Malawi Government
Ministry of Natural Resources, Energy and Environment

Malawi State of Environment and Outlook Report

Environment for Sustainable Economic Growth

2010




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Foreword

Malawi's economic development and the livelihoods of its population are largely dependent on natural resources. In order for the country to experience sustainable economic growth and alleviate poverty, Malawi must conserve its valuable environmental resources. Hence, the Malawi Government has taken various measures to safeguard the country's natural resource base. These include, inter alia, the enactment of the Environmental Management Act of 1996; the Forestry Policy of 1996; the Land Policy of 2002; the Water and Sanitation Policy of 2005; and the Biodiversity Strategy and Action Plan of 2008.

Despite these efforts, the degradation of natural resources continues to be a major threat to the social and economic development of Malawi. Malawi's high population density and the dependence of Malawians on agricultural production in the absence of other economic opportunities have led to alarming rates of environmental degradation. The result has been deforestation; decreasing soil fertility and increasing erosion; water depletion, loss of biodiversity; and increasing pollution. These poor environmental conditions are exacerbated by poverty: in order to subsist, a high proportion of the population relies on the exploitation of natural resources such as firewood and fish stocks.

The State of the Environment and Outlook Report 2010 aims to address these challenges in three ways. First, the report provides a knowledge resource for researchers and the general public. Secondly, it serves as a baseline for monitoring trends in environmental change in Malawi. Finally, and most importantly, the report is intended to inform policy-makers about the challenges facing Malawi; outline possible future scenarios for the environment and development; and provide policy recommendations to support the country's sustainable growth.

The 2010 Report is the culmination of an existing process of environmental reporting in the country. Since the passing of the Environment Management Act in 1996, districts have produced State of the Environment reports biannually. These reports have allowed the government to effectively target resource allocation through the development of relevant environmental action plans and environmental micro-projects. It is hoped that the State of the Environment and Outlook Report will increase awareness of environment and natural resources, and encourage effective resource allocation for sustainable development at the local and national levels. It will also enhance Malawi's participation in various inter-regional and international programmes and fora.

I would like to extend my thanks and appreciation to the United Nations Development Programme and United Nations Environmental Programme for supporting the report's development through the Poverty and Environment Initiative. My thanks also go to Leadership for the Environment and Development - Southern and Eastern Africa (LEAD SEA) and CEDRESSA for compiling the report. In addition, I would like to thank all those who made contributions to the report in various ways.

Grain W. Malunga, M.P.
Minister of Natural Resources, Energy, and Environment

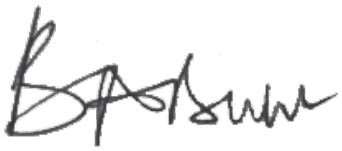
Preface

Malawi's continued economic and human development depends highly on the state of the country's environmental resources. In order for Malawians to make informed decisions about their development path, it is necessary to be able to continually assess the health of the natural resources that sustain the country. State of the Environment and Outlook Reports (SEOR) provide a key mechanism for so doing. The purpose of the SEOR is to inform and influence policy and planning processes – such as the implementation of the Malawi Growth and Development Strategy and the Millennium Development Goals– regarding issues of sustainable natural resources management.

The report uses a thematic approach, evaluating a broad range of factors that influence environmental change in Malawi. Themes such as land and agriculture, forestry and woodlands, biodiversity and water resources were assessed using the scientifically valid and well-regarded Integrated Environmental Assessment (IEA) approach. It is crucial for Malawi's policymakers to be able to anticipate how economic and population pressures will affect future development, and as such the 2010 State of the Environment and Outlook report also contains an "Outlook" component, which explores future options for the country's natural resources using scenarios. These scenarios are based on existing scientific knowledge, but adopt different assumptions about how critical uncertainties will unfold, in order to show the range of environmental situations that Malawi may face. The Outlook also assesses existing policy instruments and policy gaps in environmental management, in order to identify appropriate actions policymakers can take to support sustainable development.

The 2010 State of the Environment and Outlook was developed through a participatory and consultative approach. Stakeholders from the government, nongovernmental organizations, civil society, and research institutions were consulted throughout the process, and contributed to the selection of themes, development of scenarios and policy analysis, drafting process, and final analysis. As such, the 2010 SEOR is owned by a range of key stakeholders who have the ability to transform Malawi's environmental management and direct the country towards a sustainable future.

I am deeply grateful for the support of the UNDP and UNEP, which made the development of the 2010 SEOR possible while contributing to the expansion of our national capacity in environmental reporting.



Ben Botolo
Principal Secretary of Natural Resources,
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Integrated Environmental Assessment in Malawi

Background

Malawi is endowed with a diversified natural resource base, including some of the most fertile soils for agricultural use in Southern Africa, closed forest resources covering about 30 percent of the land, abundant water resources and remarkably diverse flora and fauna, of which the uniquely rich fish resources stand out. It has a tropical climate characterized by variable temperature, rainfall and relative humidity. If properly utilized, Malawi's natural resources can provide the basis for sustainable socio-economic development. However, they are subject to increasing pressure as a result of high population growth, poverty, and a lack of environmental awareness. The result is increased degradation of the environment, with significant loss of soil fertility, soil erosion, serious deforestation, water depletion, pollution and loss of biodiversity. The fragile state of Malawi's environment poses critical challenges to both human development and economic growth.

Informed decision making is essential to meet these challenges; as such, the state of the environment and natural resources must be periodically reviewed and assessed. A key mechanism for doing so is preparation of the environment outlook reports (previously state of environment reports). The purpose of the Environment Outlook Report (EOR), which many countries now prepare on a periodic basis, is to inform and influence key policy and planning debates – in our case, notably the Malawi Growth and Development Strategy (MGDS) – about environmental issues and sustainable natural resources management. It is vital that such issues are fully considered in policy and planning processes, including the allocation of appropriate funding to support the Government in delivering sustainable economic growth and poverty reduction.

State of the Environment Reporting in Malawi

In response to the suggestions presented in the National Environment Action Plan (1994) and the Environment Management Act (1996), Malawi has prepared State of Environment Reports every two to three years. The first National State of the Environment Report (NSEOR) was published in 1998; the second, published in 2002, was used to update the NEAP. It also informed the preparation of the first district environment reports (DSOERs) in 2002 in all 28 districts. In each district, the development of the DSOER was coordinated by the District Environmental Officer, and supported by the District Environment Subcommittee (DESC), which comprise representatives from sectoral ministries and departments, and NGOs. The DSOERs were developed with the DANIDA Environment Support Programme and the UNDP Capacity 21 Community Environmental Management and Environment Support programmes.

The NSOERs and DSOERs followed a sectoral approach using the scientifically valid Driver Pressure State Impact Response (DPSIR) Framework. This framework focuses on the state of the environment and trends in environmental changes, including forestry, fisheries, water, biodiversity, and land resources; population growth and human settlements; the energy, mining and industrial sectors; the impact of climate change; and the policy and institutional framework for environmental management. The reports were prepared by sectoral ministries and departments and coordinated by Environmental Affairs Department (EAD). The process culminated in the production of a policy brief delivered in the national assembly.

The NSOERs and DSOERs encouraged debate on environmental issues that directly affect people at both national and local levels. However, they were not been used as extensively as they might in major development decisions. The reporting processes were linked only weakly to major national development programmes, such as the Malawi Poverty Reduction Strategy (MPRS). Furthermore, the reports were not adequately disseminated to the general public; this did little to encourage public accountability and citizen action.

An Integrated, Future-oriented Approach: Environment Outlook Reporting

The State of Environment and Outlook Report was commenced in 2009 with support from the joint UNDPUNEP Poverty and Environment Initiative. The process was led by the Environmental Affairs Department (EAD) in the Ministry of Natural Resources, Energy and Environment, in collaboration with the Ministry of Development Planning and Cooperation.

The 2010 SEOR aims to integrate with the Malawi development framework from the beginning, and thus its main focus is on the Malawi Growth and Development Strategy (MDGS) and its key thematic areas. These are agriculture and food security, irrigation and water development, transport infrastructure, energy generation and supply, integrated rural

development, and prevention and management of nutritional disorders, HIV and AIDS, climate change, environment and natural resources, and Nsanje World Inland port. The SEOR also addresses the key thematic areas of Malawi's Environmental and Natural Resources Management (ENRM) Action Plan, the Millenium Development Goals, and other major development targets.

The 2010 SEOR provides a detailed account of environmental trends and dynamics using an Integrated Environmental Assessment (IEA) approach based on the DPSIR framework. This allows for continuity with previous reports, and facilitates the assessment of environmental change. It also provides policy analysis and offers analytical frameworks for decision-making (UNEP, 2007).

Preliminary, Expert and Peer Reviews

The 2010 SEOR was written by a panel of national experts organized into teams of Lead and Thematic Authors. Draft chapters were subjected to a preliminary review by a joint Task Team of the EAD, MDPC/MPEI and the thematic authors prior to a comprehensive review by sector experts. These experts were drawn from Government ministries and departments, the private sector, NGOs, academia, and the media to ensure that all information presented in the 2010 SEOR is factually correct and accurately reflects sector issues. This also promotes ownership of the report by a wide variety of national stakeholders. In order to ensure scientific and technical credibility of the report, the thematic reports were then peer reviewed by independent reviewers identified on the basis of their expertise. The peer-reviewers ensured that the report is technically accurate, competently analyzed, and properly referenced. Once the chapters were consolidated into a final draft, a national consultative workshop was conducted to secure the views of stakeholders and their consensus on the issues and actions proposed in the report. Participants included representatives from Government, Non-Governmental Organizations (NGOs), the media, and private sector organizations.

Development of Scenarios and Policy Analysis

It is crucial to anticipate how Malawi's high population pressure, environmental degradation, and economic growth will affect future development. As such, the 2010 SEOR needed an 'outlook' component, to assist in developing anticipatory policy instruments. The Scenarios and Policy Analysis chapters fulfill this function. The Scenario chapter outlines scientifically-based assumptions about how environmental trends will unfold, taking into account the potential effects of critical uncertainties such as economic growth. The scenarios developed in this process are intended to demonstrate linkages between issues, in order to provide policy-making support and stimulate engagement in policy formulation and implementation. The Policy chapter assesses available policy instruments and their relevance to ensuring good environmental management, outlines existing policy gaps, and identifies appropriate actions to address the issues raised by the preceding chapters.

Launch and Public Awareness

To raise public awareness of the report, the finalized EOR will be launched publicly, with an accompanying video and atlas of environmental change. It will also be summarized in policy briefs for presentation to the National Assembly.

Conclusions

The 2010 SEOR process and the reports preceding it, have been characterized by their reliance on external funding. A sustainable mechanism must be found for financing these processes, as current funding levels are too low to adequately support data collection and compilation expenses. When Malawian authorities and stakeholders acknowledge that environmental assets and hazards are direct determinants of developmental success – to which purpose we hope this paper is one small contribution – then it should follow that adequate investment in the EOR process, and in information systems needed to support that process, will be forthcoming.

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Dr. Yanira Ntupanyama
Director of Environmental Affairs

List of Acronyms and Abbreviations

a.s.l.	above sea level
ABS	Access and Benefit Sharing
AETS	Alternative Energy Technologies
AFOLU	Agriculture Forestry and Other Land Use
AGLP	Adolescent Girls Literacy Project
AMCEN	African Ministerial Conference on theEnvironment
ASWAp	Agriculture Sector Wide Approach
BARREM	Barrier Removal to Renewable Energy in Malawi
BERL	Bio Energy Research Limited
BEST	Biomass Energy Strategy
BFC	Bromofluorocarbons
BWB	Blantyre Water Board
CAADP	Comprehensive African Agriculture Development Programme
CARLA	Climate Adaptation for Rural Livelihoods and Agriculture
CBD	Convention on Biological Diversity
CBE	Complementary Basic Education
CBFM	Community-Based Forest Management
CBNRM	Community Based Natural Resources Management
CBRLDP	Community Based Rural Land Development Programme
CBR	Crude Birth Rate
CCODE	Centre for Community Organization and Development
CDM	Clean Development Mechanism
CDSS	Community Day Secondary School
CEPA	Communication Education and Public Awareness
CFC	Chlorofluorocarbons
CMA	Catchment Management Authority
CO	Carbon monoxide
COF	Certificate of Fitness
CRWB	Central Region Water Board
CSS	Conventional Secondary School
CURE	Coordination Union for Rehabilitation of the Environment
DANIDA	Danish International Development Agency
DCCMS	Department of Climate Change and Meteorological Services
DDP	District Development Plan
DEAP	District Environmental Action Plan
DFID	Department for Foreign and International Development
DHS	Demographic and Health Survey
DLRC	Department of Land Resources Conservation
DMC	Drought Monitoring Centre
DNPW	Department of National Parks and Wildlife
DoEA	Department of Energy Affairs
DPSIR	Drivers-Pressure-State-Impact-Response
DRA	Demand responsive approach
EAD	Environmental Affairs Department

EC	European Commission
EDOs	Environmental District Officers
EFA	Education For All
EIA	Environmental Impact Assessment
EIA	Environmental Impact Assessment
EMA	Environment Management Act
EMAS	Education Methods Advisory Services
EMP	Environmental Management Plan
ENRM	Environment and Natural Resources Management
ENSO	El Nino Southern Oscillation
EP &D	Economic Planning and Development
EPL	Exclusive Prospecting Licences
ESCOM	Electricity Supply Corporation of Malawi
EU	European Union
FAO	Food and Agriculture Organisation
FAOSTAT	Food and Agriculture Organization Statistics
FD	Forestry Department
FEWS	Famine and Early Warning System
FGLG	Forest Governance Learning Group
FPE	Free Primary Education
FRIM	Forestry Research Institute of Malawi
FY	Fiscal Year
GBI	Green Belt Initiative
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse gas
GIWA	Global International Waters Assessment
GMO	Genetically Modified Organism
GN	Government Notice
GNI	Gross National Income
GNP	Gross National Product
GoM	Government of Malawi
GPD	Gross Domestic Product
GTZ	Gesellschaft fuer Technische Zusammenarbeit (German Technical Cooperation)
GWP	Global Warming Potential
Ha.	Hectare
HEP	Hydro Electric Power
HIV/AIDS	Human Immuno-Deficiency Virus/ Acquired Immuno-Deficiency Syndrome
HTH	High Test Hypochlorite
IAS	Invasive alien species
ICT	Information Communication Technology
IEAR	Integrated Environmental Assessment and Reporting
IGPWP	Income Generation Public Works Programme
HIS	Integrated Household Survey
IK	Indigenous Knowledge
INC	Initial National Communication
IOL	IslamOnline.net

IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
IPPU	Industrial Products and other Products Use
IRC	International Water and Sanitation Centre
ITCZ	Inter-tropical Convergence Zone
ITMUA	Implementing the Third Mission of Universities
ITN	Insecticide Treated Net
IWRM	Integrated Water Resources Management
JCE	Junior Certificate of Examinations
JICA	Japanese International Corporation Agency
Kg	Kilograms
Km	Kilometre
LDCs	Least Developed Countries
LEAD-SEA	Leadership for Environment and Development Southern and Eastern Africa
LMAFDP	Lake Malawi Artisanal Development Project
LPG	Liquified Petroleum Gas
LRMC	Long Run Marginal Cost
LWB	Lilongwe Water Board
M&E	Monitoring and Evaluation
MACRA	Malawi Communications Regulatory Authority
MAREP	Malawi Rural Electrification Project
MASAF	Malawi Social Action Fund
MASTEP	Malawi Special Distance Teacher Education Programme
MBC	Malawi Broadcasting Corporation
MBS	Malawi Bureau of Standards
MCC	Millennium Challenge Corporation
MCDE	Malawi College of Distance Education
MCL	Mining Claim Licences
MDGs	Millennium Development Goals
MDHS	Malawi Demographic and Health Survey
MDPC	Ministry of Development Corporation
MEAs	Multilateral Environmental Agreements
MEGS	Malawi Economic Growth Strategy
MEJN	Malawi Economic Justice Network
MERA	Malawi Energy Regulatory Authority
MES	Master of Environmental Sciences
MGDS	Malawi Growth and Development Strategy
MHC	Malawi Housing Corporation
MHP	Ministry of Health and Population
MIITEP	Malawi Integrated In-service Teacher Education Programme
MIWD	Ministry of Irrigation and Water Development
MK	Malawi Kwacha
ML	Mining Licences
MLC	Mining Licensing Committee
MLGRD	Ministry of Local Government and Rural Development
MMCT	Mulanje Mountain Conservation Trust

MMFR	Mulanje Mountain Forest Reserve
MoAFS	Ministry of Agriculture and Food Security
MOREA	Ministry of Research and Environmental Affairs
MOU	Memorandum of Understanding
MPRS	Malawi Poverty Reduction Strategy
MRA	Malawi Revenue Authority
MS	Malawi Standard
MSCE	Malawi School Certificate of Examinations
MSF	Medecins sans Frontieres
MSS	Multi-spectoral Scanner
Mt	Metric tones
MuREA	Mulanje Renewable Energy Agency
MW	Megawatt
MWERA	Malawi Water and Energy Regulatory Authority
NALP	National Adult Literacy Programme
NAPA	National Adaptation Programmes of Action
NAPF	National Agricultural Policy Framework
NAREC	Natural Resources and Environment Centre
NBSAP	National Biodiversity Strategy and Action Plan
NCE	National Council for the Environment
NEAP	National Environmental Action Plan
NEEP	National Economic Empowerment Policy
NEP	National Environmental Policy
NEPAD	New Partnership for Africa Development
NEPL	Non-Exclusive Prospecting Licence
NESP	National Education Sector Plan
NGOs	Non-Governmental Organizations
NHBGM	National Herbarium and Botanic Gardens of Malawi
NHP	National Housing Policy
NMVOC	Non methane volatile organic compounds
NRA	National Roads Authority
NRC	Natural Resources College
NRWB	Northern Region Water Board
NSO	National Statistical Office
NSREP	National Sustainable and Renewable Energy Programme
NSSD	National Strategy for Sustainable Development
NTERA	Network of Teachers Responding to AIDS
NTFP	Non Timber Forest Product
NWRA	National Water Resources Authority
ODS	Ozone Depleting Substances
OIBM	Opportunity International Bank of Malawi
ORT	Oral Rehydration Therapy
OVOP	One Village One Product Programme
PAESP	Promotion of Alternative Energy Sources Programme
PCANR	Parliamentary Committee on Agriculture and Natural Resources
PCAR	Primary Curriculum and Assessment Reform

PES	Payment for Ecosystem Services
PPP	Public Private Partnership
ProBEC	Programme for Biomass Energy Conservation
PRSP	Poverty Reduction Strategy Paper
PSLCE	Primary School Leaving Certificate Examinations
REDD+	Reducing Emissions from Deforestation and Forest Degradation Plus
RESAKSS	Regional Strategic Analysis and Knowledge Support System
RETs	Renewable Energy Technologies
RL	Reconnaissance Licences
RTD	Road Traffic Department
SADC	Southern Africa Development Community
SAPP	Southern Africa Power Pool
SFM	Sustainable Forest Management
SIDA	Swedish International Development Agency
SLM	Sustainable Land Management
SNC	Second National Communication
SRWB	Southern Region Water Board
SSAM	Small-Scale and Artisanal Mining
SSS	Sentinel Surveillance Survey
TCA	Trans-frontier Conservation Area
TCE	Technical Committee on the Environment
TFR	Total Fertility Rate
THA	Traditional Housing Area
TM	Thematic Mapper
TTC	Teacher Training College
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNCHS	United Nations Centre for Human Settlement
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention onClimate Change
UNFF	United Nations Forum on Forests
UNICEF	United Nations Children Fund
US	United States
USAID	United States Agency for International Development
USCP	United States Country Programme
USD	United States Dollar
UTM	Universal Transverse Mericator
UV	Ultraviolet
VFA	Village Forest Area
VH	Village Headman
VNRMC	Village Natural Resource Management Committee

PART 1

Environment, People and Development

CHAPTER 1

Kayerekera Mine, Photo by Leonard Kalindekafe

ENVIRONMENT AND ECONOMIC DEVELOPMENT

Lake Chilwa Fish drying, Photo by Mathews Tsirizeni

1.1 Introduction

This chapter pursues two related objectives. The first is to provide an overview of the drivers of environmental degradation in the economy of Malawi, the pressures on the environment, the state of the environment, the impact of environmental degradation and suggested policy responses. The second is to explain the role that the environment plays in promoting development and supporting livelihoods. In this regard, the chapter highlights the significance and role of natural resources in the economy of the country and the threat posed by environmental degradation to sustainable development in the short term to medium term.

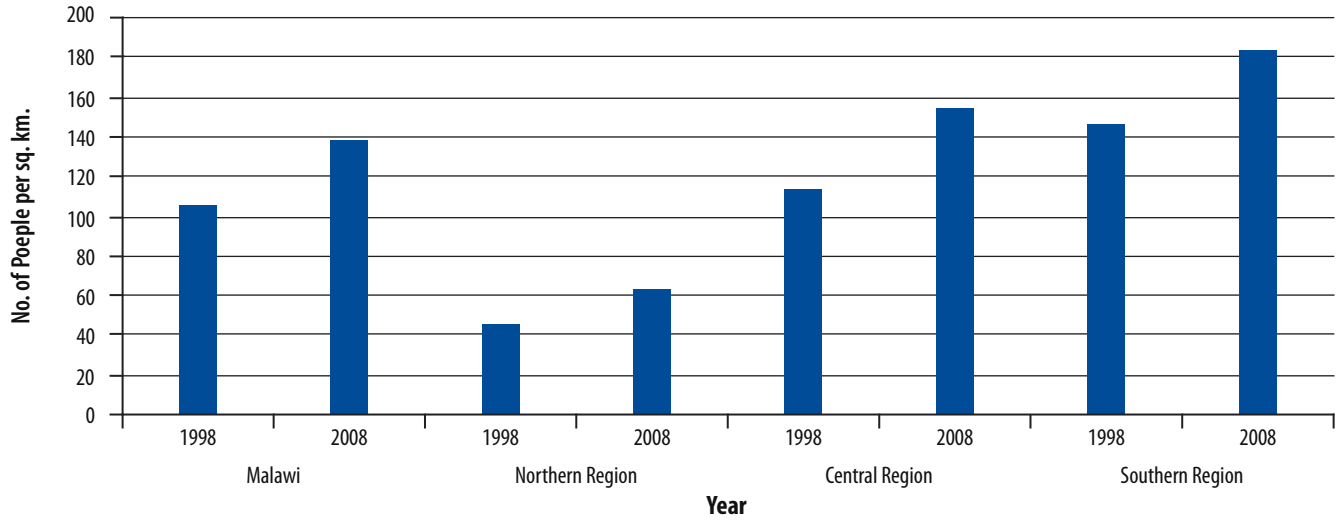
1.2 Size and Structure of the Economy

The last State of the Environment Report on Malawi covered the period 1998 to 2002. This report noted that although the population growth rate had declined to 2% per annum in the period 1987–1998 from 3.7% in the previous decade, high population density and poverty in many parts of the country were exerting unsustainable pressure upon natural resources. Young people less than 18 years of age (dependants) constitute nearly 50% of the population, placing an immense strain on the country's education and health facilities. The country needed an economic growth rate of 6% to reduce the number of poor people. The actual growth rate over the period in question averaged 2.6% per year. This was not sufficient to reduce the number of the poor. The Human Development Rank of Malawi had slipped from 163 out of 174 countries in 1998 to 165 out of 177 countries in 2002 (UNDP, 2000 and 2004).

The high rural-urban migration had led to the continued growth of unplanned and unserviced housing areas hosted by the major urban centres of Blantyre, Lilongwe, Mzuzu and Zomba. Overcrowding led to the rapid spread of communicable diseases, such as tuberculosis, diarrhoea and HIV and AIDS. Access to safe water varied from district to district. Rumphi District had the highest access rate with 67% of its population living within 0.5 km of a safe water source (GoM, 2002a). Over 20% of the national population did not have access to any toilet facility (GoM, 2002a). Literacy levels had improved from 44% for females and 73% for males in 1998 to 49 for females and 76% for males in 2002 (NSO, 2003).

Malawi faces more pressure on its land resources now than before. By African standards, its land area of 94, 276 square kilometers is comparatively small. The 2008 Census and Housing Survey revealed that the population of the country in that year was 13, 077, 160 people, having increased at an average annual rate of 2.8% from 9,934,000 in 1998 (NSO, 2008a). Population density was therefore 139 people per square kilometer, having increased from 105 people per km^2 in 1998 (Figure 1.1). This makes Malawi one of the most densely populated countries in continental Africa, surpassed only by Burundi, Gambia, Nigeria, Rwanda and Uganda. The pressure on the limited land resources is particularly severe on Likoma Island with a population density of 580 people per km^2 and in Thyolo District with a density of 343 people per km^2, and it is lowest in Rumphi District with a population density of 35 people per km^2 (NSO, 2008a). The effective distribution of population is likely to be higher because people tend to live and concentrate in valleys and on plains and avoid mountainous and hilly areas, which are included in measuring the size of land for the purpose of calculating

Figure 1.1: Population Density in 1998 and 2008.



Source: Government of Malawi, NSO, Population and Housing.

population density. Among the three regions of the country, population pressure on the land is highest in the Southern Region and lowest in the Northern Region, but in all the regions population density has increased since 1998 (Figure 1.1).

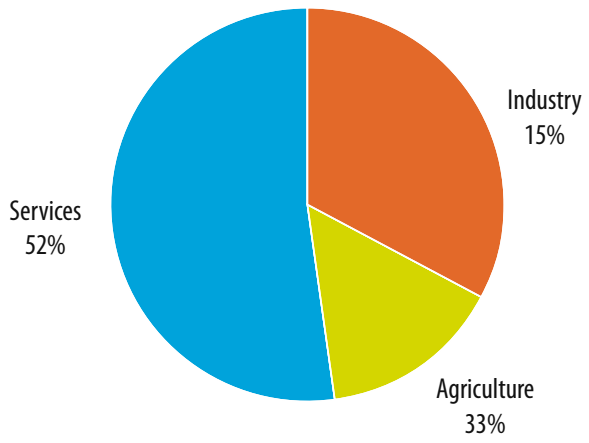
1.2.1 The Economy of Malawi

In terms of Gross National Income (GNI), which is the sum of the income created at home and abroad by a country's nationals, inclusive of capital consumption or depreciation. In 2008 Malawi's GNI measured at current market prices totaled K441, 428.4 million, according to data compiled by the Ministry of Development Planning and Cooperation, NSO, the Treasury and the Reserve Bank of Malawi (Reserve Bank of Malawi, 2008). In per capita terms, this works out to be K33, 784, equivalent to US$240, measured at the official exchange rate. According to World Bank criteria for classifying countries, Malawi is therefore a low income country (World Bank, 2009).

Gross Domestic Product (GDP) refers to the total value of output produced in the country irrespective of who owns the factors of production, and inclusive of the consumption of capital or depreciation, measured at constant market prices (GoM, 2010a). Services and agriculture contribute a significant proportion of the GDP of Malawi. Measured at constant market prices, services, agriculture and industry contribute 52%, 33% and 15% respectively (Figure 1.2).

Agriculture is defined to include crop and animal production, hunting and related service activities (forestry and logging; fishing and aquaculture). However, crop and animal production dominates this sector, with other sub-sectors accounting for relatively small shares in GDP (GoM, 2010a). According to the new series national accounts, forestry and logging contributed 1.0% and fishing and aquaculture contributed 0.7% to GDP in 2008

Figure 1.2: Sectoral Distribution of GDP in 2008.



Source: Government of Malawi, Economic Report 2010.

(GoM, 2009e). More recent research has suggested that forestry contributes significantly more to GDP than was previously estimated: roughly 5.3% of the total in 2008 (Yaron *et. al.*, 2010). For wildlife, there is no separate official estimate of its contribution to GDP, but, Yaron *et. al.* (2010) have estimated that through eco-tourism it contributes 2.7% to Malawi's GDP.

However, not all natural resources are represented in the GDP category of "agriculture". In particular, mining is included in industry. If it were added to agriculture, the total contribution of natural resources to GDP would be easier to distinguish, and quite a significant portion of Malawi's total GDP. But even without including mining, agriculture as defined above directly depends on and exploits natural resources, and as such exerts a lot of pressure on the environment. Manufacturing and construction depend on the environment directly through their demand for natural resource products, but indirectly for discharge of solid, liquid and gaseous pollutants.

In Malawi, the distribution of employment shows that in 2008, 84% of the employed (aged 15 years and above) were engaged in agriculture, forestry and fishing (NSO, 2009) indicating direct dependence on natural resources. For women, the percentage so employed was larger than the national average, at 90%. The number of people employed in agriculture in rural areas at 90%, was higher than in urban areas at 24% (NSO, 2009). For this purpose, employment is defined as both formal and informal work, whether paid in cash, in kind, or by barter.

Over 90% of the value of Malawi's exports is accounted for by natural resource sectors. Most of this originates from agriculture, with tobacco alone contributing about 67% to the country's export receipts (GoM, 2010a). The foreign exchange from these exports is an important determinant of national income in Malawi, as it finances the importation of capital and intermediate goods that are required by manufacturing industries and consumer goods, which are handled by the distribution sector.

Thus, the economy of Malawi is linked to the environment in many important ways. Several economic activities, including production, consumption and waste disposal, affect and are affected by the environment. Ultimately, the state of the environment determines the level of prosperity now and in the future. This underscores the need to examine changes both in the economy and in the environment to determine the impact on the environment of economic activities in Malawi and, conversely, how prudent use of the environment can promote sustainable development.

Despite the high economic value of natural resources and their role in the economy of Malawi, they are not used

in a sustainable manner. There is evidence that forestry resources, for example, are degrading at a fast rate of 2.6% per year (World Bank, 2002). The main cause of this is agricultural expansion caused by rapid population growth. Inadequate electricity generation, which results in electricity rationing, contributes to forest degradation by increasing firewood and charcoal demand in the major centers of Blantyre, Lilongwe, Limbe, Zomba and Mzuzu. Many natural resources continue to show declining trends, with significant economic ramifications that have yet to be accurately valued. For example, the total supply of fish is reported to have fallen by 20% over the period 1987 and 2007 (Yaron *et. al.*, 2010). Similarly, estimates based on a limited number of soil sampling sites indicate an average loss of 20 tonnes of soil per hectare per year (ibid). For wildlife, the cost of unsustainable use is said to be MK1.3 billion each year (Yaron *et. al.*, 2010).

In addressing environmental degradation, a pertinent consideration is the organisation of the economy, especially the agricultural sector. This sector is dominated by the small-scale sub-sector with many producing enterprises. The proliferation of small scale operations without access to modern means and techniques of production puts the environment at risk. At the same time it makes it difficult to enforce environmental laws and regulations.

In the medium-term, the relative contributions of different sectors of the economy to GDP are not expected to change. The output of industry is expected to rise due to expansion in output at the Kayelekera Uranium Mine and the activation of planned industrial projects, including those that will exploit the timber resources of the country. The output of the service sector and the agricultural sector is also is expected to increase. In the service sector output growth will be driven by demand as a result of rising national income, while agriculture will benefit from the recovery of the global economic recession and continuation by Malawi Government of the input subsidy programme.

1.3 Incidence and Distribution of Poverty

The 2004–2005 Integrated Household Survey defined a national poverty line for the poor at K16, 165 per person per year and K10, 029 per person per year for the ultra poor. On this basis, 52.4% of the population in Malawi was poor and 22.3% was ultra poor (NSO, 2005). Among the regions of the country, there is variation in poverty rates. The Southern Region had the highest poverty rate (60%), followed by the Northern Region (54%) and the Central Region (44%). Urban and rural poverty rates are 25% and 56% respectively, implying that a person in a rural area was more than twice as likely to be poor (NSO, 2005). The pattern of distribution of the ultra poor was similar.

Nevertheless, the incidence of poverty declined steadily to 45% in 2006 (NSO, 2007) and 40% in 2007 (NSO, 2008b). A recent report indicates that poverty has declined further to 39% (UNDP, 2010). The rate of decline has been most rapid in the Rural Northern Region where the poverty rate went down to 35%, thus displacing Rural Central Region as the region with the lowest poverty rate (The rate of decline of the ultra poor has also been fastest in Rural Northern Region which now has the lowest level of ultra poverty (NSO, 2009). The decline in the incidence of poverty is mainly attributed to increased food production facilitated by the subsidized fertilizer programme; and to recent high rates of economic growth (GoM, 2010a). However, increased surface runoff is linked to the eutrophication of rivers and Lake Malawi, and general soil degradation, both of which could have negative economic consequences.

1.4 Causes of Poverty

The Malawi Poverty Reduction Strategy (MPRS) identified limited access to land, low education, poor health status, limited off-farm employment and lack of access to credit as the causes of poverty in the country (GoM, 2002). In analysing the causes of poverty, the 2000/2001 World Development Report made use of the dimensions of poverty highlighted by poor people consulted as follows:

- Economic–people's assets and rates of returns on them: physical, human, natural, financial and social assets.
- Political–unequal distribution of political power and operation of state institutions which may be unfavourable to poor people.
- Social–norms, values and customary practices that lead to exclusion of women or the socially disadvantaged.
- Exogenous factors–droughts, floods, other natural disasters; illness and violence; and economic instability and shocks (World Bank, 2001).

Although the MPRS was not as elaborate as the World Bank in analysing the causes of poverty, it did propose a strategy for reducing poverty that addresses some of the above concerns: sustainable pro-poor growth, human capital development, social protection and good governance.

1.5 Economic Development and Strategies

1.5.1 The Growth of the Economy

Annual percentage changes in the real GDP of Malawi are shown in Figure 1.3. During 2003–5, the first three years covered in this report, the rate of economic growth was less than the minimum 6% required for reducing poverty. In 2003 and 2004, Malawi experienced favourable weather conditions from which agriculture benefited, posting positive rates of growth in both years. In turn, satisfactory performance in agriculture stimulated agro-industry and demand for the output of other sectors. Hence growth of output occurred in all sectors of the economy. However in 2005 a severe drought undermined agricultural production, leading to a reduction in the overall rate of economic growth (GoM, 2006b).

The rate of economic growth from 2006 to 2009 was more rapid (Figure 1.3), well above the minimum rate of 6% required to reduce poverty. This performance was accounted for by good rainfall and implementation of an expanded agricultural input subsidy programme. Other factors included a favourable macroeconomic climate of low rates of inflation and interest rates, low level of foreign debt following cancellation of debt by donors in 2006 which reduced foreign debt service obligations at the same time that it induced increased inflows of aid and foreign investment. The medium-term outlook is for continued pursuit of prudent macroeconomic policies following agreement with the IMF on a new Extended Credit Facility programme and consequently strong growth of real GDP. In 2010, for example, real GDP is expected to increase by 7.1% (GoM, 2010a).

1.5.2 Employment Expansion

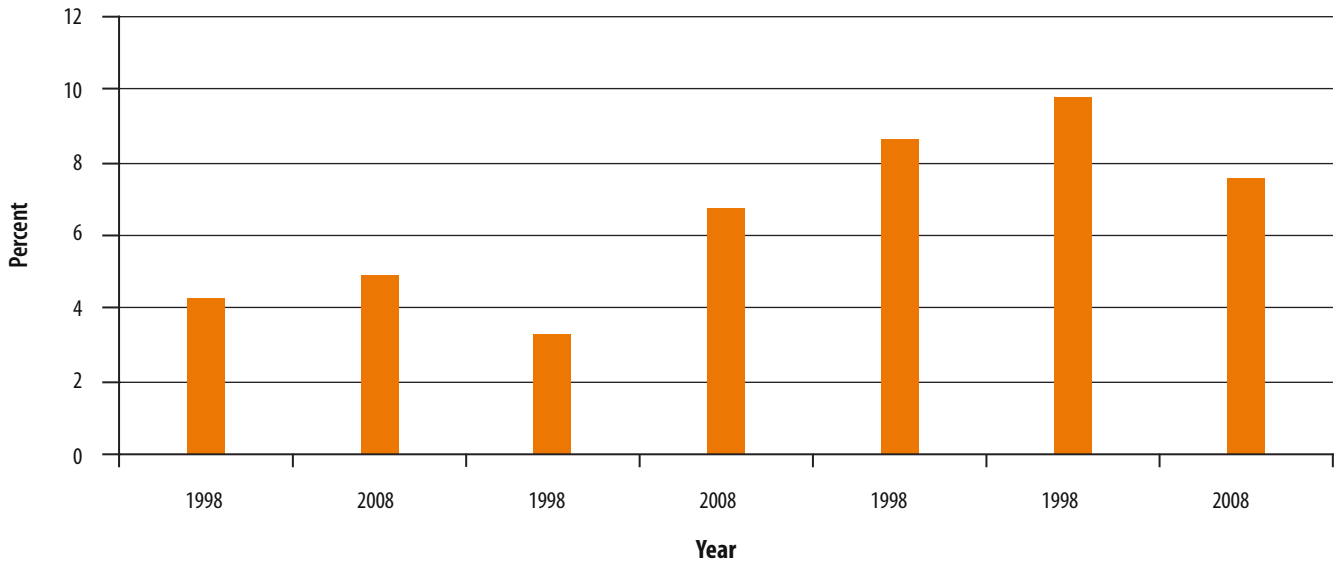
As a result of rapid rate of economic growth in recent years, and restrained growth of wages, the level of formal sector employment should have increased. However, owing to lack of appropriate data, one cannot say by how many people such employment has expanded or at what rate. Since the rate of growth of formal sector employment usually falls behind the rate of growth of the labour force, it is believed that the high rate of economic growth has failed to absorb all entrants into formal sector employment.

Acceleration of output growth is not sufficient to create adequate wage employment to absorb all entrants into formal sector employment. Formal sector employment growth is unlikely to be at rates comparable with labour force growth unless less capital-intensive techniques and sectors are prioritised.

Therefore, the majority of the workers will, for the foreseeable future, be employed or self-employed in smallholder agriculture, forestry, fisheries or in non-agricultural informal activities, making the attainment of higher productivity in these sectors crucial for output growth, for the adequacy of household incomes to meet basic needs, for meaningful increases in employment, and for limiting pressure on limited natural resources (Chipeta, 1996).

Data collected by the NSO tend to support these developments. Wage and salaried employment, which is a proxy for formal sector employment, increased from 10% in 2005 to 11% of the labour force in 2006. Afterwards, it declined to 8% in 2008. However, the proportion of the labour force that is self-employed in agriculture and other activities increased from 82% in

Figure 1.3: Gross Domestic Product Growth Rates (2003–2009).



Source: Government of Malawi Economic Report (various).

2005 to 84% in 2006 and remained at that rate in 2008 (NSO, 2006, 2007 and 2009).

1.5.3 The Budget and the Environment

The rapid growth of domestic output, national income and imports has facilitated the growth of government tax revenues, which increased from K42, 754 million in the 2003/04 fiscal year to a revised estimate of K171,135 million in the 2009/10 fiscal year. As grants increased from K23, 063 million to K92, 082 million, the total resources increased from K65, 817 million to K263, 217 million over the same time period. As percentage of GDP, revenue including grants was 36.6% of GDP in the 2009/10 fiscal year (GoM, 2010), which was higher than the ratio of 34.96% attained in 2003/04 (MEJN, 2009a). Thus, on all counts, in absolute terms total revenues and grants have increased markedly, making it possible for the government to expand recurrent as well as development expenditure.

Apart from the increase in the tax base, the growth of tax revenue is also the result of changes affecting taxes, some of which have served as drivers of environmental degradation. A good example of such tax changes is the increase in the threshold for payment of personal income tax from K36, 000 per annum in 2004 to K120, 000 per annum in 2010, which has been achieved through several annual adjustments. This has had the effect of increasing personal disposable income. It is assumed that this development has contributed to an increase in demand for computers, refrigerators and second hand motor vehicles. Used vehicles may pollute the environment more than new ones, and increased purchase of IT equipment may increase e-waste. A second example is the increase in the rebate on accompanied luggage from K10, 000 to K20, 000, announced in the same budget. This has had the effect of increasing consumption of all sorts of imported goods.

Allocation of official development assistance (ODA) to ministries that have a bearing on the environment is difficult to assess because of the way ministries are structured. Another complication is that some of the ODA resources allocated to these ministries are not used in, promoting activities that reduce pressure on the environment or in containing drivers of environmental degradation. Taking these caveats into account, the picture that emerges is that, proportionately, the amount of ODA allocated to activities that address environmental concerns has been quite limited. In the 2008/09 fiscal year, for example, only 2% of ODA (excluding budget support) was allocated to environment, lands and natural resources, while less than 1% was allocated to tourism, wildlife and culture, and energy and mining. This is in contrast to water, sanitation and irrigation which got 4% of the ODA, while agriculture received 7% (GoM, 2010b).

Frequent changes in the structure of ministries and the fact that some budgetary resources are not used for activities that concern the environment directly also make it difficult to gauge changes in the overall budget allocation to activities that have a bearing on the environment. According to the Malawi Economic Justice Network (MEJN), the budget shares going to Lands and Natural Resources, to Energy and Mines and to Agriculture and Food Security declined between the 2006/07 and 2007/08 fiscal years (Malawi Economic Justice Network, 2007). Between the 2008/09 and 2009/10 fiscal years, the approved Lands and Natural Resources allocation increased by 112.2% and that of Tourism, Wildlife and Culture increased by 15.4%. But the approved allocations to other environment-related sectors all decreased. The largest decline was in the allocation to Energy and Mines which fell by 79.6% (Malawi Economic Justice Network, 2009). The decline in the relative shares of environment sectors in the national budget is corroborated by a Regional Strategic Analysis and Knowledge Support System (RESAKSS) study in which the authors conclude that the composition of expenditure in the Agriculture and Natural Resource sector had changed between 2003/04 and 2006/07, with livestock and crops consuming almost the entire budget (over 95%) at the expense of forestry and fisheries, whose share was about 4% (Chilonda, Olubode-Awosola and Minde, 2009).

The Department of Forestry serves as an example of under-funding in environmental ministries. The other recurrent transactions (ORT) budget for the Department of Forestry for the period 2002/03 to 2007/08 averaged K50 million per year, increasing by a mere K4 million per annum. The department is thus severely under-funded by the national budget. This is partly mitigated by the availability of short-term project funding. Nevertheless, under-funding (and unfilled vacancies) limit the department's ability to enforce rules and play an appropriate role in promoting proper management and sustainable utilisation of forestry resources (Yaron *et. al.*, 2010).

1.5.4 The Malawi Growth and Development Strategy (MGDS)

The official tool for pursuing sustainable development is the Malawi Growth and Development Strategy (MGDS). The MGDS is the country's medium-term (2006–2011) development strategy. The main aim of this strategy is to create wealth through sustainable economic growth and infrastructure development as a way of reducing poverty. Apart from sustainable economic growth and

infrastructure development, the other themes in the MGDS are improving governance, social development and social protection and disaster management. It is expected that these themes will facilitate the transformation of the country from a predominantly importing and consuming economy to a predominantly manufacturing and exporting economy (GoM, 2006a).

The MGDS also contains several key priority areas which are crucial for generating rapid economic growth necessary for long-term, sustainable development. The six original areas, as modified in the revised MGDS (GoM, 2009a) and three additional ones are described in Box 1.1. One of the additional priority areas; namely, Climate Change, Natural Resources and Environment Management, addresses environmental issues directly.

As conceived and modified, several of the priority areas will put pressure on the environment. These areas are Agriculture and Food Security, Transport Infrastructure and Nsanje World Inland Port, Green-Belt Irrigation and Water Development, Energy, Mining and Industrial Development, and Integrated Rural Development.

Before elevating environment into a stand-alone priority area, it was Sub-Theme Four: Conserving the Natural Resource Base under Theme One: Sustainable Economic Growth. This sub-theme was divided into three areas; namely,

1. Fisheries, under which Malawi would ensure sustained fish availability for subsistence and cash by increasing and sustaining the productivity of fisheries, enforcing legislation to ensure sustainable production of fish, promoting the use of modern techniques of fishing, capacity building, and development of fish farming and deep-water fishing.
2. Forestry, under which Malawi would ensure sustainable use and management of forestry resources by improving productivity and value added in the industrial forestry sector, increasing reforestation in key areas, improving enforcement of regulations, initiation of reforestation and environmental rehabilitation programmes in priority areas, and introducing incentives for private sector participation.
3. Environmental Protection, where efforts for environmental protection would focus on improving compliance with environment and natural resource management laws by improving enforcement of environmental policies, legislation and cooperation in environmental, natural resource management and development, incorporating environmental

Box 1.1: MGDS Priority Areas

Original priority areas:

- Agriculture and Food Security which focuses on increasing food security and agro-processing/manufacturing for domestic and export markets.
- Green-Belt Irrigation and Water Development which will make use of lake and river water for irrigation and promote the proper management of water resources in order to meet all agricultural, domestic and industrial needs. .
- Transport Infrastructure Nsanje World Inland Port which aims at reducing production costs and improving both domestic and international trade by improving the overall road, railway, air and Shire-Zambezi river transport.
- Energy, Mining and Industrial Development which focuses on generating enough energy to reliably support long-term growth and development, including mining and industrial development.
- Integrated Rural Development which highlights developing rural growth centres to enhance employment and income-generating opportunities for the rural population.
- Public Health, Sanitation and HIV and AIDS Management which aims at improving public health and sanitation, and at preventing mitigating the devastating impact of HIV and AIDS.

Additional priority areas:

- Education, Science and Technology which is responsible for the promotion of education in the country.
- Climate Change, Natural Resources and Environment Management which focuses on mitigation and adaptation to climate change, and prevention of environmental degradation.
- Youth Development and Empowerment whose aim is to prepare the youth and endow them with resources for active participation in the development of the country.

concerns in school curricula, and establishing an environmental management information system.

4. Wildlife, whose goal is to conserve and manage protected areas and wildlife so as to contribute towards sustainable development of biodiversity and the tourism industry in Malawi.

The attainment of the objectives of the MGDS over the period 2006 to 2011 requires the pursuit of sound macroeconomic policies. These policies, whose objectives are summarized in Table 1.1, are geared at increasing and sustaining economic growth, reducing inflation, maintaining a flexible exchange rate and improving the foreign exchange position. As shown in Table 1.1, the economy is expected to grow by more than 6.0% annually, the inflation rate is expected to decline to 5.0%, the underlying fiscal deficit is expected to average 0.2%, net domestic debt is expected to decelerate to 10% of GDP, and gross reserves are expected to increase to three months of import cover. The country has made progress on all these objectives, except the one relating to foreign exchange reserves.

Inability to achieve the foreign exchange reserves target may partly reflect the official exchange rate policy stance, which is to maintain a stable nominal exchange rate (ILO/Ministry of Labour, 2010). The maintenance of a stable nominal exchange rate by administrative measures de facto implies overvaluation of the exchange rate and rationing of foreign exchange to the private sector. In the short-term the country gains from cheap imports and low inflation. In the long-term, the country loses foreign exchange on importation of cheap goods and services, domestic production of which becomes uncompetitive and hence cannot replace imports. In addition, exchange rate overvaluation undermines incentives to export and hence to earn foreign exchange.

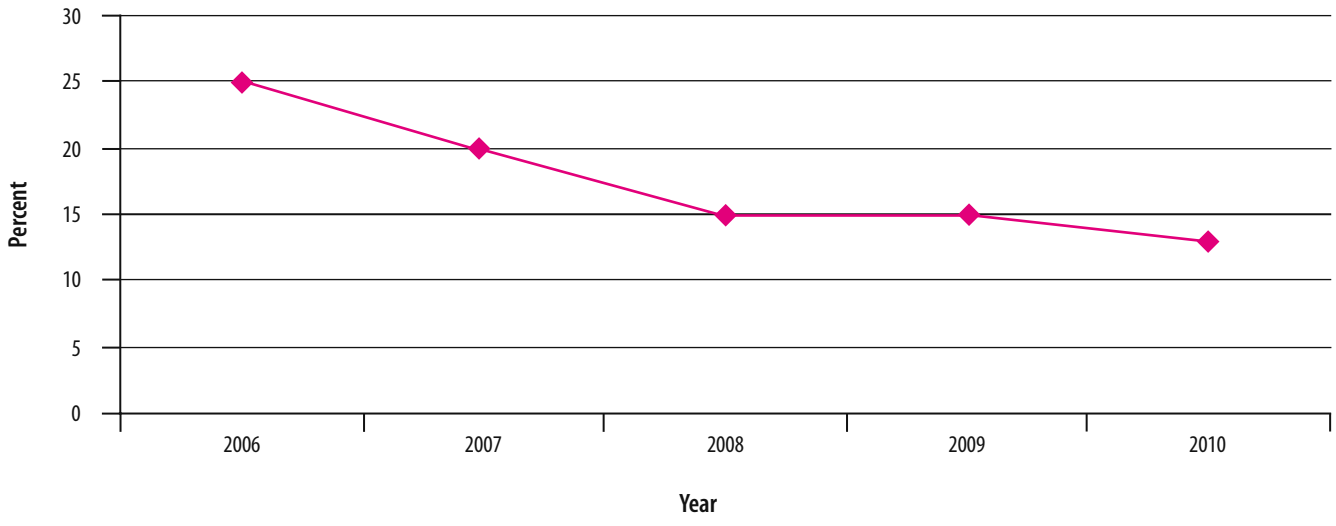
The Government cut the Bank Rate, to which all money market interest rates are tied, between 2006 and 2010 (Figure 1.4). As a result, lending rates, as well as deposit rates, have declined. The decline in lending rates has stimulated expansion in bank credit to the private sector, with net lending, for example, increasing by K7.04 billion in 2006 and K8.95 billion in 2007.

Table 1.1: Medium-term Macroeconomic Objectives.

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Inflation Rate%	9.8	13.7	16.9	9.8	6.4	7.2	5.0	5.0	5.0
GDP Growth Rate%	3.9	4.6	1.9	8.3	5.6	6.0	6.0	6.0	6.0
Net Domestic Debt% of GDP	22.3	22.6	21.5	23.3	20.8	17.6	10	10	10
Fiscal Balance% of GDP	-0.9	-4.1	-1.3	-0.9	-0.7	-1.1	-1.0	-1.0	-1.0
Gross Reserves in months of imports	1.4	1.3	1.6	2.0	1.9	2.1	3.0	3.0	3.0

Source: Government of Malawi.

Figure 1.4: Changes in Bank Rate 2006 to 2010.



Sources: Reserve Bank of Malawi (2009), GoM (2010).

Box 1.2: Millennium Development Goal 1

Target 1: Halve between 1990 and 2015 the proportion of people whose income is less than one dollar per day.

Target 2: Halve between 1990 and 2015 the proportion of people who suffer from hunger.

Source: Malawi Government, Malawi Millennium Development Goals Report 2010.

The overall fiscal deficits have remained above the targets shown in Table 1.1. In 2007/08, for example, the fiscal deficit was 2.8% of GDP. In part the deficits have been caused by delayed donor disbursements. But they have also been caused by higher than expected expenditure in key areas, such as agriculture and the input subsidy programme (GoM, 2009b).

Owing to debt forgiveness which occurred in 2006, paying off of debt and improved fiscal management, overall public debt has fallen markedly in recent years. This development has released resources for expenditure on the government's priority areas described in the MGDS.

1.5.5 Millennium Development Goals (MDGs)

Progress in reducing poverty can be assessed by examining the extent to which Malawi is likely to achieve Millennium Development Goal Number 1. The goal of this MDG is to eradicate extreme poverty. Its targets are as described in Box 1.2. According to the 2010 Malawi Millennium Development Goals Report (GoM, 2010c), commendable progress has been made towards attaining this goal. The proportion of the population living on less than one dollar per day declined from 50% in 2005 to 39% in 2009. At this rate of decline, Malawi will achieve the target of 27% by 2015. The poverty gap among the poorest people has also declined, but the country is unlikely to attain the 2015 target.

Poverty rates show the share of the population below a minimum income level, but they do not indicate the distribution of income above the threshold. Inequality measures consider the entire distribution and therefore reveal distribution above the threshold. With reference to the 2004–2005 IHS data, the NSO showed that the richest 10% of the population had a median per capita income that was eight times higher than the median per capita income of the poorest. Furthermore, the richest 10% of the population had a mean income that was three times higher than the overall median income in the country (NSO, 2005). The 2010 Millennium Development Goals Report points out that between 1998 and 2005 there was no improvement in the share of the poorest quintile in national consumption. At this rate of progress, Malawi is unlikely to meet the MDG target relating to distribution of national consumption.

Two measures for monitoring hunger are used. These are the prevalence of underweight children less than five years old, and the proportion of the population below minimum level of dietary energy consumption. There has been steady progress in reducing the problem of underweight in children. If further investment is made to address this problem, Malawi will attain the target of 14% by 2015. On the basis of the progress that has been made in reducing the proportion of population below minimum dietary energy consumption, Malawi will also meet the target of 11.8% in 2015 (GoM, 2010c).

Environmental sustainability in Malawi can be explained by examining the extent to which the country is likely to achieve Millennium Development Goal Number Seven (MDG 7), "to ensure environmental sustainability". Box 1.3 highlights MDG 7 and its targets. For Target 7.A, Malawi uses three indicators to monitor progress;

Box 1.3: Millennium Development Goal 7

Target 7.A Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources.

Target 7.B Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of the loss.

Target 7.C Halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation.

Target 7.D Achieve by 2020 a significant improvement in the lives of at least 100 million slum dwellers.

Source: GoM, Malawi Millennium Development Goals Report 2009.

namely, the proportion of land area covered by forest, the proportion of area protected to maintain biological diversity, and proportion of the population using solid fuels.

Trends in these indicators show that Malawi is not likely to meet this target. For example, the proportion of the land area covered by forest declined from 41.4% in 1990 to 36.2% in 2005, according to the 2009 Malawi Millennium Development Goals Report (GoM, 2009d). If this trend continues, by 2015 Malawi will have 32.8% of its land covered by forest, which is less than the target of 50% required to achieve the goal (GoM, 2009d). The same report indicates that the ratio of the surface area protected to maintain biological diversity has not significantly changed since 1990 when it was 0.16% will remain constant, implying that Malawi is off track in attaining the 2015 target of 0.18%. The proportion of the population that uses solid fuels rose slowly between 1998 and 2009. This too implies that the country is unlikely to achieve the 2015 MDG target of 0% (GoM, 2009d).

Regarding halving the proportion of people without sustainable access to safe drinking water and basic sanitation, Malawi uses standard indicators to assess progress; namely, the proportion of the population using an improved drinking water source and the proportion of the population using an improved sanitation facility. In 1990–92, 47% of the population had access to an improved water source. The 2015 target is, therefore to provide services to 74% of the population. According to official figures, Malawi achieved this target before 2006. By 2007, the proportion of the population that had access to an improved water source had increased to 81% (GoM, 2010c). Projections show that by 2015, the proportion of people with access to an improved water source will have increased to 94% (GoM, 2010c).

However, in the context of Malawi, an improved water source can mean a borehole, a protected well or a standpipe. The quality of water can vary from one source to another. The numbers of these facilities themselves may include sources which are not functional because they are in a state of disrepair or they have dried up. For these reasons, the data used to monitor progress may exaggerate actual access to an improved water source.

Considering access to improved sanitation, the 2009 Malawi Millennium Development Goals Report cautions readers to be aware of two types of sanitation facilities. There is improved sanitation, comprising facilities with hygiene features; and basic sanitation, comprising facilities without hygiene features. The conclusion of that report is that by 2008 Malawi had done well in ensuring that basic sanitation is accessible to all. In that year 91% of the population used pit latrines, while only 6% had no toilet facilities at all. The proportion of population with access to improved sanitation increased from 72% in 1990 to 94% in 2008 before declining slightly to 93% in 2009 (GoM, 2010c). The most recent projection is that this percentage is likely to rise to 99% by 2015. So here too good progress has been made towards achieving the MDG goal.

For achieving significant improvement in the lives of slum dwellers, Malawi uses slum population as a percentage of the urban population as an indicator of progress. Slum households are families in urban areas that lack five facilities: durable housing, sufficient living area, access to improved water, access to sanitation and secure land tenure. In absolute terms, however, the number of slum dwellers had increased from 1.0 million in 1990 to 1.5 million in 2008. Therefore, Malawi is not on target towards reducing the number of slum dwellers.

On balance, some progress has been made with respect to sustainability of the environment through the MDG initiatives. But a number of challenges remain. Both the 2009 and the 2010 Malawi Millennium Development Reports highlight the following challenges: increased deforestation due to increased demand for arable land and failure to enforce measures to curb problems of deforestation; inadequate community involvement and participation in environmental and natural resources management; poor quality of surface and ground water; and inequitable promotion of improved sanitation facilities.

1.6. Threats to the Environment

1.6.1 The Global Financial and Economic Crisis

The current economic and financial crisis began with the meltdown of the sub-prime mortgage market in the United States of America in 2007 (Abu and Ben, 2009). The economic crisis in the United States of America affected other world economies. Due to decreases in rates of economic growth, exports and tax revenues, and increases in fiscal and current account deficits, the worst affected countries are other advanced economies which have close links with the American economy. Emerging economies and low income developing economies in Africa, the Caribbean, Asia and Latin America have also been affected, but to a smaller extent. In the SADC region, the crisis first adversely affected stock markets. Later, foreign direct investment declined and contributed to a 24% fall in investment in 2009. Foreign aid and remittances are still under pressure. The economic

downturn reached its lowest point in 2009, but recovery of the regional economy started in 2010.

International banks are reputed to have reduced lending to Malawi by about $60 million in the first quarter of 2009, which is a significant amount. This reduction in international credit directly affected lending to nonbank institutions, particularly for trade credit. In addition, correspondent banks refused to increase their lines of credit. Consequently, local banks had difficulties granting credit to some of their clients, including such foreign exchange earners as smaller tobacco buyers (Briancon and Lightfoot, 2009).

The immediate impact of the global economic downturn on trade was a collapse in the international prices of most commodities, including petroleum and fertiliser. But this did not immediately translate into a reduction in import costs because of the long lead time for import contracts and the previous stockpiling of fertiliser. Tobacco prices were not significantly affected by the commodity boom and bust. In this industry, it is the level of inventories and production that matter. The impact of the crisis on tea prices was also minimal. These prices fell at the beginning of the crisis, but recovered rapidly. Coffee prices were seriously affected, perhaps because the main demand for premium coffee is from Western countries, which suffered most from the crisis (Briancom and Lightfoot, 2009).

The crisis has not affected official transfers. Both bilateral and multilateral agencies have increased their commitments and, in the case of multilateral agencies, introduced new funding instruments designed to mitigate the impact of the economic crisis. But for many NGOs which receive considerable funding from donations, indications are that the global crisis has reduced the resources that they receive by 20% (Briancom and Lightfoot, 2009). This is significant considering that their contribution to the Malawian economy is estimated at between US$100 and US$200 million a year. Directly and indirectly, this may reduce GDP by up to 1.5%. The aggregate value and variability of remittances as a result of the global crisis is not known. About 60% of the population is vulnerable to the crisis (Briancom and Lightfoot, 2009).

According to a recent study commissioned by the Malawi Economic Justice Network, between 2008 and 2009 the global economic crisis led to a decline in average household incomes by 15%, amounting to K9, 000. While a decline in incomes was recorded in all the districts of the country, the decline was most significant in those districts that grow cash crops like cotton and tobacco. On the positive side, agricultural input prices also declined over the same time period. But the global economic crisis was not the only explanation for this. The other was the increase in the rate of subsidy. With respect to remittances, 56% of the households that receive remittances from abroad reported a decline in receipts. Households as a whole reacted to the fall in incomes by reducing expenditure on non-essential items like household assets and items (MEJN, 2010). The decline in incomes may also have created pressure on the environment by causing people to over-exploit forestry, fishery and wildlife resources to survive, but no research data is available.

1.6.2 Poverty and the Environment

The underlying causes of environmental degradation are high population density and dependence on subsistence agricultural production in the absence of other economic opportunities. This is exacerbated by poverty because in order to subsist a large proportion of the population rely on what they can forage from natural resources (GoM, 2002) causing ecosystem degradation. Degraded ecosystem further induce poverty due to lower production.

1.6.3 Inflation and the Environment

Inflation exerts pressure on the environment by reducing the real value of government expenditure earmarked for rehabilitating the environment, and decreasing the real value of user and pollution charges. It also exerts pressure on the environment through an increase in investment in agriculture for food production, and increases in forestry and fisheries harvesting so as to offset the effects of inflation on real household incomes. In addition, increases in prices of housing, water, electricity and gas may encourage unsustainable practices such as increasing charcoal demand.

Inflation exerts pressure on the environment by worsening the position of the poor. This is most obviously the case with the urban poor, whose incomes are unlikely to keep pace with increases in the cost of living. Some of the rural poor are partially protected by their limited involvement in monetized activity and their ability to grow food for themselves. However, many poor rural households typically have net food deficits and, in any case, have other essential purchases to make. As such, inflation encourages them to put pressure on the environment to create extra income.

Moderate inflation (say single digit inflation) has few measurable consequences, but the more rapid the inflation, the more serious its effects. First, rapid inflation discourages and distorts investment. When there is a rapid inflationary trend, prices also tend to become unstable around the trend. The resulting uncertainty encourages short-term speculation, such as stockpiling of imported goods and agricultural goods in anticipation of further increases in prices, which cause

scarcities. Secondly, high and unpredictable inflation has a negative impact on long-term investment because investors face uncertainties and, therefore, are reluctant to commit themselves to long-term projects. Thirdly, because not all prices rise by the same percentage, the resulting changes in relative prices distort their information content and lead to inefficient allocation of investment. All this limits the expansion of formal sector output and job creation, which would attract people away from direct dependence on the environment for their livelihood.

Malawi's annual inflation rates, as shown in Figure 1.5, indicate that the average annual rate of inflation was higher during 2003 to 2005 than during 2006 to 2009. These figures mask the fact that the rates of inflation for the years 2005 and 2006 were far above these averages, 15.4% and 13.9%, respectively (GoM, 2006b). Drought conditions in 2005 caused a significant drop in the output of food crops. Since the weight of food costs in the composite national consumer price index is high (58.1%), a drastic reduction in the supply of food-stuffs caused a marked increase in food prices and hence in the rate of inflation (GoM, 2009). In 2006, the rate of inflation, though high, was lower owing to a decrease in food prices. From then onwards, Malawi has consistently experienced favorable rains. Combined with increased availability of subsidized fertilizers and seeds, the country has been producing bumper harvests of the main staple food crop (maize). This has stabilized its price and moderated the rate of inflation. Another consideration is the relative stability of the Malawi Kwacha against the currencies of the country's major trading partners.

1.6.4 Aggregate Income and Demand

Aggregate income drives demand for goods and services, including natural resource products. Aggregate income is proxied by GNP. Official data indicate that per capita GNP in Malawi increased from K14,665 in 2003 to K32,458 in 2008 (Reserve Bank of Malawi, 2008). GNP itself increased at an average annual rate of 21.3% between 2003 and 2008.

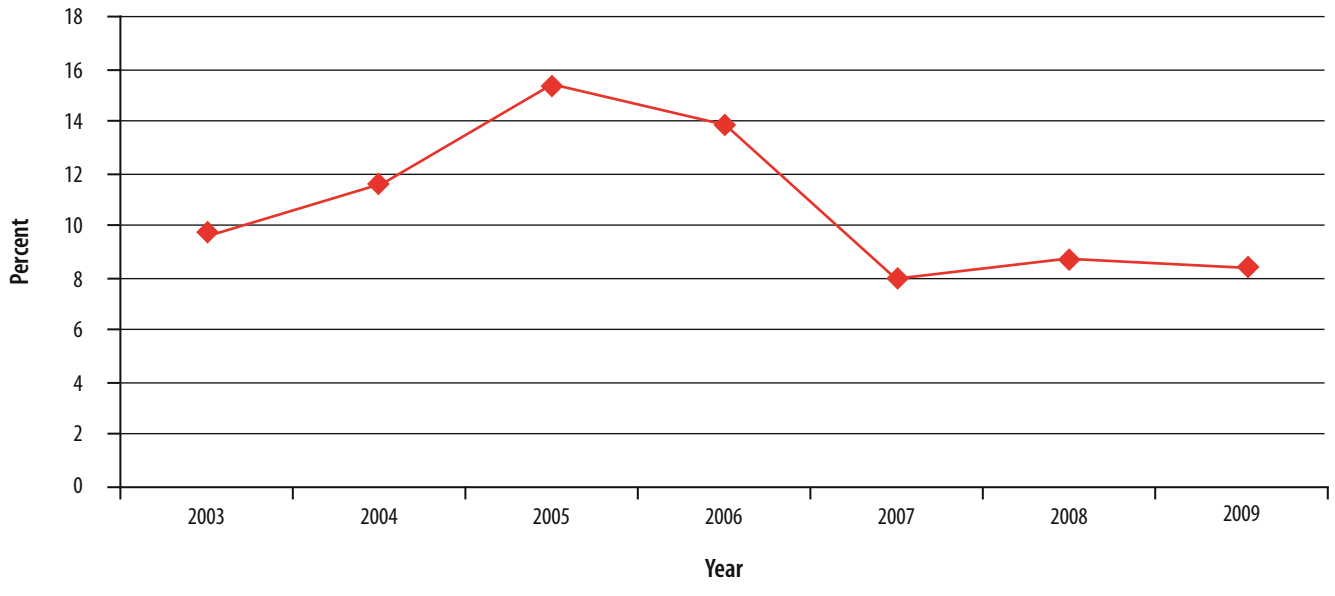
According to the Reserve Bank of Malawi (2009), private consumption expenditure makes the largest claim on national income, representing 96.1% of GDP in 2008. Hence, it is the biggest driver of demand for goods and services, including natural resource products. In the same year, gross capital formation represented 7.6% while government consumption expenditure represented 16.0% of GDP. As a proportion of GDP, exports of goods and non-factor services at 28.6% were a more significant component. The main exports were tobacco, tea, sugar and cotton, all natural resource products. Imports at 50.2% of GDP were an even larger component. The main imports were fuel oils and fertilizers, the use of which is a threat to the environment.

1.7 The Impact of Environmental Degradation

1.7.1 Environment and Economic Growth

Unsustainable use of natural resources adversely impacts on the rate of economic growth in Malawi. Yaron *et. al.* (2010), for example, have estimated that Malawi's GDP would be higher by 5.3% per year were it not for

Figure 1.5: Annual Inflation Rates (2003-2009).



Source: GoM, Economic Report (various issues).

unsustainable use of natural resources. They have also discounted the cost of damage over 10 years and found the present value of this to be 21.4% of GDP. At 2007 prices, they have estimated an annual loss of K26, 574 million. The main contributors to the annual revenue loss due to resource degradation are forestry degradation (47.8%) and soil degradation (33.8%), followed by unsustainable fisheries (14.7%). The contributions of unsustainable use of wildlife and outdoor air pollution, at 2.5% and 1.2% respectively, are comparatively insignificant.

1.7.2 Environment and National Savings

Two components of Malawi's national savings; namely, gross domestic savings and net factor income from abroad, have been negative recently. Nevertheless, gross national savings have been positive because of positive net private transfers from abroad and positive foreign savings. The resulting gross national savings have financed an equivalent amount of gross national investment since in equilibrium the two must be equal. After making an adjustment for capital consumption or depreciation, we arrive at net national investment, which is the addition to the national stock of physical capital or wealth.

But a nation's wealth consists of more than just physical capital goods. It includes human capital (skills, knowledge and health); natural capital or assets such soils and forests; and social capital (structures or organizations and norms and values). Unsustainable use of natural resources may contribute to a reduction in the country's national wealth. Addition to physical capital occurs through savings out of national income, and addition to human capital through expenditure on education. The addition to natural capital occurs if it is replenished faster than it is used up. The conventional measure of savings considers only savings out of national income and, hence, takes into account only the addition to physical capital or wealth. Adjusted net savings or genuine savings is a green accounting measure that takes into account net changes in natural capital, and makes an adjustment for increases in human capital through expenditure on education.

Table 1.2 shows adjusted net savings rates for Malawi for the period 2004 to 2007. These figures have been estimated by the World Bank by deducting consumption of fixed capital (depreciation) from gross national savings rates to arrive at net national savings rates, which represent the percentage additions to the physical wealth of the country (2006, 2007, 2008 and 2009). The rates of education expenditure have been added to net national savings rates as they represents the value of the additions to the stock of human wealth. From the resulting sums, the World Bank deducted the economic costs of net forest depletion, carbon dioxide damage and out-door air pollution to arrive at adjusted net savings rates (2009). There is no entry for energy depletion and mineral depletion which are considered to be negligible. From 2004 to 2005, adjusted net savings rates are negative. Although the rates of expenditures on education are positive, they are not high enough to offset the negative net savings rates. As a percentage of gross national income, the natural resource depletion rates are small and stable. From 2006, gross national savings rates are positive because of a marked increase in foreign savings accruing to Malawi. Without the natural resource depletion rates, the positive adjusted net savings rates in 2006 and 2007 would have been higher.

Table 1.2: Adjusted Net Savings for Malawi 2004 to 2007 (% of GNI).

	2004	2005	2006	2007
Gross national savings	-7.9	-7.6	15.7	9.6
Consumption of fixed capital	7.5	7.2	7.3	7.6
Net national savings	-15.4	-14.8	8.4	2.0
Education expenditure	5.0	5.1	4.9	3.5
Energy depletion	0.0	0.0	0.0	0.0
Mineral depletion	0.0	0.0	0.0	0.0
Net forest depletion	2.1	0.9	0.6	0.8
Carbon dioxide damage	0.3	0.3	0.2	0.3
Particulate emission damage	0.3	0.3	0.2	0.2
Adjusted net savings	-13.1	-11.3	12.2	4.2

Source: World Bank, World Development Indicators (various issues).

However, the World Bank figures on adjusted net savings overestimate the additions to Malawi's national wealth, by underestimating the value of net forest depletion and not accounting for soil erosion, fishery depletion, wildlife depletion and indoor air pollution. By adjusting for these items, Yaron *et. al.* (2010) have shown that Malawi's adjusted net savings rate in 2006 was actually significantly lower than the World Bank estimate (Table 1.3).

Table 1.3: Modified Adjusted Net Savings for Malawi in 2006 (% of GNI).

Gross national savings	15.7
Consumption of fixed capital	7.3
Net national savings	8.4
Education expenditure	4.9
Energy depletion	0.0
Mineral depletion	0.0
Net forest depletion	2.1
Soil Erosion	2.0
Fishery depletion (lower bound)	0.9
Wildlife depletion (indicative)	0.2
CO_2 damage	0.2
PM10 damage (outdoor air pollution WB 2002)	0.2
Indoor air pollution	0.7
Adjusted net saving	7.0

Source: Yaron *et. al.*, Malawi Poverty and Environment Initiative Study, 2010.

Yaron *et. al.* (2010) have concluded that the largest costs of unsustainable use of natural resources result from the loss of agricultural productivity as a result of soil degradation. Estimates of agricultural yield losses as a result of soil degradation vary among authors. According to the World Bank, the annual agricultural yield loss could be in the range of 4 to 11% (2002). These yield losses can undermine food security in the country by reducing the availability of food.

1.8 Policy Responses and Recommendations

Containing environmental degradation in Malawi requires measures to address the drivers of environmental degradation and pressures on the environment. In the medium term, the government will continue to pursue monetary and fiscal policies that will maintain macroeconomic stability in terms of low inflation, low rates of interest, sustainable fiscal and current account deficits and a stable exchange rate. This policy stance will contribute towards the continued attainment of the policy objective of high rates of economic growth of at least 6% required to reduce poverty, which will in turn generate high rates of growth of national disposable income and aggregate demand. As such, economic growth will continue to exert pressure on the environment, and there is a resulting need for the government to adopt stronger measures that would protect the environment.

Policies for addressing drivers of environmental degradation that are structural in nature will need to aim at:

- Improving the quantity, affordability and reliability of supply of alternative sources of energy, in particular electricity. The MGDS acknowledges that the provision of energy in Malawi is inadequate, unreliable and inaccessible to those who need it because of lack of competition in the energy sector, non-functioning power plants, and plants' inability to generate sufficient amounts of power. The objective of the MGDS is to reduce the number and duration of blackouts, increase access to reliable, affordable electricity in rural areas and all targeted areas, improve coordination and the balance between the needs for energy and those of other high growth sectors such as tourism and mining. So far not much has been achieved. The government and other stake-holders need to increase their commitment to improving energy supplies in the country.
- A reduction in the population growth rate. The MGDS aims at reducing Malawi's population growth rate from 2% per annum experienced in the decade prior to 1999 to 1.5% per annum. This is to be achieved by lowering fertility in all age groups through advocacy programmes so that total fertility declines from 6.0 to 4.9. This objective is to be achieved by providing accessible, affordable and comprehensive reproductive health services and by expanding the range, improving access, and improving quality of health services to reduce morbidity and mortality. The realisation that population growth rate is higher than the benchmark of 2% implies that the government needs to increase its efforts in order for the country to achieve a population growth rate of 1.5% per annum.
- Controlling inflation through appropriate monetary policies. The MGDS monetary policy objective is to achieve a 5% inflation rate by the end of 2011. Broad money is expected to anchor the monetary programme with foreign exchange sales and open market operations as the main policy instruments in influencing liquidity in the economy.

While the economy has managed to reduce the rate of inflation below 10%, lowering it further has proved difficult and the country may not attain the 2011 target of 5%, unless other measures are implemented to address the fiscal causes of high liquidity in the economy.

- Creating formal sector jobs. There are no specific measures for creating formal sector jobs in the MGDS. The MGDS envisages that high rates of economic growth will stimulate formal sector job creation. In the absence of comprehensive data on employment, it is difficult to ascertain if high rates of economic growth have succeeded in creating such jobs. Available data indicate that the share of formal sector jobs in the labour force declined between 2005 and 2008 as stated above. Issues that should be addressed to enable the country accelerate job creation include sustaining support for smallholder agriculture; maintaining a competitive exchange rate; increasing investment in education, including vocational training; adjusting curricula to market demand; and diversification of the economy, both inside and outside agriculture.
- Accelerating reduction of poverty. The objective of the MGDS is to decrease poverty by 8% through economic growth, economic empowerment and food security so as to reduce vulnerability to economic shocks. In this regard, the government is taking steps to protect those who temporarily fall into poverty through measures that increase their assets. The strategy also seeks to control fluctuations in poverty so that people do not fall below the poverty line if they are above it. Malawi has managed to reduce poverty levels. The country's achievement would have been higher if environmental degradation had been controlled. Therefore, it is imperative to reduce environmental degradation in order to sustain economic growth, economic empowerment and food security. For the purpose of addressing pressures on the environment, the government is implementing a number of interventions to prevent deforestation and forest degradation, depletion of fisheries resources, degradation of soil resources and depletion of wildlife resources. There are gaps in these interventions which should be addressed.
- Prevention of Deforestation and Forest Degradation. For preventing deforestation and forest degradation, the government is implementing a number of programmes. A well known initiative is the EU-funded Income Generating Public Works Programme (IGPWP), which aims at reducing poverty by increasing local production of fuelwood, timber and poles through community woodlots and planting on individual club member farms. Economic and financial cost-benefit analysis of this project by Yaron *et. al.* (2010) revealed that reliance only on financial returns does not make tree planting sufficiently attractive to encourage wide-spread reforestation; that adding carbon payments makes it more attractive from the farmer's point of view; and that the IGPWP practice of incentive payments of around $6 per club member in each of the first two years makes investing in tree planting financially attractive to poor farmers. In order to make tree planting more attractive, government needs to adopt the $6 per club member incentive payment in each of the first two years. Another such programme addresses the problem of charcoal production. The aim of this programme is to promote the production and marketing of charcoal from sustainably grown wood. The current policy of banning charcoal has proved ineffective and it encourages illegal charcoal production. Promoting production and marketing of charcoal from sustainably grown wood should be done through annual carbon payments, and adoption of improved charcoal kilns.
- Prevention of Depletion of Fisheries Resources. For containing depletion of fisheries resources, a promising strategy is the development and dissemination of integrated aquaculture-agriculture technologies among poor smallholders. Under this initiative, organic wastes and byproducts are used as nutrient inputs in ponds. The WorldFish Centre project also uses an innovative 'farmer participatory research' approach for technology transfer. According to Yaron *et. al.* (2010), in economic terms this project is a success with an estimated cost-benefit ratio of 1.4 over the 1986–2001 period and an internal rate of return of 15%. Preventing further depletion of fisheries resources thus requires scaling up the development and dissemination of integrated aquaculture-agriculture technologies among poor farmers.
- Prevention of Degradation of Soil Resources- The most important government programme for protecting soil resources is the Agricultural Development Programme (ADP) whose aim is to increase the area under sustainable management from 100,000 to 250,000 hectares. The two main interventions are contour ridging and planting of vetiver hedgerows ; and conservation agriculture, in which minimum tillage combined with tephrosia vogelii increases maize yield and farm profitability significantly. Cost-benefit analysis has revealed that for the first intervention the internal financial rate of return is 10% and the internal economic rate of return is 42%. This implies that the financial rate of return is not attractive, so farmers will not adopt this technology unless the government compensates them (Yaron *et. al.*, 2010). An

alternative recommendation is to combine soil conservation interventions with conservation agriculture.

- Prevention of Depletion of Wildlife. In order to contain the depletion of wildlife, there is a need to address the challenges which the various national parks and wildlife reserves are experiencing: erratic patrols in most parks leading to increased poaching; a lower than required number of scouts and inadequate coverage; inadequate field resources and equipment (boots, rain coats, torches, cooking utensils, water containers and geographical positioning systems); inadequate staff and inefficient resource management; and tree cutting, which implies that in the long term the environment will not be able to offer a good habitat for the animals.

Recently, the government has increased the funding directed to the sector and, since 2008, it has been implementing the following:

- A project aimed at restocking protected areas that are depleted, using animals from areas with excess wildlife. Excess animals have been relocated from Liwonde National Park to Majete Wildlife Reserve. In 2009, eighty-three elephants were relocated from Mangochi to Majete.
- An infrastructure project under which the Department is building staff houses, roads to protected areas, and also improving access to safe water in the protected area. This is aimed at improving the welfare of the staff.
- Promotion of ecotourism. As a way of promoting ecotourism, the government is planning to build a lodge at Vwaza Wildlife Reserve, a conference centre at Lengwe's Nyala Lodge. The Department is also in the process of developing an Ecotourism Plan.
- Electric fencing which is aimed at protecting the people from dangerous wildlife. The following parks are involved: Liwonde National Park, Kasungu National Park, and Vwaza Wildlife Reserve.

In addition to these challenges and counter-initiatives, due to the incidence of cross- border poaching involving Malawi and Zambia, there are now efforts to manage the national parks together under transfrontier conservation area (TCA) arrangements. In this case, wildlife on both sides of the border will be jointly protected from poaching.

Under the National Parks and Wildlife Act 2004 (Amended), rights to utilize and manage wildlife have been formally transferred to rural communities in some areas. This is in line with the Malawi National Environment Policy which calls for the involvement of the private sector, NGO, and community based organizations in the protection, conservation, management and sustainable utilization of Malawi's natural resources.

Through the involvement of other stakeholders such as local communities and the private sector, the management of wildlife resources is likely to improve. In this regard, the government's aim will be to ensure that various stakeholders such as concessionaires and communities are sustainably managing wildlife resources. The communities will benefit through employment in the lodges or camps and from revenue sharing. The private sector on the other hand will have an opportunity to operate eco-tourism businesses.

Over and above these measures, in order to prevent depletion of wildlife resources the government needs to increase the number of patrols in game reserves, the number of game scouts, field resources and equipment, and water containers and geographical positioning systems; improve resource management; and reduce tree cutting so that in the long term the environment can be able to offer a good habitat for the animals.

Policies for addressing policy-based factors will need to aim at:

- Maintaining high rates of excise duties on products that pollute the environment. A reduction of 50 percentage points in excise duties on all motor vehicles was announced in the 2005/06 national budget. This had the effect of increasing demand for motor vehicles, especially used vehicles which pollute the environment more that new ones. This was partially reversed in the 2010/11 budget statement, in which the Minister of Finance announced an additional excise duty on old passenger service vehicles aged between 8 and 12 years of 20%, and one of 50% on those older than 12 years, over and above the past levels. All goods carrying vehicles older than 15 years will attract 20% excise duty.
- Improving compliance by large-scale and small-scale producers with environmental laws and policies. The major constraints to improved compliance include weak enforcement capacity, insufficient economic incentives for compliance, conflicting service delivery in management of natural resources, and limited environmental awareness in Malawi. An increase in budgetary allocation to activities that deal with the protection of the environment would go a long way towards addressing these problems.

- In recognition of the contribution that natural resource-dependent activities make to GDP, increase aid and budgetary allocations to sectors that protect the environment, such as forestry, wildlife, and land and soil management; as well to sectors that prevent the buildup of pressure on natural resources. As stated above, the relative shares of these sectors in the national budget have declined recently. Proportionately, the amount of Overseas Development Assistance allocated to activities that address environmental concerns should be increased.
- Avoiding exchange rate overvaluation so as to maintain competitiveness. Since the floatation of the Malawi Kwacha in 1994, the policy objective in principle has been to have a flexible exchange rate. In practice, the policy stance has been to maintain a stable nominal exchange rate. The maintenance of a stable nominal exchange rate by administrative measures de facto implies overvaluation of the exchange rate and rationing of foreign exchange to the private sector. As noted above, in the short-term the country gains from cheap imports and low inflation. In the long-term, the country loses foreign exchange on importation of cheap goods and services, domestic production of which becomes uncompetitive and hence cannot replace imports. In addition, exchange rate overvaluation undermines incentives to export and hence to earn foreign exchange. The overvaluation of the exchange rate calls for currency devaluation.
- Ensure that the fertilizer subsidy programme is supported by alternatives to reduce the environmental impact and long-term cost of the programme. The programme is currently dependent on unsustainable donor funding. Artificial fertilizers also are environmentally damaging, causing nutrient loading in lakes. The fertilizer subsidy programme should be supported with long-term initiatives to reduce dependence on artificial fertilizer, such as conservation farming, inter-cropping with nitrogen-producing legumes, and composting.

In order to address the challenges of environmental sustainability which have been noted above, several initiatives have been put in place by the government. These initiatives, which complement or reinforce the policy measures which have been discussed above, include:

- Revision of environmental and natural resources legislation with the aim of halting the rate of environmental degradation;
- Promotion of community participation in environmental and natural resources management;
- Implementation of a tree planting season to address deforestation;
- Development of a National Adaptation Program of Action to climate change which seeks to support vulnerable communities with coping strategies to the adverse effects of climate change;
- Improvement of access to safe water and sanitation by strengthening and building capacity for common water resources management, monitoring systems, rehabilitation and construction of small community earth dams;
- Review of the National Housing Policy to help upgrade slums and reduce slum formation in the cities; and
- Prioritization of climate change, natural resources and environmental management as one of the nine key priority areas in the MGDS (GoM, 2010c and 2009.

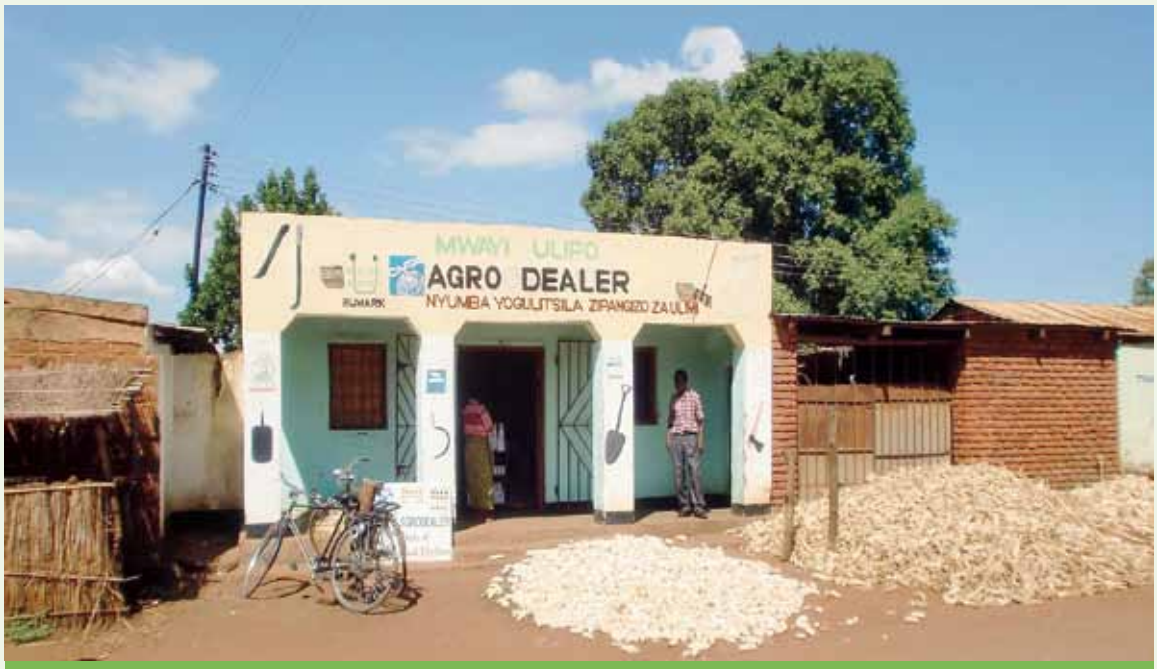
Towards the goal of ensuring environmental sustainability, the government is also urged to take steps to:

- Improve the quality of surface and ground water and develop a system for pollution control;
- Establish contingency water supply reserves and sanitation backups; and
- Integrate rural water supply with participatory hygiene and sanitation transformation.

In summary, the key policy recommendations are:

- Increase budgetary resource allocation to activities that protect the environment,
- Increase the supply of sustainable energy,
- Improve incentive programmes for reforestation, sustainable charcoal production, arresting soil degradation, and avoiding fishery depletion; and
- Improve compliance with environmental laws and policies.

Photo Essay - Malawi's Economic Activity



Sosten Chiotha

Small-scale agriculture is one of the dominant modes of production in Malawi. Agricultural trading centres in villages and small towns (shown above) play a significant role in this economic sector.

Sosten Chiotha

Tobacco is an important cash crop in the Malawian economy. However, world demand for tobacco is decreasing due to its harmful health effects backed by strong antismoking lobby. Malawi needs to diversify production away from tobacco and towards more lucrative, sustainably-grown crops.

Daimon Kambewa

Daimon Kambewa

Mathews Tsirizeni

Fisheries sector is a major contributor to Malawi's economy. Aquaculture carried out in fish ponds help increase fish yields and provide livelihoods for many adding to the food security in the country. Inset: Images of Kachulu fish ponds.

Welton Phalira

Sosten Chiotha

Sosten Chiotha

Income Generating Public Works Programme such as the Sambaisa Irrigation Scheme in Malosa provides employment to communities and contributes positively to the economy of Malawi.

Photo Essay - Unsustainable Charcoal Production

Henry Kadzuwa

Henry Kadzuwa

Charcoal production by burning trees is unsustainable in the long run as natural regeneration is impeded due to soil quality reduction from ashes and therefore destruction of seedbanks (on top soil) as well as destruction of roots of trees from burning. These images were taken at Phirilongwe Forest Reserve.

Left: Tree roots burnt leaving no chances for regeneration; Right top and below: Tree trunks placed in pits for burning.

Henry Kadzuwa

What remains of the forest reserve is a wasteland, and the output of poor quality charcoal. This could be reversed if communities become more aware of the impacts of their actions on the environment which provides livelihood for them.

