and integrated management of catchments and water resources, including water quality tools. It provides a web-based distribution point for hydrological, ecological and catchment management models, databases and other resources. It is particularly useful to support environmental flow requirement processes.									www.toolkit.net.au
CENTURY	This is a set of ecosystem models with which the potential impacts of alternative development and land use scenarios can be modelled. The influence of each scenario on forage production, the supply of fuel wood, and the amount of carbon sequestered above- and below-ground can be assessed. The effect of predicated changes in climate on each of these services can also be modelled. These outputs can then be used to assess the effect of each scenario on food production, livelihoods and soil fertility based on published datasets and available literature.									www.nrel.colostate.edu/projects/century

7.2.4 Configuration of individual catchment models

Having selected the most appropriate simulation models, these will need to be configured for each catchment. This requires information on the catchment characteristics, the current status of land use and water related infrastructure, historical rainfall and stream flow information, and estimates of past, present and future water use requirements (information gathered during the Step 2: Situation Assessment and Analysis phase, Chapter 5, Section 5.4). The individual models should be configured separately, but ensuring the ease of integration and transfer of results between models where required.

7.2.5 Validation of individual catchment models

The models should be validated against historical information on streamflow and water demands to ensure that the models give a reasonable, if not perfect, representation of the water situation in each catchment. The availability of data for calibration and validation of the various models is likely to be limited in some of the catchments and provides a potential risk and challenge to the development of simulation models. The models will have to be developed in the potential absence of reliable data and this needs to be considered when determining the required complexity of the models and interpreting the results.

7.2.6 Development of visualisation and reporting tools

Appropriate visualisation and reporting tools will need to be developed for the comparison of alternative development scenarios and options. These can either be based on existing software systems, such as WEAP, Mike Basins, or simpler, more customised Excel based visualisation and reporting tools. The type of tools developed will be based on the outcomes of the visioning and scenario development stakeholder engagement that will identify what decisions need support and the appropriate indicators required to support these decisions. The visualisation tools must provide a clear and concise output from the analysis and ideally be able to compare alternative options in a workshop environment.

Most available water resources planning tools provide a similar variety of options for the presentation of both data input and results, as well as comparison of alternative development scenarios. These are now typically presented either in the form of maps or charts or summary tables. They are widely used and have the advantage that WEAP is generally available free of charge to developing country institutions. Another advantage of many of the inbuilt visualisation and comparison tools is that it can be used in a workshop environment to give immediate results to show the impacts of alternative development scenarios coming out of discussions.

The scenario comparison tools built into existing water resources models such as WEAP are often of a very technical nature and not easily interpretable by the stakeholders. It is often necessary therefore to translate these outputs into likely impacts on a selection of key indicators (as per the Step 2: Situation Assessment and Analysis phase, Chapter 5, Section 5.4).

The impact of alternative development scenarios will then be quantified using the integrated modelling framework (centred around the water supply model) and can be displayed in a consequence table. This provides a clear way of visualising the comparison between scenarios.

7.3 Knowledge-based predictions

7.3.1 A knowledge-based approach to decision support

Catchment rehabilitation in developing countries often have to be made in data and knowledge-poor situations. Therefore, remediation objectives are often poorly articulated, raise unrealistic expectations, and often cannot be evaluated in cost-benefit terms. The conventional mathematical modelling approach, as a means of evaluating catchment rehabilitation scenarios and options, is the usual method of choice in data-rich developed countries. However, Ongley and Booty (1999)[28] maintained that conventional modelling approaches are often unsuccessful because it requires substantial investment in reliable data, scientific capacity and a sophisticated management culture that generally are not found in developing countries. They advocated for a different approach that uses knowledge-based predictions. This

approach focuses on use of local knowledge to establish meaningful program objectives. It explicitly anticipates the short-comings of conventional modelling in order that models can be realistically used. It allows the client to evaluate alternative catchment rehabilitation options with outputs expressed in degree of uncertainty in the assumptions and analytical processes included in the assessment. They contend that a knowledge-based approach builds local capacity and, by providing access to domain knowledge, reliance on foreign experts diminishes as local experts assume similar tasks elsewhere in the country. In their paper they illustrate how the knowledge-based approach can be applied using the same sub-tasks that apply to conventional modelling approaches.

7.3.2 Simple knowledge-based tools

There is much to be gained from documenting the decision-making processes of experienced individuals. It provides a way of making implicit knowledge and experience explicit and supports logic and systematic decision making. Starfield and Bleloch (1991)[30] described three types of knowledge-based tools, namely decision trees, decision tables and expert systems.