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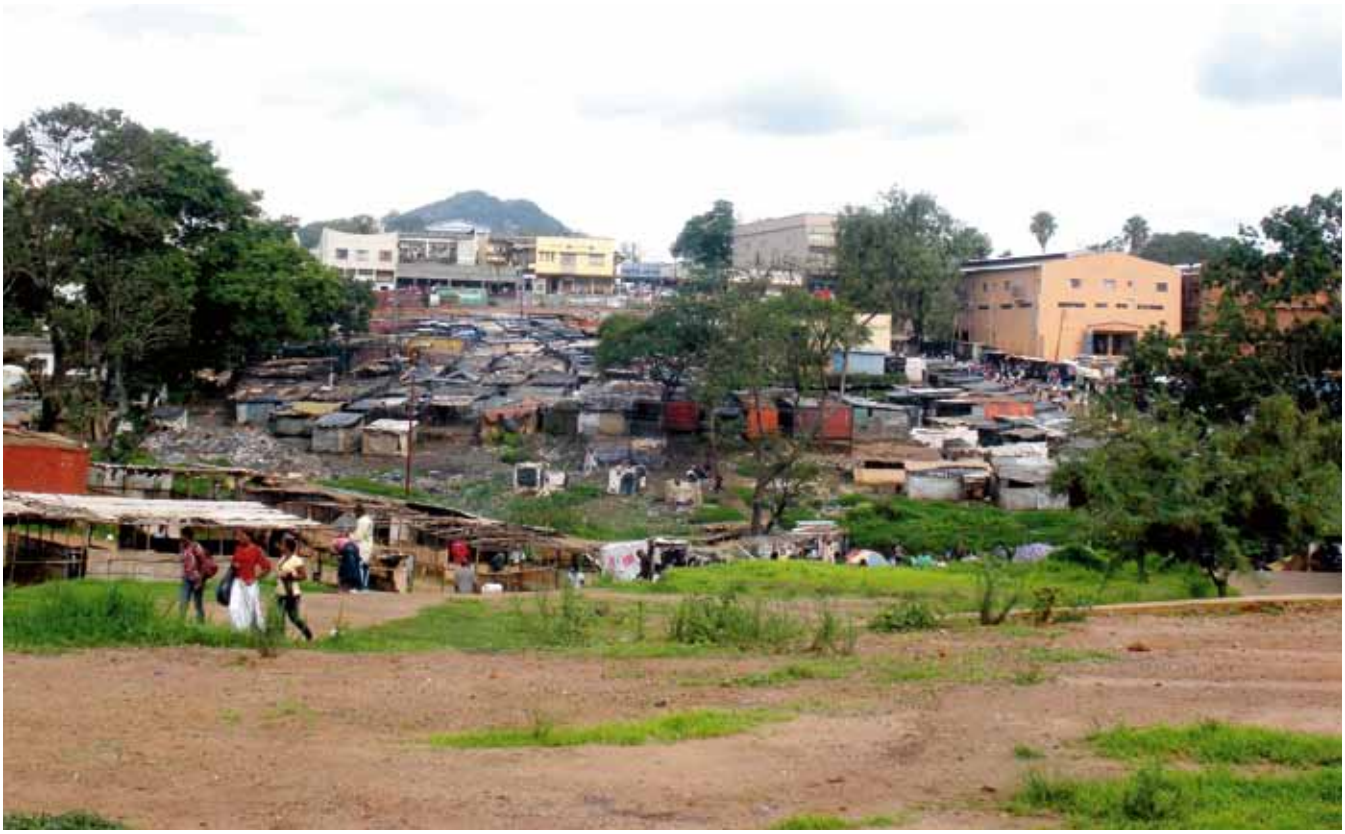
Appendix A

Malawi: Key Economic and Social Indicators

Attribute	2003	2004	2005	2006	2007	2008	2009
Population	11.4	11.7	12.1	12.4	12.7	13.1	13.4
Poverty%	..	..	54.2	45	40	40	..
GDPGrowth Rate%	4.3	4.9	1.4	6.7	8.6	9.8	7.6
GNI (Kbn.)	149.9	176.5	209.5	255.9	334.1	383.9	
Adusted GNI (Kbn.)	138.5	163.4	193.6	236.5	308.7	354.7	..
GNDI (Kbn.)	181	228	269	320	418	487	..
Adjusted Net Savings (% GDP)	-11.6	-13.1	-11.3	12.2	4.2	..	..
Fiscal Deficit (% of GDP)	-12.9	3.1	-1.8	-2.0	1.7	3.6	4.9
Inflation Rate%	9.8	11.5	15.4	13.9	8.0	8.7	8.4
Minimum Lending Rate%	48.9	27.5	33.1	22.5	19.6	19.3	19.3
Current Account (% of GDP)	..	-8.9	-17.1	-18.0	-6.0	-3.9	1.4
Exchange Rate (MK per $)	97.00	108.94	118.47	136.01	140.00	140.53	141.30
Gross Reserves in Months of Imports	1.4	1.3	1.4	1.9	2.2	1.2	0.7

Sources: GoM, Economic Report (various issues), Reserve Bank of Malawi, Financial and Economic Review (various issues) and World Bank, World Development Indicators (various issues).

CHAPTER 2



Unplanned Settlements at Limbe, Photo by Susan Taylor

POPULATION AND HUMAN SETTLEMENTS

Settlements in Zomba, Photo by Welton Phalira

2.1 Introduction

The rate of growth, density, and distribution of a country's population affects the state of the environment. The quality and number of human habitations has a direct relationship with human population growth (GOM, 2004a). Human habitats both affect and are affected by the environment. Infrastructural development resulting from the expansion of human settlements (in such sectors as water, sanitation, waste management, transportation systems, drainage and roads) in turn affect the environment. Understanding trends in human habitat and socioeconomic development is therefore crucial to maintaining environmental integrity.

The Earth Summit, held in 1992 in Riode Janeiro, led to the adoption of Agenda 21, a blueprint for action to achieve sustainable development, including the "Promotion of Sustainable Human Settlement Development". In response, Malawi has formulated several strategies, such as the Malawi Growth and Development Strategy (MGDS), and policies, such as the National Land Policy and National Housing Policy (yet to be finalized). Apart from some isolated initiatives like the "Cities Without Slums" project in Blantyre (Mbayani), there has been little effort to develop a comprehensive approach towards sustainable human settlement planning, development and management.

Low income areas such as Ntopwa in Blantyre, Chinsapo, Mgona, and Mtandire in Lilongwe and Mchengautuwa in Mzuzu are growing at unprecedented rates (GOM, 2008). Efforts to address these problems by government have been very slow and inadequate. Some NGOs, such as Habitat for Humanity and the Centre for Community Organization and Development (CCODE) through the "Malawi Homeless Federation", are assisting the government in addressing the situation (GOM, 2008).

2.1.1 Population Characteristics in Malawi

According to the 2008 census, Malawi's population has tripled since 1966, reaching 13,077,160 people (GOM, 2009a). This is likely to continue to increase as a result of intrinsic population growth, the rate of which is estimated at 2.9% (ibid). The population density is 139 persons per km^2, having increased from 59 per square km^2 in 1977: this makes Malawi one of the most densely populated countries in Africa (ibid). The 1998 Crude Birth Rate (CBR) was about 37.9 births per thousand population whereas the 2008 CBR is 39.5, implying an increase in the total number of infants born to all women during their reproductive years. The CBR is higher in rural areas (40.4) than in urban areas (34.6). At regional level, the CBR is 39.9 in the Northern Region, 40.5 in the Central Region and 38.6 in the Southern Region. The Total Fertility Rate (TFR), the number of births a woman would have if she survived to the end of her childbearing age, dramatically increased from 4.8 in 1998 to 6.3 in 2006 but slightly dropped to 5.2 in 2008 perhaps owing to adoption of family planning methods (GOM, 2006b; NSO,2000; NSO, 2009). However, Malawi's population may still be characterized as highly fertile and the situation is more serious in the rural than urban areas. Children under 18 years of age represent 50% of the population (NSO, 2009). The success of future sustainable development strategies thus lies in the youth, who represent the majority of the labour force.

Life expectancy at birth in Malawi has been reported to be as low as 37 years (NSO, 2000). However, the 2009 Human Development Index (HDI) reported a higher life expectancy, of 52.4 years. This likely reflects the reduced Crude Death Rate, which declined to 10 deaths per 1000 people from 21.1 deaths per 1000 in 1998 (NSO, 2009). This reduction in mortality also partly explains the population growth rate of 2.9%, and implies increased strain on social services.

Malawi's high population growth also is placing considerable and increasing strains on the country's natural resource base. The country's natural resources are of critical importance to its large rural community, and the economy. Agriculture, fishery, and forestry cumulatively account for more than a third of Malawi's GDP. Agriculture alone accounts for 90% of all export earnings, while also employing nearly half of those in employment (GOM, 2004b). Increased population density leads to increased demand for land for human settlements and other related services.

2.1.2 Urbanization

Malawi's land mass is small. The total surface area is 11.8 million hectares, of which 9.4 m ha (80%) is land. This is divided into holdings, of which 1.8 m ha are public, 1.2 m ha are estates, 0.3 m ha are urban and 6.1 m ha are held by customary tenure. The remaining 2.4m ha is covered by water, predominantly Lake Malawi. Eighty-six percent of the population lives in rural areas. These people are primarily dependent on subsistence agriculture; nearly 60% of this group cultivate less than 1 hectare of arable land. Over time there has been a decrease of the rural population due to migration to urban areas.

The regional population distribution pattern is uneven, but shows a steady increase in the Northern and Central regions from 1987 to 2008 (Table 2.1). However, the population of the Southern region declined over the same period. The urban population has increased from 10.7% in 1987 to 15.3% in 2008 but concentrated in four major cities of Blantyre, Lilongwe, Mzuzu and Zomba.

Table 2.1: Proportion of Urban and Rural Population % Distribution of People.

Region (Malawi)	1987	1998	2008
Urban areas	10.7%	14.4%	15.3%
Rural areas	89.3%	85.6%	84.7%
Northern Region	11.4%	12.4%	13.1%
Central Region	38.9%	40.9%	42.1%
Southern Region	49.6%	46.6%	44.8%

Malawi remains the least urbanized country in Southern Africa but it has a higher urban population growth (5.2%) than the regional average of 3.5% (UNCHS, 2001). Declining land sizes and earnings from agriculture have induced this migration (NSO, 2005). Increased urbanization could also be accounted for by extension of urban area boundaries to incorporate surrounding villages and rated properties developed in the urban fringe. The opportunities expected in urban areas are not available because urban employment is not growing as anticipated. These migrants find ill-equipped schools, over-burdened medical facilities, unreliable public transport, intermittent electricity and water supplies, and appalling sanitation facilities. Shrinking budgets for social services and indifference at the policy level have left city assemblies unable to cope with the proliferation of slums and squatter communities. This may worsen environmental degradation as the poor urban dwellers exploit fragile ecosystems including floodplains, steep hillsides and wetlands.

2.2 The State of Human Settlements in Malawi

The fundamental components of human settlements include adequate and affordable shelter, safe and affordable drinking water, and appropriate and affordable management systems for domestic and industrial waste (UN-HABITAT, 2010).

2.2.1 Household and Housing Characteristics in Malawi

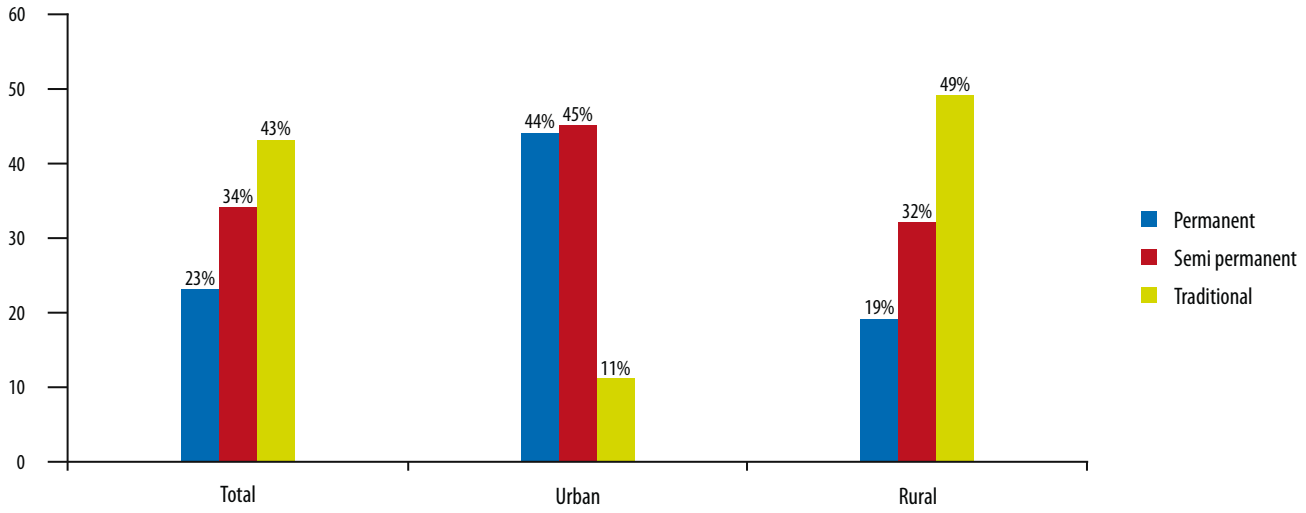
The 2008 Malawi Population and Housing census main report showed that household size by region is 5.2 (North); 4.7 (Central); and 4.4 (South), with a national average of 4.6. According to the 2009 NSO report, there were 2,869,933 dwelling units in Malawi. However, using the average household size of 4.6, only 2,842,861 houses would be required to house the population. However, data is not available to assess the actual demand for housing. Over 100 000 people are waiting to be allocated a house through Malawi Housing Corporation, suggesting failure to meet urban housing demand (UN-HABITAT, 2010). It is estimated that about 21,000 houses will be needed every year to meet the rising demand for housing in urban areas by 2020 (UN-HABITAT, 2010). This suggests that Malawi's cities are ill-equipped to deal with the growing number of people migrating into urban centers.

2.2.2 Poor Quality Housing and Unplanned Settlements

Poor quality housing is visible in rural areas and urban unplanned settlements. The Population and Housing census report (2009) indicated that about 43% were traditional housing, 34% semi-permanent and 23% permanent (Figure 2.1). The building materials for permanent house include; burnt bricks, concrete or stones and iron sheets, tiles, concrete or asbestos for the roof. The semi-permanent house is built of sundried bricks and grass thatched, while a traditional house is built of mud walls with a thatched roof.

The major environmental problem in human settlement especially in urban areas is existence of slums particularly in unplanned/squatter settlements. In 2001

Figure 2.1: Population in Dwelling by Housing Characteristics.



Lucy Chipeta

A traditional house in one of the squatter settlements.

it was estimated that over 90% of Malawi's urban population lived in slums characterised by, among other things, overcrowding, lack of potable water and poor sanitation facilities (UNCHS, 2003). The high percentage of households living in traditional housing and construction of poor quality housing may be generally due to lack of capital for house development.

In Malawi there are few institutions that support house construction. These include New Building Society, some commercial banks, employer housing schemes government, City Assemblies, Malawi Housing Corporation, Malawi property investment Corporation and Malawi Government rural housing loans (UN-HABITAT, 2010). Finance is accessible to fewer than 35% of the urban population and less than 16% of urban households can afford an average house. No government subsidies are available and development finance is dear (Chapinduka and Cloete, 2007). In rural areas credit facilities are almost non existence apart from Habitat for Humanity, which builds houses for the poor in rural and peri-urban areas.

The high cost of building materials in relation to household income has contributed to construction of poor quality housing. For example, the average price of the cheapest low cost house is estimated at MK300 000.00; this greatly exceeds the average annual per capita income (Kadale Consultants, 2009; Manda, 2009; UN-HABITAT, 2010). This flags a clear need and demand for affordable housing microfinance.

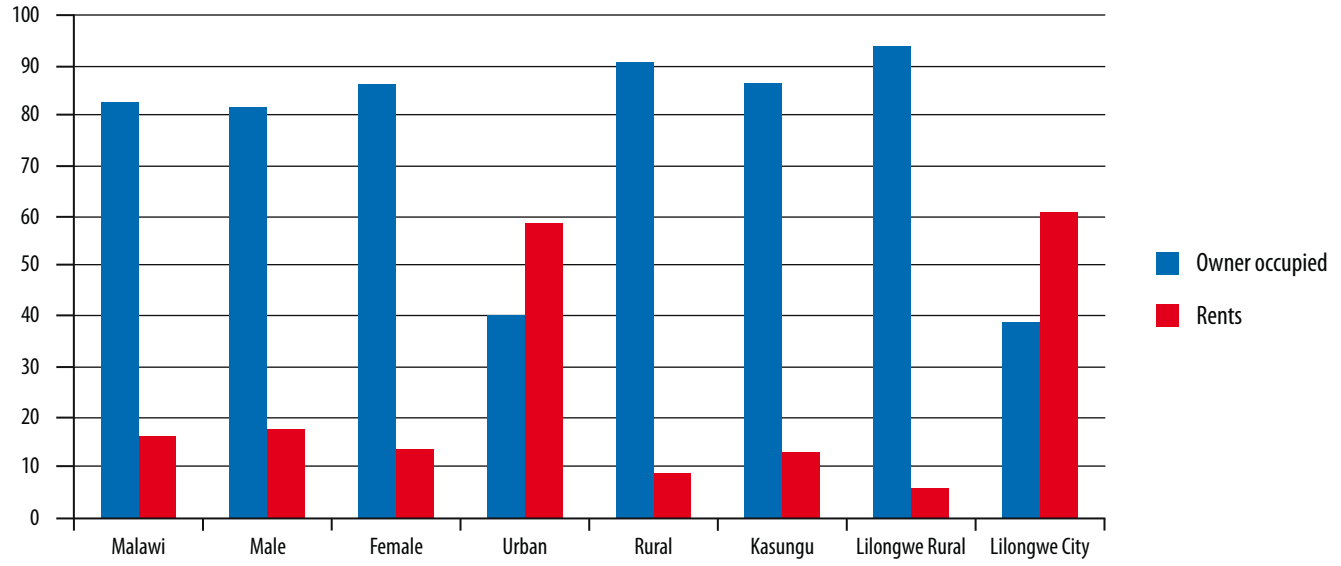
The increase in human population means an increase in demand for housing. However, due to deforestation, the materials necessary for construction have become scarce. This has a negative impact on both traditional and modern housing construction needs.

2.2.3 Housing Tenure and Occupancy

"Tenure" refers to the rights and obligation governing how land or housing is held, while "occupancy" refers to the number of people living in a house. At the national and regional levels, more women than men are accommodated in their own houses (Figure 2.2). This may be attributable to the higher population of women in the country, as well as to the predominance of matrilineal inheritance patterns in most parts of the country.

In urban areas, a large number of households live in rented accommodation. This subjects the majority to insecurity of tenure: through forced eviction due to non-payment of rents, or when land-lords want to raise the

Figure 2.2: Type of Tenure by Gender, and Place of Residence.



Source: Welfare Monitoring Survey, 2008, (NSO).

rents. In squatter settlements located in areas not zoned for residential use, people can be evicted by the city authorities. Insecurity of tenure is a typical characteristic of unplanned settlements.

Overcrowding is a typical condition in most unplanned settlements, where houses are relatively smaller and more cramped. A study of informal settlements in three Malawian cities indicated that 37% of households had 6 or more members living together, 22% had 4 members and 16% had 3 members (Manda, 2009). The same study established that 15% of the plots had more than 2 households on a plot, 13% had 4 households and 11% had about 5 households. Normally the traditional housing plots are about 400m^2, implying overcrowding on the plot as well as within the household (Figure 2.3).

2.2.4 Environmental Degradation

House construction, especially in rural, unplanned and Traditional Housing Areas (THAs) adversely affects the physical environment in various ways. For instance, areas used for brick moulding are heavily degraded leaving borrow pits that act as waste dumping sites and breeding grounds for mosquitoes and other disease vectors. However, these can be put to good use for irrigation or fish farming.

Construction using burnt bricks contributes to deforestation leading to biodiversity loss, soil erosion and soil infertility (Dagba *et. al.*, 2005; Zingano, 2005). Apart from the above impacts, squatter and slum development leads to loss of aesthetic beauty of the settlements evidenced from indiscriminate waste disposal, poor drainage, visibility of unmanaged waste water, poor sanitation, erosion in the settlements, poor visual appearance of construction materials such as grass/plastic cover and unkempt mud walls (Figure 2.4 gives types of building materials used in Malawi).

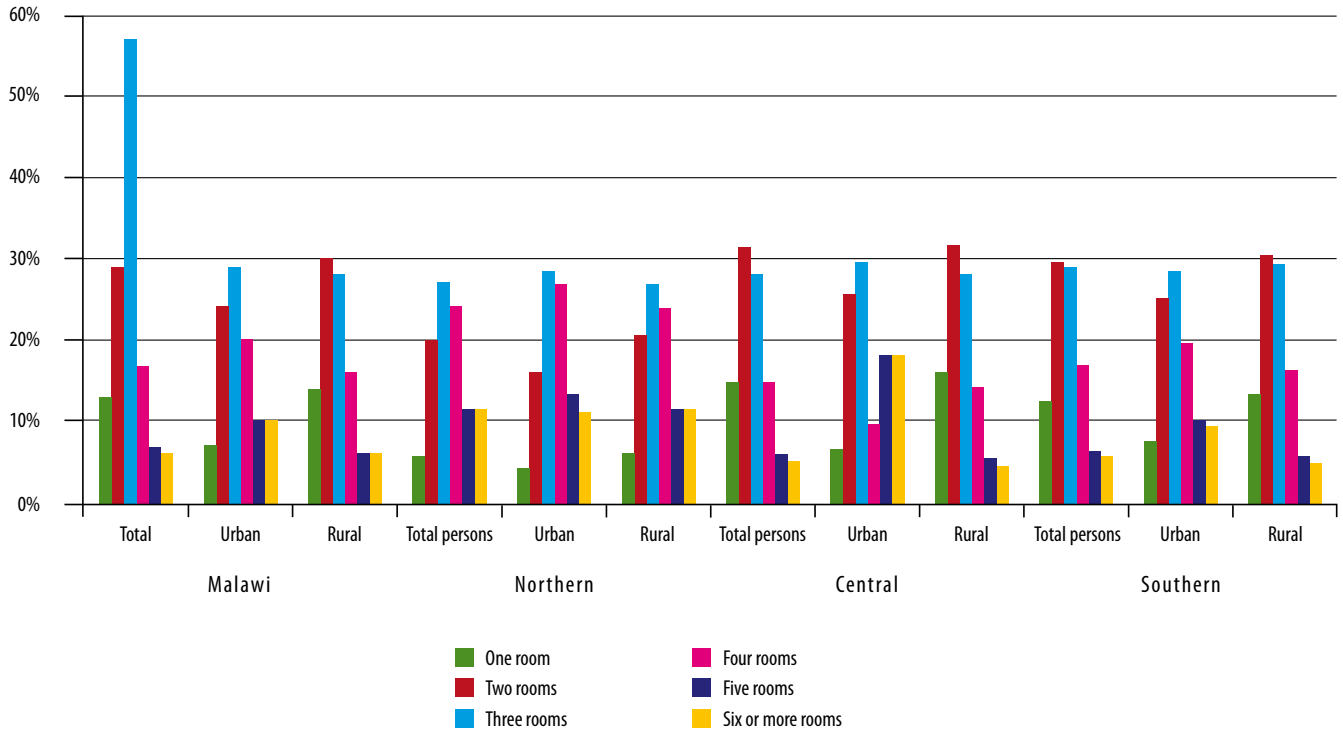
Sosten Chiotha

Construction using burnt bricks contributes to deforestation, as wood is used in brick kilns.

2.2.5 Safety of Housing

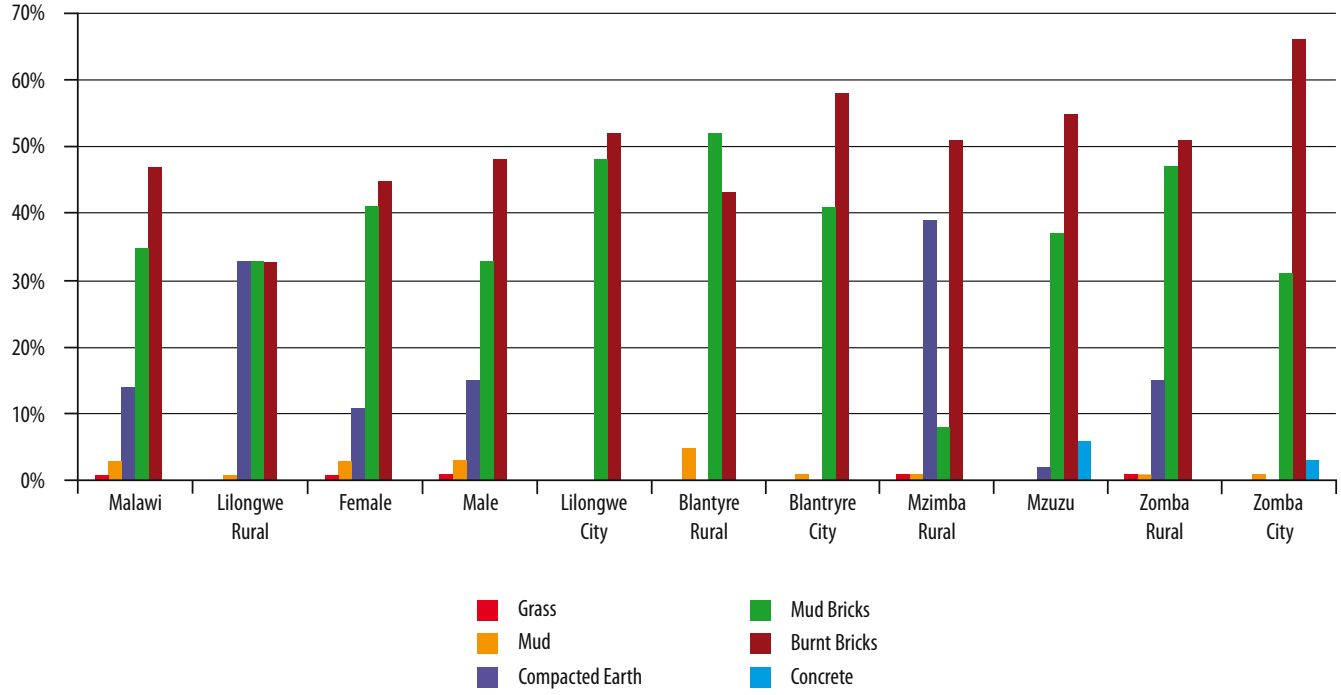
There is also need to have national construction standards to safeguard against natural disasters such

Figure 2.3: Number of Persons by Number of Rooms Residing.



Source: Welfare Monitoring Survey, 2008, (NSO).

Figure 2.4: Building Materials used in Malawi.



as earthquakes (as experienced by Karonga district in 2009) and weather related disasters. In addition, as most Malawian houses are built of temporary materials such as grass, they are vulnerable to fire hazards.

2.2.6 Urban Agriculture

Urban agriculture contributes to the food security of the urban poor and is practiced in most urban areas of Malawi. The city authorities were more concerned with agricultural activities taking place along streams and Malawi housing corporation also tried to discourage urban agriculture on their land especially in high density housing areas but this has not been seriously adhered to. In Lilongwe for instance the1986 zoning scheme reserved about 2,300 hectares of land for agricultural purposes (City of Lilongwe, 1986). The primary driving force behind the continuous increase in urban agriculture is an increase in rural urban migration as well as the worsening of the economic situation of the urban population. Although the various agricultural activities have contributed to food security and helped to supplement the incomes of the low income households, they have also contributed to environmental degradation, especially siltation of water and contamination from fertilizers.

Initiatives Taken by the Malawi Government

National Policy and Legal Considerations for Human Settlements

Postcolonial Malawi has attempted to address human settlement in its policies by prioritizing access for all to 'housing that does not leak' (UN-HABITAT, 2010). The Vision 2020 recognized the problem of rural-urban migration as exacerbating the development of squatter settlement. The policy strategy as stipulated in vision 2020 was to plan development, eliminate squatting in urban areas, control unhygienic behaviour, street vending and provide potable water. Implementation of the above strategies involve: physical planning to cover all settlement, enforce building codes enabling the building of permanent houses, reviewing and enforcing policies and ordinances on settlement patterns.

The 2002–2006 Malawi Poverty Reduction Strategy Paper (PRSP) mainly focused on sustainable poverty reduction through socio-economic and political empowerment of the poor but did not give attention to the issues of human settlement including urban development and housing. But the emphasis on poverty reduction may imply improvement in the quality of settlements. The 2006 Malawi Growth and Development Strategy (MGDS), which succeeded the PRSP, identified land and housing as critical to socio-economic development. The National Environmental Policy (2004) and the National Environmental Action Plan (NEAP, 2004) recognize the need to improve human settlements and recommend promotion of urban and rural planning services that provide all inhabitants with a healthy environment.

The National Environmental Policy (2004) recognizes the need to improve human settlements and recommends promotion of urban and rural housing planning services that provide all inhabitants with "healthy environment and health concerns. In addition NEP recognizes that urban, district and rural planning and development activities should incorporate human settlement and

health concerns. The National Environmental Action Plan (NEAP) similarly advocates that human settlements should incorporate environmental concerns as well as disaster preparedness. Although the health status of human settlements is of concern in this policy, enforcement of the policies remain a challenge.

The Malawi National Land Policy of 2002 provides an enabling environment for investment in housing. It recognizes the need for equitable access to land in rural and urban areas, arrests growth of unplanned settlements and regularizes land tenure. The Land Policy proposes transfer of the administration of urban land leases to respective local governments in line with the Decentralization Policy to improve development control and land allocation to reduce illegal development (ALMA Consultancy, 2006). There is no deliberate settlement policy to guide development of rural settlements but the National Land Policy extends the application of planning and development control to all rural and urban areas. This is likely to control illegal development and building on environmentally fragile land. The policy also grants land tenure security to investors, developers and individual households in urban areas, in order to encourage planned development and ensure timely and effective utilization of land.

The National Physical Development Plan (GoM, 1987) makes provision for a decentralized urbanization strategy by promoting the development of small and medium sized town to usher migration away from large cities. This is regarded as a way of reducing problems of housing, sanitation and congestion in big cities. The National Decentralization Policy (GoM, 1998) followed and the Local Government Act (1996) which devolved local projects implementation including development and management of low income housing to local assemblies. However the implementation of the policy is constrained by influence of central government in local politics, recruitment and project selection (UN-HABITAT, 2010). The 1999 National Housing Policy (NHP) aims at regulating the provision of housing. It also provided framework for the upgrading of informal settlements but it still lacks sustainable solution to environmental issues related to housing as the development of unplanned settlements without basic services is continuing. To respond to the challenge of increasing population pressure on settlements, the government has formulated a Population Policy which stipulates the minimum number of children of 4 per family.

Family Planning Programme

The goal of this programme is to reduce infant and maternal mortality by lengthening the intervals between births to allow women adequate time to recover from the effects of pregnancy and child-birth and to look after the nutritional and health needs of the children and women themselves. This plan was set in place in 1999 (GOM, 1999). One of the specific objectives of the programme was to reduce population growth rate from 3.2% to 2.4% by the year 2002. However, population growth rate in 2002 was at 2.3%. The target of 2.2% was reached in the year 2003. Nevertheless, looking at the current data as collected by the Malawi National Statistical Office in 2008 Malawi Population and Housing Census, it shows that Malawi's population has increased with a growth rate of 2.8% (NSO, 2009).

Legal Framework for Human Settlements

The Environment Management Act (1996) recognizes the need for living in a clean environment and therefore stipulates enforcement against non compliance by the Department of Environmental Affairs. The Town and Country Planning Act (1988) complements the Environment Management Act as it makes all unauthorized development in a planning area illegal and the Department of Physical Planning in the Ministry of Lands, Housing and Urban development in collaboration with cities are responsible for implementation.

The Local Government Act of 1998 mandates local authorities to do all planning and this gives an opportunity for easy control of human settlement development and the ministry of Local Government and Rural Development in liaison with local authorities are responsible for implementation and enforcement. The power of controlling development is vested in the minister responsible for planning but delegated to local authorities in Blantyre, Lilongwe, Zomba and Mzuzu in which town planning committees have been established under the Town and Planning Act 1988 and Local Government Act 1998. The committees are mandated to oversee development control. However, Malawi is yet to formulate specific polices to deal with rural settlements.

The Role of Civil Society

Civil society and NGOs have contributed to the improvement of the human settlements by providing basic services and low cost housing. The National Industry construction Council has contributed in training of artisans and also development of low cost technologies.

However, most of the policies relating to settlement are not integrated. Our analysis specifically isolates ineffective policies, cumbersome land allocation procedure, reactive planning, lack of political commitment and lack of human and financial resources as being responsible for development of unplanned settlements in urban areas and poor quality housing in rural areas. Some of these issues are summarized below:

Inefficient Policies

There is no comprehensive policy providing for guidance to deal with the unplanned settlements. There is no policy which explicitly deals with insecurity of tenure for the urban dwellers. The 1999 Malawi Housing Policy partially addressed the issue of insecure tenure through upgrading of settlements The Environmental Policy (2004) recognizes the existence of slums but is not backed by land related policies. The Acts recognize the illegality of slums but do not provide solutions for their legalization. Local government and planning authorities have treated the issue of security of tenure on ad-hoc basis by regularizing land through land adjudication and registration.

Cumbersome Land Allocation Procedure

The acquisition process in the formal sector is cumbersome, complex and time consuming and it is not known to majority of the population in urban areas. Lack of knowledge of the procedure for land acquisition makes provision in the informal sector attractive. In these settlements land is easily accessed at a reasonable cost. Land is allocated by chiefs who have been incorporated in the cities due to expansion of the boundary, and these continue their traditional role of land allocation. Some of the land lords in the informal sector may not necessarily be chiefs but might be those that have lived in the area for a long time and assumed land lordship. According to Chome (2002) the traditional system of land acquisition also provides security of tenure to the whole family. This is through registration of all members of the family at the chiefs' place so death of the spouse does not subject the surviving spouse and children to property grabbing (Chome, 2002).

Incomplete Conversion of Customary Land to Public Land

It seems incomplete conversion of land from customary to public in planning areas has also contributed to squatter development. The government has declared land public without compensating or resettling the customary land owners. It seems that apart from Lilongwe City where people were resettled and compensated, many cities expand outwards incorporating villages with their customary titles without officially compensating them and officially converting the customary tenure to public land.

The inability of the planning department to prepare plans for all rural and urban settlement has contributed to unplanned development. Also, the Physical Planning Department has not been able to prepare plans for the whole country. According to various records from Town Planning, structural plans have been prepared for almost all district centers, growth centers and major trading centers to guide development. Most of these plans have been non operational because of lack of legality of boundaries. Due to lack of capacity in the public and private sectors, there is a deficit of 817 (88%) of the total number of required professionals) (Mkwambisi, 2009). In the technical sector there is a deficit of about 92% (Appendix)

2.2.7 Government Initiatives

Public Housing Programmes

Malawi government after Independence established Malawi Housing Corporation (MHC) to construct public housing. This organization built several houses to meet the demand for the middle and low income households; however the demand has surpassed supply. At present the estimated demand for housing is 100, 000 and the MHC supplies about 100 houses per year. The urban poor have failed to benefit and their option remained in informal housing. To complement MHC efforts, some public institutions and NGO like Habitat for Humanity and CCODE are assisting in provision for housing for the poor in Malawi The Rural Housing Programme was launched in 1981 in order to address the problems of shortage and quality of housing in rural areas.

Sites and Services

On recognition of the contribution of households to build own houses in informal settlements, sites and services were introduced in the 1970s. These are meant to provide low income people with serviced plots that have tenure security but where houses can be constructed by plot owners. In Malawi the sites and services have played a major contribution to legally acceptable housing development, but as a result of not meeting the demand most of the urban poor resort to living in unplanned settlements.

Some unplanned settlements were upgraded in Ndirande, Mbayani, and some secondary centres under the "cities without slums" initiatives. In order to alleviate the housing problems and also to encourage house ownership the government introduced the house ownership scheme which was offered to civil servants through a special fund.

Rural Growth Centres and Secondary Centres Project (Chitukuko cha Mmatauni)

Rural Growth Centres and Secondary Centre Development Programme were initiated to provide lower level urban settlement hierarchy to attract low and middle income workers thus decongesting major urban areas.

The Proposed National Housing Policy and Production of Malawi Urban Housing Sector Profile

The government has reviewed the 1999 National Housing policy to try to make provisions for the

upgrading of unplanned settlements. This Housing Policy also makes provision for access to housing finance and general improvement of living conditions in unplanned settlements. Malawi government also embarked on development of urban housing profile with the support from UN-HABITAT. The housing profile document provides an understanding of the critical housing issues and how shelter is delivered and those factors that are hindering improved access to housing.

Training Courses

The government in preparation for decentralization of human settlement planning has embarked on a number of course in physical planning, land surveying, quantity surveyors and land administrators in the universities of Mzuzu and University of Malawi and at Natural Resource Colleges for the technicians. Land should be provided at affordable cost, this entails reducing plot sizes or increasing the density in housing areas.

2.3 Water Supply, Sanitation and Waste Management in Human Settlements

2.3.1 Access to Safe Water

Provision of quality water, access to safe water, sanitation and management of waste, have remained perpetual challenges in human settlements, despite government's efforts to alleviate these problems (GOM, 2006). Providing the population with potable water within 500 meters of walking distance is one of the key policy statements. By 1998, about 26% of the Malawian population used boreholes and 25% were using unprotected wells as main sources of drinking water.

Only 25% of the population used piped water inside a dwelling unit (NSO, 2000). However, 2008 Malawi's census final results indicates that about 48% of the population prior to the census used boreholes as a main source of drinking water in the dry season, 18.3% used unprotected wells and 11.9% used community stand pipes (NSO, 2009).

Seasonal variations also determine how households access water. More households proportionately draw water from unprotected sources during the wet season. Proximity to areas that become swamps during the rainy season is a factor; use of such swamps reduces time needed to fetch water (NSO, 2009). Nonetheless, the proportion of households with safe drinking water increased between 2005 and 2007 to 81%, and is projected to reach 91% by 2015, far exceeding the MGD target of 74%.

Access to water resources has significantly improved to about 75% in 2006 (NSO, 2009) but tremendous challenges in accessing safe water abound due to pollution (Kwanjana, 2009). The high rate of urbanization and rapid population growth in urban settlements have forced residents to source water from long distances and unprotected areas. There is relatively more access to piped water among urban dwellers than in the rural areas but the proportion of households accessing water from unsafe sources has increased between 1998 and 2008. The informal settlements are served by water kiosks that are managed by the communities. Water managed by communities has a myriad of problems including transparency issues, failure to pay bills, and hygiene (Manda, 2009).

Women, men and children use water resources and systems differently due to practical and strategic needs and gender norms prescribed by society. In Malawi, this specialization means that women and girls are responsible for collecting water for cooking, cleaning, and washing. Women are therefore the primary managers of water and sanitation (Figure 2.5).

2.3.2 Sanitation and Hygiene

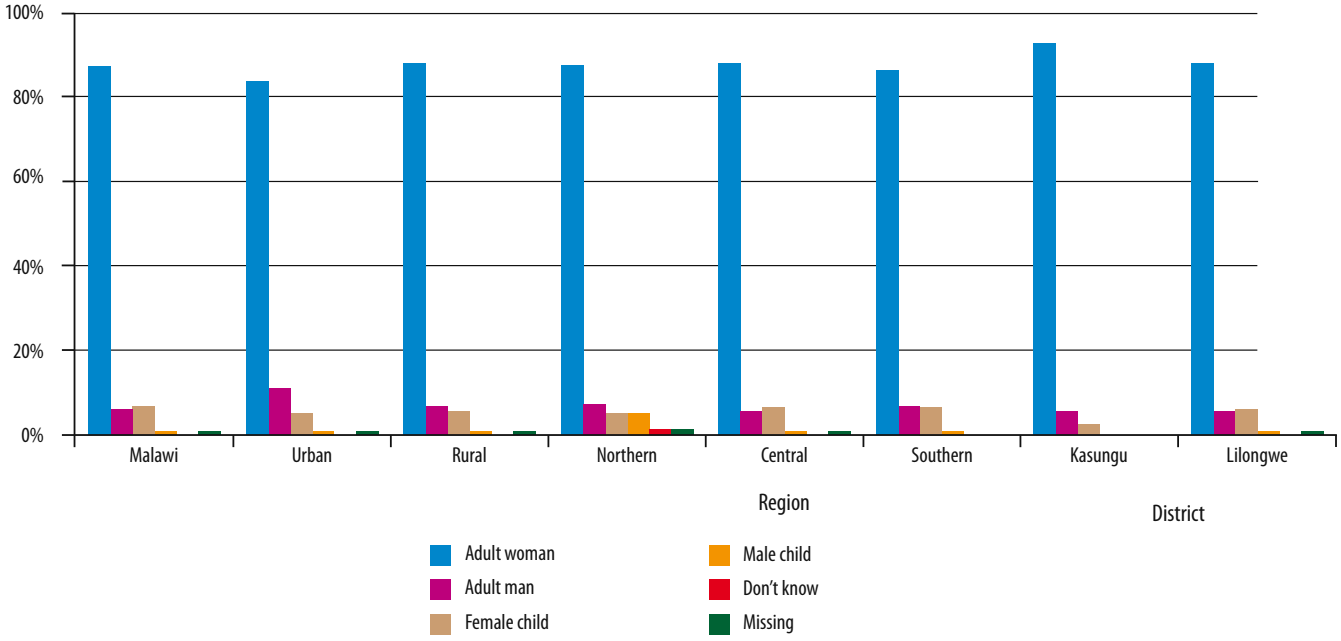
The Malawi National Sanitation Policy focuses on access to "improved sanitation facilities and services through health education, adoption of safe hygiene and practices, construction of improved sanitation facilities at household and community level, and in institutions, and promotion of safe re-cycling of liquid and solid waste for sustainable environmental management and socio-economic development (GOM, 2008b). The policy's strategy is focused on halving the proportion of people who do not have access to basic sanitation, by improving access to good sanitation facilities from 81% to 100% by 2015. (GOM, 2008b). Poor sanitation remains a major concern in Malawi, as it puts pressure on health systems due to increased water and airborne diseases. There are two major avenues of contamination; the use of water from unprotected wells and improper storage facilities, and the practice of locating toilets near water sources.

Data obtained from the Department of Health reveals that incidences of cholera in Malawi were mostly found in high density settlements. This indicates that unhygienic conditions due to congestion, poor water sources, unavailability of toilet facilities, and indiscriminate disposal of refuse, have a serious negative impact on human health in Malawi.

2.3.3 Waste Management

As population density and the rate of urbanization rise, waste management poses a greater challenge. In future, waste management is expected to become more difficult

Figure 2.5: Who is Responsible for Collecting Water?



and costly for both the government and city residents. Various types of indecomposable wastes are generated in cities, which, if improperly managed, negatively affect the aesthetic value of the environment and increase the prevalence of long-term pollution.

Disposal of waste can be problematic and create human and environmental health problems. Figure 2.6 shows that about 50% of households dispose of their waste in rubbish pits. In most cases, households from the selected locations in the cities of Lilongwe, Blantyre and Mzuzu dumped waste in a pit within the plot (42.3%), or by throwing waste on roadside (11.9%). A significant number of households (25.4%) did not say where they dump waste; from this, it can be supposed that many respondents dump waste anywhere they can find empty space. Such behaviour may give rise to epidemics and create breeding grounds for disease vectors.

2.3.4 Responses

The Government of Malawi created Water Boards to facilitate the supply of water services in both rural and urban areas. But these water boards have had difficulty meeting the demands of the increasing population; as a result, many have suffered from financial hardship. Water boards do not generate adequate funding to fund new connections and extension to unplanned settlements. In addition, Water Boards incur losses as a result of illegal connections, unreported leakages, and default in payment of bills by water user association kiosks and individuals (ALMA, 2006).

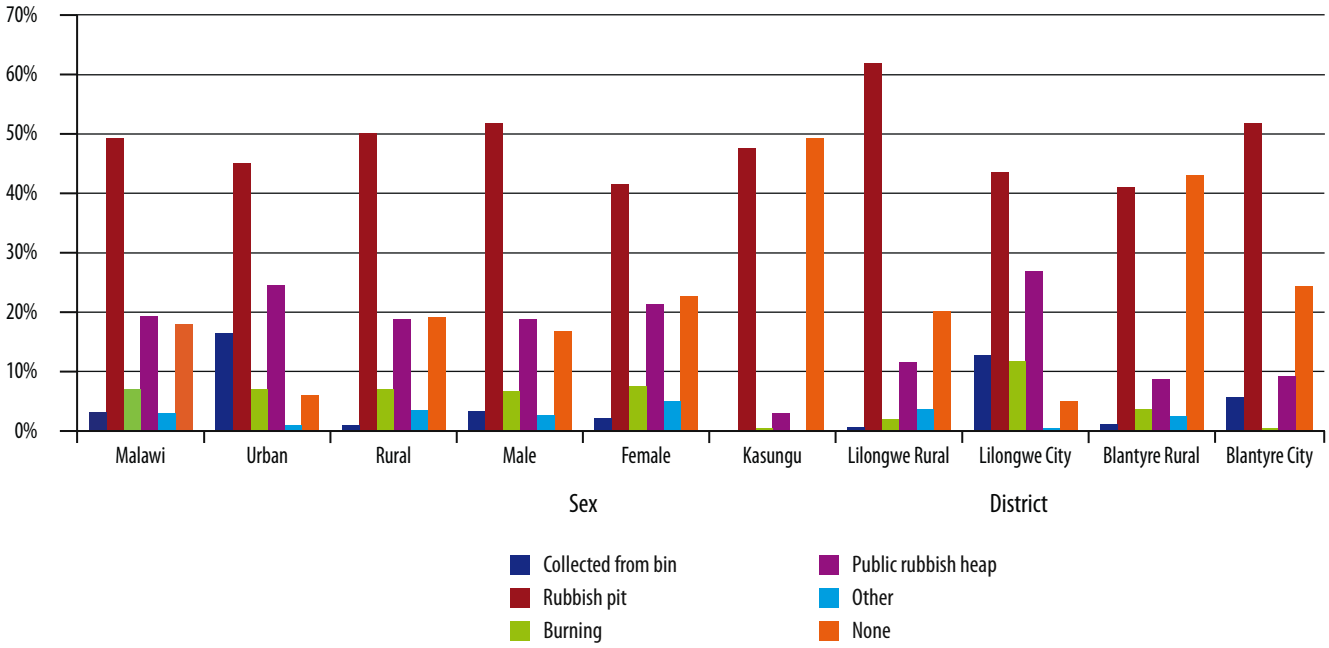
Funding to extend water into non-services settlements has been provided by the European Union-ACP Water Facility and the European Investment Bank (UN-HABITAT, 2010). Some funding of small water and sanitation projects in informal settlements has also been extended by the Malawi Social Action Fund (MASAF), Ministry of Irrigation and Water Development (MoIWD), European Development Fund-MOP and charitable organizations such as Water for People, Water Aid, Action AID, CCODE, Plan International, and Care.

Malawi has formulated a number of strategies that will address settlement issues, such as the Malawi Poverty Reduction Strategy and Malawi Growth and Development Strategy. The latter includes a goal to 'increase access to good drinking water and sanitation through the construction and rehabilitation of water facilities and reduction of the incidence of waterborne diseases (UN-HABITAT, 2010).

Lucy Chipeta

Waste disposal in an unplanned settlement in Kasungu.

Figure 2.6: Percentage Distribution of Households by Type of Waste Disposal.



Source: Government of Malawi, 2005.

The government has also reviewed several policies such as Water Policy, Sanitation Policy, Waste Management Bylaws, and Public Health Act in order to harmonize activities and programmes. It has also restructured institutional responsibility for water and sanitation; for example, the Ministry of Water and Irrigation is now responsible for both water and sanitation.

2.4 Transport Infrastructure and Human Settlements

Transport infrastructure is a key component of an enabling environment for private sector-driven growth and provision of timely and quality social services. Road-based transport is the most dominant mode in Malawi, due to the country's extensive road network (GOM, 2005; NRA, 2005; GOM, 2006). Roads are the only mode of transport that provides vital links between urban centres, peri-urban centres and remote areas of Malawi. Currently, road infrastructure handles more than 70% of the internal freight traffic and 99% of internal passenger traffic. Additionally, road transport handles more than 90% of international freight and passenger traffic. Evidently, the road infrastructure network plays and will continue to play a crucial role in the social-economic development of Malawi.

The Government of Malawi has prioritized the need for a designated public road infrastructure network that ensures provision of adequate, safe, reliable, efficient and economical transport services in order to meet the country's current and future road transport needs and to promote economic growth (NRA, 2005).

The official road network extends across 15,451 kms, and comprises main, secondary, tertiary, district and urban roads (as shown in Appendix). An ongoing study reclassifying the road network shows that the total network, including undesignated roads, is approximately 28,000 kms. The roads included in this study will be incorporated into the designated road network once gazetted (NRA, 2005; NRA, 2010).

In Malawi, walking is the most common travel mode in both rural and urban areas. About 50% of workers in low income urban areas daily walk distances of 3–5 km daily because public transport is too expensive. However, bicycle use for private and public transport has also dramatically increased. This is a positive, environmentally friendly mode of transportation that the government can encourage. Motor vehicles are complimented by handcarts, animal carts and wheelbarrows in the transportation of goods and services, especially over short distances (UN-HABITAT, 2010). These uses are important for road design, upgrade and maintenance. Most roads lack designated foot and cycle paths.

2.4.1 Key Concerns for Transport Infrastructure

The efficient operation of transport infrastructure and services is critical to attainment of the MDGs in Malawi. However, Malawi's transport infrastructure has a number of problems including

- Poorly maintained access roads
- Limited air links,
- Limited freight and rail capacity

The inadequacy of the transportation infrastructure results in high costs of production for businesses and industries. Transportation accounts for 55% of production costs in Malawi, compared to 17% in other less developed countries. This is compounded by Malawi's landlocked status, which is a major disadvantage to businesses as it increases the costs to importers and exporters. If the country is to register positive economic growth these limitations need to be addressed (GOM, 2006; United Nations Economic and Social Council, 2009).

Although African countries share the problem of high transport costs, landlocked countries face the most excessive transport costs, limiting both domestic and regional connectivity. In view of this, the Malawi Government has prioritized the development of transport infrastructure particularly road, rail, and marine. These were selected as key priority areas for investment in the five years between 2006 and 2011. In 2005, as part of the same initiative, Malawi began promoting the re-opening of the Shire-Zambezi Waterway to facilitate access to the Indian Ocean and the international market. The development of this route is intended to reduce inland transportation costs by 60% (GOM, 2005).

Road Transport

High transport costs and poor access to some parts of the country remain an impediment to economic growth in Malawi. Poor access roads mainly result from the deteriorating condition of the country's overall road network, especially in the rural areas and in unplanned urban settlements. This problem is compounded by the enormous backlog for maintenance of the road infrastructure which creates unsafe and impassable roads. According to the NRA (2005), 37% of Malawian roads are in poor condition, 34% in fair condition and only 24% in good condition. Poor quality feeder roads also impact on the ability of rural areas to engage in economic activities (NRA, 2005; GOM, 2006).

The long-term goal of the MGDS is to reduce the cost of road transportation in order to contribute positively to economic growth. As such, emphasis placed on improving mobility and accessibility to key road corridors within and outside Malawi while facilitating improved mobility and accessibility of rural communities to goods and services in the rural areas at low cost. The key strategies are expected to concentrate on ensuring availability of adequate, safe, reliable, efficient and economical transport services in key corridors that meet the country's current road transport needs and aligned to the future vision (GOM, 2006). Some of major strategies include:

- Providing adequate network of roads based on appropriate standards through rehabilitation and upgrading of "all weather" roads to meet sub-regional agreed standards;
- Undertaking routine road maintenance to clear backlog through use of modified "Performance-Based Term Maintenance Contracts";
- Upgrading all unpaved roads from fair to good condition (NRA, 2005; GOM, 2006).

The National Roads Authority (NRA) was established in 1998 under an Act of Parliament (Act No. 13 of 1997) as an autonomous body under the Ministry of Works and Supplies (now Ministry of Transport and Public Works). Its mandate is to maintain and rehabilitate all designated public roads in Malawi using dedicated revenue from the fuel levy and other road user charges (NRA, 2007). Each year funds are allocated to meet its mandate and achieve the MGDS goals. With the new policy drive and some progress done, it is expected that by 2011, 71% of the road network will be in good condition, 18 % in fair condition with only 11 % in poor condition (GOM, 2006).

Water Transport

Water provides a better and cheaper alternative means of transport for certain parts of the country and as a link to the sea. Apart from the local lake transport benefits (of Ilala and Mtendere) of transporting bulky goods and linking remote areas and the Islands of Chizumulu and Likoma, Malawi has not benefited much from this mode of transport because the port system is inadequate to handle the present exports of agro-processing industry and imports (GOM, 2006). Water transport has been prioritised as an alternative means for export-led growth. Government, therefore, has an obligation to maintain the ports and explore ways to involve the

Sosten Chiotha

Transport using waterways is important as it links remote areas including islands. Above: Ship Ilala.

private sector. The Shire–Zambezi waterway project, for example, entails the construction of a 238-km waterway from Nsanje through the Shire and Zambezi rivers to the proposed Port of Chinde, in Mozambique. Nsanje World Inland Port will integrate the four modes of transportation of road, rail, air and water into a multimodal transport system that will connect Malawi to other regional sea ports. The project is designed to benefit Malawi, Mozambique, Zambia and Tanzania and may also benefit Burundi, Rwanda and Zimbabwe through links to different transport corridors. COMESA, the SADC and NEPAD have embraced the project as a regional initiative that will foster regional integration in line with NEPAD objectives (Zhuwakinyu, 2008).

Rail Transport

Rail transport still remains the cheapest form of transport in Malawi. However, its usage is limited but has potential for growth especially for moving both domestic and international cargo. Over the past decade, the networks had largely been neglected and vandalised. Malawi Government long-term goal is to have an efficient, affordable and effective rail network that eases pressure from the road network and provides an alternative means of transport both to people and transportation of goods. The development of the rail network will have to be linked to target areas such as ports, industrial sites and national borders. For example, development of Nsanje World Inland Port has initiated plans to maintain and rehabilitate the railway system from Nsanje to Blantrye, Lilongwe, Salima and Mchinji (GoM, 2006).

Air Transport

Air Transport is the most expensive mode of transport for Malawi, with landing rights restrictions and fees which are prohibitive and uncompetitive. The long-term goal of the government, therefore, is to reduce the cost of air transportation while ensuring international competitiveness.

2.4.2 Transportation Challenges

Private Car Ownership

Private car/vehicle ownership is low in Malawi compared to other African countries. In the early 1990s, the country had two cars per thousand people. Although car ownership has increased from 20,000 in 1992 to 96,146 in 2007 and 130,000 in 2008 (rising to 10 cars per 1000), it is still low for the region (GoM, 2007; UN-HABITAT, 2010). Despite the comparatively low level of car ownership, the increase of vehicles has led to traffic congestion on the country's roads especially in urban areas. For example, in Lilongwe City the number of registered vehicles peaked at around 14,700 in 2003

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Rail transportation is inexpensive and can ease the pressure from road networks. Restoration of existing railway networks (e.g. Chipoka Railway Station shown in photo) will help to achieve this.

and has varied from 4,700 to 6,800 annually from 2004 onwards (JICA, 2010). The average annual growth rate of registered vehicles on an accumulated basis is 16.7% from 2003 to 2008. Growth in private car ownership has implications for the demand, provision and usage of transportation infrastructure, creating congestion, pollution, and environmental problems.

Traffic Congestion

Traffic congestion has increased dramatically in Malawi in recent years. This is in part due to the influx of settlers in urban and peri-urban areas; road infrastructure is insufficient to accommodate the vast number of commuters dwelling in informal settlements and travelling to/from the city centre. An increase in traffic congestion increases fuel consumption, negatively impacting both the economy and the environment. Congestion also poses a safety threat to pedestrian and bicycle traffic.

In order to improve traffic flow, there should be overtaking lanes in some long distance sections of roadways. There is also a need to have roads that bypass main cities to further reduce congestion. For example, traffic from the North to the South of Malawi should be able to bypass Lilongwe before Kamuzu International Airport. Similarly, traffic from Zomba should be able to bypass Limbe before Mapanga.

Traffic Accidents

Malawi has one of the highest traffic fatality rates in the world, at 245 deaths per 10,000 vehicles (Figure 2.7). These rates are extremely high, particularly when compared to those reported in the developed countries of Western Europe, North America, Australasia and Japan, which are in the range of 1.5 to 4 (Odero, 2004).

Susan Taylor

Trading along the main road.

The number of traffic accidents exceeded 7,000 in 2005, but began to decrease between 2005 and 2007. A total of 4,435 road accidents occurred in 2007, with 738 classified as fatal accidents and 604 as serious injury cases. Most fatal road accidents occurred in the big population centres of Lilongwe, Blantyre and Ntcheu district. In 2007, the fatal accidents in Lilongwe City are estimated at 18%, followed by Blantyre at 15.4%. This is probably because Lilongwe has experienced rapid traffic growth over the past decade and as a result, traffic congestion has become a problem in the city. Unplanned developments resulting in many access roads from the main arterial roads led to pressure on the roads. Trading along major roads has also contributed to fatal accidents.

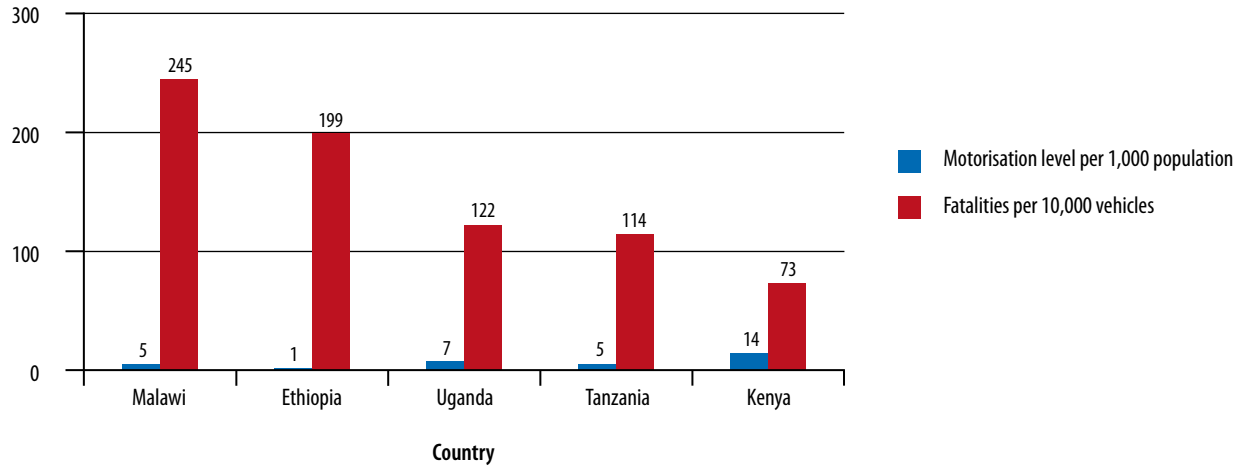
The World Health Organization estimates the top 10 leading causes of mortality and disability in Malawi. In this ranking, road traffic accidents are the seventh highest cause (Bowie, 2006). Disability can impoverish the family of the victim (WHO, 2004). About 30% of the road accidents are attributable to poor road infrastructure, while the majority are due to human error by road users. Infrastructural causes include the prevalence of narrow, single lane roads, with broken or poorly maintained shoulders, poor visibility, pot holes and poor surface drainage during the rainy season.

Lack of footpath facilities or sidewalks and cyclist lanes further contribute to road accidents because pedestrians, cyclists and 4-wheelers compete for the same space; this is a primary cause of road traffic deaths. Road infrastructure development is largely car-traffic oriented, even though car traffic currently serves less than 10% of travellers.

However, contribution of poor road infrastructure to road accidents is minimal compared to human factors in Malawi. For example, in 2005, an assessment of accident sites indicated that the road condition was good or fair at the site of 94% of all fatal road traffic accidents. Only 3% occurred on potholes, 2% on corrugated roads, and 1% because of slippery road conditions. Most accidents happen on straight roads: 83% in 2004, and 73% in 2005. 16% of accidents occurred at an intersection, 6% at bridges, 4% at T-Junctions, and 1% at curves (National Road Safety Council, 2005). Most accidents happen in dry conditions when visibility is clear and roads are dry. Dry conditions prevailed in 98% of all fatalities in Malawi in 2005, with the remaining 2% of road traffic accidents occurring in rainy conditions when roads are slippery and there was poor visibility due to rains and fog (National Road Safety Council, 2005).

Accidents on well-maintained roadways may occur because drivers slow down on poor condition road sections where the shoulders are heavily degraded and then speed up to pass other cars in well-maintained areas. These accidents could also be the result of poorly-maintained vehicles.

Figure 2.7: Fatality Rates and Motorization Levels in Selected Countries in Sub Saharan African Countries 2004.



Source: Odero 2004.

Lucy Chipeta

Lucy Chipeta

Road accident on M1–Masasa, Dedza Sign post for potholes, M1, Lizulu, Ntcheu.

2.4.3 Transportation, Health and the Environment

Soil Erosion

Transportation corridors have an environmental impact. Road construction programmes have contributed to environmental degradation in various ways in Malawi (GOM, 2005; NRA, 2007).

Heavy machinery used in road construction may cause soil erosion. Mitre drains and culverts can also cause erosion when draining water away from the road. Similarly, the shoulders of the roadside can get washed away in the rainy season if they are not properly sealed, further contributing to soil erosion. Construction can also affect soil by modifying surface features: through the creation of borrow pits; slope failure; sedimentation of road-side drains and water bodies; and soil contamination and compaction. Soil related losses include lower crop yields, declining fisheries income because of sedimentation of water bodies and water pollution, and declining property values of roadside households and business sites.

Deforestation and Biodiversity Loss

New road infrastructure may open up forest lands that were previously difficult for people to access. This can accelerate the rate of deforestation, thereby also accelerating the rates of soil erosion, siltation and sedimentation. Biodiversity loss can also result from such a rapid degradation of natural habitat.

Occupational Health Hazards

In road development activities and transport operations, noise is generated by (a) construction machinery, (b) vehicles, (c) friction between vehicles and the road surface, and (d) driver behaviour. Noise associated with road development and transport operation activities degrades human welfare, sonically vibrates structures, and disturbs wildlife. Noise created by blasting at quarries and by loud machinery can cause long-term damage to human hearing and disrupt/displace wildlife.

Dust

The use of heavy machinery in road maintenance and rehabilitation, especially on earthworks, produces large amounts of dust during dry season. Unchecked dust creation causes lung damage, crop damage, impedes visibility for drivers and workers, and can be a nuisance to nearby villagers. Dust created by blasting at quarry sites can be harmful to human beings as well as fauna and flora.

Sanitation

Sanitation is of utmost importance at construction camp and working sites. Pit latrines constructed for use by temporary labourers who do not live in the area are sometimes constructed in ways/locations that can threaten drinking water supplies or are not filled in properly when they are no longer being used. Similarly, road development projects usually intersect drainage basins and subsequently alter or modify the local hydrology. Road development can lead to both alteration and modification to the surface water and ground water flow, causing water table fluctuations, and water quality degradation

Lucy Chipeta

Erosion of road drains.

2.4.4 Interventions and Policy Options

There are a number of measures which have been implemented in Malawi to improve road safety for vulnerable road users. Some of the interventions are listed below.

Policy Approaches

Malawi is a party to the African Ministers Declaration on Transport, and to the MDG goal of 'reducing road traffic crashes by 50% in 2015". The overall objective of these commitments is to develop an affordable, environmentally safe, efficient transport system. This is to be achieved through the development of sustainable transport policies.

This goal is reflected in the policy document for the Ministry of Transport and Public Works and its associated Action Plan, as well as in the Malawi Growth and Development Strategy. The Malawi road safety institutional framework includes the Ministry of Transport and Public Works, the N.R.A., the National Road Safety Council, and the Department of Road Traffic and Traffic Police.

Environmental Engineering

Traffic calming is an appropriate tool for reducing unsafe traffic speed and fatalities. Malawi has implemented volume and speed control measures in urban centres to control congestion and overspeeding. Speed control measures consist of horizontal deflection, horizontal narrowing and vertical deflection. Roundabouts (horizontal deflection) and speed humps are also common features in Malawian cities. Roundabouts are a popular speed calming technique that reduces collisions with pedestrians by about 75% as compared to traditional inter-sections, especially when the roundabouts are limited to a single lane (Shinar, 2007). However, indiscriminate use of roundabouts by pedestrians can be dangerous, especially in the absence of traffic singals (Shinar, 2007).

Traffic lights and pedestrian crosswalks are also employed to reduce collisions at busy intersections. Before 2006, there were only five sites with traffic lights in Blantyre, and one site in Lilongwe. Currently, there are nine sites in Blantyre, eleven sites in Lilongwe, and one site each in Zomba, Mzuzu and Mangochi. Marked pedestrian crossings are also common on main roads in towns and cities. However, these are less effective because most drivers do not comply with this measure, thereby increasing the risk to pedestrians.

Spatial Separation

Overpasses, pedestrian bridges and underpasses are excellent means of separating cars from other road users. However, their effectiveness depends on usage (Shinar, 2007). The country has only four pedestrian bridges, two in Lilongwe and the other two in Blantyre. These were constructed in 2006/07 at busy locations; however there is limited use of the infrastructure. This suggests need for a review of the design and/or trial of other simple and inexpensive means.

One-way streets are also used in urban areas to reduce vehicle collisions and increase the visibility of drivers and pedestrians. Other engineering solutions include improvement of road geometry in specific areas, such as the increase of travel lanes on Paul Kagame, Presidential Highways in Lilongwe and Chipembere Highway in Blantyre. More roads in these cities need this treatment to significantly reduce congestion and accidents.

Policy Options for Road Infrastructure Development

The Ministry of Transport and Public Works is party to several regional and international agreements regarding the protection of the environment (e.g. MARPOL 73/78, regarding Maritime Pollution). Locally however, the challenge still remains to ensure that programmes and activities are in line with the National Environmental Policy.

Vulnerability to Climate Change

No comprehensive inventory exists regarding the vulnerability of Malawi transportation infrastructure to climate change impacts, or the potential damage costs. Road conditions such as poor drainage can expose roads to flood damages such as washing away of bridges and destruction of road surfaces (creating potholes and broken shoulders).

The National Environmental Policy (2004) emphasizes addressing air quality and climate change as a cross-sectoral policy goal. The objective of this focus is to minimize the adverse impact of climate change and variability, and to reduce air pollution and greenhouse gas emissions. One of the strategies to attain this goal is to reduce gas emissions from the transport sector and the manufacturing industry. Options include the use of fuel-efficient vehicles, improving urban road design to reduce distance of travelling and congestion which uses more fuel over shorter distances, thereby polluting more (Figure x shows GHG emissions from transport). Malawi also needs to develop green space conservation and increase the availability and usage of safe public transport.

2.5 Conclusion

The chapter has found that there is no settlement policy or other legal instrument to guide settlement development. As a result, settlements have developed in a haphazard and unsafe manner, particularly in informal urban settlements and rural areas. Rapid population growth and the inability of authorities to meet the needs of the growing population contribute to the many problems facing settlements in Malawi. The growth of unplanned settlements is characterized by unsanitary conditions, overcrowding, lack of safe and portable water and lack of services such as roads and drainage systems. Major urban areas are also characterized by traffic congestion, including pedestrian, bicycle, and motorized traffic. This could be due to poor city planning, which never incorporated the impact of growing population and need for expansion. The establishment of the rural growth centres to redirect rural population to small urban areas is one way of addressing the issue of rapid urbanization.

Land-related laws have been reviewed and enacted to deal with human settlement problems, but some of the policies and legal instruments are outdated and inappropriate for Malawian settlements and need to be revisited. To achieve sustainability in human settlements, several steps must be taken. A settlement policy must be developed and enforced, and human settlements-related laws must be reviewed to ensure that they are relevant to the Malawian situation. Linkages between government, NGOs, the private sector and communities must be developed to coordinate efforts and ensure a comprehensive approach is taken to settlement development. This will enable the country to achieve sustainable, environmentally friendly settlement development.

2.6 Recommendations

Malawi is still struggling to meet the demand for water and sanitation services, to regulate the development of human settlements, and to create a safe and reliable transportation network. The government, the private sector and local communities must collaborate in the provision and maintenance of these services. The following are some specific recommendations for target sectors.

Waste Management

- Increase the capacity and scope of waste management programmes
- Improve and extend programmes to recycle and reuse waste paper, plastics and water
- Encourage the conversion of organic waste into compost by setting up demonstration plots and training local communities
- Increase the coverage of campaigns for improved hygiene and waste management practices

Human Settlements

- Simplify land administration so that people are able to regularize and access land through formal means
- Release land zoned for housing in a timely fashion to avoid land speculation and increase poor people's access to land
- Revise outdated land use plans to properly zone for settlement developments and create an inventory of land allocations
- Formalize informal settlements and extend services such as water, electricity, and waste disposal to these areas
- Develop a comprehensive settlement policy to guide settlement development and supply of services

Transportation Infrastructure

- Reduce congestion in urban centres by creating bypass routes around cities on major routes (such as a North-South road bypassing Blantyre before Limbe)
- Focus on rehabilitating and extending Malawi's railway network to improve transportation of goods
- Increase the safety and availability of public transportation
- Develop walking paths, bypasses, and other pedestrian/bicycle corridors to reduce the high proportion of vehicle-related deaths

Photo Essay–Road Infrastructure, Erosion, and Safety

Sosten Chiotha

The photograph above shows a road heavily damaged by erosion. Constant repairs of such roads (see soil in left hand corner) are inefficient and costly for the government. People are also forced to walk in traffic because there is no pedestrian corridor, creating a serious public safety hazard.

Sosten Chiotha

The photograph above shows how these problems have been successfully addressed in Blantyre. A paved sidewalk has been added to provide space for pedestrians, and the tarmac road has been well-maintained.

Sosten Chiotha

Migration to urban environments can have a detrimental effect on natural resources in the bordering peri-urban area. The image above shows an abandoned brick making area near Mangochi Boma. Biodiversity recovery such as trees is hampered by illegal waste dumping and fires. The image below shows an area of extensive deforestation of Nalikule forest near Lilongwe city due to high wood demand from the city and infrastructure (transmission lines, roads) development.

Sosten Chiotha

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Appendix

Number of Professionals and deficit in Land Related Activities.

Capacity	Professional Need	Technicians				
	Needs	Deficit		Needs	Deficit	
Physical planners	130	101	78%	210	190	90%
Survey Mapping	100	88	88%	260	210	81%
Land Administrators	200	178	89%	520	430	82%
Total in Public	430	367	85%	990	830	84%
Private sector	500	450	90%	1000	1000	100%
Grant Total	930	817	88%	1990	1830	92%

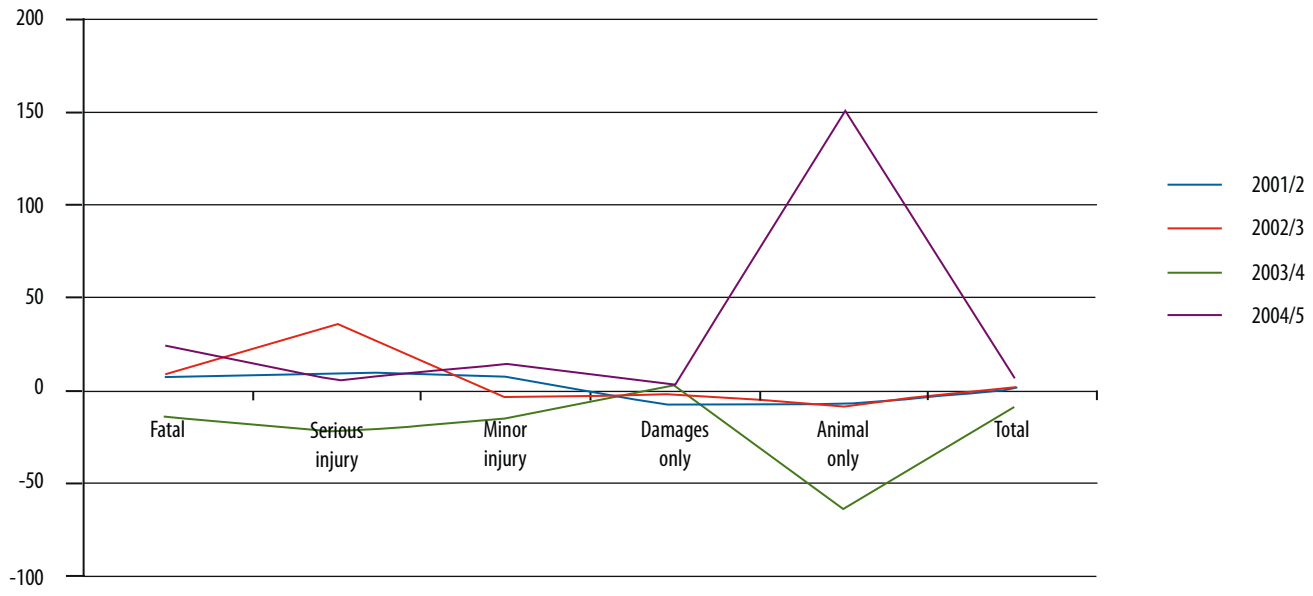
Source: Mkwambisi 2009.

Designated Public Road Infrastructure Network.

Road Class	Paved		Unpaved		Total	
	Km	%	Km	%	Km	%
Main	2,809	70	548	5	3,357	22
Secondary	407	10	2,718	24	3,125	20
Tertiary	44	1	4,077	36	4,121	27
District	8	0	3,491	31	3,499	23
Urban	770	19	579	5	1,349	9
Total	4,038	100	11,413	100	15,451	100
%		26		74		100

Source: National Road Authority 2005.

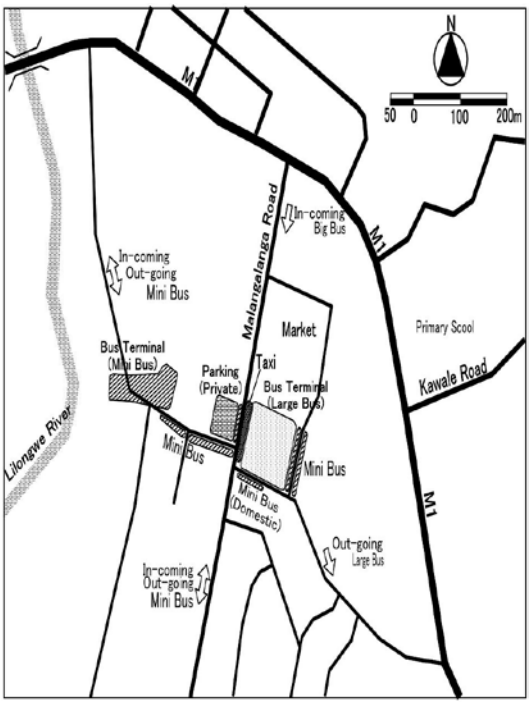
Percentage Change of Number of Traffic Accidents Per Year 2001 to 2005.



Problems faced in road infrastructure around Central Bus & Minibus Terminal in Lilongwe old town

Miriam Joshua

Illegal public transport by light trucks near Lilongwe Town Hall roundabout



Miriam Joshua

Chaotic movement between Vehicles and pedestrians near Central market

Miriam Joshua

No paved sidewalk & shoulder, uneven condition between shoulder and road.

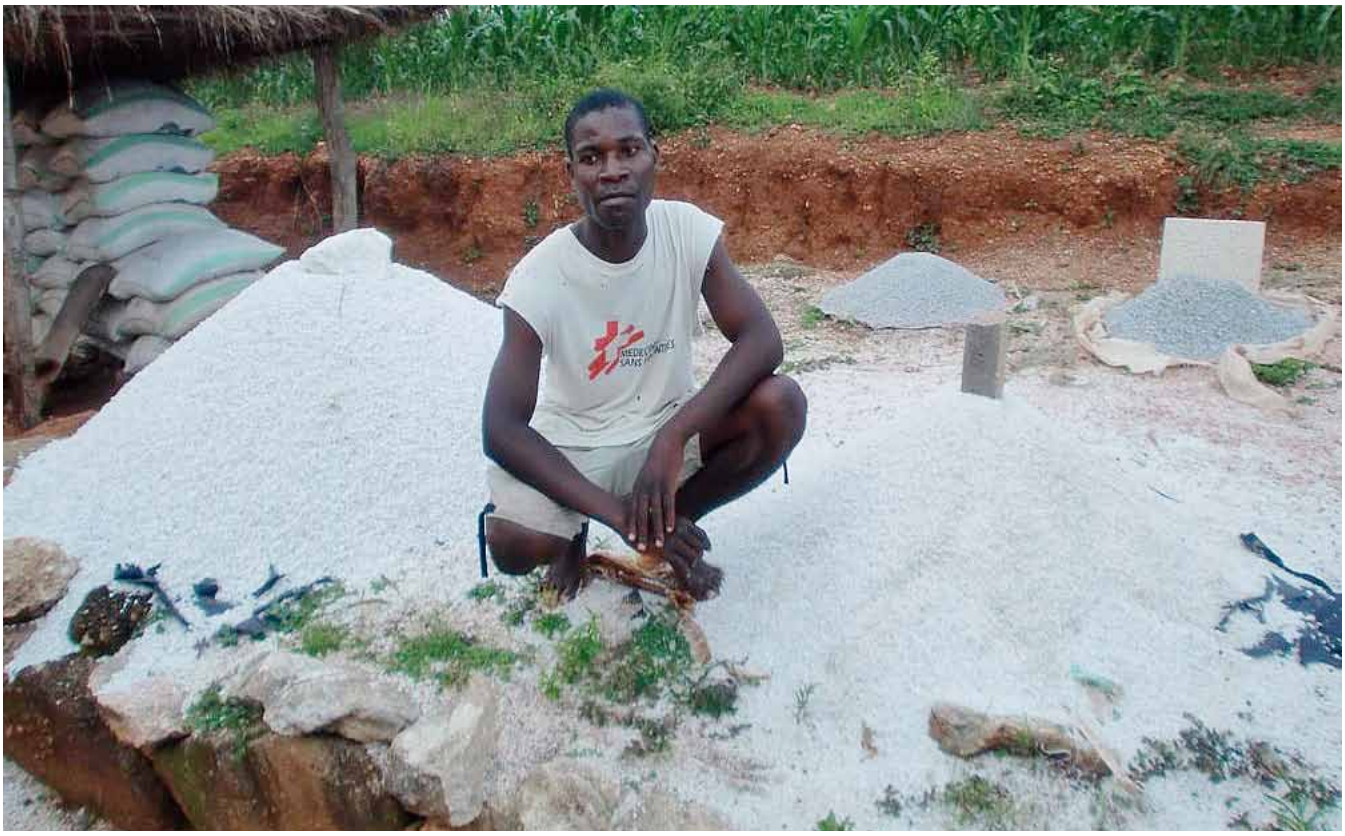
Miriam Joshua

Enforcing long distance walk from M1 to minibus depot

Miriam Joshua

Pedestrian traffic near market and Bus depot Long-distance bus passing route (one way) market and Bus depot Long-distance bus passing route (one way)

CHAPTER 3



Man Next to Terrazzo, Photo by Sosten Chiotha

ENERGY, INDUSTRY AND MINING

Kayerekera Mine, Photo by Leonard Kalindekafe

3.1 Introduction

The energy sector comprises five main sub-sectors, namely: electricity, biomass (fuel wood), petroleum products, coal, and other renewable energy sources (GoM, 2009). The industry sector could be broadly classified into three industrial sectors, namely, primary, secondary and tertiary such as The primary sector deals with the extraction of primary products from the natural resources such as agriculture, mining, quarrying, forestry, fishing, and hunting. The secondary sector involves value addition to primary production by conversion activities that include manufacturing, processing and packaging. This sector includes such important areas as textile, food processing, brewery and bottling, smelting, metal fabrication, chemical processing, ship building and construction industry. Finally, the tertiary sector utilizes primary and secondary products to produce services such as banking, tourism, restaurant, hotel and power utilities. This chapter will only cover primary industries (mining, quarrying and primary energy products) and secondary industries (manufacturing/processing and energy utilities).

The geology of Malawi is complex and it hosts a variety of minerals of economic importance. The mining sector has been declared a priority sector and this has resulted in increased activity as evidenced by the opening of the first commercial mine at Kayerekera in Karonga. Mining exerts negative and positive impacts on the environment. The impacts however are not be uniform as they depend on the geology and the mineral mined, the mining and processing methods and the geographic area for the mine.

There have been limited studies to assess the trends and status of energy, mines and industry in Malawi. Thus due to unavailability of data it has been difficult to determine the impact of energy, mining and industry sectors on the environment and assess progress made in the last decade. Unavailability of data has also compromised sound decision making on strategies to be followed to minimize the impacts of energy, mining and industry on the environment. This chapter recognizes the reliance of these sectors on natural resources as raw materials and therefore provides an overview of the impacts of the sectors on the environment and approaches to be followed to minimize environmental degradation whilst contributing to the economic growth.

3.2 Overview of the Energy, Industry and Mining Sectors in Malawi

3.2.1 Energy Resources

Energy needs are mainly derived from fuel wood, which accounts for 88.5% of the total energy demand. The rest of the energy is supplied from hydrocarbon fuels (6.4%); electricity (2.8%); and coal (2.4%) (GoM, 2009). This is a slight change from the situation in 2002[1] when biomass accounted for 93% of the country's aggregate energy demand, electricity (2.3%), petroleum products (3.5%), coal (1%) and other renewable energy sources (0.2%) (GoM, 2006) (Table 3.1).

Biomass

Biomass energy is obtained from firewood, charcoal and crop/industrial residue. About 67% of fuel wood is used in rural households for cooking and heating, 15% in urban households, 7% is used in tobacco and tea industries and the remainder (11%) is used for other purposes, including small scale and urban industries (Annual Economic Report, 2008). The Malawi Biomass Energy Strategy (BEST) reported similar figures in 2009 (GoM, 2009). In a report released in 2010, the Millennium Challenge Corporation (MCC) suggested that 98% of rural households, 64% of urban households in Lilongwe and 42% in Blantyre and Mzuzu use fuel wood for cooking (MCC, 2010).

Sugar manufacturing companies in Malawi, (Dwangwa and Illovo) are currently producing ethanol from molasses. Some of the molasses is sold to other companies to expand ethanol production and reduce overreliance on main grid electricity supply for small industries.

Table 3.1: Percent Contribution of Main Energy Sources in Malawi, 2002 to 2009.

Energy Source	% Contribution	
	2002	2009
Biomass	93	88.5
Electricity	2.3	2.8
Hydrocarbon Fuels	3.5	6.4
Coal	1.0	2.4
Renewable and Alternative Sources	0.2	*

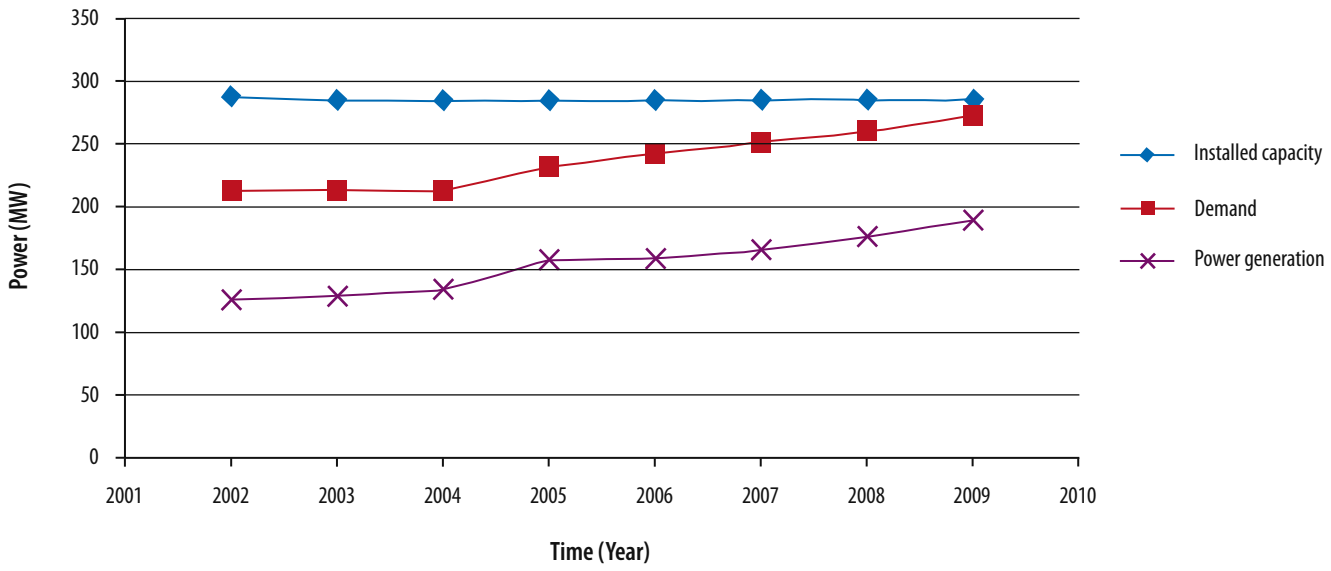
*Data Not Available; Source: GoM (2009).

[1]The most recent State of the Environmental Report for Malawi was published in 2002. The year 2002 will be taken as the baseline case. For slowly changing trends, it will be sufficient to compare data for 2002 and 2009 only without loss of generality. A case in point is the energy mix in Malawi.

Electricity

Electricity in Malawi is generated by hydropower plants operated by Electricity Supply Commission of Malawi (ESCOM). 98% of the hydro-electric power is generated by Nkula, Tedzani and Kapichira (Phase 1) hydropower plants, all installed along the Shire River and the remaining 2% is produced by Wowve power plant in the Northern Region (GoM, 2010). Electricity generation from solar panels and wind turbines have been initiated in a few locations such as Thyolo, but needs to be upscaled. The country's total installed capacity is 284 MW against the suppressed demand of 344 MW (ESCOM, 2010) (Figure 3.1). Of this 4.5 MW is generated by Wowve power plant.

Figure 3.1: Installed Capacity, Demand and Generation for Electricity in Malawi.



Source: GoM (2009).

Overreliance on Shire River for generation of electricity is risky because chances of outflow from Lake Malawi receding below the minimum elevation of 474 m above sea level as was the case between 1915 to 1935 are high. If this happens Malawi will not generate enough electricity for both industrial and domestic use. To manage the risk, electricity generation is being diversified beyond Shire River through development of several mini hydropower schemes (GoM, 2010). Malawi has also been exploring possibilities of importing electricity from the SADC Region.

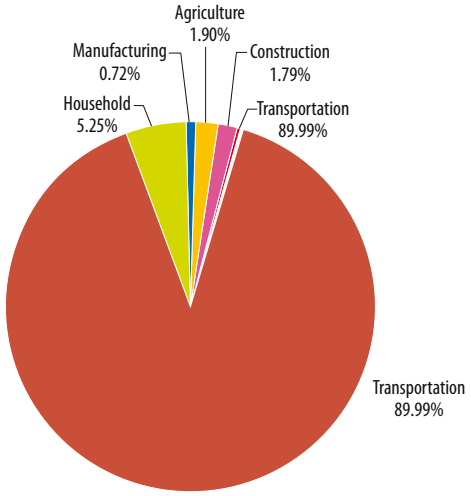
Petroleum Products

Malawi is heavily dependent on imported petroleum products mainly used by the transport sector and accounts for up to 89.99% of total consumption of hydrocarbons (Figure 3.2). The rest is shared by industry and domestic use, with industry consumption ranging from 2.87% and Agriculture consumption around 1.90%. Domestic use of paraffin fuels (currently estimated at 5.25%) is in general declining due to poor supply (GoM, 2010). Ethanol which is used for fuel blending is currently being produced at a rate of 18 million litres per annum.