A decision tree is a way of arranging qualitative arguments that lead to one decision rather than another. Below is an example of a decision tree for the choice of best restoration procedures for the control of algal problems (Cooke et al, 2005)[31] (Figure 7-2).

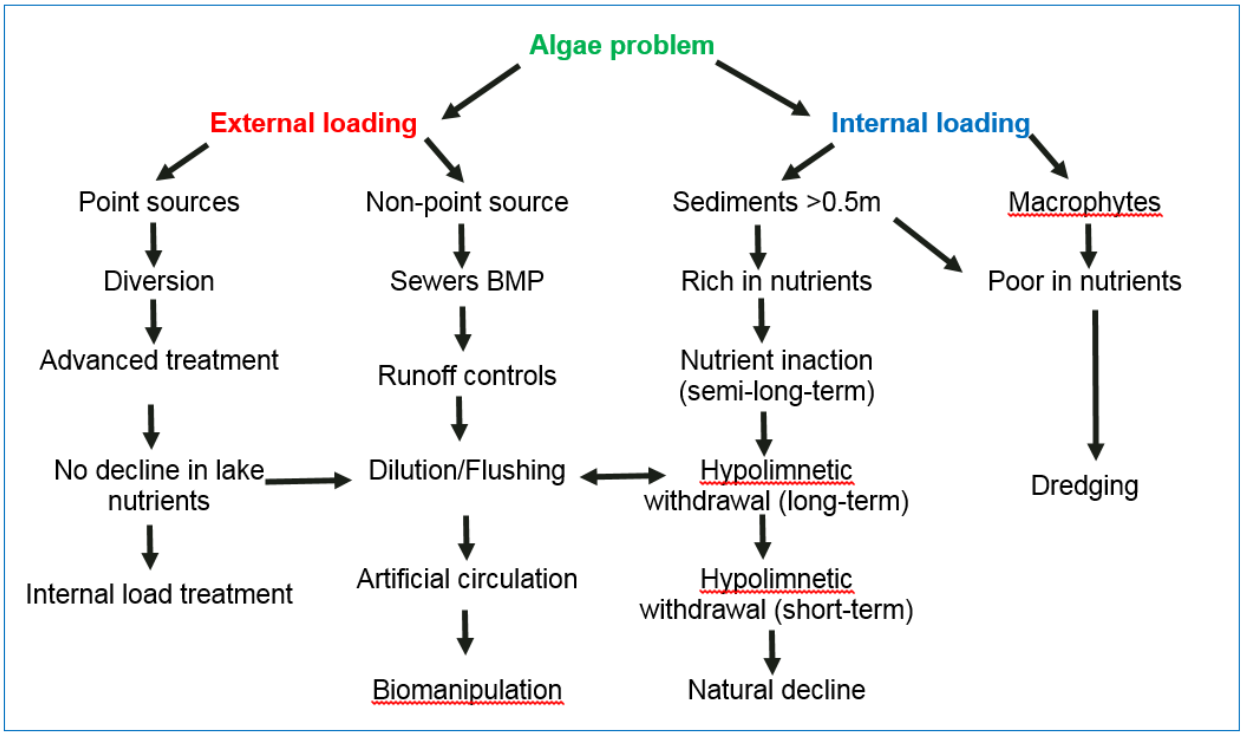


Figure 7-2: An example of a decision tree for selecting management options to deal with algal problems in a lake (adapted from Cooke et al., 2005[31])

The problem with a decision tree is that it is often structured to arrive at a single option or decision. From experience we know that catchment management problems are often due to a combination of many contributing factors. Despite these shortcomings, the structure of decision trees provides insights into the decision-making processes and priorities of an expert or group of experts.

Decision tables provide another way of arranging expert knowledge in order to make it explicit. Below is an example of a table listing the suitability of different non-point source management options (Olem and Flock, 1990)[32] (Figure 7-3).

[30] Starfield, A M and Bleloch, A L. 1993. **Building models for conservation and wildlife management.** Burgess International Group, Edina, MM.

[31] Cooke, GD, Welch, EB, Peterson, SA and Nichols, SA. 2005. **Restoration and management of lakes and reservoirs**. 3rd Edition. CRC Press, Taylor & Francis Group, Boca Raton.