Coal

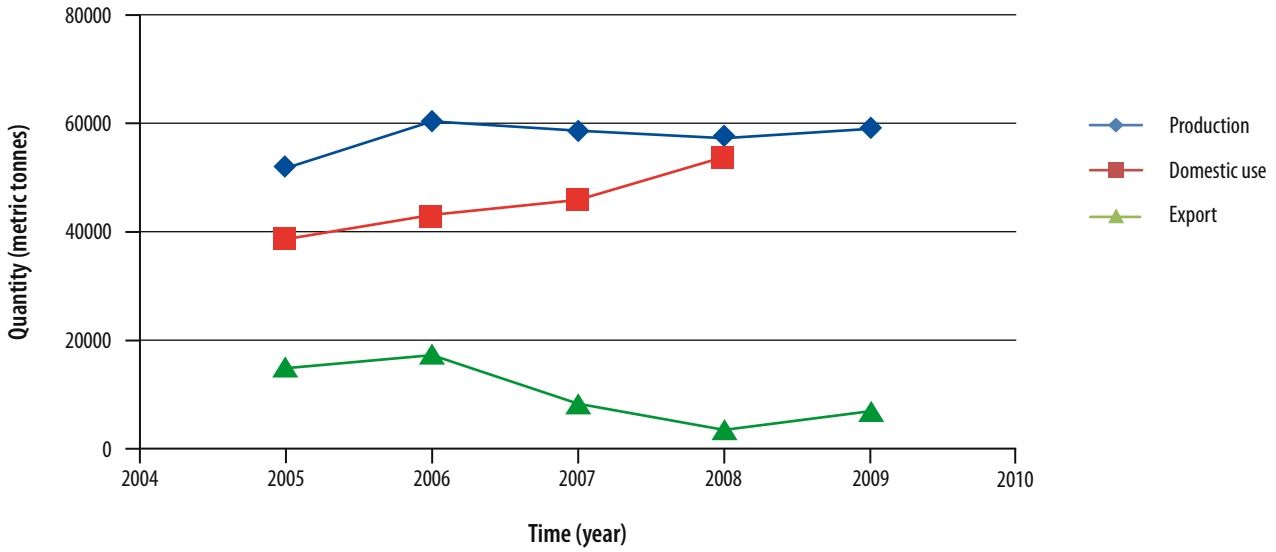
In Malawi, coal is used exclusively as an energy source for industrial production mainly for tobacco processing, textile and sugar production, and beer brewing. The production of coal in Malawi has increased from 52, 000 tons (2005) to 59,000 tons (2009) (Figure 3.3) (DoE, 2010).

Figure 3.2: Shares of Petroleum Products' Consumption by Sector.



Source: DoE 2010, Energy Demand Assessment Report, IAEA.

Figure 3.3: Coal Production and use in Malawi (2004-2009).



Source: GoM(2009).

Table 3.2: Energy Balance for 2008 in kToE.

Economic Sectors	Coal	Petroleum Products (Motor)	Electricity		Solar Systems	Traditional Fuels	Total
			Specific	Non-specific			
Agriculture	-	5.30	6.30	0.70	-	110.00	122.30
Construction	-	5.00	-	-	-	-	5.00
Mining	-	1.00	2.85	0.15	-	-	4.00
Manufacturing	97.69	2.00	25.30	6.73	-	50.00	181.72
Services	1.99	-	13.19	10.30	1.10	80.00	106.58
Transportation	-	251.13	-	-	-	-	251.13
Household	14.64	-	18.39	20.91	1.30	3,400.00	3,455.24
Total	114.32	264.43	66.03	38.79	2.40	3,640.00	4,125.97

Source: DoE 2010, Energy Demand Assessment Report (to be published by IAEA)

Table 3.2 illustrates the energy balance for 2008 for Malawi and 88.2% amounting to 3640.00kToE is contributed by traditional fuels followed by petroleum, coal and electricity. Solar power only contributes a minimal amount of 2.4kToE The heavy dependance on traditional fuels is detrimental to the environment.There is a scope for exploring sustainable sources of power such as wind and solar energy. Further to this,Table 3.2 indicates that 98% of the total coal is consumed by the manufacuring sector and the remainder is used by service sector and some are exported. The total coal production in the country in 2008 was equivalent to 49.34kToE. Department of Mines have noted that a similar amount of coal was imported and consumed in the country. Based on these figures, coal consumption in the country in 2008 was estimated at 98.68 kToE. The continued coal imports from Mozambique is because the main coal fields in Malawi are located 900 km from Blantyre, where most of the major coal consumers are based while Moatize in Mozambique is only 90 km away from Blantyre (GoM, 2008)

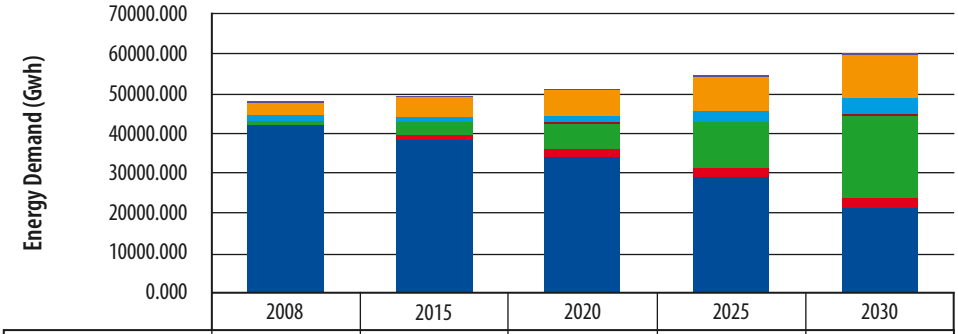
Renewable and Alternative Energy Sources

The most important renewable and alternative energy sources for Malawi are solar, wind, solarwind hybrid systems, natural gas, biogas and briquettes but contribution towards total energy demand is still very low being less than 1% in 2009 (GoM, 2009).

Energy Demand Projections

According to the Energy Demand Assessment Report (DoEA, 2010), energy demand will grow significantly in the next 20 years as a result of projected human population

Figure 3.4: Energy Demand by Energy Form in Malawi.



	2008	2015	2020	2025	2030
Solar thermal	11.630	20.734	29.705	40.837	53.70865385
Motor fuels	3068.624	4880.992	6563.815	8537.829	10947.03751
Fossil fuels	1329.565	1154.073	1833.381	2702.979	4214.782714
Soft solar	16.282	69.439	106.381	155.791	215.4024626
Electricity	1220.244	3447.934	6522.472	11789.353	20910.54146
Modern biomass	0.000	1098.993	1586.206	2151.893	2225.003578
Traditional fuels	42333.200	38589.727	34477.185	29169.807	21501.57155

Source: DoE 2010, Energy Demand Assessment Report - to be published by IAEA.

growth coupled with increased industrialization. Figure 3.4 shows projection of total energy demand by energy form to 2030 and usage of modern biomass grows from 0 to 2225 GWh in the same period. However, consumption of traditional fuels will decrease by half in 2030 from the 2008 consumption of 42,333GWh based on projections made by Energy Demand Assessment Report (unpublished).

3.2.2 The Industry Sector

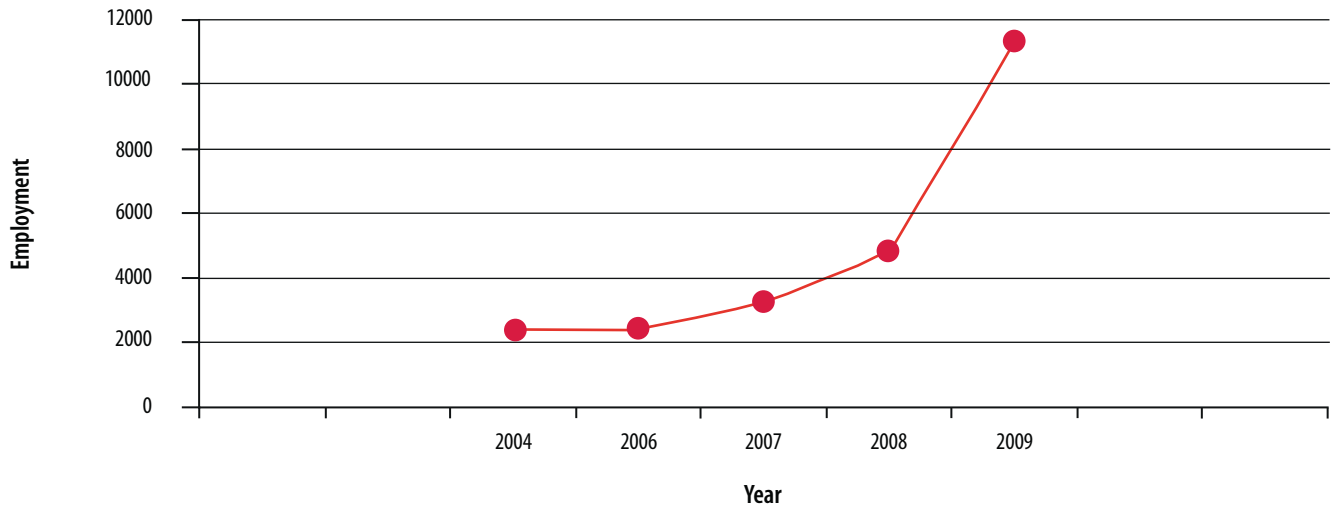
Malawi's industrial production or manufacturing sector has not grown significantly during the last decade. Malawi's ambition is to see the sector grows through value addition, export development and employment creation (MGDS, 2005).

Manufacturing Industry

During the last decade, Malawi's large manufacturing companies such British American Tobacco (BAT), David White Head and Sons (DWHS), Brown and Clapperton (B&C) have closed its operation and new establishments have been few and far apart. Interestingly, there has been an upsurge in the number of micro/small manufacturing enterprises, with some being registered whilst the majority could be considered informal.

In Malawi, large manufacturing enterprises are concentrated in the cities of Blantyre and Lilongwe. Other large manufacturing establishments are in Mzuzu, Mulanje, Thyolo, Dwangwa and Nkhata-Bay.

Figure 3.5: Employment in Mining Sector 2004–2009.



Source: GoM 2010.

Malawi Export Base

The MGDS identified agro-processing as a priority area, covering production and processing of tea, tobacco, sugar, wheat and cotton. This strategy will be key in driving development in these sectors.

Malawi has a narrow export base mostly arising from three products, namely, tobacco, tea and sugar. Table 3.3 shows export contribution of some products from 2002 to 2009. Tobacco and tea have shown steady growth over the years while sugar has shown steady decline over the years.

Table 3.3: Export Contribution 2003–2009.

	2002	2003	2004	2005	2006	2007	2008*	2009**
Tobacco	17,893.1	24,191.2	22,303.5	31,621.1	54,810.3	51,729.6	82,917.0	106,602.0
Tea	2,827.8	3,481.5	5,132.5	5,909.9	6,514.9	7,281.7	5,191.4	9,655.5
Sugar	2,684.2	10,571.4	7,881.4	5,408.5	5,191.1	8,227.9	7,341.3	9,635.0
Apparel and clothing	2,684.2	3,858.1	4.795.5	5,241.6	5,252.2	3,515.4	1,692.7	2,113.7
Cotton	260.8	483.9	2,224.3	1,847.1	1,832.7	3,062.2	3,070.3	2,612.0
Nuts	378.1	1,132.0	1,581.0	1,473.0	3,172.5	3,346.8	1,502.8	3,446.2
Pulses	218.1	494.1	608.3	327.9	617.8	1,814.9	846.7	2,332.2
Wood-sawn and plied	62.7	178.6	219.3	413.7	481.2	963.0	1,291.3	986.7
Natural Rubber	152.9	265.8	399.0	248.1	664.9	694.8	1,025.6	232.9
Coffee	175.6	245.1	217.5	321.3	201.7	514.9	203.7	281.1
Spices	224.0	141.2	170.7	174.0	569.0	190.4	442.6	675.3
Hides and Skins	32.1	31.5	44.0	67.5	113.3	122.4	138.3	121.7
Wooden furniture				277.5	435.9	154.9	341.6	675.3

Source: National Statistical Office (NSO)/ Ministry of Trade and Industry.

3.2.3 Mining Activities in Malawi

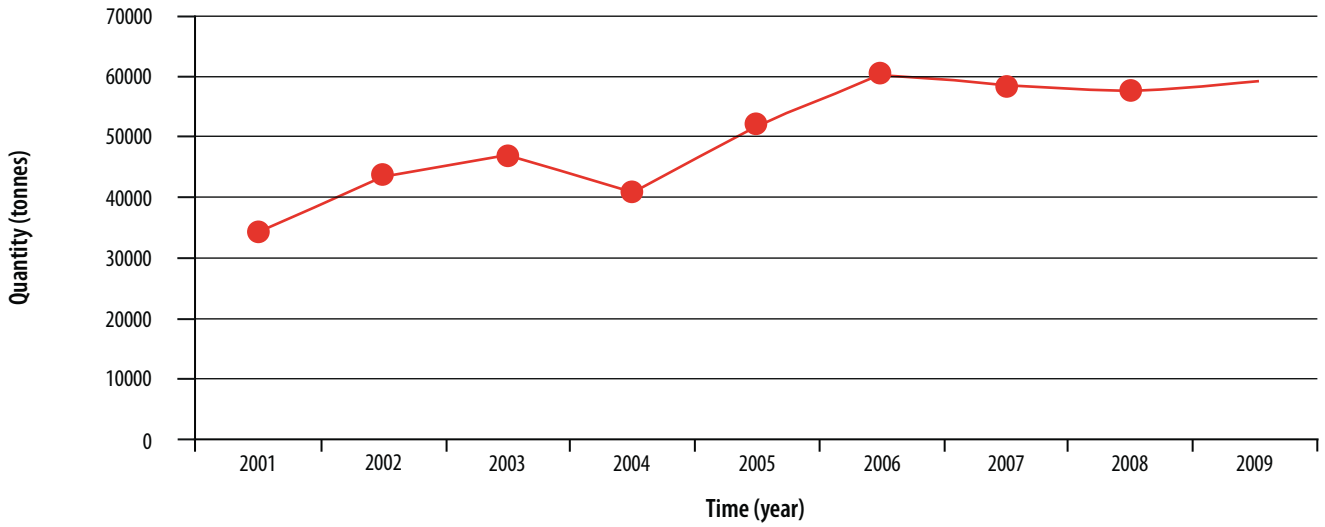
Mining contributes 3% of Malawi's GDP (GoM, 2002) but is expected to rise to more than 10% when production at Kayerekera Uranium Mine reaches its full production capacity and 20% when all upcoming mining projects are fully implemented and operational (UNSCD, 2010). The economic contribution from mining should ease pressure on agricultural production which contributes 34% of the GDP (GoM, Annual Economic Report, 2010). Employment in mining sector has increased in Malawi as shown in Figure 3.5.

Mining operations in Malawi are classified as large-medium, small-scale and artisanal. Small-scale and Artisanal Mining for industrial minerals and gemstones have been identified as key to encouraging economic growth in the country, particularly in rural areas. Large-medium scale mines explore and exploit heavy mineral sands, uranium, niobium, coal, platinum group metals, rare earth elements, base metals, gold and limestone. Artisanal and Small-scale Mining (ASM) focus on industrial minerals and gemstones. Quarrying for construction and sand mining in rivers are equally important small scale mining activities, especially in urban areas and peri-urban areas. Most artisanal and small-scale miners exploit small deposits in remote areas. ASM operators often operate illegally and receive little supervision or support from the local or central government authorities. ASM cause significant damage to public health and the environment by destroying the landscape and spreading pollutants. However, with adequate support, ASM can contribute to economic and sustainable development, particularly in rural areas.

Mineral Production

The mineral production figures for the period 2001 to 2009 are indicated in Table 3.4. The mineral production trend shows a generally moderate increase between the years 2006 and 2009. Quarry aggregate, gemstones terrazzo, and uranium production, however, showed a very marked increase.

Figure 3.6. Coal production in Malawi During the Period From 2001–2009.



Source: GoM, 2010.

Gemstones Production

A general rapid and tremendous improvement was reported in production of gemstones in 2009 as compared to the preceding years. Most of these gemstones are being exported to different parts of the world including Germany. Mzimba district remains the largest supplier of these gemstones followed by Chikhwawa and Ntcheu districts.

Coal Production

There are an estimated thirteen coal fields in the northern region and two in the southern region, with a total estimated reserve of 800 million tones. Most of the coal mines are opencast. However, at Mchenga, Kaziwiziwi and Eland Coal Mines, both opencast and adit mining methods are employed.

Mchenga, Kaziwiziwi and Eland Coal Mine companies are largest producers of coal in Malawi. They produce almost 90 percent of all coal in the country. They have a combined maximum capacity of up to 10,000 metric tones of coal production per month when operating at full capacity (GoM, Annual Economic Report, 2010). Figure 3.6 shows the trend in coal production in the period 2001 up to 2008. There was a decrease in between 2003 and 2004 probably reflecting the closure of Changalume cement factory and also a general decline in economic performance of the Malawi economy.

Table 3.4: Mineral Production During the Period 2001–2009.

Product	2001	2002	2003	2004	2005	2006	2007	2008	2009
Coal (Mt)	34410	43372	47037	40891	51870	60408	58 550	57 477	59,201
Cement Limestone (Mt)	108761	86234	23965	-	28755	34226	42 088	45980	47150
Agric Lime (Mt)	2597	6776	8752	13527	22733	21147	20 965	23 495	25900
Quarry Aggregate (m^3)	396652	73543	103196	108196	110506	123850	146033	348,080	970550
Gemstones (Kg)	152	2305	2297	18720	1994	2 171	3 710	11 946	306.7
Ornamental Stones (tonnes)	186	120	450	320	72	126	179	332	-
Terrazo (m^3)	49.1	3960	330	628	1150	1200	1560	10150	12355
Clay/Pottery (Pieces)	-	800	820	835	3000	3500	3910	4210	-
Uranium Concentrates (Kgs)	-	-	-	-	-	-	-	-	58,582
Other Industrial Minerals (tonnes)	-	60	11	15	-	2299	2409	3500	-

Source: GoM, Dept of Mines, 2010.

Leonard Kalindekafe

Kayerekera Uranium Mine

Uranium Production

The Kayerekera sandstone-hosted uranium deposit lies within the Permian Karoo sedimentary rocks, 52 km west of Karonga town in the northern region of Malawi. Paladin Energy Ltd, an Australian publicly listed company holds 85 percent Investment Promotion Agency (MIPA) and Malawi Export Promotion Council (MEPC) was made last year but they still remain separate entities to-date. This has led to foreign investors being discouraged to invest in the country.

3.2.4 Minimizing Pollution Associated with Mining, Energy and Industrial Activities

The major forms of pollution associated with the mining, energy and industry sector include air, water and noise. Mining operations are renowned for fueling air pollution through the emission of dust particles and noxious gases into the atmosphere. The main sources of dust in mining are drilling, blasting, crushing and screening processes that sieve minerals into several desired sizes. The coal sourced from Mchenga has an average sulphur content of <1 percent (GoM, 2002). This releases sulphur dioxide into the air and may lead to acid rain formation. However, with the low level of emission of these gases in mines in Malawi, its impact is likely to be minimal.

The discharge of wastes from mines generally causes pollution of surface and ground water resources. The same is true of used oils and greases from workshops from industries. Not only does water pollution have serious repercussions on aquatic life, but also polluted water may be fatal to downstream users who use such water bodies as sources of water supply for domestic consumption.

In mines and quarries, noise is oftentimes caused by the transportation of minerals from the quarry to the plant, drilling operations, crushing of ore and blasting or fragmentation of ore. Operations in Malawi are estimated to generate noise of between 80 and 110 decibels depending on the size and distance from the source of operation (GoM, State of Environment Report, 2002). Of potential concern is the level of noise related to deafness, mainly in drillers and machine operators.

Spillage of fuels during storage and transportation has oftentimes resulted in the pollution of water bodies and soils. At the consumer end, the combustion of petroleum produces by-products such as carbon dioxide, carbon monoxide and sulphur dioxide contribute to air pollution. Long term effects include acid rain and climate change (emission of greenhouse gases such as carbon dioxide, methane, etc.).

The problem of heavy metal pollution is not yet a significant concern in Malawi. Generally, heavy metals such arsenic and cadmium may enter the soil and water bodies through mineral processing facilities and tailing dumps where they may pose a serious threat to people. Ingestion of tiny amounts of arsenic may be fatal.

Firewood and charcoal are important sources of indoor pollution as these energy sources are normally used in enclosed spaces. The base case estimate of health costs from indoor air pollution for Malawi has been estimated at MK3.3 billion, and this represents 0.66% of GDP lost at 2007 prices (GoM, 2010).

3.2.5 Minimizing Social Impacts Associated with Mining, Energy and Industrial Developments

Mining, energy and industrial activities may provide jobs and markets for locally produced goods and services. For example, the construction of access roads and introduction of services such as water and electricity, schools and clinics into an area may impact positively on the community. However, these activities have the potential to interest in the project through its subsidiary Paladin (Africa) Ltd, with 15 percent shareholding by the Malawi Government. Kayerekera contains measured and indicated resources of 13,630t uranium oxide (0.03 percent cut-off) mostly within 100 m of surface (GoM, 2010).

The uranium is mined by surface method and the mined uranium ore is sent to a mill which is located close to the mine. The Kayerekera Uranium Mine was commissioned in April 2009 (see photo). It is currently the largest mining investment in the country; and by the end of year 2009, the company had produced 58,582 Kgs of uranium

concentrates valued at 1.287 billion Malawi Kwacha. The company reached full production capacity in April 2010. The mine is expected to have a 15 year mine life, producing at least 1,000t of uranium oxide per year.

Rock Aggregate Production

A large increase was experienced in production of rock aggregate during period between 2007 and 2009 (Figure 3.7). Malawi has 24 operating quarries for production of rock aggregate both at commercial and project level, nine (9) of which are commercial quarries and the remaining fifteen (15) are project quarries. Combined production by quarrying companies and artisanal miners registered a total of 970,550 tones of rock aggregate in 2009. Accelerated infrastructural development in Malawi after 2006, resulted in the exponential growth of quarry stone production between 2007 and 2009.

Limestone Production

Limestone is essential in many chemical and industrial processes. In Malawi, limestone is used extensively in the manufacture of Portland cement, agricultural lime and sugar refining. Most limestone deposits occur in the PreCambrian basement complex formation stretching between Blantyre and Lilongwe, with sedimentary limestones occurring in the Karoo Super group and younger formations in the northern and southern extremities of the country.

During the period 2001 and 2003, a decrease in production was evident (Figure 3.7) due to the closure of Changalume Portland Cement Factory by Lafarge Company. A moderate production increase over the period 2005 to 2009 was a direct result of production by Shayona Cement Corporation.

3.3 Opportunities Provided by Energy, Industry and Mining Sources

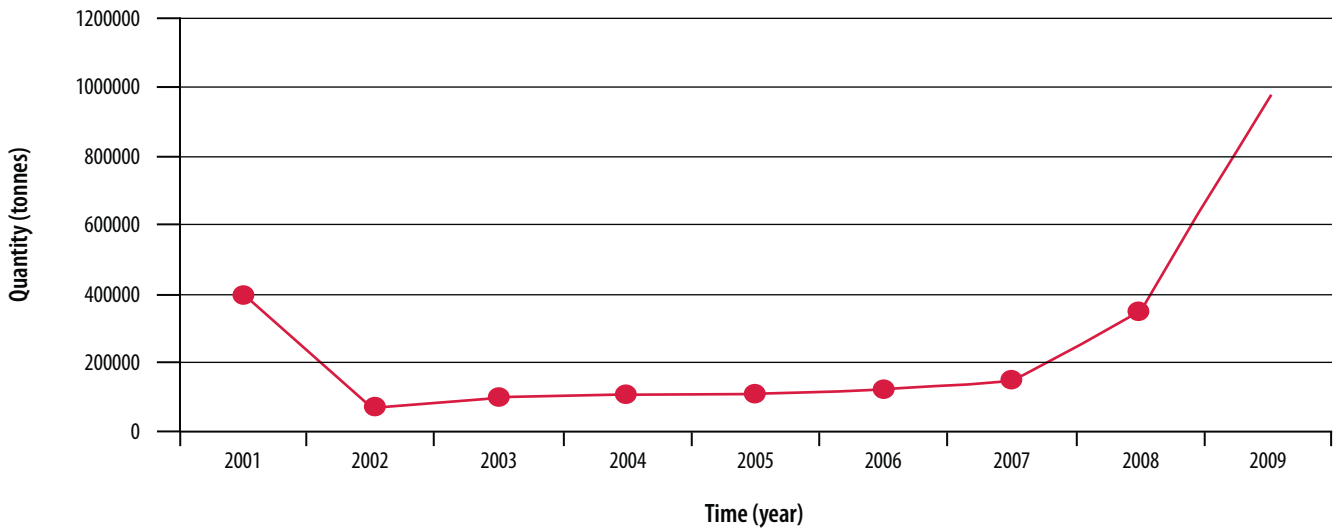
Energy resources have the potential to promote socio-economic development in Malawi, particularly in the industry and mining sectors.

Most of the industries depend either on electricity, coal, or fuelwood as sources of energy. It is envisaged that in future the uranium mine at Kayerekera will supply nuclear energy to the industrial sector. Therefore, with improvements and diversification of sources of energy, Malawi will experience rapid industrial development.

In connection with agricultural production, energy resources are crucial for the successful implementation of the Greenbelt Initiative. The Greenbelt Initiative, a national programme that is intended to irrigate more than one million hectares of land in the country, is highly dependent on the availability of electricity and petroleum products to operate motorized pumps for irrigated agriculture. At present, treadle pumps are widely used in small scale irrigation schemes. Treadle pumps are although labor intensive is a solution to rural irrigation needs, nevertheless motorized pumps also need to be encouraged for irrigation use.

Malawi produces a lot of biomass principally from agriculture and forestry. Using clean and efficient biomass conversion technologies, biomass from agriculture and forestry can be converted to bio-energy using. Such bioenergy production could be a source of energy to serve the needs of rural and urban communities. Additionally, bioenergy can foster development of the industrial sector and reduction of greenhouse gas emissions.

Figure 3.7: Quarry Aggregate Production (Mt) (2001–2009).



Source: GoM, 2010.

Production of ethanol from sugar molasses at Dwangwa and Illovo Sugar Companies (7 million and 10.8 million litres per year respectively) offers an opportunity for Malawi to use ethanol to propel petrol vehicles and reduce engine maintenance costs at the same time. Energem and Total Malawi have expressed interest to stock and sell ethanol at their pumps, thus offering another opportunity for nationwide distribution of ethanol (Maluwa, 2010).

3.4 Strategies for Promoting Industrial, Energy and Mining Development in Malawi

3.4.1 Promoting Alternative Energy Sources

Although natural stocks of firewood may be high, wood resources available to the majority of the rural population in Malawi are dwindling (Yaron *et. al.*, 2010). Increases in the human population will only exacerbate the situation if no action is taken. Current initiative by the Malawi Government and its developmental partners in seeking alternative sources of energy should continue. For example, through the Programme for Basic Energy and Conservation in Southern Africa (ProBEC), Rocket Stoves should be promoted country wide.

There is good potential for the "rocket-based tobacco curing technology" being developed for tobacco farmers. The current Biomass Briquette Initiatives should continue to be implemented using community groups especially women for use and sale as an alternative source of fuelwood. Women were involved with the design of inexpensive and easy to maintain wooden briquette-making machines.

3.4.2 Diversification of Hydropower Resources and Electricity Sources

Malawi has hydropower potential on a number of perennial rivers. Rivers like Shire, Ruo, Bua, Dwangwa, South Rukuru, North Rukuru, Wovwe, and Songwe could generate over 1500MW of electricity. Potential hydropower sites like those located at Kholombizo, Mpatamanga on Shire, Lower Fufu on South Rukuru and Manolo on Songwe have the potential to produce between 100 and 400 MW. These alternative hydropower sources should be investigated further.

Although coal has great potential to contribute significantly to the energy sector, coal mining in the country is currently underdeveloped. With the discovery of more coal reserves in the country, Malawi should investigate the potential of generating electricity from coal using cleaner production technologies. This also applies to Renewable and Alternative Energy Sources (RETs). The amount of insulation in Malawi averages 5.59 kWh/m^2/day and wind speeds greater than 4.7 m/s at acceptance frequencies for power generation have been reported (GoM, 1997). In terms of availability, solar energy is a more attractive option as it is less site specific than wind energy. However due to the initial high costs for solar, wind and solar-wind hybrid systems, there are no large scale installations that use these technologies in the country. Therefore, improvements in technology are keys to the wide application of solar and wind energy as sources of energy in Malawi.

3.4.3 Improving Quality of Industrial Products

Accessibility of both local and international markets is often determined by the quality of the products. Currently standards of some products produced in Malawi are not internationally recognised. The problem is exacerbated by the fact that the Malawi Bureau of Standards (MBS) is not internationally accredited. This means that Malawi has problems penetrating international markets. Currently, MBS standards focus on three aspects: Food and agriculture (i.e. food products), Chemicals and textiles (e.g. soaps and detergents), and Engineering materials (i.e. building materials). In order ensure that Malawi's industrial products survive in the competitive market, the capacity of MBS should be improved and efforts should be made to ensure that MBS has the required international accreditation.

3.4.4 Lobbying and Advocacy

The Malawi Confederation of Chambers of Commerce and Industry (MCCCI), Consumer Association of Malawi (CAMA), Centre for Policy and Advocacy (CEPA) are some of the private institutions that are responsible for lobbying and advocacy (on behalf of industries) on issues that need to be addressed by government. The Government has been negotiating Economic Partnership Agreements (EPAs) with European Union (EU) and other trade protocols within the Southern Africa Development Cooperation (SADC)/Common Market for Eastern and Southern Africa (COMESA) countries. These trade agreements enable Malawian companies to export some goods such as sugar and garments in more favourable trade terms.

3.4.5 Improving Energy, Industrial and Mining Human and Infrastructure Capacity

State of the infrastructure has a big impact on the cost of production. In recent years, the government has made effort to improve road and telecommunication infrastructure. The most recent infrastructural project that has potential to reduce cost of importation and exportation of bulk products is the Shire-Zambezi Inland Port.

3.4.6 Promoting Public Private Partnerships (PPPs)

Malawi government recognizes the importance of Public Private Partnerships (PPPs) in development of infrastructure, for improvement of service delivery, and enhancing the quality of life for Malawians. Malawi has thus put in place a PPP national steering committee comprising Ministry of Development Planning as the Chairman, The Privatization Commission as Secretariat (The Privatization Commission of Malawi, 2006).

3.5 Challenges Facing the Industrial, Energy and Mining Sectors in Malawi

3.5.1 Contributing to Reduced Deforestation

Between 1990 and 2010, forest cover has declined from 41% to 34% (FAO, 2010). The resultant deforestation degrades catchment areas leading to siltation and reduced base flows in rivers. For example, the siltation of the Shire River interferes with hydropower generation, and has also resulted in increased incidents of flash floods and the destruction of transport infrastructure (e.g. roads and railway lines). Mining activities, use of biomass as a source of energy, infrastructure development (roads, dams etc.) related to industrial development, clearing of natural woodlands for agricultural expansions are among the factors that have contributed to the current rate of deforestation. Industry, mining and energy sector therefore faces a challenge to balance growth and reducing deforestation.

3.5.2 Inadequate and Unreliable Power Supply

Hydropower generation is the main source of electricity in Malawi. Contributions from solar and biogas towards meeting the demand for electricity and other energy needs in the country is very small (GoM, 2009).

In Malawi, about 6% of households in Malawi are supplied with electricity and most of these are in urban centers (NSO, 2005). Only 2% of rural households are electrified despite the fact that 85% of people in Malawi reside in rural areas. The situation is unlikely to improve in the short term due to the current diminished generation capacity which is a direct result of low hydraulic head, siltation and weed infestation. Inevitably, the energy sector is also affected by extreme weather events such as droughts and floods, which negatively impact on hydroelectric power generation along the Shire River. The water flow disruptions have been exacerbated by siltation caused by poor and unsustainable agriculture practices and deforestation in the catchment area, and invasive weeds such as water hyacinth. Growth of the industry and mining sectors therefore are constrained by the unreliable power supply. This has greatly affected uranium mining at Kayerekera.

3.5.3 Strengthening, Institutional and Human Capacities for Improved Coordination and Enforcement

Despite Malawi having numerous institutions with enormous opportunities, some of the institutions are not growing. For example, Malawi Industrial Research and Technology Development Centre (MIRTDC), National Association of Business Women (NABW) and National Association of Small and Medium Enterprises (NASME) have been in existence for almost two decades but they do not have their own offices to-date. Other institutions were formed with the aim of undertaking one activity but their mandate has widened over the years without increasing office space and laboratory facilities. Staff retention is also a problem. An example is Malawi Bureau of Standards (MBS) which was established in 1972 with the sole aim of testing quality of exported tobacco but now it is involved in standard development and quality assurance.

Coordination and enforcement are some of the problems facing the industry, mining and industrial sector. For example, solid waste management is under city councils but Environmental Affairs Department (EAD) has the responsibility of ensuring compliance. However, EAD has no capacity to oversee waste management issues efficiently due to lack of resources such as staff and equipment.

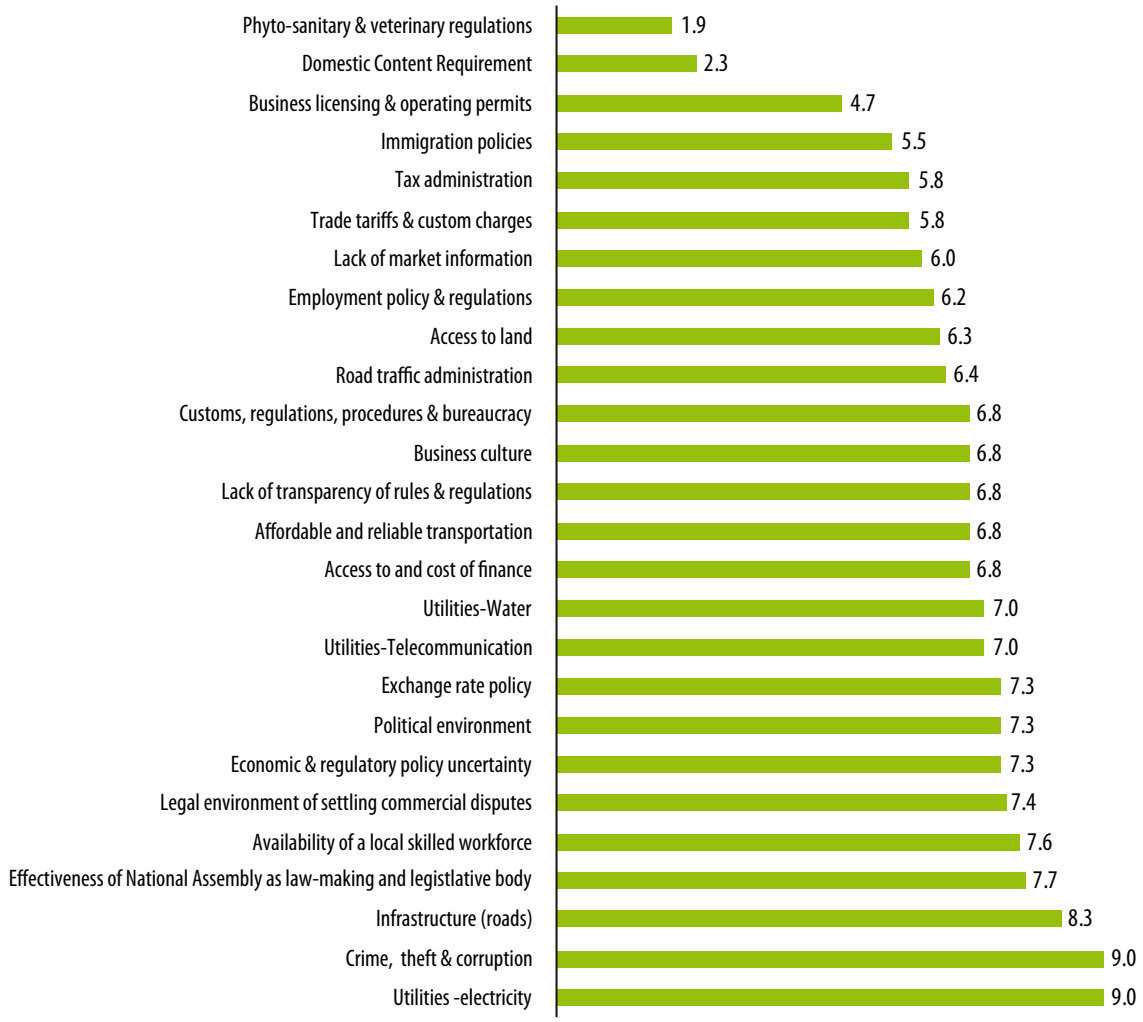
Since enforcement is under the jurisdiction of a government body, no one has the authority to pin down government. Another example is management of Chikangawa Forest where people with concessions to extract resources from the forest are supposed to replant trees. The government is supposed to replant trees on behalf of saw millers. However, government lacks capacity to fulfill this obligation while the concessionaires comply.

3.5.4 Inadequate and Unharmonised Investment Policies

A conducive business environment is important in order to woo investors. However, Malawi has several obstacles which face the business community. According to the Malawi Confederation of Chambers of Commerce and Industry's Business Climate Survey Report of September 2008, the top-most major obstacles are utilities (electricity); crime, theft and corruption; and infrastructure (roads). Apart from frequent black outs, erratic water supply is another problem.

Malawi needs to offer competitive environment in order to attract foreign investors. However, the obstacles to

Figure 3.8: Rating of Obstacles to Doing Business in Malawi.



Source: The Malawi Confederation of Chambers of Commerce and Industry–The Malawi business climate survey.

business as stipulated in Figure 3.8 (particularly erratic water and power supply) may be moderate in other countries. Malawi needs to give incentives such as tax holidays or tax reductions to investors (which are offered in most SADC countries) in order to woo them.

Malawi imports most of the materials required in the industrial sector. This requires foreign exchange. Of late, Malawi has been hit by foreign exchange shortage making it difficult for the industries to import the materials in time and in the required amounts.

In order to improve efficiency, Malawi has seen some companies being merged while others have been dissolved. Some of the companies are still waiting to be merged after announcement in parliament. Such companies are in dilemma because of the uncertain future. The uncertainty is also a threat to investors and employees. For example, the announcement to merge Malawi cause negative social effects: proliferation of informal settlements, conflicts among various ethnic groups, high crime rates, and prostitution and the spread of HIV/AIDS. Occupational diseases arising from inhalation of dust particles and radiation from certain minerals like uranium are another social impact although concrete data on the same is not yet available for Malawi.

Mining operations generally use large volumes of water for the extraction of minerals from rocks. Also, systems intended to provide cooling in mines use vast quantities of water. This has potential to deplete the available water resources. Nearly all mines and quarries in Malawi depend on ground water and rivers as resources of water supply, but so far there has been no report of water resources depletion resulting from mining operations. This has potential to reduce water available for agriculture and domestic use.

3.6 Policy Responses for Promoting Energy, Mining and Industry Growth

The Malawi Government has undertaken several policy response measures that are aimed at ensuring security of the energy, industry and mining sectors as follows:

The Malawi Government has since the 1970s embarked on extensive forest conservation and afforestation projects mainly through tree planting projects. Tree Planting programme has is now strongly linked to climate mitigation through a programme implemented by Department of Forestry and LEAD on tree planting for carbon sequestration and other services, where farmers are given an incentive for planting and managing trees.

Regarding the energy sector, the Government of Malawi has recently recognized that a more pragmatic approach to the energy sector is required. A result of this the Malawi Biomass Energy Strategy (BEST) of 2009. BEST outlines measures designed to improve sustainability of biomass energy supply and promote appropriate alternatives. In addition to this, the National Energy Policy of Malawi (2003), the Malawi Energy Regulation Act (2004) and other energy laws have opened up the energy market thereby removing ESCOM's monopoly in electricity generation and distribution. In order to regulate the energy sector in accordance with the existing energy laws, the Malawi Government in 2004 established the Energy Regulatory Authority (MERA). This will be superseded by the Malawi Water Energy Regulatory Authority (MWERA).

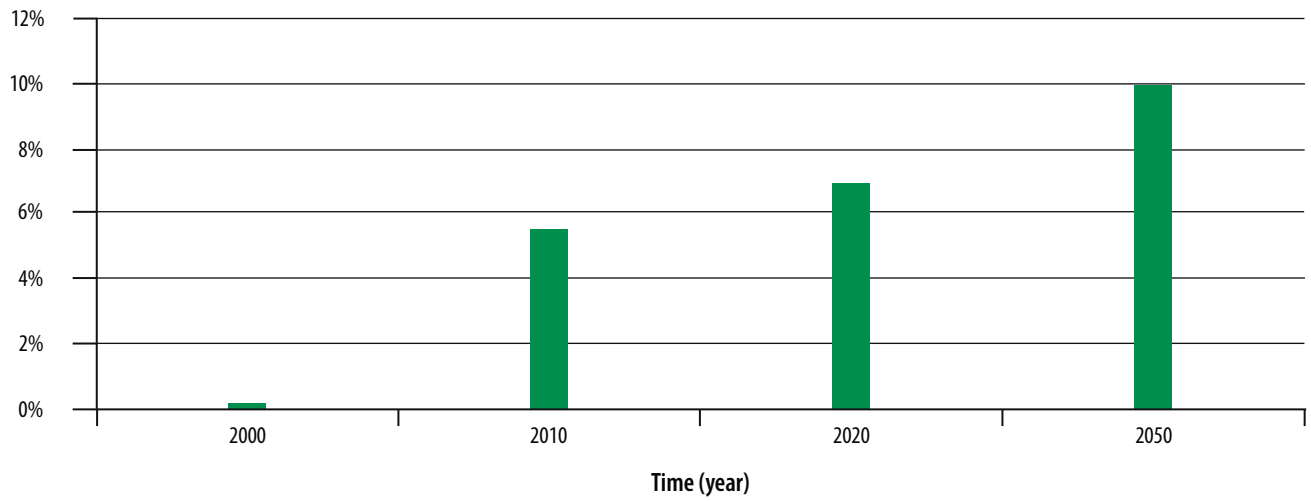
The Malawi Government also established the National Sustainable and Renewable Energy Programme (NSREP) in 1999 under the Department of Energy Affairs to act as an umbrella body for the promotion of RETs. One of the projects overseen by NSREP is the Promotion of Alternative Energy Sources Project (PAESP). Due to limited funding, PAESP is currently concentrating on the promotion of four alternative energy sources namely; biomass briquettes, liquefied petroleum gas (LPG), paraffin and ethanol. Realizing the potential of increasing the contribution of RETs and AETs to the energy supply, Malawi has through the National Energy Policy 2003 set ambitious targets for RETs and AETs as shown in Figure 3.9.

The Department of Energy through the Village Electrification Project, a component of MAREP, is experimenting on the suitability of stand-alone solar-wind hybrid systems for rural electrification. The hybrid systems compensate for the shortfalls of a solar only or wind only system. The project entered its second phase in 2010 after the successful completion of the first phase that saw 450 households electrified.

The Government of Malawi is aware of the importance of improving the efficiency of energy usage and conservation measures. The Department of Energy and NGOs are continually undertaking projects to improve the efficiency of charcoal production, charcoal burners and wood fuel stoves. The Government, through the Department of Energy and in partnership with ESCOM, will roll out a project in 2011 to phase out incandescent bulbs in the country. This is a more efficient use and a conservation measure of energy. It is estimated that about 50 MW of energy will be conserved as a result of this initiative.

The general increase reported in mining in Malawi may be attributed to macroeconomic environment that favoured increased investments in the sector during the period 2001 to 2010. Traditionally Malawi was considered to be an agro-based economy up until 2006 when the Government of Malawi formulated the Malawi Growth and Development Strategy (MGDS) as the over-arching tool for achieving economic growth and development over the period from 2006–2011. The Government declared mining as one of its nine priorities in the country's Growth and Development Strategy. This change in policy has led to the development of a number of initiatives in the

Figure 3.9: Projection of the Contribution of the Renewable Energy Technologies (RET) and Alternative Energy Sources (AES) to the Total Energy Mix in Malawi.



Source: GoM (2009)

mining sector, including: revision of the Mineral Policy and the Mines and Minerals Act, and the establishment of commercial mining enterprises. In the more general environmental field, the government legislated for equitable access to natural resources, which naturally include mineral resources and the social and economic benefits that accrue from it. Government has in place policies with options and mechanisms to ensure that adequate share of benefits from the mineral sector are provided to the communities impacted by mineral activities. The gender factor is considered with participation in the sector by Association of Women Miners in Malawi and National Association of Business Women (NABW) in Malawi.

Currently a major pressure in all mining operations is the optimization of financial costs of environmental management over the entire life cycle of the mines, which includes rehabilitation and environmental restoration activities. Environmental restoration, a major cost item in the planning of a mine, used to be the one for which the expenditure could be readily reduced in difficult financial times. However, the negative effects of such short-term survival strategies are often only evident at a much later stage. The larger mining concerns have brought about significant changes to environmental remediation strategies to address that need. In Malawi this is addressed through legal provisions of having an Environmental Impact Assessment (EIA) for all major mining projects.

3.7 Conclusions

Being an agricultural based economy, agro-processing sector must be given technical, financial and legislative support to enable the sector contribute more to the economic development of Malawi. The industrial production sector is small but has a lot of potential to improve its contribution to GDP, offer employment opportunities to Malawians and increase Malawi's capacity to add value to its primary products before they are exported to other countries.

The mining sector has been declared a priority sector by the Malawi government and increased activity is evident with the opening of the first commercial mine at Kayerekera in Karonga and other upcoming exploration ventures some in bankable feasibility stages. The geology of Malawi complex as it is hosts a variety of minerals that are being mined for both the domestic and export market.

Malawi is largely dependent on biomass as its source of energy with coal, electricity, hydrocarbon fuels and RETs and AETs collectively contributing only 12 percent to the total energy demand. Only about 6 percent of Malawian households have access to electricity. Petroleum and coal are mainly used in transport and industry respectively and currently have no significant contribution to domestic energy consumption. RETs and AETs are used mainly at the household level and in small institutions mostly at project level. Proportionately these are not significant sources of energy for Malawi.

The energy sources are under pressure from a rapidly growing population, growing demand from a diversifying and growing industrial sector, degraded environment and from a lack of energy options.

Environmental degradation and pollution associated with energy, industry and mining are critical concerns in Malawi. Examples of such impacts include the loss of integrity of catchment areas, indoor pollution, soil erosion, air pollution and land use change.

Data is, however, limited or not available in a format well-suited for strategic decision making about the impacts of the energy, industry and mining sector. Sustainable methods, as well as regular reporting on progress, are of the utmost importance. That as a requirement some of the profits derived from sector be applied to create sustainable jobs in other economic sectors, should receive the highest political priority.

The Government of Malawi has put in place several measures to ensure energy security and sustainable exploitation of minerals and energy sources in the country.

3.8 Recommendations

The MGDS document has laid down an excellent road map that would facilitate Malawi to move from being a primary producer to a secondary producer. The challenge is that the list is long and resources are not there to meet all the prioritised developmental needs. Malawi need to relook at the list of priorities and take a deliberate effort to phase the plans into more implementable lots. For example, with the pressures against tobacco globally gaining momentum, there have been suggestions that Malawi needs to move faster in diversification of cash crops and the industrial base in general.

Critical to the management of environmental impacts of mines in Malawi would be the requirement for a very detailed database on all existing and abandoned mines. For each of the many minerals and products, and mined resource utilization, planners need to know the following:

- How much was available initially, with the current knowledge of proven reserves?
- How much has already been extracted?
- At what rate is the resource being depleted?
- What is the likely future rate of exploitation?
- When will the known resource be exhausted?

- How much remains undiscovered?
- How will local and international economic factors of supply and demand influence the drive to explore for and exploit more mineral resources?
- What are the environmental implications of rehabilitation and restoration once mining operations cease?

Critical to the management of environmental impacts from the energy, industry and mines sector in Malawi would be the requirement for a very detailed database on all existing and abandoned industries. The establishment of a database designed specifically for the management of environmental and social impacts of energy industry and mines within the context of sustainability is essential for Malawi, and such database should be housed in departments like Department of Mines or Department of Environmental Affairs.

Securing a skilled labour force-both hourly and salary is a continuing challenge. Critical shortages of university faculty that can teach mining and the use of new technologies in mining applications are emerging at a time when the need for workers with ever advancing skills is increasing. The emerging mining industry needs employees with a broader range of skills-computers, chemical engineering, environmental sciences and multiple languages, as well as mechanical, electronic and electrical skills. Sustainable development of the energy industry and mining sector requires considerable capacity building, training, and significant scientific research and technological development. It is recommended that the Malawi government take a very critical assessment in the relevant departments followed by subsequent relevant actions to address the capacity problems.

Equally critical would be the integration and harmonization of the social, economic and environmental management policies and strategies for governing energy, industry and mining with other relevant policies, e.g. Water Policy, Land Policy, etc.

Government should ensure and enforce the carrying out of an EIA process in accordance with existing guidelines.

In conclusion, the chapter highlights three sectors that are key to sustainable development in Malawi. While agriculture is undoubtably the main driver of the Malawi economy, the inclusion of mining in the priority development areas has paid dividends as shown by the exponential growth of employment by the sector since 2002. The diversity of mining activities has allowed inclusion of small scale operators, including women as active participants, providing the much needed social inclusion in the sector.

Photo Essay - Siltation and its Impact on Hydroelectric Production

Sosten Chiotha

Sosten Chiotha

Heavy soil erosion due to deforestation has led to extensive siltation in Malawi's rivers. Above left, over a foot of sediment has collected in the intake at Nkula hydro plant on Shire river. The sediment from the river is rich in clay and sand, and as such is poor for cultivation (seen at a dumping ground, above right).

ESCOM

ESCOM

Siltation greatly reduces the capacity of hydroelectric generators in Malawi. It collects in grates and filters, necessitating constant maintenance, and damages turbines. A functioning intake filter is seen below left, while one damaged by silt and debris can be seen on right.

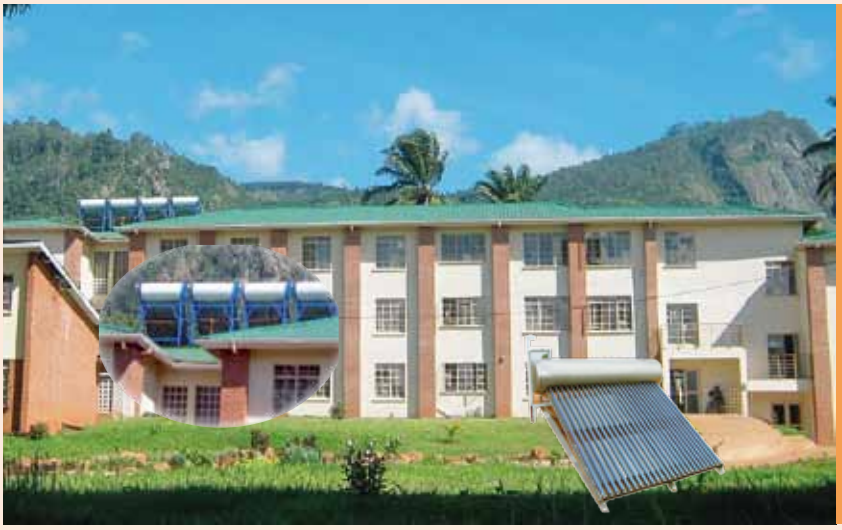
Photo Essay - Alternative and Green Energy

Welton Phalira

An alternative to charcoal and firewood as fuel sources is briquettes using straw and organic waste. Firewood and charcoal have negative impacts on forest resources.

Seston Chiotha

Jatropha is an eco-friendly energy source that can be grown in Malawi. Mass production of jatropha will help Malawi reduce her dependence on fossil fuels.



Deepa Pullanikkatil

Solar geysers provide efficient heating that conserves energy and is cost effective over time. Above, Students accommodation of Chancellor college has solar geysers installed making an example of how clean and green energy can be used in Malawi. Policies to incentivise consumers to use green technology will help in the long term to attain sustainability in energy supply.

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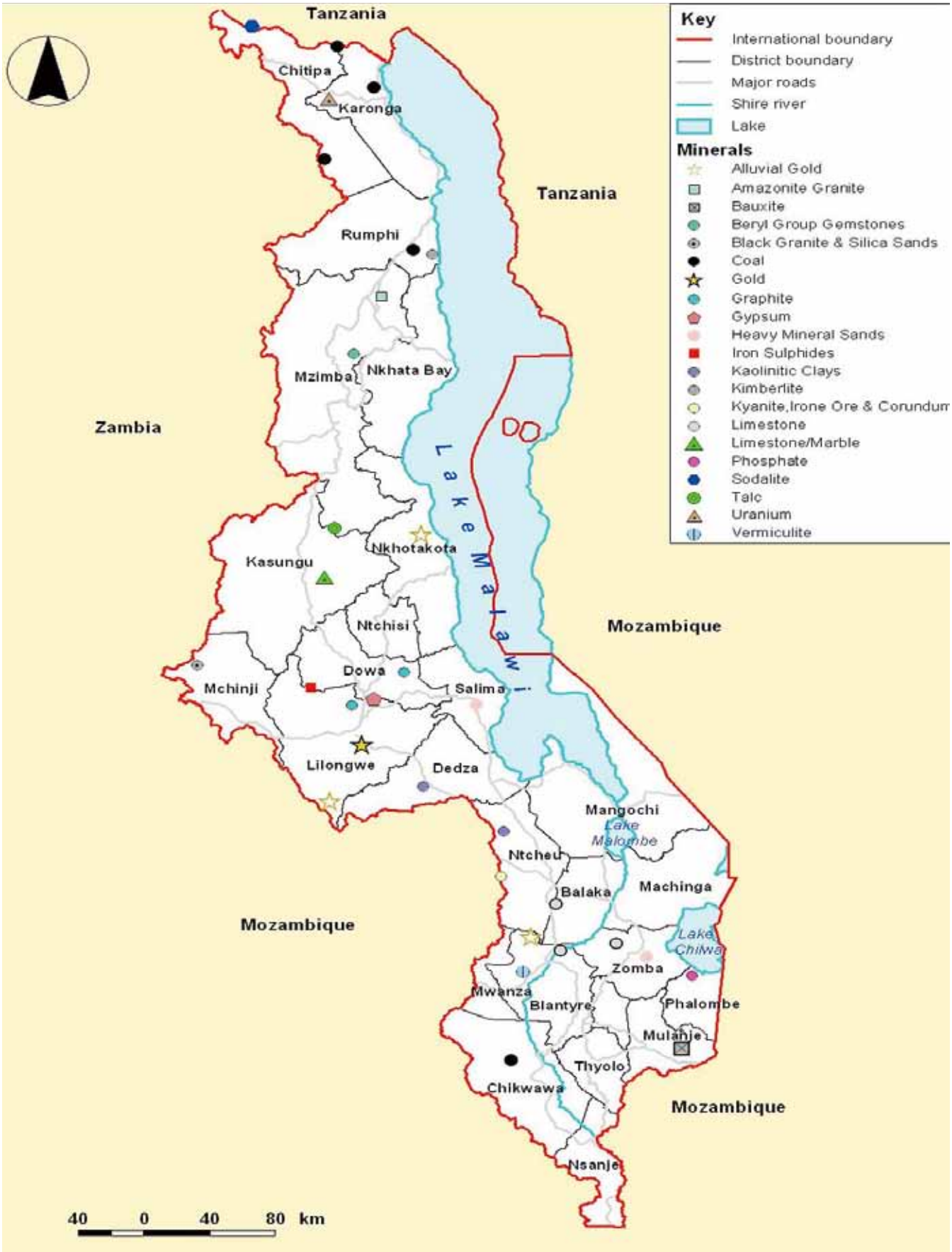
Appendix

Geographical Distribution of Minerals.



Source: EAD, 2009.

Table 3.5: Number of Licences issued (2001–2009).

Type of Licence	2002	2004	2006	2007	2008	2009	Minerals
Non-Exclusive Prospective Licence (NEPL)	42	71	60	61	73	42	Gemstones, Ornamental stones
Mining Claim Licence (MCL)	15	28	23	50	35	12	Gemstones, Ornamental stones
Reserved Minerals Licence (RML)	22	13	22	57	52	17	Gemstones, Ornamental stones
Exclusive Prospecting Licence (EPL)	17	15	15	35	32	19	Uranium, HMS, Base Metals, PGM,
Mining Licence (ML)	15	5	8	12	13	7	Limestone, Gypsum, Iron Ore,
Reconnaissance	-	-	-	-	1	4	Glass Sands, Coal

Source: GoM, Dept of Mines, 2010

Table 3.6: Export of Minerals and Mineral Based Products (2001–2009) (Source: GoM, Dept of Mines, 2010).

Product	2001	2002	2003	2004	2005	2006	2007	2008	2009
Coal (Mt)	-	25,446	10,715	5,636	14,755	17,350	8,192	3,500	6,830
Gemstones(Kg)	148	2,305	2,297	1,820	1,642	2,171	3,710	11,946	18,695
Ornamental Stones(Mt)	-	120	450	320	70	126	178	332	167.8
Agric Lime(Mt)	-	-	-	-	280	-	-	100	1,040
Rock Aggregate(m^3)	-	2,581	2,560	-	628	-	-	-	8,285
Pottery/ceramics (pieces)	-	-	-	-	600	700	910	1,022	-
Uranium Concentrates(tonnes)	-	-	-	-	-	-	-	-	58,600
Other Industrial Minerals	-	-	-	-	-	2,299	110	7,023	4,830

Key: Data not Available Source: GoM, Dept of Mines, 2010).

Table 3.7: Formal Employment in the Mining Sector (2001–2009).

Sub-sector	2001	2002	2003	2004	2006	2007	2008	2009
Coal	-	-	-	629	713	1,013	1,110	1,310
Cement Lime	-	-	-	55	68	86	96	110
Agricultural Lime	-	-	-	86	164	174	194	1,392
Quarry Aggregate	-	-	-	440	660	1,030	2,030	4,030
Cement	-	-	-	-	348	358	348	648
Gemstones/Mineral Specimens	-	-	-	150	125	166	125	1,176
Ornamental Stones	-	-	-	-	45	47	37	37
Clay/Pottery	-	-	-	900	178	155	125	115
Terrazo	-	-	-	175	169	176	196	996
Other ndustrial Minerals	-	-	-	-	20	41	538	1,544
TOTAL	-	-	-	2,435	2,490	3,246	4,799	11,358

Source: GoM, 2010

CHAPTER 4

Spraying of Insecticides, Photo by Sosten Chiotha

HEALTH AND THE ENVIRONMENT

Kamuzu College of Nursing Students, Photo by University of Malawi Central Administration Office

4.1 Introduction

Malawi's health care service comprises 260 medical doctors, 4,812 nurses and midwifes and 10,507 health surveillance assistants (Kashoti, 2009 and Muula, 2009). In addition to this, Traditional Healers (though not recognized by the government), compliment government efforts. It is estimated that about 80% of the rural communities consult traditional healers for help. Despite the comprehensive health care delivery system, the system is constrained by shortage in human resources, essential drugs and laboratory facilities. Human resources shortage is largely caused by brain drain, low life expectancy, the aggravating HIV/AIDS prevalence, high mortality rates and changing environment. For example, problems of deforestation and afforestation in some parts of Malawi, together with some agricultural practices are being associated with increased incidences of river blindness, malaria and sleeping sickness. Shortages of essential drugs is among the challenges facing Malawi's health care system.

Malawi's environment and sanitation have shown signs of deterioration mainly due to population pressure and unsustainable use of natural resources. This chapter therefore provides an overview of diseases whose occurrence is very much dependent on the environment. These diseases have been grouped into water and sanitation related diseases, human contact diseases and vector borne diseases. With a high rate of urbanization, a number of diseases associated with water, sanitation and hygiene have become more prominent. Malawi's efforts to manage these diseases have also been assessed. Finally, the chapter provides environmental strategies that must be followed to minimize incidences of diseases and the negative impact they cause on the economy of Malawi.

Sosten Chiotha

Women can be exposed to waterborne diseases and pollution through daily water contacts for routine domestic activities.

4.2 Water and Sanitation Related Diseases

4.2.1 Cholera

Cholera is a bacterial disease which is spread by drinking contaminated water and eating contaminated food, exacerbated by lack of or inadequate hand washing practices and poor sanitation (Chingayipe, 2008). In Malawi, cholera outbreaks usually occur in the rainy season, i.e. between October and April.

Although cholera and diarrhoea outbreaks mostly occur during rainy season, the situation is different in other parts of the country. For example, cholera is prevalent throughout the year around Lake Chilwa because the lake is contaminated. Since the lake has no outlet, all the wastes from uplands are concentrated in it (News Reports, 2002). The lake is shallow and there is constant mixing of water and sediment creating permanent turbid conditions that favour survival and multiplication of the bacteria.

Between 1989 and 2003 the number of cholera cases and number of deaths showed an increasing pattern (Table 4.1), but these decreased significantly between 2005 and 2007 (WHO, 2008).

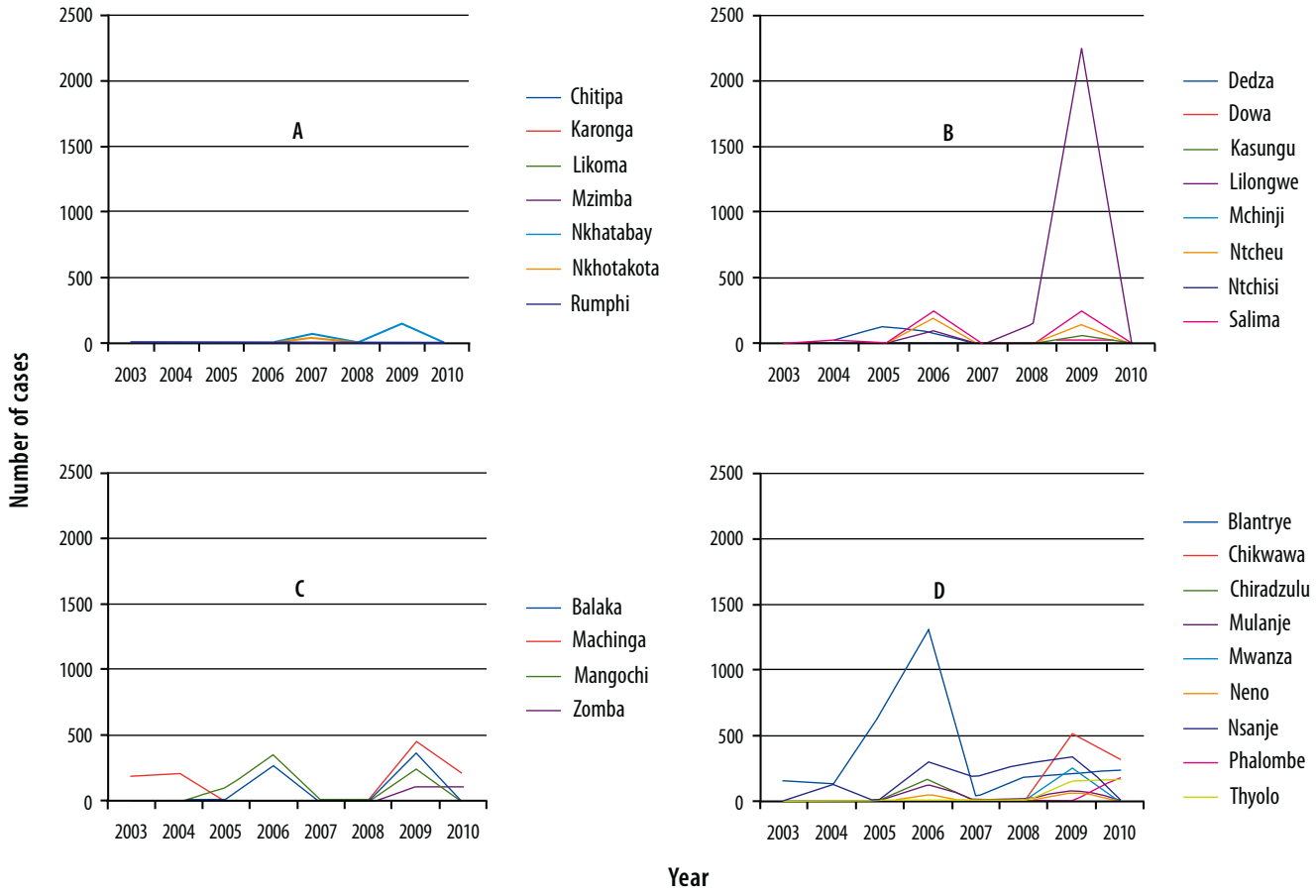
Table 4.1: Cholera Cases in Malawi from 1989 to 2007.

Period (Years)	Number of Cases	Number of Deaths
1989–1990	21,808	497
1993	25,193	524
1999	26,508	648
2002–2003	33,150	981
2005–2006	4,508	-
2006–2007	264	-

Source: WHO 2008.

Incidences of cholera cases in the three regions of Malawi between 2003 and 2009 presented in Figure 4.1 show that prevalence was low throughout the period. In the northern region, the highest prevalence occurred in 2009 with about 200 cases in Chitipa (Figure 4.1A), whilst in the central region, the highest prevalence occurred in 2009 in Lilongwe with 2,260 reported cases (Figure 4.1B). In the Eastern Region, all districts experienced high peaks of cholera in 2009. It must be pointed out that in 2005, 2007 and 2008, there were no incidences of cholera in the eastern region.

Figure 4.1: Incidences of Cholera from 2003 to 2010 in Northern (A), Central (B), Eastern (C) and Southern (D) Regions.



Source: GOM, Ministry of Health and Population 2010.

While most regions experienced peaks in 2009, the Southern region experienced highest prevalence in 2006 in Blantyre with about 1,302 cases reported (Figure 4.1D).

4.2.2 Diarrhoea

Diarrhoea is among the top ten causes of hospital admissions and deaths in Malawi and is responsible for most of the illnesses and deaths that occur among under–five children in Malawi (GoM, 2003).

Blood Diarrhoea

Figure 4.2 shows prevalence of blood diarrhoea in the regions of Malawi covering the period 2003 to 2010. In the northern region, Mzimba experienced persistently high prevalence of blood diarrhoea. However, despite Likoma Island and Nkhata Bay being surrounded by water, they experienced the lowest prevalence of blood diarrhoea cases (Figure 4.2A). In the central region, the highest prevalence occurred in Mchinji, with 50,000 cases.

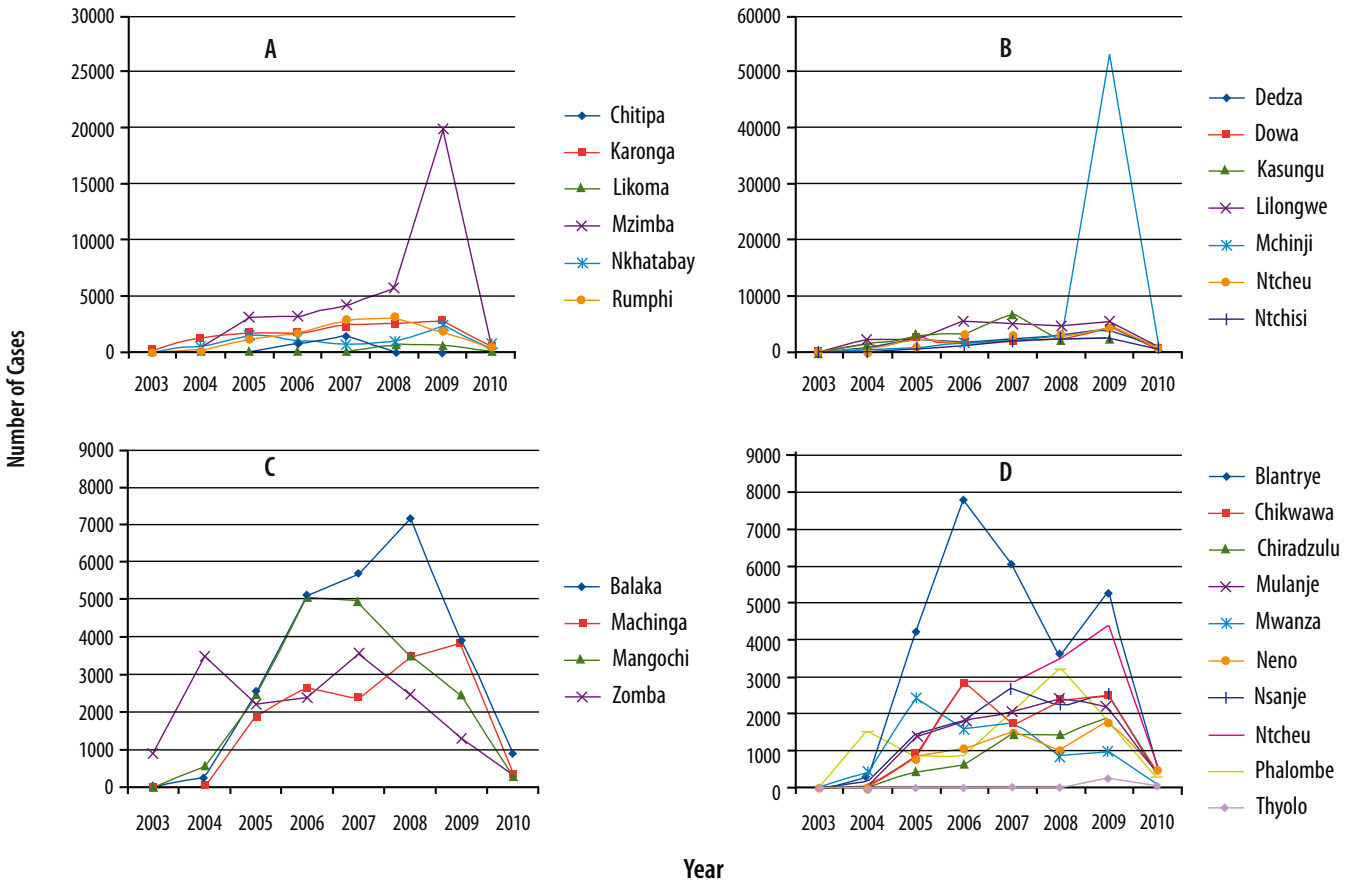
In the eastern region (Figure 4.2C), number of blood diarrhoea cases increased sharply in Balaka, Mangochi and Zomba districts from 2004 to 2007 reaching a maximum of 7000 reported cases. This was followed by a sharp decline. On the other hand, the number of cases in Machinga increased gradually from 2004 until 2009. Balaka and Mangochi had same trend from 2003–2006. Generally, after 2006, the incidences in all districts in the region increased sharply.

In the southern region, Blantyre had exceptionally high prevalence of blood diarrhea cases from 2003 to 2009. The highest was 8,000 cases in 2006. The prevalence in Blantyre decreased sharply between 2006 and 2008 before increasing again in 2009. Thyolo recorded the lowest prevalence throughout the seven years (2003–2009).

Ordinary Diarrhoea

Non-bloody diarrhoea appears to show a similar trend. In the northern region, Mzimba had persistently high prevalence and the highest was recorded in 2007 with 17,000 cases (Figure 4.3A). In the central region, (Figure 4.3B), Lilongwe had high prevalence (reaching the peak of 21,000 in 2009). The rest of the districts followed the same trend (increasing from 2004–2006, declining in 2007 and finally rising in 2009). In the eastern region, Mangochi had high prevalence whilst Machinga experienced the lowest prevalence

Figure 4.2: Incidences of Blood Diarrhoea in Northern (A), Central (B), Eastern (C), and Southern (D) Regions from 2003 to 2010.



Source: Government of Malawi 2010.

throughout the period (Figure 4.3C). In the southern region, Blantyre experienced the highest number of cases (up to 16,000 cases in 2009). The prevalence for Blantyre increased sharply from 2008 to 2009 (3,700–16,000 cases) (Figure 4.3D).

Factors Contributing to Increased Incidences of Diarrhoea

There is high rate of migration into the cities of Malawi resulting in overcrowding and high population of people living in squatters and slums. Squatters and slums are not provided with the safe municipal water and sanitation facilities (UNICEF, 2004). These conditions result in poor sanitation. This is why the two cities, Blantyre and Lilongwe, experienced high incidences of cholera and diarrhoea. The districts that are hardest hit by the epidemics are those exposed to annual flooding, lakeshore areas, poor urban and peri-urban areas and places with large migratory populations for example Nsanje, Chikhwawa and Nkhata-Bay.

In societies highly affected by HIV and AIDS, people spend more time looking after the sick and less time collecting water, cleaning the home, and other house chores. This also leads to sanitation problems in the home, putting family members at risk.

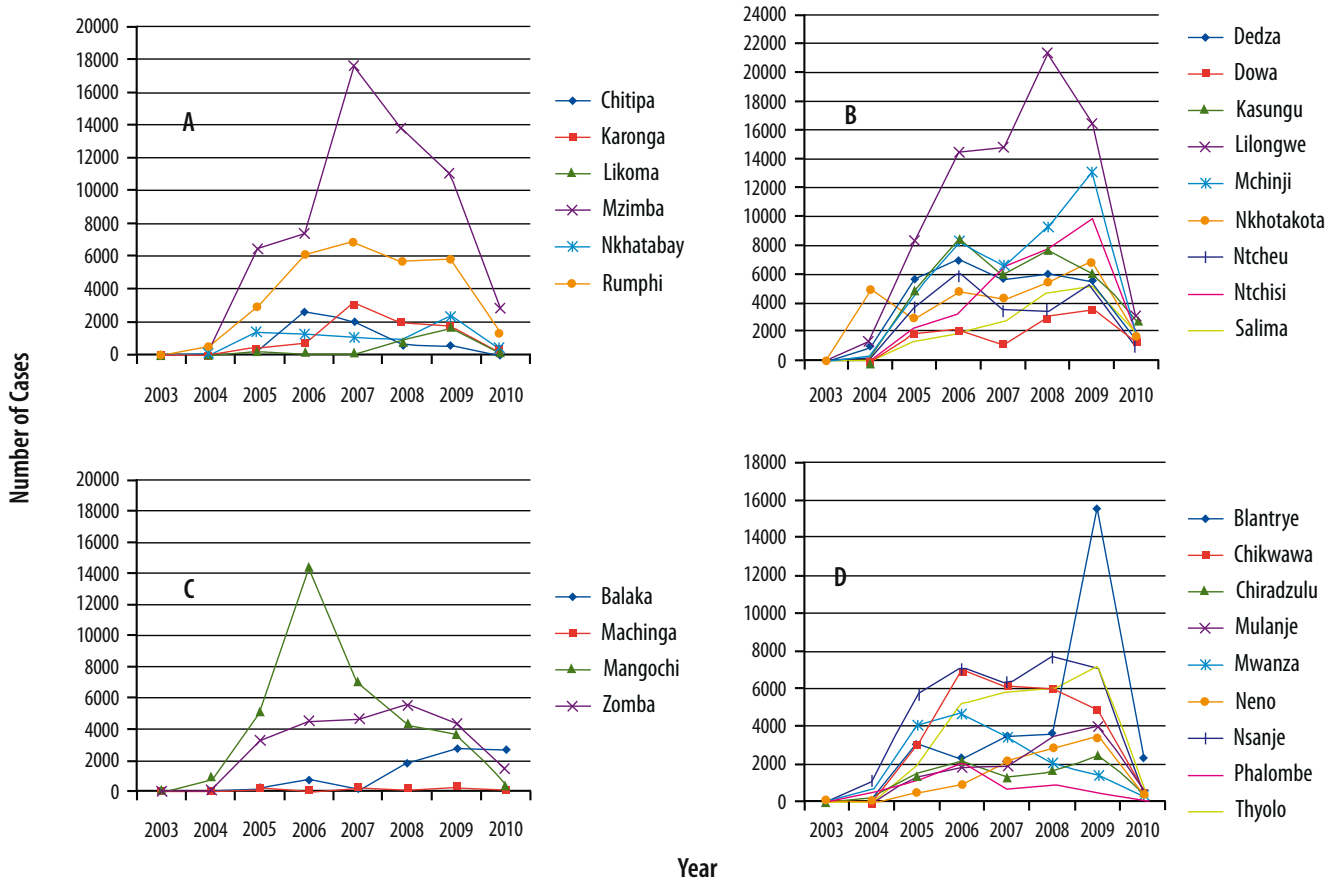
Transboundary movements and agricultural practices also contribute to prevalence of waterborne diseases. For example, due to rice irrigation schemes in Karonga, there is high prevalence of water canals, which increases the incidence of contaminated water and therefore posing a threat to residents.

National Response Programmes for Managing Water Borne Diseases

Malawi has put in place several mechanisms to control sanitation related diseases including cholera. Because cholera epidemic emanates from interlinked causes, the responses are also multifaceted. The mechanisms that have been put in place include: health education through health talks, role plays and drama; household level chlorination of water; isolation of cases, following up of cases and case management (UNICEF, 2004; WHO, 2008).

Between 1994 and 1997, Malawi was a member of the Southern African Initiative for Cholera Control and Strengthening of Epidemic Diarrhoeal Diseases Preparedness and Response. This initiative provided training of trainers for surveillance and case management and laboratory support. In 2001 and 2002, Malawi established response coordination with Ministry of

Figure 4.3: Incidences of Non-bloody Diarrhoea.



Source: Government of Malawi 2010.

Health and Population and UNICEF and embarked on hygiene education and chlorination of water supplies (WHO, 2008).

In 2002, Malawi formed a National Cholera Task-force whose objective was to reduce cholera-based morbidity and mortality. Additionally, In 2002/03 and 2003/04, cholera was part of the UN Consolidated Inter-Agency Appeals, led by WHO and UNICEF. The epidemic has also attracted funding from agencies like Oxfam, the Norwegian Refugee Council, World Vision and US Peace Corps. Non-Governmental Organizations and international organizations also help Malawi in strengthening the response capacity. For example, Medecins sans Frontieres (MSF) help in setting up special isolation units, install latrines and donate plastic sheeting and special cholera beds. MSF also undertakes intensive bedside training and increase capacity of Malawian nurses (in handling cholera cases and containing outbreaks) through mentoring programmes (Medecins sans Frontieres, 2010).

During outbreaks, chemicals such as High Test Hypochlorite (HTH) are used to decontaminate health facilities and purify water supplies. Oral rehydration salts and Ringer's Lactate IV solution are given to the victims as part of treatment. Households are given UNICEF Family Water kits which contain buckets, soap and water purification tablets.

Despite these efforts by the Government of Malawi and non-governmental organizations, Malawi continues to experience cholera outbreaks. Some of the underlying factors include critical shortage of medical supplies, inadequate case management and lack of preparedness.

4.3 Human Contact Diseases

4.3.1 HIV and AIDS

Environment and HIV and AIDS

HIV and AIDS infections have a seriously negative impact on the environment. This can be seen through the loss of human capacity for environmental management and the aggravation of poverty and associated over-harvesting of natural resources. Poor environmental conditions also affect health of HIV/AIDS patients: overcrowded conditions facilitate transmission, and increase the spread of associated opportunistic infections.Table 4.2 shows HIV prevalence rate by sex and age while Table 4.3 shows prevalence by socio-economic characteristics.

National Response to HIV and AIDS

Malawi is a signatory to the 2001 Declaration of Commitment on HIV/AIDS and produces HIV and AIDS Monitoring and Evaluation Reports, which also serve

Box 4.1: Case Study of Karonga Showing How Agricultural Practices and Transboundary Movements Contribute to Increase in Water-borne Related Incidences

Diarrhoea diseases have remained a challenge in Karonga due to high prevalence water canals emerging from rice irrigation schemes (Banda and Nyirenda, 2000). Transboundary movements also contribute to increasing cases of diarrhoeal diseases, including cholera (Banda and Nyirenda, 2000). There is therefore need for government to institute measures to ensure that people getting into Malawi are examined thoroughly. This should be applicable to other life threatening diseases. Karonga district hospital, Karonga District Environmental Health Office and border health post should be well equipped to contain the spread of the diseases in case of outbreaks. Health education campaigns should also be promoted to inform the people on hygienic practices and how to manage the diseases at household level. Besides, Village Health Committees should be strengthened and encouraged.

Table 4.2: HIV Prevalence by Age and Sex.

Age Group	15–19	20–24	25–29	30+	Total
Female	3.7%	13.2%	15.5%	17.0%	13.3%
Male	0.4%	3.9%	9.8%	17.5%	10.2%

Source: USAID-Malawi (2008).

as the UNGASS Country Progress Reports (UNGASS country progress report, 2010).

In 1988, the Government of Malawi created the National AIDS Control Program (NACP) to coordinate the country's AIDS education and HIV prevention efforts. To guide implementation of NACP, five year strategies for management of HIV/AIDS are produced. The first five-year strategy covering the period 1989–93 had objectives of HIV prevention through blood safety, behaviour change communication and management of STIs. The second strategy (1994–98) recognized that HIV/AIDS was a multi-sectoral issue and included issues of counseling and care of people living with AIDS (PLWAs).

A National Strategic Framework (NSF) for HIV/AIDS was developed for the period, 2000–2004. The Malawi National AIDS Commission (NAC) was established in June 2001 and has since overseen a number of AIDS prevention and care initiatives, including programmes to provide treatment, increase testing, and prevent mother-to-child transmission of HIV. Various indicators have been determined to monitor future progress (Table 4.4). A national HIV/AIDS policy developed in 2003, laid down the guiding principles for all national HIV/AIDS programs and interventions. A national action framework was also developed for the period 2005 to 2009 (Kemp *et. al.*, 2003, USAID, 2008). Malawi has recently produced a comprehensive National HIV Prevention Strategy covering the period 2009–2013 that seeks to consolidate all prevention interventions in one single coherent framework with clear management and implementation mandates (UNGASS country progress report, 2010).

Table 4.3: HIV Prevalence (%) by Socio-economic Characteristics.

Characteristic		Women	Men	Total
Residence	Urban	18.0	16.3	17.1
	Rural	12.5	8.8	10.8
Region	Northern	10.4	5.4	8.1
	Central	6.6	6.4	6.5
	Southern	19.8	15.1	17.6
Education	None	13.6	9.2	12.3
	Primary 1-4	12.3	6.5	9.7
	Primary 5-8	13.2	10.8	12.0
	Secondary +	15.1	12.9	13.7
Wealth	Lowest	10.9	4.4	8.3
	Second	10.3	4.6	7.6
	Middle	12.7	12.1	12.4
	Fourth	14.6	11.7	13.2
	Highest	18.0	14.9	16.4

Source: NAC, 2009.

In 2004 there were 10,761 HIV patients on treatment in Malawi. Since commencement of free antiretroviral therapy (ART), more than 140,000 people were on treatment by mid 2008. The number of patients on treatment reached 198,846 by December 2009 (USAID, 2008; UNGASS country progress report, 2010).

4.3.2 TB in Malawi

Tuberculosis continues to be a major public health problem in Malawi. According to the Malawi Health Management Information Bulletin (2008) over 7,000 TB cases were evaluated from new smear positive cases in 2007/08 of which over 6,000 were cured and over 700 resulted into deaths. This represented a cure rate of 81% and death rate 10% respectively. Looking at the history of TB in Malawi, cure rate has slowly been

Table 4.4: HIV Indicators.

Indicator	Baseline	Source
HIV incidence rate among adult population (15–49)	1.6% (2007)	Incidence studies
% of sexually active population (15–49) who are HIV positive	14.20% (DHS, 2004)	DHS, SSS
Prevalence of HIV pregnant women aged 15–24 years attending ANC	14.3% (DHS, 2004)	SSS
% of infants born to HIV-positive mothers who are infected	21% (2007)	EPP modelling

Source: NAC, 2009.

declining over the period 2005/06 and 2007/08. The rate declined by 4 percent between 2005/06 (73%) and 2006/07 (76%) and the decline almost doubled (7%) between 2006/07 and 2007/08 (81%) (Figure 4.4). On the other hand, TB death rates declined over the same period by almost four fold. The rate declined by 13 percent between 2005/06 (16%) and 2006/07 (14%). The biggest decline of 29 percent was observed over the periods 2006/07 (14%) and 2007/08 (10%).

TB cases in Malawi have tremendously increased due to co-infection with HIV (Harries *et. al.*, 2001). According to Chimzizi and Harries, (2007) the rise in TB case notifications from 5,334 per year in 1985 to more than 28,000 per year since 2006 can be attributed to the HIV epidemic. In fact 77% of TB patients are found co-infected with HIV. Case fatality rates in patients with smear-positive pulmonary TB have risen from 5% in 1985 to more than 20%, and are even higher among those with smear-negative TB, who are more severely immune-suppressed.

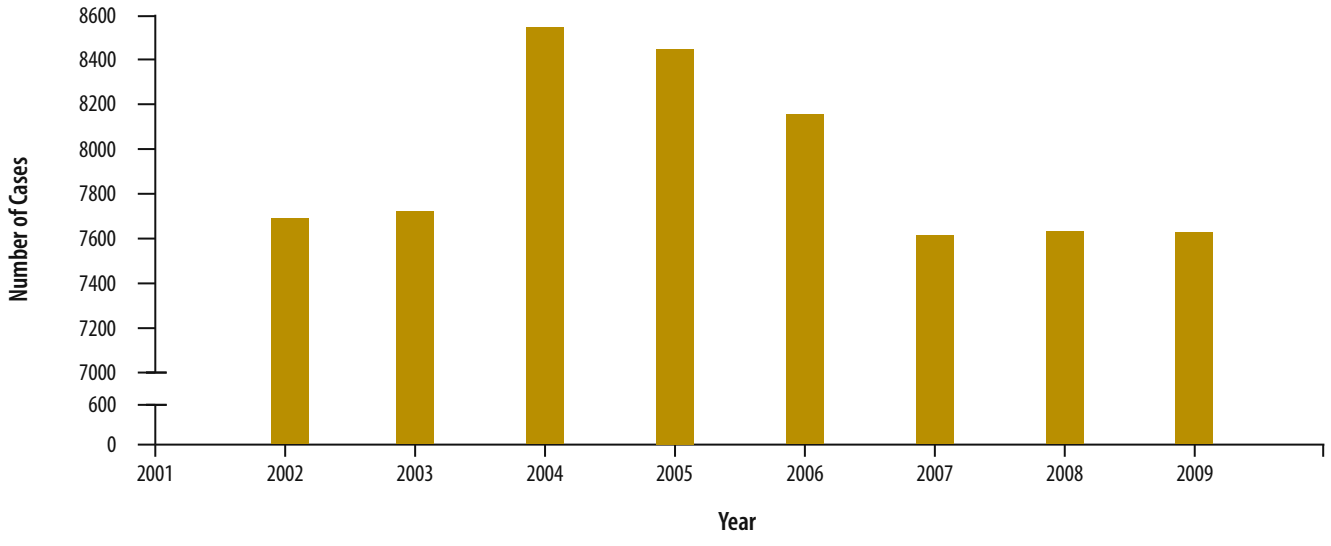
Apart from the impact of TB-HIV co-infection on number of TB cases, there has been a marked congestion in TB wards where most patients received treatment. A country-wide survey in 1999 found a TB bed occupancy rate of 100% (Harries, 2003). Since TB is an airborne disease this poses a health risk to the patients themselves and others including their guardians and health workers.

TB and the Environment

TB has been linked with environmental risk factors that go hand-in-hand with poverty such as poorly ventilated housing infrastructure, tobacco smoke, malnutrition, overcrowded living conditions, and excessive alcohol use. Many countries in the developing world struggle to provide the basic services and are thus unable to control the TB epidemic (Schmidt, 2008; Liverpool associates in tropical medicine, 2010; Garcia, 2001).