PRACTICE	EFFECTIVENESS	LONGEVITY	CONFIDENCE	APPLICABILITY	POTENTIAL NEGATIVE IMPACTS	CAPITAL COST	O&M COST
Addition of Tertiary Treatment to Middletown Treatment Plant	E	E	E	E	E	F	F
Construction of Sedimentation Basins at Inlets to Lake	G	E	G	G	G	F	F
AGRICULTURAL PRACTICES							
—Conservation Village	F-E	G	G	G	F	F	F
—Contour Farming	F-G	P	F	G	E	E	E
—Pasture Management	F-G	E	E	G	E	E	E
—Crop Rotation	F-G	G	G	G	E	E	E
—Terraces	F-G	G	G	G	E	F	G
—Animal Waste Management	E	E	E	E	E	F	F
—Grass Waterways	E	E	G	G	E	G	E
—Buffer Strips	E	E	E	E	E	G	E
—Diversion of Runoff	G	G	F-G	F	E	F	G
CONSTRUCTION CONTROLS							
—Erosion Control Ordinance	E	E	E	E	E	E	E
—Runoff Control Oridnance	E	E	E	E	E	E	E
—Field Inspections	E	E	E	E	E	E	E

Legend: E = Excellent G = Good F = Fair P = Poor

Figure 7-3: An example of a decision table for selecting a suite of best catchment management practices to reduce nutrient loading to a water body (Olem & Flock, 1990)[32]

Decision tables like the one depicted above provide a range of catchment management interventions. These interventions range from unsuitable to very suitable for addressing specific problems and from this the manager can select a portfolio of interventions.

Expert systems provide a means of capturing knowledge in the form of IF-THEN rules, to add explanations, and to provide an inference mechanism to navigate the rule base. An expert system generally consists of a number of core components. These are the knowledge base which stores factual or heuristic knowledge in the form of if-then rules, a reasoning engine which is a mechanism for manipulating the rule-base, an explanation subsystem where the logic for certain decisions are captured, and a user interface that communicates with a user.

Expert systems form a branch of the field of artificial intelligence, which has been described by Turban and Aronson (1998)[33] as the study of the thought process of humans (to understand what intelligence is) and the representation of those processes via machines (such as computers and robots). A knowledge-based expert system or expert system shell is an “intelligent” computer programme that uses knowledge and inference to solve problems that are difficult enough to require significant human expertise to solve the problem. Components of an expert system usually comprises knowledge-based tools which incorporates knowledge as rules, an inference engine which navigates through the rules to solve the problem, and the user interface which interacts with the user by asking questions. So while the knowledge base is the “qualitative model”, the expert system shell is the general-purpose programme for exercising that model and uses the knowledge base to operate logically on the answers to the questions (Starfield and Bleloch, 1991)[30].

7.3.3 Other artificial intelligence tools

Fuzzy logic deals specifically with uncertainty by simulating the process of normal human reasoning by allowing the computer to behave less precisely and logically than conventional computers do (Loucks and

[32] Olem, H, and Flock, G. eds. 1990. **Lake and Reservoir Restoration Guidance Manual. 2nd Edition**. EPA 440/4-90-006. Prepared by the North American Lake Management Society for the USEPA, Washington, DC.

[33] Turban, E and Aronson, J E. 1998. **Decision support systems and intelligent systems**. Fifth Ed., Prentice Hall Upper Saddle River, New Jersey.

van Beeck, 2005)[27]. In a fuzzy rule-based system, typically, all possible rules are executed during each execution of the system, but the strength ranges from "not at all" to "completely", depending on the relative degree to which their fuzzy antecedent propositions are satisfied by the data. In other words, it extends the notion of logic beyond simply true or false. To allow for partial or continuous truths as imprecise knowledge or reasoning are important aspects of expertise in applying common sense to decision-making. However, fuzzy models are not always used as they are complex to develop and it requires considerable computing power.

Bayesian networks have been successfully used to assist problem solving in natural resource management applications (Pollino and Henderson, 2010)[34]. Bayesian networks offer assistance to decision-makers working with complex and uncertain problems by assembling disparate information in a consistent and coherent framework and incorporating the uncertainties inherent in natural systems and decision making. A key feature of the successful adoption of Bayesian networks as a modelling tool in decision-making is their relative simplicity when compared with other modelling approaches. They are graphical models, capturing cause and effect relationships through influence diagrams. The use of probabilities to characterise the strengths of linkages between variables means that these can be defined using both quantitative and qualitative information. Being probabilistic, Bayesian networks can readily incorporate uncertain information, with these uncertainties being reflected in model outputs. Sensitivity analysis tools allow characterisation of uncertainties so that key causal factors and knowledge gaps can be identified. Model outcomes are testable, both quantitatively and through formal review processes.

Genetic algorithms have been described as intelligent heuristic search methods that demonstrate self-organisation and adaptation on the sole basis of exposure to the environment, similar to biological organisms. Attaining such a goal would provide special capabilities in pattern recognition, categorisation, and association; that is, the system would be able to learn to adapt to changes (Turban and Aronson, 1998)[33]. An example is a real-time predictive model for forecasting dinoflagellate blooms in South African reservoirs by means of hybrid evolutionary algorithms (Van Ginkel *et al*., 2007[35], Cao *et al*., 2006[36]).

Page (1990)[37] reviewed the application of expert system technology to environmental problems and found that there was a clear emphasis on diagnostic or interpretive systems in problem areas such as environmental impact assessment, species identification, management of hazardous waste, and failure diagnosis of wastewater treatment plants. Little work has been done in environmental planning application and predictive expert systems, although, he found a number of integrated systems which were aimed at providing user-guidance in large scale model-based decision support systems, generally in the form of rule-based knowledge representation.

7.4 Integrating climate modelling into the hydrological analysis

Global climate change will affect the management options we choose today. Climate models are mathematically driven dynamic tools used to simulate atmospheric conditions, either globally (GCM) or over a focused region (RCM), for the purpose of examining the change from the current climate while being influenced by anthropogenic climate change factors. This is done by using the current atmospheric, land use and ocean conditions as the initialisation points of the models. The simulation will follow one of four climate change scenarios based on global economic and industrial development. These are the Relative Concentration Pathways (RCPs) and represent the range of scenarios from industry focused on increased fossil fuel usage and indifferent world governments to the uptake of green sustainable technologies and very proactive governments.

[34] Pollino, CA and Henderson, C (2010). **Bayesian networks: A guide to their application in natural resource management and policy**. Technical Report No.14, Landscape Logic.

[35] Van Ginkel, C, Cao, H, Recknagel, F and Du Plessis, S. 2007. **Forecasting of dinoflagellate blooms in warm-monomictic hypertrophic reservoirs in South Africa by means of rule-based agents**. Water SA, 33(4): 531-538.

[36] Cao, H, Recknagel, F, Welk, A, Kim, B and Takamura, N. 2006. **Hybrid Evolutionary Algorithm for Rule Set Discovery in Time-Series Data to Forecast and Explain Algal Population Dynamics in Two Lakes Different in Morphometry and Eutrophication**. In: Recknagel, F (ed.), 2006. Ecological Informatics. 2nd Edition. Springer-Verlag Berlin, Heidelberg, New York, 347-367

[37] Page, B. 1990. **An analysis of environmental expert system applications**. Environmental Software, 5:177-198.

Climate models iterate the atmosphere over progressing states in time as forced by the RCP and are therefore able to present climatic conditions years in the future. Among the output of the models are variables of seasonality, temperatures, rainfall, soil moisture, evapotranspiration. Further analysis such as heatwave character, drought likelihood, rainfall intensity and distribution can be done on these outputs. Climate models simulate the atmosphere at varying spatial resolutions from 5 degree to 0.1 degree squares according to latitude and longitude, relative to the objectives of the project. Increasing the spatial resolution however significantly increases the computing time required to create the climate scenarios and as such the standard practice is to present climate data at a scale of 2.5 degree squares. Further resolution can be gleaned in the post-simulation of the GCM through downscaling the output to give regional climate character. This method uses detailed topography, land use and local meteorological readings as additional simulation parameters to provide more localised context to the climate scenarios. The downscaled data provides the base rainfall information for the hydrological modelling and allows for more on-the-ground climate interventions to be put in place.

Further information on GCMs, model downscaling, Malawian climate and weather capacity and the implementation of downscaling methodologies into hydrological modelling can be found in the following publications:

- World Bank : Shire Integrated Flood Risk Management Project; and
- World Bank : Support to the Department of Climate Change and Meteorological Services Malawi.

7.5 Risk Ranking

Risk ranking is a more formal two-step approach to risk assessment. This normally requires additional support from experts or local authorities with knowledge and experience in risk management. This method involves the quantification of the consequence or severity of the impact. It considers the likelihood of its actual occurrence to determine significance and importance in relation to other impacts. Refer to Table 7-3.

Definitions for consequence and likelihood must be drawn up prior to undertaking the assessment to ensure the objective evaluation of risks and impacts. As with Descriptive Assessment, consideration must be given to the effectiveness of any existing control measures.

Each issue is then compared with the whole list to ensure their relative likelihood and consequence are appropriately categorised, refer to Table 7-4. Issues are then mapped in a matrix to identify if they are of low medium or high significance, refer to Table 7-5. Levels of significance are defined prior to the exercise in order to ensure consistency in the rating of each impact.