TB patients, especially those from the rural areas seek medical attention from traditional healers before attending hospitals for modern chemotherapy. This means that most rural patients start TB treatment when the disease has advanced. Such patients do not respond to medication quickly and this contributes to the high mortality rate. Brouwer *et. al.*, (1998) showed that in 33 smear positive TB patients receiving treatment from traditional healers, three quarters either did not improve or deteriorated.

Figure 4.4: Trend of New Smear Positive TB Cases in Malawi from 2002 to 2009.



Source: Government of Malawi, MoH (2010).

TB Control Initiatives

Malawi was one of three African countries to pilot the WHO ProTEST initiative (1999–2002), which promoted HIV testing and counseling among TB patients as an entry point to HIV prevention, treatment and care services. With the support of bilateral and multilateral donors, Malawi developed a three-year TB/HIV plan (2003–2005) which was then integrated into the five-year national TB control plan (2001–2005). The principal objectives were to scale up HIV testing among TB patients and, for HIV-positive TB patients, to provide cotrimoxazole preventive therapy and facilitate access to antiretrovirals (Chimzizi and Harries, 2007).

In 1996, the National TB Programme (NTP) decided to try and tackle the problem of congestion in TB wards by decentralizing the initial phase of treatment, giving patients the choice of remaining in hospital, attending health centres or receiving treatment at home under the supervision of family guardians. Based on unpublished studies, this intervention demonstrated that good treatment success rates were associated with one-third of patients opting for guardian-based therapy and about one-quarter opting for health centre supervision (Harries, 2003).

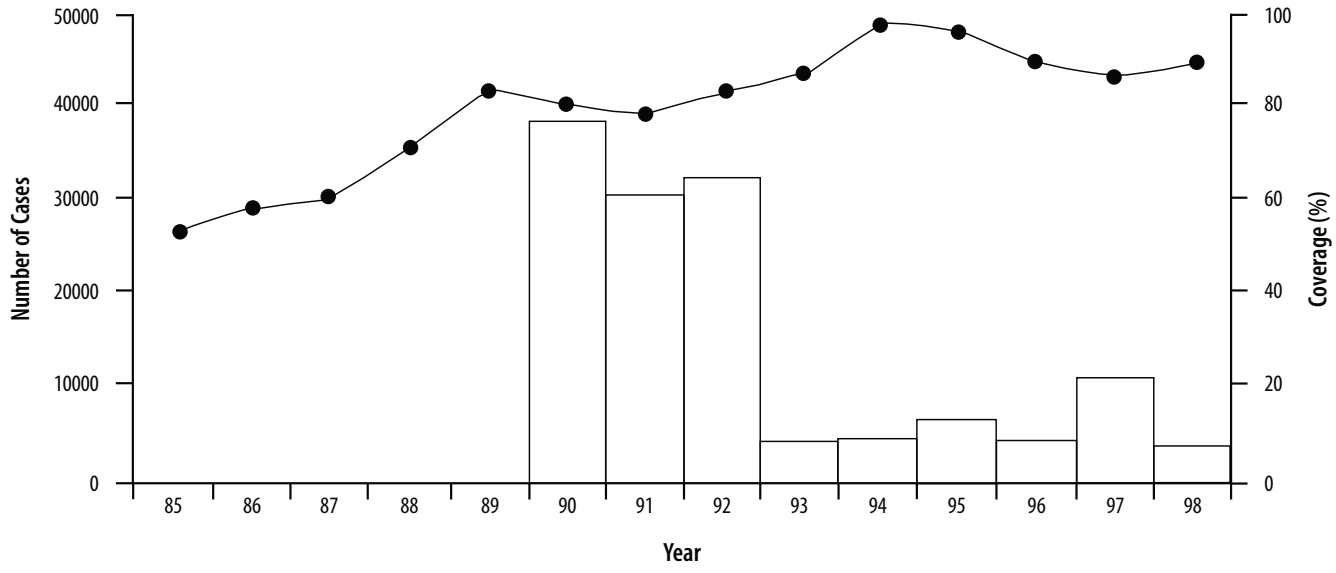
4.3.3 Measles

Measles is one of the re-emerging diseases in Malawi and has affected all age groups. The measles outbreak which started in February 2010 is considered the largest measles epidemic in Malawi in the last 14 years (Figure 4.6). The Southern and Central parts of Malawi were the most affected whilst the Northern region was the least affected, with Karonga and Chitipa districts having no reported cases (GOM, 2010 and DREF MDRMW006, 2010; Table 4.5). To contain the situation, the Government of Malawi, through the Ministry of Health (MoH), planned to vaccinate over six million children nationwide at an estimated cost of USD 4.1 million (DREF MDRMW006, 2010).

Prior to 1993, and despite the high vaccine coverage rate as depicted in Figure 4.5, measles was reported as the third largest cause of mortality (20.6%) in the second year of life. The incidence of measles dropped drastically from 1993. However, several thousand measles cases were still being reported annually until the mass measles vaccination campaign took place in October 1998. For example, in 1997, Malawi had a measles outbreak reporting about 10,845 cases (Figure 4.6).

In order to control measles outbreaks, the Government of Malawi implemented the WHO's Expanded Programme on Immunization (EPI) in 1979. WHO's EPI was initiated in 1974 to promote immunization for all children with a basic schedule of measles at 9 months (WHO, 2001, 2003). The Malawi immunization schedule follows the EPI standard schedule, except that measles vaccination is recommended from age 10 months (GOM, 2003). The measles prevalence, despite the high vaccination coverage in the mid-1990s, could be attributed to either false estimates of vaccination coverage or low vaccine efficacy (Yamaguchi *et. al.*, 2002). However, the major decrease in measles cases observed from 1993 are attributed to the Malawi government's concerted efforts in training health workers, improving immunization safety and strengthening of disease surveillance and monitoring skills. Social mobilization campaigns in encouraging parents to immunize their children against measles have also been a great success.

Figure 4.5: Measles Vaccination Coverage and Number of Reported Cases in Malawi from 1985 to 1998 (line with bullets indicates the measles vaccination coverage; and the bars show the number of reported cases).



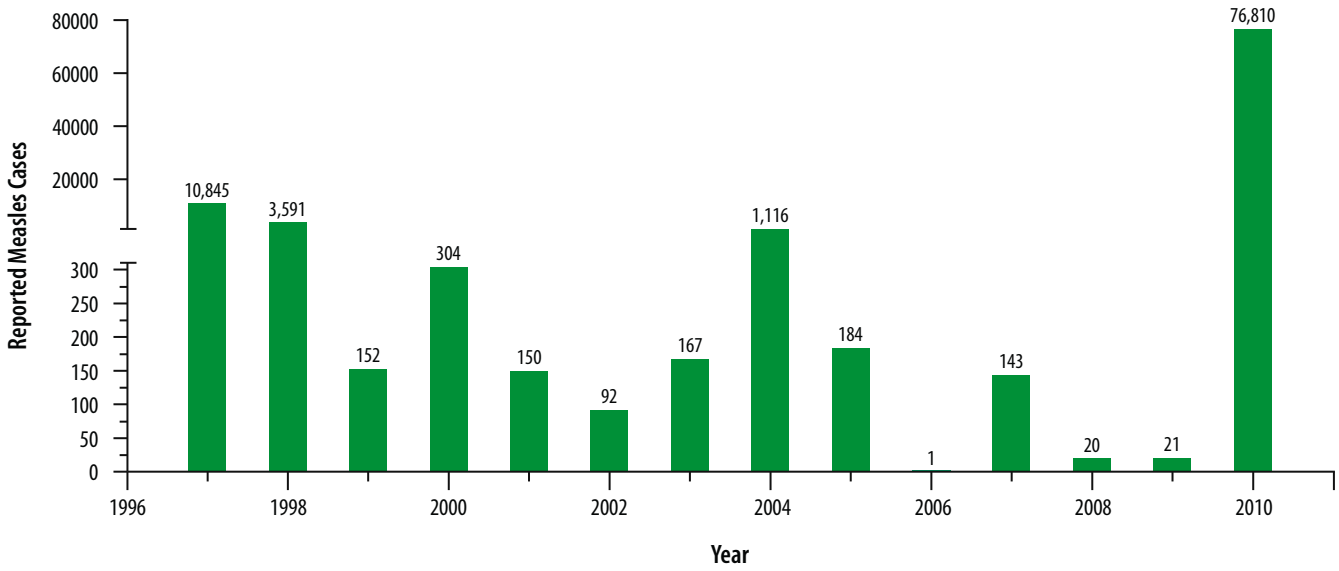
Source: Yamaguchi *et. al.*, 2002

Table 4.5: Measles Cases and Deaths by District in 2010.

Northern Region			Central Region			Southern Region		
District	No. Cases	No. Deaths	District	No. Cases	No. Deaths	District	No. Cases	No. Deaths
Chitipa	0	0	Dedza	514	3	Balaka	2,706	6
Karonga	0	0	Dowa	1,505	12	Blantyre	8,344	14
Likoma	103	1	Kasungu	3,502	33	Chikwawa	439	2
Mzimba	2,046	16	Lilongwe	14,991	18	Chiradzulu	2,783	8
Nkhata-Bay	69	0	Mchinji	1,146	1	Machinga	3,410	7
Rumphi	235	2	Nkhotakota	2764	2	Mangochi	8,715	22
			Ntcheu	2,197	1	Mulanje	4,444	15
			Ntchisi	1311	4	Mwanza	351	6
			Salima	712	4	Neno	628	3
						Nsanje	354	2
						Phalombe	411	1
						Thyolo	4,587	6
						Zomba	7,768	6
Total	2,453	19	Total	28,643	78	Total	44,041	98

Source: Ministry of Health (2010).

Figure 4.6: Fourteen Year Trend of Measles Cases from 1997 to 2010.



Source: DREF MDRMW006, 2010; Government of Malawi, 2010.

4.3.4 Influenza

H1N1 Pandemic Influenza

In the 2009 H1N1 pandemic influenza Malawi had a total of 20 suspected cases of which four were confirmed with no mortalities. The first case was identified at Ntcheu (Biliwiri) border in Aug 2009, involving a Malawian in transit from South Africa to Mangochi. The other three cases were from Mzuzu. The population at risk of the H1N1 flu pandemic includes health and port of entry workers, children aged 5–14 yrs and young adults aged 15–29 yrs, pregnant women and people with chronic diseases (Malawi Government, Ministry of Health, 2010; OSAC, 2009).

H5N1 Avian Influenza

The H5N1 avian influenza outbreak did not affect Malawi. Though there is no evidence that H5N1 strain of bird flu got to Malawi, the virus could still arrive with migratory birds. Lake Chilwa is one of the wetlands highly patronized by migratory birds between December and March (CIRAD, 2010), hence this is a risk area.

National Influenza Responses

Malawi scheduled round one H1N1 vaccination campaigns in Oct 2010 and round two in November 2010. This is because H1N1 virus is still in circulation and chances of future outbreaks are highly likely. Target groups for the vaccination campaigns included; health workers (33,620), port of entry workers (961,800), pregnant women (237,500), children aged 5 years and people with chronic diseases (66,480). Several partners to the Malawi Government donated H1N1 vaccines through WHO enough to vaccinate about 10% of the total population (Malawi Government, 2010).

Malawi drafted an emergency plan for avian influenza and has set up a passive surveillance network. Media campaigns have been done for public awareness. AAI National Task Force has also been constituted. In 2006, Malawi released both the Avian Influenza Implementation plan and the Avian influenza communication plan.

Two epidemiological surveys of the influenza virus in wild birds were conducted in February 2006 and April 2007 in the framework of Technical Cooperation Programmes (TCP) of FAO. The main objectives were to evaluate the Avian Influenza prevalence, in particular the highly pathogenic strains, among wild bird populations, including both migratory and resident bird species; and also to provide technical support to the national surveillance programme through capacity building of national counterparts on sampling techniques, thus there is some capacity within Malawi to monitor the spread of the disease.

Despite the efforts being made, it is important to note that it is challenging to determine the impact of influenza in developing countries due to lack of an influenza surveillance system. Limited public knowledge of the virus has lead to minimal understanding of the influenza epidemiology and its impact in many developing countries. Support for influenza awareness campaigns and vaccination programmes have been overshadowed by other public health challenges, such as HIV and AIDS, tuberculosis and malaria, which are given much priority (Health Protection Agency, 2010).

4.4 Vector Borne Disease and Environment

Environmental and vector risk factors play a role in more than 80% of the diseases regularly reported by the World Health Organization. Globally, nearly 25% of all deaths and of the total disease burden can be attributed to the environmental risk factors. In children, however, these environmental risk factors account for slightly more than 30% of the disease burden (WHO, 2006).

4.4.1 Malaria

Malaria is one of the major public health problems in Malawi; and the leading cause of morbidity and mortality. Although progress in reducing malaria prevalence has been reported, malaria remains the number one cause of hospital admissions among children under five and pregnant women.

It is estimated that between 2003 and 2008 there have been more than 8 million episodes of malaria per year throughout the country. Anaemia, most of which is considered to be attributable to malaria, is estimated to be responsible for about 40 % of all hospitalizations and 40 % of all hospital deaths in children under age five (GoM, 2008).

Table 4.6: Malaria Cases and Trends in Malawi

Year	Malaria as Proportion of OPD	Trend Comment
2003	30%	
2004	48%	Increase
2005	30%	Stable
2006	34 %	Increase
2007	34%	Increased stability
2008	34%	Increased stability

Malaria Status and Trends (2003–2009)

Malaria cases accounted for between 30 and 48 % of Out Patient Department attendance during this period (Table 4.6).

For under five Malaria cases expressed as a proportion of the total under-five populations (2.3 million) show increasing prevalence since 2004. During the reporting period 73% of the country's under five population was affected by malaria, with districts like Machinga (100%), Mwanza (100%), Nkhata Bay (133%) and

Table 4.7: Spatial Distribution of Malaria.

District	Total Population		Total Malaria Cases as % of Total Population		Total Impatient Per 1000 Population		% of Malaria Cases as % of Total OPD Cases	
	2008	2003	2008	2003	2008	2003	2008	2003
Chitipa	174,693	152691	36	27	0.6	17	33	28
Karonga	258,074	230026	40	26	0.5	57	37	33
Nkhata Bay	213,927	197762	54	34	0.7	32	36	33
Rumphi	160,298	162158	83	32	0.6	44	30	24
Mzimba	787,445	635712	24	32	0.1	32	29	39
Kasungu	671,391	589019	27	29	0.6	68	41	39
Nkhotakota	310,909	275213	57	42	0.7	40	34	32
Ntchisi	239,328	207997	39	51	0.7	55	28	36
Dowa	526,604	469924	53	20	0.5	29	40	26
Salima	354,977	332284	55	39	1.0	34	40	31
Lilongwe	2,033,049	1720784	22	15	0.3	79	36	25
Mchinji	456,314	395171	37	25	1.3	35	51	34
Dedza	669,511	552786	35	12	0.8	23	22	25
Ntcheu	511,184	443474	42	32	0.7	75	45	38
Mangochi	802,568	711179	45	38	1.2	73	43	22
Machinga	447,243	417594	53	25	0.8	113	38	26
Zomba	747,620	653929	34	28	0.4	34	37	33
Chiradzulu	309,012	273893	34	24	0.3	71	35	35
Blantyre	1,203,398	1027808	34	32	0.1	60	25	32
Mwanza	184,862	162739	71	60	1.3	-	48	-
Thyolo	611,424	539610	34	21	0.8	75	37	33
Mulanje	575,014	506598	31	28	0.7	108	33	35
Chikhwawa	477,534	425080	51	40	0.7	65	43	34
Nsanje	245,927	223278	62	36	1.4	74	50	28
Phalombe	322,409	280043	39	28	0.9	37	35	38
Balaka	335,449	295623	46	17	0.4	139	30	28
Qech						35	6	6
KCH							7	8
ZCH						85	14	29
MCH						42	10	5
Malawi	13,630,164	11,882,375	38	28	0.635	55	34	30

Salima (135%) revealing that the under five years aged children being attacked by malaria several times. Malaria deaths among the under five as a percentage of total malaria deaths, have been increasing ranging from 5% to 33%, with the highest increased observed between 2004 (43%) and 2006 (57%). The percentage malaria deaths has stabilized at around 60% since 2007.

Table 4.8: Schistosomiasis Cases in Malawi.

District	Year							Total
	2003	2004	2005	2006	2007	2008	2009	
Balaka	76	34	942	2,514	1,829	2,802	2,178	10,375
Blantyre	0	5453	4,646	5,639	5,260	3,959	4,342	29,299
Chikwawa	0	1108	707	2,636	5,295	2,953	2,238	14,937
Chiradzulu	0	58	880	2,022	2,739	3,732	2,308	11,739
Chitipa	124	1866	245	2,023	1,098	1,420	836	7,612
Dedza	0	2679	1,949	2,631	2,921	2,472	2,580	15,232
Dowa	0	0	206	451	603	741	861	2,862
Karonga	292	1375	1,144	1,640	1,729	1,543	1,599	9,322
Kasungu	0	677	2,726	3,315	3,851	2,995	2,209	15,773
KCH	0	0	0	0	0	0	1	1
Likoma	65	297	268	555	208	685	609	2,687
Lilongwe	20	3772	1,840	2,461	2,868	2,532	3,381	16,874
Machinga	2,914	6327	4,374	4,519	4,699	4,102	3,878	30,813
Mangochi	0	7465	5,426	4,525	4,594	3,106	1,595	26,711
Mchinji	0	70	831	699	1,421	2,075	2,843	7,939
Mulanje	0	0	2,042	3,848	4,734	4,887	5,974	21,485
Mwanza	26	189	221	1,569	1,253	820	501	4,579
Mzimba North	94	641	1,028	827	1,046	1,271	855	5,762
Mzimba South	182	615	1,032	1,517	1,861	2,611	2,524	10,342
Mzuzu C. Hospital	0	0	20	19	4	7	1	51
Neno	14	118	246	533	714	502	552	2,679
NKhatabay	58	243	936	542	319	340	1,034	3,472
Nkhotakota	0	1896	7,041	6,576	5,980	4,865	6,318	32,676
Nsanje	0	669	3,458	4,518	4,944	4,135	3,720	21,444
Ntcheu	0	644	765	1,565	1,838	1,793	1,873	8,478
Ntchisi	405	1192	411	977	1,535	1,922	2,164	8,606
Phalombe	1	898	1,700	2,893	2,629	1,809	1,942	11,872
Qech	0	0	43	302	353	240	182	1,120
Rumphi	0	103	367	372	470	442	426	2,180
Salima	730	3024	2,632	3,016	2,768	2,241	2,088	16,499
Thyolo	485	1727	1,673	4,475	4,613	3,847	3,054	19,874
Zomba	1,549	5717	3,477	5,217	5,803	4,117	1,953	27,833
Zomba Central Hospital	0	0	107	125	0	4	11	247
Total	7,035	48,857	53,383	74,521	79,979	70,970	66,630	401,375

Morbidity

In general, new Malaria cases accounted for between 30% and 35% of Out Patient Department (OPD) attendance between 2004 and 2008 (Table 4.7). At least 2.6 million new cases attended the OPD from June to December 2009 with the under fives consisting nearly 50%. The results indicate that on average at least 190 persons per 1,000 populations had malaria between 2004 and 2008 period. In 2009/10, 152 cases/1,000 were reported representing a 25% increase, indicating rising trend in new malaria cases. On the other hand, while malaria affected about 46% of under-fives from July to December 2008 the number increased by 18 percent the following year.

The increase coincide with change of treatment policy when Artemethnin combined treatment was introduced. The treatment policy requires that all Malaria cases be treated at clinics as opposed to before Artemethnin combined treatment when treatment could be purchased in any shop which resulted in self treatment.

Mortality

Although malaria incidence is on the increase, the disease is curable as evidenced by the substantial decline in malaria inpatient deaths per 1,000 malaria inpatients from 55 in 2003 to 0.635 in 2008. Only Nsanje, Mangochi, Mchinji, Mwanza and Salima still register mortality of over 1 per 1000 patients admitted. This decrease in mortality could be a result improved malaria case management such as introduction of Artemesinin based treatment.

Average prevalence of malaria between 2003 and 2008 was higher in the following districts: Mwanza (60%), Ntchisi (51%), Nkhotakota (42%), Chikhwawa (40%), Salima (39%), Mangochi (38%), Nsanje (36%), and Nkhata Bay 34% of the population in the districts. In the year 2008 the malaria prevalence increased considerably in Mwanza (71%), Nsanje (62%), Nkhotakota (57%), Salima (55%), Nkhata Bay (54%) Machinga 53%, Chikhwawa (51%), Mangochi (45%). On the other hand Dedza had only 12% of its population affected by malaria in 2003 and had the lowest prevalence in 2008 in the country. The low average temperatures for some parts of Dedza could be attributed to this low prevalence.

National Malaria Responses Programme

Malawi's national malaria strategy has two components namely; Treatment and prevention. Prompt Treatment using Artemisinin Combined Therapy (ACT) has been in use since December 2007, a change from Sulpadoxin Pyrethren (SP). The ACT is not sold in shops as such all treatment is clinical based which has resulted in improved case management. SP is still used in pregnant mothers as a prophylaxis that is taken twice during the nine months of pregnancy.

Apart from treatment the other strategy targets the vector. First are Insecticide-treated mosquito nets (ITN). The nets are non-toxic to humans, but can repel and kill mosquitoes for up to three years. Currently country wide the ITN coverage is at 60% (GOM, 2008). This coverage is still low and government has now changed the policy from pregnant mothers only as recipients of the nets to universal coverage, so that everybody has access to ITNs (NMCP). Another change is that only Long Lasting Insecticide treated nets are being distributed. These Nets have a net's life span treatment of insecticide (WHO, 2008).

Indoor residual spraying (IRS) is the second strategy targeting the vectors: IRS involves the coordinated, timely spraying of the inside walls of houses with insecticides. Mosquitoes are killed when they land on these sprayed walls, reducing malaria transmission. Since IRS is expensive priority has been given to areas along the Lake shore districts of Karonga, Rumphi, Nkhata bay, Nkhotakota, Salima, Mangochi and the lower Shire districts of Nsanje and Chikhwawa, where malaria prevalence is very high (GOM, 2010).

DDT was proposed to be used in IRS but due to possibilities of contaminating agricultural products its usage was discouraged, less environmentally persistent insecticides which protect the population for only a few months such as pyrethroids are currently being used.

4.4.2 Bilharzia (Schistosomiasis)

In Malawi, nearly a quarter of the population live in endemic areas. Urinary bilharzia is the most common type in Malawi. Fresh water snails, *Biomphalaria pfeifferi, Bulinus globosus* and *B. nyasanus*, serve as species-specific intermediary host of the parasites. Infection is through the skin following contact with snail-infested aquatic environment/water.

Schistosomiasis is primarily a rural disease associated with daily activities related to water contact such as farming, rice growing, fishing, bathing and recreation.

Since 2003, the disease has been on the rise possibly due to increase in water human contact activities such as irrigation farming and increased population that has resulted in informal settlement dwellers using bilharzia infested water sources (Table 4.8). Although Lilongwe and Blantyre are not associated with large water bodies, they have been reporting increase in prevalence of bilharzias. This could be due to use of snail infested

Sosten Chiotha

Floating huts in Lake Chilwa increase exposure to the disease.

water especially in slums but also could be a result of increase in rural-urban migration.

Bilharzia is easily treated with Praziquintel. However, mass drug administration of Praziquintel programmes of the 1980s and 1990s have been scaled down to a few districts. Due to high reinfection opportunities, these mass treatment programmes need to be sustained to reduce disease burden but also to provide confidence to the tourism industry.

Sosten Chiotha

Haematuria (Bloody Urine): a typical symptom associated with urinary bilharzia.

4.4.3 Sleeping Sickness

(Human African Trypanosomiasis)

There are two forms of sleeping sickness recognized in man in Africa. The first is an acute infection caused by the more virulent Trypanosoma brucei rhodesiense (the Rhodesian sleeping sickness) found in the savannah areas of eastern and South- Central Africa including Malawi, and the chronic T. b. gambiense (gambian sleeping sickness) found in the riverine, lake and humid, forested areas. These environmental conditions influence the distribution of vector Tsetse fly (Glossina sp.) and large population of wild ungulates that serve as parasite reservoir.

Due to environmental degradation, Tsetse/large herbivores are no longer widely spread in Malawi. Currently, the country has three importance foci namely: Vwaza marsh wildlife reserve in Rumphi, Kasungu National Park and Nkhotakota Wildlife Reserve.

Cases of sleeping sickness have been reducing since 2003 (Table 4.9). In 2003, 76 cases were reported and the last mortality from the disease were single mortalities in 2004 and 2006(GoM, 2008).

Table 4.9: Sleeping Sickness Reported Cases from Endemic Districts.

Year	Sleeping Sickness Reported Cases from Endemic Districts		Totals
	Nkhotakota	Rumphi	
2000		7	7
2001	3	3	
2002	38	7	45
2003	28	45	73
2004	10	46	56
2005	14	21	35
2006	14	39	53
2007	2	31	33
2008	7	38	44

4.4.4 Filariasis

The two common types of Filariasis in Malawi are the onchocerciasis (River Blindness) and Lymphatic Filariasis (Elephantiasis). Onchocerciasis is caused by a nematode called Oncohceria volvulus while elephantiasis is caused by Wuchereria bancrofti.

Lymphatic Filariasis

Parasites causing Elephantiasis are transmitted by mosquitoes of the genera Culex, Aedes, Mansonia and Anopheles. The disease occurs sparsely through out the country. As of 2007, 382 million people were exposed and at an increasing risk bancroftian filariasis in African

countries including Malawi (WHO 2008). Poor sanitary conditions, i.e., polluted water, blocked open drains, roadside ditches, broken septic tanks and accumulation of sewerage effluents, which often accompany rapid urbanization, have created conducive breeding habitats for some of the vector.

4.4.5 Onchocerciasis

The Black flies (Simulium spp), which breed in well oxygenated fast flowing rivers, is the vector for river blindness. In Malawi, river blindness was known from the early 1930s but the disease magnitude was never quantified until the 1980s and 1990s. As of 2006, it was estimated that up to 750,000 people are infected and most of these are from southern region of Malawi (Thyolo, Mwanza, Mulanje, Blantyre, Phalombe, Chiradzulu and Chikhwawa). In the high risk areas, it is estimated that 1.5 million people are at risk of contracting infection (NOTF, 2009).

Interventions

The number of people provided with prophylaxis for onchocerciasis has increased as more districts are included in the control program since 2002 (Table 4.10). Every individual staying in the endemic areas where the disease prevalence is over 40% gets one tablet in a year as a preventive strategy. Currently, the Mass Drug Administration (MDA) of mectizan to the eligible population in the risk communities is the only intervention that is being implemented.

Table 4.10: Number of People Provided with Prophylaxis for Onchocerciasis.

Year	Number of People on Prophylaxis
2004	684,524
2005	691,069
2006	737,503
2007	800,535
2008	843,847
2009	859,336

For Trypanosomiasis, there is a Tsetse control programmes in the wildlife reserves where traps impregnated with pheromones and insecticide are deployed. Currently these are in use in Nkhotakota and Vwaza wildlife reserves.

Considering Filariasis, the major response is prophylactic mass drug administration and treatment. Drugs used are Mectizan for Onchocerciasis and Ivermectin for Lymphatic filariasis. The Government of Malawi embarked on a mass drug (Ivermectin and Albendazole) distribution campain as prophylaxis in 2008, in eight districts of southern Malawi. In 2009 the Mass drug administration was extended to cover the whole country. Response by vector control is very limited such as larviciding in Zomba for Onchocerciasis in 2010 (Table 4.10).

4.5 Strategies for Managing Environmentally Related Diseases

4.5.1 Strengthening and Harmonizing Environmental Policy and Institutional Framework

Sometimes, national development programs may have unintended influence on transmission of certain diseases. For example, water development programmes such as water harvesting and irrigation may increase transmission of diseases such as bilharzias and malaria. Following an eco-health implementation of such projects would take an integrated approach that minimizes unintended health risks.

There is also need to consolidate various disease control strategies. For example, control of Filariasis and malaria need not be separate control/prevention programs because their vectors (black flies and mosquitoes) can be controlled using same larvicide (Bti).

4.5.2 Providing Clean Drinking Water and Other Sanitation Infrastructure

With respect to water-borne diseases, it is important that people live hygienic lifestyles. People should have access to clean water. This will be possible if government provided for clean, affordable and readily accessible water facilities especially in high density areas.

Government should make it mandatory that every household should have a toilet and access to clean, affordable and potable water. Since many people in high density areas are poor, government should make deliberate measures to ensure chemicals for decomposing waste in pit latrines is affordable. Government should also put in place mechanisms to inspect toilets that people use and water points where they collect water.

People need to be encouraged to use proper toilet facilities and wash their hands regularly and particularly after toilet use and before eating. Introduction of school sanitation and hygiene promotion programmes as done by UNICEF is one way of dealing with cholera from the grassroots. Increased preparedness, focus on sanitation

Box 4.2: Zomba Vector Outbreak

So far not much was known about Simulium flies population occurring in Zomba. However an increase in human black fly biting activity was reported to the Zomba District Health Office (DHO) from the Zomba Plateau around Malosa and Domasi areas in early May 2006.

Rapid Epidemiological Assessment was conducted in 6 districts of southern Malawi, with more emphasis in Zomba, between March25th and April 7th, 2007 to review the onchocerciasis situation and assess the increase in black fly biting phenomenon reported from Zomba Plateau. Epidemiological and entomological observations were made.

Results: In 14 villages of Zomba, 150 males and 279 females were examined, while in the other 5districts, 7 villages were screened, 141 males and 233 females. In Zomba, male samples were generally inadequate. Women turnout was higher. Thus in Zomba, male nodule rates were scored for only 3 villages that had reasonable attendance. Nodule detection rate was low, out of 14 Zomba villages, only four had few positive cases, while 10 had none at all. Nodule rates were equally low in the 7 villages of the other 5 districts checked, an indication of no detectable change in the disease endemicity level.

In the Zomba plateaus acute skin disease was highly prevalent; Outof14villages at least 10 had cases of skin lesions, while in 5 of these, the skin problems affected between30% to over 80% of the women examined. Intense itching was a frequent complaint, demonstrated with signs of scratching, scarification of skin of lower legs and shins, hyper-pigmentation, popular dermal lesions as well as sores.

Intense fly biting was often reported, especially in early mornings and late afternoon/evening when working outdoors. The Zomba flies were identified to be S. zombaense a complex of Damnosum. S. zombaense was never known to have population explosion risking people's health although it has been in the mountain forest for long.

The ongoing environmental degradation contributed to the resultant radical ecological disturbance- large scale deforestation of pine plantations and huge wild fires on the previously forested mountain slopes may have contributed to a population explosion of the black flies, which in turn gave rise to the large numbers of human biting females, to the detriment of the local residents. Since then a control strategy of killing larva in the rivers has been in place only in Zomba to avoid having the disease established by applying Bti. Bti is only restricted to a small proportion along the Domasi river as a result of requirements of the EIA guidelines. (MOG 2008).

and hygiene (and not water resources only), provision of good water in peri-urban areas are important steps in permanent eradication of sanitation related diseases. However, with the prevalence of complexities such as recurring drought, extreme poverty, food shortages and HIV/AIDS, Malawians remain highly vulnerable. The solution is to move from emergency responses to balanced water and sanitation programmes that reach vulnerable groups (UNICEF, 2004).

Development of Integrated Water Resources Management, IWRM (an approach which promotes coordinated development and management of water, land and related resources in an efficient, equitable and environmentally sound manner) and implementation of water efficiency plans need to be properly planned so as to establish an enabling framework that encourages pro-poor water management and service delivery mechanisms recommended for MDG achievement. The following measures are key to reducing the high incidences of water and sanitation related diseases: better sanitation and more widespread use of oral rehydration therapy (ORT) to manage the effects. Studies show that improving water supplies, sanitation facilities and hygiene practices reduces diarrhoea incidence by 26% (WHO, 2010). More importantly, Malawi should come up with an ecohealth approach in response to the Libreville agreement.

Photo Essay - Water and Human Health

Sosten Chiotha

Sosten Chiotha

The photographs above shows water harvesting facility. While water harvesting is a positive development in the country, the standing water in the tanks creates a breeding ground for mosquitoes that transmit malaria. This can be addressed through the provision of netting to cover stagnant water.

Sosten Chiotha

The photograph above shows a pit latrine that has been constructed beside a river. The proximity of the latrine to river creates a serious health hazard, as pollution from *Escherichia* coliform (*E.coli*) and other bacteria could easily contaminate drinking water. Policymakers and health practitioners must adopt an eco-health approach to hygiene and health interventions in order to ensure that efforts are not contradictory.

Photo Essay - Eco Health

Sosten Chiotha

Buildings designed with eco health aspects such as placing mosquito nets on windows will help reduce health risks.

Sosten Chiotha

Provision of adequate water supply ensures better hygiene thus reducing diseases transmission. However, water points must be managed well to avoid pools of stagnant water that could become breeding grounds for insects.

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CHAPTER 5

Children Planting Trees in Kutengule Village (Machinga), Photo by Sosten Chiotha

ENVIRONMENTAL EDUCATION AND PUBLIC AWARENESS

Zomba Faith Leaders March for World Wetlands Day, Photo by Deepa Pullanikkatil

5.1 Introduction

Education in Malawi traditionally consists of formal academic training at primary, secondary and tertiary levels. However, the National Education Sector Policy and Plan (NESP) has recently recognised the institutionalisation and/or improvement of Early Childhood Education and Non-formal education as part of the sector's strategies for increasing access in line with the Millennium Development Goal (MDG) goal number 2 of Universal Primary Education and Education For All (EFA) goals (Government of Malawi, 2008b).

Formal primary schooling is for 8 years. The official age range for primary schooling is 6 to 13 years. A few of the children under the age of 6 attend Early Childhood Development Centres where the facility exists. At the end of primary school, a national examination, the Primary School Leaving Certificate Examination (PSLCE) is administered. Non-formal education, equivalent to primary schooling, is offered to adults and youth who might have dropped out of primary school or those who never enrolled. Non-formal education for adults is offered throughout the country while that for youth, called Complementary Basic Education (CBE) is currently been piloted in a few districts.

Secondary schooling consists of two levels, junior secondary and senior secondary, both running for two years. The official secondary age range is 14 to 17 years. Completion of junior secondary leads to the award of the Junior Certificate Education (JCE) and completion of senior secondary leads to the award of the Malawi School Certificate of Education (MSCE).

Tertiary education includes schooling at Universities, Teacher Training Colleges (TTCs) and Technical Education Colleges (TECs). The entry qualification for this level is an MSCE. Students studying to become primary school teachers enrol in Teacher Training Colleges (TTCs) while those for secondary school enrol in Universities. Other private institutions that offer certificate courses in different specialisations such as accounting, marketing and other areas of study are also part of tertiary education.

Formal education at all the three levels is offered by different groups including Government, Non-Governmental, and private organisations. The government secondary schools are divided into Conventional (CSS) and Community Day Secondary Schools (CDSS). The latter were upgraded from Distance Education Centres after a secondary school unification policy was passed in 1999. These schools, though in majority, have limited resources.

Environmental education and awareness however takes place at both the formal education level and non-formal level through awareness campaigns. Science and wildlife clubs and the media are some of the avenues for awareness campaigns in schools and among community members. There are also other non-formal environmental education programmes managed by NGOs and other government institutions. Furthermore, informal environmental education and awareness avenues exist in form of media reports and programmes, as well as through various cultural/traditional networks.

There are four media channels in Malawi: mass media, group media, traditional/folk media, and interpersonal media. There are over 13 radio stations in Malawi: the main stations, with national coverage, are MBC and ZBS. There are also several newspapers, of which the Nation Publications and Blantyre News Papers are the leading daily and weekly publications. There are also various magazines published on a monthly and quarterly basis on different topics.

This report will discuss the state of formal, non-formal and informal education and awareness, and their role in environmental education.

5.2 Education and Sustainable Development

5.2.1 The Policy Context

The importance of educating all people, in order to achieve sustainable development and poverty reduction, is highlighted by MDG number two. Further, an educated populace would contribute to the achievement of the rest of the MDGs including ending poverty and hunger, gender equality, reduced infant and maternal mortality rates, combating HIV and AIDS, achieving environmental sustainability and achieving global partnerships. The 1992 Rio Earth Summit's Agenda 21 also demonstrated international commitment to strengthening the role of education, training and public awareness in achieving sustainable development. The United Nations Decade of Education for Sustainable Development (UNDESD) (2005–2014) was launched in 2005 as a further manifestation of the importance of education in achieving sustainable development which includes environmental management. The Ministry of Education, Science and Technology in collaboration with the Malawi Commission for UNESCO oversee the implementation of UNDESD.

At the regional level, Education Ministers in Africa signed a statement of commitment to implement UNDESD in 2006. The Ministers agreed to ensure that principles

of sustainable development are included in educational development frameworks, programmes and activities at all levels in their respective countries. Similarly, the African Ministerial Conference on the Environment (AMCEN) has taken various steps in partnership with UNEP, to strengthen the development and use of environmental knowledge for sustainable development. AMCEN 12 in particular emphasised the importance of capacity building through environmental education and training and technology-enhanced learning in order to achieve sustainable development. The Ministers suggested three strategic approaches in achieving the purported capacity building:

(i) mainstreaming environmental education across all relevant government institutions

(ii) designing environmental education programmes suited for primary, secondary and tertiary education sectors, and

(iii) fostering cooperation with the non-formal environment education sector.

At the local level, the Malawi Poverty Reduction Strategy Paper (MPRSP), whose mandate ended in 2006, clearly included education, especially in science and technology education, as a key ingredient for poverty reduction and achieving sustainable development (GoM, 1999). The Malawi Growth and Development Strategy (MGDS) (GoM, 2005) which is the overarching strategy covering five years, from 2006/07 to 2010/2011 fiscal years, has included education as one of the priorities among priorities. The areas of emphases in education are increasing access and retention; improving quality and relevance, improving equity, management and supervision and training of teachers. It is expected that relevant education would include environmental education and awareness and, as recommended by AMCEN 12, environmental education could be mainstreamed in the education sector.

The National Education Sector Policy and Plan (NESP) (GoM, 2008b) is the living policy document for the education sector operating between 2008 and 2017. This document draws on local, regional and international development policies such as Vision 2020, MGDS, MDGs and EFA. Its three thematic areas closely mirror those in the MGDS–expand equitable access, improve quality and relevance and improve governance and management of the education sector. Again, relevant education would include environmental education and awareness as issues affecting Malawian society.

5.3 Formal Education

In formal education, environmental education and awareness is incorporated into curricula, programmes and science and wildlife clubs which are developed according to the national goals of education in Malawi. The discussion in this section will concentrate on the linkages between the curriculum and environmental education at the different levels of primary, secondary and tertiary education. The role of the school environment in enhancing environmental education and awareness will also be discussed.

5.3.1 The National Goals of Education

The National Goals of Education guide all activities of the formal education sub-sector. These are presented in seven categories of knowledge and skills (ethical and social-cultural; occupational and entrepreneurial; practical; citizenship; creativity and resourcefulness; economic development and environmental skills; and scientific and technological skills) that learners should achieve by the end of schooling. The economic development and environmental skills category has four sub-goals. Three of the four sub-goals relate directly to the environment. These are (GoM, 2001c):

Sub-goal 5: creating in the learner an awareness of the dependence of Malawi's economy on agriculture

Sub-goal 6: developing in the learner an awareness of appropriate environmental resource utilization and management practices

Sub-goal 7: developing an appreciation of the impact of rapid population growth on the environment and delivery of social services.

These national goals are translated into curricula and other activities for primary, secondary and tertiary levels. Each of these levels will be discussed in turn.

5.3.2 The Primary School Curriculum

The Primary Curriculum and Assessment Reform (PCAR), which became operational in 2005, is the unit of analysis for primary school curricula. In PCAR, environmental issues are mainstreamed in subjects such as agriculture, geography, science, and social and development studies. All students are required to register for all the subjects. This ensures that all students enrolled in school have access to environmental education and awareness.

5.3.3 The Secondary School Curriculum

The 'economic and environmental skills' section of the National Goals of Education prescribe twenty sub-goals for secondary education. Of these, six relate to the environment; these are knowledge of environmental resources, knowledge of methods for conserving resources, understanding of the importance of conserving Malawi's natural resources; understanding the impact of rapid population growth on natural resources and delivery of services; applying conservation measures to

Malawi's natural resources; and applying appropriate environmental resource utilization and management practices. A further nine relate to agriculture: its importance, appropriate practices and methods, food and cash crop production methods, animal husbandry practices, land and animal husbandry and aquaculture (Government of Malawi, 2001d). This shows that the majority of the sub-goals of 'economic and environmental skills' for secondary education relate to the environment.

As in primary school, environmental issues are mainstreamed in the curricula of secondary education, particularly in agriculture and biology. Other subjects in which environmental issues are mainstreamed include geography, physical science and social and development studies. However, only biology and social and development studies are core subjects and therefore taken by all students. Both agriculture and geography are optional subjects at this level, and while physical science is a core subject like biology, 78% of secondary schools in Malawi do not offer the subject due to resource limitations (GoM, 2008a). The unavailability of physical science courses that waste management issues as well as issues of alternative sources of energy which hinges on fuel wood as one of the major contributors to environmental degradation in Malawi.

Information Communication Technology (ICT) was introduced in the secondary school curriculum as a subject in 2000. This provides an opportunity Malawians to access information about environmental issues within the country and worldwide. However, only a few schools are able to offer the subject due to shortage of computers and lack of trained teachers. To benefit from this technology, schools must be supplied with computers and Chancellor College Faculty of Education and other teacher training institutions must train teachers to deliver ICT education.

5.3.4 Tertiary Education Curricula and Programmes

Teacher Training Curricula

Primary school teachers are expected to be able to teach all subjects taught at primary school level. As such, the subjects taught at the Teacher Training College (TTCs) reflect the diversity of subjects in primary school. The training programme for TTCs therefore includes ten learning areas which all potential teachers must study: agriculture, science and technology, numeracy and mathematics, expressive arts, literacy and languages (Chichewa and English), foundation studies, social and environmental sciences, life skills and religious studies. Environmental issues at this level are covered in agriculture, science and technology and social and environmental sciences. As such, fully trained primary school teachers are deemed to have adequate knowledge of issues about the environment which they could in turn teach their students.

University Curricula and Programmes

The University of Malawi has stand alone programmes on the environment, both at Bachelors and Masters levels. At the Bachelors level, Bunda College of Agriculture has stand alone programmes in Environmental Studies through the Faculty of Environmental Sciences. These include courses in Aquaculture and Fisheries, Forestry and Horticulture and Natural Resources Management in addition to general agriculture programmes. Graduation statistics for these programmes in the past five years are shown in Table 5.1.

The table shows significant progress in environmental training by Bunda College. However, these numbers remain low, and some sectors, such as Horticulture

Table 5.1: Bunda College Faculty of Environmental Science graduates 2005–2009.

Programme	2005		2006		2007		2008		2009		Total	
	M	F	M	F	M	F	M	F	M	F	M	F
Environmental science	26	15	4	12	2	4	7	3	6	2	45	42
Horticulture	0	0	5	0	4	0	3	1	9	4	22	5
Natural resources management	0	0	14	2	2	3	4	4	5	4	25	13
Forestry	0	0	0	0	1	1	4	0	6	5	11	6
Totals	26	15	23	14	9	8	18	8	26	15	103	66

Source: University of Malawi, 2009.

and Forestry, have such low enrollment they pose a challenge to capacity development. However, efforts by Bunda College in Forestry are supplemented by Mzuzu University, which offers degrees in the same area. Statistics for Mzuzu University Forestry programme graduates since the programme started in 2003 are shown in Table 5.2. This is a notable contribution to the Forestry area of the environment.

Table 5.2: Mzuzu University Forestry Graduates 2003–2009.

Year	2003	2004	2005	2006	2007	2008	2009	Total
Students	21	39	32	44	25	29	67	257

Source: Mzuzu University, 2009.

In addition to undergraduate programmes, Bunda College also offers Masters Programmes in various environmental sectors. The programmes and the graduates in the past five years are summarised in Table 5.3. The College has made strides in training students in Aquaculture and Fisheries. However, numbers remain low: scholarships should be provided to attract more students to these fields.

Table 5.3: Bunda College Masters Graduates 2005–2009.

Programme	2005		2006		2007		2008		2009		Total	
	M	F	M	F	M	F	M	F	M	F	M	F
Agronomy	1	0	2	0	0	1	0	0	0	0	3	1
Animal science	4	0	0	0	1	2	1	1	0	0	6	3
Agroforestry	1	0	0	0	1	0	0	0	1	0	3	0
Crop science	1	0	0	0	0	0	0	0	0	0	1	0
Forestry and horticulture	0	0	1	1	0	0	0	0	0	0	1	1
Social forestry	0	0	0	0	0	0	1	0	0	0	1	0
Aquaculture & fisheries science	4	1	1	0	5	0	1	0	9	1	20	2
Plant protection	2	0	0	0	0	0	0	0	0	0	2	0
Rural development and extension	0	0	0	0	0	0	0	0	1	0	1	0

Source: University of Malawi, 2009.

The Polytechnic also offers programmes on the environment. Table 5.4 shows statistics for the past five years which indicate significant training has been done in the area of Environmental Health and Environmental Management.

Chancellor College does not offer undergraduate programmes in environmental studies, although aspects are mainstreamed in the Bachelor of Science and Education Science courses. However, it offers a Master of Environmental Studies (MES) programme, and houses two environmental research centres–Leadership for Environment and Development (LEAD) Southern Africa and Natural Resources and Environmental Centre (NAREC). Introduced in the 1999/2000 academic year, 93 students have been enrolled in the MES programme although not all the students have graduated (Table 5.5). In 2000, 15 students graduated from the programme, while 12 and 7 graduated in the subsequent two years. There were no graduates in 2003 and 2004. When compared to the enrolment of 93 students, it is clear that the completion rate of students in the programme is poor. This implies that the implementation of the programme may need strengthening.

An analysis of research topics shows that 23% of the research conducted by MES students has been on the impact of human practices (such as charcoal and soap making, pottery, urban agriculture) on the environment. Other projects have been on the impact of natural disasters, such as landslides and floods, on the environment. This is followed by ecology and economic valuation of different plant and animal species as well as practices such as integrated aquaculture, land reform and resettlement programmes, which together cover approximately 13% of the research carried out. This is followed by assessment of water quality (7%), use of

Table 5.4: The Polytechnic Graduate Statistics for BSc. 2005–2009.

Programme	2005		2006		2007		2008		2009		Total	
	M	F	M	F	M	F	M	F	M	F	M	F
Environmental health	27	6	26	6	31	9	35	9	25	11	144	41
Environmental management	13	2	23	13	18	5	13	3	3	3	70	26
Environment, science and technology (Physics)	3	0	0	0	0	0	0	0	2	2	5	2
Totals	43	8	49	19	49	14	48	12	30	16	219	69

Source: University of Malawi, 2009.

Table 5.5: Chancellor College Graduation Statistics for MES 2005–2009.

	2005		2006		2007		2008		2009		Total	
	M	F	M	F	M	F	M	F	M	F	M	F
Graduates	1	1	0	0	5	2	2	1	3	0	11	4

Source: University of Malawi, 2009.

indigenous species and knowledge (6%), management of natural resources (6%), assessment of knowledge, skills and attitudes of school children and community (5%) and some isolated studies on energy choices, insect abundance and many others. This shows that there is wide coverage of environmental issues in the research activities of the students.

Technical and Vocational Education Curricula

Technical education in Malawi is offered through different trades–bricklaying, carpentry, refrigeration, welding, fabrication and others. In the teaching of these trades, no special attention is given to environmental issues. This is so despite the fact that some of the trades, such as brick-making and carpentry, are major contributors to deforestation.

The Natural Resources College was originally mandated to train agriculture extension workers to certificate level. In 2003, it began offering diploma programmes, and there are currently diploma programmes in Agriculture, Irrigation, Animal Health and Environmental Management. However, the certificate programmes have now been discontinued.

5.3.5 The School Environment and Quality of Education

The mainstreaming of environmental education in curricula as discussed above is indicative of Malawi's commitment to achieving environmental education and awareness through formal education. However, the fulfilment of this commitment depends on the quality of teaching and learning in the schools. Quality of education is influenced by many factors, including the availability of human and material resources such as teachers, classrooms, books, and school facilities such as toilets and clean water sources. This section discusses the provision of these resources and how they might affect the quality of education, including environmental education and awareness. Enrolment, drop out and repetition rates are discussed first, as indicators of the internal efficiency of schools.

Enrolment

The achievement of environmental education and awareness is partly dependent on the number of students enrolled in formal education. Education statistics depict an increasing trend in enrolment at all levels of education. Table 5.6 shows the increasing trend in enrolment for selected years. The years are selected based on major policy changes that had an impact on student enrolment at the different levels.

Table 5.6 shows that whilst primary school enrolment was about 360 thousand by the time Malawi got independence in 1964, three decades later in 1994, enrolment rose to above 1.8 million. When Free Primary Education (FPE) was introduced during the 1994/5 academic year there was a sudden increase in enrolment to almost 2.9 million, an increase of about 68%. Clearly, reducing the direct costs of schooling to children's families resulted in greater willingness to send children to school. Since 1994, the enrolment has more

Table 5.6: Enrolment for All Levels of Education for Selected Years.

Year	Primary	Secondary	MCDE	TTC	University
1964	359,841	5,951	-	1,368	180
1965	377,720	7,573	1,424	1,387	87
1966	286,056	6,539	1,856	1,226	498
1993/4	1,860,819	46,444	42,308	3,624	3,684
1994/5	2,895,423	48,360	57,481	3,085	3,601
1999	2,896,280	75,959	166,781	9,401	3,527
2000	3,016,972	46396	118,063	8,548	3,977
2001	3,187,835	57,635	118,617	13,252	3,654
2002	3,164,191	45,989	93,767	12, 522	4,565
2003	3,112,513	54492	76, 258	12,129	4, 745
2008	3,600,771	233,573	-	3,794	7,972

or less stabilised with only about 3.6 million students enrolled in 2008.

The increase in enrolment after FPE put pressure on the education system. Resources such as classrooms and teaching and learning materials for students were in short supply. These posed a challenge to the quality of education as will be discussed later.

Secondary school enrolment took a more or less similar trend to that for primary education since independence. The increasing demand for secondary education meant that the conventional secondary schools could not accommodate all the students. This led to the creation of Distance Education learning centres under the Malawi College of Distance Education (MCDE). In subsequent years, the number of students enrolled with MCDE increased tremendously that by 1994 the majority of secondary school students were enrolled with MCDE. By 1999, the conventional secondary schools enrolled less than half of the students that MCDE enrolled to the extent that a policy was formulated, with the influence of DANIDA, on unification of secondary education. With this policy, all MCDE centres were to become Community Day Secondary Schools (CDSS) where students would be taught normally like any conventional secondary school and that provision of resources, including infrastructure and teaching and learning resources would be made equal. As such the number of students enrolled with MCDE declined to zero by 2004 with all students enrolled in secondary schools.

The provision of resources such as adequate classrooms and other infrastructure, qualified teachers, and textbooks in CDSS however has remained a challenge to the present day. This has profoundly affected quality of secondary education in these schools. In recent years, the general trend in transition from primary to secondary school has kept on increasing gradually and interestingly, on average more girls than boys make it to secondary school (see Table 5.7).

Table 5.7: Transition Rate (%) from Primary to Secondary 2005–2008.

Transition Rate/Sex	2005	2006	2007	2008
Boys	35	39	36	39
Girls	37	42	38	41
Both	36	40	37	40

Source: Government of Malawi, 2008a.

After the 1994 FPE, the demand for teachers increased, and untrained teachers were recruited to ease the situation. These were later trained through the Malawi Integrated In-service Teacher Education Programme (MIITEP), which was introduced in 1995. The numbers of teacher trainees is shown in Table 5.6. The increasing number of student enrolment in primary and secondary schools led to liberalisation of education to allow private institutions to take part in the provision of education. It is clear from Tables 5.8 and 5.9 that the number of schools and students in the private sector is rapidly increasing, especially for secondary education. This is a potential threat to quality of teaching and learning, as shown by the closure of many such schools by the Ministry of Education in 2009.

5.4 Repetition and Dropout Rates

The internal efficiency of schools is evidenced by promotion, repetition and drop out rates. Statistics

Table 5.8: No. of Schools by Type 2005–2008.

Year	Primary Schools			Secondary Schools		
	Public	Private	Total	Public	Private	Total
2005	5004	155	5159	719	259	978
2006	5041	190	5231	788	318	1106
2007	5086	221	5307	715	334	1049
2008	5118	343	5461	788	372	1160

Source: Government of Malawi, 2008a.

Table 5.9: No. of Students by Type of School 2005–2008.

Year	Primary Schools			Secondary Schools		
	Public	Private	Total	Public	Private	Total
2005	3169553	31093	3200646	143967	39887	183854
2006	3242483	38231	3280714	166307	52003	218310
2007	3264594	42332	3306926	148845	61840	210325
2008	3542019	58752	3600771	160709	72864	233573

Source: Government of Malawi, 2008a.

show that there are much higher student drop out and repetition rates in primary school compared to secondary and tertiary education sub-sectors. Table 5.10 for example shows the repetition rates by gender and standard in primary schools for 2008. Tables 5.10, 5.11, and 5.12 show that males tend to repeat more than females, while females are more likely to dropout before completion than males.

The reasons for drop out include attending to family responsibilities, early marriages and pregnancy, lack of tuition fees, and seeking employment in order to offset the shocks of poverty at household level (GoM, 2008a).

School drop has a two-fold effect on the environment. First, dropout reduces the number of students who have access to environmental education through formal

Table 5.10: Repetition Rates by Gender and Standard 2008.

	Std. 1	Std. 2	Std. 3	Std. 4	Std. 5	Std. 6	Std. 7	Std. 8
Male	26.00	23.26	25.03	19.52	17.24	14.04	12.49	19.79
Female	24.75	22.18	23.34	17.83	16.69	13.83	12.86	17.56
Average	25.37	22.71	24.18	18.67	16.96	13.04	12.67	18.80

Source: Government of Malawi, 2008a.

Table 5.11: Drop Out Rates for Primary Education 2008.

	Std. 1	Std. 2	Std. 3	Std. 4	Std. 5	Std. 6	Std. 7	Std. 8
Male	10.88	2.21	8.06	6.01	9.37	7.38	4.11	5.23
Female	13.20	0.37	8.33	6.59	10.36	11.16	13.21	20.37
Average	12.60	1.28	8.19	6.3	10.17	9.26	8.49	11.59

Source: Government of Malawi, 2008a.

Table 5.12: No. of Secondary School Drop Outs.

Reason	Form 1		Form 2		Form 3		Form 4		Total		Total
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	
Pregnancy	23	515	41	696	30	342	33	293	127	1,846	1,973
Marriage	166	436	170	539	130	118	118	182	584	1,399	1,983
Fees	1,664	1,399	1,409	1,154	810	714	714	518	4,597	3,730	8,327
Employment	32	11	26	12	48	46	46	15	152	54	206
Sickness	39	47	49	59	33	33	33	30	154	172	326
Family responsibilities	49	55	66	60	63	63	63	52	241	224	465
Dismissed	98	27	159	54	258	263	263	78	778	212	990
Other	437	394	307	234	257	183	183	132	1,184	963	2,147
Total	2,505	2,884	2,227	2,808	1,629	1,433	1,453	1,300	7,817	8,600	1,6417

Source: Government of Malawi, 2008a.

schooling. Secondly, drop outs rely on the environment for survival through low-skilled, natural resource based employment (such as selling charcoal).

5.5 The Primary School Environment

5.5.1 Number of Classrooms

The student to classroom ratio for all primary schools in the past five years is shown in Figure 5.1. It is clear that the increase in enrolment of students is not corresponding well with the rate at which classrooms are constructed. These over-crowded classrooms are not conducive to learning.

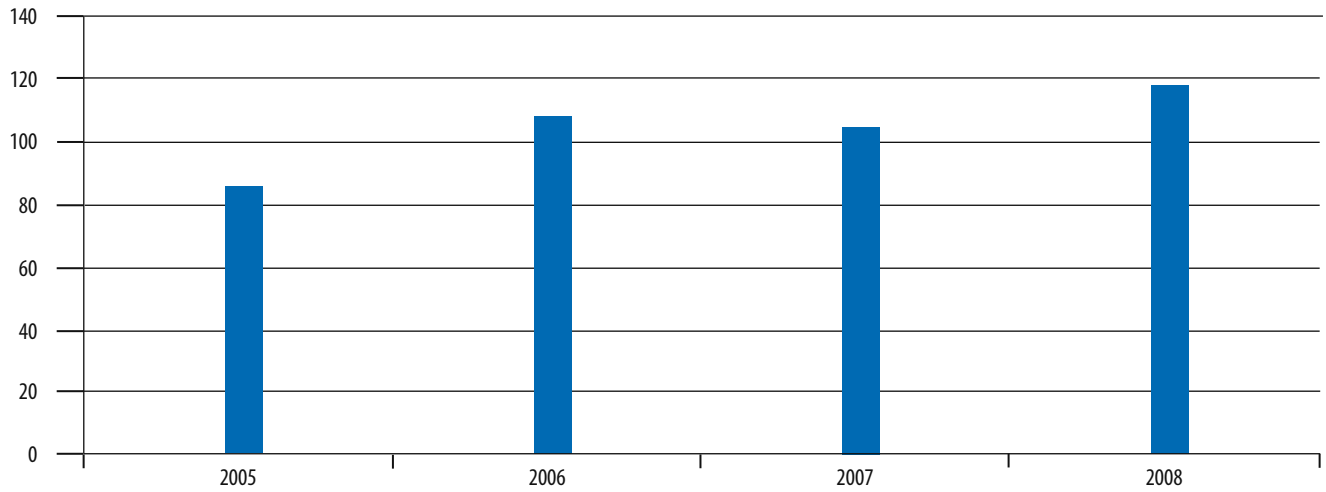
5.5.2 Number of Teachers

The student to teacher ratio is high in Malawi (Table 5.13), reducing the quality of student-teacher interactions. In addition, some students are taught by untrained teachers, further limiting the quality of teaching and learning.

5.5.3 Nature and Condition of School Buildings

For teachers and students to operate well in the school environment, there is need for appropriate buildings and facilities. For teachers, buildings and facilities such as staffroom, head teachers' office, storerooms, workshops, and teachers' houses and toilets, would play a role. For students, number of classrooms, libraries and

Figure 5.1: Student to Classroom Ratio for All Primary Schools 2005–2008.



Source: Government of Malawi, 2008a.

Table 5.13: Average Student/Teacher Ratio for All Primary Schools 2005–2008.

Year	2005	2006	2007	2008
Student/teacher ratio	71	76	78	78
Student/trained teacher ratio	83	84	88	90

Source: Government of Malawi, 2008a.

recreation halls would influence their learning. Table 5.14 shows the numbers of these amenities in primary schools in 2008.

According to Table 5.14, almost all amenities that teachers need in order to be effective in their work are unavailable or inadequate. Staff rooms are critically in short supply and some of the teachers do not have houses. Learning buildings such as libraries are in short supply, limiting children's access to additional reading materials. In many schools, classroom facilities are inadequate or overcrowded. As such, some schools employ temporary shelters, as shown in the photograph.

5.5.4 Sanitation Facilities

Table 5.15 shows the number of toilets for both teachers and students in primary schools. Clearly, toilets and latrines are in short supply and not meeting the set standard of one latrine for every 60 pupils. In some cases, the condition of the permanent toilets is poor.

5.5.5 Hygiene

According to Malawi School Wash 2008, hygiene is achieved when schools have appropriate facilities, when teachers and pupils have relevant knowledge of sanitary practices, and when this knowledge is applied

Dorothy Nampota

Temporary classrooms at a primary school.

(GoM, 2009). All schools are expected to provide school children with suitable facilities for washing, in close proximity to the area where they are learning. National statistics show that 81.1% of the schools have no hand washing facilities (GoM, 2009). 4.2% of schools that have hand washing facilities also have soap available. The remaining 14.7% have hand washing facilities but no soap. Such poor hand washing facilities encourages the spreading of diseases amongst school children and staff.

5.5.6 Provision of Water

A recent study by the Ministry of Education, through the school WASH project showed that about 81.5% of primary schools use drinking water from a protected water source (GoM, 2009). The water sources include boreholes, taps and protected wells. This is conducive to students' health and therefore their participation in

Table 5.14: No. of Buildings by Condition for 2008.

Building	Existing Rooms Complete in Use Permanent	Temporary	Under Construction Permanent	Temporary	Required
Staffrooms	1073	165	90	26	3542
Headteachers' office	2079	480	157	61	3106
Storerooms	2054	243	171	12	4026
Workshops	76	14	4	5	2426
Teacher's houses	11075	5421	1949	354	32687
Classrooms	30666	6865	1931	470	25050
Libraries	394	137	59	24	3949
Recreation hall	139	25	15	1	2893

Source: Government of Malawi, 2008a.

Table 5.15: No. of Sanitation Facilities by Condition for 2008.

Building	Existing Rooms Complete in Use		Under Construction		Required
	Permanent	Temporary	Permanent	Temporary	
Water toilet - male staff	275	19	19	0	1,194
Water toilet- female staff	333	23	12	1	1,373
Pit latrine- male staff	3,141	1,250	222	123	5,126
Pit latrine- female staff	2,588	775	188	105	5,201
Water toilet- boys	794	35	40	2	4,883
Water toilet- girls	852	16	46	0	5,387
Pit latrines - boys	14,086	7,823	1,087	897	35,833
Pit latrines - girls	14,218	8,100	1,071	887	51,627

Source: Government of Malawi, 2008a.

school activities. However, there is a need to improve facilities at the remaining 18.5% of schools that are still drinking water from unprotected sources.

5.5.7 Number of Textbooks

Table 5.16 shows a lack of availability of textbooks especially for agriculture, science and technology and social and environmental science. Combined with the unavailability of libraries mentioned earlier, fewer students have access to reading materials related to the environment. Teacher's guides are also largely unavailable (see Table 5.17). As such, many teachers are teaching without necessary guidance, a situation that is particularly challenging for untrained teachers.

National education statistics do not show the number of textbooks for the various subjects in secondary schools. However, the situation is known to be better than is the case for primary school.

Table 5.16: No. of Student Books by Subject and Class 2008.

Subject	Number of Books/Class							
	Std. 1	Std. 2	Std. 3	Std. 4	Std. 5	Std. 6	Std. 7	Std. 8
Kuyamba sukulu	319,001	5,764	1,846	1,345	4,283	2,482	1,122	1,223
English	403,153	576,141	129,288	103,184	407,829	190,288	80,120	81,144
Chichewa	393,786	566,604	113,532	95,822	403,576	189,194	71,389	74,067
Mathematics	23,249	40,405	118,963	92,467	291,068	154,541	83,588	77,509
Numeracy	389,062	548,556	19,449	13,210	124,147	31,031	894	898
Expressive arts	352,761	505,828	4,495	7,281	348,523	8,773	1,344	1,763
Bible Knowledge	205,274	382,632	2,200	5,210	305,434	4,716	955	990
Agriculture, Science & Tech	1,321	2,224	1,076	1,348	43,601	5,109	3,393	2,612
Agriculture	254	1,144	287	1,735	313,835	15,785	54,212	52,884
Science & Tech	206	2,499	431	1,939	334,523	146,052	16,854	15,887
Social & Env. science	914	3,591	6,985	7,847	330,941	12,129	14,314	15,280
Religious Educ	134,167	216,399	3,159	3,056	180,492	4571	1,996	1,579
Life skills	110,344	425,068	96,981	62,887	325,394	23,997	58,191	51,267

Source: Government of Malawi, 2008a.

Table 5.17: No. of Teachers' Guides by Subjects and Class 2008.

Subject	Number of Books/Class							
	Std. 1	Std. 2	Std. 3	Std. 4	Std. 5	Std. 6	Std. 7	Std. 8
Kuyamba sukulu	10,015	89	17	31	29	57	17	25
English	11,386	10,960	4,867	4,429	7,398	16,337	3,868	3,816
Chichewa	11,369	10,869	4,660	4,387	7,320	16,333	3,505	3,340
Mathematics	583	772	3,155	2,981	5,268	13,387	3,508	3,050
Numeracy	10,864	10,336	537	448	2,314	2,894	69	77
Expressive arts	10,628	10,373	472	529	6,622	2,438	406	348
Bible Knowledge	9,959	7,378	385	376	5,304	2,058	245	194
Agriculture & Science and Tech	268	167	94	82	1,233	1,131	194	192
Agriculture	44	39	30	81	5,672	2,668	2,344	2,212
Science & Tech	49	49	49	114	6,072	11,744	732	760
Social & Environ science	66	71	168	218	7,485	3,066	693	680
Religious Education	4,862	3,861	1,412	1,632	5,037	1,811	1,727	1,688
Life skills	1,530	6,658	2,319	3,008	7,121	3,515	4,558	4,451

Source: Government of Malawi, 2008a.

5.6 The Secondary School Environment

5.6.1 Number and Nature of School Buildings

Table 5.18 shows that school buildings are not sufficient for the students enrolled in secondary schools. This is true for classrooms and laboratories for the subjects that mainstream environmental education such as biology and physical science. All other school buildings, including teachers' houses, are also in short supply. These conditions are particularly evident in Community Day Secondary Schools, which comprise 78% of secondary schools. The effect is that much of the teaching of the subjects is didactic, with less practical work. This style of teaching does not facilitate meaningful learning.

5.6.2 Sanitation Facilities

Sanitation facilities for both teachers and students are also limited in secondary schools: Table 5.19 shows the extent of the shortfalls. The photograph shows one of the toilets for staff at a Community Day Secondary School.

Dorothy Nampota

A classroom block constructed with hydra-form bricks.

Dorothy Nampota

A permanent staff toilet at one secondary school.

Table 5.18: No. and Condition of School Buildings by Condition.

Building	Existing Rooms				Total Required
	Complete		Incomplete		
	Permanent	Temporary	Permanent	Temporary	
Classrooms	5,136	336	338	24	1,627
Libraries	368	141	44	6	525
General store	389	57	25	1	511
Book store	247	43	26	1	447
Workshops	69	12	0	0	200
Computer lab	121	18	11	0	405
Biology lab	154	12	10	2	532
Physical science lab	198	21	18	4	513
H/Economics lab	70	5	1	0	324
Multipurpose lab	114	7	12	0	410
Recreation hall	183	20	14	2	514
Girls hostels	483	34	51	0	751
Boys hostels	645	33	23	0	840
Dining room	120	20	5	1	349
Kitchen	175	40	14	3	349
Head teachers office	679	128	66	1	361
General office	252	31	26	2	442
Staff room	612	101	49	5	449
Teachers houses	3,046	326	164	21	5,132

Source: Government of Malawi, 2008a.

Table 5.19: No. of Sanitation Facilities by Condition 2008.

Building	Existing Rooms				Total Required
	Complete		Incomplete		
	Permanent	Temporary	Permanent	Temporary	
Water toilets male	350	8	12	3	302
Water toilets female	271	13	9	2	283
Pit latrine male	821	124	42	14	645
Pit latrine female	616	71	31	8	593
Water toilets boys	1,365	23	23	12	1,146
Water toilets girls	1,133	36	20	12	1,217
Pit latrine boys	3,155	395	151	35	2,320
Pit latrine girls	2,992	399	158	34	2,504

Source: Government of Malawi, 2008a.

5.7 Non-formal Education

Non-formal Education (NFE) has been defined in different ways in the past four decades. However, the following definition by Coombs and Ahmed (1974) has remained dominant:

'any organised, systematic, educational activity carried on outside the framework of the formal system to provide selected types of learning to particular sub-groups in the population, adults as well as children. (Coombs and Ahmed, p.8)

This form of education exists within the formal education sub-sector, in the form of science and wildlife clubs, for example. It is also available through programmes offered by the government and non-governmental organizations. This section will discuss some of these non-formal education programmes and their contributions to environmental education and awareness.

5.7.1 School Science and Wildlife Clubs and Societies

Clubs and societies in primary, secondary and tertiary educational institutions are often used to achieve incidental learning. 'Edzi toto' (No to AIDS) clubs, emphasising awareness on HIV and AIDS issues, are common in primary schools. Wildlife clubs are also available in some primary and secondary schools, although they are almost non-existent in tertiary education institutions. According to information provided by Wildlife Environment Society of Malawi (WESM), only one TTC had registered a wildlife club by 2009. Of the 1,500 wildlife clubs registered with WESM, about 96% are in primary and secondary schools. Clubs for out of school youth, which exist in some communities, constitute the remaining 4% of registered clubs. Considering the large number of schools (over 5,000 for primary and over 1, 000 for secondary), there is a need to encourage more schools (particularly tertiary education institutions) to form such clubs. The same is true for community clubs given the large number of students who drop out of school.

The role of WESM is not only to register the clubs but coordinate their activities and conduct environmental education and awareness campaigns. As such WESM encourages club members to visit National Parks and Game reserves, where they are given public lectures, play games and take tours that teach them about environmental challenges. Each of the five National Parks has youth hostels for students.

Science fairs and competitions, implemented in the early 1990s, served as a way of strengthening the activities of science clubs, most of which had activities relevant to environmental management. These were discontinued in the late 1990s, but the newly established NCST plans to resume these activities.

5.7.2 Outreach Activities by Universities

Research work and outreach activities carried out by students and staff are poorly documented at the university level. This lack of data limits analysis of the state of environmental education in universities. However, a recent study on Implementing the Third Mission (outreach) of Universities in Africa (ITMUA) has shown that there are attempts to achieve environmental education and awareness through outreach activities at Chancellor College (Nampota, 2010).

Chancellor College research centre LEAD (Southern and Eastern Africa), for example, has made notable strides in reforestation through empowering communities with inputs for seedling production and facilitating their transplantation. Other initiatives include tree planting with Chancellor College staff and surrounding communities; training Members of Parliament in climate change adaptation and mitigation; a clean campus campaign and the development of facilities for making fire briquettes as an alternative to charcoal.

5.7.3 The National Adult Literacy Programme

The National Adult Literacy Programme (NALP) was conceived in 1986 as a way of meeting the learning needs of adults aged 15 years and above who had never attended school or dropped out of school before attaining permanent literacy.

NALP contributes to environmental education and awareness by increasing the number of literate adults who can access print media on environmental issues. In addition environmental issues are covered in the agriculture syllabus. However, anecdotal evidence shows that it is largely women who attend the learning centres.

5.7.4 Complementary Basic Education

As part of efforts to achieve the MDG goal of Universal Primary Education, the Ministry of Education, Science and Technology with support from GTZ, introduced a new programme which is an equivalent form of primary education. The programme, called Complementary Basic Education (CBE), targets primary school drop outs and non-enrolees aged between 9 and 17 years. It began in 2006 in three pilot districts; since 2009, the programme had expanded within the pilot districts and to other districts.

CBE contributes to environmental education through improving literacy. The curriculum for CBE also includes agriculture and the environment as one of the learning areas in addition to Chichewa, English, Livelihoods, Citizenship and Numeracy. However the challenge with CBE is that the facilitators are volunteers and do not receive adequate training (Nampota, 2009).

5.8 Non Governmental Organizations

Non-governmental organisations are also involved in non-formal education of communities in Malawi and some of their programmes relate to the environment. A number of NGOs in the country incorporate literacy components into their development programmes to enhance the implementation and impact of their programme activities. One such NGO was the Adolescent Girls Literacy (AGLIT) project which began in the Chikhwawa district in 1997, aimed at improving the reproductive health of adolescent girls (10–18 years) who had dropped out of school through a combined literacy and health curriculum.

In the late 1990s, approaches to achieving improved livelihoods in rural communities shifted from 'literacy comes first', as in the AGLIT example, to 'literacy comes second' (Moleni, 1999). The latter approach encouraged target groups or communities to identify their own needs, implement development projects and develop their literacy skills through such activities. The REFLECT (Regenerated Freirian Literacy through Empowering Community Techniques) approach by Action Aid in Malawi is one example of such a programme. REFLECT is a theoretical framework for teaching literacy, developed by the Brazilian educator Paulo Freire with a practical methodology based on the techniques of Participatory Rural Appraisal (PRA). The contribution of such a methodology to environmental education and awareness lies in the increased relevance of the programmes (syllabus and teaching approach). Most of the problems that communities face have something to do with the environment.

Other NGOs directly focus on environmental issues in specific communities and not all of them could be singled out in this report. One example is WALA which is working with communities in agriculture and fish farming.

5.9 Government Institutions

Environmental education and awareness activities for the different departments and institutions are summarised as follows:

5.9.1 Forestry

The Department of Forestry has a public awareness unit that uses both print and electronic media. However, TV programmes and video shows stopped being produced in 2009.

The Malawi College of Forestry in Dedza district is responsible to training forestry assistants, and is complemented by the Forestry programmes at Bunda College of Agriculture and Mzuzu University.

5.9.2 Agriculture

The Ministry of Agriculture has an extension department that is responsible for creating awareness of improved farming practices. The staff under the extension service are graduates of Bunda College and the Natural Resources College.

5.9.3 Fisheries

The department of fisheries has a fisheries training institution, Malawi College of Fisheries. Unlike NRC, Malawi College of fisheries continue training fisheries assistants through a certificate course, although there are plans to proceed in the direction of NRC and start offering diplomas.

5.9.4 Parks and Wildlife

The Department of National Parks and Wildlife conducts informal public awareness campaigns with local communities surrounding protected areas on a weekly and sometimes daily basis. The limitation of the activities of this department is that they only take place in districts and areas where there are protected areas.

5.9.5 Ministry of Health–Health Education Unit

The Ministry of Health and its Health Education Unit are implementing education and awareness programmes on environment and cross cutting issues.

5.10 Informal Education

The Malawi Government describes Informal Environmental Education and awareness as education which is acquired 'in passing', through conversations, news, and/or personal experience (Malawi Government, 2006). In this case the major players in the informal sub-sector are the electronic and print media, religious organisations, and families and local communities.

5.10.1 Electronic and Print Media

Currently, a programme on 'Chilengedwe' is being featured every week on TV. However, such programmes

are not featured everyday. A report released in the Daily Times of 23rd July, 2010 by Malawi Communications Regulatory Authority (MACRA) showed that political issues take the larger share of the programming for all radio stations. This is followed by economic issues. Agriculture comes third for most of the radios while direct issues about the environment are occasionally featured.

5.10.2 Religious Organisations

Churches and Mosques are important arenas for environmental education since this is where large groups of people gather regularly. Traditionally, religious leaders have concentrated on preaching the word of God. However, peoples' overall well being is of equal concern. This necessitates the need to train religious leaders in environmental issues so that they can pass on the messages to their followers. The training workshop for religious leaders given by LEAD SEA in 2010 is a good beginning. See the photo essay at the end of this chapter for the work that has been subsequently done by faith leaders in environmental awareness-raising.

5.10.3 Indigenous Knowledge

Indigenous knowledge is defined as the cumulative body of knowledge, know how, practices and representations maintained and developed by people with extended histories and interactions with the natural world (ICSU, 2002).

5.11 Environmental Commemoration Days

The Malawi Government sets aside days to commemorate specific environmental issues (See appendix 1). These usually take place every year. However, not many people are aware of the days.

5.12 Strategies to Improve Environmental Education and Awareness

5.12.1 Formal Education

This report has discussed some of the major challenges for achieving environmental education and awareness. In the formal school sub-sector, Free Primary Education emphasised quantity rather than quality. The quality of the school environment with regard to human and material resources, sanitation and hygiene facilities declined. The proliferation of private primary and secondary schools and in recent times, tertiary education, has also contributed to the deteriorating quality of education. The Secondary school environment was further affected by the policy on unification of secondary education when CDSSs were converted into normal secondary schools.

Strategies to improve the situation have been many and varied and most have already been implied in the foregoing discussion. Despite this however, some additional notable efforts are discussed briefly in this section. In 2009 for example, efforts were made by the Minister of Education, to track the state of resources for private schools and close those that did not meet the minimum requirements.

Other strategies have concentrated on construction of school buildings such as classrooms, laboratories, teachers' houses. For example recently, the Government has set aside money for construction of 1,000 teacher houses through the Local Development Fund.

5.12.2 Non-formal Education

Within the non-formal sub-sector, strategies exist to enhance environmental education and awareness. One strategy aims at minimising the pressure exerted on the environment by school drop outs through a programme known as Complementary Basic Education.

5.12.3 Informal Education

The sensitisation of media personnel and faith leaders is necessary to extend environmental education and awareness. This can be accomplished through training programmes (such as those run by LEAD SEA). Media personnel should be encouraged to develop ongoing newspaper articles, radio segments, and television programmes that address environmental issues. Faith leaders should be encouraged to emphasize environmental stewardship in their ministry, and to take a leading role in training and educating their congregations.

5.13 Recommendations

The following are the recommendations following from the discussion that has been made in this report.

Formal Education

- Incorporate a policy statement on environmental education and awareness into the NESP.
- Make agriculture and geography core subjects in the secondary school curriculum.
- Improve provision of teaching and learning materials, including trained teachers and textbooks in subjects where environmental issues are mainstreamed.

- The school environment should be improved with respect to sanitation and hygiene.
- Secondary teacher training should include environmental education as a core subject in the curriculum.
- Inspection of schools should extend to Government Secondary Schools and be conducted as an annual activity by the Education Methods Advisory Section (EMAS) of the Education Ministry
- Improve the student completion rate in the various postgraduate programmes offered by the University of Malawi.
- Include environmental issues in Technical and Vocational Education.
- Universities should enhance their outreach activities and environmental issues should be one of the focus areas. In addition, there is need for proper documentation of out-reach activities conducted.

Non-formal Education

- Expand Complementary Basic Education into all districts.
- Encourage secondary and tertiary educational institutions to form wildlife and environmental clubs.
- District level associations should be formed between Group Village Headmen and Natural Resources Committees, regardless of whether the district contains a protected area.

Informal Education

- Ensure that national environmental commemoration days take place, and that different stakeholders participate in the activities.
- Increase the coverage of environmental issues on the radio, as this medium reaches a large number of Malawians
- Improve linkages between the different government departments, NGOs and the media to enhance the media coverage of environmental issues.
- Strengthen fora such as rural seed fairs and agricultural shows, through which indigenous natural resource management techniques can be shared.
- Develop a multimedia, countrywide communications strategy on environmental issues that includes:
    1. Mass media (TV, Radio, Print journalism)
    2. Group media (Meetings, mass rallies, conferences)
    3. Popular and folk media (Dramas, music, dance, poetry)
    4. Interpersonal media (Speeches, seminars, interviews)
- Encourage media organisations to network and collaborate to deliver environmental media coverage.
- Utilise existing decentralised structures (such as the Village and Area Development Committees and District Executive Committees) to disseminate information.

Photo Essay - Informal Environmental Education

Sosten Chiotha

Deepa Pullanikkatil

Environmental awareness can be developed in youth and adults alike through hands-on afforestation programmes and public rallies. These programmes have proven to be successful in reducing deforestation and environmental degradation.

These photographs were taken during a commemoration of World Wetlands Day held by Zomba faith leaders in conjunction with LEAD SEA. With representatives from all major faith groups, the commemoration raised awareness about the environmental and economic importance of wetlands. Faith leaders and members of their congregations planted trees on Zomba Plateau in recognition of the role that forests play in maintaining healthy wetlands.

Deepa Pullanikkatil

Deepa Pullanikkatil

Photo Essay - Informal Environmental Education

Sosten Chiotha

An increase in human black fly biting activity was reported to the Zomba District Health Office (DHO) from the Zomba Plateau around Malosa and Domasi areas in early May 2006. An assessment indicated that girls were more vulnerable to bites from the flies, due to their uniform being skirts which expose their legs to the flies.

Intense itching was a frequent complaint, demonstrated with signs of scratching, scarification of skin of lower legs and shins, hyper-pigmentation, popular dermal lesions as well as sores. This may affect education of girls to some extent, while boys are not affected as much.

The ongoing environmental degradation contributed to the resultant radical ecological disturbance- large scale deforestation of pine plantations and huge wild fires on the previously forested mountain slopes may have contributed to a population explosion of the black flies, which in turn gave rise to the large numbers of human biting female flies, to the detriment of the local residents.

Sosten Chiotha

Photo Essay - Eco Health

University of Malawi Central Administration Office

Eco health approach will require that curricula for health professionals should integrate the nexus between environment and health.

University of Malawi Central Administration Office

5.14 References

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Appendix

Commemoration Day/Week	Environmental Issue	Date/Week	Lead Agency
National Tree Planting Day/Week	Deforestation	2nd week of January	Department of Forestry
World Wetlands Day	Wetlands conservation	2 February	Environmental Affairs Department
World Forestry Day	Deforestation	21 March	Department of Forestry
World Water Day	Water resource depletion and degradation	22 March	Ministry of Irrigation and Water Development
World Meteorological Day	Climate change and air pollution	23 March	Department of Climate Change and Meteorological Services
International Labour Day	Human resources	1 May	Ministry of Labour and Vocational Training
World Environment Day	All environmental issues	5 June	Environmental Affairs Department
World Day to Combat Desertification and Drought	Desertification and drought	17 June	Department of Forestry
World Population Day	High population growth rate	11 July	Ministry of Health
International Day for Education	High illiteracy rate and declining education quality	17 July	Ministry of Education, Science and Technology
International Day for the Protection of the Ozone Layer	Depletion of the ozone layer	16 September	Environmental Affairs Department
World Habitat Day	Human habitat degradation	2 Monday of October	Department of Housing
International Day for Natural Disaster Reduction	Natural disasters	13 October	Disaster Preparedness, Relief and Rehabilitation
World Food Day	Food insecurity	16 October	Ministry of Agriculture and Irrigation
International Biodiversity Day	Threat to biodiversity	29 December	Environmental Affairs Department

CHAPTER 6

Women Using a Treadle Pump, Photo by Gibson Mpepho

LAND AND AGRICULTURE

Grain Storage Facility, Photo by Deepa Pullanikattil

6.1 Land Sector

Malawi has a total territorial area of approximately 11.8 million hectares, of which 20% is covered by water (GoM, 2002). Forests, wildlife reserves, settlements and infrastructure cover about 19% of the total area (ibid). The remaining 61% of land is used in different ways depending on topography, soils, agro-climate and other social and cultural factors (ibid). Table 6.1 below shows that 1.7 million hectares of land in Malawi are currently protected areas; this leaves 7.7 million hectares available for agriculture. However, not all land is suitable for agriculture, due to limitations such as poor soil quality and access.

Table 6.1: Land Use and Availability in Malawi.

Land Use	Million Ha.	% of Total
Total Land Area of Malawi (Excluding water)	9.4	100
Protected Area (National Parks, Forest and Game Reserves)	1.7	18
Land Available for Agriculture	7.7	82
Land Available for Smallholder Agriculture and Estates	7.7	82
Estimated Land Under Estates	1.2	13
Land Available for Smallholders	6.5	69

Source: Adapted from Malawi Government, 2002.

Land is a key asset for economic growth and development in Malawi. The economy continues to rely heavily on agriculture and natural resources for a significant share of Gross Domestic Product (GDP), national food needs, employment, and export revenue. Agriculture, natural resource use and other land-based activities are also the primary sources of livelihoods for Malawians.

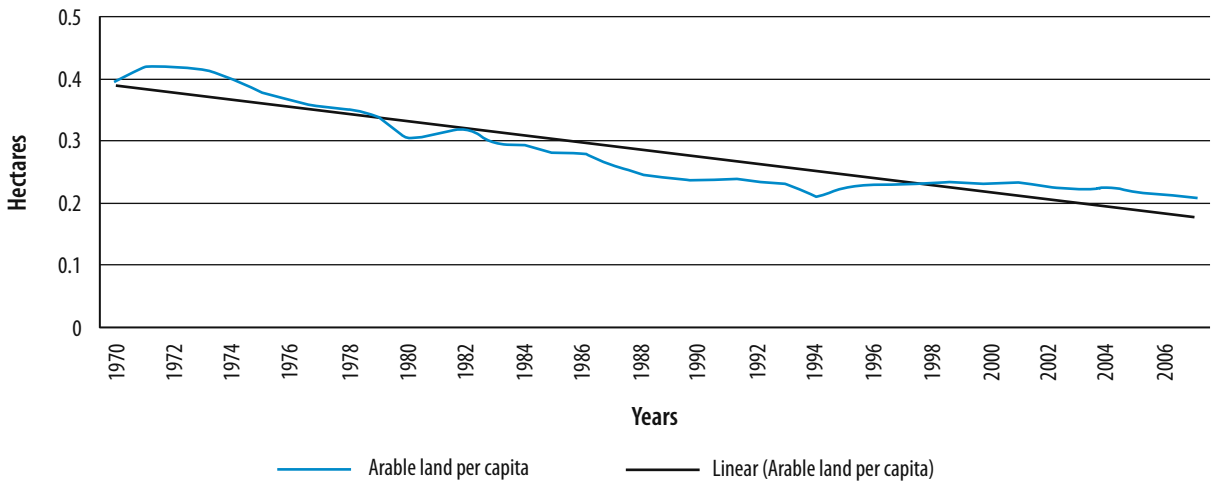
The average land holding size per household in Malawi is 1.2 hectares; available land per capita is estimated at 0.33 hectares (GoM, 2010c). Per capita land holdings (Figure 6.1) have been declining from about 0.4 hectares in 1970 to about 0.2 hectares in 2007, partly due to a high population growth rate that has led to intergenerational fragmentation of land holdings. In addition, per capita land holdings are highly skewed, with the poor holding only 0.23 hectares per capita compared to the rich, who hold 0.42 hectares per capita. The pressure on land leads to degradation that affects all sectors of the economy, including mining, tourism, agriculture, irrigation, water, forestry and wildlife. The land sector in Malawi faces a number of challenges including inequitable distribution, limited access to land and benefits arising from it, under resourced land administration institutions, insecure tenure regimes, weak institutional capacity, unsustainable utilization leading to different forms of degradation, limited investment, conflicting sectoral land related policies and lack of other policies such as National Land Use Planning Policy.

6.1.1 Physiography and Soils

Malawi is characterised by an extremely diverse physical environment. This wide range of relief is a major determinant of the climatic, hydrological and edaphic conditions of the country, and hence its agricultural potential. As shown in Figure 6.2, Malawi is divided into four main physiographic zones (GOM, 2002) namely highlands, plateaux, the Rift Valley Escarpment and the Rift Valley Plains.

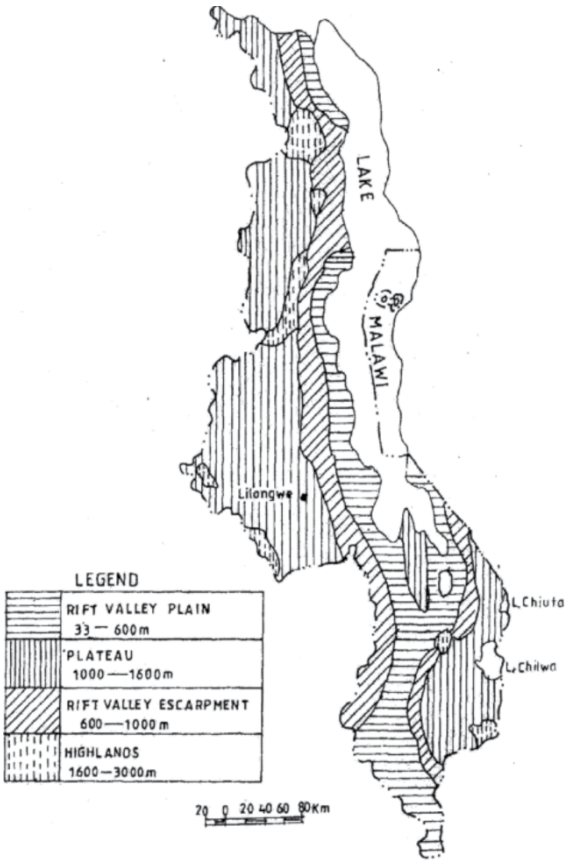
The Highlands are extensive tracts of land, the most prominent of which are the Mulanje, Zomba and Dedza mountains. They attain elevations of 1,600–3,000m above sea level (a.s.l).