Table 7-3: Likelihood and severity definitions

Descriptor	Description
Likelihood	
Likely	Will probably occur in most circumstances; has been observed regularly (e.g. daily to weekly).
Possible	Might occur at some time; has been observed occasionally (e.g. monthly to quarterly or seasonally).
Unlikely	Could occur at some time but has not been observed; may occur only in exceptional circumstances.
Severity / Consequence	
Major impact	Major health or environmental impact; illness in community associated with the environmental degradation; large number of complaints; significant level of community concern; significant breach of regulatory requirement.
Moderate Impact	Minor health or environmental impact (e.g. not health related, aesthetic impact) for a large percentage of the community; clear rise in complaints; community annoyance; minor breach of regulatory requirement.
No/minor Impact	Minor or negligible health or environmental impact (e.g. not health related, aesthetic impact) for a small percentage of the community; some manageable disruptions to operation; rise in complaints not significant.

Table 7-4: Likelihood-severity/ consequence risk matrix

		Severity / Consequence		
		No/minor impact	**Moderate impact**	**Major impact**
Likelihood	**Likely**	Medium	High	High
	Possible	Low	Medium	High
	Unlikely	Low	Low	Medium

Table 7-5: Risk ranking definitions to prioritise actions

Risk ranking	Meaning	Description
High	Clearly a priority: requires urgent attention	Actions need to be taken to minimize the risk. Possible options should be documented (as part of an improvement plan) and implemented based on community priorities and available resources.
Medium	Medium- or long-term priority: requires attention	Actions may need to be taken to minimize the risk. Possible options should be documented (as part of an improvement plan) and implemented based on community priorities and available resources. Or where the likelihood of a hazard occurring is low because effective control measures are in place but the consequences are major (e.g. microbial risks), special attention should be given to maintaining the control measures and their appropriate operational monitoring to ensure that the likelihood remains low.
Low	Clearly not a priority	Actions may need to be taken but not a priority, or no action is needed at this time. The risk should be revisited in the future as part of a review process. Or control measures are effective, and attention should be given to ensure that the risk remains low.

Through the process of risk ranking, appropriate mitigation measures can be identified in order to mitigate the risks.

8 Role of a Catchment Management Committee

8.1 Catchment Management Committees (CMCs)

The National Water Resources Authority (NWRA) will be established and take over the functions of water resource management from the National Department of Water. The NWRA will have local representation in three Catchment Management Boards, proposed to be the Shire, Linthipe and Rukuru Catchment Management Boards for the southern, central and northern catchments of Malawi respectively.

The National Water Resources Act (2013) ("the Act") makes provision for the establishment of Catchment Management Committees (CMCs) for individual or groups of catchments on a local scale to involve all stakeholders and to assist the NWRA in local water resource management. The powers, functions and operations of CMCs are described in the Act and are interpreted as follows.

8.2 Function and purpose of CMCs

The functions and purpose of the CMCs are described in the Act. According to section 29, the CMC shall, in relation to the catchment(s) for which it is appointed, advise officers of the NWRA at the appropriate regional office concerning:

- water resources conservation, use and allocation;
- the grant, adjustment, cancellation or variation of any licence and permit under this Act; and
- any other matters pertinent to the proper management of water resources.

Based on the relevant Catchment Management Strategy (CMS), a CMC may also undertake, on its own initiative and with funding received in accordance with section 31 of the Act, water resources conservation activities and works.

The CMCs have the important function of sensitising water users on protection and management of catchments, watercourses and water bodies. The Act states that CMCs shall…. "*be under a duty to promote and sensitise all users of watercourses and water bodies within the applicable water management area on the protection and management of the watercourses and water bodies and the conservation and equitable, efficient and sustainable utilisation of such watercourses and water bodies in conformity with national legislation and with regional and international water and environmental conventions*".

The NWRA shall provide the CMCs with technical assistance in carrying out this function. Volume I of these Guidelines will also serve to guide the CMCs and capacitate them.

Although the CMCs are new, these powers and functions were exercised in the past by the Water Resources Department divisions led by the Water Resources Board (WRB) secretariat. The decentralisation of functions to the regional Catchment Management Boards and CMCs will contribute to improved stakeholder participation in catchment and water resources management at the local level.

8.3 Establishment of CMCs

A CMC may be established for:

- a specific catchment area, after public consultation, on the proposal of the community and stakeholders concerned;
- the Authority may establish a catchment management committee on its own initiative.

It is clear from this that, especially in the early stages, when communities and stakeholders require to be sufficiently empowered in many cases, the NWRA can take the initiative in establishing CMCs. The NWRA (on receipt of a proposal or on its own initiative) may:

- give the CMC a name and determine its area, which means that a single or group of catchments can become the jurisdiction area of a CMC; or
- change or amend the name or area of an existing catchment management committee.

The NWRA can thus go ahead and form CMCs as required and there is flexibility for the areas and names of these CMCs to be modified at any time in the future. The advantage of this is that CMCs can be put in place rapidly even if they are later re-organised according to emerging needs and priorities.

The composition of a CMC is provided in the Act as set out in Table 8-1 below:

Table 8-1: Composition of a CMC

Composition of a CMC in terms of section 28 of the Act
Representatives of ministries, departments or other public bodies responsible for matters relating to water resources in the catchment area e.g. Agriculture, Forestry, Land Resources, Environment, Energy, etc.
Representatives of any regional development authorities and local authorities whose areas of jurisdiction or any part thereof fall within the catchment area concerned
Representatives of farmers within the catchment area concerned
Representatives of the business community operating within the catchment area concerned
Representatives of the non-governmental organizations engaged in water resources management programmes within the catchment area concerned
Other persons who have demonstrated competence in matters relating to the management of water resources

The proposal for the establishment of a CMC should contain the name of the CMC, a description of the water resources concerned, proposed functions and funding sources and the feasibility of the proposed CMC in terms of locally available technical, financial and administrative capacity.

8.4 Funding of CMCs

The funding of CMCs will come from two sources as indicated in the Act as follows:

- from the Authority, on request, a percentage from the proceeds of the collection of water charges; and
- from any other lawful source, including the Water Resources Trust Fund established under the Act.

A minimum of 20% of the NWRA's revenue from the collection of water charges and fees shall be earmarked for "*use by the catchment management committees for their statutory purpose*". The exact percentage will be determined by the Minister on an annual basis. It is important to note that how these funds may be distributed to the CMCs is not stipulated. However, in view of the fact that CMCs will receive these monies on request (and therefore according to need), it is assumed that the distribution will be proportional to the level of approved activity in each CMC. It is therefore very important that stakeholders actively support their local CMC to plan and implement projects for improved water resource management.

CMCs that receive and manage funds must submit an annual audited statement of their accounts to the Authority or to the provider of other funding, where applicable.

8.5 Relationship to NWRA and implications

One of the established CMCs is to be represented on the NWRA Board. There should be a close relationship between the CMCs and the NWRA to actively promote local water resources management.

The CMC must (in relation to the catchment for which it is appointed) advise officers of the NWRA at the appropriate regional office regarding the following:

- water resources conservation, use and allocation;
- the grant, adjustment, cancellation or variation of any licence and permit under this Act; and
- any other matters pertinent to the proper management of water resources.

The NWRA must provide the CMCs with technical assistance in carrying out this function. The CMCs will serve as catchment technical committees that previously reviewed and made recommendations to the National Water Resources Authority Board on the following matters:

- draft principles for water resources conservation, use and allocation.
- feasibility studies for granting water rights, consents to discharge waste and various permits.
- recommendations of revolving any other matters pertinent to proper management of water resources.

The CMCs are not technical bodies and so will have to make use of either the NWRA regional and hydrometric district offices or outside technical expertise (such as consultants, etc.) to assist them in these tasks. This is similar to the existing practice of the WRB referring certain tasks such as authorisation of feasibility studies for granting water rights, drafting principles of water allocation or any other matter required, to the attention of the WRB's Technical Committees. These Committees deliberate such recommendations and present further recommendations to the WRB. It indicates that the Committees have been decentralised and broadened to allow participation in the decision-making and management process by a wider range of stakeholders.

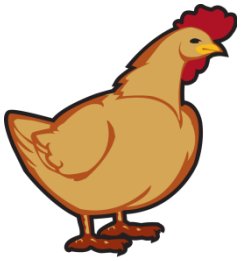
The CMCs will also have to coordinate functions with local Associations for Water Users (AWUs), and district committees involved in environmental management to ensure synergy and integration of efforts. The success of a CMC will depend largely on the active involvement of stakeholders in the area and the functions they perform for the improved management of water resources.

9 Alternative sources of income to support improved catchment management and protection

9.1 Introduction

A lack of income generating opportunities, energy supply, and food security, along with rapid population growth, have been identified as key drivers behind deforestation and catchment degradation in all catchments in Malawi, and in particular in areas with high population densities such as the southern region. It is therefore critical that alternative and sustainable livelihood opportunities be developed as part of a holistic approach to the protection of critical ecosystems and to protect catchment areas, while at the same time supporting social and economic development and improved livelihoods for all communities.

The old adage that says “your chicken is not safe if your neighbour is hungry” applies to the communities facing food insecurity. This section considers the existing knowledge and practice for the development of sustainable livelihoods as being critical in the protection of common resources, and presents a few ideas for alternative income generating opportunities that could be considered. Alternative approaches to addressing the issues of limited energy supply options, food insecurity and low agricultural productivity and technical guidelines to implement these are included in Volume II: Chapter 6.