Figure 6.1: Trends in Per Capita Arable Land, 1970–2007.



Source: GOM, 2010c, Computed Based on FAOSTAT Data.

Figure 6.2: Major Physiographic Regions of Malawi.



The Plateaux are located at elevations of between 1,000 and 1,600m a.s.l, and cover extensive tracts of the Central and Northern Regions. Their gently undulating surfaces are characterized by broad valleys and interfluves and thus are drained mainly by "dambo" streams that flow seasonally through shallow and swampy valleys.

The East African Rift descends from the plateaux in a series of stepped faults, known collectively as the Rift Valley Escarpment. This zone is, in general, highly dissected and characterized by bare, recently eroded surfaces.

The Rift Valley Plains are low lying plains largely formed by the deposition of materials eroded from the Rift Valley Escarpment. They are characterized by subdued relief and gentle slopes, and extend along parts of the Lake Malawi shore and the Upper Shire Valley. Average elevations are less than 600m a.s.l and decline to below 100m a.s.l in the Lower Shire Valley.

The Department of Agricultural Research classifies Malawian soils into three major soil types; eutric, chrome and haplic (GOM, 2002).

Eutric leptisols are commonly referred to as lithosols. The most widespread of the lithosol group are the shallow stony soils found on steep slopes. This soil type covers 2,243,390 ha, and occurs in all areas of broken relief.

Chromic luvisols are also referred to as latosols. These red to yellow-coloured soils are found in the Lilongwe Plain and parts of the Southern Region, and are among the best agricultural soils in the country. They are generally of good structure and are normally deep and well drained, but include weathered ferrallitic soils, which are of low natural fertility and easily exhausted. Latosols cover an area of 2,233,153 ha. Ferralic cambisols have similar characteristics to chromic luvisols, and mostly occur on the western border of the country.

Haplic lixisols include the alluvial soils of the lacustrine and riverine plains, vertisols of the Lower Shire Valley and the Phalombe Plain and mopanosols in the Liwonde and Balaka areas. These cover a total area of 1,671,495 ha.

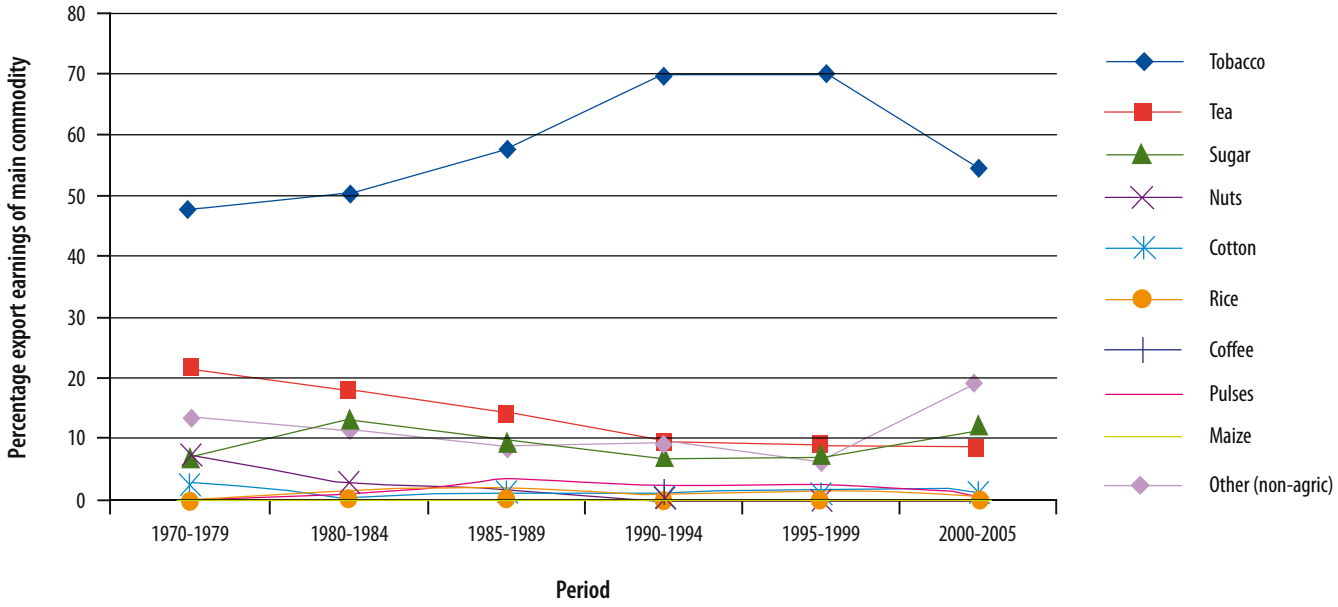
6.1.2 Agriculture Sector

Land in Malawi is primarily used for agriculture, which drives the economy, employing 84% of the national workforce and contributing 39% of the gross domestic product (NSO, 2009). The smallholder and the estate sub-sectors contribute more than 70% and less than 30% respectively to agricultural GDP (GoM, 2007). Agriculture is dominated by an estimated 6 million smallholder farmers, who cultivate fragmented customary lands with limited use of productivity enhancing technologies. Smallholder farmers cultivate mainly food crops such as maize, cassava and sweet potatoes to meet subsistence requirements. By contrast, the estate subsector focuses on high value «cash crops» for export, such as tobacco, tea, sugar, coffee and macadamia. This subsector comprises about 30,000 estates cultivating 1.1 million hectares (World Bank, 2003). Estates contribute only about 20% to total national agricultural production, but provides over 80% of the agricultural exports (GoM, 2007).

Figure 6.3 shows the contribution of different crops to export earnings and illustrates the dominance of tobacco. Tobacco has since recovered from the temporary decline shown from 1995–2005, and despite the worldwide anti-smoking campaign, tobacco revenues are high. The contributions of the other crops to export earnings have been low and declining, although the drive towards diversification of export crops has led to an increase in the production of nuts and sugar since 1995.

The Malawi Growth and Development Strategy (MGDS) recognizes the importance of both agriculture and land. Many of its targets are focused on developing this sector. For instance, the MGDS seeks to heighten agricultural productivity, increase agro-processing for export, maintain biodiversity in agriculture, and ensure tenurial security and equitable access to land. It is hoped that this will allow Malawi to attain broad based social and economic development that respects the ecological integrity of land and land based resources.

Figure 6.3: Composition of Export Earnings by Main Commodity (percentage), 1970–2005.



Source: adapted from Chirwa *et. al.* (2007).

6.2 Key Land and Agriculture Issues

6.2.1 Key Land Issues

Access to Land and Tenure

Broadly, land tenure comprises the system of rights and institutions governing access to and use of land. It includes the rules and regulations developed by societies to determine how land is accessed, allocated, used and exchanged. Cultural, political, legal and economic factors mediate land tenure. Land rights and the way in which they are issued and enforced have major implications for the use and management of land as well on the social and economic development of Malawi and its citizens.

There are three categories of land tenure in Malawi: customary, private and public land tenure. Customary land falls under the jurisdiction of traditional authorities and is administered under customary law. The distribution and control of this land is vested in the hands of traditional leaders. Public land is held by the government and set aside through appropriate legislation for such reasons as national development, security and tourism.

Past agricultural policies that tended to favour private ownership of land for lucrative commercial farming encouraged the conversion of customary land to private ownership. The presence of estates forced poor smallholder farmers to occupy and operate on very small landholdings. This can be clearly seen in Mulanje and Thyolo, where the prevalence of large tea plantations forced small-holder farmers onto small parcels of land, or even to landlessness. Inequality in land distribution among social classes is also not uncommon, as the elite tend to have better access to the land market. Promotion of tenurial security and equitable access to land is the goal of the 2002 National Land Policy (GOM, 2002).

Women's Access to Land

Despite legislative and policy reforms, women in Malawi have largely remained marginalized when it comes to land rights, despite their high degree of involvement in agricultural production. Whether in patrilineal or matrilineal societies, access to land is typically mediated by men (spouses or uncles). Women have difficulty both in making independent decisions about land use, and in accessing the benefits derived from land ownership. Box 6.1 gives an example of one woman's struggle to access land she inherited after the death of her father.

Land Use and Land Cover Changes

Successive censuses have indicated that Malawi's population is growing rapidly (see Chapter 2, Human Settlements). This has led to growth in agricultural activities, both as a national-level policy to enhance food security and economic growth, and as a result of individual families seeking to produce enough food to feed their members. Population pressure has led to agricultural expansion onto marginal lands (such as hill-slopes), deforestation, and the growth of agricultural activities has resulted in the dwindling of the forest and the general declining of soil productivity due to increased erosion and reduction in the soil fertility status. There has also been encroachment of settlement and cultivation in protected areas although the extent of this has not been quantified at national level.

Box 6.1: Excerpt from the 2009 Action Aid Annual Report

"She narrated her life story to stress just how difficult it is for a woman to own land under Ngoni culture. "My father had three wives. Mum was the second wife. There were two of us in our family. My sister got married a long time ago and lives at her husband's village.

"I visited the chief three times to request him to instruct my stepbrother to give us our share of our deceased father's land. But on all these occasions the chief said a woman is not allowed to own land in Ngoni culture. So we somehow got used to our fate and suffered silently year in and year out.""

The growth of agricultural activities has resulted in the dwindling of the forest and the general declining of soil productivity due to increased erosion and reduction in the soil fertility status. There has also been encroachment of settlement and cultivation in protected areas although the extent of this has not been quantified at national level.

A recent study by Total Land Care analysed land use changes in Chia Lagoon Catchment which provides a snapshot of the watershed as of 2000 and gives the general trend of the land use and land cover from 1972 to 2000. All the changes indicate that there was increased human activity from 1972 to 2000 resulting in rapid changes taking place in the watershed such as increased agricultural activities and more land being put to less vegetation cover, exposing it to other environmental hazards (see box 6.2).

A total of 32,898.6 ha changed from one land use/ land cover type to another. Out of this 34.0% changed from miombo woodlands to sparse or degraded forest. While 27.2% changed from miombo woodlands to intensive agriculture and 16.3% changed from sparse or degraded forest to intensive agriculture. This represents 77.6% of the changes from miombo woodlands (good land cover) to other land cover types which are less efficient cover types. An additional 4.6% changed from miombo woodlands to cultivated/bare land.

The changes underscore the increased intensity of activities in the watershed resulting in the depletion of forest resources and increased agricultural and environmentally unfriendly practices. Out of the 32,898.6ha only 5% changed from other land use/ land cover types to miombo woodlands between 1972 and 2000. This implies that few activities are being implemented within the watershed to protect the existing forests and to regenerate the degraded forests.

Land Degradation and its Impacts

The most potent form of land degradation is the slow insidious process of soil erosion. AGRIFOR (2006) reported that unfertilized local maize yielded 1,700 kg/ ha in the 1960's and this has fallen below 1,000kg/

Box 6.2: Land Use/Land Cover Changes in Chia Lagoon Catchment

Chia Lagoon watershed is located between latitudes 13° 0' and 13° 27' S; 33° 55' and 34°20' E, covering a total area of 991km^2 (99100ha). It extends from Nkhotakota district (a few metres from Lake Malawi) to Ntchisi district.

Landsat images for the years 1972 (Landsat MSS), 1990 (Landsat TM) and 2000 (Landsat ETM) were acquired and re-projected to UTM, Datum: Arc 1950 and Ellipsoid: Clarke 1880. Image classification was done for 1972, 1990 and 2000 using supervised classification method (maximum likelihood algorithm) in ILWIS 3.3. Visual interpretation was done and based on the spectral characteristics; classes were isolated and identified from the image. To ensure good classification and best class differentiations, as many classes as possible were selected. After running the classification, closely related classes were merged, remaining with 9 dominant classes for the watershed.

The analysis identified nine (9) major land use/land cover classes. The general trend shows a decline in the "original" land cover (miombo forest from 50,739.8 ha to only 23,468.1 ha). This is a loss of about 53.75% in 28 years. The area under intensive agriculture grew from 6,850.5 ha in 1972 to 22,286.5 ha in 2000. This suggests that there has been a growing deforestation activity in the watershed leading to subsequent reduction in the miombo forest reserves. The land covers Sparse or Degraded Forest and Fallow/Grassland may have slight confusion in the classification, but field verification revealed that the two classes were appropriately disaggregated during classification. These two classes also increased. There was almost no increase in the water body area and slight decline in wetlands.

Source: Haig L.A. Sawasawa, et. el., 2007

ha in 2000's. This declining productive capacity of the land is being attributed to deterioration of soil structure and fertility. Malawi Government (1994) reported that the cost associated with replacing soil nutrients in form of inorganic fertilizer was equivalent to USD 300 million annually. The state of land degradation from 1990's to present has not improved and has actually worsened.

The direct cause of land degradation is inappropriate land use and management practices by various land users such as smallholder farmers, estate farmers, road and building constructors, traders in forest and wildlife products and artisans.

There are a number of institutions in Malawi which have the responsibilities of protecting and managing the land-based natural resources. These institutions include the Department of Land Resources Conservation, Department of Forestry, Department of Irrigation, Department of Water Resources Development and Department of National Parks and Wildlife. While each of these departments have single sector policies what is conspicuously absent is an overall policy that would harmonize the different sector policies, arbitrate policy conflicts and tackle the cross-sectoral nature of land degradation. It is also clearly evident that there are no formal coordination structures between these departments and ministries, at policy, operational and implementation levels. If there is any coordination then it is informal and characterized by being short lived, because of high staff turnover and institutional instability, such as when one department could be under different Ministries within a five year period during which Malawi takes the opportunity to change governments.

There are a number of impact indicators of land degradation. These include tonnage of sediments, loss of crop yield, pollution of water bodies and courses, surface crusting and loss of vegetative cover. World Bank (1992) estimated that the average annual soil loss for Malawi was 20ton/ha/yr. This estimate was based on a number of assumptions such as: household practicing continuously cultivation of the same piece of land; increased acreage of cultivation over steep slopes and marginal areas. There has been no comprehensive work on estimation of soil loss in Malawi over the years. However, it could be assumed that the trends of soil loss have increased since the proportion of both household carrying continuous cultivation and that of cultivated land spreading over the steep slopes has increased (Total Land Care, 2009).

Specific sites with increased soil loss have been identified by the Department of Land Resources Conservation (DLRC). In the Northern Malawi the areas include the Chiweta-Livingstonia Rift valley Escarpment following the Mzuzu-Karonga via Chiweta bitumen road, and the Chitipa-Karonga Hills following the Karonga-Chitipa road now under construction. Estimates of average annual soil loss in Karonga are being projected at 34t/ha/yr compared to 29t/ha/yr for 1991(DLRC, 2009). Similarly those of Nkhata Bay are put at 43t/ha/yr compared to that of 22t/ha/yr for 1991. It is assumed that the increased upgrading of roads into bitumen standard, is encouraging households to settle along such infrastructures and has been the case for other such roads in the past for readily available market and ease of transportation of their produce. In Central region, soil loss for Kasungu is being projected at 30t/ha/yr compared to 20t/ha/yr in 1991(DLRC, 2009). In the Southern Region, soil loss has been projected for Mulanje at 32t/ha/yr compared to that of about 29t/ha/yr (DLRC, 2009). In a recent study, Mlava *et. al.* (2010) estimated that soil erosion in the Linthipe cathment in 1994 was negligible at the minimum, but could reach 50 t/ha/annum. This, however, increased to assume an upper range of 57 t/ha/annum in 2008. In the Lower Shire catchment, erosion was estimated to be in the range 3 t/ha/year to 31 t/ha/annum in 2008. Focusing on slopes of less than 20% in the Linthipe catchment, Mlava *et. al.* further established a weighted average soil erosion of 12 t/ha/annum. While these figures may not give an accurate assessment of absolute soil loss they serve to give an indication of the order of magnitude of the trend of soil loss in Malawi.

While there are no recent comprehensive estimates of soil loss work by Jamu *et. al.* (2003) shows that the soil loss in Likangala and Domasi River catchments ranged from 4t/ha/yr around the plain of Lake Chilwa to as much as 55t/ha/yr on the Mutiya area which is on the Zomba Mountain foot slopes.

A definitive picture of increased soil loss in Malawi could be ascertained from the change in land cover detection studies. Green and Nanthambwe (1990) estimated that in 1991 about 48% of the land in Malawi was under cultivation. Malawi Government (2002) reports national average annual rate of deforestation of 2.8%, with the Northern Region topping at 3.4%, while those of central and southern regions being below the national average since in these regions most of communal woodlands have already undergone deforestation. The land cover change is in the direction of high vegetation canopy to that of poor canopy. This deterioration in land cover change is indicative of increased soil loss since a small change in land cover could lead to a proportionally high amount of soil loss. This is because there is a curve-linear relationship between vegetation cover and the tonnage of soil erosion (Stocking, 1978).

Following these increased tonnage of soil loss, their impact on crop yield should also have been increased. For instance World Bank (1992) estimated that a loss of 20t/ha/yr could result into crop yield loss of between

4%–11%. Furthermore, such increased soil erosion of many river catchments the rate of sediments should also have increased. However, there have been very scanty studies on sedimentation in Malawi, despite the numerous impacts of sediment deposits. Sediment deposition affects fish reproductive success and could have adverse impact on biodiversity (Jamu *et. al.*, 2003). They also increase the cost of potable water treatment, and are being seen contributing to disruption of hydropower generation while reducing the efficiency of transportation of goods on the Lake Malawi. Jamu *et. al.* (2003) reported sediment deposition of 300–400t/ha/yr at the mouth of Likangala River in 2002. Sediment deposition on water bodies and river courses leads to the destruction of fish spawning grounds. While no study has been carried out to give a better picture on the impact of sedimentation on biodiversity the indication appears to be that of worsening trends over sites and time.

Land Reform and Poverty Reduction

Although the arguments for improved access to land is to address the issue of inequalities, there is growing evidence that access to a production resource like land with improved tenure security does improve productivity and therefore incomes of smallholder farmers. The Community Based Rural Land Development Project (CBRLDP) implemented by Malawi Government to address the land shortage has shown that productivity of maize and tobacco had improved from 450 Kg/ha to 1,800 kg/ha and from 300kg/ha to 800 kg/ha respectively in the 2006/2007 growing season (Table 6.2). During the same period, average annual income increased from MK18,700.00 to MK30,500.00. Although it is difficult to attribute improvement in productivity to improved land tenure security, it is certain that access to productive resources like land gives an opportunity for people to participate in poverty reduction activities provided that the land so allocated is not environmentally fragile and people adhere to proper land management practices.

Funding for Sustainable Land Management Activities

A recent study (FAO, 2009) has shown that Government, donors and NGOs spent an estimated MK3 million to 4.5 million per year on sustainable land management activities and investments in the past three years, equivalent to about 0.8% to 1% of GDP. This gives an idea on the amount spent on sustainable land management in Malawi by the major players; however it excludes activities and investments on private estates that are believed to be high. In general the expenditure on sustainable land management activities are low to make any significant impact in redressing land degradation problems.

Institutional Framework for Land Management

According to the public expenditure review for sustainable land management in Malawi (FAO, 2009), the institutional framework is characterized by understaffing and lack of coordination. The departments that carry out land management related activities are severely understaffed: the Land Resources Department in the Ministry of Agriculture has an establishment of about 150 positions which are mostly field based but the vacancy rate was at 70% in 2008; the Forestry Department with 6000 staff at District level is handicapped by its large but insufficiently qualified staff; Environmental Affairs Department has very little presence at District level; the Lands Department lack the capacity both at national and local levels to implement the dictates of the 2002 policy (FAO, 2009). Existing human resources for sustainable land management is therefore, generally poor.

Table 6.2: Impact of the CBRLDP on Poverty.

Productivity and Income	39 Households Relocated in 2006/07	32 Households Relocated in 2005/06
Maize Productivity		
Baseline	450kg/ha	962kg/ha
After resettlement	1,800kg/ha	2,000kg/ha
Burley Tobacco Production		
Baseline	300kg/ha	519kg/ha
After Resettlement	800kg/ha	1,390kg/ha
Average Annual Household Income		
Baseline	K18,700	K54,000
After Resettlement	K30,500	K88,000
Household Food Security (months)		
Baseline	5 months	
After Resettlement	8 months	

Source: CBRLDP Management Unit (2010), Data Provided by the Monitoring and Evaluation Unit.

6.2.2 Key Agricultural Issues

Key issues and constraints in the agricultural sector include low and stagnant yields, over dependence on rainfed farming which increases vulnerability to weather related shocks, low level of irrigation development, and low uptake of improved farm inputs (GOM, 2006). In addition, low profitability of smallholder agriculture is influenced by weak links to markets, high transport costs, few farmer organizations, poor quality control and lack of market information.

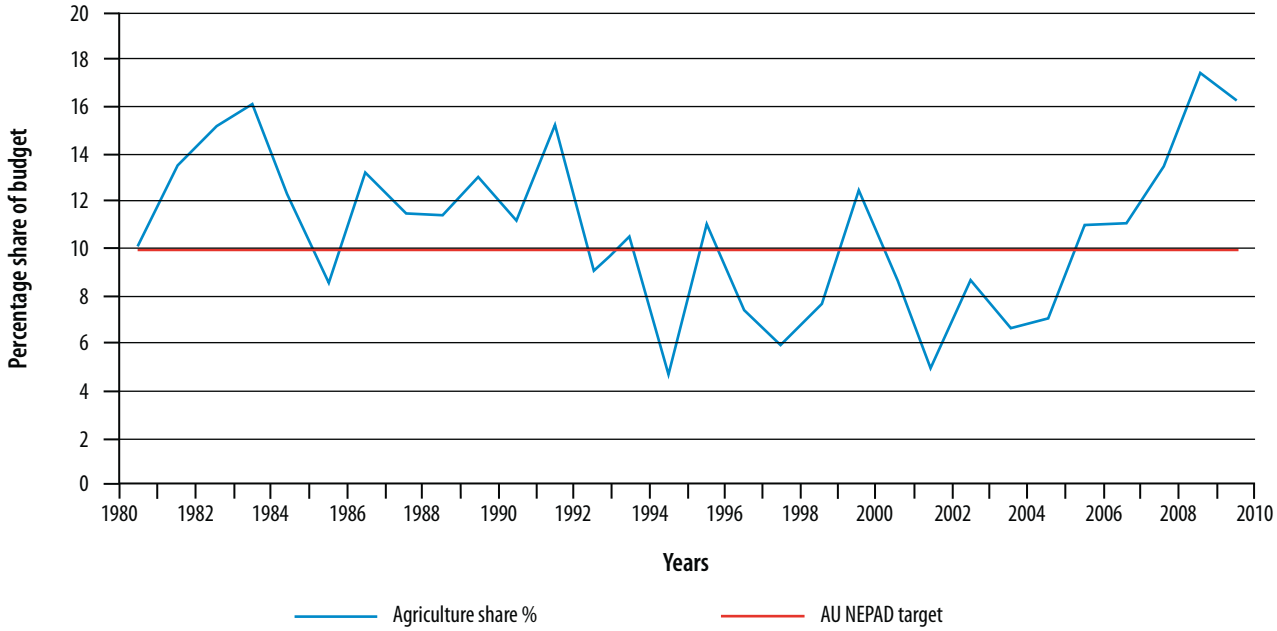
Trends in Agricultural Sector Investments

The Agriculture share of the national budget has been fluctuating, However from 2005/06 the allocation to the sector has seen significant improvement being above 10% of the national budget (Figure 6.4), a target set both by the African Union under the Comprehensive Africa Agricultural Development Programme (CAADP) and the Dar-es-Salaam Declaration on Agriculture and Food Security of SADC. The bulk of this allocation, about two thirds of the 2006/07's recurrent expenditure, for example, was used to subsidize the distribution of fertilizer and maize seed (GOM, 2009). The trend has continued up to the current 2010/2011 budget where government has prioritized the input subsidy programme.

Crop Production

The main crops cultivated in Malawi are shown in Table 6.3. Smallholders cultivate mainly food crops such as maize; the main staple grain, cassava and sweet

Figure 6.4: Agriculture as a Share of Total Government Budget.



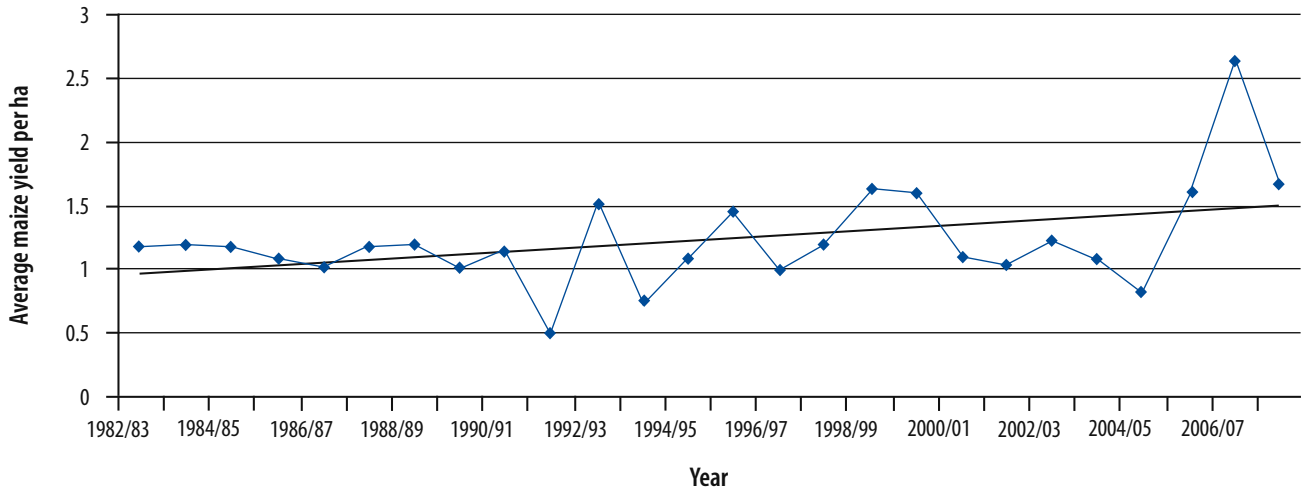
Source: GoM, 2010c.

Table 6.3: Types of Crops Grown in Malawi.

Marketability	Classification	Specific Crops
Food Crops	Cereals	Maize, Rice, Sorghum, Pearl Millet, Finger Millet, Wheat
	Grain legumes	Beans, groundnuts, soybeans, pigeon peas, cowpeas, ground beans, chick pea, field pea, green gram, guar beans
	Root & tuber crops	Cassava, Sweet potato, Irish Potato
Cash Crops	Cash Crops	Tobacco, Tea, sugarcane, cotton, coffee
	Spices	Chillies, Turmeric, Ginger, Pepper, Paprika, Cinnamon, Garlic
	Vegetables	Cabbage, tomatoes, onions, leaf vegetables (rape, Chinese cabbage..., okra, carrots, eggs plants, lettuce, cucumbers, mushroom production
	Oil Seeds	Sunflower, sesame, castor seed

Source: GoM, 2008.

Figure 6.5: Maize Yield Trend 1982/83 to 2006/07.



Source: MoAFS, 2008.

potatoes to meet subsistence requirements while estates focus on high value cash crops for export such as tobacco, tea, sugar, coffee and macadamia. On a small scale, small-holder farmers also grow cash crops such as cotton, tobacco and sell surplus excess food crops.

Maize yields have been low and fluctuating around one tonne per hectare per year (Figure 6.5) from 1982/83 2004/05 due to a number of reasons including declining soil fertility, droughts, poor agricultural practices, limited access to improved farm inputs (mostly seed and fertilizers), poor extension services and low market incentives. Yields improved from 2005/06 mostly due to improved access to improved inputs such as seed and fertilizers through the Government input subsidy programme

A comparison between production of maize and hectarage under maize shows that production has been fluctuating while area under maize has remained fairly constant throughout the 1989 to 2008 period (Figure 6.6). This confirms that the increase in production has been to a large extent influenced by improvements in yields through intensification; increased use of production enhancing technologies such as improved seed and fertilizers (Figure 6.7).

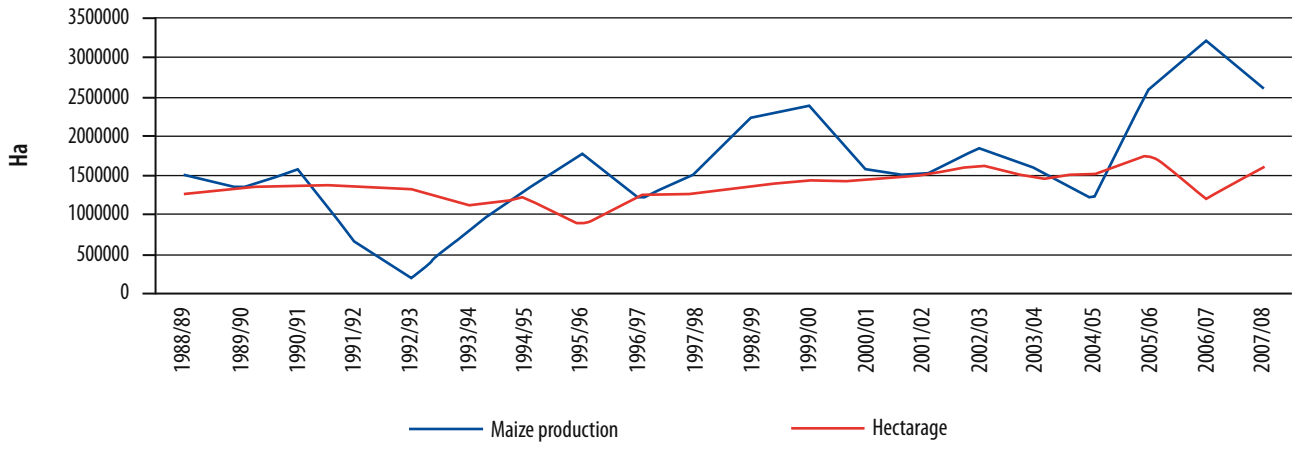
The steep increase in production of maize since 2004 can be attributed to government's intervention of subsidized inputs that has improved access to seed and fertilizers to the farmers who could not otherwise have accessed the inputs due to high costs.

Fertilizer Consumption

Historical total fertilizer consumption in the country shows upward trend from approximately 125000 metric tonnes of fertilizers of different types in 1991/92 to 300000 metric tonnes in 2006/07 (Figure 6.7).

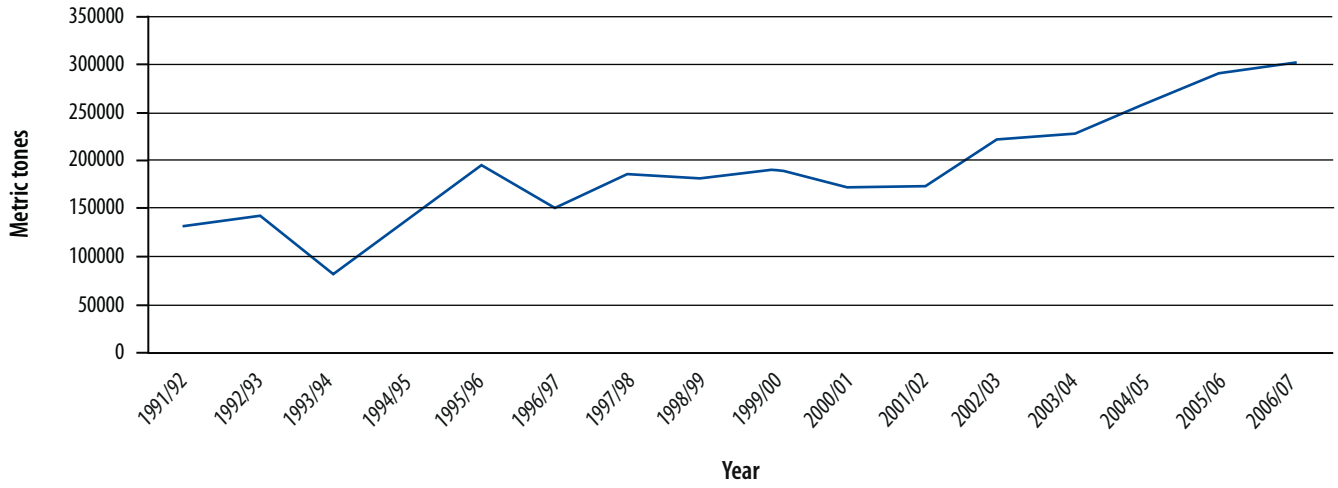
The high increase in the last four years of this period can be attributed to government's input subsidy programme which has assisted in increasing the uptake of fertilizers.

Figure 6.6: Maize Production and Hectarage Under Maize.



Source: Developed from Data from MoAFS, 2008.

Figure 6.7: Trend in Fertilizer Consumption from 1991/92 to 2006/07.



Source: GoM, 2008.

Although this increase in fertilizer consumption has translated into improved agricultural production, it is prudent to say that they also tend to mask the effects of unsustainable land management practices whose impacts will only be seen when the subsidy is removed and the farmers' access to fertilizers is constrained.

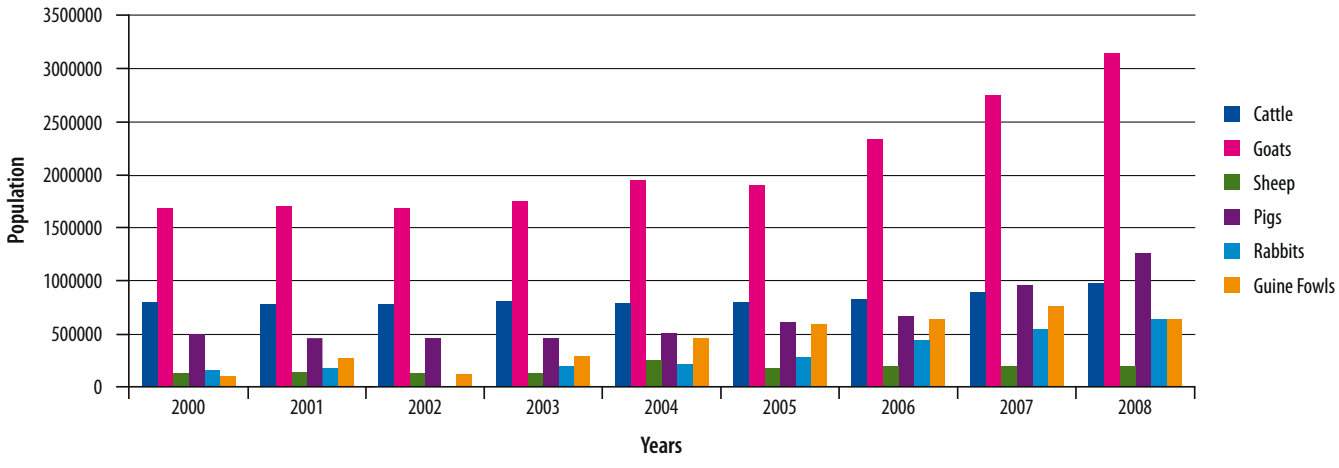
Livestock Production

According to GoM 2010c the trends in levels and growth of livestock per capita show that livestock production has been declining over the past years. The numbers of chickens and cattle per capita have been declining, The per capita number of goats, however, has marginally increased. Trends in the stock of livestock are however variable with gains in the one year being almost wiped out the following year.

The poor performance of the livestock sector is partially a reflection of the lack of emphasis in the agricultural strategies and policies towards the sector. Another factor is the poor performance of the crop sector that has tended to be extensive, expanding to marginal as well as dambo areas that have long been traditional grazing areas, thus reducing grazing area. It can therefore be argued that improvements in productivity in arable farming will lead to increases in grazing livestock in Malawi. The dairy farming sector in Malawi is just being developed, but it faces several capacity constraints including lack of financial resources to purchase cows, poor farm management, outdated machinery in some dairy processing plants, and lack of competition in milk processing (GoM, 2010c).

In recent years, however, livestock population has shown upward trend signalling positive results from improved extension and management promoted by stakeholders (Figure 6.8). The latest livestock census has shown that cattle population in Malawi has increased to about 1.1 million in 2009/10. However, this increase does not match with the increase in human population growth hence the low per capita growth.

Figure 6.8: Livestock Population Trend 2000 to 2008.



Source: Malawi Government, 2008.

Box 6.3: Accounting for Successes in Agricultural Development

The success of the agricultural sector in the late 1990s is partly explained by the direct government support to broader-based programmes to reach smallholder farmers through targeted input programmes such as Targeted Input Programme (TIP) and 'Starter Pack'. These programmes provided packages of technologies in terms of improved seeds and fertilizers and made them accessible to the poor. The scaling down of the targeted input programme has been partly attributed to the food crisis in 2002.Similarly, the implementation of another broad-based intervention - the input subsidy programme - since 2005/06 season has led to remarkable growth in food and cash crop production leading to improved food self sufficiency during the 2004/05 to 2008/09 seasons.

Source: Malawi Government, 2009.

Irrigation Agriculture

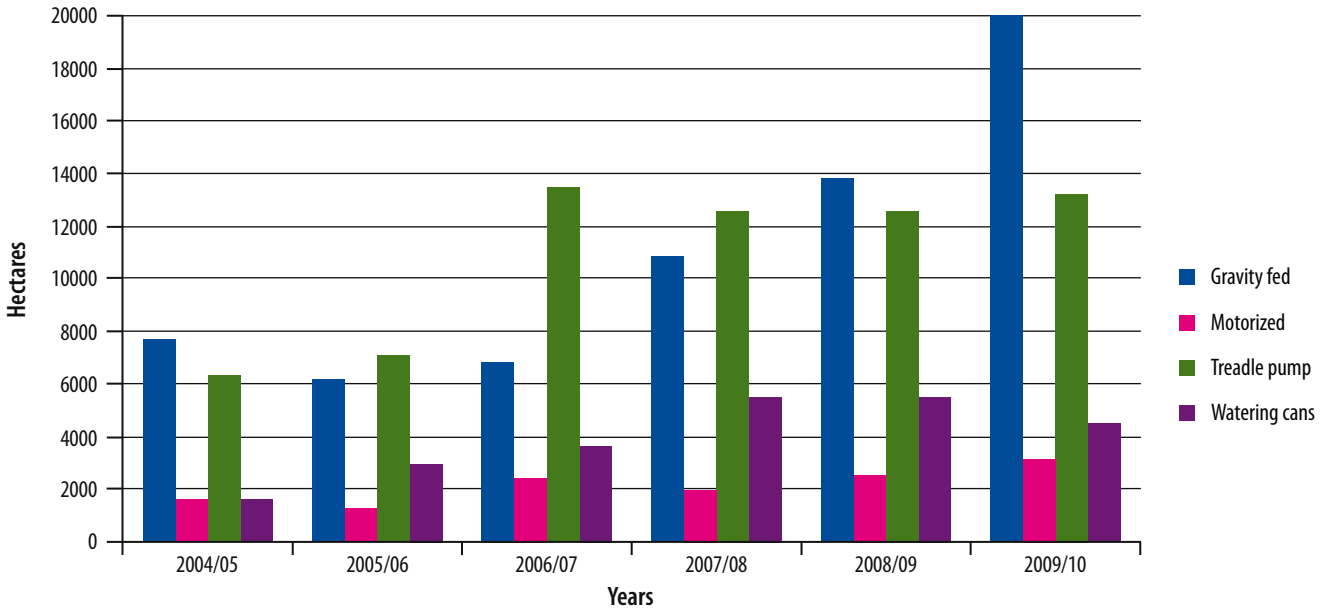
Due to unreliable weather patterns experienced over the past years, Malawi is intensifying irrigation agriculture to reduce its over dependence on rain fed agriculture which is vulnerable to changes in climate (Figure 6.9). To further enhance this aspect, the government of Malawi has initiated the Green Belt Initiative that will greatly improve the availability of water and irrigation in the country. Current data shows that Malawi irrigates about 88,000 hectares (22%) of it's irrigable land.

It is evident from Figure 6.10 that the trend in irrigation development has been slow. From 2004/2005 to 2009/2010 Malawi increased irrigation on irrigable lands from roughly 16% to 22%. The area under irrigation in the estate subsector has been constant, while in the smallholder sub-sector the coverage has been increasing steadily from about 16,000 hectares in 2004/05 to 40,000 hectares in 2009/10 (Figure 6.9). The total area under irrigation in both subsectors has increased from about 64,400 hectares in 2004 to about 88,000 hectares in 2009/2010, utilizing 22% of the total irrigation potential.

The drive to extend irrigation coverage increases the need for improved land management, to ensure that Malawi avoids the soil degradation that arises from unsustainable irrigation practices. In particular, the Green Belt Initiative target of one million hectares under irrigation should be reassessed since the total irrigation potential of the country is estimated at only 400,000 hectares. More detailed assessments need to be done to ensure that irrigation projects are done in an environmentally sustainable way.

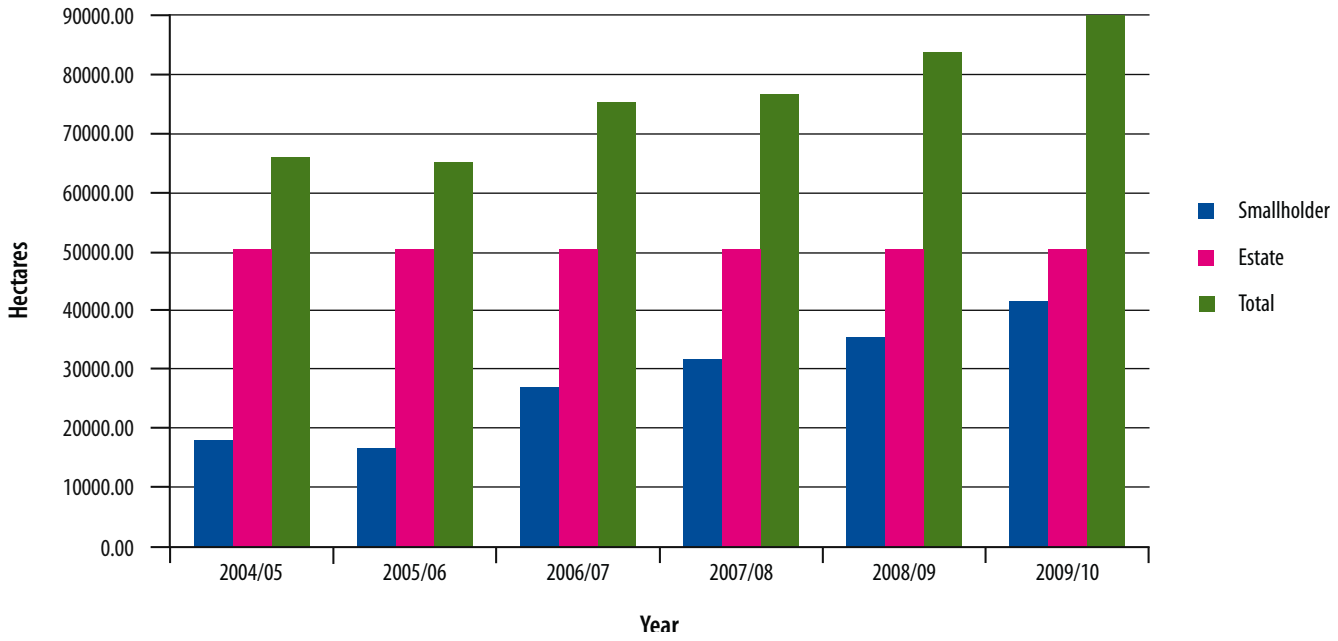
The systems of irrigation under the smallholder subsector are mostly gravity fed, motorised, treadle pumps and watering canes. From 2004/05 hectarage under gravity fed increased from just under 8,000 hectares to about 20,000 hectares while area under treadle pump irrigation in the first three years increased from 6000 hectares to 13,000 hectares in 2006/07 and stabilized

Figure 6.9 Area Under Smallholder Irrigation by Type; 2004/05 to 2009/10.



Source: Ministry of Irrigation and Water Development, 2010.

Figure 6.10: Trend in Irrigation Development Smallholder and Estate Subsector 2004/05 to 2009/10 in Hectares.



Source: Ministry of Irrigation and Water Development, 2010.

up to the current year 2009/2010 at just about 12,000 hectares (Figure 6.9). Treadle pump use has been blamed for riverbank cultivation and the resultant soil erosion although this has not been quantified. This calls for improvements in the technology to allow water to be pumped to areas away from the riverbanks.

6.2.3 Emerging Issues

Farming for Energy

Bio-energy issues have implications on land use, agriculture and food security. With high cost energy sources worldwide and concerns for the environment on the use of fossil fuels that contribute to climate change, attention is growing on the production of energy from biotic sources. Cultivation of certain crops is promoted to provide raw materials for the production of biofuels to replace the fossil fuels or to be blended with it and reduce use of environmentally unfriendly fuels.

Malawi does not yet have a policy on biofuels but there are initiatives by the private sector to produce fuels from trees such as jatropha. There are debates on the pros and cons of going for biofuels with those against arguing that the promotion of the biofuels will promote food insecurity as farmers will shift from growing traditional food crops to bio-fuel crops. There will also be competition for grain to be used for food and for energy. The other dimension of these initiatives is that this requires vast land and it may lead to displacing people from their land therefore creating a landlessness situation, loss of production resource, hunger and poverty. This may also cause serious land grabbing problems by multinationals and the elite to produce the lucrative energy crops at the expense of the smallholders.

The area under bio fuel crops is not yet known, there are however indications that this is on the increase judging from the number of organizations working with smallholder farmers to produce them.

Climate Change

The most serious impact of climate change on land is exacerbation of desertification. Desertification relates to both the process and the end state of dry-land degradation, involving soil erosion, soil degradation, deforestation and degradation of the natural vegetation, as well as declining biological productivity of the land.

Climate change impact on land and agriculture is most evident through the recurring extreme weather events such as droughts and flooding that have been common in the country during the past years. This has reduced the ability of the land to support production and provision of goods and services. The country's over dependence on rain fed agriculture increases the vulnerability to climate change shocks. However, agriculture, forestry and other land uses offer opportunities for activities to mitigate and adapt to effects of climate change. Land management technologies that promote carbon stocks offer opportunities to contribute towards reduction in greenhouse gas emissions. Sustainable land management practices improve the resilience of food production systems to effects of climate change by improving water availability and providing carbon sinks.

6.2.4 Crosscutting Issues

Gender in Agriculture and Land

Currently, Malawi land tenure system gives women varying degrees of access to land. Under the private freehold system, women have rights to access land but very few of them have the resources to purchase such land on the open market or to acquire land and register it privately. The land rights are mostly registered in the name of the husband and in the event that the husband dies women are evicted. The customary land held under the traditional or customary system allows women secondary access through marriage, but as soon as the marriage breaks up they lose the right to cultivate lineage land. Joint land ownership for husband and wife is not a common practice.

In southern region and parts of central region the matrilineal inheritance systems, women tend to have more secured rights to land than under patrilineal systems dominant in the northern region although they have little authority over land allocation and benefits arising from it. In the land redistribution programme the government is implementing on pilot basis, women constitute about 22% of beneficiaries. The National Land Policy 2002 promotes registration of individual, family and community titles and gives men and women equal access to and ownership of land. Once the enabling legislation is passed and implemented the gender biases will be minimized. In spite of women's lack of access to land, they are the main actors in agricultural production activities.

HIV and AIDS

The HIV and AIDS pandemic is more than just a health problem. It impacts negatively on the land and agriculture sectors in many ways. First reduces the quality and quantity of labour available to these sectors and thereby affecting productivity. Secondly it diverts resources that could have been allocated to production to address this pandemic.

This pandemic deprives families of their sources of income and creates gaps in social fabric of the families. After loss of a member of the family property and land rights issues surface and often the children and spouses are not allowed to continue using land that belonged to the deceased. This creates landlessness and loss of productive assets that lead to perpetuation of poverty.

HIV and AIDS pandemic calls for development and dissemination of technologies in agriculture and land management; labour saving to take care of the lowering of quality and quantity of labour in those sectors due to the pandemic. Crops high in protein and food fortification are required to provide the needed energy and improve natural immunity systems of the communities. Lastly, interventions to improve security of tenure to the remaining members of the families need to be developed.

Environment

Land includes land covered with water, buildings and other things permanently affixed to land as well as any interest in the land including the air above it and it also includes the effects of human activities past and present. It therefore means land defines our environment as it is a foothold of all living or dead organisms.

All environmental issues are linked directly to the use and management of land both in the urban and rural areas. Land if properly used holds the key to mitigation of climate change and adaptation to the impact of climate change through measures that improve carbon capture and storage and also improve water use efficiency. Main-streaming of environmental concerns in land policies and programmes is the drive for sustainable land management.

6.3 Strategies for Sustainable Land and Agricultural Management

6.3.1 Regional Policy Framework

Malawi, as a member of several regional economic groupings, aligns its development activities to be consistent with achieving the development targets set at regional level. Under the New Partnership for Africa's Development (NEPAD), Africa's Heads of State and Government have recognized the critical importance of land and agriculture as the cornerstone of sustained growth and poverty reduction through adoption of the Comprehensive African Agricultural Development Programme (CAADP) - a strategy to put African agriculture on the path of strong and sustained growth. The principles of CAADP include achieving a 6% annual agricultural growth and allocating at least 10 percent of budgetary resources to the agricultural sector. The Malawi Agriculture Sector Wide Approach (ASWAp) shares the principal elements and priorities of CAADP and closely mirrors its emphasis on agricultural productivity. CAADP comprises four mutually reinforcing pillars:

(1) sustainable land and water management;

(2) improved market access and integration;

(3) increased food supplies and reduced hunger; and

(4) research, technology generation, dissemination and adoption. Malawi's achievement of over 10% budget allocation to agriculture is consistent with

CAADP ideals and its recent signing of CAADP compact is a commitment that will trigger increased investment in that sector.

The ASWAp process is a path that Malawi has taken to align its agricultural development agenda with the CAADP agenda. The ASWAp process has developed the Government and Development partners' code of conduct and the Memorandum of Understanding (MOU) on financing support to ASWAp implementation. These documents, together with the ASWAp document are part of the Country's CAADP Compact signed in 2010 that signals Government's commitment to its implementation. As the Agriculture Sector Wide Approach and the CAADP are rolled out, there will be need for close collaboration in three areas:

(i) Mainstreaming NEPAD principles and targets in pursuit of development, poverty alleviation and food security objectives;

(ii) Supporting Malawi's thrust to build and strengthen policy and institutional capabilities, and

(iii) Supporting Malawi's efforts to build a knowledge management system around agricultural development issues supportive to national and regional development agenda and also embracing peer review mechanism in enhancing collective responsibility and local ownership.

In the area of land, Malawi subscribes to relevant international and regional policies including the United Nations Convention for Combating Desertification (UNCCD), the Southern Africa Action Programme for Combating Desertification, the United Nations Convention on Biological Diversity (UNCBD), the NEPAD Action Plan on the Environment, the Africa Land Policy Framework and Guidelines and pillar 1 of the Comprehensive Africa Agricultural Development Programme (CAADP). Domestication of these international instruments through policies, legislation and programmes shows Malawi's commitment to addressing issues of agriculture and land management.

6.3.2 National Policy Frameworks

The Malawi Growth and Development Strategy

Land management and agricultural development in Malawi are driven by the Malawi Growth Development Strategy (MGDS) which emphases in the areas of agriculture, food security, irrigation and disaster risk reduction, land tenure security, equitable land access, development of land markets and sustainable utilization of land based resources. This is expected to transform the country from being a predominantly importing and consuming economy to a predominantly manufacturing and exporting economy. The MGDS represents a policy shift from social consumption to sustainable economic growth and infrastructure development and places emphasis on nine key priority areas of management of climate change, environment and natural resources, the Greenbelt initiative to irrigate up to one million hectares of land, new water supply systems, reformation of the education sector while entrenching science and technology, development of roads and Nsanje World Inland Port Development, integrated rural development, Public health, sanitation and HIV and AIDS management, youth development and empowerment, and energy, mining and industrial development.

The Agricultural Policy Framework (APF) and Strategy

For increased agricultural productivity, an enabling environment is required. In an attempt to harmonize policies, the Government has recently reviewed the various national development strategies, agricultural strategies and agricultural-related legislation and policies and produced a National Agricultural Policy Framework (NAPF). The NAPF is a synthesis of and summarizes the objectives of agricultural development, strategies and policies that will be pursued to achieve both stated and commonly perceived agricultural objectives (MoAFS, 2006). The purpose of the NAPF is therefore to increase agricultural productivity so as to ensure food security and sustainable agricultural growth and development. This is envisaged to be attained through increased food and cash crop production, horticultural production, livestock production, fisheries production, and agro-forestry production.

The overall goal of the food security policy is to significantly improve food security of the population. Specifically, the policy seeks to guarantee that all men, women, boys and girls, especially under-fives in Malawi have, at all times, physical and economic access to sufficient nutritious food required to lead a healthy and active life.

Key elements of the policy include promotion of irrigation development and integrated water resources management, promotion of fisheries and aquaculture development, promotion of sustainable harvesting of natural food resources and improvements in the coordination and management of food aid and imports.

Currently, there are more than 193 projects on food and nutrition security in Malawi. Through the Food and Nutrition Joint Task Force Technical Secretariat harmonised impact and output indicators have been developed to ensure easy tracking of progress and projects' contribution towards attainment of the food security policy goals.

The Greenbelt Initiative (GBI)

The GBI is aimed at using available water resources to increase production, productivity, income and food security at both household and national levels. The GBI aims at intensifying irrigation farming, livestock and fisheries development (GOM, 2010b). Components of the GBI include:

(i) Infrastructural Development and Rehabilitation (Irrigation infrastructural Development), water resources development, water supply and sanitation, development of other ancillary infrastructure, promotion of rural growth centres;

(ii) Land Administration

(iii) Environmental management, Land degradation prevention, Catchment management, Pollution control, Fisheries management and Climate change mitigation and Adaptation);

(iv) Technology development and dissemination (research activities, crops development, livestock development, aquaculture development, irrigation agronomy, extension services)

(v) Institutional Development and Capacity Building

(vi) Agro-processing and market development (market linkages and infrastructure, agricultural financing, government investment window, agro processing

(vii) Monitoring and Evaluation.

The Agriculture Sector Wide Approach (ASWAp)

The ASWAp has been developed as a means of achieving agricultural growth and poverty reduction goals of the MGDS. ASWAp offers a strategy for supporting priority activities in the agricultural sector in order to increase agricultural productivity. The ASWAp envisages a single comprehensive programme and budget framework with a formalized process for better donor coordination and harmonisation of investment and alignment of funding arrangements between GoM and donors. The main focus areas for the ASWAp include Food security and risk management, Commercial agriculture, agro-processing and market development and Sustainable agricultural and water management. Like GBI, key support services include technology generation and dissemination and institutional strengthening and capacity building. HIV prevention and AIDS impact mitigation and gender equity and empowerment are the two main crosscutting issues. Sector wide approach requires strong national ownership and inbuilt capacity to drive processes in the entire value chain. If Malawi has to successfully implement ASWAp more needs to be done on capacity building especially when there will be no place for programme management units.

National Environmental Policy-2004

In line with agriculture, this policy seeks to promote environmentally sustainable agricultural development by ensuring sustainable crop and livestock production through ecologically appropriate production and management systems, and appropriate legal and institutional framework for sustainable environmental management. The National Environmental Policy is an umbrella environment policy which is presently coordinated by the Environmental Affairs Department. The need for a high level autonomous body to coordinate issues of environment cannot be overemphasized if environmental degradation is to be curbed.

Other policies or initiates with a bearing to agriculture and food security include the Nutrition Security Policy, National Irrigation Policy and Strategy, National Land Policy, Fisheries and Aquaculture Policy (2001), Strategic Plan to Improve Livestock Production (2003–2008), National Forest Policy (1996) and the Poverty Alleviation Policy Framework (1994) and the Gender and HIV and AIDS Policy.

National Land Policy

The policy sets out to provide a framework for land administration that will ensure tenure security and equitable access to land. It also aims at facilitating the attainment of broad based social and economic development through optimum and ecologically balanced use of land and land based resources (GOM, 2004). It has a number of specific objectives which include:

- Ensure secure tenure and equitable access to land without discrimination to all citizens of Malawi as stipulated under Article 28 of the Constitution, and encourage land based investments;
- Ensure accountability and transparency in the administration of land matters, and ensure that existing rights in land, especially customary rights of the smallholders, are recognized, clarified and ultimately secured by appropriate legislation;
- Instill order and discipline into land allocation and land market transactions to curb land encroachment, unapproved developments, land speculation and racketeering; and
- Establish enabling mechanisms to ensure equitable access to land for all Malawians that will be translated into statutory mandate to prevent extreme land concentration in a few hands, individuals and/or organizations.

Full implementation of the National Land Policy awaits the new Land Law which is still being discussed. However, it is clear that the implementation of the policy

requires capacity that is currently lacking at national and decentralized structures. The new policy puts the whole country as a planning area with registration of customary estates and decentralization of land administration as key components of planning. All these require trained personnel, institutional and governance structures that are yet to be developed. It is however envisaged that the new Land Law will seek to address all these bottlenecks and smoothen the implementation of the policy.

The Malawi Land Reform Programme Implementation Strategy (2003–2007) indicates that there were a number of projects being implemented and being planned. The ones under implementation included the Land Adjudication and Registration project that aimed to improve the land registries and produce registration maps and issue certificates to right holders, the Land Acquisitions and Distribution Project that acquired land for redistribution to the landless and the Land Policy Reform programme that led to the development of the national Land Policy and subsequent laws, regulations, procedures and programmes.

Following the development of the Land policy a number of projects were designed that included Strengthening the institutional and legal framework for Land Reform Programme implementation, Malawi Land Policy Awareness Project, the Community Based Rural Land Development Project (CBRLDP) and the Pilot Customary Rights and Registration Project. By 2007, only the Capacity Building project through the Natural Resources College, the Polytechnic and the University of Mzuzu and the CBRLDP were being implemented.

Projects and Programmes

The Community Based Rural Land Development Project

Considerable land pressure in Malawi as a result of combination of socio-economic factors- population growth; conversion of customary land into other land tenure categories, and poverty has led to inequality in accessing land and tenure insecurity.

The CBRLDP, financially supported through a grant (US$27million) from the World Bank is one of the initiatives by the Government of Malawi in implementing the Land Reform Programme. CBRLDP is a community-driven Project focusing on rural areas, where poverty is most pervasive, and seeks to free up underutilized land resources for agricultural production through market-assisted land redistribution approach in the following districts Mulanje, Thyolo, Machinga, Mangochi, Balaka and Ntcheu. The Project has been implemented since July 2004.

The project goal is to contribute towards poverty reduction as it supports activities of Sustainable Economic Growth of the Malawi Growth and Development Strategy (MGDS) as land is basic factor of production as well as source of livelihood for the majority of Malawians. The Project also supports activities towards attaining MDG goal one: Eradicate extreme poverty and hunger and goal Seven: Ensure environmental sustainability.

The project objective was to provide secure land to 15,000 food insecure, landless and/or land-poor households through grants (US$1,050/household) for land acquisition, settlement and farm development in six pilot districts.

This pilot project is deemed to be successful in that it has delivered 95% of the land planned to be redistributed and has benefited 14144 families out of 15000 planned representing 94% achievement (Table 6.4). About 22% of the beneficiaries are female headed households. This has not only benefited the land poor districts of Thyolo and Mulanje but with a number of families from the other districts being relocated within the districts. No estates in Mulanje and Thyolo were offered for sale under the willing seller willing buyer principle and as such no settlements took place in these districts.

The project was expected to close in 2009 but it has received a one year extension to consolidate most of the activities including resettling the remaining nearly 1000 families, building capacity for land administration and completing the registration process of the group land titles. As a pilot project lessons from this will be used to scale up the activities in other parts of the country. It should be noted that Malawi does not currently have a resettlement policy.

Resettlement led to deforestation in the settled areas. Post-settlement interventions such as tree planting were encouraged to minimize the damage this caused. Other lessons learned from this project include the importance of proper selection of resettlement land to avoid environmentally fragile areas and the need to provide post settlement support in terms of extension, marketing and other social infrastructure.

CBRLDP project has improved food security as shown in Table 6.2, where after resettlement households have been able to increase productivity of crops thus improving incomes.

Resource Conserving Technologies for Addressing Land Degradation

To address the problems of land degradation Malawi has been implementing resource conserving technologies such as; agroforestry, contour ridge alignment, contour vetiver hedge rows, organic manure making and other physical and biological technologies. In general these technologies fall under two broad categories: soil and water management and soil fertility enhancement

Table 6.4: Achievement of the CBRLDP 2004/5 to March 2010.

Performance Indicator		Year 1 2004/05	Year 2 2005/06	Year 3 2006/07	Year 4 2007/08	Year 5 2008/09	Year 6 2009/10	Total	Achievement (%)
Beneficiary household	Projected beneficiaries	1,050	3,000	4,950	4,050	1,950	0	15,000	
	Actual	0	455	4,067	3,700	4,434	1,488	14,144	94
Beneficiary groups	Projected BGs	32	90	149	122	59	0	452	
	Actual	0	17	178	163	193	64	615	136
Acquired land	Projected hectarage	2,310	6,600	10,890	8,910	4290	5,280	33,000	
	Actual hectares	0	1,086	9,060	8,108	9,744	3,257	31,255	95
Sub-projects	Projected number of sub-projects	32	90	149	122	59	0	452	
	Actual sub-projects	0	17	178	163	193	64	615	122
	Number received	0	64	185	361	268	64	942	
	Number approved	0	8	132	202	254	64	660	
	Number fully disbursed	0	0	17	178	163	193	551	89

Source: CBRLDP Management Unit, 2010.

technologies. Table 6.5 shows some of the technologies in use in Malawi.

The amount of land under these different technologies is not known but the Land Resources Conservation Department estimates that about 30% of cultivated land is conserved (Gawamazi, 2010, personal communication). Contour ridging is the most commonly promoted soil and water conservation practice although adoption is not very encouraging.

Despite years of promoting resource conserving technologies, cumulative achievement is difficult to quantify. First, the achievements of various players are not aggregated together with those of government. Reports from the District Agricultural Offices often do not include activities of other players such as NGOs. Visual evidence suggests that not much has been achieved.

In a study done in the late 90's on adoption of these technologies among smallholders, Evans *et. al.* (1999) concluded that:

- Around 5% of Malawian smallholders are engaged in good soil and water management of which one third are supported by donor funded projects;

Table 6.5: Examples of Resource Conserving Technologies Practiced in Malawi.

Soil and Water Management Technologies	Soil Fertility Enhancement Technologies
Contour ridging	Agroforestry
Box/tied- ridging	Organic and inorganic fertilizers
Raising of footpaths and garden boundaries	Liming
Contour stone lines	Residue incorporation
Contour vegetative hedgerows	Legume intercropping
Gully reclamation	Crop rotations
Stream bank protection	Improved fallows
Terracing	
Basin planting	
Storm drains	
Swales	
Rain-water harvesting	

Source: Adapted from Banda M. and Nanthambwe, 2010.

- The level of effective soil management extension coverage is low;
- Economic factors "shocked" farmers into looking for alternatives to inorganic fertilizers for maintaining soil fertility;
- Adoption of better soil management was catalyzed and supported by external assistance rather than being spontaneous;
- There are no socio-economic barriers to participation; and,
- When correctly applied, recommended soil conservation and soil improvement practices had striking and very rapid production benefits.

In the estate sub sector, there are no latest statistics on resource conserving technologies. As noted by Nyangulu (2002) there appears to be distinct differences between estates of different sizes. A considerably larger proportion of the 100 to 500 and greater than 500-hectare estates had measures (49% to 63%) compared to the small estates (33% to 41%). As expected, a greater proportion of large estates tend to use graded bunds, storm drains and vegetated waterways. The same appears to hold for windbreaks. The large estates' level of investment is high. The use of tractors enables them to deep plough. Apart from breaking the hard pan, this is a mode of water harvesting which enables rainwater to be captured and made available to crops. This is therefore bound to reduce running water.

Conservation Agriculture

Of late, the Ministry of Agriculture and Food Security has been promoting a system of agriculture that minimizes soil disturbance (minimum or zero tillage) and maximum cover through cover crops or mulch and some form of crop rotation. This is what has come to be termed conservation agriculture which is promoted through the National Task Force on Conservation Agriculture whose secretariat is the Department of Land Resources Conservation in the Ministry of Agriculture and Food Security.

Recently there has been a study to document conservation agriculture in Malawi which has revealed that there are a number of players who are promoting some form of conservation agriculture. There is no systematic and unified monitoring system to the effect that it is difficult to estimate hecterage under this practice (Mloza-Banda Nanthambwe, 2010).

In the year 2008/2009 LRCD reported 110% achievement rate on planned targets on conservation agriculture activities; this was twice what was achieved the previous season. This was as a result of the efforts made in up scaling the technology.

Area under conservation farming registered 18,471 hectares out of the target of 16,789 hectares and participation was 60,758 of the 73,336 farmers planned. For 2009/2010 area under conservation farming fell down to 16,028 ha and the participation was 37,594 farmers comprising 16,990 males and 20,604 females. For four consecutive seasons (2006 to 2010) the cumulative hectarage under conservation agriculture is reported as 102, 363 ha done by 270,598 farmers of which 151,376 were males and 119,222 females representing 44% female participation.

6.4 Conclusion and Recommendations

The importance of land and agriculture to Malawi's social, political and economic development, as well as sustainable resource management cannot be overemphasized. The limited amount of land available, economic dependency on agriculture and the need to meet the demands of ever increasing population make it imperative that land must be put to uses for which it is ecologically and economically most suited. This needs putting in place policies that guide ownership, secure tenure, promote investment and ensure sustainable long term use of this limited resource. The increasing cases of encroachments and land related disputes is a manifestation of the urgent need to implement the aspirations of the 2002 National Land Policy in totality and this requires building the requisite institutional and legal frameworks to support its implementation.

- From the issues addressed in this paper the following are some of the key messages and fields to generate data and information regularly to support the process. Information on land use and soils are particularly out of date and there is urgent need to institute studies to collect and update information on land;
- Malawi is dependent on agriculture which in turn depends on the soils. There is need to strengthen the soils research institutions to provide data for planning of interventions such as the Green Belt Initiative that require detailed soils data for irrigation is a high knowledge intensive intervention;
- The Input Subsidy programme has been a success in improving productivity of most crops especially maize. Farmers are able to access improved seed and fertilizers because the inputs are subsidized. While currently there is adequate political will to sustain this programme, there is need to seriously

look at an exit strategy for this intervention and build mechanisms for gradual withdrawal of subsidies;

- The fertilizer subsidy programme has lifted many Malawians from poverty and enabled the country to dramatically improve food security. However, long term plans for the programme must recognize that it is environmentally damaging and dependent on unsustainable donor funding. Extensive use of inorganic fertilizers depletes soil and leads to pollution of lakes and rivers. Eventually this could lead to decreased revenues from both agriculture and fisheries. In recognition of this, the programme must be integrated with more sustainable agricultural practices: training farmers in conservation tillage, composting, and intercropping. Proper natural resources will also increase the benefits of this valuable programme.
- Irrigation has the potential to increase crop production in this country; however despite years of promoting irrigation farming the uptake is only 22% of the total potential irrigable land. Green Belt Initiative is meant to fast track this adoption to increase the land under irrigation by one million hectares when the known potential for irrigation in the country is only 400,000 hectares. Detailed irrigation potential assessment for the various irrigation systems and proper Environmental Impact Assessment should be part of this initiative to avoid or mitigate negative environmental impacts;
- Implementation of agriculture and sustainable land management is constrained by a number of issues including limited resource allocation and human resource capacity constraint, yet these are the sectors that the economy depends on. There are high vacancy rates in most environment and land related departments in particular at field level. There is need to address these issues and also provide adequate training and adequate financial resources to utilise modern technologies for the improvement of land and agricultural productivity through sector wide approach that demands strong national ownership and drive;
- Rapid population increase poses a serious threat to the ability of the land resources to provide and produce goods and services at sustainable levels. This calls for a radical rethink of land as a production resource; there should be serious land use planning that will ensure the economic allocation and use of land. To this effect a National Land Use Planning Policy is required to regulate the development of land resources in the country;
- Land utilization studies should be carried out to update information on the levels of under utilization of land in both customary and private tenure systems with identifying idle land that can be acquired on willing seller willing buyer principle for those who have the resources to sustainably utilize it under similar arrangements as in the present Community Based Rural Land Development Project respecting the ecological limitations.

Photo Essay - Best Practices in Agriculture and Forestry

Sosten Chiotha

The photograph illustrates the difference that effective water and soil management can make to crop yields. The maize crop on the left-hand side is significantly more productive than on the right. In the short term, fertilizers can help improve crop yield. However in the long term a sustainable option could be conservation agriculture and intensive farming to maximize yield in limited land areas.

Sosten Chiotha

The photograph shows a forest plantation that mitigates the damages caused by earlier deforestation and resultant soil erosion. Intercropping has been used to stimulate biodiversity and provide extra revenue.

Welton Phalira

"Conservation agriculture is a concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment" (FAO 2007)

Shown here, crop residue is used to enrich the soil. Conservation agriculture could help improve food security while conserving environment and also help reduce rural urban migration when crop yields improve and are sustained.

Photo Essay - Cultivation on Marginal Lands

Sosten Chiotha

Cultivation of marginal lands (such as steep slopes and marshlands) began in rural areas with the clearing of wooded hills for agriculture.

Sosten Chiotha

This practice has led to significant soil erosion and degradation. The road (shown) underneath the cultivation site above was previously covered in soil. It is now bare, and cultivation has extended upto the kerb of the road.

Sosten Chiotha

Cultivation on marginal lands now extends to urban areas. The vegetative cover of the mountain on the left has been almost entirely removed by farmers desperate for land.

Photo Essay - Erosion Along River Banks

Sosten Chiotha

Erosion along river banks contributes to shortage in arable land. Shown above, steep slopes along river banks with crops cultivated to the edge of the slopes. Heavy rains causing rapid river flows continue eroding river banks which have few trees and natural vegetative cover.

Sosten Chiotha

Cultivation along river banks removes natural vegetative cover thus exposing soil to erosion. Buffer zones indicating distances for farms from river banks have not been followed, thus contributing to soil erosion leading to decrease in arable land.

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PART 2

State of the Environment

CHAPTER 7

Buffalo, Photo by African Parks (Majete)

BIODIVERSITY

Bird with Fish in Beak, Photo by Maggie Parsons

7.1 Introduction

7.1.1 The Concept of Biodiversity

The Convention on Biological Diversity (CBD) defines biodiversity as the variability among living organisms from all sources including, inter alia: terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems. This report will follow the CBD definition of biodiversity, which came to be widely used nationally after Malawi became party to the CBD in 1994. However, despite the term biodiversity being in use for over a decade, there is no local definition, and as a result biodiversity is perceived differently by different stakeholders.

To a local Malawian, biodiversity is viewed as natural resources (plants and animals) provided by nature as a source of livelihoods. Other stake-holders perceive natural resources as God given and, therefore, unlimited. This perception does not emphasize on conservation but rather on utilization and assumes that "God" will always provide alternatives when the desired products become scarce or extinct. Utilization of biodiversity or natural resources at the local level is also influenced by cultural dimensions. For example, owls are associated with witchcraft and as a result they are not hunted for food. Some forests, e.g. Khulubvi in Nsanje, have religious values as they are considered shrines in local religious beliefs and are thus protected.

Most policy documents appear to group biodiversity into four economic sectors; forestry, fisheries, wild life and agriculture. For example, the National Strategy for Sustainable Development (NSSD) (GoM, 2004) provided strategies for forestry, fisheries and wildlife under the biodiversity thematic area. This treatment of biodiversity is problematic since it does not take into consideration other components of biodiversity such as micro organisms. This means that these components are not given priority in terms of research and conservation. The National Biodiversity Strategy and Action Plan (NBSAP) attempted to correct the situation and discussed biodiversity following a thematic approach. This approach enabled discussion of all components of biodiversity (ecosystems, species and genetic) found in terrestrial, aquatic and agro ecosystems. Despite embracing a comprehensive approach, researchers and policy makers continue to view forestry, fisheries and wildlife as main sectors of biological resources.

Malawi occupies about 0.06% of the world land area and Lake Malawi is the world's nineth largest fresh water body. Despite the small area, Malawi has rich biodiversity and accounts for 4% of the world fish species. About 95% of Lake Malawi fish species are endemic to Malawi and ninety-five percent of these species are haplochromine cichlids, which are internationally recognized as an outstanding example of rapid speciation, with a potential to provide greater insights into the understanding of the evolutionary process. The contribution of Malawi's biodiversity to global biodiversity is, therefore, significant.

Interaction of biodiversity components in an environment results into a variety of ecosystem services (in form of clean air, water, food and shelter) which are of benefit to human kind. The benefit of ecosystem services to human kind in Malawi is adequately summarized in Figure 7.1. According to a number of studies the evaluation of biodiversity should go beyond numbers and include functional redundancy because removal or loss of one species upon which others critically depend is far more serious than one whose ecological niche can readily be replaced by other species.

Malawi's economy is dependent and based to a great extent on biological diversity such as sources of raw materials for agro-industrial development and exports. Despite this importance, biodiversity is threatened by a number of factors which have contributed to the current status of biodiversity loss. Studies on the status of biodiversity were undertaken during the preparation of the NBSAP and most of the results were presented in the 2002 SOER report used here as baseline.

7.2 Threats to Biodiversity

Future trends and status of biodiversity in Malawi will depend on the impact of pressures or threats on biodiversity. The NBSAP identified population pressure, invasive species, habitat loss and fragmentation and poverty as the major causes of biodiversity loss. However, pollution and climate change are considered emerging threats to biodiversity and the extent to which these affect biodiversity in Malawi will be highlighted

7.2.1 Habitat Loss, Fragmentation and Degradation

The conversion of natural ecosystems and habitats is one of the major causes of biodiversity loss. Habitat loss is mainly as a result of deforestation from agricultural expansion and increasing demand and use of biomass energy which continues to be the main source of energy for most Malawians.

Malawi's economy is agricultural and natural resource based with the majority of Malawians practicing subsistence farming characterised by small land holdings ranging from 0.5 and 1.5 hectares; continuous cultivation on the same land; and encroachment into marginal lands and protected areas. For instance,

Figure 7.1: Biodiversity and Human Well-being in Malawi.

around Mulanje Mountain the areas of agricultural encroachment were 81 ha internal and 50 ha on the boundary (Kayembe, 2008). At national level, encroachment of 20% of Forest reserves was estimated to cause damage approximately worth more than K2.47 Million with forests seriously affected being: Dwambazi, Thuma, Mchinji, Malosa, Namizimu, Bangwe, Kongwe and Perekezi (GoM, 2004a). Alternative land uses for urban development, infrastructure development and mining have also contributed to reduction or degradation of important habitats and ecosystems. A good example is the conversion of Kalwe Forest Reserve for the construction of the new Nkhata Bay District Hospital. Kalwe Forest Reserve is among the remaining rain forests in Malawi. Another example is the proposed sugar irrigation scheme and factory to be constructed within an ecologically sensitive wetland (Lifuwu Dambo) in lakeshore district of Central Malawi, Salima. Lifuwu wetland is an important habitat for migratory birds and also supports the livelihoods of surrounding communities in terms of fishing and agriculture (GoM, 2010).

7.2.2 Invasive Alien Species

Invasive alien species (IAS) are biological organisms that are introduced into an ecosystem from outside but usually cause environmental and economic harm through displacement of native species through competition, predation or transmission of pests and diseases. The NBSAP reported that there were 29 species of invasive alien species in Malawi comprising 17 plants, three fish and nine invertebrates. The number has now increased

to 31 with the discovery of black wattle and Eucalyptus bug. However, unpublished information from the National Herbarium and Botanic Gardens of Malawi (NHBGM) estimated the number of plant invasive alien species alone to be 29 (NHBG, 2010). This list is based on information from literature, but no studies have been done in Malawi to determine the extent of the invasiveness of the species. For example, guava (*Psidium guajava*) is listed as invasive because it has been reported invasive elsewhere. Of the 18 plant IAS, water hyacinth (*Eichhornia crassipes*) is the most widespread and the most harmful. It was discovered in southern Malawi during the late 1960s, and spread slowly northwards in the Lower Shire River. By 1995 it was found in the Upper Shire River, just south of Lake Malawi and is now present in most parts of Malawi, including the far north of the country (Phiri *et. al.,* 2001).

Due to rapid growth rates, water hyacinth covers water surfaces which reduces the amount of light thereby affecting rates of plankton growth. For pelagic fish species, water hyacinth might affect breeding patterns because of reduced visibility. Although, water hyacinth is a threat to aquatic biodiversity, it plays an important ecological function through succession for other aquatic plants and as a habitat for other species such as snakes, birds and tortoises.

The most undesirable impact of water hyacinth and other aquatic weeds has been on the economy through reduced capacity on hydro-electric power generation.

Lantana camara is also another IAS that is widespread in Malawi and has been reported to be threatening native vegetation in Majete Widlife Reserve. Mesquite (*Prosopis juliflora*) thrives in saline conditions and after being introduced as a live fence in agroforestry now colonizes a large area at Swang'oma in the Lake Chilwa basin (Chikuni *et. al.,* 2001; Munyenyembe and Sambo, 1998. Apart from displacing the indigenous vegetation at Swang'oma, mesquite is also a threat to the local people and livestock because it forms thick thorny bushes.

Sosten Chiotha

Floating islands of water hyacinth on the Shire River.

Invasive alien fish species recorded in Malawi such as the common carp and Nile tilapia have potential of overtaking the indigenous biodiversity through hybridizing with their relatives found in Malawi's aquatic ecosystems. However, these have so far not caused any damage to the unique fresh water fish since use of these species within the Lake Malawi basin is prohibited by the Fisheries Act.

About five (e.g. cypress aphids, giant pine aphids) invertebrate IAS have been recorded in the forests of Malawi. Of these, cypress aphid (*Cinara cupressivora*), first reported in Malawi in 1986 is considered to be the most destructive and by 1990 the aphid had killed exotic conifer trees with an estimated value of over USD40 million (Murphy, 1996). During the 1990s, FRIM introduced *Pauesia juniperorum* as a biological control agent against cypress aphids. Of late, the major activities of the project have been to monitor the impact and performance of the biological control agent in various parts of Malawi. The most recent studies have observed that *P. juniperorum* is capable of reducing the population of cypress aphids by up to about 30%. This is probably the reason why insignificant number of trees has been reported to have been killed by the aphids. If the current management regime continues, the aphids may be wiped out in Malawi by 2020. Similarly, the weevil (*Neochetina eichhorniae*) was introduced in lakes and rivers as a biological control agent for the water hyacinth (Heard and Winterton, 2000; Julien *et. al.,* 1999). The impact is still being assessed.

Other invasive alien invertebrate species including cassava mealy bug, cassava green mite, larger grain borer and spotted stalk borer have caused great losses in agriculture.

The larger grain borer (*Prostephanus truncatas*) was accidentally introduced in Malawi in the early 1990s through food aid and has been responsible for significant post harvest losses in maize. The Ministry of Agriculture and Food Security (MoAFS) has an integrated control programme which combines use of resistant varieties and pesticides. The cassava mealy bug (*Phenacoccus manihoti*) caused serious damage in cassava in the 1980s but the bug was almost wiped out in Malawi through the IAS management programme that focused on use of a diverse range of parasitoids and predators. However, recent media reports seem to suggest that cassava mealy bug has reappeared in the lakeshore

Box 7.1: Loss of Indigenous Knowledge and Impacts on Biodiversity Conservation: The Case of Lake Chilwa Fisheries

Lake Chilwa is a shallow saline inland lake located on latitudes 15°E and 15°30'NE and longitudes 35°30'NE and 36°E. It was designated as a RAM-SAR site in 1997 and is a wetland of national importance in Malawi since it supports a diverse range of fish species and is also destination for migratory waterfowl. Lake Chilwa fishery contributes more than 30% of Malawi's total fish catches.

Lake Chilwa used to be a traditional fishery using traditional methods of fishing. Fishing activities were controlled by traditional leaders, chiefs and elders (Njaya 2001; Njaya 2006). Chiefs and elders from Chisi Island and the surrounding communities used to perform rituals and make offerings to ancestral spirits on Chaone Hill adjacent to Chisi Island and were responsible for enforcement of customary laws governing traditional fisheries. Traditional way of fishing was observed by new settlers to the lake. For example, the coming of the Yao ethnic group (mostly traders) followed by the Lomwe ethnic group, meant that Lake Chilwa fishery became a multiethnically diverse and heterogeneous community. As a result of this there has been loss of traditional and local knowledge practices which were relevant to conservation and sustainable use of fisheries resources in the fishery such as: no fishing at night; no fishing in areas covered by sedge grass 'mlulu' because they act as fish refugee and breeding areas; no using of rowers because the lake is shallow; no fishing during the rainy season; no fishing in waters surrounding Chaone Hill; no fishing in open waters, 'kumpale'.

Currently, commercialisation and immigration of fishermen from other areas has destroyed these indigenous knowledge systems and the customary institutional structures that used to manage the fishery because people fish for economic purposes. Loss of such indigenous knowledge has contributed towards over-exploitation of fish; traditional exclusion zones that acted as fish refugee areas because they were regarded as sacred and protected areas e.g. Chaone Hill are no longer protected.

districts of Malawi. Original biological control agents of cassava mealy bug are still being maintained at Chitedze Research Station, hence there is likelihood that the outbreak will be contained before it spreads to other areas of the country.

Issues to be addressed in relation to IAS management include:

- Designation of a specific line authority mandated to coordinate IAS activities,
- Strong border control and quarantine activities with adequate human and infrastructure capacity,
- Adequate resources to quarantine invasive species,
- Sufficient public education and awareness on invasive species and their impacts,
- Adequate platform for collaborative and coordinated actions on invasive species both nationally and cross-border,
- Effective and up to date legislation and regulatory/ policy frameworks for addressing invasive species and their impacts,
- Sufficient information, research on control, eradication, prevention and management of invasive species.

7.2.3 Factors Contributing to Biodiversity Loss

Nearly 90% of the Malawi population is forced by their low economic base to depend on natural resources endowment for energy (fuelwood), food, construction material, medicine, and fodder. This overdependence on natural resources has contributed to local extermination of some widely used natural resources such as wild edible orchids.

Fish used to account for about 60–70% of the protein intake in the 1970s up to late the 1980s but recent estimates put the figure at 28%; Jamu and Chimatiro, 2005). The decline in dependency on fish for animal protein is due to high human population growth rate which puts increased pressure on the sector resulting in overfishing (CIA, 2010). Present per capita consumption of fish of between 4–7g/year is a big drop from mean 14kg/year registered in the 1970s (FAO, 2005). Thus loss of fish biodiversity will have a negative impact on the economy of Malawi and livelihoods of people that depend on fish for a living.

The cultural diversity of Malawi has played an important role in sustaining biodiversity throughout centuries. In most cultures, areas rich in biodiversity have been

designated as sacred or protected areas for a variety of reasons. For example, Chaone hill on Chisi Island and the surrounding waters were designated as sacred and fishing exclusion zones; Mbande Hill in Karonga District is a cultural reserve that is designated as sacred and protected area by the Ngonde people. In addition, graveyards all over Malawi are designated as sacred and protected areas where harvesting of forest and wildlife resources is prohibited. However, most of these conservation sensitive traditional practices, beliefs and customs are rapidly breaking down and disappearing together with the biodiversity that they may have helped to conserve. This loss of extensive traditional knowledge systems, practices and innovations is as a result of changes in the socio-economic environment and the impacts of such changes on biological and cultural diversity cannot be ignored.

A number of factors, e.g. inadequate enforcement of policy, inadequate pricing policy, HIV/AIDS and break down of cultural values contribute to overexploitation of natural resources in Malawi. In particular, current pricing policies do not consider biodiversity as an economic good or service, and this has resulted in inaccurate pricing of biological resources, leading to over harvesting. A good example is Malawian timber, which for decades has been the cheapest in the sub-Saharan region. This promoted uncontrolled and unsustainable harvesting of timber in Chikangawa pine plantation for export to neighbouring countries and beyond.

HIV/AIDS is also contributing to the over-utilization of biodiversity in Malawi. Approximately one million people are currently estimated to be living with HIV and AIDS in Malawi. This significant rate of infection has led to over-harvesting of traditional medicines to treat opportunistic infections associated with the disease. It has been reported that HIV/AIDS also leads to a loss of traditional knowledge (about, *inter alia*, resource management), loss of human capacity, and diversion of conservation funds to meet HIV/AIDS-related costs, thereby further undermining efforts in community-based natural resources management (Torrell *et. al.*, 2007).

Effluents from major factories and domestic and commercial sewages which are often discharged knowingly or unknowingly into the river systems make the water to be laden with oils and grease, phosphates, nitrates and plastics and other pollutants. A study carried out on levels of pollution in the city of Blantyre showed significant concentration of nitrates and sulphates upstream, on site and downstream of industries. The level of pollutants in the rainy season were lower (about 50 mg/l) than in the dry season (about 250 mg/l for nitrate and 100 mg/l for sulphates).

Agriculture is another sector which pollutes the terrestrial and aquatic ecosystems through use of fertilizers and herbicides which later leach into the soil but also find their way into water bodies through runoff. For example, data collected in 1996–98 showed that the rivers supplied 0.26 to 0.40 g P $m^{-2}y^{-1}$ and 2.0 to 4.5 g N $m^{-2}y^{-1}$ to the surface of Lake Malawi and this was accompanied by abundance of *Planktolyngbya tallingi*, an indicator of nutrient availability and poor light condition. *P. tallingi* replaced the previously dominant *Planktolyngbya nyassensis* in some parts of the southern tip of the lake. In addition, a nitrogen fixing blue-green algae which is often a climax species in highly eutrophic situations and has a toxic form was also reported.

Bush fires are a threat because they destroy habitats but also kill wildlife. For example, harmful bush fires have

Sosten Chiotha

Deepa Pullanikkatil

Left: Drying of Lake Chilwa; Right: recovery of Lake Chilwa.

been reported to have contributed to the reduction of Mulanje cedar stands on Mulanje Mountain.

7.2.4 Climate Change

Climate change is an emerging threat to biodiversity conservation due to the increasing frequency of floods and droughts, and the increased presence of alien species. It is projected that Malawi will experience an increase in temperature within the range of 1–3°C. This will result in reduced water levels in all major lakes of Malawi thereby threatening fish biodiversity. The total desiccation of Lake Chilwa in 1995 threatened the survival of fish species and fisheries. Fish breeding sites in Lake Chilwa were further affected during the 2001 drought. Loss of *Oreochromis shiranus* was so severe that the lake had to be restocked with Lake Malawi genotypes of *O. shiranus*.

Sosten Chiotha

Effects of drought on a garden in Chikwawa. Maize is susceptible, whilst cucumber is resistant.

The increase in temperature may also change species composition in Malawi, in favour of species that are better adapted to drier environmental conditions. For example, populations of Nyala (which are only found in Lengwe National Park) have been reported to be declining due to erratic rainfall patterns associated with climate change (as well as poaching). To correct the situation, the Department of National Parks and Wildlife (DNPW) has increased the distributional range of Nyala antelopes by reintroducing them in Majete Wildlife Reserve and Kuti Ranch in Salima.

Due to climate change, drier areas such as Chikwawa and Nsanje are projected to be drier and experience extreme rainfall shortages and reduction in forest cover. Changes in rainfall and temperature patterns may lead to extinction of less resilient organisms of economic importance such as soil micro organisms and pollinators. Finally, with increase in temperature some sensitive species will shift in their distribution range.

7.3 Trends in and Status of Malawi's Biodiversity

7.3.1 Introduction

This section is divided into terrestrial ecosystems, aquatic ecosystems and agro ecosystems. Aquatic ecosystems are further subdivided into riverine and lakes and small water bodies. Trends and status of species (plants and animals) will also be discussed.