9.2 Existing knowledge and practice

Malawi faces a nexus of development challenges in many areas. The high population growth rate in rural areas (85%), low agricultural productivity due to small acreage (0.8ha/household) and poor farming technology, food insecurity, limited employment opportunities (<10% on salary income), low electricity connection (9%) and other factors have worsened the poverty levels. The national poverty rate is at 50.7% (Poverty headcount ratio at national poverty line (% of population)), with the southern region at 63%. This extreme situation has placed enormous pressure on natural resources - especially forestry, land and water as these become over-utilised to support the livelihoods of communities.

Experience from a number of programmes, for example Emanuel International’s project in the Lingoni Watershed Mitwara Village, on natural resources management have provided the inspiration that natural resources from a catchment area can provide sustainable livelihoods to its communities. There are a number of ways to enhance sustainable, secure, and equitable access to natural resources for rural communities and to address issues of deforestation and land degradation that are caused by human activities.

Natural resources are regarded by community members as “Pools of Common Resources”. In Malawi “Pools of Common Resources” include rivers, open woodland or grassland for livestock grazing, wood supply for building materials and burial services, medicines, crop residues after harvest, game, fish in rivers, aquifers, irrigation channels, livestock water supply points etc. The use of these resources offers various opportunities for the generation of alternative incomes provided they are managed in a sustainable way and where possible alternative opportunities for livelihood support are developed.

Realising the benefits of the protection of critical ecosystems and improved catchment management for communities in terms of sustainable livelihoods is therefore critical to addressing the issues of catchment degradation. The challenge with common resources, such as open woodlands, rangeland, fisheries and water resources, is that they can become exploited by individuals to the detriment of the wider community and social and ecological systems. This is particularly true when there is a lack of sustainable alternative livelihoods (food, energy, water, housing material, etc.) and there is a lack of ownership or control of the available natural resources. This is referred to as the ‘tragedy of the commons’ and is a major driver in the decline of natural ecosystems services across the globe. Recognising the importance of providing alternative sustainable livelihoods and community control of natural resources is therefore critical to improved catchment management and rural development.

9.3 Policy reform and current practice

Although the government has put in place new policy frameworks for managing natural resources which are reinforced by a number of programmes including the Shire River Basin - these are challenged by counterproductive human activities such as theft, illegal tree cutting in the reserves, uncontrolled charcoal burning, overexploitation and bush fires. These human activities are largely driven by poverty and are unchecked due to a lack of enforcement. All these aspects, underpinned by a strong leadership, will need to be addressed in order to support improved catchment management.

9.4 Alternative rural livelihoods

In recognition of the importance of sustainable livelihoods as a critical requirement for reducing the impact of catchment degradation, improving the well-being of the communities living in and around catchment areas in Malawi is a critical requirement for improved catchment management and resource protection. A number of interventions have been developed with a view to increasing the options for generating income and improving food security.

These interventions focus primarily on promoting alternative rural livelihoods in the form of a rural enterprise development programme and include natural resources-based income generating activities and tree planting for conservation purposes and as an income generating opportunity. The intended outcome of this programme would be increased sources of income that would improve the well-being of the communities within the catchment, as well as enhancing and recognising the value to communities of the protection of critical natural resources.

9.4.1 Rationale of rural enterprise development

Rural enterprise development has long been recognised as critical in tackling poverty and reducing the potential impact on natural resources. It is premised on diversification and innovation of the rural economy by increasing its market orientation and fostering value addition to rural products. The transformation of agricultural and natural resources products will lead to additional non-farm employment, increased incomes and ultimately a reduced pressure on natural resources.

Many studies have confirmed the important role that rural enterprises development (RED), particularly medium size enterprises (MSEs), plays in poverty reduction. For instance, it is asserted that Gemini Report, 2000)[38]:

- MSEs contribute income to about 25% of the Malawian households;
- MSEs employ about 38% of the total Malawian labour force;
- Off-farm enterprises employ about 22% of the total labour force;
- In the whole sector, women account for 42% of the total employment;
- The MSEs contribute about 15.6% to the GDP; and
- Over 80% of MSEs are located in the rural areas.

RED promotes an alternative growth paradigm for communities within Malawi and is therefore critical in reducing the risks of continued deforestation and catchment degradation.

9.5 Likely Enterprises to be promoted

9.5.1 Agro-forestry enterprises

A number of on–farm tree enterprises are one of the means of crop diversification. These can be key coping mechanisms for those members in the community that are vulnerable to shocks and food insecurity. The following trees have proved to be more profitable if planted for business purposes in Malawi: *Jatropha curcas*, *Moringa oleifera*, *Acacia polycantha* and *Azadirachta indica*. These leaves,

[38] The Malawi National Gemini MSE Baseline Survey (2000). The survey was conducted by a multi-disciplinary team from Ebony Consulting International, the National Statistical Office (NSO), Kadale Consultants, and Wadonda Consult and was funded by the British Department for International Development (DFID).

flowers, branch cuttings and fruits have many uses. Other interventions include planting of trees for commercial purposes and agriculture. This initiative would be promoted in collaboration with afforestation interventions within the catchment management approach.

9.5.2 Forest based enterprises

The most common forest based enterprises are shown in Figure 9-1.

The community will be trained in the philosophy of co-management of the natural resources with an emphasis on partnership between the community and government through the planning, implementation and monitoring process of the natural resources. In this case, the government strengthens the capacity of community institutions in planning as well as co-managing state forests in partnership with the Department of Forestry.

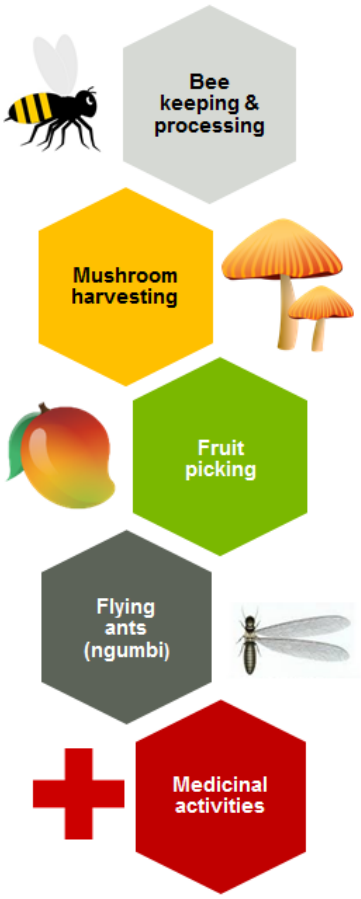


Figure 9-1: Forest based enterprises

9.5.3 Off-farm enterprises

There are a number of off-farm enterprises such as:

- Chitetezo mbaulas: *fuel efficient stoves, which reduce the amount of firewood needed*.
- Fireless cookers or 'Wonderbags': *insulated cooking containers made from local materials*.
- Woven baskets: *baskets for protecting seedling trees from goats and livestock (Figure 9-2);* and
- Poultry farming: *for eggs, meat or manure*.
- Fruit products: *produced from collected fruits e.g. jams, juice, palp.*

Figure 9-2: Example of a woven basket to protect a tree (source: S. Braid)

9.5.4 Value chain

Marketing of local products has always been problematic in Malawi. However, organisations like the Farmers' Union of Malawi (FUM) and the National Association of Smallholder Farmers in Malawi (NASFAM) have stepped in to promote such products through proper branding, packaging and advertising. The two organisations also provide support in market research.

Elements across the entire value chain such as input support, irrigation, processing / storage facilities, credit facilities, market information, infrastructure, extension services, business / management training, etc. should be identified and supported. Cost estimates will need to be made where relevant. Tasks include:

- Compile information regarding market opportunities for targeted smallholder farmers including contact information of potential buyers, quality standards and price information.
- Develop and implement training programmes to enable marketing groups to improve business management practices.
- Provide technical support to implementing partners to enhance systems for collective marketing of commodities and purchasing of inputs among marketing groups.
- Build capacity of farmer marketing groups to link effectively to private sector service providers.
- Facilitate interventions to improve productivity of targeted commodities.

Other considerations include financial incentives and/or economic policies at a National level in order to promote the production of value-add products in Malawi, e.g. jams and fruit juice, such that they can compete realistically with imported products. Likewise these could be applied to the supply of raw materials from Malawi to processing plants e.g. fruit to juicers or jam manufacturers.

Activities such as recycling and re-use should also be considered and supported through economic tools. Paper, cardboard, plastics, tin, glass, can all be collected for re-use for further packaging. Collection points could pay incentives per weight or number of items collected. The process of collecting these materials will help to clean up the Malawi countryside and place more value on solid waste management. Industries such as Coco cola, Carlsberg, Nampak, etc. collect and recycle these materials as part of reducing their operating footprints.

9.5.4.1 Market linkages

The marketing aspect of the programme is a critical area. There is tendency for people to produce what the available resources can easily produce, and not what the market demands. Market surveys should therefore be conducted before support is provided to an entrepreneur.