7.3.2 Terrestrial Ecosystems

Several different methods of describing ecosystem-level biodiversity have been applied to Africa such as Eco-Floristic Zones (Sharma, 1988). These methods are based on the major vegetation type found growing in a particular area. According to White's classification, vegetation in Malawi is represented by three regional centres of endemism (White, 1970). First, the country lies entirely within the Zambezian regional centre of endemism characterized by different forms of woodland and thicket, within the altitudinal range of 500–2050 m. Secondly, most of the "forest" category is in the uplands and Afromontane elements are the most numerous constituents of the forest vegetation overall, forming the Afromontane Archipelago-like regional center of endemism.

The proportion of Afromontane endemic or near-endemic species increases with altitude within the range 500–2450 m. Local factors of mountain size and exposure play a role in determining altitudinal limits of various species. The evergreen bush-land/thicket and evergreen shrubland lie within the Afromontane region, mainly above 1500–1600 m, while grassland is most extensive on some of the high plateaux or in dambos at the lower levels. Thirdly, there are enclaves of lowland rain forest with an important proportion of the "Eastern" elements, forming the Eastern (Forest) regional mosaic, altitudinal range 500–1300 m. This classification, as modified by Dowsett–Lemaire *et. al.* (2001) is adopted in this report and is summarised in Table 7.1. These vegetation types are further grouped into two major terrestrial ecosystems; forests and grasslands.

Most vegetation types are found in National Parks and Wildlife Reserves, Forest Reserves, and protected hill slopes, and natural woodland on customary land. However, forests in Malawi are under severe threat of depletion. The total forest cover is estimated to be declining at the rate of 1.0 to 2.8% annually due to deforestation for fuel-wood, settlement and agricultural expansion. For example, Forest Resource Mapping and

Table 7.1: Vegetation Types of Malawi.

Vegetation Type	Defining Characters	Malawi Examples
Zambezian Woodland		
Zambezian Miombo Woodland	Dominated by species of Brachystegia alone or with Julbernardia and Isoberlinia	Occurs widely in forest reserves throughout the country, but used to be the main vegetation of plateau and its scarps
Zambezian Mopane Woodland	Dominated by *Colophospermum mopane*	Mua Tsanya FR, Vwaza marsh, Liwonde NP and Lower Majete WR
Zambezian Undifferentiated Woodland	Defined by the absence of miombo and mopane dominants but often dominated by *Acacia* and *Combretum* species	Used to be wide spread in Shire Valley, Phalombe, Lilongwe and drier lake shore plains, but much has been destroyed due to farming and settlements
Transition Woodland	They are intermediate between forests and woodlands, may be secondary or ecotonal	Small fragments are found in Nkhata Bay, Vinthukutu, Mulanje Mountain, and Nyika Plateau at upper limit of miombo, just before Afromontane
Deciduous Forests and Thickets	Characterised by canopy species which are deciduous for more than a month and understorey species deciduous for several month	Small patches of deciduous forests are found in Lengwe and Liwonde NPs; deciduous thickets are found in Lengwe and Liwonde NPs
Evergreen forest		
Riparian Forest	Characterised by species adapted to banks of river courses or influenced by flood (occurs at all altitudes)	Rivers in Nyika and Viphya Plateaux, Dzalanyama FR
Lowland Rain Forest	Characterised by the presence of only 0–25% of Afromontane species	Foothills around Thyolo and Mulanje Mountains, Malawi Hills (Nsanje), and Kalwe and Nkuwazi FRs
Mid altitude Rain Forest	Defined by flora containing a mixture of lowland and Afromontane elements and confined to lower slopes of high mountains	Mulanje Mountain foothills, Kaning'ina FR, Chipata Mountain
Afromontane Rain Forest	Essentially evergreen, though some emergents may lose their leaves for a week or two	Ntchisi Mountain, Misuku Hills, Mafinga Mountain, Nyika and Viphya Plateaux
Undifferentiated Afromontane Forests	They occur on high plateaux (2250–2450 m) and nearly all species are evergreen	
Hagenia abyssinica forest		Nyika National Park
Juniperous procera forest		Nyika National Park
Widdringtonia whytei forest		Mulanje Mountain
Afromontane Bamboo	Dominated by *Arundinaria alpine*	Dedza and Mulanje Mountains
Afromontane Evergreen Bushland and Thicket	Defined by the dominance of *Erica* species	Widespread and common on larger mountains (Dedza, Mulanje, Nyika)
Afromontane Shrubland	Characterised by stunted individuals of bushland and thicket	Nyika National Park, Mulanje Mountain
Afromontane Grassland	Mainly, secondary, fire-maintained grassland	Misuku Hills, Mulanje Mt, Nyika and Viphya Plateaux, Dedza Mt, Zomba-Malosa Mts.

Biomass Assessment of 1991 showed that in 1973, *Brachystegia* forests occupied 45% of total land area of Malawi (36.5% if Lake Malawi is included) while in 1990/91 land under forest cover was estimated to be 25.3% (20.5% if Lake Malawi is included). This indicates that land under *Brachystegia* forest reduced by 44% over a 19 year period. It was further estimated that reduction of *Brachystegia* forests in flat areas was nearly 62% mainly due to agricultural growth. These figures are based on 1993 Biomass Assessment study and in the absence of a recent comprehensive country wide forest assessment it can only be estimated that land under forest cover is less than the 1993 estimates.

Land under protected area has increased steadily from 1897 when Lake Chilwa and Elephant marsh game reserves were created. Available information shows that over 70% of land under Protected Areas network was already gazetted before independence in 1964. In 1998, Malawi had a total of 94 protected areas (comprising 85 Forest Reserves, five National Parks and four Wildlife Reserves) and occupied a total of 1,869,974 ha (Table 7.2). Data from Forestry Department shows that the number of forest reserves has increased to 88, giving a total of 97 protected areas and occupying a total of about 2,018,198 ha. This means that land under protected areas has increased by 148,224 ha (8%). Currently, about three forest reserves are proposed for protection and if approved by parliament this will bring the number of protected areas to about 100. In addition, there are over 240,000 ha of ungazetted land that is being considered for formal protection.

The primary reason for preserving forest reserves is catchment protection. In addition to this function, forest reserves also play a crucial role of biodiversity conservation, forest production, protection of water supply, erosion control, nutrient recycling, carbon capture and storage. Public Lands Utilization Study (PLUS) of 1998 reported that three forest reserves were originally created for conservation of biological diversity. Currently, fourteen forest reserves are valued for biodiversity conservation and presence of rare and unique species. In addition, all vegetation types appear to be represented in all protected areas of Malawi although the actual conservation status is not documented.

There has been no study to assess the protection level of each vegetation type in Malawi. Despite this, unpublished data from the Forestry Department indicates that there has been extensive encroachment into some forest reserves such as Thyolo, Ndirande, Kalwe, Zomba-Malosa such that the actual area under forest cover may be less than that reported in official documents. In addition, other reserves with valuable timber such as Mulanje cedar (*Widdringtonia whytei*) are prone to extensive exploitation.

Recent studies to assess the status and distribution of Mulanje Cedar reported a decline in area under cedar from 1462 ha in 1989 to 845.3 ha in 2004. This represents a 617 ha decrease within 15 years, implying that cedar was being cleared at the rate of 40 ha per year.

7.4 Aquatic Ecosystems

Aquatic ecosystems constitute about 22% of the total surface area of Malawi, mainly comprising the areas occupied by the four major lakes (Malawi, Malombe, Chilwa and Chiuta). There are three major types of aquatic ecosystems in Malawi: lakes and small water bodies (e.g. lagoons), rivers, and wetlands.

Table 7.2: Trends in Forest Cover.

Forest Type	1973	1991	Change	2000	2007
Evergreen forest (ha)	87,990	82,620	-5,370		
Brachystegia forest hilly (ha)	2,399,610	1,685,850	-713,760		
Brachystegia forest flat (ha)	1,913,300	733,110	-1,180,190		
Forest plantations (ha)	50,620	136,430	85,810		
Total Forests (ha)	4,451,520	2,638,010[i]	-1,813,510	2,562,000[ii] -76,010	3,336,000[iii] (36% land area is forest cover)

Source:

(i) Forest Department, Forest Resources Mapping and Biomass Assessment 1993

(ii) Earth Trends 2003

(iii) FAOSTAT 2010

Elton Laisi

Bwaghe River in Chilumba, Karonga (normally perennial).

David Nangoma

Widdringtonia whytei forest on Mulanje Mountain.

7.4.1 Rivers and Streams

Malawi has 17 major catchment basins which occupy a total area of 94, 276 km^2 and whose total storage is estimated to be 100 m^3. The Shire Basin with a total drainage area of 18, 945 km^2 is the largest, whilst Chizumulu Island, with an area of 3.3 km^2 is the smallest. Most of the rivers in these basins are perennial but could at times become ephemeral depending on how much rain has been received during the year and the state of catchment.

7.4.2 Lakes and Small Water Bodies

Lakes and small water bodies occupy approximately 30,121 km^2. Lake Malawi is the largest and occupies about 20% of Malawi's total area whilst Lake Kazuni in Vwaza marsh is the smallest. Lake Malawi stores the bulk of the renewable surface water resources and is home to a diversity of fish. Lake Malawi basin is extraordinarily rich in vertebrates considering the small area that it occupies. The number of vertebrate species is currently estimated to be 1,772 but the number could be as high as 2,000 species because there have been

limited studies and it is likely, therefore, that further studies on small mammals, amphibians, reptiles could detect new records for Malawi.

7.4.3 Wetlands

Wetlands are lands which are transitional between terrestrial and aquatic ecosystems. Their main characteristic is that they have a low water table or the land is periodically covered with shallow water. Wetlands perform many functions ranging from regulation of stream flows, purification of water, water storage and maintenance of biodiversity. Wetlands such as Lake Chilwa and Elephant marsh play an important role in biodiversity as a bird sanctuary and destination for migratory birds. Despite their importance, wetlands are threatened. Conservation status of marshes and swamps is presented in Table 7.3 which indicates that most wetlands have been modified by human activities.

Following the signing of the RAMSAR convention, Malawi developed a management plan for wetlands to protect these biodiversity hot spots. In addition, a management plan for the RAMSAR site, Lake Chilwa wetland was published in 1998 and this serves as a guide in implementation of activities. However, only a small proportion of Malawi's wetlands are protected whilst the rest are openly accessed and prone to overexploitation. Key to achieving sustainable management of wetlands is through community participation but this is constrained by lack of an enabling policy and Act to regulate sustainable use of wetlands.

7.5 Agricultural Ecosystems

The driving force of Malawi's agricultural sector and hence the economy is its agro-biodiversity (defined as the variability among living organisms associated with cultivated crops and domesticated animals and the ecological complexes of which they are a part). It comprises the diversity of varieties and breeds used for food, fodder, fuel and pharmaceuticals and species that support production such as soil microorganisms and pollinators.

7.5.1 Domesticated Crops

Malawians grow a wide variety of crops including cereals (maize, rice, sorghum), legumes (groundnuts, beans, pigeon peas, cowpea), roots and tubers

Table 7.3: Conservation Status of Major Marshes and Swamps of Malawi.

Ecosystem	Conservation Status	Conservation Status
Marshes of Ruwenya Hills	V	The area is sparsely populated and is not protected. Human activity is minimal.
Marshes of Chitipa	E	Not protected, currently threatened by shifting cultivation
Northern tributaries of South Rukuru River system	V	Part of the wetland is within Nyika NP. Bush fires and shifting cultivation are major threats to the wetlands
Vwaza Marsh	P/V	Approximately 100,000 ha of the marsh is protected in the Vwaza Marsh Game Reserve, including the whole of Luwewe River and its flood plains. The eastern corner of the marsh is, however, not protected and has been used for settlement.
Marshes of Kasungu Plain & the Bua River	E	The plain has been extensively deforested. The northern part of the plain (between Bua and Dwangwa Rivers) is reserved through Kasungu National Park whilst part of the lower course of Bua river is protected in Nkhotakota WR.
Lake Malawi marshes	P/V	Marshes associated with lake Malawi are not protected
Lake Chilwa wetland	E	Not protected but in 1997 it was designated a RAMSAR site. Lake Chilwa biodiversity is threatened by cultivation, invasive species and over fishing. There are plans to designate sections of the wetland community conservation areas.
Shire Marshes (Elephant marsh, Ndindi marshes)	V	The entire wetland system is not protected and is threatened by cultivation and waterweeds like water hyacinth, *Eichhornia crassipes, Salvinia molesta* and *Azolla nilotica.*

Source: Ecosystems of Malawi; issues paper prepared for the NBSAP process.

Legend (Adapted from South African Biodiversity Act)

Critically Endangered Ecosystems (CE) - ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation.

Endangered ecosystems (E) - ecosystems that have undergone degradation of ecological structure, but are not critically endangered.

Vulnerable Ecosystems (V) - ecosystems that have high risk of undergoing significant degradation as a result of human intervention.

Protected Ecosystems (P) - ecosystems that are of high conservation value or of high national importance although they are not within the protected areas network.

(cassava, sweet potato and potato), horticultural (bananas, guava, oranges, tangerine, lemons), vegetables (cabbage, tomatoes, carrots, onions) as well as cash crops (tea, tobacco, cotton and sugarcane). Sorghum (*Sorghum bicolor*) and millets (*Pennisetum spp.* and *Eleusine coracana*) are indigenous cereals that were gradually replaced by the introduction of maize (*Zea mays*). Current agricultural policies favour maize production because it is the main staple food. There are efforts to promote production of the indigenous cereals because they are drought resistant. The local flint maize varieties have hybridized with new hybrids that have been released over the years hence what is termed local varieties nowadays are generally recycled hybrids.

Beans (*Phaseolus vulgaris*) have high genetic diversity and the popular varieties include red kidney, white, speckled/variegated etc. The Bean/Cowpea project has promoted bean multiplication and conservation among smallholder farmers. Bambara groundnut (*Voandzeia subterannea*) contributes more biologically fixed nitrogen than groundnuts and has received considerable attention when it comes to ex-situ conservation in Malawi.

The Malawi Plant Genetic Resources Centre is mandated with germplasm conservation activities in the country. As of 2004, the genebank had 2514 accessions from 56 species including 2074 seed samples and 440 vegetative materials from all regions in Malawi. Species in storage include cereals (*Z. mays, Oryza sativa*), legumes (*Phaseolus vulgaris, Pisum sativa*), root and tuber crops, vegetables and vegetative material (*Musa sp., Manihot esculenta, Plectranthus esculenta*).

Crop biodiversity faces losses from genetic bottle-neck through natural disasters such as droughts and floods which might wipe out entire yields thereby preventing people from saving stock of certain genotypes. Another threat is from genetically modified varieties which might dilute the local genotypes. Current legislation only permits cultivation of GM crops in Malawi after rigorous contained field trials. No institutions have been given a permit to undertake field trials of GMOs in Malawi

although Bunda College applied to conduct contained field trials of GM cotton at Bunda College.

7.5.2 Domesticated Animals

Malawi's animal genetic resources comprise ruminant livestock, mammalian monogastrics, and poultry. Majority of the livestock (95%) are of the indigenous type which have low fertility and growth performance, low milk yield (1 litre/day for cattle) and early ages at maturity resulting into smaller mature body sizes. These species are at risk of genetic erosion due to indiscriminate cross-breeding programmes, stock thefts and diseases. There are also smaller populations of exotic breeds and their crosses, which are mainly on large/commercial farms.

The indigenous Malawi Zebu (MZ) cattle account for more that 90% of all cattle found in Malawi. Declining trends in milk and beef production necessitated the importation of exotic breeds for crossing with indigenous Malawi Zebu. There has been crossbreeding of Holstein/Friesian bulls with indigenous Malawi Zebu cows to improve milk production and Brahman/Sussex/Africander/Charolais bulls with Malawi Zebu cows to improve beef production. The programme resulted in improved birth weight, weaning and mature weights. Records from Mbawa Research Station showed that the birth weights of Malawi Zebu bull calves declined from 27kg in 1988 to 15kg in 1997 whilst that of heifer calves declined from 26kg to 14kg over the same period. This declining trend probably indicated that there was a lot of in-breeding within the herd thereby making Malawi Zebu vulnerable (Chikagwa-Malunga, 2001).

Among domesticated small livestock, goats (*Capra hircus*) are the most popular and there are four main genotypes in Malawi. The indigenous local goats are abundant whilst the Boer goat (introduced from South Africa), the Boer crosses and the Saanen (introduced for milk production) are less abundant and rare. Sheep (*Ovis aries*) are present in three genotypes in Malawi, the indigenous (local) types, the Dorper (an introduced breed from South Africa for mutton) and the Dorper crosses. The local sheep are highly abundant, the Dorper crosses being less abundant and the Dorper breed is extremely less abundant (Chikagwa-Malunga, 2001). The types of poultry that are raised include chickens, pigeons, ducks and guinea fowl. Data from MoAFS shows an increasing trend for chickens, guinea fowl and ducks but low numbers for turkeys.

7.5.3 Status of Species

Microorganisms

The term microorganisms encompasses viruses, bacteria, fungi, algae and protoctists. About 700 species of microorganisms have so far been identified in Malawi and the actual number of species is likely to be much greater than this. The low percentage of identified microorganisms in Malawi is partly because of the absence of trained systematists, most of the identifications having been done during the colonial days.

Table 7.4 indicates that 89 viruses were recorded in Malawi. Of these 42 are reported from agricultural crops (largely polyviruses) and 30 (Paramyxoviruses and Poxviruses) on various livestock. Like viruses, only bacteria that cause diseases in crops, livestock and humans have been recorded. Approximately 60 species of bacteria belonging to 20 genera have been recorded in Malawi. A survey of fungi of Malawi identified about 500 species of fungi representing about 0.7% of the known global total. Most of the reported species are associated with major economic crops such as maize, rice, groundnuts, tobacco and coffee. Of the 500 species, about 53 species are edible mushrooms which are commonly found in miombo woodlands (Table 7.4).

Table 7.4: Described and Estimated Species of Microorganisms in the World Compared with the Number of Species Described in Malawi.

Group	Described Species	Estimated Species	Malawi Species	Percent of Described Species
Viruses	5,000	500,000	89	1.78
Bacteria	4,000	3,000,000	60	1.50
Protoctists	40,000	100,000	23	0.06
Algae*	40,000	350,000	66	0.17
Fungi excluding macro-fungi	70,000	1,500,000	500	0.71
Totals	159,000	5,450,000	738	0.46

*Algae, although listed separately, are now considered part of the kingdom Protoctista.
Source: Groombridge (1992).

Invertebrates

The number of invertebrate species in Malawi is not known. Table 7.5 gives an indication on how this diversity is apportioned among the various phyla and classes. More than 8,770 invertebrate species have been documented for Malawi through collection and literature records, with insects dominating. This represents an increase from 8,621 species as reported in the SOER of 2002. Looking at the expected country proportions it is apparent that our basic knowledge of the various taxa is uneven. For example, nematodes, crustacea and insects are better known than expected while earthworms, myriapods, and arachnids are more poorly represented.

Vertebrates

There have been no studies to update Malawian records on amphibians, reptiles and birds. Thus, figures reported in the latest edition of the SOER are still valid. All amphibians are associated with aquatic ecosystems (e.g. Lake Chilwa, Elephant Marsh, Vwaza Marsh, Ndindi Marsh and flood-plains of the Shire River) which are under threat due to cultivation and pollution. About 11 amphibian species are listed on IUCN Red Data list (Table 7.6). Twelve reptile species are endemic to Malawi. In addition to the endemic reptiles, the following species/sub-species are considered to be rare in Malawi: *Rhampholeon brachyurus* and *Sepsina tetradactyla* (from Shire highlands); *Geochelone pardulis babcocki; Naja melanoleuca; Psammophis angolensis;* and *Proatheris superciliaris* (from Lower Shire valley and Lake Malawi shoreline).

Table 7.5: Observed and Expected Numbers of Species of Invertebrates of Malawi.*

Phyla/Class	World[1]	Malawi Observed	Expected[2]	%[3]
Porifera	250	2	2	0
Cnidaria	100	3	1	+200
Platyhelminthes	7,500	35	62	-44
Acanthocephala	750	1	6	-63
Nematoda	13,000	173	107	+62
Rotifera	2,000	13	17	-24
Nematomorpha	230	2	2	0
Annelida	6,200	7	51	-86
Mollusca	25,000	183	206	-11
Tardigrada	531	2	4	-50
Pentastomida	60	13	<1	+>1,200
Chelicerata (Arachnida)	73,470	332	606	-45
Mandibulata (Uniramia)	917,700	7,850	7,572	+4
Myriapoda	12,500	36	103	-65
Insecta	905,200	7,814	7,469	+5
Crustacea	18,000	170	149	+14
Invertebrates	1,064,791	8,786		

*Source: Table Modified from Dudley (1997).

[1]Values extracted from Minelli (1993) but modified so as to include only species from terrestrial and fresh water habitats. The largest taxa have been rounded off to the nearest number for the 1000 species whilst the smaller taxa (with a few exceptions) have been rounded to the nearest 100. Taxa known not to be present in Malawi (i.e. Pabigradi, Megaloptera, Rhephidioptera, Grylloblattodea) are also not included.

[2]Based on the proportions of the world freshwater and terrestrial fauna.

[3]Short-fall or excess of the observed as a percentage of the expected number.

Amongst the better-studied taxa, the molluscs contain 47 endemic species from a total of 183 species. Eight species are listed by IUCN as either Vulnerable (*Bulinus nyassanus*, Planorbidae); or Endangered (e.g. *Bulinus succinoides, Lanistes nasutus, L. nyassanus, L. solidus;* and *Bellamya ecclesia*).

A checklist of birds has not been reviewed recently implying that the number of birds recorded in Malawi

Table 7.6: Threatened Amphibian Species of Malawi.

Scientific Name	English Name	Degree of Threat	Endemicity	Current Localities
Arthroleptis francei	France's Squeker	EN	Endemic	Mulanje
Arthroleptis reichei	Eiche's squeaker	NT		Misuku hills
Mertensophryne nyikae	Nyika dwarf toad	VU		Nyika plateau
Hyperolius pictus	Variable reed frog	LC		Nyika plateau
Hyperolius spinigularis	Spiny throated reed frog	LC		Mulanje mountain
Phrybobatrachus stewartae	Stewart's puddle frog	DD		
Phrynobatrachus ukingensis	Ukinga puddle frog	DD		Misuku, Rumphi, Zomba
Amietia johnstoni	Johnston's river frog	EN	Endemic	Mulanje mountain
Nothophryne broadleyi	Mongrel frog	EN		Mulanje mountain
Scolecomorphus kirkii	Kirk's caecilian	LC		Southern Malawi
Ptychadena broadleyi	Broadley's ridged frog	EN	Endemic	Mulanje mountain, Zomba plateau

Key: EN (endangered), NT (near threatened), VU (vulnerable), LC (least concerned), DD (data deficient)
Source: IUCN (2010).

remains 648 species. Over a third of these are considered to be uncommon or rare and of long-term conservation concern. Since there have been no studies to assess the conservation status of birds of Malawi, only nine species continue to be listed on the IUCN Red Data List (of 2010). However, many of the biome-restricted species found in Malawi may be considered to be under conservation threat since their distribution in now restricted to a small number of sites. Those species whose main distribution lies outside of existing large protected areas may be especially vulnerable to local extinction in the short to medium term.

Sosten Chiotha

A herd of cattle, part of Malawi's agroviodiversity.

Mammals

There are about 192 recorded mammal species, 125 of which are small mammals. This is an increase from 187 mammals as reported in the latest edition of SOER and NBSAP. This increase is due to five new records comprising bats and small mammals. Most large mammals e.g. elephants (*Loxodonta africana*) only occur in the national parks and wildlife reserves.

However, smaller mammals e.g. bats and rodents may be found even outside protected areas as long as patches of natural and semi-natural habitat remain as part of the landscape mosaic. For example, Happold (2001) report that a small area (115 ha cultivated, 165 ha uncultivated) in the Shire Highlands of southern Malawi supported 22 species of bats and ten species of rodents and shrews. Several of these species were of restricted range and this farm is considered to be an important contribution to conserving and maintaining the diversity of small mammals in Malawi. Conservation and management of patches of semi-natural habitats are, therefore, an essential part of an overall biodiversity programme for Malawi.

Hippopotamus and otters are probably the only mammals that have a true affinity for aquatic habitats. The hippopotamus populations show a declining trend due to habitat loss and conflict with human activities. Substantial hippopotamus populations are protected within Liwonde National Park, Kasungu National Park and Vwaza Wildlife Reserve. Two species of otters are recorded in Malawi, the Cape clawless (*Aonyx capensis*) and the spotted necked (*Lutra maculocollis*).

Table 7.7: Threatened Mammal Species of Malawi.

Scientific Name	English Name	Degree of Threat (IUCN)	Current Localities
Diceros bicornis	Black rhino	CR	Liwonde NP, Majete WR
Hippopotamus amphibius	Hippopotamus	VU	Elephant Marsh (lower Shire River), the south-west arm of Lake Malawi, Upper Shire River and Lake Malombe in Liwonde National Park.
Loxodonta africana	African elephant	VU	Nyika NP, Thuma FR, Namizimu FR, Kasungu NP, Vwaza, Liwonde, Nkhotakota
Lycon pictus	African wild dog	EN	Vwaza, Kasungu, Nkhota Kota, Mwavi
Rhynchocyon cirnei	Checkered elephant shrew	NT	Widespread in forests
Panthera leo	Lion	VU	Liwonde, Kasungu, Vwaza, NkhotaKota
Paraxerus palliates	Red squirrel	LC	Mulanje, Liwonde, Viphya, Ntchisi, Lower Shire
Lutra amculicollis	Spotted necked otter	LC	Shire river, L. Chilwa, Nkhotakota,

Key: CR (Critically endangered); EN (endangered); NT (Near threatened); VU (Vulnerable); LC (least concerned).

Source: IUCN 2010.

Eight mammal species are under threat as per IUCN list of threatened species (Table 7.7). Among the large mammals, the black rhinoceros is critically endangered.

Black rhinos were locally extinct but these were reintroduced in Liwonde National Park and Majete Wildlife Reserve. Currently, there are 22 rhinos in Malawi (11 in Liwonde and 11 in Majete). According to IUCN (2010) cheetah (*Acinonyx jubatus*) which used to be in Kasungu and Nyika National Parks are known to have been extirpated in Malawi. Possible causes of their extirpation include loss of habitat, conflict with farmers and poaching. There are plans to reintroduce cheetah in Majete Wildlife Reserve by 2012. Compared against 2002 data, it is evident that the number of animals in protected areas has changed significantly.

Table 7.8: Wildlife trends in Vwaza Wildlife Reserve.

Species	2005	2008	Trend (%)
Roan	827	611	-26
Eland	952	1198	+26
Zebra	476	300	-37
Reed buck	964	1120	+16
K/Springer	62	44	-29
Common duiker	187	171	-9
Bushbuck	138	93	-33
Bush pig	38	41	+8
Warthog	175	192	+10

Source: DPNW.

Population trends in Nyika National Park show a general decline. The decline of roan antelope and zebra is of much concern as the two are key species for tourist attraction in the park. A general decline has also been observed in Vwaza Wildlife Reserve with zebra as the most affected (Table 7.8). Elephants are the only animals that increased in number between 1985 and 2007.

Although this is case, the information does not present the true picture since populations found in Forest Reserves (e.g. Thuma Forest Reserve and Namizimu Forest Reserve) are not included. Although mammals found in Forest Reserve and customary land are easy targets for poachers some forest reserves such as Mulanje Mountain Forest Reserve have high biological diversity (Box 7.2).

Plants

Information from the National Herbarium and Botanic Gardens indicated that Malawi has about 5500 to 6000 species of flowering plants. This estimate is based on herbarium specimens. However, considering that a number of taxa represented in Malawi have undergone taxonomic revisions (which might have recommended reduction of some names to synonyms, or described new species), it may be argued that the exact number of flowering plants is not known.

Similarly, the knowledge about non flowering plants (Bryophytes and Pteridophytes) is limited and there have been no new studies to update the available information. However, it has been estimated that the number of Bryophytes could be 250 species, 200 of which are mosses.

Box. 7.2: Ecotourism, lessons from Majete Wildlife Reserve

Majete Wildlife Reserve (MWR) has an area of 70,000 ha. It is situated in southern Malawi, Chikhwawa District. Majete was gazetted a wildlife reserve in 1960s and has been under the management of the DNPW until 2003 when African Parks signed a Public Private Partnership to manage the reserve under a concession for a period of 25 years. Due to inadequate funding and inadequate law enforcement most large mammal species e.g. elephants, black rhinoceros, lions, buffalos, eland, zebra, sable antelope were subjected to heavy poaching and were completely eliminated by the early 1993.

African Parks (Majete) Ltd (APM) became the first Private Company to be given a management concession of a Protected Area in Malawi. Under six years, significant achievements have been registered in the restocking programmes, infrastructural developments and socio-economic developments.

About 3000 animals and 11 species have been translocated from Liwonde/Lengwe National Parks, and others purchased from South Africa or Zambia. Majete now has three of the "Big five". There are 215 elephants, 11 black rhino and over 300 buffalos that have been re-introduced in Majete. Future plans include restocking Majete Wildlife Reserve with the predators such as lions, leopards and cheetahs by 2012.

Species	Elephant	Buffalo	Sable	Water-buck	Warthog	Nyala	Impala	Zebra	Black Rhino
Status in 2003	0	0	0	0	0	0	0	0	0
Status in 2010	215	306	255	295	158	58	428	177	11

Out of the documented plant species, 261 are considered threatened, vulnerable, rare or endangered. Despite the high number of threatened species only eleven plant species have legal protection. However, studies conducted in recent years have shown that a large number of plant species are vulnerable since their populations are declining due to over exploitation and habitat degradation.

Fish

Lake Malawi, a UNESCO World Heritage for fresh-water diversity of the world, has more fish species than any other lake in the world. The total number of fish species found in Malawi is estimated to be in excess of 1,000 species (Turner, 1995). Over 800 fish species have been described in Lake Malawi alone, 95% being haplochromine cichlids, and 99% of which are endemic to Lake Malawi. Due to this fascinating high biodiversity, Lake Malawi fish are the most studied for behaviour and evolutionary patterns. The Malawi Government considers Lake Malawi biodiversity as one of the major resources needing deliberate intervention to conserve.

Lake Malawi National Park, the world's only underwater national park has a 100-metre zone of gazetted areas closed to fishing to protect the brightly coloured mbuna fish, the rock dwelling cichlids.

State of Fish Stocks in Lake Malawi

Traditional artisanal fishermen who use beach, seine and gill nets account for about 85–90% of the annual catch in the major water bodies in the country. These fishermen are a threat to fish biodiversity because they

Kenneth McKaye

Representative rock dwelling mbuna fish.

mostly exploit inshore fisheries resources due to lack of off shore fishing gears. The chambo/kasawala fishery is the most popular with consumers and as a result has been heavily exploited over the years and its stocks have generally been in the decline. Between 2000 and 2009, commercial Chambo landings were 123.201 metric tonnes per year whereas utaka stock landings have been averaging 1043.82 metric tonnes per year.

The three genera *Clarias* (mlamba), *Bathyclarias* (bombe) and *Bagrus* (kampango) contributed 3.43% to total commercial landings and 4% of the total traditional landings between 2000 and 2009. This is much lower than what was reported in the 1998 SOER suggesting that stocks have decreased by 20% between 2000 and 2009.

State of Fish Stocks in Lake Malombe

The mean total landings for Lake Malombe (2000–2007) was 5,202 tonnes per year which is lower than 8,000 tonnes per year reported in the late 90's. Fish landings between 2000 and 2006 indicate that Lake Malombe fishery was dominated by kambuzi fishery but there was a sharp decline in 2007 whilst the chambo fishery showed an increase (Figure 7.2).

Chambo used to be the main fishery in 1970s increasing to a level of more than 6000 tonnes in 1980. The general decline of the Chambo fishery in Lake Malombe led to over-harvesting of a group of small tilapia locally known as kambuzi (a collective name describing a group of related fishes called Haplochromines). As a result, landings of kambuzi declined to 100 metric tones in the early 1990s.

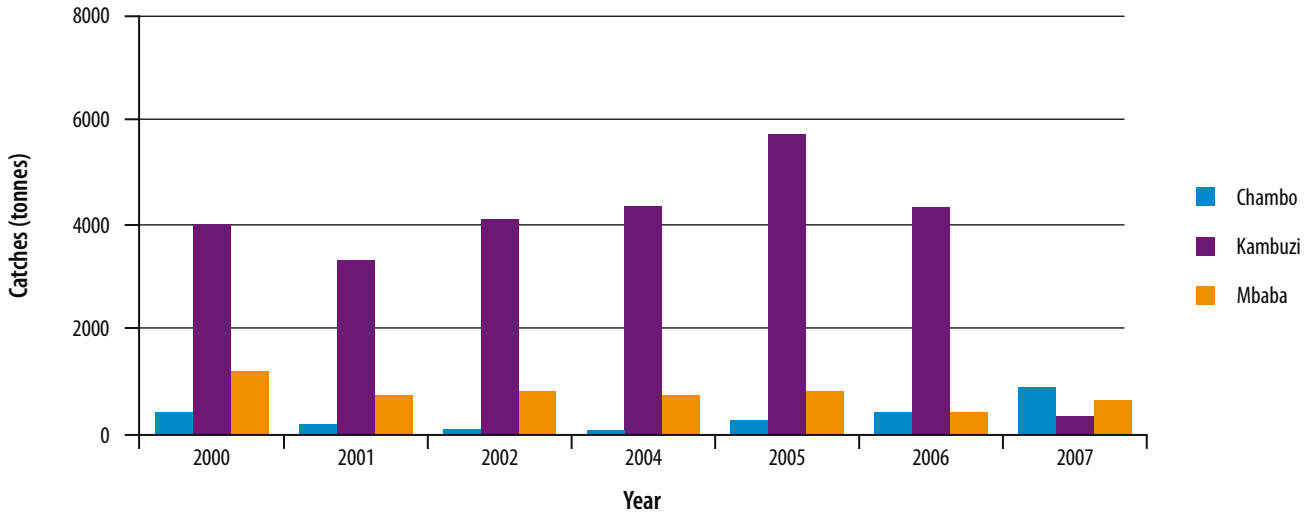
Likangala, Phalombe and Sombani on the Malawian side, and Mnembo river on the Mozambican side.

Delaney *et. al.* (2006) reported that Mnembo river is less adversely influenced by human populations compared to Likangala and Domasi and has high abundance of *Barbus spp.* and a strong presence of riverine species such as *Labeo, Pareutropius* and *Brycinus*. Lake Chilwa fishery is dominated by *Barbus spp.* (matemba), *Oreochromis shiranus shiranus* (makumba) and *Clarias gariepinus* (mlamba) (Figure 7.3).

State of Fish Stocks in Lake Chiuta

Fish catches in Lake Chiuta are dominated by similar species as those found in Lake Chilwa. Between 2000 and 2009, the fishery has been dominated by Makumba

Figure 7.2: Lake Malombe Fish Catches for Chambo, Kambuzi and Mbaba (2000–2007).



Source: Department of Fisheries, Unpublished.

State of Fish Stocks in Lake Chilwa

Lake Chilwa is endorheic and is one of the most productive lakes in Africa for fish. In the 1970s Lake Chilwa contributed on average 24% of the total annual fish production in Malawi (Furse *et. al.*, 1979). This reduced to 20% in the 1990s and data from 2000–2009 indicate that Lake Chilwa now contributes 10.54% of the country's fishery. The mean total landings for Lake Chilwa for the same period are at 7,537.093 metric tonnes per year, lower than the peak of 12,000 tonnes per year in the '90s (EAD, 1998).

Of the twenty-eight fish species recorded in the Lake Chilwa basin, only thirteen have been found in the lake itself. Several species including *Labeo cylindricus* and *Tilapia rendalli* inhabit inflowing rivers and only enter the lake in wet season when the salinity of the waters is reduced. The lake has five major influent rivers: Domasi,

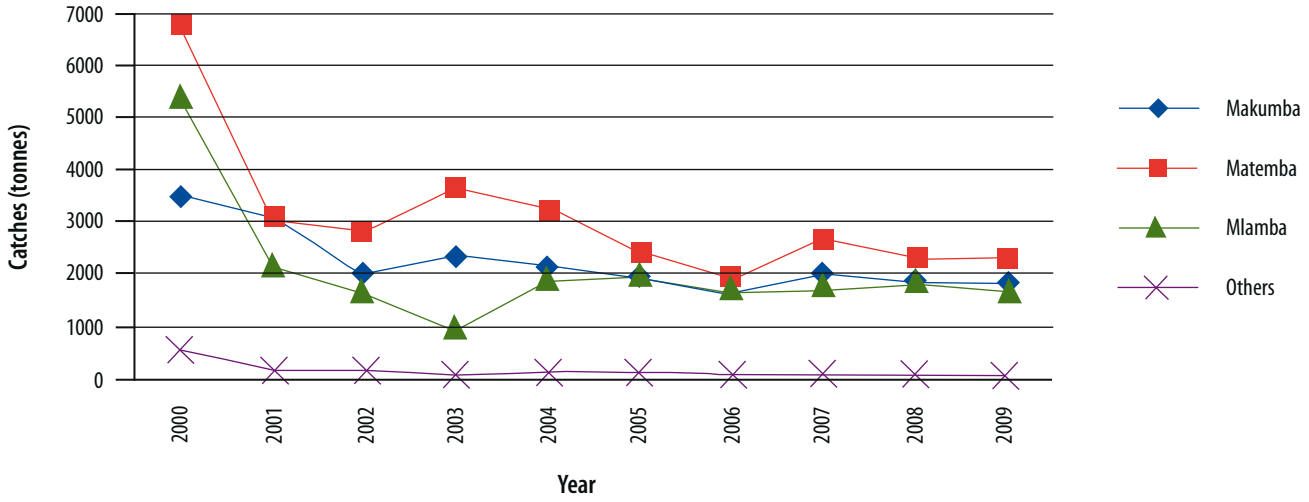
while Matemba registered the lowest landings. The fishery has been declining from a peak of 3,000–6,000 metric tonnes in 2000 to around 2,000 tonnes in 2009.

State of Riverine Fish Stocks

Major rivers of the country such as North and South Rukuru, Songwe, Bua, Dwangwa and Linthipe have important fisheries whose data is not consistently recorded except for lower Shire. The lower Shire has a record of 61 species but only three species *C. gariepinus* (mlamba), *O. mossambicus, O. placidus* (makumba) and *Bargus spp.* (matemba) have large biomass and economic importance.

The fishery of the rivers is mainly made up of cyprinids (mpasa, kadyakolo, sanjika) and catfishes which usually migrate from Lake Malawi into its tributaries

Figure 7.3: Lake Chilwa Fish Species Catches (2000–2009).



Source: Department of Fisheries, Unpublished.

during spawning season which coincides with the rainy season. A preliminary fish biodiversity survey in 14 rivers in central and southern Malawi by Likongwe (2005) recorded a total of 199 fish taxa belonging to 13 families (Table 7.9). The dominant family was Cyprinidae (35.68%) followed by Cichlidae (23.12%). Upper Shire and lower Ruo registered the highest number of species (39) whilst lower Diamphwe had the least number of fish species (10).

Table 7.9: Frequency (No.) of Fish Families Observed Across the 14 Rivers[1] in Malawi.

Fish Family	Freq of Fishes	%	Rank
Characidae	2	1.01	9
Cyprinidae	71	35.68	1
Mormyridae	20	10.01	3
Clariidae	18	9.05	4
Schilbeidae	2	1.01	9
Mochokidae	16	8.04	5
Distichodontidae	4	2.01	8
Cichlidae	46	23.12	2
Protopteridae	2	1.01	9
Malapteruridae	2	1.01	9
Anguillidae	8	4.02	6
Amphiliidae	6	3.02	7
Anabantidae	2	1.01	9
Total	199	100.0	

Source: Likongwe (2005).

[1]The rivers under study were lower Dwangwa, lower Bua, lower Lingadzi, lower Linthipe, lower Lilongwe, lower Diamphwe, Upper Shire, Muloza, lower Ruo, Lichenya river, Likhubula, Thuchira, Lisungwi and Mkulumadzi.

Malawi's Response to the General Decline in Fish Production

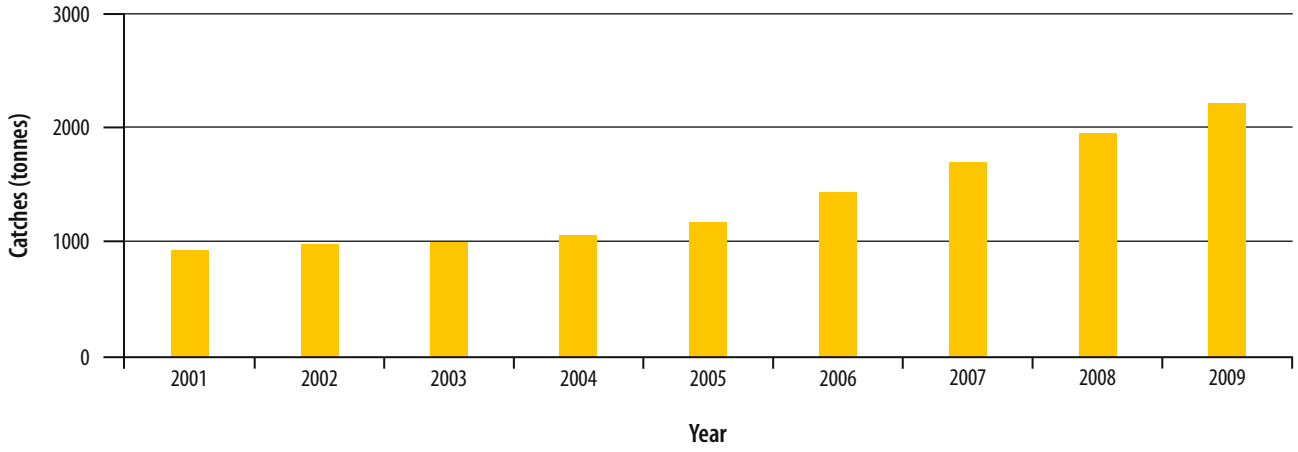
Aquaculture, through pond and cage culture contributes an estimated 1500 tonnes of fish yearly. The potential for pond aquaculture is vast with potential areas spanning 14,200 km^2 (10–25% total land area) while cage culture can be established in virtually all water bodies covering about 24,000 km^2 (Department of Fisheries, Unpublished Data). Aquaculture production accounts for about 2% of the nation's total fish production and the sector is growing. Between 1980 and 2001, fish production from aquaculture increased by 7.36%. The introduction of the Presidential Initiative on Aquaculture Development in Malawi (PIAD) also gave a big boost to the aquaculture sector hence the increase from 2006 (Figure 7.4).

Cage culture is a recent development in the aquaculture sector driven by declining capture fisheries. In 2004, Malawi Development Corporation (MALDECO) in Mangochi and GK Aquafarms in the Lower Shire initiated large-scale commercial fish farms (Russell *et. al.*, 2008). MALDECO aquaculture has invested in the cage culture of chambo (*Oreochromis spp.*), while GK Aquafarms produces *O. mossambicus* and common carp (*Cyprinus carpio*). MALDECO targets to produce 3,000 tonnes of chambo in order to supplement declining capture chambo fisheries from Lake Malawi and other lakes (Windmar *et. al.*, 2008). The catches from cage culture have increased from <100 tonnes in 2005 to 600 tonnes (Figure 7.5).

In 2005, the International Union for Conservation of Nature (IUCN) conducted a red list assessment of 423 Malawian fish species. The assessment showed the following:

- 65.72 % of Malawian fishes were of least concern (LC), implying that they were quiet abundant;

Figure 7.4: Fish Catches from Aquaculture.



Source: Department of Fisheries.

- 27.42% were vulnerable (VU);
- 4.12% lacked data for assessment (DD);
- 2.36% were endangered (EN);
- 0.47% were not evaluated (NE);
- There were no critically endangered (CR), near threatened (NT) and extinct (EX) fish species among the 423 species conside

The endangered fish species were from the two most species diverse families of fishes in Malawi: Cichlidae and Cyprinidae (Table 7.10). The ten species are probably endangered due to over exploitation by fishermen since they are commercially important species.

7.6 The Impact of Biodiversity Loss

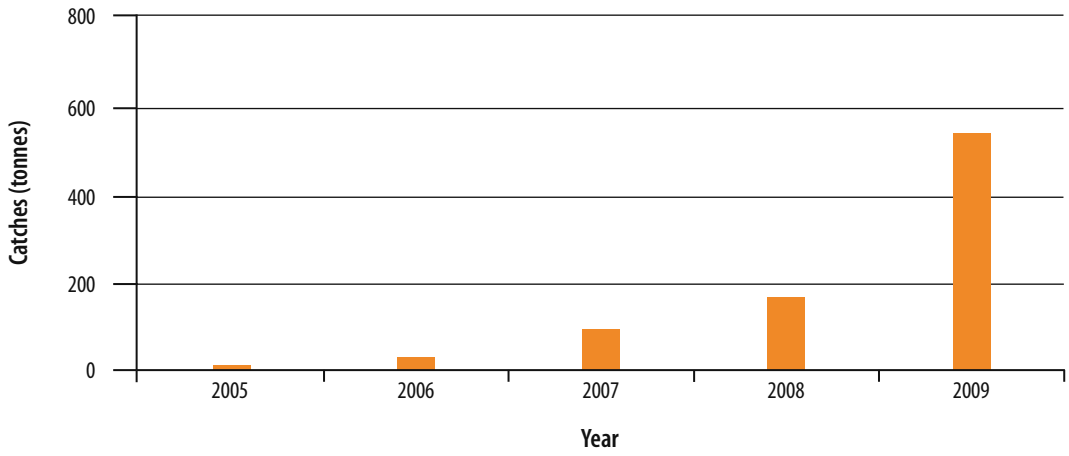
Destruction of ecosystems and biodiversity loss has significant consequences on the economic and social systems through damage to the health, function and services that the ecosystems and biodiversity provide.

Unsustainable use of natural resources is equivalent to giving up 5.3% of GDP of Malawi each year. Table 7.10 compares the contribution of forestry, fisheries and wildlife to GDP in official statistics against estimates based on recently published specialist studies.

The economic value of ecosystems services is yet to be quantified in Malawi. Natural habitats provide indirect services such as preventing soil erosion and provide habitats for wildlife which are genetic reservoirs for various species. Wetlands such as the Lake Chilwa basin filter pollutants and serve as water recharge areas and nurseries for local fisheries. Thus, loss of biodiversity would lead to loss of ecosystems services derived from natural resources and increase vulnerability of livelihoods for communities that depend on these resources.

Agrobiodiversity contributes about 40% of the Gross Domestic Product (GDP) and accounts for more than 90% of employment and 90% of merchandise export earnings. However, the economic value of wild

Figure 7.5: Fish Catches from Cage Culture.



Source: Department of Fisheries.

Table 7.10: Contribution of Natural Resource Sectors to GDP.

NR Sector	Official Statistics	Additional Contribution Identified	Total Share of GDP	Sources of New Evidence
Forestry	1.8%	4.3%	6.1%	BEST (2009)–charcoal & firewood
Fisheries	4.0%	-	4%	
Wildlife	-	2.7%	2.7%	WTTC (2009)–nature-based tourism
Total	5.8%	7.0%	12.8%	

Source: Malawi Economic Study DPC 2010.

relatives of crops and animals as sources of genetic material for breeding programmes for disease and pest resistance and yield improvement were not part of the economic study. This also applies to soil micro organisms and pollinators which play an important role in agricultural production. These non tangible benefits though important are not valued in monetary terms. The contribution of agrobiodiversity to the economy is, therefore, underestimated.

Majority of Malawians depend on natural resource endowment for a living as sources of fuel-wood, food, timber, medicines, and construction poles. This means that loss of biodiversity will have serious implications for the people who depend on them and any value cannot adequately convey the level of dependence on natural resources for the survival of the people.

The contribution of tourism to the GDP is now estimated to be 3.8% and grew by 12% in 2007 against the world's growth of 5%. This growth is supported by an increase in international visitors which increased from 11% to 19.5% between 2004 and 2006. Lake Malawi, with its wide range of endemic fish, is a major tourist attraction. This is followed by wildlife based tourism in national parks and wildlife reserves where large mammals such as elephant, buffalo, zebra are the major source of attraction. This means that loss of wildlife and fish will affect the tourism industry and hence the economy.

Biodiversity satisfies a number of social and cultural functions in Malawi. Spiritually, all Malawian ethnic groups believe in the existence of a supernatural being or ancestral spirits that are associated with graveyards or mountain areas covered by forest biodiversity. For example, the Ngonde people of Karonga District worship their ancestral spirits in Mbande Hill, whilst the Manganja of Nsanje worship their ancestral spirit M'bona in Khuluvi Forest. The practice contributes to knowledge about biodiversity and actual conservation in sacred sites.

The conservation of biodiversity can be facilitated or hindered by existing cultural practices. Some rituals and traditions make use biodiversity extensively. One such example is the Chewa tradition of Gule Wamkulu, recently declared a Masterpiece of Intangible Cultural Heritage by UNESCO. Gule Wamkulu is a secret society that performs ritual dances at harvests, weddings, funerals, and the installation of chiefs. The dancers wear costumes and masks made of wood, straw, and animal skins; each dancer represents a specific character (including spirits of the dead, wild animals, and slave traders) (UNESCO, 2008).

The plants and animals that are used to make these costumes are collected or hunted from the natural environment; without biodiversity conservation, these materials will no longer be available. The connection between cultural preservation and biodiversity conservation provides a further incentive for environmental management (UNESCO, 2008).

7.7 Malawi's Strategies for Biodiversity Conservation

7.7.1 National Biodiversity Policy and Institutional Framework

In response to the Rio agreements, Malawi in 1994 developed a National Environmental Action Plan (NEAP) which provides a framework for integrating environmental considerations into national economic and social development programmes and plans. In l1996 Malawi adopted an overarching National Environmental Policy (NEP) in order to promote sustainable social and economic development through the sound management of the environment. The policy provides for the conservation of biodiversity in Section 4.12 which seeks to conserve, manage and utilise sustainably the country's biological diversity (ecosystems, genetic resources and species) for the preservation of the National Heritage.

Legal instrument for the implementation of the principles of environmental and natural resource management as contained in the NEP are governed by the Environmental Management Act (EMA). The EMA was

Julian Bayliss

Julian Bayliss

Examples of fauna species endemic to Mulanje Mountain Forest Reserve Rhampholeaon *platyceps* (Malawi dwarf stumptailed chameleon) and Amphilius sp. (Indigenous mountain catfish) from a river near Mulanje Mountain Forest Reserve.

enacted to remove the lack of an overarching statute providing general environmental protection. Sectoral policies and legislations were required to be revised to be consistent with this Act. Thus as required by EMA, Malawi undertook a review and reform of environmental and natural resources management policies and legislation in 2004. The reviews were designed to address deficiencies and the overreliance on central government control over the use of natural resources and lack of community participation on natural resource management. The reform was also in response to the requirements of CBD article 6b.

The policies have worked to ensure that biodiversity conservation contributes to social economic development through the promotion of benefit sharing and incentives. They have also promoted community participation.

7.7.2 National Biodiversity Institutions

Management of biodiversity in Malawi is not a responsibility of a single government department but is a responsibility of all departments with mandate for the management of various components of biodiversity. The Forestry Department (FD), Department of Fisheries (DoF), Department of National Parks and Wildlife (DNPW), National Herbarium and Botanic Gardens (NHBG) and Environmental Affairs Department (EAD)are the major government agencies whose core mandates include biodiversity conservation and sustainable use. Specific biodiversity functions for these departments are prescribed in relevant sections of the Constitutions and further elaborated in sector specific policies and legislations. The EAD has the overall responsibility for co-ordinating government departments and agencies that have specific responsibilities for the management of biodiversity. The FD is charged with management of forestry biodiversity both within and outside protected areas whilst the DNPW is responsible for the conservation of ecosystems including biodiversity within them. The DoF has a huge responsibility of managing the endemic and diverse fishes of Malawi.

The EAD is also charged with harmonization of national environmental policies and legislation and also coordinates environmental activities through a number of committees such as:

- The Cabinet Committee on Agriculture and Natural Resources (CCANR) - the highest policy and decision making body responsible for environmental policy issues and informs Parliament on the state of the environment.
- The Parliamentary Committee on Agriculture and Natural Resources (PCANR) - a committee that lobbies parliament on all matters to do with the environment.
- National Council for Environment (NCE) - a policy advisory institution which operates through working groups and national steering committees, advises both the CCANR and PCANR on environmental issues.
- The Technical Committee on Environment (TCE) - a body responsible for examining scientific issues and making recommendations for action.
- The National Biodiversity Steering Committee (NBSC) - a committee that follows up and monitors implementation of biodiversity issues.
- National Biosafety Regulatory Committee (NBRC).

The current implementation structure will likely change when the Environmental Management Bill is approved by

Parliament. It is envisaged that a National Environmental Protection Authority will have the mandate to coordinate and monitor all activities concerning protection and management of the environment and the conservation and sustainable utilisation of natural resources, including regulation of access to genetic resources, policy formulation, law enforcement and environmental mainstreaming.

7.7.3 Biodiversity Mainstreaming

Malawi as part of the global community has committed itself to a number of international protocols and conventions and is obliged to integrate these into national programmes and policies. For example, Malawi is required by Article 6b of the CBD to integrate as far as possible the three objectives of the Convention into national programmes and policies. In response, Malawi has included biodiversity considerations into cross cutting national plans, strategies, programmes and policies such as the National Adaptation Programme of Action (NAPA), National Strategy for Sustainable Development (NSSD), Malawi Growth and Development Strategy (MGDS) and the Millennium Development Goals (MDGs). For example, Malawi published the MGDS in 2006 as a medium term strategy for wealth creation and economic growth. The strategy sets out a national vision, areas of strategic interventions or priority areas and the approach for achieving the vision. The MGDS addresses biodiversity issues under the sub-theme related to natural resources base. Thus if implemented in line with the NBSAP, proposed interventions for the forestry sector will lead to reduced environmental degradation whilst fisheries interventions will assist Malawi maintain the fisheries biodiversity.

7.7.4 Priority Areas

Although, Malawi has put in place conducive legislation, policies, strategies and programmes to facilitate biodiversity conservation and sustainable use, biodiversity conservation is still problematic. There are a number of priority issues that must be implemented first if Malawi is to make strides in biodiversity conservation. In this recognition, Malawi through the National Capacity Self Assessment (NCSA) process identified national biodiversity priority issues which are similar to those identified in the NBSAP. The 22 priority actions identified in the NBSAP were not associated with indicators; as such, there is no basis for measuring progress in implementation. Both the NBSAP and NCSA priority areas have been synthesized and are here grouped into six priority areas. These priority areas will assist Malawi achieve the revised biodiversity 2010 targets when implemented together with NBSAP strategies.

Reduce the Rate of Biodiversity Loss

It is evident from the assessment of the status of biodiversity presented in this report that Malawi's biodiversity is on the decline. Causes of biodiversity loss are complex and as such will require a multidisciplinary approach to tackle.

Improve Stakeholder Appreciation of the Importance of Biodiversity

Adequate and appropriate economic, social and environmental policy, legal and institutional frameworks already exist but what is lacking is implementation that recognises the importance of biodiversity in all the three pillars of development. Policy planners and programme implementers need to recognise that the achievement of MGDS goals depends on the supply of ecosystem services that depend on attributes of biodiversity and its conservation. For instance, sustained economic growth depends on agro-biodiversity and the natural resource base of forestry, fisheries and wildlife biodiversity. Social protection and disaster risk management depend on regulating services such as flood regulation by forest catchment areas.

Therefore, there is need to integrate biodiversity conservation into current policies and economic systems by incorporating values of biodiversity effectively in all aspects of development policy implementation. There is also need to develop biodiversity conservation and sustainable use specific public information and out-reach activities which should be accessible to many different groups including local communities in order to raise appreciation on the importance of biodiversity. Malawi needs to effectively implement the Programme of Work on Communication, Education and Public Awareness (CEPA) that aims to assist parties, educators and civil society to integrate biodiversity into all levels of the formal education systems.

Protect Traditional Knowledge, Innovations and Practices

Malawi has made little progress in mainstreaming Indigenous Knowledge Systems (IKS) and protection of traditional knowledge, technologies, and practices that are relevant for biodiversity conservation into national policies and programmes. Nevertheless, it is well known that cultural knowledge and practices effectively contribute towards biodiversity conservation in agricultural systems, fisheries resource use and management, forest resource management and wildlife management. For example, the Fisheries Department has integrated indigenous knowledge, practices and beliefs that ensure sustainable conservation of fisheries

diversity in their Participatory Fisheries Management Programme. According to Scholz and Chimatiro (2004), the fishery at Mbenji Island in Salima uses traditional governance systems, practices and beliefs to open and close the fishery and enforce customary regulations.

Develop incentives for biodiversity and ecosystem services provided by biodiversity Malawi has an obligation as required by Article 11 of the Convention to adopt in as far as possible appropriate, economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity. Malawi has made some progress towards adopting measures to promote incentives in biodiversity conservation and sustainable use through collaborative management of forest reserves and national park and revenue sharing with surrounding communities.

Although natural resources management policies (e.g. the Wildlife Policy) have some provisions that promote provision of incentives for communities to participate in biodiversity conservation, the concept of incentive measures has not been integrated into other institutions and policies whose core business is not biodiversity conservation. For example, lack of legislation on intellectual property rights (IPR) means that genetic resources and indigenous knowledge are exchanged freely and as such the potential resulting from commercial and technological benefits do not trickle down to the local communities.

Another problem is that Malawi's biodiversity is inadequately valued due to poor pricing of biological resources. In recognition of these inadequacies, Malawi has initiated a process to review and document incentive measures in Malawi and the results will be used to develop guidelines and procedures for incentive measures for biodiversity conservation and sustainable use.

Payment for Ecosystem Services (PES) is a good incentive for both biodiversity conservation and economic growth in Malawi because it will instill responsibilities and obligations on conservation of biodiversity by different stakeholders and partners since it will be perceived as national wealth. It can also be a financing mechanism for biodiversity conservation while acting as an economic incentive for conservation of biodiversity by local communities who can get livelihood benefit from payments by business corporations such as ESCOM and Water Boards for maintenance of catchment area ecosystem services.

The main drivers of ecosystem services change in Malawi include anthropogenic activities that lead to habitat transformation through deforestation, agricultural expansion, land use, soil erosion, siltation of rivers, introduction of invasive alien species and pollution. Terrestrial, aquatic and agricultural ecosystems in Malawi are failing to provide optimum ecosystems services because of ecosystem service degradation. For example, it was estimated that siltation and invasion by water hyacinth of Shire River cost ESCOM loss of 140 megawatts of power at Nkula B, Tedzani I and II hydroelectric power stations, translating into K3 to K4 Million Kwacha per day. As a result of intermittent power supply, industry and trade sectors were also losing nearly K30 to K40 Million per day.

Develop a Regulatory Framework for Access and Benefit Sharing (ABS)

One of the objectives of the CBD is to ensure access to genetic resources and the fair and equitable sharing of the benefits arising out of its utilization. Malawi has put in place mechanisms for ensuring access and benefit sharing in forestry, fisheries and wildlife through Community Based Natural Resources Management (CBNRM) activities. For example, some kind of access and benefit sharing is provided for in the Forestry Policy, Fisheries Conservation and Management Policy, Wildlife Policy and National Parks and Wildlife Act (2004) as amended. The Wildlife Policy is significant as it promotes granting of user rights to communities who legitimately use the land on which wildlife occurs, and recognises the importance of equitable distribution of benefits and revenues derived from sustainable use of wildlife resources. In line with this policy, DNPW is implementing the following programmes:

- Resource Use Programme which allows harvesting of selected wildlife resources by adjacent communities;
- Wildlife related enterprises; and
- Revenue sharing with adjacent communities.

Resource Use Programmes are also practiced in Forestry and Fisheries.

Articles 8 (j), 10 (c), 17 (2) and 18 (4) of the CBD require parties to respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities, promote their wider application with the approval of relevant communities and encourage fair and equitable benefit sharing from the use of such knowledge, innovations and practices. In addition, articles 15, 16 and 19 require that ABS mechanisms as stipulated in the Bonn Guidelines, should be established as a basic model for ABS in contracting parties, and are meant to be used as one of the strategies for ensuring sustainable use and conservation of genetic resources. Apart from the legislation on access to genetic resources, there is no legal framework for regulating access to genetic resources. In order to ensure that benefit arising

from the use of Malawi's genetic resources is shared equally with communities the following must be put in place:

- Develop *sui* generis system that will protect farmers and breeders rights over varieties developed by the farmers; inalienable rights of local communities over their biological resources and associated knowledge, technologies and practices and traditional medicine practitioners' rights over medicinal plants, knowledge technologies and practices. Build endogenous capacities on ABS amongst relevant government institutions in scientific, technical, legal and policy issues, IPR, local community roles and rights in relation to ABS regimes.
- The current Procedures and Guidelines for Access and Collection of Genetic Resources in Malawi and the Procedures and Guidelines for the Conduct of Research in Malawi developed in 2002 are inadequate and need strengthening for ABS. The process to develop Access and Benefit sharing regulatory framework should be speeded up.
- Put in place national and local level (since genetic resource material collection is site specific) effective implementing institutions that are not fragmented in order to ensure clear and transparent regulatory and permitting processes.
- Raise public awareness on the importance of regulating access to and protecting rights over biological resources, traditional knowledge, technologies and practices at the local, district and national levels in Malawi. Explore ways of ensuring that all stakeholders effectively participate in the regulation of access & sharing of benefits accruing from utilization of genetic resources, knowledge, technologies and practices. This will ensure that genetic resources are not exported or exported by other users without adequate safeguards.

7.7.5 Mainstream Gender and Youth into Biodiversity Conservation

Generally, women are the main custodians and users of biodiversity. For example, women are involved in food preparation using resources from biodiversity such as cereals, legumes, vegetables, firewood and water. In addition women are also involved in collection and storage of various species of plants for various uses. Whereas a man would select a variety of crops, e.g. maize, based mainly on profitability, a woman would also consider such aspects as palatability, storability, resistance to drought and poundability. These different gender roles and responsibilities should be taken into account when designing biodiversity programmes so that the social structure is not disrupted. The same approach should be taken when it comes to the youth.

Promote Public Private Partnership (PPP) and Ecotourism for biodiversity conservation

Although PPPs in natural resources management are not supported by a national policy, successful PPP arrangements are being implemented in the wildlife sector. African Parks (Majete) entered into a PPP arrangement with Department of National Parks and Wildlife regarding the management of Majete Wildlife Reserve in 2003. Through the partnership, Majete Wildlife Reserve has restocked species that were once locally extinct (Box 7.2).

It is envisaged that the Nyika Transfrontier Project will be managed under a PPP arrangement between Nyika Foundation (a lead organisation to be entrusted with the management of the project) and DNPW and Zambia Wildlife Authority. Proposals are also under consideration by the Forestry Department to enter into a PPP arrangement with Mulanje Mountain Conservation Trust (MMCT) for the management of Mulanje Mountain Forest Reserve. This will only be possible when the draft PPP policy is approved.

Ecotourism is a form of tourism that emphasizes on biodiversity conservation whilst improving the well-being of local people surrounding protected areas. The main objective of ecotourism is linking tourism development with biodiversity conservation especially wildlife and forest resources. The challenge for the tourism sector in Malawi is on how to make tourist destinations highly competitive through sustainable maintenance of ecosystems services such as maintaining biodiversity, aesthetic and scenic features. The case of Majete Wildlife Reserve has proved that there is a strong link between ecotourism and PPPs because they both target biodiversity conservation by involving local communities that surround either protected areas or holiday resorts.

7.8 Conclusion and Recommendations

Biodiversity has been the basis for people's livelihoods for generations because direct and indirect services are derived from it. The previous State of Environment Report (2002) reported that there was decline and extinction of wild animal species and populations as well as indigenous plant species due to deforestation, poaching, encroachment, uncontrolled bush fires and selective use of species. The situation has not improved to date because currently, biodiversity is still under threat from habitat loss, IAS, over-harvesting, loss of IK, undervaluation of biodiversity, lack of comprehensive ABS mechanisms at both local and national levels, pollution and climate change. These are exacerbated by poverty and HIV/AIDS. The impact of these threats is that the resilience of

ecosystems is undermined, thereby limiting the services that are associated with these systems.

There have been positive approaches to combat poverty and promote biodiversity conservation by encouraging communities to engage in income generating activities such as honey and fruit juice production and rearing of selected wild animal species e.g. Guinea fowls. Reintroduction of neglected indigenous plant species into people's diets is a boost to agrobiodiversity but also a contribution to nutritional status. Issues of PPP are gaining prominence around protected areas and co-management approaches should be introduced in areas where not currently in place to reduce human-wildlife conflicts. Communities should be rewarded for looking after biodiversity and be trained in cost-benefit analyses for natural resources. The Forestry sector should encourage IK practices that conserve biodiversity such as those present in Dambe area (collect caterpillars without cutting down trees) but discourage wanton tree felling as is the case in Vinthukutu (next time there might be no more trees for the caterpillars).

There is an urgent need to develop a management plan for eradication of invasive alien species e.g. water hyacinth and Lantana spp. Biodiversity is crucial to the reduction of poverty, due to the basic goods and ecosystem services it provides and it is also integral to key development sectors such as agriculture, forestry, fisheries and tourism.

Hence, biodiversity conservation policies and legal frameworks should ensure that threats to biodiversity conservation are adequately addressed. Policy and institutional framework strategies should include harnessing the greater potential that biodiversity has to increase its contribution to GDP and sustained economic growth through improved livelihoods and women and youth empowerment. There should be mainstreaming of biodiversity into key economic and development sectoral policy implementation such as land, agriculture, forestry, energy, mining, business and trade in order to address negative impacts that can hinder significant reduction of biodiversity loss by 2015. There is also need to mainstream climate change issues into biodiversity conservation policies and programmes including all MGDS priority areas that depend on biodiversity and ecosystem services. There is need to come up with policy implementation strategies that address threats of climate change to biodiversity but also strategies that use biodiversity to adapt to climate change impacts on human wellbeing.

Biodiversity conservation policy and programme implementation requires concerted efforts and the combined strength of all sectors of society in Malawi. There is need to have policy implementation alliances at local, national, regional and international levels between policy makers, civil society, indigenous and local communities and business and the private sector. In order to maximize on economic opportunities that biodiversity has to offer, public and private agencies should integrate biodiversity concerns into their planning and implementation for the simple reason that loss of biodiversity will mean loss of benefits derived from biodiversity.

Photo Essay: Biodiversity and Culture

Sosten Chiotha

The photograph above shows that values of biodiversity extend to aesthetics and culture. The picture shows Phalombe Sopa dancers in elegant dance costumes of various plant and animal species.

Mpho Nenwelli

Culture and biodiversity have an ambivalent relationship. Traditional practices can both conserve biodiversity and sustainably exploit biodiversity. Biodiversity must be conserved in a manner that can fill both ecological and cultural needs.

Shown above is a costume worn only in graveyards. Graveyards all over Malawi are designated as sacred and protected areas where harvesting of forest and wildlife resources is prohibited. It remains a challenge for Malawi to ensure that these conservation sensitive traditional practices, beliefs and customs are preserved along with the biodiversity that they may have helped to conserve.

Sosten Chiotha

Sosten Chiotha

Flacourtia indica commonly known as Nthudza is a fruit rich in vitamins and minerals. Protection of biodiversity ensures such indigenous fruits are not lost (left).

Malawi is rich in biodiversity as shown in photo of genetic diversity of mangoes (right).

Sosten Chiotha

Sosten Chiotha

Diet in Malawi goes beyond conventional food sources. There is need to document indigenous knowledge related to these sources. There is a potential of domesticating many animals and plants (eg. edible ants such as Mafulufute shown in photo) as was found successful in domesticating guinea fowl in Malawi.

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CHAPTER 8

Tree Canopy, Photo by Deepa Pullanikkatil

FORESTS AND WOODLANDS

Firewood Transportation, Photo by Sosten Chiotha

8.1 Introduction

Forests and woodlands provide social, economic and environmental benefits globally and nationally. They support livelihoods through the provision of shelter (house construction, and furniture), energy (fuel wood), shade, medicinal plants and food. Forest and trees also contribute to rural incomes through collection and sale of various forest products including non timber forest products (NTFPs). Forests contribute to the economy of the country through timber exports and the provision of jobs in forestry. They also are important in the provision of ecosystem services such as nutrient cycling and soil formation.

Despite their importance, forests are declining due to deforestation. This chapter therefore provides an overview of the current state of forests, their economic importance, the impacts of deforestation and forest degradation and initiatives undertaken to address these problems.

8.2 Classification of Forest Resources

Malawian forests are either classified based on land tenure or by type. When defined by type, forests are grouped into natural/indigenous or plantation forests. When classified by land tenure, Malawian forests are classified as Public, Customary or Private according to the Malawi National Land Policy (2002).

8.2.1 Forest Resources Classified by Land Tenure

(a) Government (Protected) Forests on Public Land

Public forests include forest reserves, national parks and wildlife reserves. The Department of Forestry (FD) manages forest reserves and the Department of National Parks and Wildlife (DNPW) manages national parks and wildlife reserves. While the main objective of the DPW is to protect wild animals, all wildlife, including forests, is protected.

Over 70% of the land under the Protected Areas network was gazetted before independence in 1964. Land under protected areas has increased steadily from 1897, when Lake Chilwa and Elephant Marsh game reserves were created. In 1998, Malawi had a total of 94 protected areas (comprising 85 Forest Reserves, five National Parks and four Wildlife Reserves) which occupied a total of 1,869974 Ha. Data from Forestry Department shows that the number of forest reserves has now increased to 88, for a total of 97 protected areas that occupy about 2,018,198 Ha. This means that land under protected areas has increased by 148,224 ha (8%). Currently, three forest reserves are proposed for protection: if approved, this will bring the number of protected areas to 100. In addition, there are over 240,000 Ha of ungazetted land that is being considered for formal protection (Appendix).

The primary reason for forest reserves is catchment protection. In addition to this function, forest reserves are crucial for biodiversity conservation, protection of the water supply, erosion control, nutrient recycling, carbon capture and storage. The Public Lands Utilization Study (PLUS) of 1998 reported that the initial three forest reserves in Malawi were created for conservation of biological diversity (Orr *et. al.*, 1998). Currently, fourteen forest reserves are valued as sites for biodiversity conservation and the presence of rare or unique species (Orr *et. al.*, 1998). In addition, all Malawian vegetation types appear to be represented in protected areas, although the actual conservation status of vegetation is not well-documented.

There has been no study to assess the protection level of vegetation in Malawi. Unpublished data from the Forestry Department indicates that there has been extensive encroachment into some forest reserves such as Thyolo, Ndilande, Kalwe, and Zomba-Malosa, such that the actual area under forest cover may be less than that reported in official documents. In addition, other reserves with valuable timber such as Mulanje cedar (Widdringtonia whytei) are prone to extensive exploitation.

Recent studies to assess the status and distribution of Mulanje Cedar reported a decline in coverage from 1462 Ha in 1989 to 845.3 Ha in 2004. This represents a 617 Ha decrease within 15 years, implying that cedar was being cleared at an approximate rate of 40 Ha per year.

Reserves comprise mostly natural forests, with only 90,000 Ha (11.5% of forest reserve area) of exotic trees. All 28 Districts of Malawi, with the exception of Likoma Island and Balaka, have at least one or more gazetted and/or proposed forest reserves. These are strategically located in hills and mountain catchment areas in order to protect water catchments and fragile areas from environmental degradation. Although access is controlled, forest reserves are a de facto source of livelihoods for adjacent communities. Local communities collect firewood and non-timber forest products (NTFPs) which they also sell. In a few selected areas, the government has entered into co-management agreements with adjacent communities to achieve sustainable forest management (SFM) through the sharing of management responsibilities and utilization rights. This allows communities to use forest products

such as firewood and NTFPs and share in Government revenue generated from the sale of forest products.

National Parks and Wildlife reserves comprise an estimated 1.1 million hectares; 11.7 % of Malawi's total land area. There are 5 National Parks and 4 wildlife reserves (Table 8.1). However, not all Parks are forested; some, such as Nyika and Kasungu, are partly grasslands. Just as in Forest Reserves, co-management programmes are being implemented in these Parks and Wildlife reserves.

Table 8.1: National Parks and Wildlife Reserves.

Park	Area Hectares	Year Established
Nyika	320,078	1966
Lake Malawi	7,365	1980
Kasungu	228,147	1930
Liwonde	54,633	1972
Lengwe	100,198	1928
Vwaza	98,214	1956
Nkhotakota	178,568	1938
Majete	77,754	1955
Mwabvi	35,193	1951

(b) Customary Forests

Customary forests are those located on unallocated common access land, and Village Forest Areas (VFAs) under the jurisdiction of Traditional Authorities (TAs). They cover about 1.1 million hectares, 11.7% of total land area. The Forest Act (1997) allows for communities to form Village Natural Resource Management Committees (VNRMCs) for the management of these forests. Although there are no restrictions on forest product use for domestic purposes, a license is required by the VNRMC for commercial usage of forests. A registered VNRMC or a Forestry official is empowered to confiscate and prosecute anybody found with forest products without a license or permit. A registered VNRMC is also empowered to manage forests in VFAs and on common access land. The 1997 Forest Act makes provisions for any village headman in consultation with Forestry Department (FD) to designate any area of unallocated land as a VFA, to be managed according to a management plan and agreement signed at the District Council level. Currently, there are 2,565 VFAs. A number of VFAs have not been surveyed and as a result the total area under VFAs is not known. Table 8.2 shows the number of VFAs per District and the estimated areas of surveyed VFAs as at June, 2010.

(c) Private Forests (Leasehold and Freehold)

Private forests are either freehold, leasehold or privately owned forests on customary land. Free-hold forests are mostly owned by tea estates and leasehold forests are owned by tobacco estates. There is no current data on extent of private forests, however, it can be assumed that they cover 275,000 hectares out of 365,000 hectares which is the total area of plantations and 90,000 hectares belong to Government.

8.2.2 Forest Resources Classified by Type

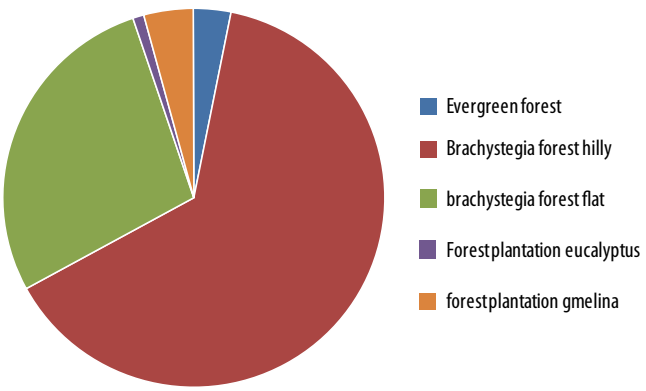
Natural Forests

Natural forests are the major vegetation cover of Malawi. Indigenous vegetation types as delineated by Dowsett–Lemaire (2001) are summarized in Appendix. Malawi's vegetation is dominated by miombo (Brachystegia) woodlands (Figure 8.1), which are found in most of the forest reserves and on customary land.

According to FAO Statistics, forests (comprising indigenous forests and plantations) are estimated to occupy about 3,336,000 Ha, representing about 36% of Malawi's land area. This is an increase from 1991 as estimated by the Forest Resources Mapping and Biomass Assessment (1993) which estimated 2,638,010 Ha to be under forest cover (or 27% of Malawi's land area).

Most vegetation types are found in National Parks and Wildlife Reserves, Forest Reserves, on protected hill slopes, and on customary land. However, forests in Malawi are under severe threat of depletion. The total forest cover is estimated to be declining at the rate of 1.0 to 2.8% annually due to deforestation for fuelwood, settlement and agricultural expansion. Forest Resource Mapping and Biomass Assessment of 1991 showed that in 1973, Brachystegia forests occupied 45% of total land area of Malawi (excluding Lake Malawi), while

Figure 8.1: Forest Types by Area as of 1992.



Source: GOM, 1993.

Table 8.2: Village Forest Areas by District and Area Estimate as 30th June 2010.

	District	No. of VFAs	Indigenous	Exotic/Planted	Mixed	No. of Surveyed VFAs	Area of Surveyed VFAs
1	Chitipa	122	69	0	43	26	1,181.6
2	Karonga	41	41	0	0	22	4,975.6
3	Rumphi	50	44	0	6	33	6,993.97
4	Nkhatabay	16	16	0	0	12	222.6
5	Mzimba	27	27	0	0	16	293.76
6	Nkhotakota	176	174	2	0	13	719.93
7	Kasungu	192	143	21	28	63	841
8	Ntchisi	112	63	30	19	12	52.54
9	Dowa	47	30	9	8	22	149
10	Salima	37	12	23	2	5	1,76.21
11	Mchinji	169	49	63	57	2	79.65
12	Lilongwe	438					1,139.30
13	Dedza	263	252	0	11		
14	Mangochi	43	11	4	28	4	1,141.47
15	Ntcheu	26	19	1	6	13	571.67
16	Balaka	28	19	0	9	12	240
17	Machinga	21	8	2	11	6	675.65
18	Neno	46	46	0	0	0	214.9
19	Zomba	95	20	58	17	61	719.96
20	Mwanza	21	2	1	18	6	117.1
21	Blantyre	188	115	52	21	56	
22	Phalombe	112	84	4	24	0	661.2
23	Chiradzulu	29				3	40
24	Mulanje	119	22	82	15	23	9.92
25	Thyolo	41	0	0	41		16.4
26	Chikhwawa	56	50	0	6	31	1,797.29
27	Nsanje	56				24	8,754
28	Likoma	1					
	TOTAL	2,565	1,316	352	370	465	31,784.72

in 1990/91 land under forest cover was estimated to be 25.3%. This indicates that land under Brachystegia forest declined by 44% in less than twenty years. In flat areas, the level of decline in coverage is far higher, nearly 62%, as a result of agricultural growth. These figures are based on the 1993 Biomass Assessment study. No recent comprehensive country wide forest assessment has been done. However, it can be safely assumed that land under forest cover is significantly less than the 1993 estimates.

Plantation Forests

Most plantations are owned by the Government. Government plantations cover 90,000 Ha while, private plantations cultivate 275,000 Ha (FAO, 2010). The largest Government plantation is Viphya, which covers 53,000 Ha; other notable plantations include those in Chongoni, Dedza, Zomba and Mulanje. The Viphya plantations were established for pulp production, but are now used for timber production after the establishment of a paper factory proved unfeasible. Timber plantations are mostly planted

with pine. Eucalyptus plantations, which were established to meet the growing demand for fuelwood and poles, are also common. Almost all Government plantations have been established in forest reserves. Appendix provides a full list of Government plantations by area and purpose.

8.3 Current Status of Forest Resources in Malawi

8.3.1 Current Extent of Forests

Forests and woodlands are estimated to cover 3,237,000 Ha, about 34% of the total land area of Malawi (FAO, 2010). This figure was extrapolated from the 1993 Forest Resources Mapping and Biomass Assessment for Malawi Report (GoM, 1993). The 1993 report estimated forest cover at 2,642,800 Ha, while the Malawi report for Food and Agriculture Organization (FAO) gives an estimate of 3,830,00 Ha for the same period. The discrepancy is due to the use of different forest classification systems. These figures are seriously outdated, and the extent of forest cover is now likely much lower. However, no comprehensive survey of forest cover has been done since 1993: for the purposes of monitoring and making evidence-based decisions, this data urgently needs to be collected.

8.4 Economic Importance of Forests and Woodlands

The importance of forests and trees to Malawian livelihoods cannot be over emphasized. People depend on forests for provision of construction materials (poles and timber for construction); health (food and medicinal herbs), financial capital through sale of forest products (timber and non-timber); cooking (96.7% of people use firewood or charcoal (GOM, 2005) and for religious ceremonies. Managing forest resources in a sustainable manner therefore has enormous benefits for the people that depend on forest resources for a living.

The contribution of forests to the GDP is officially 1.8% (GOM, 2010b). However, according to the Malawi Biomass Energy Strategy (BEST) report, if traded and collected fuel wood in urban and rural areas are taken into consideration, the contribution of forests to the GDP is estimated to be 4.4% (GOM, 2009). This, however, does not take into account the role of forests in tobacco growing and processing, protection of catchment areas for sustainable water supply, hydroelectric power generation and environmental protection.

The BEST report estimates employment from traded wood at 129,775. The timber industry also employs a substantial number of people in pit sawing, small mobile sawmills and large sawmills such as those of Wood Industries Corporation (WICO) and RAIPLY. The Department of Forestry employs about 6,400 people.

Forests play several roles in the maintenance of healthy ecosystems. They provide a habitat for diverse flora and fauna, protect watersheds, regulate climate by sequestering (capturing) carbon dioxide and are important for eco-tourism. Another environmental function of forests is that of preventing land degradation and controlling soil erosion and water loss. These functions are essential for the continued productivity of the agricultural sector in Malawi.

8.5 Threats to Forestry Resources

The main threats to Malawian forests are deforestation and forest degradation. Deforestation refers to a total

Welton Phalira

Sale of firewood in markets.

Sosten Chiotha

Sale of mushrooms along Malawi's roads.

change in landscape and land use, typically the removal of all trees in a forested area to create land for agriculture and settlements. Forest degradation refers to deterioration in forest condition. Forest degradation is manifested in reduced crown cover (forest density) due to selective tree cutting; poor tree health due to frequent fires and debarking for medicines; and reduced biodiversity due to selective tree cutting (i.e. of timber trees). In estimating forest cover, forest reserves are assumed to be intact, although in actual fact they are often degraded due to illegal cutting of trees for charcoal, firewood and the collection of edible caterpillars.

According to the Malawi official report to FAO (2010) and FAO forest classification system, deforestation rate is estimated to be 1% per year. The 1993 Biomass Assessment Report put the deforestation rate at 2.8%. If forests were declining at the rate of 2.8% annually, Malawi's forest cover would be 1.5 million hectares. But this is not the case since protected forests alone account for about 2.2 million hectares. Therefore, it makes more sense to use the FAO forest classification system, which puts the current forest resources at 3,237,000 hectares, representing 34% of land area. Table 8.3 shows forest decline over the years. It is also clear from Figure 8.2 that forest cover has changed tremendously between 1979 and 1999.

There are several causes of deforestation and forest degradation. Actions that directly cause forest decline are called 'direct or immediate causes' while factors that influence actions are called 'underlying' causes (CIFOR, 2000).

Table 8.3: Forest Cover Change Between 1992 and 2010.

Year	Area in Hectares	Change in Hectares	% Change/Year
1990	3,896,000	164,500	
1995	3,731,500	164,500	-1%
2000	3,567,000	165,000	-1%
2005	3,402,000	165,000	-1%
2010	3,237,000	165,000	-1%

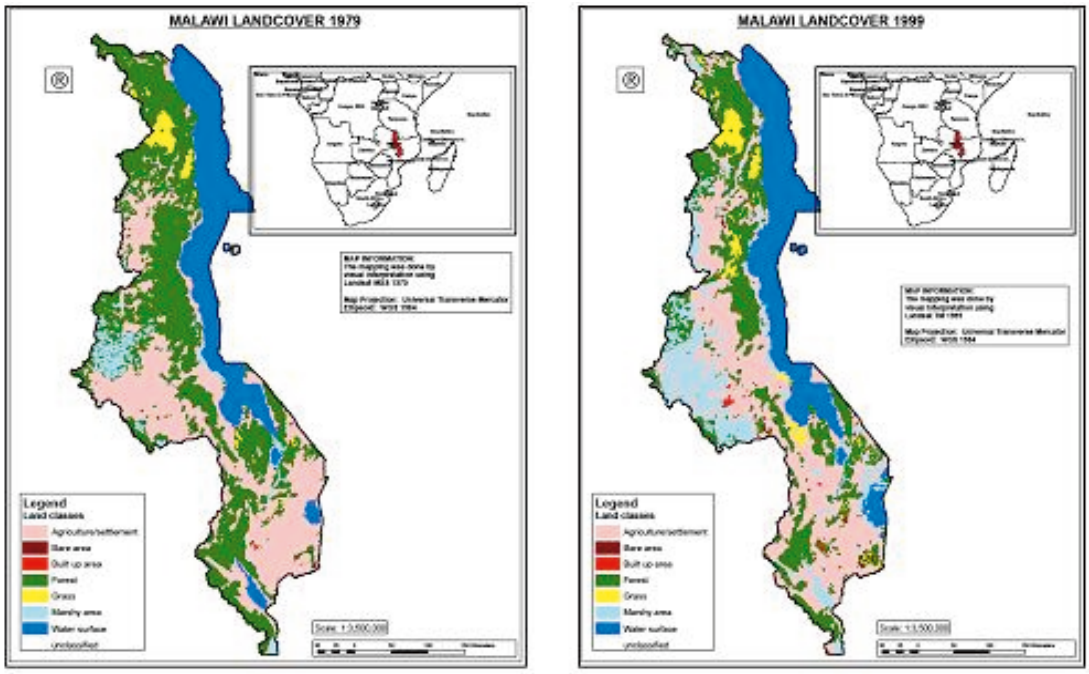
Source: GoM, 2010 Department of Forestry.

8.5.1 Direct Causes of Deforestation

Forest resources in Malawi are under massive pressure from human activities such as agricultural expansion; human settlement; unsustainable harvesting for energy and timber requirements; and uncontrolled fires.

Over the years, land under agriculture has been increasing at the expense of forest areas. Information from the National Statistical Office (NSO) indicates that area under tobacco growing increased from 194,000 to 253,000 between 2000 and 2007 (Table 8.4). Information from World Development Indicators showed that agricultural land increased from 30,700 sq km in 1963 to 44,400 sq km in 2003 (Table 8.5). Due to population growth, more forest land is being cleared for housing and accompanying agricultural land. Figure 8.2 clearly shows that land under cultivated increased with increasing population.

Figure 8.2: Visual Presentation of Forest Cover Change Between 1979 and 1999.



Source: GoM, 2010 Department of Forestry.

Table 8.4: Area Under Tobacco Cultivation Between 2000 and 2007.

Year	2000	2001	2002	2003	2004	2005	2006	2007
Area in Hectares under tobacco ('000)	194.0	136.6	158.0	-	301.0	389.7	312.0	253.0
Burley	160.8	125.0	148.0	318	256.5	369.1	287.0	229.0
Flue-cured	10.7	8.5	10.0	10	16.7	14.6	19.0	20.0
Fire Cured	21.0	3.1	..	74	25.7	6.0	6.0	4.0
Sun/Air Cured (a)	1.0	..	..	..	2.1	..	..	..

Source: National Statistical Office Year Book, 2008.

Table 8.5: Agricultural Land Area (1963 and 2003).

Year	Agricultural Land in Sq Km Over Total Land Area	% Agricultural Land Over Total Land Area
2003	44,400	47.19
1993	38,000	40.39
1983	35,900	38.16
1973	32,000	34.01
1963	30,700	32.63

Source: World Development Indicators on www.nationmaster.com as Sited in GOM, 2010, UNDP/PEI, Economic Study.

Over reliance on fuel wood for energy is another major cause of deforestation. According to GOM (2009b) 96% of Malawians rely on charcoal and firewood for their energy requirements. Firewood is the main source of energy. 96 percent of the rural population depend of firewood. In urban areas, it is estimated that 43% of the urban population depend on charcoal whilst 42% depend on firewood for energy.

Charcoal production is very destructive. About 6.08 million standard bags of charcoal are estimated to be used in the four largest urban areas annually. This requires 1.4 million cubic metres of wood and about 15,000 hectares of forestland cut per year (Kambewa *et. al.*, 2008). Nearly 60% of the charcoal is produced in Forest Reserves and National Parks; almost 40% comes from customary land; and 2% of charcoal enters Malawi from Mozambique. In addition the traditional earth kilns used by the charcoal producers are inefficient, with an efficiency ratio of 20% (Makungwa, 1997).

Charcoal burning is allowed under license from a sustainable source (section 81 of the 1997 Forestry Act). However, no indigenous forests have been certified as a sustainable forest, suggesting that charcoal making from forest reserves is illegal.

Uncontrolled fires which occur in natural forests annually destroy regenerants. Controlled fire burning has been known to improve forest cover as is the case in Chimaliro Forest Reserve where co-management of the forest reserve is being practiced. Fires have been most destructive in Government pine plantations. Approximately 8489.78ha of plantation forests was burnt in 2009 (GOM, 2010).

Other direct causes of deforestation and forest degradation include cutting of trees for harvesting of edible caterpillars and use of herbal medicines. Cutting trees for collection of caterpillars is a problem in Ntchisi and Chimaliro Forest reserves.

Developmental activities have also contributed to deforestation. For example part of kalwe forest reserve has been cleared to pave way for the contraction of a new Nkhatabay district hospital. Road construction has been especially destructive as it involves removal of trees to pave way for the road as well as clearing and digging some areas for quarry. For example, parts of Matandwe Forest Reserve have been heavily degraded due the construction of Nsanje road.

Another potential cause of deforestation is climate change. According to the model simulations using the Holdridge model conducted under the Second National Communication for Climate Change, different forest types will respond differently to adverse effects of climate change. The potential changes will range from no change in forest types such as those of Nyika and Viphya

Plateau to drastic changes in those of in the north of Kasungu Game Reserve and South of Vwaza Marsh. The changes will favour forest species that adapt to increasing dry or drought conditions. Trees that usually grow in warm parts of the country will now grow in areas such as Dedza and Viphya and species adapted to cold areas might adapt or disappear. We might see increased wild fires with increased droughts which might destroy forests.

8.5.2 Indirect Causes of Forest Degradation

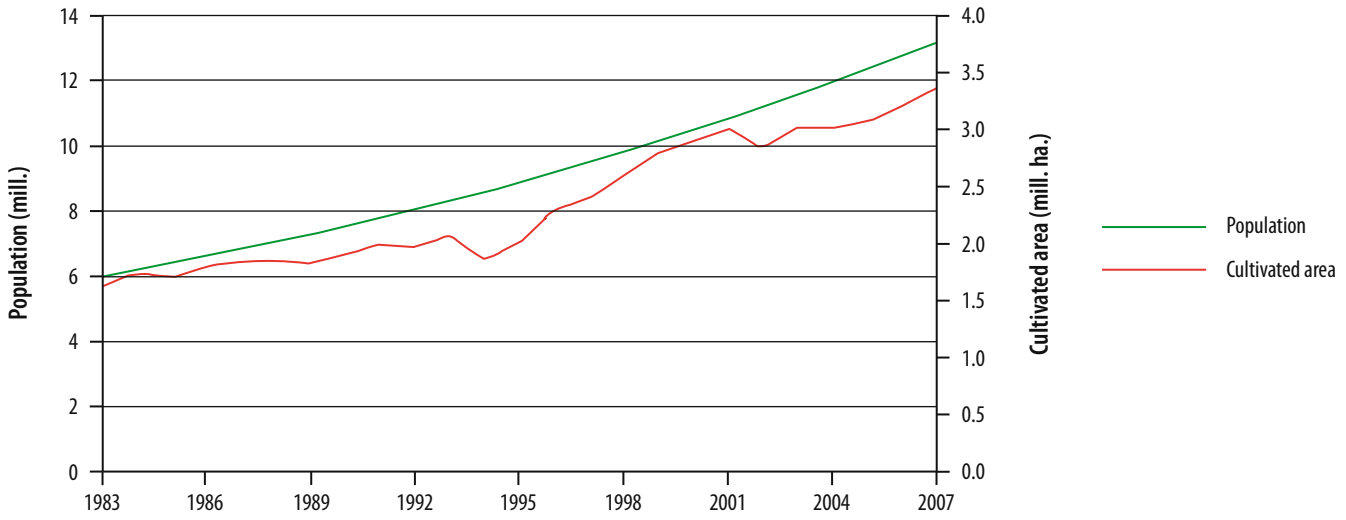
Indirect causes of deforestation are factors that influence actions that lead to deforestation and forest degradation such as population growth, poverty, HIV/AIDS and land tenure.

Malawi's population has increased from 1,574,454 in 1931 to 13,066,320 in 2008 (NSO). As population increases there is increase in production and consumption which requires increasing land under agriculture and settlement and increased consumption of forest products. Population growth also puts pressure for farmlands (Figure 8.3).

It has been demonstrated in chapter one that Malawi has narrow economic base and that incidences of poverty are high. Due to poverty therefore Malawian use natural resources including forests for a living, thus putting pressure on forest resources. The emergency of HIV/AIDS is also aggravating the problem of unsustainable utilisation of forests. Infected and affected people are using forests as safety nets and sources of income for vulnerable families such as child headed households (GOM, 2008).

As already pointed out about a third of Malawi forests are on Public Land (unallocated or common access forests) and they have no real ownership. Forests on these lands are considered free goods and suffer what is called 'The Tragedy of the Commons'. Land titling as planned by the government will ensure that forests on previously common access land are protected by the title holder. This means that 'The tragedy of the commons as a food basket is averted by private property, or something formally like it. But the air and waters surrounding us cannot readily be fenced, and so the tragedy of the commons as a cesspool must be prevented by different means, by coercive laws or taxing devices that make it cheaper for the polluter to treat his pollutants than to discharge them untreated' (Hardin, 1968).

Figure 8.3. The Relationship Between Population Growth and Area Under Cultivation Between 1983 and 2007.



Source: GOM, 2008 (Biomass Energy Strategy Report).

Box 8.1: Effects of Sedimentation in Malawi: A case of Mudi Dam

Mudi dam is located in the commercial city of Blantyre. The dam is 15m high and has a storage capacity of 1.5 million m^3 with a treatment plant of design capacity of 45,000m^3 per day. But it only supplies 8,000m^3 per day to date. The Blantyre Water Board supplements water from this dam with that from the Walkers ferry on Shire River to supply Blantyre. Currently the annual average daily demand from the two water sources is 70,700m^3 per day. However, the operating costs from the Walkers Ferry are very high due to pumping costs and that the Shire carries a high silt load in rainy season causing sedimentation at the intake, high treatment costs and frequent pump wear. Mudi Dam is therefore an important source of supply due to its low cost of operation. But the dam has become vulnerable to increased siltation as a result of soil erosion in the catchment and its direct release into the reservoir caused by deforestation in Ndirande mountain Forest Reserve and cultivation of crops in the catchment area. Approximately 30% of the dam is filled with silt and there is blossoming of water weeds in the reservoir due to eutrophication.

8.6 Impacts of Deforestation and Forest Degradation

The current trend in deforestation and forest degradation is having a negative impact on the social, economic and environment condition of the country. For example, clearing and development of catchments and river basins results in unstable soil structures which has resulted in accumulation of nutrients and silts in aquatic ecosystems. According to Kadewere (2007), 30% of the Mudi Reservoir supplying water to Blantyre City is filled with silt (refer to Box 1). This has reduced the dam capacity by 80%. In addition forest conversion in catchment area has contributed to loss of water quality and eventually risks to water borne diseases. Currently Blantyre Water Board spends several million Kwachas in water treatment. A comprehensive economic study of the contribution of renewable natural resources to the national economy (Yaron *et. al.*, 2010) has estimated that Malawi is losing US$ 93 million (about 2.4% of the current GDP) due to unsustainable use of forest resources.

Deforestation increases soil erosion which leads to reduced agricultural production. According to the Economic Study (GoM, 2010), Malawi lost MK7,540 million in the agriculture sector in 2007 due soil losses. This was 1.6% of the GDP at the time and 6.3% discounted over 10 years.

Deforestation and forest degradation have contributed to reduced electricity generation. It has been demonstrated in Chapter 3 that the existing generation capacity of 287MW is inadequate, unreliable and inaccessible in meeting the needs the majority of Malawians. Siltation and water weeds blockages reduce the water flow in the river resulting into high cost of electricity generation. As a result power cuts and fluctuating power levels are a major problem. Taking into account all losses, economic costs due to problems of power generation are put at MK1, 433 million as at 2007, representing a 0.3% of GDP and 1.9% discounted over 10 years (Yaron *et. al.*, 2010). Government spends approximately MK134 million annually on weed and silt management (see Table 8.6).

Forest degradation is affecting livelihoods especially that of women and children. Women and children spend more time searching for firewood and forest foods. Forest resources have an important safety net and income equalizing effect across rural households particularly those from poorest segments who earn their

Table 8.6: Annual Cost of Weed Management and Other Remedial Actions to Clean Malawi's Three Power Stations.

Power Station	Description of Cost	Cost in MK	Cost in US$
Liwonde Weed Management Station	Capital costs	17,800,000	127,142.86
	Labour	17,630,000	125,982.57
	Sundry, services and supply	4,230,000	30,214.29
	Maintenance	3,400,000	24,285.71
	Fuel cost	8,226,000	58,757.14
	Sub-total	51,286,000	366,328.57
Nkula Power Station	Dredging operation cost	15,000,000	107,143
	Diving services cost	4,000,000	28,571
	Cost of dredger and work boat	24,000,000	171,429
	Sub-total	43,000,000	307,143
Tedzani power station	Diving service cost	60,000	429
	Sub total	60,000	429
Kapichira Power station	Hire of dredger and work boat	24,000,000	171,429
	Dredger operation costs	12,000,000	85,714
	Diving services	4,000,000	28,571
	Sub-total	40,000,000	285,714
	Total Remedial cost	134,346,000	959,614.57

Source: GoM/EAD 2010. Private Public Sector Partnership on Capacity Building for SLM in the Shire River Basin Project Document.

income from selling firewood, timber, non wood forest products and charcoal production. Forest deforestation therefore have a devastating effect on the communities that depend on forest products for a living.

Deforestation and forest degradation are contributing about 20% to the GHG that cause global warming. Trees capture and store carbon and thereby mitigating climate change. Effects of climate change are straining the global and national economies as countries meet the costs of mitigation and adaptation to climate change. For example, Malawi spends million of Kwachas managing effects of floods and droughts. Despite, Malawi harvesting enough, approximately 20 million kwacha has been used to assist about half a million people that did not harvest enough during the 2009/10 season.

8.7 Strategies for Sustainable Management of Forestry Resources

The current Forestry Policy of 1996 and Forestry Act of 1997 were formulated and instituted to provide enabling environment and mechanism for managing trees and forest on customary and public land whilst mainstreaming a rights-based and livelihood approaches for all stakeholders. The Policy recognises the problem of deforestation and its effect on the environment and people's livelihoods. In order to control deforestation and promote sustainable management of forests and woodlands the following strategies are used:

8.7.1 Establishment and Management of Industrial Plantations

Establishment of plantation dates back to the 1950s. Pine plantations were established for provision of timber while Eucalyptus plantations were for the purpose of bridging the gap between supply and demand for wood energy and poles. Currently, the Government of Malawi is managing 90,000 hectares of plantations forests with the largest being Viphya Plantations (covering 53,000 hectares). Viphya plantations were originally established for the production of pulpwood for paper. With the support of the World Bank, Wood Energy Project, fuelwood and poles plantations were established between 1978 and 1984. Other plantations are managed by tea and tobacco estates and smallholder farmers totaling 275,00 hectares.

Management of Government plantations is facing a number of hurdles due to lack of resources and high demand. In 1995, Government retrenched all plantation staff and as a result resources to the forestry sector were reduced. This has led to poor management and degradation of plantations. Viphya Plantations are experiencing high incidences of fires and as a result about 10,000 hectares out of the 53,000 hectares need to be re-planted. Dedza and Zomba Plantations also need replanting. Some of the plantations such as Fort Lister in Mulanje are extensively barren. To improve management of plantations, government should consider privatizing some plantations.

8.7.2 Promoting Participation of Local Communities in Tree Planting and Forest Management

The Forestry department together with other Government departments and NGOs provide communities with technical expertise, inputs and other incentives for tree planting. It has been observed however that on average 60% of the planted trees survive due to lack of capacity and resources to management the tress. It is recommended that management costs in the form of public works programmes should be included in tree planting programmes. This may be view as an incentive for communities to participate in tree planting and management. Payment for tree planting and management is being piloted under the 'Tree Planting and Management for Carbon Sequestration and Other Ecosystem Services Programme'. So far 397 tree planters have planted 616 hectares and a total of 414.8 million trees have been planted (Table 8.7). In February, 2010 Cabinet approved a 'Reward for Tree Planting and Management' initiative whose modalities are still being worked out.

Table 8.7: Number of Trees Planted (2000–2009).

Year	Target	Trees Planted
2000–2001	60,000,000	30,064,296
2001–2002	50,000,000	46,540,815
2002–2003	50,000,000	42,293,739
2003–2004	50,000,000	44,196,587
2004–2005	50,000,000	31,429,235
2005–2006	50,000,000	47,293,067
2006–2007	60,000,000	51,748,417
2007–2008	60,000,000	56,548,731
2008–2009	60,000,000	64,708,069

Source: GOM/FD 2009.

Payment for Ecosystem Services (PES) including carbon trade might give also incentives to people to care for their planted trees. However, even in carbon trade projects, such as Clinton Foundation, survival rates have been reported at only 61%. In order to increase

forest cover, natural regeneration of forests should be encouraged. Some of the notable success stories in promotion of natural regeneration are regeneration of Sendwe Hill in Lilongwe and Mangweru Hill in Blantyre. Natural regeneration is encouraged through controlled cutting of young regenerants. Part of Machinga Hills which have experienced deforestation is now showing signs of recovery (see photo).

8.7.3 Enhancing Management of Forest Reserves Through Public Private Partnerships

Acquisition of land for conservation of forests under government protection started in the 1920s under the colonial rule. Most of the forest reserves were gazetted for protection of water catchment areas, biodiversity conservation and production of wood resources. Gazettment has continued up to this day while at the same time some reserves have been lost to encroachment and degazettment for developmental purposes. The first forest reserve to be gazette is Dzalanyama which was first gazetted as Central Angonilani Game Reserve in 1911 and then in 1922 as a Forest Reserve under Government Notice 11 (GN 11).

Forest reserves have encountered dramatic increase in encroachment and illegal cutting of trees during the transition from one party rule to multiparty democracy in the early 90s. People with inadequate land moved into forest reserves and charcoal making was now being done openly. The slogan 'power to the people' was interpreted as meaning anybody could do anything including cutting trees in the forest reserves at will. This led to disappearance of trees in forests such as Ndirande, Soche and Thyolo forest reserves. This led to a policy shift to promote resource use by adjacent communities through co-management. The actual implementation of co-management arrangements started in 1999 With the World Bank Project in Nkhatabay, Kasungu and Machinga. More recently, under the EU supported project 'Improved Forest Management for Sustainable Livelihoods programme' 12 Districts are implementing co-management in State forests. In addition to promoting co-management arrangement the government is currently exploring possibilities of engaging private organizations in the management of forest reserves as is the case with National Parks and Wildlife Reserves.

Sosten Chiotha

Signs of natural regeneration in Machinga Hills.

8.7.4 Establishment and Management of Village Forest Areas (VFAs)

The creation of Village Forest areas was provided for in the 1942 Forest Act (Cap 63.01). Village Headmen (VHs) were encourage to demarcate part of customary land for forest conservation. The initiative was enforced in the 1997 Act. The 1997 Act included a provision for management of forests by Village Natural Resource Management Committees (VNRMCs) rather than just VHs. Guidelines have now been formulated on management of these forests

8.7.5 Strengthening Community-based Forest Management (CBFM)

In supporting CBFM, the department supports development of effective institutions at village and district level to manage forest resources. In this regard, Village Natural Resource Management Committees (VNRMCs) have been established to spearhead forest conservation and management both on customary land and forest reserves. The department also supports community tree planting and management on customary land by providing technical advice and inputs. It also supports formation of Village Forest Areas. Contribution of forest to individual livelihood is enhanced through promotion of better management and utilization of indigenous forest, plantations, woodlots and trees. Advice and support is also given to running of Forest-based Enterprises (FBEs) for increased cash income.

Management of VFAs is facing lots of ownership challenges. Land which was designated for establishment of VFAs have been reclaimed by their previous owners for cultivation. For example, Lilongwe used to have over 1,500 VFAs during the ADB supported Lilongwe Forestry Project 1995 to 2003 but this has reduced to only 438 VFAs because some VFAs were reclaimed for cultivation.

8.7.6 Strengthening Institutional and Human Capacities

Institutional development involves staff training, acquiring necessary equipment for running of the offices and management of the forests, reviewing the Forest

Act and Policy, formulating and reviewing forest rules and regulations, national guidelines and standards for sustainable forest management.

The Government is providing training at certificate and diploma level at Malawi College of Forestry and Wildlife. The college has been recently accredited to the University of Malawi. Other long term training at BSc and MSc level has been supported by Government and different donors. Community training is being provided by extension workers at local level.

8.7.7 Strengthening and Harmonizing Forestry Policies

The 1942 Forest Act was reviewed in 1997 and a comprehensive Forest Policy was formulated in 1996. A supplementary policy on Community-Based Forest Management was formulated in 2003. The Policy is currently being reviewed to include issues of climate change and HIV and AIDS. The policy review process that is currently going on shows that implementation is more of a problem rather than the policy itself. The review also seeks to harmonize the forestry policy with other policies whose operations affect forestry management such as the irrigation, land, electricity policies.

8.8 Conclusions and Recommendations

As seen from above forests play multiple roles in social and economic development; and environmental protection. Therefore, it is important that forests are managed in a sustainable manner. In order to achieve this some of the following issues need to be addressed:

8.8.1 Improve Forestry Data Collection

The last comprehensive forest cover and biomass assessment was done in 1992. The forest cover area being used by the Department of Forestry is extrapolated from the 1992 assessment and then it is reclassified using the FAO system. Forest data needs o be updated at frequent intervals as conditions and factors that cause deforestation change all the time. An up to date information on forests in Malawi will assist with planning for tree planting, forest conservation and carbon finance. There are currently opportunities available for this work under the EU supported IFMSLP II and UNDP supported multi-sectoral 'Programme to Manage Climate Change in Malawi' and Malawi 'African Adaptation Programme' which are under implementation.

8.8.2 Improve Forest Governance

Forest reserves face encroachment (illegal settlements and opening up of gardens) and illegal cutting of trees for charcoal making and firewood. Law enforcement has not been successful. There is need to fully implement the co-management initiative in the IFMSLP sites in order to have clear demonstration of success.

Good forest governance approaches at all levels are necessary for sustainable forest resources management. Currently there is inadequate regulation enforcement for Forest Act. Non compliance is evident from availability of illegal forest produce like charcoal, indigenous and cedar timber on the market. Robustness of institutions at all levels entrusted with forest resource management is lacking. Institutional capacity for local level institutions such as the VNRMCs and Block Committees is inadequate to guarantee sustainability.

8.8.3 Control Plantation Fires

Plantations fires have presented a major problem in recent years, and this has been exacerbated by financial constraints leading to few field workers who are employed to manage and protect the plantations. The other problem is inadequate tools and materials to properly manage these plantations. However, there is an opportunity under the 2010 JICA assistance to Malawi where vehicles and fire fighting equipment will be procured. Annual fire plans formulation needs to be enforced for all plantations.

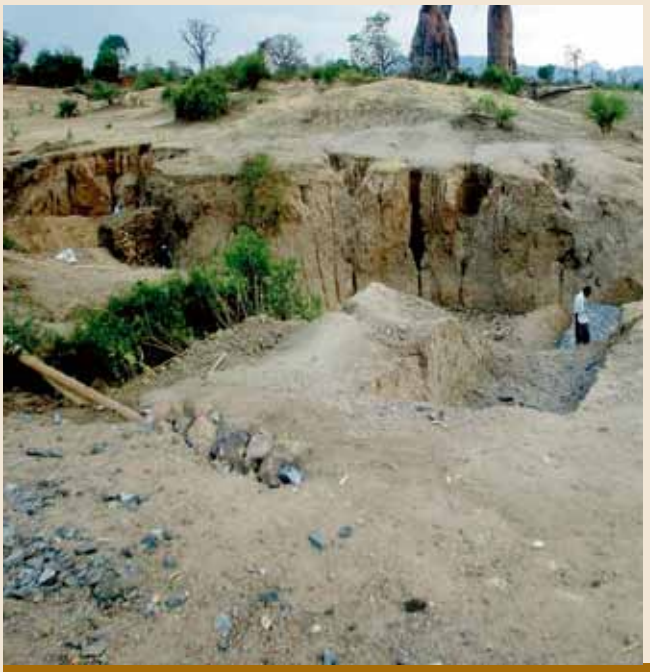
8.8.4 Develop an Adaptation Strategy for Climate Change-related Threats to Forestry

Forests need to be resilient to withstand the threats of climate change such as increased fires due to droughts and change in species composition including extinction of some species. The government needs to get prepared by conducting research into how forests are going to be affected by climate change and come up with a strategy to deal with the situation. REDD

8.8.5 Initiate Payment for Ecosystems Services Programmes

Local communities need support to plant trees and conserve natural forests as they struggle to meet their livelihood needs. The above causes of deforestation show that people prefer to use forests for other uses rather than keep them for environmental conservation. This is because forests, especially natural ones, are looked at as free goods and 'God given'. There is no market value attached to them. When people sell timber, charcoal or firewood, the cost reflects labour and transport rather than the cost of the wood itself (which is the cost of maintaining the resource). This makes using wood products artificially cheap, and creates an incentive for misuse. By developing payment for ecosystems services programmes, those who would otherwise cut down forests can be paid to maintain these resources.

Photo Essay - Erosion and Infrastructure Damage



Sosten Chiotha

Sosten Chiotha

Extensive erosion due to deforestation and land mismanagement in Kasinje district has created the large gullies that can be seen in the photograph above. This erosion is now threatening both the few remaining baobab trees in the area, and the nearby road. Measures to protect the road (top right) are costly and temporary solutions that do not address the underlying causes of erosion.

Photo Essay: Afforestation

Sosten Chiotha

Gibson Mpepho

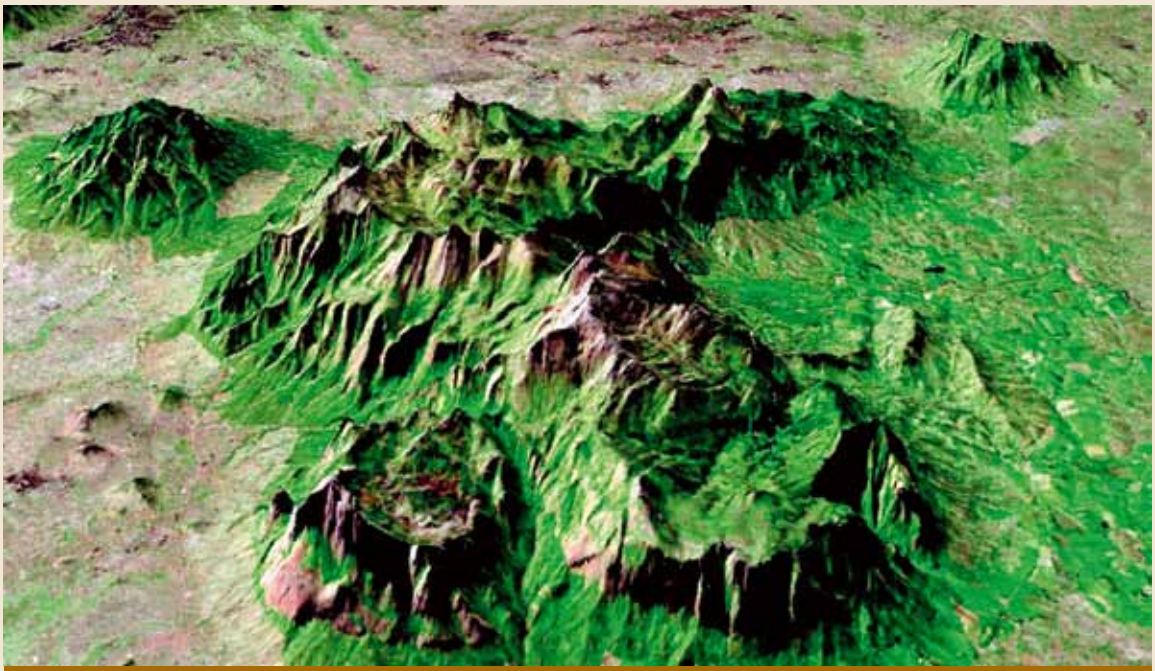
Above left: Agroforestry is one solution to the increasing pressure on forests by communities searching for agricultural land. Agroforestry involves intercropping agricultural crops and trees. Communities plant indigenous trees that can be used for fruit, medicine, construction or fuelwood, and tend to these trees while growing their crops in the same area. As shown in image on left, maize can be grown alongside the trees; such intercropping can improve yields and the health of biodiversity in the area.

Above right: Involving communities in co-management of forests is possible when they benefit from preserving trees. In addition to the direct benefits afforded by trees, indirect benefits can also be derived from forested areas. The photo shows one example, of bee-keeping in Mithundu, Lilongwe. A clay pot housing bees is hoisted on a tree; the honey thus collected is sold for extra income.

Photo Essay - Deforestation

Africa Atlas 2006

Mulanje Massif in 1973.



Africa Atlas 2006

Mulanje Massif in 2006.

Note decreasing forest cover and cultivation on marginal lands in both series of images. Source: Africa Atlas.

Rapid deforestation reduces Malawi's ability to act as a carbon sink and contributes to soil erosion thus affecting water quality and also impact on the local climate.

Photo Essay - Deforestation and Natural Regeneration

Sosten Chiotha

The hill in Machinga covered with trees in 1994. The spectacular thick foliage and colours of young leaves are shown.

Sosten Chiotha

The same area showing a slight reduction in density of forest canopy in 1997.

Sosten Chiotha

In 2005 the hill is almost completely devoid of trees however, natural regeneration is helping rehabilitate the hill.

Sosten Chiotha

In 2010, natural regeneration has begun to show results.

This photo essay traces deforestation of a hill in Machinga which is now undergoing natural regeneration from 1994 to present.

Unsustainable use of forest resources causes dramatic changes in landscapes. Trees cut down for firewood or burnt down for charcoal destroys habitats for flora and fauna. Government of Malawi's policy of natural regeneration will help in increasing forest cover in Malawi.

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Appendix

Gazetted Forest Reserves as of June 2010.

No.	Forest Name	District	Area Km^2	Area (Ha)	Year Gazetted
Northern Region					
1	Chikhang'ombe	Chitipa	5	500	2002
2	Mafinga hills	Chitipa	42.6	4260	1976
3	Mahowe	Chitipa	59.168	5916.8	2002
4	Matipa	Chitipa	10.62	1062	1948
5	Mughese	Chitipa	6.73	673	1948
6	Jembya	Chitipa	137.64	13764	1981
7	Musisi	Chitipa	67.34	6734	1948
8	Wilindi	Chitipa	9.07	907	1948
9	Karonga North escarpment	Karonga	79.076	7907.6	2002
10	Karonga South escarpment	Karonga	130.502	13050.2	2002
11	Vinthukutu	Karonga	22.27	2227	1948
12	Ruvuo	Nkhata-Bay	47.929	4792.9	1935
13	Mtangatanga	Mzimba	84.43	8443	1948
14	Perekezi	Mzimba	147.6	14760	1935
15	Bunganya	Mzuzu	34.7	3470	1973
16	Kawiya	Nkhata-Bay	6.439	643.9	
17	Chisasira	Nkhata-Bay	33.9	3390	1935
18	Kalwe	Nkhata-Bay	2.1	210	1956
19	Kaning,ina	Nkhata-Bay	165.55	16555	1935
20	Kuwilwe	Nkhata-Bay	6.99	699	1935
21	Mkuwadzi	Nkhata-Bay	26.68	2668	1927
22	South Viphya	Nkhata-Bay/Mzimba	1147.8	114780	1958
23	Uzumara	Rumphi	5.96	596	1948
Central Region					
24	Chongoni	Dedza	126.4	12640	1924
25	Dedza mountain	Dedza	32.6	3260	1926
26	Dzenza	Dedza	8.29	829	1948
27	Msitolengwe	Dedza	0.58	58	1974
28	Dedza-Salima escarpment	Dedza/Salima	326	32600	1974
29	Mua-Livulezi	Dedza/Salima	121.47	12147	1924
30	Mua-Tsanya	Dedza/Salima	10.62	1062	1932
31	Dowa hills	Dowa	24.2	2420	1974
32	Kongwe	Dowa	18.13	1813	1926
33	Ngara	Dowa	22.53	2253	1958
34	Chimaliro	Kasungu/Mzimba	160.787	16078.7	1926

No.	Forest Name	District	Area Km^2	Area (Ha)	Year Gazetted
35	Dwambazi	Nkhotakota/Nkhata-Bay	763.096	76309.6	1996
36	Dzalanyama	Lilongwe/Dedza/Mchinji	989.34	98934	1922
37	Nalikule	Lilongwe	1.04	104	1948
38	Thuma	Lilongwe/Salima	163.95	16395	1926
39	Mchinji	Mchinji	191.66	19166	1924
40	Bangwe	Ntcheu	13.48	1348	1948
41	Chirobwe	Ntcheu	10.686	1068.6	1960
42	Dzonzi	Ntcheu	40.2	4020	1924
43	Mvai	Ntcheu	42.68	4268	1924
44	Kaombe	Ntchisi	38.9	3890	1992
45	Ntchisi mountain	Ntchisi	97.12	9712	1924
46	Mdirasadzu	Ntchisi	155	15500	1974
47	Malele Island	Salima	2.07	207	1930
48	Senga hills	Salima	16.881	1688.1	1958
Southern Region					
49	Chigumula	Blantyre	6.22	622	1925
50	Michiru	Blantyre	39.66	3966	1970
51	Milare	Blantyre	0.85	85	1989
52	Mudi	Blantyre	0.417	41.7	1922
53	Ndirande	Blantyre	17.09	1709	1922
54	Soche hill	Blantyre	3.63	363	1922
55	Chiradzulu	Chiradzulu	11.46	1146	1924
56	Malabvi	Chiradzulu	2.07	207	1927
57	Liwonde	Machinga	294.73	29473	1924
58	Malosa	Machinga	85.99	8599	1924
59	Mangochi	Mangochi	325.53	32553	1924
60	Mangochi Palm	Mangochi	5.1	510	1980
61	Namizimu	Mangochi	869.94	86994	1924
62	Phirilongwe	Mangochi	161.29	16129	1924
63	South Nyasa Island	Mangochi	2.7	270	1935
64	Mulanje mountain	Mulanje	552.09	55209	1927
65	Sambani	Mulanje	1.29	129	1948
66	Thuchila	Mulanje	24.34	2434	1925
67	Masatwe hills	Mwanza	73.88	7388	
68	Michiru mountain	Mwanza	14.48	1448	
69	Mkanya hills	Mwanza	3.16	316	
70	Mlindi hills	Mwanza	6.88	688	
71	Nankhwazi hills	Mwanza	1	100	
72	Neno escarpment	Mwanza	68.44	6844	

No.	Forest Name	District	Area Km^2	Area (Ha)	Year Gazetted
73	Nkula/Tedzani	Mwanza	30.92	3092	
74	Phirilanjoka	Mwanza	2.76	276	
75	Thambani	Mwanza	106.7	10670	1927
76	Tsamba	Mwanza	32.4	3240	1928
77	Twiti mountain	Mwanza	10.32	1032	
78	Zaka hills	Mwanza	0.56	56	
79	Matandwe	Nsanje	262.05	26205	1931
80	Amalika	Thyolo	5.2	520	1974
81	Kalulu hills	Thyolo/Nsanje	28.23	2823	1958
82	Lichenya	Thyolo	1.29	129	1948
83	Masambanjati	Thyolo	0.92	92	1914
84	Masanjere	Thyolo	1.01	101	1930
85	Thyolo	Thyolo	13.21	1321	1924
86	Thyolomwani	Thyolo	9.32	932	1930
87	Zomba mountain	Zomba	59.37	5937	1913
88	Bunda Forest Reserve	Lilongwe			
	NATIONAL TOTAL			879,430.10	

Proposed Forest Reserves as of June 2010.

1	Muwanga	Chitipa	7.49	749.00
2	Chipala	Chitipa	12.27	1,227.00
3	Mbula	Chitipa	11.15	1,115.00
4	Therere	Chitipa	20.97	2,097.00
5	Kamphyongo	Chitipa	6.35	635.00
6	Kapembe	Karonga	8.1	810.00
7	Nambatata	Karonga	3.453	345.30
8	Kalembo	Karonga	14.46	1,446.00
9	Chimaliro	Rumphi	2.9	290.00
10	Chombe	Rumphi	55.99	5,599.00
11	Sonjo	Mzimba	9.971	997.10
12	Ighembe	Karonga	4.55	455.00
13	Chamthasha	Karonga	4.98	498.00
14	Choma/mbweza	Nkhatabay	71.31	7,131.00
15	Mzumagazi	Nkhatabay	78.9	7,890.00
16	Chisasiro extension	Nkhatabay	174.04	17,404.00
17	Kandoli hills	Nkhatabay	26.16	2,616.00
18	Phirilongwe extension	Mangochi	483.28	48,328.00
19	Kawinga/nyambi hills	Machinga	67.34	6,734.00
20	Chingale hills/namatunu	Zomba	68.53	6,853.00
21	Chikwawa extension escarpment	Chikwawa	48.25	4,825.00
22	Chawa	Kasungu	0.58	58.00
23	Mfumbati	Ntchisi	21	2,100.00
			1,202.024	120,202.40

Government Plantation Forests in Malawi by Area and Function.

1	Lusangadzi	8,083.20	Timber
2	Mazamba	5,897.00	Timber
3	Nthungwa	8,798.10	Timber
4	Chikangawa	6,831.50	Timber
5	Kalungulu	7,637.80	Timber
6	Luwawa	8,912.20	Timber
7	Champhoyo	6,534.60	Timber
8	Ighembe		Pole/Fuelwood
Central Region			
9	Kaombe	1,281.40	Timber
10	Ntchisi	218	Timber
11	Dzalanyama	1,700.00	Timber
12	Katete	3,204.00	Pole/Fuelwood
13	Chongoni	3,811.00	Timber
14	Dedza	1,771.00	Timber
15	Dzonzi-Mvai	1,791.70	Timber
16	Ngara	1,221.80	Fuelwood/Poles
17	Dowa Hills	383.9	Fuelwood/Poles
Southern Region			
18	Nauko	3,000.00	Fuelwood/Poles
19	Zomba Mountain	2,003.00	Timber
20	Zombaouterslopes	1,453.00	Timber
21	Michiru	1,063.80	Timber/Fuelwood/poles
22	Chigumula	3,431.00	Timber
23	Chambe	579.2	Timber
24	Likhubula	55.7	Timber
25	Easter Outslopes	1,252.60	Timber
26	Fortlister	3,430.80	Timber
27	Ndala	10.9	Fuelwood/Poles
28	Thuchira	1,945.30	Fuelwood/Poles
29	Nanchidwa	2,804.60	Fuelwood/Poles
30	Amalika	500	Fuelwood/Poles
31	Milare	85	Fuelwood/Poles
32	Bangwe	308	Fuelwood/Poles
	Timber	75,472.80	20 (Timber plantations)
	Fuelwood/Poles	14,527.20	11 (Fuelwood Plantations)
	Grand Total	90,000.00	

Vegetation Types of Malawi; Adapted from Dosset Lamer 2001.

Vegetation Type	Defining Characters	Malawi Examples
Zambezian Woodland		
Zambezian Miombo Woodland	Dominated by species of *Brachystegia* alone or with *Julbernardia* and *Isoberlinia*	Occurs widely in forest reserves throughout the country, but used to be the main vegetation of plateau and its scarps.
Zambezian Mopane Woodland	Dominated by *Colophospermum mopane*.	Mua Tsanya FR, Vwaza marsh, Liwonde NP and Lower Majete WR.
Zambezian Undifferentiated Woodland	Defined by the absence of miombo and mopane dominants but often dominated by *Acacia* and *Combretum* species.	Used to be wide spread in Shire Valley, Phalombe, Lilongwe and drier lake shore plains, but much has been destroyed due to farming and settlements.
Transition Woodland	They are intermediate between forests and woodlands, may be secondary or ecotonal.	Small fragments are found in Nkhata Bay, Vinthukutu, Mulanje Mountain, and Nyika Plateaux at upper limit of miombo, just before Afromontane.
Deciduous Forests and Thickets	Characterised by canopy species which are deciduous for more than a month and understorey species deciduous for several month	Small patches of deciduous forests are found in Lengwe and Liwonde NPs; deciduous thickets are found in Lengwe and Liwonde NPs.
Evergreen forest		
Riparian Forest	Characterised by species adapted to banks of river courses or influenced by flood (occurs at all altitudes)	Rivers in Nyika and Viphya Plateaux, Dzalanyama FR.
Lowland Rain Forest	Characterised by the presence of only 0–25% of Afromontane species	Foothills around Thyolo and Mulanje Mountains, Malawi Hills (Nsanje), and Kalwe and Nkuwazi FRs.
Mid altitude Rain Forest	Defined by flora containing a mixture of lowland and Afromontane elements and confined to lower slopes of high mountains	Mulanje Mountain foothills, Kaning'ina FR, Chipata Mountain.
Afromonatne Rain Forest	Essentially evergreen, though some emergents may lose their leaves for a week or two	Ntchisi Mountain, Misuku Hills, Mafinga Mountain, Nyika and Viphya Plateaux.
Undifferentiated Afromontane Forests	They occur on high plateaux (2250–2450 m) and nearly all species are evergreen	
Hagenia abyssinica forest		Nyika National Park.
Juniperous procera forest		Nyika National Park.
Widdringtonia whytei forest		Mulanje Mountain.
Afromontane Bamboo	Dominated by *Arundinaria alpine*	Dedza and Mulanje Mountains.
Afromontane Evergreen Bushland and Thicket	Defined by the dominance of Erica species	Widespread and common on larger mountains (Dedza, Mulanje, Nyika).
Afromontane Shrubland	Characterised by stunted individuals of bushland and thicket	Nyika National Park, Mulanje Mountain
Afromontane Grassland	Mainly, secondary, fire-maintained grassland	Misuku Hills, Mulanje Mt, Nyika and Viphya Plateaux, Dedza Mt, Zomba-Malosa Mts.

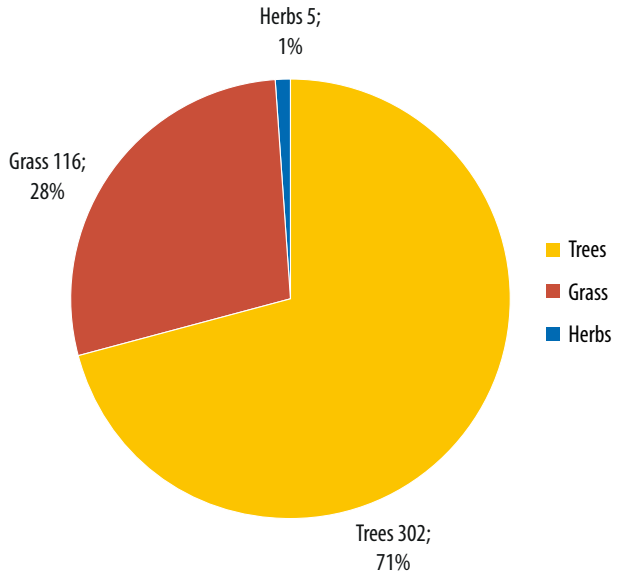
Economic Costs of Unsustainable Forest Resource Use.

Natural Resource & Source of Cost–base Case	Annual Cost (2007 Prices)			Discounted Cost of Damage Over 10 Years	
	MK Million	US$ Million	% of GDP	MK Million	% of GDP
	12,983	93	2.4%	31,795	11.0%
Unsustainable roundwood (excl fuelwood)	3,100	22	0.4%	12,710	2.4%
Unsustainable fuelwood	6,089	44	1.2%	2,495	4.8%
Flood prevention (indicative only)	232	2	0.2%	1,987	0.8%
Indoor air pollution	3267	23	0.7%	13,394	2.7%
Outdoor air pollution - WB 2002	327	2	0.2%	2,417	0.5%

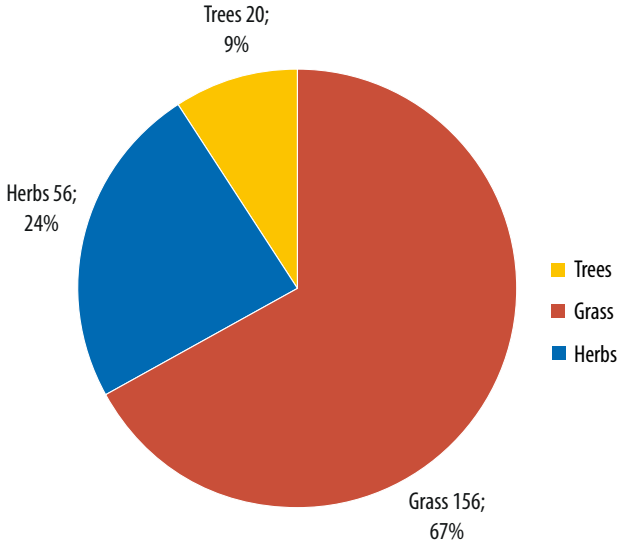
Source: GOM, 2010. Economic Study. UNDP/UNEP Malawi Poverty and Environment Initiative.

Overall Quantity of Seed Emergence in Charcoal Producing Spots as Compared to Non-charcoal Production Spots.

Bon Charcoal Production Spots.



Charcoal Production Spots.



Source: Kadzuwa, 2010.

Trends in Forest Cover

Forest Type	1973	1991	Change	2000	2007
Evergreen forest	87,990	82,620	-5,370		
Brachystegia forest hilly	2,399,610	1,685,850	-713,760		
Brachystegia forest flat	1,913,300	733,110	-1,180,190		
Forest plantations	50,620	136,430	85,810		
Total Forests	4,451,520	2,638,010[i]	-1,813,510	2,562,000[ii] -76,010	3,336,000[iii] (36% land area is forest cover)

Source:
i Forest Department, Forest Resources Mapping and Biomass Assessment 1993.
ii Earth Trends 2003.
iii FAOSTAT 2010.

CHAPTER 9

Photo of Play Pump, By Sosten Chiotha

WATER RESOURCES

Photo of Lake Malawi, By Shibu Balakrishnan

9.1 Introduction

Climate change will have a disastrous impact on southern Africa, of which Malawi is part, having major influence on the environment including water availability (Nkomo, *et. al.*, 2006). The onset of the rainy season is around October to November in most parts of Malawi, with the highest rainfall occurring around February to March or early April especially in the north. The rains tail off in late April and May when winter begins. Rainfall distribution in Malawi is, in part influenced by local physiography and the direction of the prevailing wind systems which have an important determining factor on the amount of rainfall received. For example, the incidence of the south-easterly winds on the western shores of Lake Malawi heightens rainfall in these areas (Archer and Laisi, 1980), which is why Nkhotakota, Nkhata Bay and Mwangulukulu in Karonga have the highest annual rainfall totals on record. Similarly, the dominating features of the Zomba Mountain and the Shire Highlands influence high rainfall in the districts of Zomba, Thyolo and Mulanje thereby creating high runoff in these areas.

Annual rainfall distribution is critical in ensuring water resources availability over time. The country's annual water balance is the sum of the antecedent precipitation, the current precipitation, evaporation and outflow through the Shire River to the Zambezi. The mean annual runoff over the land area of the whole country is 196 mm, equivalent to 588m^3/s, corresponding to about 19 percent of the country's mean annual rainfall (GoM, 2008). This means therefore that the balance of 81 percent of the total rainfall that the country receives is either stored as surface or groundwater, with much of it being lost to the atmosphere through evaporation. Although the country has the largest riparian area of Lake Malawi, 65.9%, it contributes only 42.6% of the total inflow into the lake while 27.2% of the lake's area in Tanzania drains 52.9% of its total inflow and only 4.5% from Mozambique which shares 6.9% of the lake's total area. Therefore, only about 19% of the country's annual rainfall and net storage in its lakes and reservoirs can be put to use for the socio-economic development of the country and rain-fed agriculture.

The ambition of Malawi is to propel the country from a low-income to a middle or higher-income nation. This however implies engaging an extra gear to accelerate development and growth in the various sectors of the economy which will also have an impact on the available water resources. It must be recognized however that water is a finite resource. The Vision of Equitable Social and Economic Development in Southern Africa recognizes that water is increasingly becoming a limiting factor for socio-economic development, and goes on to underscore the fact that water scarcity makes it absolutely essential for improved management (SADC/GWP, 2002). Furthermore, the region's Vision is focused on equitable access to water of acceptable quantity and quality. However, water is a finite resource, and is becoming scarcer as a result of human activities through pollution. Prior to the Earth Summit in Rio 1992, a meeting of experts in Dublin in 1985 cast four principles, the first of which states the fact that water resources are finite and must be recognized as such. People's perception that water will always be available in the quantities that they need must therefore change, and societies should be converted to view water as a resource which will never increase, but rather decrease.

In view of the variability in rainfall and runoff in the various river basins, development programmes need to be implemented by striking a balance between the water needs of the people, those of the economy, and the requirements of the environment. The fact that water resources are finite indicates that new measures including conservation, demand management and continuous auditing must be part of the development agenda. This chapter therefore outlines the key issues that are of paramount concern affecting water resources, isolates the driving forces that lead to their status and discussing the pressures and impacts on the resource and ushers in strategies for consideration in order to meet the desired management framework.

9.2 Status of Water Resources

9.2.1 Surface Water

The drainage system of the country has been divided into 17 water resources areas (WRA) and each representing a river basin. The water resources areas are further sub-divided into 78 water resources units from which hydrological data is collected for purposes of water resources management.

Lakes and Reservoirs

Lake Malawi stores the bulk of Malawi's renewable surface water. The Shire River is the largest river in the country and the only outlet of Lake Malawi. There are also other lakes, including Lake Chilwa, an inland drainage lake without an outlet, Malombe–an inflation of the Shire River below its outlet from Lake Malawi, Lake Chiuta (shared with Mozambique), Lake Kazuni, Chia Lagoon and Lake Chiwondo. Three large marshes are of economic significance: the Elephant Marsh, Ndindi Marsh and Vwaza Marsh (Table 9.2).

Table 9.1: Distribution of Fish Ponds in the Three Regions of the Country (2003–2008).

Region	Number of Ponds	
	2003	2008
Southern	3,500	3,750
Central	2,900	3,100
Northern	3,100	3,150
Total	9,500	10,000

Source: Department of Fisheries.

Lake Malawi stores an average of 90 km^3 of live storage (water that can flow out through the Shire River) and has a surface area of 28, 760 km^2 and an estimated total volume of 7,725 x 109 m^3 at the mean lake level of 474.00 metres above mean sea level. This is an important asset for the country as it plays a vital role in the socio-economic development of Malawi. Out of this volume, the Shire River drains an annual average of about 18 km^3 of water into Mozambique. The annual surface water yield on land is about 13 km^3 and predominantly drains into Lake Malawi and the Shire River. More than 90 per cent of this runoff occurs in the rainy season, during the months of December to April (Laisi, 2007).

Rivers and Streams

The country has 17 major catchment basins that vary in size from the largest: the Shire Basin with a total drainage area of 18,945 km^2, to the smallest: Chizumulo Island, with an area of 3.3 km^2. Most of the rivers in these basins are perennial, but could become annual in periods of low rainfall. These 17 catchment basins have a total area of 94, 276 km^2 with an average annual rainfall of 1,037 mm representing an average annual runoff of 196 mm or 588 m^3/s.

Rivers of the North

Rivers of the north such as the North and South Rukuru, cover a total catchment area of more than 2,000 km^2. However, due to human interventions, it is uncertain if these rivers can continue to maintain good flows. The Ministry of Irrigation and Water Development (MOIWD) installed water level and flow measuring networks for these rivers in the early 1950s, as it did for those in the central and southern regions. As such, 40 years of data exists for the primary stations, from which indications of trends in river flows can be deduced. This data shows that rivers no longer flow regularly, but instead have unusually high flows during the early and middle part of the rainy season, characterized by flooding, and unusually low flows in the dry season.

Because of frequent flooding of the North Rukuru, Karonga Township has frequently been inundated and experienced significant losses of property. To minimize occurrence of these predicaments, the government has constructed a leveé along the banks of the river and a flood drain across the township to carry excess waters to the lake without affecting the settled areas.

As the rains finish, some rivers begin to dry up. This can be observed in central Karonga's Bwaghe, Remero and Ruasho and Mwesia rivers. These rivers are particularly disadvantaged due to low rainfall in the Lupembe area. While other rivers in the country were still flowing well, these rivers were either dry or close to running dry in

Table 9.2: Major Reservoirs and Marshes in Malawi.

Reservoir	Surface Area (Km^2)	District(s) of Location
Lake Malawi	28,750	Karonga, Rumphi, Nkhata Bay, Nkhotakota, Salima, Dedza and Mangochi.
Lake Chilwa	683	Phalombe and Zomba.
Lake Malombe	303	Mangochi.
Lake Chiuta	60	Machinga.
Lake Kazuni†	-	Mzimba and Rumphi.
Chia Lagoon	22	Nkhotakota.
Chiwondo Lagoon†	-	Karonga.
Elephant Marsh†	-	Chikwawa and Nsanje.
Ndindi Marsh†	-	Nsanje.
Vwaza Marsh†	-	Rumphi.

† Signifies that the Surface Area is Not Known As Yet.

May 2010. For the Mwesia, which carries a new bridge on the road between Karonga and Chitipa, evidence of significant prior flooding was clear, and indications of undercutting the bridge were also vivid. Because most of its tributaries were running dry, the North Rukuru, one of the largest rivers in the country was also showing signs of poor flows. By May 2010, it was possible to cross the river by wading below the Karonga-Kaporo Bridge which is close to its mouth on the shores of Lake Malawi.

Similar incidences of flooding followed by dry spells are also a problem on the South Rukuru River, which drains a catchment area of 11,993 km^2.

Finally, the amount of sand that can be seen in these dry river beds and the waters of the North Rukuru indicates an unprecedented rate of erosion in the headwaters of these systems.

Rivers of the Centre

The Central Region consists of a central plateau and an escarpment zone to the east. Due to its relatively lower elevation, most of its rivers emerge from dambos and flow through a small gradient before reaching the escarpment zone, where the flow velocities begin to accelerate. The major rivers in the centre are the Dwangwa, the Bua, and Linthipe.

The Linthipe River has its source at Dedza Township. It meanders through mountains and knolls and is later joined by its two major tributaries, the Diamphwe and Lilongwe, on its way to Lake Malawi. Much of the waters of the Linthipe comes from the perennial Diamphwe and Lilongwe rivers. The mean annual rainfall within the basin is between 900 and 1000 mm. Flow measurements for the Lilongwe River have been taken ever since a station was opened at the Lilongwe Bridge more than four decades ago on October 21, 1955. Another station was also opened at Salima on September 25, 1952 to measure daily flows and yields. Based on its mean annual flow of 8.70m^3/s it is expected that the demand for water within the city will exceed what the river is able to supply by 2011 (Malawi Water Partnership, 2006).

Rivers of the South

Most of the rivers in the south of the country originate from the Kirk Ranges, the Shire Highlands, and the Zomba-Malosa massif. The Rivi Rivi, Lisungwi, Wankulumadzi, Mwanza and the Nkombeziwafodya all drain the right bank of the Shire River with the Lunzu, Likabula, Mwamphanzi and other smaller rivers draining the left bank. They drain areas of poor vegetation where rainfall is also low and there is high land degradation. Consequently, rivers such as the Rivi Rivi, Lisungwi and Wankulumadzi are highly laden with silt. Water abstraction from these rivers is relatively low, due to comparatively low economic activities in their catchments.

Flowing to the north and east from the Shire Highlands, the Mulanje Mountain, and the Zomba-Malosa Massif are the Sombani, Phalombe, Thondwe, Likangala and the Domasi rivers. The Domasi River supplies water to the Domasi Rice Irrigation Scheme while the others are important sources for water supply to the City of Zomba and rural communities that are serviced by gravityfed piped water supply systems. Major water demand in this system results from irrigation for tea, coffee and other crops within the Shire Highlands.

9.2.2 Surface Water Quality

Many river basins in the country are under severe pressures due to deforestation, unsustainable agriculture, settlements, mining, industry, commerce, tourism and climate change. These activities have influenced changes in water quality especially due to sediment loads, industrial wastes, chemicals from agricultural lands, and the proliferation of aquatic vegetation.

Sediment Load

Soil erosion, originating from areas which have been severely deforested, is evident in many catchment basins. Soil loads that are carried by rivers and streams downstream change the channel configuration in the process. As a result, these rivers and streams are unable to effectively convey flow, increasing the risk of flooding. The large concentrations of sand in river beds reveals the gravity of the problem of soil erosion and siltation in river channels, as in central Karonga, the Nkhotakota lakeshore, the Shire valley and rivers that flow towards Lake Chilwa.

Agricultural Chemicals

While agricultural chemicals such as inorganic fertilisers, herbicides and pesticides are essential for increasing agricultural output and preventing post-harvest crop losses, these chemicals also play a role in the proliferation of algae in many river channels. Fertilisers are also the reason for the growth of other riverine vegetation that inhibits the smooth flow of water in the process.

Industrial Wastes

The growth of the industrial sector in Malawi has not been matched by the development of waste disposal mechanisms. Effluent from small and large companies, as well as solid wastes from service centers such as

Lake Malawi in 2001.

Lake Malawi in 2006.

Source: Africa Atlas 2006.

restaurants, is often released into river systems. The effluent is unsightly, unhealthy, and decreases the availability of clean water.

The water quality of the Lilongwe River is slowly degrading because of an increase in chemicals discharged into the river system either directly or indirectly (Kwanjana, 2009). An increasing number of industries in Lilongwe are contributing to the bio-chemical constituents in the waters of Lilongwe River (Kwanjana, 2009). These are lead, cadmium, nitrates, phosphates, BOD, suspended solids and faecal coliform. (Kaonga, *et. al.*, 2008). Blantyre's Mudi River, which is also highly polluted and has aroused the anger of villagers dependent on it, who bears the brunt of this pollution.

A comparison of water sample standards to those of the World Health Organization and the Malawi Bureau of Standards indicated that most chemical values were above safe limits. The study further showed that high heavy metal values were more likely to be detected during the dry season, as they are diluted in the rainy season.

Suspended Solids

The benefits that arise with the development of the commercial sector also come with serious environmental challenges. In areas of high concentration of people such as at markets, it is necessary to provide adequate facilities for waste disposal. Unfortunately, while government provides some services, the disposal of solid wastes is often carried out wantonly. High levels of plastics are deposited randomly in the major cities of Blantyre, Lilongwe, Mzuzu and Zomba. These plastics often end up in rivers and can be a great hazard to birds and other fauna.

Aquatic Weeds

The most common aquatic weeds found in the country are the Water Hyacinth (*Eichhornia crassipes*) Kariba Weed (*Salvinia molesta*) Water Lettuce (*Pistia stratiotes*),

Parrot's Feather (*Myriophyllum aquaticum*) and Red Water Fern (*Azolla filiculoides*). Under favourable conditions these aquatic weeds develop thick mats that give the illusion there is no water beneath.

Aquatic weeds, which can reduce agricultural, domestic and industrial pollution and provide a continuous supply of phytoplankton, can also be a menace. Some of the harmful effects of aquatic weeds include (Lancar and Krake 2002):

- Reduction of water storage capacity in reservoirs, tanks and ponds;
- Impediment of flow in irrigation canals and drainage systems;
- Reduced fish production;
- Interference with navigation and aesthetic value for tourism, and;
- Enhancing habitats for mosquitoes.

9.2.3 Groundwater

Malawi is highly dependent on groundwater for water supply to rural areas. It is expected that irrigation using groundwater will rise in the future as pressures for economic growth and food production become more acute (Hollingworth and Chiramba, 2005). In areas of low stream density, groundwater can play a leading role in water supply for domestic needs as well as for agriculture. Some urban centres in the country such as Chitipa, Karonga, Dowa, Salima, and Dedza, have depended on this resource.

The country's dependence on groundwater is more pronounced in the rural areas. Due to changes in policy, the functions of water provision in rural areas are now carried out mainly by private contractors under the general supervision of government and non-state actors. By 2006, there were 4,896 boreholes in the Northern region, 12,068 in the Central region, and 14,074 in the Southern region.

9.2.4 Groundwater Quality

The challenges facing groundwater are twofold. Firstly, there is inadequate control of groundwater abstraction, resulting in over-exploitation; and secondly, pollution by cities, industry or agriculture (UNEP, 1996). Many aquifers are being over-exploited, which will lead to reduction in ground-water availability if not controlled. In addition, the absence of a comprehensive groundwater map makes it difficult to guide water development. The only comprehensive assessment of ground-water in the country was carried out over two decades ago. It has been observed that on a national scale groundwater quality is generally acceptable for domestic water requirements, although there have been incidences where groundwater quality has not been fit for human consumption (GoM, 1986).

Typical groundwater quality problems in the country are: unpleasant smell due to high concentrations of sulphur in the bedrock and high salinity caused by evaporative concentrations in shallow water tables. Other groundwater quality problems are associated with high levels of iron which are widespread throughout the country, especially in the Basement aquifer. High iron content in groundwater has been blamed for corrosion of borehole linings and hand pump components. Manganese concentrations of above 1mg/l are common in the South Rukuru Basin and present similar problems as those caused by iron. In addition, manganese is also responsible for the bad taste of groundwater and discoloration. The Lower Shire Valley is prone to having groundwater with high levels of chloride, causing boreholes to be abandoned. Elsewhere, fluoride content is beyond the acceptable levels for potable water supply, causing dental fluorosis. Pollution of ground-water from faecal matter is high in several areas, indicating that groundwater facilities should be strategically located away from populated areas to minimize levels of pathogens. Nitrate concentrations are highest in areas of high agricultural activity due to use of inorganic fertilizers.

9.2.5 Water Resources Availability

While Malawi has significant volumes of water in its lakes and rivers, it is considered water-stressed as its renewable water resources per capita are less than 1,400 m^3 (GoM, 2008). With per capita water availability of only 961 m^3 in 1990, expected to decrease to 403 m^3 in 2025 (Hollingworth, *et. al.*, 2005), Malawi is worse off in terms of water availability than many other countries in the SADC region. With climate change coupled with land degradation and water pollution, the situation of water availability in the country would become more serious than anticipated unless pragmatic measures are put in place and strong enforcement mechanisms are implemented in water resources development and management.

Water availability in rural areas is dependent on the presence of perennial rivers and streams, from which gravity-fed piped water supply systems draw water for supply to the rural population. In the urban areas, water availability could become worse with some of the sources of water supply either being silted (such as Mudi Reservoir in Blantyre), subjected to competing uses, unable to satisfy demand, or highly salinated from groundwater sources. Should the current influx of migration of people from the rural to urban areas not be curtailed, water availability in urban areas will be under intense pressure.

9.3 Challenges in Water Resources Management

As the country develops further, there will be increasing pressures on the natural resource base, particularly water resources. To address water resource management challenges (e.g. policy provisions and enforcement, institutional arrangements, financial and human resources capacity, technology, awareness, climate change and variability, availability, quality, gender, HIV/AIDS) periodic assessment of resource availability, use, and management will be required. Changes that ensure sustainability may be required in the overall use of resources, even if these changes come with a high price.

9.3.1 Pressures from Agriculture

Agriculture will likely continue to be the main foreign exchange earner of the country in the near future. The transformation of farmers from subsistence to commercial agriculturalists necessitates increasing output per unit area of land, so that farmers produce a marketable surplus. In addition, the government is desirous to transform the whole length and breadth of the lakeshore, the Shire Valley and other valleys in the 17 major catchment basins into a green belt of plantations with various crops for local consumption and export. This means that more water will be required as new irrigation schemes are opened up under the Greenbelt Initiative, resulting in additional abstractions from rivers and streams as well as from groundwater aquifers. Some of the river basins may already be experiencing over-abstraction for domestic and industrial use due to the numerous water permits and grants issued by the Water Resources Board (WRB). Competition for water would be made worse during times of drought.

Elton Laisi

Rainfed subsistence agriculture in Lilongwe.

The current position of Malawi as a net food exporter rather than importer will also exert pressure to produce more agricultural products for export. The exportation of food products will add value to earnings received through exportation of cash crops such as tobacco, cotton, timber and other products. The need for more foreign exchange earnings will be an impetus towards maintaining a gradual progression in food and cash crop production. In such a situation, many river basins are likely to be taken up as agricultural lands, resulting in the removal of the vegetation that secures the river banks.

Since both the public and private sector cannot absorb a large amount of the labour force, agriculture will continue to be the main employer of Malawi's population for some time to come. The transformation of the subsistence sector into a commercially viable enterprise will ensure that more of the country's population is financially secure, and entrench the majority of the rural population in the activities of the sector. In addition, the expansion of the industrial sector will heavily depend on the agricultural sector for raw materials to be used in agro-processing.

Elton Laisi

Irrigation farming on the banks of Sambainsa River in Zomba.

9.3.2 Pressures from Transport

It is the aim of the government to ensure the provision of a coordinated transport environment that fosters the safe and competitive operation of commercially viable, financially sustainable, and environmentally friendly transport services and enterprises. This broad goal promises a transport service in which agricultural and industrial products are moved from sources of supply to areas of demand with minimal interruption.

Lake Malawi offers a cheap two-way highway from and to the southern port of Monkey Bay and other ports to

the north, as far as Chilumba in Karonga. Lake transport is the cheapest means of transportation of people and goods between the three regions of the country. Once the Nsanje World Inland Port becomes operational, it is expected that there will be more movement of cargo between Malawi and the outside world.

The lake is a natural reservoir that sustains the flow of the Shire River. In times of high lake levels, it becomes necessary to regulate the flow of the Shire by releasing more water so as to stabilise the lake's level. Regulation during times of drought is also required to maintain the levels and flows of the Shire for power generation, water abstraction for Blantyre, and agriculture in the Lower Shire Valley.

Malawi will soon be connected to the sea through the Shire-Zambezi Waterway. The Nsanje World Inland Port will be a major hub of transportation of goods to and from the country, increasing agricultural and industrial exports to overseas markets and imports of processed goods. The Nsanje World Inland Port will also require stable levels for cargo ships and barges to dock with ease, and this will require maintaining the level of the Shire River even during times of low lake levels. For smooth operation of the port, regulation of the level of Lake Malawi and the flow of the Shire River will also become necessary so that ships and barges can dock with ease and close to points of call.

9.3.3 Pressures from Energy

The energy supply of the country is 96.7 per cent hydroelectric and 3.3 per cent fossil fuels. Some of the electricity is exported to Mozambique and Zambia and is yet to connect to the Southern African Power Pool (SAPP). The drive to accelerate socio-economic development will require more energy plants to serve urban centres and industrial requirements. New hydroelectric plants will need to be established at potential sites such as Mpatamanga, Fufu falls and elsewhere, including mini hydroelectric schemes on Malawi's perennial rivers and streams.

The demand for more energy will be influenced by rising population, urbanisation, rural electrification and industry. Growth of various sectors of the economy such as agriculture, industry and tourism will translate into more demand for energy to pump water to irrigation plantations, drive the machines of industry and facilitate the creation of a haven for tourists. With hydropower ranking highest among environmentally-friendly sources of energy, more rivers with potential for hydro-power generation will be exploited for energy requirements of the country.

Energy resources, currently concentrated on the Middle Shire, will experience increased competition for water if alternative sources for domestic and industrial water supply for the City of Blantyre are not identified. Moreover, while the turbines of the Middle Shire require steady flows of the Shire River, years of low flows often influence the partial closure of the gates at Liwonde in order to maintain acceptable levels of Lake Malawi above for the smooth operation of harbours and ports. Downstream, reduced flows caused by the partial closure of the gates at Liwonde would lead to reduced hectarage at the Illovo Sugar plantation in Chikhwawa, which entirely relies on the Shire for the irrigation of its produce.

9.3.4 Pressures from Integrated Rural Development

Integrated rural development will consist of various initiatives including the establishment of rural growth centres, aimed at bringing basic urban facilities closer to the rural masses. Some of these growth centres, such as Neno and Nthalire, will be established in districts that share borders with neighbouring countries. It is expected therefore that they will be centres of vibrant activities where trade and commerce as well as socialisation will occur. Most of the trading centres that are situated close to the border have the benefit of accessing goods from neighbouring countries which are not readily available in Malawi.

In districts such as Chitipa and Karonga that share borders with the Republic of Tanzania, people trade freely in various agricultural goods such as livestock, maize, rice, beans, cocoa, peas, vegetables and others. Large quantities of grain are traded with neighbours across the Songwe River in exchange for textiles and other merchandise. This exportation of grain, which is produced through irrigation, translates to "exportation of the water" required in the growing of the crop. The amount of water used in producing the crop which is then "exported" is called virtual water.

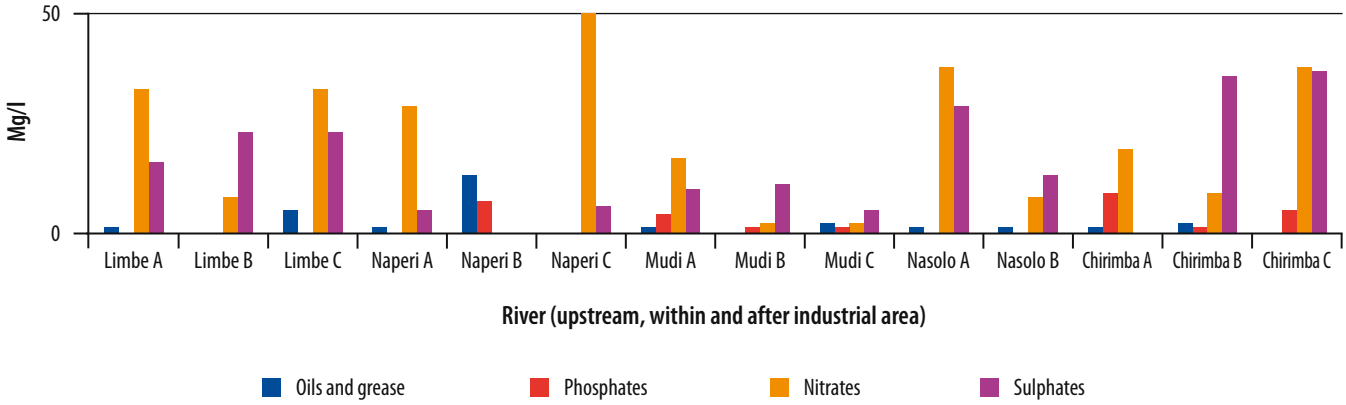
Therefore, rural centres which are likely to attract more cross-border trade and commerce will also be centres of water export to neighbouring countries, where such trade involves exchange of agricultural goods.

9.3.5 Pressures from Industry

The major industries of the country are concentrated in the cities of Blantyre, Lilongwe and Mzuzu, except for those located close to sources of raw materials such as Kayelekera, Viply, Vizara, Dwangwa and Nchalo. New industries are likely to sprout up as small urban centres attain township status and there is more growth in the agricultural sector to support agro-processing activities. Similarly, other industries of all sizes are expected to be established in areas where raw materials are plentiful, including quarrying and sand mining which could impact adversely on the water resources of the country.

Pollution of rivers and streams by industry is a serious concern as more water is laden with oils and grease, phosphates,nitrates, sulphates, plastics and other pollutants. It has been observed that effluents from industries in the City of Blantyre have a high potential for polluting rivers and streams, and could result in gross impairment of water quality in the receiving water bodies (Kuyeli, *et. al.*, 2009). A study carried out on the levels of pollution in the city shows significant concentrations of nitrate and sulphates upstream, onsite and downstream of industries. The levels of concentration however are low during the rainy season, barely reaching 50 mg/l (Figure 9.1).

Figure 9.1: Water Quality of Rivers in Blantyre During the Rainy Season.



Source: Data from Kuyeli, S. M. *et. al.* (2009).

It is reasonable to suggest that these relatively low levels occur as a result of high dilution during the rainy season as most of the pollutants are dissolved and carried away by the flow. In the dry season however, concentration of pollutants rise drastically and as observed in Chirimba, nitrate levels were close to 250 mg/l with those of sulphates surpassing the 100 mg/l mark. The high levels of nitrates observed were thought to result from blocked sewer lines that serve industrial areas as well as small-scale subsistence farmers along the river banks using fertilizers. While this finding is limited to Blantyre, similar occurrences may be true for other urban centres such as in Lilongwe, Mzuzu and Zomba. With the growth of the industrial sector, pollution of rivers and streams is expected to increase.

9.3.6 Pressures from Mining

The mining industry is also a sectors that can cause serious environmental problems, arising from the removal of top soil to get to the desired minerals. This entails removal of vegetation, and due to the movement of heavy equipment, compaction of the soil, which inhibits free water infiltration and percolation. Mining areas frequently become areas of high population density, as new settlements boom due to the employment created by the mine. Pollutants from these settlements ends up in river systems and depending on the nature of the pollutant could cause serious health hazards to the people living downstream.

9.3.7 Pressures from Fisheries

The fisheries industry requires sustained water supply and availability in all the major river basins of the country where various species of aquatic fauna dwell. Modification of habitats within riverine systems can have disastrous effects on fish, negatively affecting their breeding grounds. Fish catches from major fishing grounds in the country such as Lake Malawi, Lake Chilwa, Lake Malombe, Chia Lagoon and the Shire River have been declining since 1987 (see Figure 9.2).

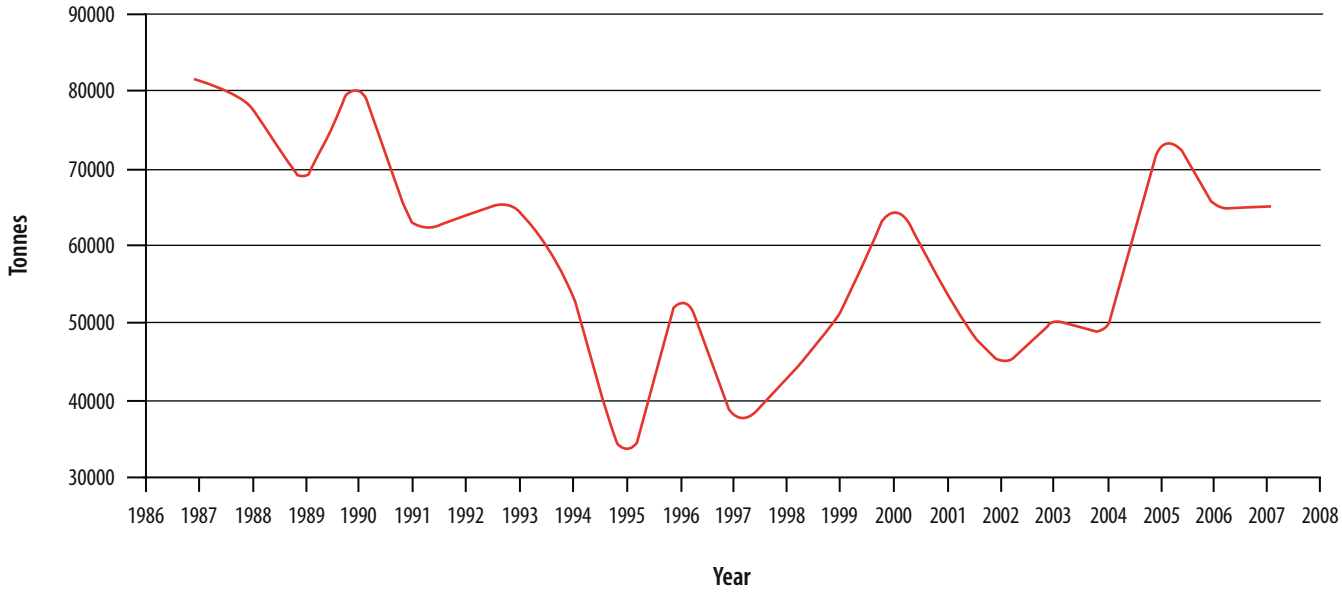
There has been a steady rise in fish earnings, which indicates that the cost of fish per unit weight has been rising (see Figure 9.3). In order to increase consumption of fish in rural areas, there has also been a rise in aquaculture development, as shown by the rise in the number of fish ponds since 2003(see Table 9.1).

The rise in the demand for fish has resulted in the fisheries sector taking further strides through the Presidential Initiative on Aquaculture Development to expand fisheries in the country by promoting fish breeding within Lake Malawi and to compliment catches from capture fisheries. Another initiative is the cage raising and distribution to fish farmers of Tilapia species, in order to increase fisheries production.

The major source of animal protein for the majority of the Malawian population is fish, which accounts for 60% of all animal protein intake at the household level. Fish is also an important foreign exchange earner for the country. Growth in the number of fish ponds implies more pressure on the water resources of the country.

Climate change would have a serious impact on these systems, disabling them during times of extreme drought. As more and more ponds are constructed, more water will be abstracted from rivers and streams, regardless of the size of the system. Stiff competition for water is

Figure 9.2: Fish Catch from Major Fishing Grounds in Malawi (1987–2007).



Source: Data from Malawi Government/UNEP (2010).

likely to arise between users of irrigation agriculture, fisheries, and environmental water requirements, as can be currently seen in the Domasi River Basin.

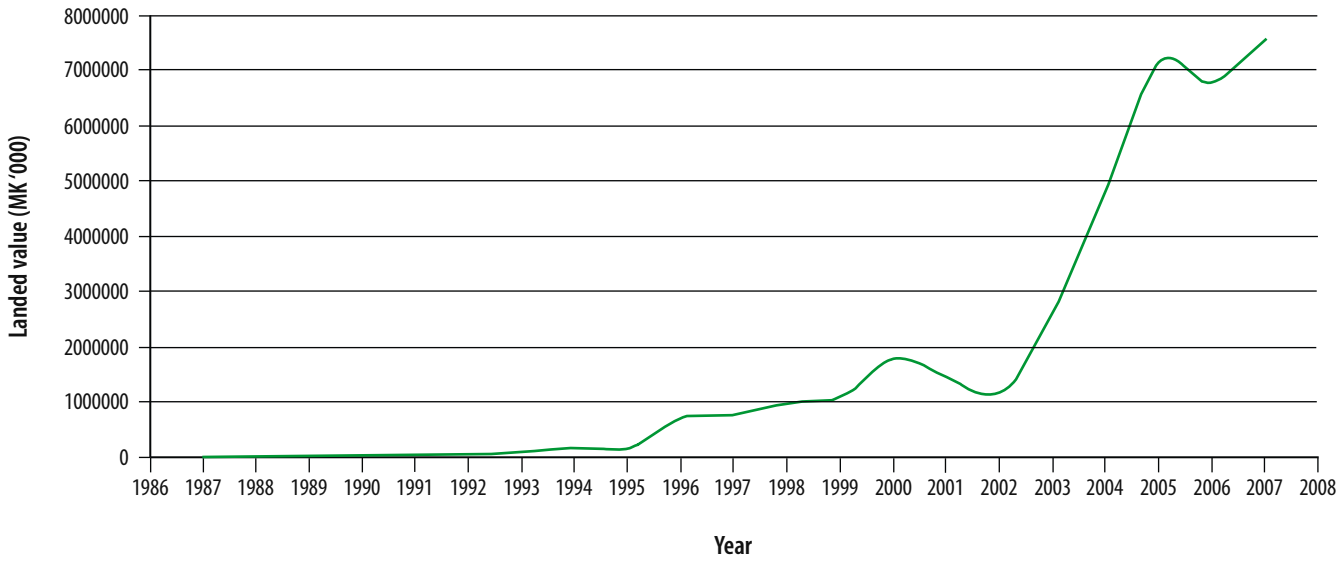
9.3.8 Pressures from Tourism

Malawi's tourism industry is not yet fully developed. While some of the tourist hotels and lodges belong to large corporations and companies, the majority are individually-owned with inferior infrastructure.

The largest concentration of tourist destinations is on the lakeshore: in Karonga, Rumphi, Nkhata Bay, Nkhotakota, Salima and Mangochi. The single most important concern with regard to the hospitality industry is solid waste and effluent disposal. With this high concentration of hotels and lodges, the most cost-efficient option for the disposal of effluent is dumping in Lake Malawi. Due to the absence of proper sewerage systems in the rural tourist areas, most resort to using septic tanks which may overspill into the lake. The release of effluent into water bodies such as the lake results in the overgrowth of algae due to the high levels of nitrates. A satellite view of the waters of Lake Malawi show alarming changes in water quality between 2001 and 2006. The colour of the waters of the lake was clearer in 2001 than in 2006, as evidence of eutrophication became more vivid.

In 2001, there were noticeable changes in water quality at the deltas of the major rivers such as Limphasa, Dwangwa, Bua and Linthipe. Due to the south-easterly

Figure 9.3: Annual Fish Earnings in Malawi Kwacha (1987–2007).



winds, the pollution of the lake was limited close to the shoreline and blown north-wards from the deltas. However, in 2006, the entire southern third of the lake, from Dwambazi to Lake Malombe, was under threat. The damages caused by unsightly algal blooms will negatively affect both fish production and tourism revenues.

9.3.10 Environmental Water Requirements

In the minds of many people, demand for water is associated with human requirements. It is rare to associate water demand with environmental requirements. However, water determines the carrying capacity of ecosystems, and evaporation is an important link in the hydrological cycle, since it accounts for over 90 per cent of the source of precipitation (Salomão, 1993).

Unfortunately, many areas in the country are undergoing an unprecedented rate of deforestation: the removal of natural vegetation due to settlements, cultivation and other activities. Much of the southern and central regions of the country are highly deforested and prone to continued exploitation. Nonetheless, some regions of the country, particularly in the north, still have pristine environments populated with various species of vegetation and fauna. These ecosystems are important biodiversity reservoirs that function to maintain river flows, reduce erosion, minimize flooding and promote groundwater recharge.

9.4 Vulnerability of Water Resources

The achievement of socio-economic development and growth is dependent on addressing the social and economic driving forces that lead to environmental degradation and the depletion of natural resources (Laisi and Wilson, 2005). Development and growth can be responsible for both positive and negative results and if the latter outweigh the former, the consequences can impede the sustainability of development.

The implementation of the priority areas in the MGDS will have both positive and negative impacts on the water resources of the country. Water resources may be vulnerable to climate change, over-abstraction, catchment degradation caused by new settlements, cultivation and pollution from agricultural lands, mining and industry, proliferation of aquatic weeds and other invasive species, wastage through domestic or institutional losses as a result of poor maintenance of infrastructure, salinisation and excess runoff which would reduce groundwater replenishment. Sustainable development and growth that will change the social and economic status of the people entirely depends on sustainable management of the environment.

9.4.1 Surface and Groundwater Resources

The country's annual renewable freshwater resources are already among the lowest in the region and water availability per capita is stressed (Hollingworth and Chiramba, 2005). Against this background, implementation of development programmes and projects require pragmatic approaches that take into account economic efficiency, social equity and ecosystem sustainability. Principal driving forces at the moment are the following:

- Increasing food production to achieve self sufficiency and security;
- Development and establishment of agro-processing industries;
- Reduction or alleviation of poverty;
- Increasing area under irrigation;
- Provision of water to industry and for rural and domestic needs;
- Development of the transport infrastructure;
- Energy generation and supply;
- Population pressure;
- Services requirements; and
- Inherent geographical challenges.

In the course of satisfying the demands of the above, there will be increased pressures on and competition for water resources which could comprise people's access to potable water resources. Water is a flow resource that sets up chain reactions affecting its own availability and quality: change in one part of the system tends to trigger changes in other parts of the same system. In this regard, government will want to ensure that development does not impose any unacceptable externality costs on resources, by depleting groundwater aquifers or polluting drinking water sources of downstream water users. Current water practices must not compromise the ability of the water system to provide essential supply and ecological functions for present and future needs (Rees, 1998).

9.4.2 Competition for Water

Dependence on rainfed agriculture cannot guarantee sustained food production due to incidences of dry spells and drought. As such, the government will likely continue to encourage the opening up of more land for irrigated agriculture through the Greenbelt Initiative. These projects demand more water, increasing the

pressure on already limited resources. Competition for water will also arise due to the requirements of other sectors such as energy, tourism, forestry, domestic water supply, industry and transport. Many individuals and corporate entities are engaged in various kinds of trade, industry, commerce and agriculture, requiring and accelerating the pace of groundwater abstraction. The fact that groundwater requires no treatment particularly for domestic use, means that the resources is cheap and can easily be abused and overexploited (UNEP, 1996).

9.4.3 Decreased Allocation

Since water is a poorly managed and finite resource, the per capita water allocation is expected to decrease with time. Decreased allocation will be influenced by pollution from industries, mining sites, agricultural lands; increased siltation of rivers and reservoirs due to erosion; rising population exerting additional demand on the finite resource; competition for water between and among various users; and extreme events such as droughts.

With the per capita water allocation projected to drop to 300m^3 by 2032, all development programmes must address this impending challenge. Water requirements will form an essential part of the demand chain and adequate allocation will have to be made irrespective of decreased allocations to sectors. Sustainable management of catchment basins will therefore be a prerequisite to sustained rather than inadequate supply.

9.4.4 Ecohealth

Ecohealth refers to the linkages between environmental health and human health. Human health is likely to be adversely impacted upon as ecosystems are degraded.

Box 9.1: Effects of the 2009–2010 Dry Spells in Malawi

Seasonal progress

After a six-week spate of dry spells in most of southern Malawi, heavy rainfall has started falling from the first week of February 2010, thereby prompting many farmers to replant. There is no chance that such late-planted crops will reach maturity, even if rains continue until the end of March, when rains normally finish in most parts of Malawi.

Rainfall data from the Department of Climate Change and Meteorological Services (DCCMS) reports show that the Lower Shire and lakeshore areas received rainfall amounts below 74 percent of the long-term average between October 1, 2009 and January 31, 2010. This has resulted in failed crop germination and crop establishment. This also resulted in failed crop management activities like fertiliser applications. Some seasonal activities, such as weeding and fertiliser application, which provide labour opportunities, have been suspended, thereby affecting poor people who rely on the sale of own labour for cash or in-kind payment.

Key food sources for the Lower Shire and implications of the drought

The extended dry spells in the Lower Shire will result in no harvest at all for all summer crops, including maize, sorghum, millet, and cotton in the livelihood zone. This will also mean limited incomes as a result of no casual labour opportunities for poor household members who rely on working in the gardens of richer households. A winter crop that contributes about 9 percent of all food consumed in the year for poor households may be realised in September after winter cultivation.

A number of assessments are lined up in the next two months to inform food security programming decision-makers in a timely manner. The First Round Agriculture Production Estimates are due for release in a few weeks. The results should reflect the impacts of the drought on all crops through the end of January 2010 for the whole country. FEWSNET, in partnership with MoAFS, WFP, and FAO will conduct a national crop situation assessment in the whole country to determine the extent of the damage caused in the different parts of the country.

Since the extended dry spells in the Lower Shire livelihood zone have followed previous dry spells in the same area in previous seasons, and many people in the affected areas may not harvest any crop at all, then it is necessary for the government to extend food assistance support to the affected communities, with more attention given to the households who will not harvest any summer crops at all. Rainfall data shows that by January 31, 2010, southern Malawi and the lakeshore areas have received cumulative rainfall below 74 percent of long-term averages [and] it is likely that summer harvests in these areas will be substantially reduced and will lead to a larger number of food-insecure households in the 2010 consumption year.

Source: http://www.fews.net/docs/Publications/Malawi_FSU_February_2010_final.pdf

For example, the frequent occurrence of floods inundating low-lying areas would increase the incidences of malaria due to the expansion of mosquito-breeding grounds. The pollution of freshwater by floodwaters would increase the prevalence of waterborne diseases such as cholera, dysentery, and diarrhoea. Reduced access to water resources would also reduce crop production and cause nutritional disorders, further disadvantaging the elderly, the disabled and those affected by the HIV/AIDS pandemic.

9.5 Strategies for Sustainable Water Resources Management

The sustainable management of water resources depends on a number of factors which must be clearly understood prior to water resources exploitation. Both surface and groundwater resources of the country are an invaluable asset for domestic water requirements, agriculture, transport, energy, tourism, forestry, fisheries, biodiversity and the environment.

Decline in water availability and slow growth in the proportion of people who have access to water resources is influenced by root causes which have to be identified and addressed. These root causes arise from policies and actions in almost all sectors of the economy.

Obvious linkages exist between root causes that lead to water scarcity and reduced access to water resources, their immediate causes, the impacts on ecosystems and resultant consequences. Policy and decision-makers must set priorities that aim at satisfying the needs of the human being in a sustainable manner, while observing the principle that water has a social and economic value that has to be safeguarded.

The fact that water is perceived as a free commodity signifies the fact that there is inadequate awareness of the challenges that water resources are facing. Concerted effort is required by local counsellors, members of parliament, ministers, government officials, non-governmental organisations, faith organisations, the media, academia and others to bring to the fore the challenges that water resources face, in the context of improving the socio-economic status of the people of Malawi.

In reducing current or future threats, the pressure release model deserves attention as a way of taking comprehensive action. The pressure-release model assumes that there is an impending disaster when a hazard is ignored and that people and the environment become vulnerable as a result.

9.5.1 Policy Harmonization

Unharmonised policies are one of the five challenges facing the water resource sector. In addressing the above challenges, a number of legal frameworks exist that provide for the sustainable management of water resources in the country have been put in place. These legal frameworks include:

- The National Environmental Policy (NEP);
- National Strategy for Sustainable Development (NSSD);
- Environmental Management Act (EMA);
- National Environmental Action Plan (NEAP);
- District Environmental Action Plans (DEAPs);
- National Water Policy (NWP);
- Water Resources Act (WRA);
- Water Works Act (WWA); and
- Other sectoral policies which also focus on the resource such as the Agriculture Policy and the Forestry Policy.

The above legal instruments provide a framework for managing natural resources. However, there are still coordination, enforcement and monitoring challenges that reduce the impact of these instruments. For instance, while the Water Policy prohibits anyone from cultivating within given limits along the river banks, the introduction of the treadle pump in the agriculture sector has meant that farmers have intensified cultivation of the river banks, thereby accelerating their erosion. Another example is the establishment of fish ponds by the fisheries department to increase the protein intake of Malawians and improving their nutritional status. However, some of the fish ponds are rarely fed by running water and become breeding grounds of mosquitoes. Improving people's nutrition has inadvertently led to increased cases of malaria. This illustrates that it is necessary to coordinate policies among sectors so that one policy does not detract from another but rather adds value. Nonetheless, the introduction of the (new) National Water Policy, the revision of the Water Resources Act, the finalisation of the Sanitation Policy and other legal instruments are positive steps towards the consolidation of water governance.

In the southern African sub-region, HIV/AIDS is both a rural and urban poor issue, where socio-economic, cultural and gender-related vulnerabilities relate closely to AIDS, food insecurity and poverty (UNEP, 2002). According to studies carried out on people infected with HIV/AIDS in Malawi (IRC, 2007) it was observed that in 70 to 80 per cent of the surveyed households the head of the household was infected and the water and sanitation requirements of the household were seldom

fulfilled. According to the IRC (2007), the country's poverty, coupled with HIV prevalence, are a serious hindrance to normal water and sanitation-related activities. The survey indicated that those that are already vulnerable regularly fall ill due to diarrhoea; other illnesses and effects of poor water quality are also evident among the home-based care population infected with the HIV/AIDS virus; and households with home-based care patients often travel long distances to collect water, which is exceptionally difficult for ill clients. It is necessary for government to review water policy and its implementation to respond to these needs.

9.5.2 Stakeholder Coordination and Participation

Various stakeholders were involved in the process of developing the Integrated Water Resources Management and Water Efficiency Plan, and the conceptualization of the National Water Development Programme. These consultations were held in each region and consisted of members of various water users associations, NGOs, water experts, traditional leaders, politicians, directors of government departments, principal secretaries, heads of parastatals, the media and water technical experts from the southern African sub-region.

While water resources management is best carried out at the catchment basin level, the move by government to devolve some of its functions to the local level ought to be commended. Catchment management will be carried out at various levels by catchment councils and sub-catchment councils. The sub-catchment council would be responsible for regulation of and supervision in the exercise of permits; monitoring water flows and use in accordance with allocations; electing at least one representative for the catchment council; promoting catchment protection; monitoring waste discharge into river systems; assisting in data collection and participating in catchment planning; and collecting rates and fees.

Similarly, the catchment council would administer the following:

- preparation of an outline for the river system; determination of applications and granting of permits for water use;
- regulation and supervision of water use;
- supervising the performance of sub-catchment councils; and conflict resolution amongst users.

The sub-catchment council would report to the catchment council which would in turn report to the National Water Resources Authority. According to government, the setting up of the National Water Resources Authority shall facilitate the implementation of the following activities (GoM, 2005): co-coordinating and harmonizing the activities of Catchment Management Authorities and all other stakeholders; prescribing and determining the establishment of Water Users Associations; determining and collecting fees related to water abstractions and discharges; approving any developments and/or improvements related to water resources; ensuring that water resources buffer zones are properly managed; declaring water catchments as water controlled areas; controlling and apportioning water use in the country; and issuing water abstraction and discharge licenses.

Decentralisation will involve those that are directly within catchment basins, who are concerned with water availability and quality, in the management of water resources. This will also ensure that people are aware of the challenges the water resources of the country are facing and build their capacity to deal with emerging issues.

9.5.3 Catchment Management

The present and future challenges facing water resources arise partly from the way catchments are managed in the country. With the introduction of the (new) National Water Policy, it is hoped that most of these challenges will be addressed. For instance, the government has made provision in the policy for devolving the functions of catchment management to the local level, where each basin will have a Catchment Management Authority (CMA) to oversee sustainable natural resources management. At the helm of these structures will be the Malawi Water and Energy Regulatory Authority (MWERA) responsible for the overall administration and governance issues affecting water resources and energy needs. It would also be responsible for assisting each CMA in effectively and efficiently carrying out its functions in the overall management of each river basin.

Currently, catchment management falls under several sectors including Department of Forestry, Department of Parks and Wildlife, Fisheries Department, Department of Land Resources, Environmental Affairs Department (EAD), water utilities, and Ministry of Local Government. The new approach of assigning the responsibility of basin management to CMAs will therefore improve the current situation: this is a positive development that government has initiated.

While the current intention is to put in place an effective catchment management framework, research and development should be taken into consideration to set benchmarks for future operational profiles. Most importantly, there ought to be a programme for re-establishing a comprehensive water resources monitoring network and carrying out catchment basin audits. Current programmes lined up specifically for catchment management involve the establishment of the National

Water Resources Authority (NWRA) that will be mandated to institutionalise IWRM in the country. The following strategic objectives laid out by the MOIWD will assist in sustainable catchment management: the establishment of inter-ministerial committee responsible for the effective coordination of government activities in IWRM; the creation a national database of information on IWRM to ensure information sharing among national, regional, district and local institutions; and the enhancement of coordination through the use of technology.

9.5.4 Capacity Building

The ministry responsible for water affairs in the country has plans to empower communities and other water users to manage water resources efficiently and effectively through building capacity at the local level. This strategy will be most important as it is government's intention to promote local ownership of water resources projects. Such projects will form part of District Development Plans (DDPs) under the general direction of the NWA. The government has already established the water training institution in Mangochi and collaborates with tertiary institutions by offering scholarships to promising individuals to train them in water resources management. In addition, sharing of knowledge on water resources and its management is important and much effort has been taken in this area through advocacy and campaigns. The World Water Day and the World Environment Day are some of the annual programmes that offer opportunities to people to learn about the value of water in particular and the importance of sustainable management of the environment in general.

Current programmes are creating awareness among communities at district levels in various aspects of IWRM; developing participatory approach to natural resources management through consultations with communities and stakeholders; exploring and integrating indigenous knowledge systems in natural resources management and their relationship to IWRM; building capacity in curriculum development in tertiary institutions and other learning environments; and supporting district institutional capacity development.

Appropriate and adequate technology to manage the water and associated sectors must be seriously considered. One of the strategies for the effective management of water resources is to collect and analyse data to manage and monitor current and future availability of water resources (GoM, 2004). Advanced technology is required for the continuous measurement of precipitation, evaporation, temperatures, relative humidity, river flows and reservoir levels, silt loads in river channels, water quality, groundwater flows and availability and other relevant and useful parameters in water resources.

Primary gauging stations previously had flood measuring facilities which included cable cars suspended between two columns on each bank of the river and an automatic water level recorder. Unfortunately, these facilities have been vandalized or removed from many stations across the country and it has become impossible to evaluate the impacts of climate change on river flow regimes in their absence. One such case is on the South Rukuru at Phwezi where staff gauges have been neglected and a water recording house and cable car abandoned.

The main challenge in maintaining these facilities is the provision of adequate incentives for those that man them. Since each of the numerous river-gauging stations is supposed to be read every day, every such station has to have a reader who is paid an honorarium every month. Until lately, the honorarium has been a pitiful MK150/month, which has made many gauge readers abandon their work (Chipeta, 2010). With the tremendous economic development and growth that the country is enjoying, it is strongly recommended that these stations be reopened and the monthly honorarium for gauge readers increased so that the country can collect sufficient data on water resources.

Good progress has been achieved in regards to human capacity building. Of particular interest is the strong collaboration between the MOIWD and the University of Malawi. Under mutual arrangements employees of the ministry are offered scholarships to study with the universities of Dar-es-Salaam, Harare, and Malawi in various fields in the water sector under the WaterNet programme. In addition, the proposed establishment of a water training school in Mangochi is a welcome development.

9.5.5 Water Supply, Sanitation and Hygiene

Water supply, sanitation and hygiene are the domain of several players. Both the public and private sector play an important role in providing these services, including NGOs. Among the programmes laid out for water supply, sanitation and hygiene are:

- Promotion of water harvesting through the construction of small and medium-sized earth dams;
- Promotion of water harvesting by use of ground-level or overhead tanks and from roof catchments;
- Establishing appropriate water supply and sanitation systems using demand-driven and demand-responsive approaches to enhance socio-economic activities;

- Establishing a training institution in water and sanitation that is accredited to an institution of higher learning; and
- Undertaking installation and construction of water supply and sanitation infrastructure.

9.5.6 Research and Development

Research is necessary to understand water systems behaviour and changes in water availability. Malawian ecosystems are undergoing serious changes due to human activities, and documentation of such changes is necessary to develop tools for sustainable resources management. Currently, the ministry responsible for water affairs in the country has no systematic programme of data collection, processing, and analysis of sediment, groundwater and water quality (GoM, 2008). This gap has to be closed as the demand for data on sediment/ silt load, ground and surface water and water quality is increasing. Various government and private sector institutions require this data for the design of hydraulic structures, water supply, and irrigation schemes (GoM, 2008). The ministry had a regular programme of research and documentation until the early 1990s, focusing on catchment characteristics in the areas of ground and surface water.

Trends in surface water resources availability within various catchment basins and groundwater mapping are two important areas that require government attention. This programme becomes more urgent now than ever before as Malawi's water scarcity index predicts that the country will experience absolute water scarcity by 2025, approaching the water barrier status thereafter (Hirji, *et. al.*, 2002). To improve the situation the government has put in place the following research programmes for implementation:

- Establishing a sustainable groundwater monitoring network and improving a surface water monitoring network including the development of water quality maps;
- Conducting comprehensive research and studies to establish surface and groundwater resources potential to guide management and development of the resources;
- Establishing a water sector resource centre; and
- Development of early warning systems for water-related disasters.

These programmes are intended to provide a clear understanding of the water resources situation in the country, and thereby provide information on the trends in availability, usage, modifications in quality necessary for sustainable water resources management.

9.5.7 Enforcement, Monitoring and Evaluation

Policy enforcement is necessary to ensure effectiveness and compliance. Sound policies developed through consultative processes have high compliance levels as stakeholders are accountable to its pronouncements. Monitoring ensures that people comply with policy so that actions are taken within the given limits of the statues. While there are numerous provisions dealing with the environment and natural resources, enforcement is weak, as is evidenced by resultant land and water resources degradation through erosion and water pollution, deforestation, charcoal burning, drilling of boreholes without prior assessment of resource availability, over-abstraction of surface water resources and other such concerns.

To improve upon these challenges, the MOIWD will be the lead institution to undertake the monitoring and evaluation activities of the implementation of IWRM in the country (GoM, 2008) the aim being to assess performance of policy implementation and its impact on the overall socio-economic development of the country while objectives are to monitor and evaluate the performance of the implementation of IWRM with a view of assessing whether the objectives and outputs are being realised. Specifically the following activities have been arranged:

- Visit and examine all existing hydrological stations in the country and make recommendations as regards requirements and optimal population;
- Examine the existing hydrological monitoring equipment and accessories available for data processing including the ones used for flood forecasting and recommend new ones to be procured and established;
- Review the flood monitoring system for the Lower Shire Valley and make recommendations for its effectiveness and efficiency;
- Design a groundwater resources monitoring network for the country and recommend necessary equipment;
- Examine the current hydrological database and make recommendations for efficient data scrutiny, analysis, processing and retrieval system; and
- Review the organisational structure and arrangements for data collection in the light of decentralisation and devolution of certain functions to District Councils.

9.5.8 The Role of Gender

The importance of gender in water resources use, development and management is well recognized. Sustainable water resources management is possible

only with the involvement of all stake-holders, including women and the youth. One of the principles of integrated water resources management is that women play a central part in the provision, management and safeguarding of water (Solanes and Gonzalez-Villarreal, 1999): as such, they need to be engaged in water resources management at all levels.

Similarly, youth cannot be left out of management programs. They are an emerging force as activists in social, economic and environmental issues (Schaap and van Steenbergen, 2001). In Malawi, progress has been made in building awareness about the role natural systems play in determining water resources availability and quality. The participation of women and the youth in catchment re-afforestation programmes demonstrates their appreciation of the role vegetation plays in maintaining riverine systems.

9.6 Conclusions and Recommendations

The re-evaluation is hinged on what was previously recommended for implementation and attempts to assess what progress has been achieved or what improvements have been made in the overall management of the resources. The following recommendations were made in order to address the critical issues affecting water resources in the country (GoM, 2002):

- More projects should be embarked on to rehabilitate and protect catchment areas, especially in the Central Region;
- Water conservation projects, such as the construction of major, medium and small multi-purpose dams should also be embarked on. This should include educating the communities and the implementation of rainwater harvesting;
- The Water Resources Board should be given more powers through legislation to penalise offenders regarding the discharge of effluent and other activities in or near water bodies;
- In addition to carrying out Environmental Impact Assessments for development projects, environmental audits should be done for existing projects in order to come up with mitigation guidelines;
- Community awareness in environmental issues, such as catchment protection, should be encouraged; and
- Adequate resources should be provided for monitoring of water resources for both quantity and quality.

Three prime driving forces towards water scarcity that is projected for the near future and access to water resources can be identified as:

Population growth which is rising at 2.39 per cent per annum (African Development Bank, 2008); Urbanisation due to movements from rural areas in search of opportunities and growing at 6.7 per cent after 2000; and Industrialisation including agriculture and mining.

These three forces will have an overriding impact on the country's water resources and government will need to focus on the following priorities to avert the negative consequences expected with the development drive (Falkenmark, 2000):

Addressing the current reduced usability of available water resources and the depletion of fresh-water availability and its implications for various sectors of the economy now and into the future and for the development of wealth in general; Identifying efficient incentives, such as market forces, consumer pressure, etc., in order to reduce disastrous freshwater deterioration from industrial wastes and effluents; Clarifying the patterns of human exposure to water-related diseases and hazards; and Developing risk assessment methods.

Other than only carrying out an Environmental Impact Assessment (EIA) for every project, it will also be necessary to develop risk assessment options and avoid taking costly choices at the expense of water resources availability and access to them (Rees, 2002). Integrated environmental assessment and reporting (IEAR) should also be carried out on regular basis at the district, regional and national levels. A set of strategies is required in the process. The following strategies are necessary and important for sustainable water resources use and management:

9.6.1 Water Resources Assessment; Understanding Resources and Needs

This would involve undertaking the following activities: obtaining a holistic view of water resources in each and every river basin in the country; examining quantity and quality of surface and groundwater resources; establishing short and medium-tern requirements based on credible physical and socio-economic data; and providing adequate financial resources for a robust monitoring system.

9.6.2 Water Resources Knowledge Base

This involves undertaking the following activities: collection and storage of data on the hydrological

cycle; providing access to physical, socio-economic, demographic and water use data from a cross-sectoral perspective; clarifying institutional responsibilities and allocating financial resources for human resource development; re-establishing and/or revamping the hydrometric and hydro-meteorological networks for resource monitoring; and providing for periodic resource assessment for the information of policy makers.

9.6.3 Water Resources Assessment

This would involve undertaking the following activities: Water demand assessment; Environmental Impact Assessment; Strategic Impact Assessment; Social Impact Assessment; and Risk assessments at various probabilities.

9.6.4 Modelling in IWRM

This involves analyzing data from various sectors and creating a coherent framework which supports decision making processes. This will outline future scenarios as a guiding model towards achieving integrated water resources management and water governance. Strategic thinking in water governance is required and this entails issue identification, defining management options, establishing decision criteria, data acquisition and decision support processes and implementation.

9.6.5 Development of Water Management Indicators

This would involve setting targets and goals and monitoring management performance to usher in transparency and enable civil society and government to judge spatial and temporal variations in water cycle elements, efficiency in water use, efficiency and effectiveness of service delivery, water quality, quality of biodiversity and ecosystems and performance of water service providers.

9.6.6 Ecosystem Assessment

This would require an integrated approach involving the National Water Authority, the Malawi Water and Energy Regulatory Authority and the Environmental Affairs Department. Activities would focus on the management of ecosystems, particularly lacustrine and riverine systems and ground-water reserves, in order to minimise the impact of water use on the functioning of the aquatic ecosystems. Riverine and lacustrine biota will survive and reproduce if natural flow regimes are maintained or simulated.

Photo Essay - Water for Irrigation

Gibson Mphepo

Canal irrigation and other small-scale irrigation projects have dramatically increased agricultural production. The development of irrigation infrastructure is largely due to the current government's Greenbelt Initiative. The extension of this program to all areas where irrigation is ecologically possible will further improve agricultural output, incomes, and GDP. Many of the projects have provided greater opportunities to women.

Gibson Mphepo

Photo Essay - The Erosive Power of Water

Sosten Chiotha

Water has the power to cause large scale soil erosion. Shown above: River bank with good vegetative cover and farmlands in the distance.

Sosten Chiotha

The same area after water flows wiped out vegetation cover and also posing threat to farmlands as soil erosion reduces the land available for farming

Photo Essay - Water Pollution and Eutrophication

Sosten Chiotha

Siltation and the run-off from fertilizer use have increased the nutrients available to water plants. This has led to excessive growth of weeds such as water hyacinth, and the clogging of waterways that are used for transport, hydroelectrical generation, and consumption. The photograph above shows water weeds in the Shire River, while the photograph below shows buildup of debris due to siltation and water-weeds at Nkula. Hydropower station.

Sosten Chiotha

Photo Essay - Siltation and Water Quality

Sosten Chiotha

Water quality of rivers depends on its catchment areas. If the catchment is well vegetated, water quality will be good with less silt from runoff. Shown above is Mulunguzi river which appears to have less silt as catchments are less degraded.

Sosten Chiotha

The Mulunguzi River leads into the Likangala river in Zomba. Shown above, Likangala river is highly turbid from silt due to catchments having less trees and vegetation cover as well as farming along the river banks. Note the difference in colour of water.

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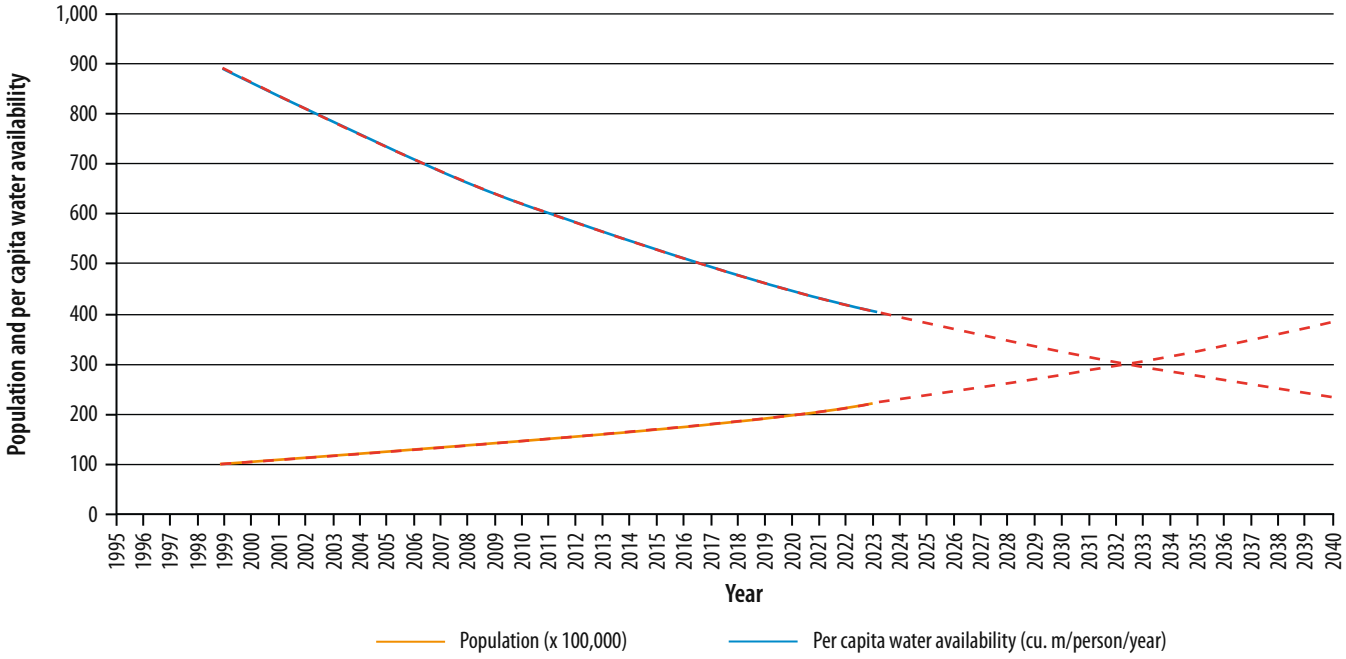
Appendix

Population and Per Capita water Projections for Malawi (1999–2040).



Recommended Drinking Water Standards for Malawi.

Constituent(s)	Unit	WHO	MBS (Drinking Water) MS214:2005	MBS (Borehole & Shallow Wells) MS733:2005
Arsenic (As)	mg/l	0.05	0.05	0.50
Cadmium (Cd)	mg/l	0.01	0.005	0.01
Cyanide (CN)	mg/l	0.05	0.05	0.07
Fluoride (F)	mg/l	1.5	1.0	6.0
Lead (Ld)	mg/l	0.05	0.05	0.05
Nitrate (NO_3)	mg/l	45	10	45
Selenium (Se)	mg/l	0.01	0.02	0.01
Faecal coliform Treated water Untreated water	number/100ml	 0 0	 0 0	 0 50
Faecal streptococci Treated water Untreated water	number/100ml	 0 0	 0 0	 0 0
Calcium (Ca)	mg/l	200	150	250
Magnesium (Mg)	mg/l	150	70	200
Chloride (Cl)	mg/l	600	200	750
Aluminium (Al)	mg/l	0.20	0.3	0.50
Copper (Cu)	mg/l	15	1.0	2.0
Hardness ($CaCO_3$)	mg/l	500	500	800
Colour	TCU	15	10	50

Constituent(s)	Unit	WHO	MBS (Drinking Water) MS214:2005	MBS (Borehole & Shallow Wells) MS733:2005
Sodium (Na)	mg/l	200	200	500
Potassium (K)	mg/l	-	50	-
Iron (Fe)	mg/l	1.0	0.2	3.0
Manganese (Mn)	mg/l	0.50	0.1	1.5
Conductivity at 25°C	ms/m	-	150	3500
Total Dissolved Solids	mg/l	1000	1000	2000
Sulphate (SO_4^{2-})	mg/l	400	400	800
Zinc (Zn)	µg/l	15 mg/l	5 mg/l	15 mg/l
pH Minimum	pH units	6.5	5.0	6.0
pH Maximum	pH units	8.5	9.5	9.5
Turbidity	NTU	5	1.0	25

Water Production, Consumption, and Expenditure for Lilongwe (2001–2009).

Year	Production (M^3)	Consumption (M^3)	Cost (MK)
2001	20,235,000	14,457,334	460,842,418
2002	21,170,000	15,001,536	435,192,437
2003	23,333,000	15,029,171	758,270,581
2004	25,019,000	15,670,971	994,716,000
2005	25,085,000	17,197,933	985,897,872
2006	25,397,000	16,330,412	1,218,646,188
2007	24,716,000	16,150,812	1,328,402,495
2008	25,735,000	18,149,118	1,762,495,255
2009	27,018,000	17,398,106	1,723,383,000

Source: Lilongwe Water Board.

Water Production, Consumption, and Expenditure for Blantyre (1989–2009).

Year	Production ($M^3 \times 10^6$)	Consumption ($M^3 \times 10^6$)	Cost (MK)
1989	16.39	13.42	N/A
1990	17.04	13.39	N/A
1991	17.21	14.20	7,352,413
1992	18.54	14.80	7,737,943
1993	19.86	15.65	N/A
1994	20.71	16.66	10,599,155
1995	21.16	17.08	13,107,829
1996	22.77	18.21	N/A
1997	22.28	17.84	69,568,000
1998	23.10	17.87	89,296,000
1999	23.89	17.63	N/A

Year	Production ($M^3 \times 10^6$)	Consumption ($M^3 \times 10^6$)	Cost (MK)
2000	25.05	17.18	N/A
2001	24.94	16.33	260,867,000
2002	25.66	16.64	N/A
2003	26.56	17.58	433,980,000
2004	33.86	18.81	555,966,000
2005	28.77	15.74	583,278,000
2006	30.60	15.11	611,366,000
2007	28.99	13.96	703,202,000
2008	29.38	13.77	704,708,000
2009	28.64	15.70	694,716,000

Source: Blantyre Water Board.

Rivers and Streams in Malawi.

WRA	River Basin	Area (km^2)	Rainfall (mm)	Runoff		Percent Runoff
				mm	m^3/s	
1	Shire	18,945	902	137	82	15.2
2	Lake Chilwa	4,981	1,053	213	34	20.2
3	South West Lakeshore	4,958	851	169	27	19.9
4	Linthipe	8,641	964	151	41	15.7
5	Bua	10,654	1,032	103	35	10.0
6	Dwangwa	7,768	902	109	27	12.1
7	South Rukuru	11,993	873	115	44	13.2
8	North Rukuru	2,091	970	252	17	26.0
9	Songwe	1,890	1,601	327	20	20.4
10	South East Lakeshore	1,540	887	201	10	22.7
11	Lake Chiuta	2,462	1,135	247	19	21.8
12	Likoma Island	18.7	1,121	280	-	-
13	Chizumulo Island	3.3	1,121	280	-	-
14	Ruo	3,494	1,373	538	60	39.2
15	Nkhotakota Lakeshore	4,949	1,399	260	41	18.6
16	Nkhata Bay Lakeshore	5,458	1,438	461	80	32.1
17	Karonga Lakeshore	1,928	1,208	361	22	35.1

Source: Data from GoM/UNEP (2010).

CHAPTER 10

Photo of Rainbow, By Susan Taylor

ATMOSPHERE AND CLIMATE CHANGE

Photo of Sunset, By Deepa Pullanikkatil

10.1 What is Climate Change?

According to United Nations Framework Convention on Climate Change (UNFCCC), climate change is attributable to anthropogenic (human induced) emissions, such as carbon dioxide from fossil fuel use, which alter the composition of the global atmosphere (Boko *et. al.*, 2006). Climate change, which implies long term or permanent shifts in weather pattern covering a wide region is often confused with climate variability which is short term and often localized (UNEP, 2002). This chapter will cover both climate change and climate variability. In addition, it will cover other gaseous and particulate pollutants that could alter the state of the atmosphere.

While climate change science and debates may be reserved for the experts, the ordinary Malawians understand it from the many climate-related events that have impacts on their livelihoods. The climate-related events manifest themselves in terms of delayed onset of rains and consequently delays in planting dates as well as increased frequency, intensity and spatial spread of climate extreme events such as floods and droughts. Furthermore, the trends in the spread of diseases like malaria and diarrhoea are also attributed to climate change and climate variability (ActionAid, 2006).

10.1.1 Climate Change and Sustainable Development

Climate change has direct and indirect impacts on virtually all social and economic sectors of Malawi. The National Adaptation Programmes of Action (NAPA), which was officially launched by Malawi's President, His Excellency Professor Bingu wa Mutharika in February 2008, identified eight vulnerable sectors that required urgent adaptation interventions and were recommended for funding. The sectors are agriculture, water, human health, energy, fisheries, wildlife, forestry and gender.

From the sectors identified in the NAPA, it can be observed that the majority depend on the availability of natural resources, which are sensitive to climate change and variability. For instance, Lake Chilwa is reported to have desiccated (fully dried up) in 1903, 1913–16, 1922, 1934, 1943–48, 1967, 1973, 1975 and 1995–96. The complete drying of the lake resulted in loss of biodiversity in general and led to the total collapse of the fishery industry and wetland agriculture (Njaya *et. al.*, 1996). The impacts on food security and livelihoods were felt beyond the Lake Chilwa basin.

Impacts of climate change on various socio-economic sectors in Malawi is summarized in Figure 10.1. It is evident from Figure 10.1 that climate change impacts would greatly deter progress in many sectors that are critical to social and economic growth of Malawi. As such, any plans to develop initiatives must recognize the links and interdependency that exist between sectors to ensure co-benefits and synergy.

During the NAPA study, gender was one of the cross cutting issues that was adequately covered as shown in Box 10.1. One cross cutting issue that was excluded was the link between HIV/AIDS and climate change impacts.

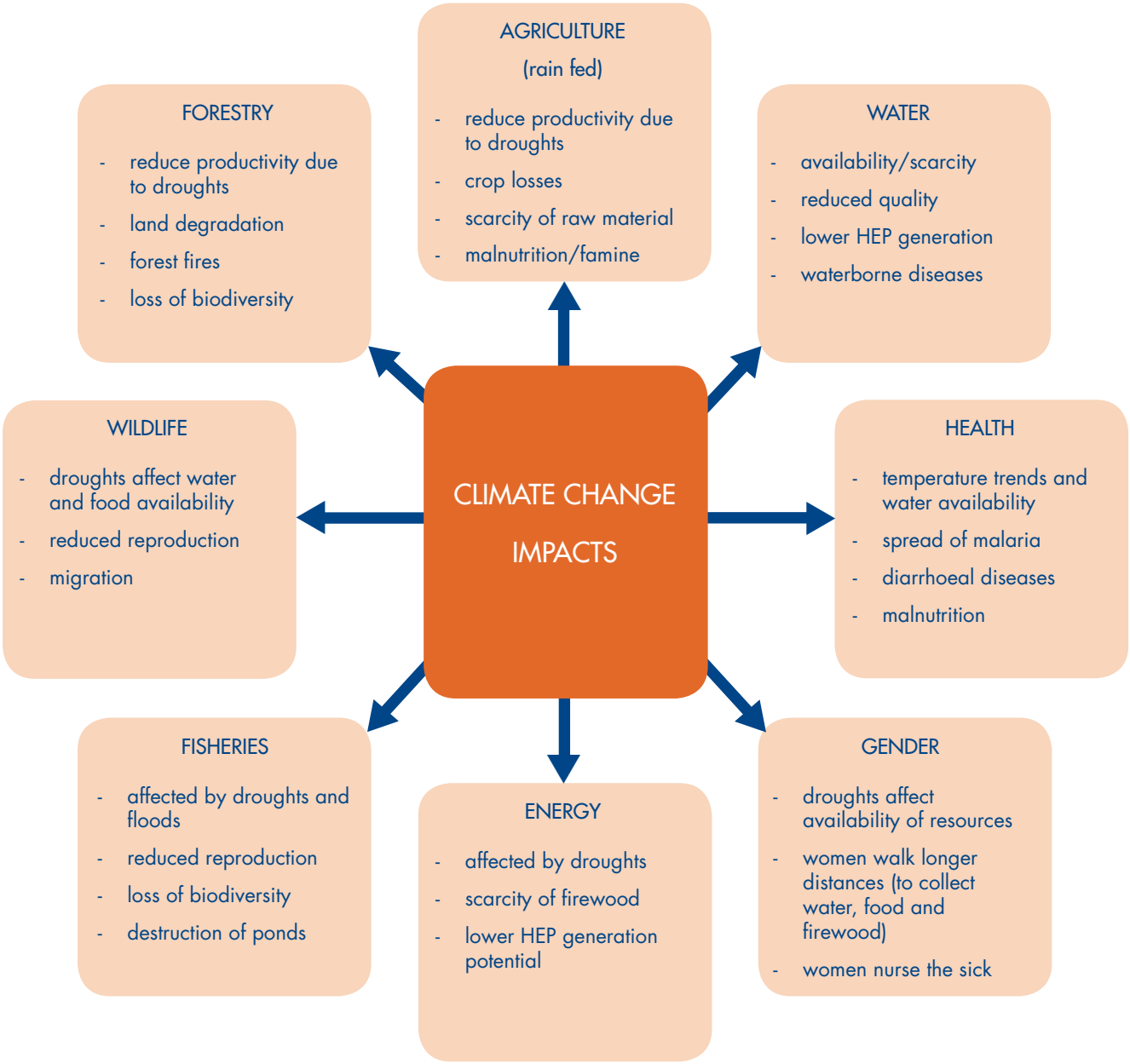
Studies by the World Bank (2007) and Oxfam International (2009) have shown a strong link between climate change and HIV/AIDS. About one in seven Malawians are infected with the virus, and many more are affected by associated diseases. The disease is crippling Malawi's institutions through staff attrition, high

Sosten Chiotha

Sosten Chiotha

Left: Lake Chilwa in a normal period; Right: Lake Chilwa completely desiccated in 1995.

Figure 10.1: Impacts of Climate Change on Various Sectors in Malawi.



vacancy rates, absenteeism and increased workload. At the household level, affected members would not be able to adequately contribute to the financial sustainability of their families. This in turn would expose to the disease female members of the family through unsafe sex in exchange for money or food.

Many of the sectors that are critical for social and economic development of Malawi are negatively affected by the impacts of climate change. Climate change, therefore, is one of the biggest threats that could derail Malawi from attaining the Millennium Development Goals (MDGs). As such, climate change issues need to be part and parcel of Government of Malawi's planning. Thus, the inclusion of climate change within natural resources and environment sub-section, as one of the priority areas in Malawi Growth and Development Strategy (MGDS), goes a long way in showing the Government's commitment and determination to finance climate change activities through the national budget.

10.2 Malawi's Climate and Weather Systems

Malawi's climate could be described as tropical continental moderated by Lake Malawi, high altitude and proximity to the influence of westerly frontal systems in South African coast. The major rain bearing systems include the Monsoon, Inter-tropical Convergence Zone (ITCZ), The Congo Air Boundary and Tropical Cyclones. Malawi has two major seasons, the rainy season and the dry season. The mean annual rainfall ranges from 725mm to 2500mm, and annual mean temperatures

range from 12°C to 32°C. Malawi's precipitation is also influenced by the El Nino/Southern Oscillation (ENSO) associated with low rainfall and droughts, and the La Nina which is associated with intense rainfall and floods. Malawi has also seen increased occurrence of extreme weather events (DCCMS, 2010; GOM, 2002; ActionAid, 2006) (Figure 10.3).

10.2.1 Evidence of Changing Climate

Despite the lack of comprehensive scientific research to answer the question of climate change, various studies and anecdotal evidence indicate that the climate is not the same. Malawi's climate is changing. Studies undertaken by Department of Climate Change and Meteorological Services (DCCMS) show that there are some long term changes in rainfall and temperatures patterns in some areas. Although regional models project a general decrease in precipitation, based on from Karonga, Salima and Chileka local differences do exist (DCCMS, 2010; IPCC, 2007). Figure 10.2 shows the trends for Karonga for the period 1920 to 2009. Despite the annual variations in mean rainfall, the linear trend line for Karonga shows a steady decline in rainfall between 1920 and 2009. Figures 10.4. and 10.5. show the standardized seasonal rainfall for Salima and Chileka over time. The bars above the zero imply more than normal rainfall, while the lines below imply less than normal rainfall. The results show an increasing trend for above normal rains for Salima and rather erratic rains for Chileka.

Box 10.1. Climate Change Impacts on Various Sectors

Impacts of climate change and climate variability are poised to severely affect the productivity of various socio-economic sectors of Malawi. According to NAPA, the following some of the impacts of climate change:

i. Water is a essential resource for human, animal, agricultural and industrial use, and for the maintenance of ecosystems. Increasing droughts would affect water availability and drying of water bodies, Floods would affect water quality through contamination.

ii. Malawi's economy and peoples livelihoods depend on rain-fed agriculture. Thus persistent droughts and erratic rainfall would result in poor crop yields or total crop failure, leading to serious food shortages, hunger and malnutrition, shortage of industrial raw materials and reduced foreign exchange earnings. Floods would have similar effects.

iii. The human health sector is also is expecting to see increased incidents of chronic ailments such malaria, cholera, dysentery and malnutrition.

iv. About 98% of Malawi's electricity is generated by hydropower from the Shire River. The electricity sub-sector is very sensitive to climate and has been recently affected by both floods and droughts. The 1991/92 droughts resulted in low flow rates in the Shire River which considerably reduced electricity generation capacity.

v. The Fisheries sector is affected by both droughts and floods. Droughts have been responsible for the declining or even drying up of water bodies resulting in low fish production and loss of biodiversity. In 1995, extended drought period was responsible for drying of Lake Chilwa resulting in total loss of fish stocks. In 2000/1, a number of fish ponds were destroyed by floods in Malawi.

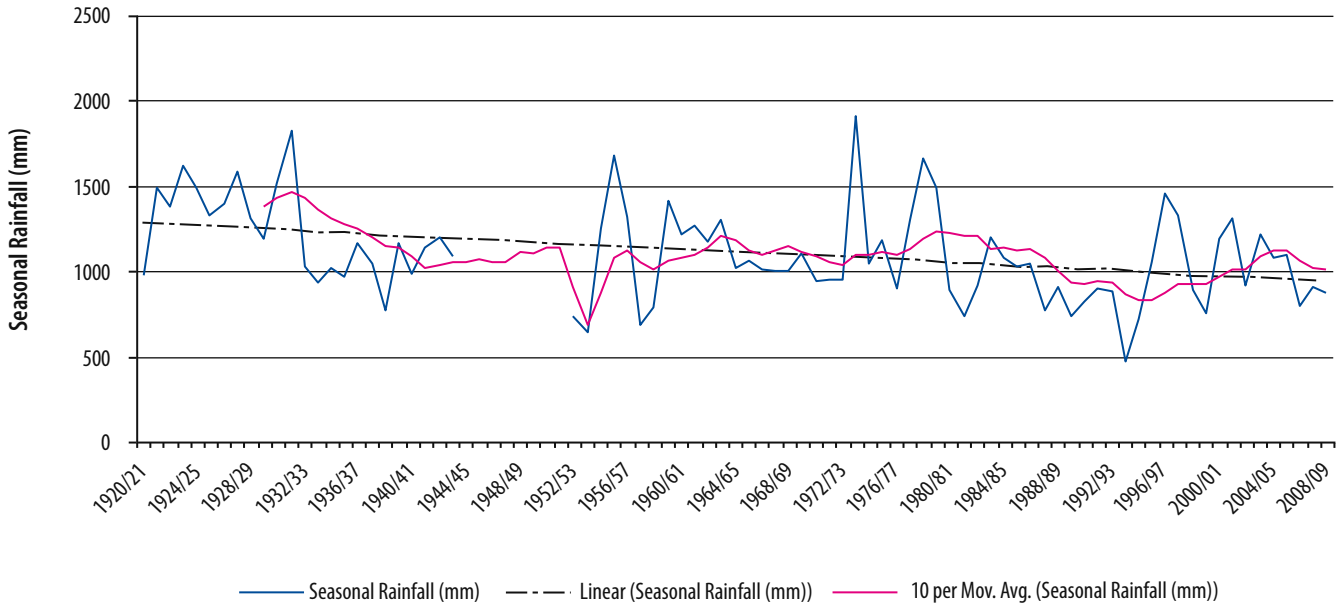
vi. The major climatic hazard that affects the wildlife sector is drought since it affects availability of food and water. For example, the 1979/80 drought resulted in the deaths of Nyala in Lengwe National Park in Chikwawa and the migration of most animals from the game reserve.

vii. The major climatic hazards that threaten the forestry sector are extended droughts, which lead to reduced forest productivity, land degradation and loss of soil fertility, as well as forest fires. For example, during the drought of 1995, some 5,550 ha which represents 36% of Chongoni forest were destroyed by forest fires caused by human activities such as hunting resulting in smoke haze, pollution, loss of seedlings and biodiversity.

viii. Women bear most of the burden in activities that are most impacted by adverse climate, including walking longer distances in search of water, firewood and are regularly exposed to and inhale harmful emissions from fire places. Women also play a key role of ensuring that food is available to the family, especially their children. Women also carry the responsibility of caring for the sick members of the immediate and extended families.

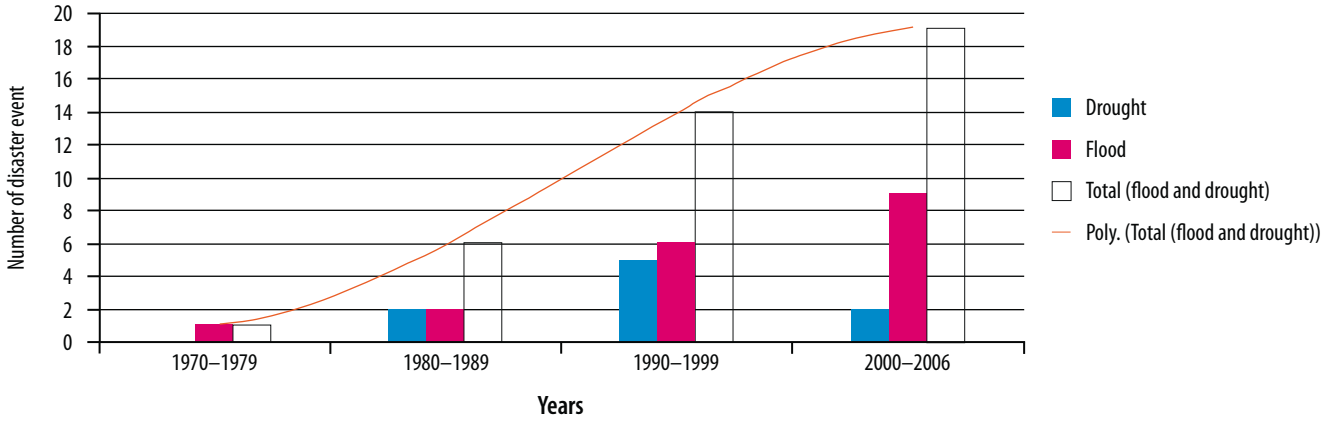
Source: GOM (2006). Malawi's National Adaptation Programme of Action (NAPA).

Figure 10.2: Rainfall Trends for Karonga from 1920 to 2009.



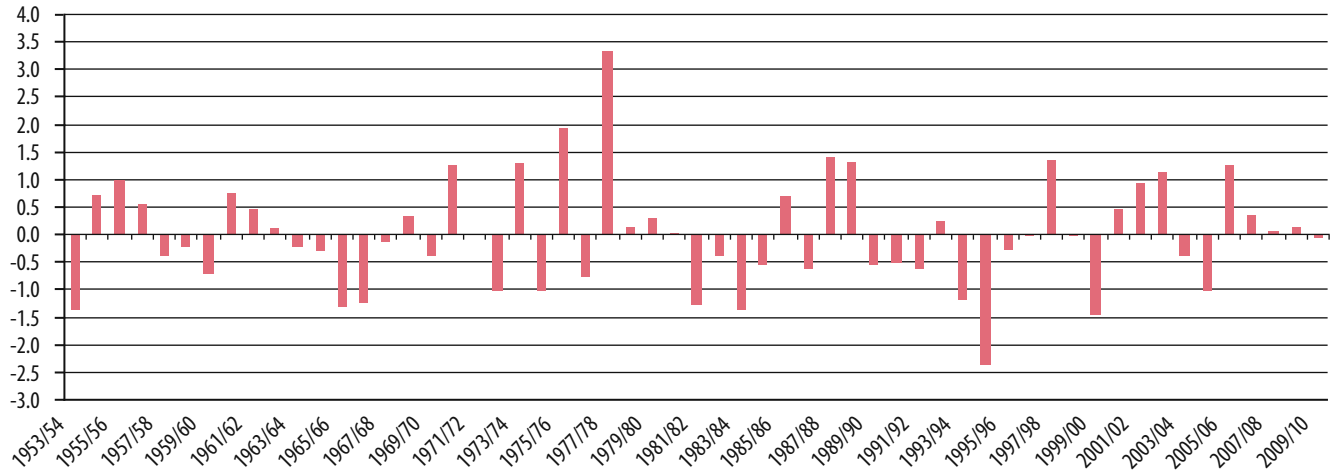
Source: DCCMS (2010).

Figure 10.3: Frequency of Extreme Weather Events.



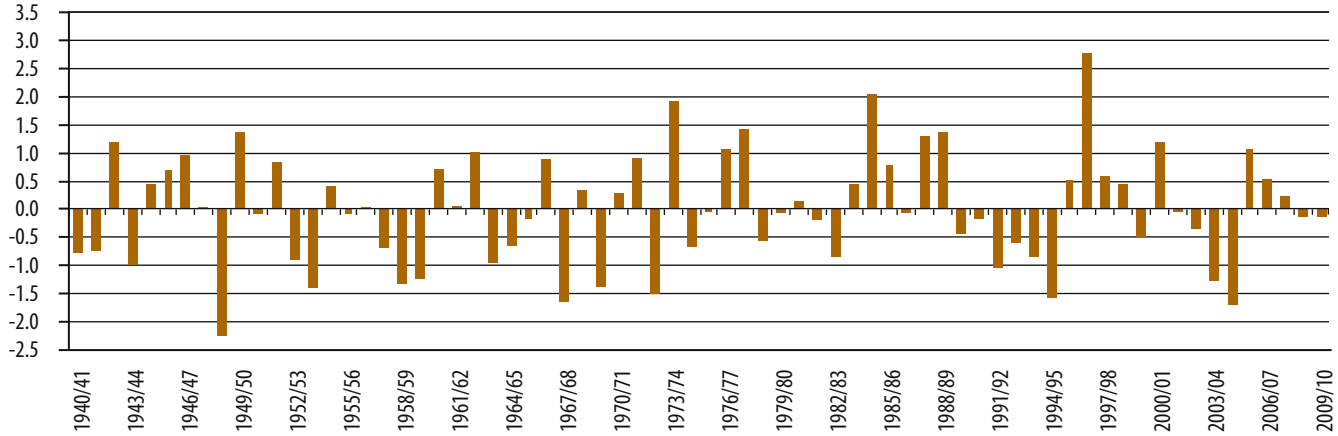
Source: ActionAid (2006).

Figure 10.4: Standardized Season Rainfall in Salima. From 1953/54 to 2009/10.



Source: DCCMS (2010).

Figure 10.5: Standardized Season Rainfall Time Series for Chileka-1941/42 to 2009/10.



Source: DCCMS (2010).

Figure 10.6. shows the mean temperature anomalies for Mzuzu, Nkhota-Kota and Bvumbwe for the period 1965 to 2009. It is evident from Figure Figure 10.6 that all three stations showed above normal temperatures from 1983 to 2009. This suggest that the whole country is warmer than two decades ago. The data on minimum and maximum temperatures indicate warmer winters and hotter summers.

Research from other sources (e.g. Action Aid) which is based the available climatological and other data to assess trends in climate related indicators such as rainfall, temperature and frequency of extreme climate events revealed noticeable shifts in climate pattern. At community level, smallholder farmers in the southern region of Malawi have noticed a shift in the onset of first rains. In the past few decades, onset of rains was around October/November but now it tends to lean towards November/December (Action Aid, 2006; Tadross *et. al.*, 2009]). It is evident from Figure 10.3 that Malawi has experienced increased frequency in the number of extreme weather events in terms of droughts and floods (Figure 10.3). It was reported by Action Aid (2006), further that localized floods have spread from the 9 traditionally prone districts before 2001 to 22 districts by 2003.

One other anecdotal evidence of reduced overall precipitation over Malawi and countries around Lake Malawi basin could be inferred from the trends in the Lake Malawi levels overtime. Lake levels indicated upward trend between 1972 and 1980, and a steady decline which persisted between 1980 and 1997 before turning up again from 1998 onwards. Despite the annual variations of the lake levels which range from about 473 to 477 metres, the statistical trend line shows a steady descent due to steady drop that persisted for 17 years between 1980 and 1997. The trend line further suggests that cumulatively over the assessed period the lake has received a net water deficit (Figure 10.7). This proposition is line with other studies conducted in Lake Tanganyika and Lake Malawi basins (Catherine *et. al.*, 2003).

Figure 10.6: Mean Annual Temperature Anomalies for Mzuzu, Nkhota-Kota and Bvumbwe 1965 to 2009.

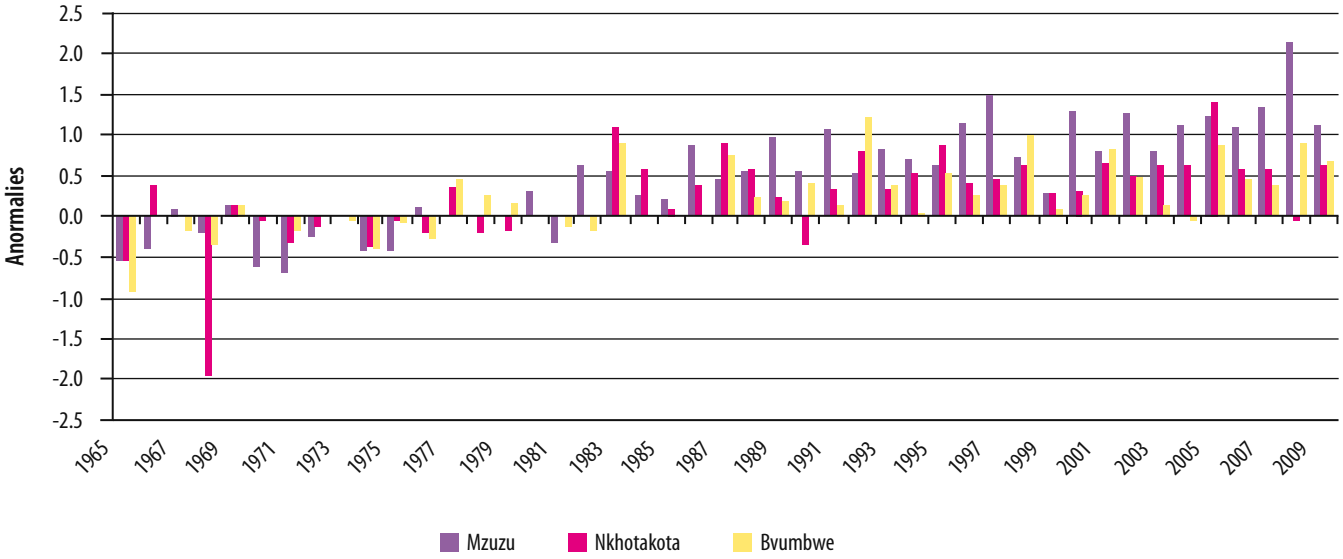
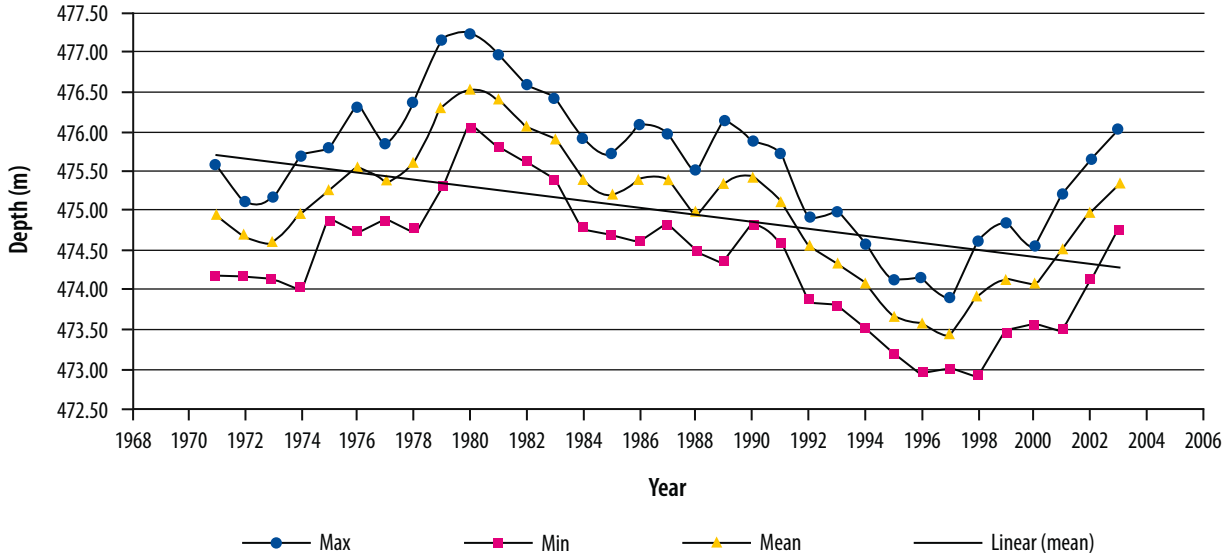


Figure 10.7: Trends in Lake Malawi Levels.



Source: Data from Water Department, Adapted in NAPA Energy Sectoral Report (2005).

Based on the analysis of climate projections done as part of the preparation of the Second National Communication (SNC), the trends indicate that annual rainfall for Malawi is expected to decrease by a maximum of 4.8% by 2075, but with a lot of month-to-month variations. High intensity rainfall events are also projected to increase. The same projections also indicate that annual temperatures will rise by a maximum of 2.7°C by 2075 while monthly temperatures are projected to rise, more during winter than summer (GOM, 2009a).

10.3 Inventory of Greenhouse Gases

Since mid 1990s, Malawi has undertaken three major studies to inventorize its greenhouse gas (GHG) emissions by source and sinks. These studies were undertaken as part of the United States Country Programme (USCP), Initial National Communication (INC) of Malawi and the current Second National Communication (SNC) of Malawi. Both INC and SNC, Malawi emerged as a net emitter of GHG i.e. the total emission levels exceeded the sink capacity (Smith, 2001; GOM, 2001; GOM, 2009a).

The major sources of GHG emissions in Malawi can be categorized into four main groups (Table 10.1). The data was processed further to assess how each sector contributed to the total emissions (Table 10.2). The results indicate that on average Malawi emits around 22708 Gigagrammes (Gg) of carbon dioxide equivalent. The most significant sector is Agriculture, Forestry and Other Land Use (AFOLU) which accounts for 95% of the total emissions. The major sources of emissions from AFOLU include livestock, chemical fertilizers, burning of agricultural residues, use of biomass fuels, as well as emissions reductions from within the Forest sector. The Energy sector is second and mostly accounts for combustion of and fugitive emissions from fossil based solid, liquid and gaseous fuels.

Table 10.1: Major Sources of GHG in Malawi.

Group		Sub-groups
1	Energy	Combustion of fossil fuels Fugitive emissions NB: does not include combustion of biomass
2	Industrial Processes and Other Product Use (IPPU)	Mineral processes Solvents
3	Agriculture Forestry and Other Land Use (AFOLU)	Livestock Land use Non-CO_2 emissions
4	Wastes	Solid waste disposal Incineration/open burning Waste water treatment

Source: GoM, 2002.

Table 10.2: Sectoral Greenhouse Gas Emissions in CO_2 Equivalent.

Sectors	Total Emissions in Gigagrams Per Year						
	1995	1996	1997	1998	1999	2000	Annual Mean
Energy	743.5	753.0	808.7	844.2	782.4	726.8	776.4
Industrial Processes	59.6	46.8	38.7	48.4	57.7	59.7	51.8
AFOLU	21007.0	21226.3	21555.7	21623.4	21869.6	22334.3	21602.7
Wastes	248.6	259.4	270.5	281.6	293.5	308.8	277.1
Annual totals	24053.6	24281.4	24670.5	24795.5	25002.2	25429.5	22708.0

Source: Adapted from GoM (2009a): Draft Second National Commuication.

10.4 Inventory of Indoor and Ambient Air Pollutants

Most of the sources of GHGs also emit other gaseous and particulate emissions. The pollutants that are emitted include sulphur dioxide, nitrous oxide, carbon monoxide, non-methane volatile organic compounds, and particulate matter (PM) (APINA, 2008; Hicks,2008) (Figure 10.9).

Approximately 76% of global particulate matter air pollution occurs indoor and in developing countries Fullerton *et. al.*, 2008). The major source of indoor air pollution is the use of solid fuels such firewood, charcoal and coal (Fullerton *et. al.*, 2008). For Malawi, biomass accounts for 93% energy supply, and virtually all the 85% of Malawi's population living in the rural area depend on biomass energy for cooking. Between 6% and 8% of the population have access to the national grid electricity (Gondwe *et. al.*, 2003).

Kenneth Gondwe

Sale of charcoal along Zalewa.

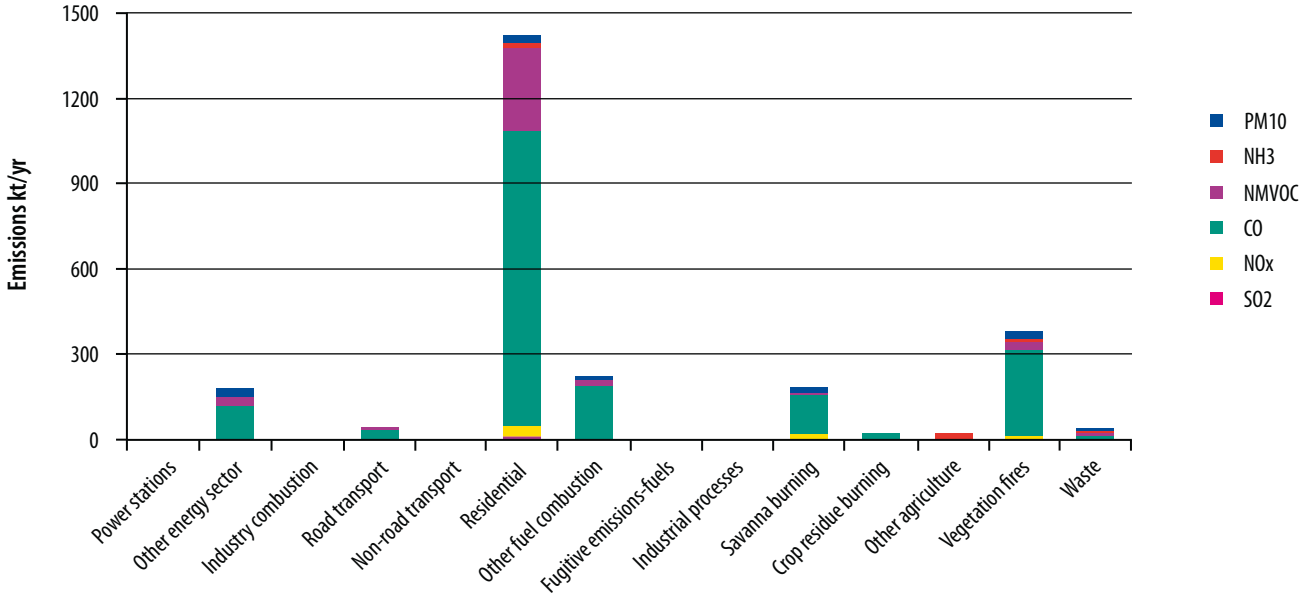
Malawi has also experienced a tremendous increase in motorized vehicles in the last ten years as evidenced by congested roads in the four major cities of Blantyre, Lilongwe Mzuzu and Zomba. Most of the vehicles used vehicles from Asia and Europe most of which have exceeded emission limits. Furthermore, most of the vehicles are poorly serviced and maintained. The challenge for Malawi is that vehicle certification concentrates on mechanical, electrical and structural soundness and not exhaust emissions. Thus Malawi has no legal framework to monitor emissions from vehicles.

Data from the Road Traffic Commission indicate that that In 1999, the proportion of goods vehicles was three times higher than passenger vehicles. In 2007, the proportion of passenger vehicles was significantly higher, implying a rate of growth in the number of passenger vehicles much faster than that of goods vehicles.

Air Pollution Information Network for Africa (APINA) undertook a comprehensive inventory of air pollution in Malawi as part of Swedish International Development Agency (SIDA) funded regional project covering Tanzania, Zambia, Malawi, Mozambique, Zimbabwe, Botswana and South Africa. Figures 10.10 show the summary of the result of the inventory which included all gaseous emissions not addressed under GHG inventories as well as particulate emissions (PM10 and PM2.5).

Figure 10.10 show that carbon monoxide is the largest pollutant in terms of the total anthropogenic emissions, seconded by non-methane volatile organic compounds (NMVOC). Figure 10.9 further shows total anthropogenic emissions in terms of percentage composition of the various pollutants, the highest being CO at 73% and the lowest is SO_2 at 1%. The major contributors of both CO and NMVOC were manufacture of solid fuels (charcoal production), transport, combustion in other sectors and burning of crop residues. The contributions made by other pollutants are small.

Figure 10.8: Total Emissions for Malawi for Year 2000.



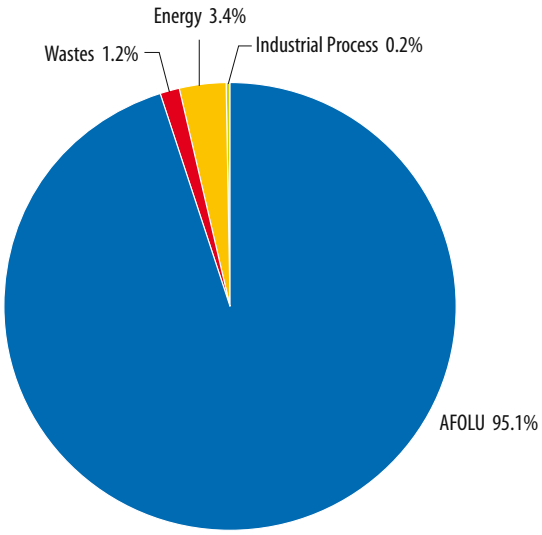
Source: APINA (2008).

The results of emissions inventory give a good picture of the national circumstances in terms of socio-economic dynamics of a country. Malawi being an agro-based economy, very low industrial production base and with over 90% of its population relying on biomass based fuels for cooking and space heating, it would be expected that the residential and agriculture sectors to be of more significance compared to other sectors such as industrial processes.

As shown in figure 10.11, indoor air pollution is a threat to the wellbeing of populations in the developing countries. Various studies conducted in Malawi and elsewhere clearly show that indoor air pollution is one of the major causes of morbidity and mortality affecting the poorer sector of the population especially women and children (Fullerton *et. al.*, 2008). Apart from the inability to afford alternative energy sources, some households cook in poorly ventilated houses thereby exposing the family members to gaseous and particulate emissions.

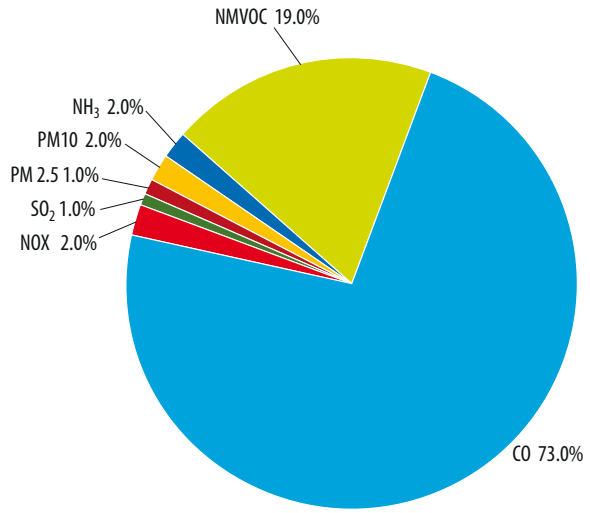
There have been very few impacts studies on particulate matter conducted by Malawian scientists, with the exceptions of the Zomba/Changalume study (Dolozi, Krempp, 1998), the small-scale lime makers in Zalewa (Gondwe, 2001) and research submitted to APINA conferences (Gondwe, Chipofya, 2003). Potentially, people living close to quarrying sites such as Njuli and Soche are exposed to particulate matter which could affect people's health and agricultural productivity.

Figure 10.9: Sectoral GHG Emissions.



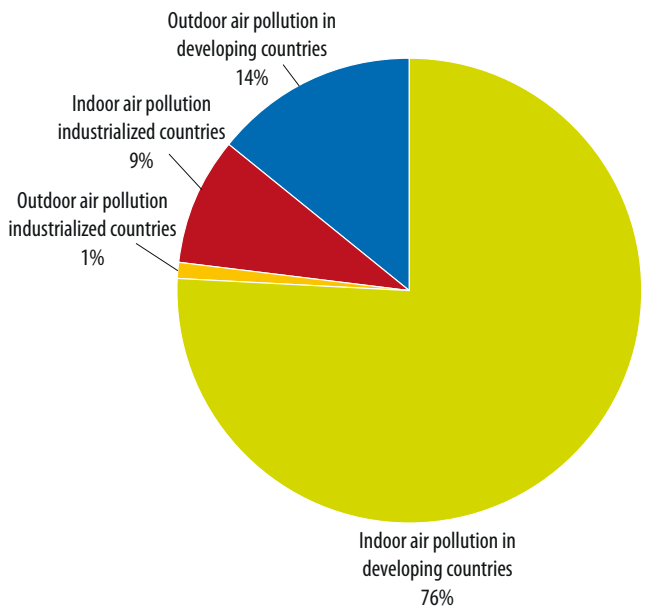
Source: Gondwe/Mhango (2008), APINA Malawi Report.

Figure 10.10: Contributions of Air Pollutants to Total Emission for Malawi 2000.



Source: Gondwe/Mhango (2008), APINA Malawi Report.

Figure 10.11: Total Global Exposure to PM, Pollution.



Source: Fullerton *et. al.* (2008).

Without documented evidence to support their cases, such negative impacts on people's health and their sources of livelihoods pass unnoticed and, therefore, not captured in the national statistics.

According to studies by the World Health Organisation (2008), air pollution causes 2.4 million deaths per year globally. Respiratory diseases such as asthma and pneumonia may be used as biological barometer of the state of air in a given area. Poor quality air may also result in acid rain, accelerated corrosion on structures and loss of productivity of plant species (APINA, 2008; Kim J *et. al.*, 2005).

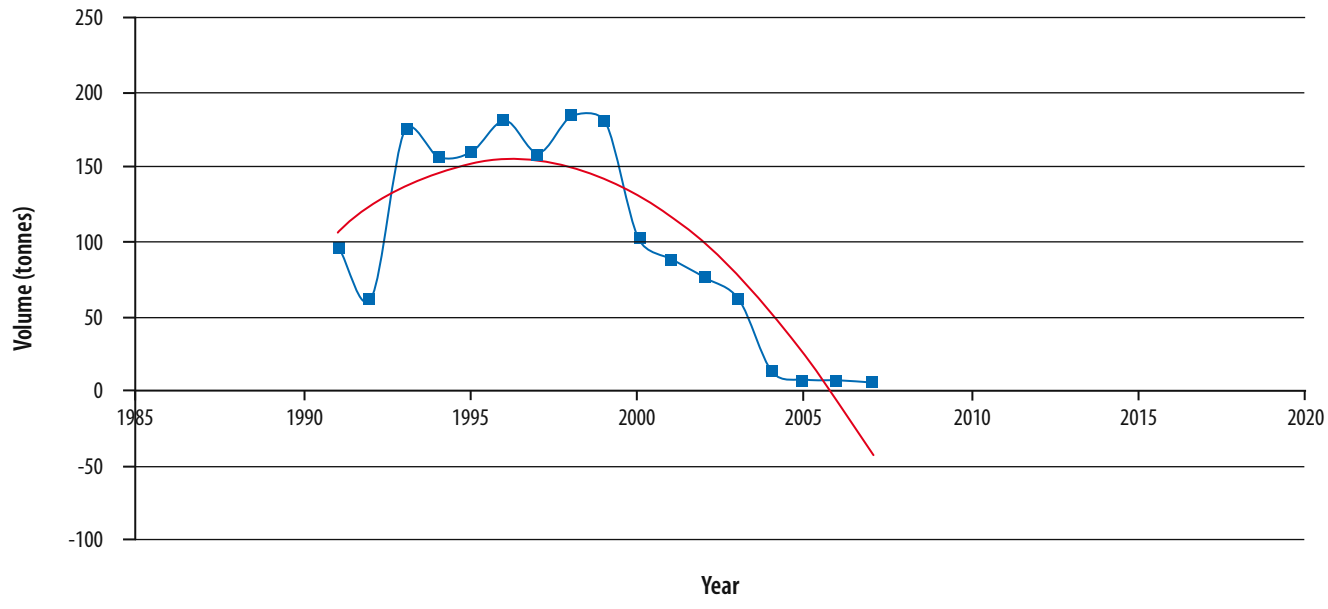
10.5 Inventory of Ozone Depleting Substances

Ozone (O_3) is the main substance found in the outer atmosphere called stratosphere (ozone layer) which lies between 10 and 50 km above the Earth surface. The ozone layer is very important to humans and other ecosystems in general because it naturally limits the ultraviolet-B (medium wave) rays of the sun from reaching the earth's surface. Over the years, it was observed that 'holes' were being formed within the ozone layer resulting in excess UV-B reaching the earth surface.

A group of man-made gaseous chemicals known as organohalogen compounds which are used in refrigeration, pesticides and coolants react with ozone when released into the atmosphere. Examples of halogens are Chlorofluorocarbons (CFCs) and bromofuorocarbons (BFC). Through the Montreal Protocol the use of ozone depleting substances were banned. It is important to note that due to the strengthening and adoption of the Montreal Protocol, reports indicate that the concentration of ozone in the atmosphere is stabilizing and the ozone layer will fully recover.

Figure 10.12 shows the inventory of ODS used in Malawi from 1991 to 2007. Before year 2000, Malawi was consuming between 150 and 200 tonnes of ODSs. Beyond 2000, there was a very sharp decline in tonnage as a result of phasing out of methyl bromide which was used in tobacco industry.

Figure 10.12: Consumption of ODS in Malawi.



Data Source: UN Statistics Division.

Table 10.3: Impacts of ODS on Human Health and Ecosystems.

Area/Sector Affected	Impacts
Human health	Skin cancer and cataracts
Plants	Plants damage, reduced yields and quality as well as increased susceptibility to diseases
Marine	ecosystems
Phytoplankton productivity is reduced, affects early stages of marine animals including fish hence affecting fish yields	Biochemical
cycles	Affects terrestrial and biogeo-chemical cycles- impacting on GHG sources and sinks
Materials	Accelerate damage to plastic materials

Source: Adapted from "The Environmental Effects Assessment Panel Report for 2006: FAQs", Coordinated by P J Aucamp, South Africa.

As party to the Vienna Convention and Montreal Protocol, Malawi Government, through the Environmental Affairs Department, has been undertaking periodic ODS inventories for Malawi reporting on production and/or consumption of ODS (GOM, 2004; GOM, 2009b; GOM, 2010). The inventories show similar trend in terms of the sharp reduction in the use of ODS and finding alternatives to ODS. The reports also observed that there was the lack of capacity in terms of competent refrigeration technicians, lack of equipment for the recovery of ODS and lack of enforcement.

No comprehensive studies on the impacts of ODS on humans and ecosystems in have been done in Malawi. Various studies (Aucump, 2006) have shown that exposure to high level of UVB has negative effects on human health, plant productivity, marine ecosystems, biochemical cycles and materials (Table 10.3). The beneficial effect to UVB exposure is increase in production of vitamin D which prevents rickets. Furthermore, reports by IPCC (2007) have shown that ozone depleting substances, just like GHGs, also contribute towards global warming but with substantially higher global warming potential (GWP).

10.6 Measures to Respond to Adverse Impacts of Climate Change

10.6.1 Responses to Impacts of Air Pollution

Policy and Regulatory Response

The issue of indoor and ambient air pollution have not been fully addressed in the Malawi National Environmental Policy and Malawi Energy Policy. However, the Malawi Energy Policy has clearly shown how it plans to move the sector from being predominantly biomass-based to higher quality energy sources and forms as shown in Figure 10.12. The Government has also established Malawi Energy Regulatory Authority to govern the energy sector. At a regional level, Malawi has been one of the active members in the development of regional regulatory framework on transboundary air pollution which was being facilitated by APINA and UNEP-Nairobi. However, no binding agreement have been made yet (APINA, 2008).

The Malawi Government through the Malawi Bureau of Standards developed and published in 2005 Malawi Standard MS 737:2005 "Industrial emissions- Emissions from mobile and stationary sources- Specifications". This Standard specifies maximum allowable limits for gaseous and particulate pollutants, and proposes mechanisms to reduce them. These limits are in line with guidelines developed by World Health Organization (WHO, 2008). Table 10.4. shows the emission limits for stationary and mobile sources.

Strategies

Malawi Government, through the Department of Energy, embarked on the development of a number of strategies to operationalize the implementation of Malawi Energy Policy. One such policy is the Biomass Energy Strategy (BES) which was supported by German Government through GTZ. BES addresses the issue of sustainable utilisation of biomass resources. This could be achieved, among other interventions, through the improvement of the efficiency of current energy technologies such as stoves and kilns. For instance, women who are already involved in making of clay pots may be taught how to make clay-stove liners or clay stoves. Reduction in firewood or charcoal used translate into cash savings and reduction in gaseous and particulate emissions (ProBEC, 2009).

Table 10.4: Ambient Air Quality Standards Limits.

	Maximum Concentration in Ambient Air	Averaging Period
Suspended particulate matter PM10 micro g/cu. m PM2.5 micro g/cu. m	0.5 25 8	1 year 1 day 1 year
Carbon monoxide ppm	9 35	8 hours 1 hour
Sulphur dioxide	0.2 0.08 0.02	1 hour 1 day 1 year
Nitrogen dioxide	0.12 0.03	1 hour 1 year
Ozone, ppm	0.12	
Lead micro g/cu. m	0.5	year
Photochemical oxidants ppm	0.1 0.08	1 hour 4 hours

Source: Malawi Bureau of Standards MS 737: 2005.

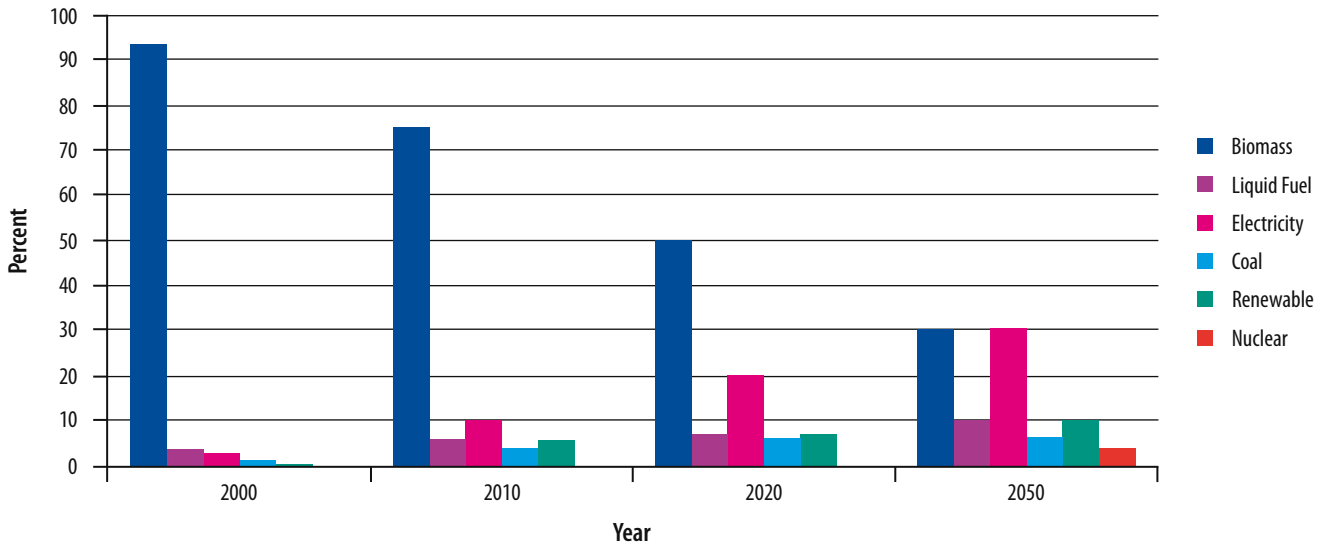
Programmes, Projects and Other Initiatives

Figure 10.13 shows the Energy mix projections for future as envisaged in NAPA.

A number of Government departments and ministries have undertaken projects and activities which have a bearing on indoor and ambient air pollution. The Government, through the Department of Energy, has been working on a number of programmes to enhance the sustainability of energy resources through energy efficiency and promotion of alternative energy sources. Some of the projects/ programmes are:

- National Sustainable and Renewable Energy Programme (NSREP) which provided a unified platform of renewable and sustainable energy interventions in Malawi. This programme phased out.
- Barrier Removal to Renewable Energy in Malawi (BARREM) project which facilitated establishment of test and training facilities at Mzuzu University, training of engineers and technicians, and promotion of solar systems in rural clinics, schools and homes, and improvement in tobacco kilns. This project also phased out.

Figure 10.13: Energy Mix Projections for 2000 to 2050.



Source: Data source Malawi Energy Policy, adapted in NAPA-Energy Sector.

- Malawi Rural Electrification Project (MAREP) which aims at extending electricity grid to rural area and is locally funded through energy fund derived from fuel levy. This is an ongoing programme.
- Promotion of Alternative Energy Sources Project (PAESP) targeted to reduce Malawi's reliance on firewood and charcoal as main sources of energy. Although governments and private sectors may work together to promote and disseminate alternative energy sources such as electricity grid or liquefied petroleum gas (LPG), it does not imply that people will be able to access these other energy forms. Access will require the population to wire their houses, purchase the end-use device (such as electric or gas stove) and to pay for the energy.

Other initiatives include:

- Implementation of Partnership for Cleaner Fuels and Vehicles through DoE and UNEP which saw Malawi successfully phasing out leaded petrol and shifting to lower sulphur diesel.
- Malawi has been blending ethanol in fuel since 1982, and has installed capacity of about 30 million litres of ethanol per year (Batidzirai, 2007). The GoM has now made ethanol blending mandatory (MERA).
- About 25000 smallholder farmers are currently involved in growing about 6 million jatropha curcas trees for production of bio-diesel. These farmers are working with Bio Energy Research Limited (BERL) in collaboration with other partners.
- Promotion of briquettes and briquetting technologies using waste materials as substitute for firewood and charcoal
- Promotion of wind technology for water pumping.

10.6.2 Responses to Impacts of Climate Change and Climate Variability

Most of the initiatives to reduce indoor and ambient air pollution through use of more efficient end-use devices also directly contribute to a reduction in GHG emissions. As such, there is a co-benefit in implementing mitigation measures at the source level rather than at the pollutant level.

Policy and Regulatory Responses

As regards legislative framework, Malawi Government has undertaken a number of initiatives to address this very critical issue despite the fact that current Policies and Acts do not adequately address issues of climate change and climate variability. As per its obligations to UNFCCC, Malawi produce its emissions inventories to report on its status of emissions and sinks, as well National Communication to report on various initiatives on climate change in the country.

So far Malawi has published: GHG Inventory for base year 1990 under USCSP; GHG Inventory for base year 1994 under UNFCCC in 2001; Technology Transfer and Needs Assessment Report in 2002;

Research and Systematic Observation (2005); Initial National Communication of Malawi in 2003; GHG Inventory for 1995 to 2000 (draft report awaiting publication); Second National communication of Malawi (draft report awaiting publication).

Strategies

The Government has included climate change as one of its priority areas in the Malawi Growth and Development Strategy (MGDS) which guides the development path for Malawi. The climate change focus aims at addressing some of the areas identified through the NAPA process. This means climate change is receiving the focus it deserves at the highest level.

Programmes, Projects and Other Initiatives

As highlighted in the overview, Malawi published its NAPA in 2006 which was officially launched in 2008. Through the NAPA, vulnerable areas or sectors that required urgent adaptation interventions were identified and various projects were recommended for funding. These were:

- Improving community resilience to climate change through the development of sustainable rural livelihoods,
- Restoring forests in the Upper and Lower Shire Valleys catchments to reduce siltation and associated water flow problems,
- Improving agricultural production under erratic rains and changing climatic conditions,
- Improving Malawi's preparedness to cope with droughts and floods, and
- Improving climate monitoring to enhance Malawi's early warning capability and decision making and sustainable utilization of Lake Malawi and lakeshore areas resources.

Other initiatives include:

- Quantifying emissions
- Carbon sequestration projects to enhance Malawi's capacity to profit from the Carbon Market and empower its rural communities to conserve forest resources;

- Clean Development Mechanism (CDM) provides an opportunity to access funding through carbon markets for environmentally friendly/mitigation technologies. Malawi has few CDM projects but with the approval procedures and implementation criteria that are being developed, Malawians will soon be better prepared to develop winning proposals;
- Climate Adaptation for Rural Livelihoods and Agriculture (CARLA) project which will be piloted in six vulnerable districts of Karonga, Dedza, Salima, Zomba, Chikhwawa and Nsanje;
- Sustainable Land Management of the Shire River Basin project has been approved for funding through the Global Environment Facility (GEF).
- The country has also seen an increase in participation of higher education institutions in terms of capacity building and research programmes such as Mzuzu University, Bunda College, Chancellor College and the Polytechnic.
- Furthermore, Malawi has seen growing interest and support from other stakeholders such as UNDP programmes, DFID, OXFAM, Action AID, CURE, LEAD and many other non-governmental organization involved in climate change related programs
- Promote climate change adaptive technologies through promotion of drought resistant crop varieties; crop diversification, conservation agriculture, small scale irrigation and organic farming;
- Private sector are now offering crop weather insurance services;
- Preventive health services through promotion of insecticide treated nets (ITNs) and prevention of diarrhoea diseases through water treatment;
- Improved fisheries research, monitoring of fisheries in Malawi lakes, co-management of fisheries resources and fish farming/aquaculture.
- Artificial water points in the parks, breeding programmes, co-management of park resources/ community ranching, fire management and capacity for translocation.
- Flood management/early warning systems, water harvesting and water shed management
- Women empowerment programmes e.g. entrepreneurship training and microfinance initiatives, participation in tree planting and improved water supply as well as alternative energy sources e.g. briquettes.
- Co-management of forest resources and fire management, and improved forest extension services.

10.6.3 Responses to the impacts of Ozone Depleting Substances

Policy and Regulatory Responses

Malawi is a signatory to Montreal Protocol and has made good progress in banning and finding alternatives for the ODSs. The protocol was developed to address the issue of compliance and finding of alternatives to ozone depleting substances.

Strategies

There have been no specific strategies developed to address the issue of ODS, instead several programmes such as phasing out of methyl bromide were used to achieve the objectives of the Montreal Protocol. In this connection, Malawi established three retroffing centres for refrigeration equipment and training of technicians and customs officials.

Programmes, Projects and Other Initiatives

Malawi phased out the use of methyl bromide in tobacco industries and banned the importation of refrigerators and air condition equipment that use ODS. Potentially, the phasing out of methyl bromide would have affected tobacco production, a key foreign exchange earner. However, all the stakeholders that were involved in phasing-out initiative did their part perfectly well. According a report by UNEP Ozone Secretariat Malawi, the programme on phasing of methyl bromide was singled out as one of the exemplary project as regards the commitment to adhere to the Article 10 of Montreal Protocol. The use of methyl bromide affected more than 400,000 tobacco farmers. Malawi exceeded phase-out targets (UNEP, 2007).

10.7 Challenges

Despite the success that Malawi has made, there are a few areas that deter progress in addressing effects of climate change.

Human Resource Capacity

The field of climate change and atmospheric pollution has seen an upsurge in the number of players in the area of climate change. However, the majority lack the necessary knowledge and expertise in various areas of climate change and atmospheric pollution.

Inadequate Monitoring Infrastructure

Currently, all the inventories undertaken are based on historical activity data and default emission factors. For instance, emission from vehicles are estimated based on the amount of fuels used multiplied by a default factor but this may not be accurate. With no programmes that regularly monitor levels of emissions from mobile and stationary sources, it is difficult to assess the accuracy of the inventories.

Inadequate Policy Guidelines

There are no overall policy guidelines that could regulate the sector and harmonise interventions. This is particularly important since the impacts of climate change cut across all sectors. The lack of policy guidelines also limits the sector's capacity to plan and budget accordingly.

Awareness

'Climate change' has a buzzword that most Malawians would want to comment on. Any extended drought or flood is linked to climate change. This is mostly due to lack of awareness and knowledge gaps at all levels; from policy makers down to ordinary person in the street.

Knowledge Generation and Dissemination

Very few academicians and researchers undertake climate change and atmospheric pollution related research. And for the few that do, their findings do not always reach potential users.

Inadequate Funding

Although climate change is one of priority areas government funding for climate change interventions is relatively low. Thus with limited resources, it is not possible for the government to implement all prioritized climate change activities and programmes alone. Alternative funding avenues need to be explored.

10.8 Conclusions

The state of atmosphere and climate change in Malawi is critical to the achievement of socio-economic development aspirations. Impacts cover virtually all sectors and significantly affect the segment of our populations in the rural areas who have low adaptive capacities and lack alternative source of livelihoods.

This chapter has demonstrated that Hydro electric power generation is very climate sensitive. Delayed onset of rains or extended period of drought in the Lake Malawi basin potentially result in total loss of generation capacity due to cessation of flow of Shire River. Such a scenario would have disastrous effects on the socio-economic fabric of our country.

10.8.1 Emission Trends

The trends in the total emissions of GHG and other air and particulate pollutants are likely to continue increasing. Motor vehicle population is expected to increase as levels of affluence increase despite the new taxation policy on imported used motor vehicles. The challenge is that most of the cars on the roads of Malawi are even in worse state than the imported used vehicles.

Malawi is likely to remain a net emitter for some years since the capacity to increase the level of sink through afforestation programmes are thwarted by continued deforestation for timber, rapid population growth, opening up of new farms and over-dependency on firewood and charcoal. Total net emissions have not changed significantly over the past 10 years. Assuming linear projection, Malawi would emit over 30,000 Gg CO_2-equivalent per annum by 2020 if the prevalent circumstances continue.

Malawi has ably developed and published its air quality standards through Malawi Bureau of Standards. The air quality standards would potentially contribute towards reduction in vehicular and industrial emissions. The challenge is how to translate standards into action on the ground and put mechanisms to enforce adherence.

Finally, this chapter has also demonstrated that Malawi is on course to becoming a zero-ODS emitter. The challenge is to remain vigilant especially in terms of control of importation of second hand refrigerators which may still be using ODSs

10.8.2 Alternative Energy Surces to Firewood and Charcoal

Through the PAESP programme, the Government is promoting switching to alternative energy sources. In the past alternative sources such as solar PV, biogas, grid electricity through MAREP and biomass briquettes were promoted and disseminated but the uptake has been rather slow and insignificant.

This intervention may be a bit more complex to implement because it may have a major cost implication attached to it which majority of Malawians cannot afford. Hence, this may call for a multi-sectoral approach which would include economic empowerment of the population to enable them move up the energy ladder.

10.9 Recommendations

10.9.1 Need for An Operational Framework for Climate Change Programmes

The Government, though EAD and DCCMS, has used the media, workshops and seminars, academic institutions and policy makers to raise the profile of climate change interventions. Despite the efforts to bring coordination and synergy, the level of coordination between government and non-governmental actors in implementing various climate change projects is minimal. Therefore, there is an urgent need for an operation frame-work which could coordinate all climate change activities and provide a forum for exchange of knowledge and lessons in order to be more efficient and effective.

10.9.2 Unified Climate Change Policy

Climate change impacts affect almost all the key social and economic sectors of Malawi. At the highest level, it would be necessary to have an overall climate change policy which would provide guideline to sectoral policies. This would also facilitate the mainstreaming of climate change issues in the various sector strategies, plans and budgets, as well as provide platform to identify co-benefit opportunities.

10.9.3 Switching to Alternative Energy Sources

When populations remain stuck in the lower end of the energy ladder it is an indication of lack of alternatives, low economic capacity or both. It is impossible to shift a poor household up the energy ladder unless externally supported say through a grant, donation or a subsidy. In order to succeed in the energy switch the following pre-conditions need to be satisfied: significant socio-economic changes are made in relation to economic empowerment of the rural population, alternatively develop a kind of subsidized programme targeting the poor household; significant investment in alternative energy sources such as grid extension and micro/mini hydro power and awareness raising stressing on the benefits to switch to alternative energy sources.

10.9.4 Improving Law Enforcement and Coordination

MS 737: 2005 not only stipulates the standards but also proposes a number of interventions that could contribute towards reduction of emissions. What remains is to put measure and build capacity for enforcement of emissions control from motor vehicles and other sources.

Although significant progress has been made in phasing out ODSs, but to ensure total phasing out continuous monitoring and control is necessary. In this regards, EAD, MBS and Malawi Revenue Authority (MRA) need to work together to enforce the control of the importation of products or sub-stances that could emit ODSs.

10.9.5 Institutional and Human Resource Capacity

As the Government is building its internal capacity to handle issues of atmosphere and climate change, efforts should be made to look at wider needs in other actors so that Malawi would be able to make a significant contribution in climate change debate at all levels. Furthermore, these institutions, need equipment and facilities to undertake meaningful research and studies to investigate, monitor, document and share their finding for the benefit of Malawians and the global community. There is need to encourage young Malawian scientists to study in the field of climate change, encourage high level research and publication in various aspects of climate change field, such as inventories, adaptation, mitigation and policy.

Photo Essay - Alternative Fuel Sources

Sosten Chiotha

Traditional charcoal production, shown above, is highly destructive to the environment. It requires extensive timber resources to produce, and releases greenhouse gases into the atmosphere when used. Charcoal is one of the most common fuel sources in Malawi.

However, recent initiatives by the Government of Malawi have explored the possibility of environmentally sustainable alternative fuel sources. Biofuels from sugarcane or jatropha (shown below) are one promising result.

Deepa Pullanikkatil

Photo Essay - Climate Change Adaptation

Sosten Chiotha

Sosten Chiotha

The photograph to the right shows the after-effects of a flash flood. Extreme climate events such as drought or flood cause extensive damage to food crops (maize is show in the photograph) and necessitate farmers to take adaptive measures.

Left: Crop diversification is a way of adapting to climate variability and change. Photo shows paprika grown along with maize.

Sosten Chiotha

Sosten Chiotha

A common adaptation measure to crop loss is the gathering of forest products for food. Shown above right and to the left are edible wild tubers, Buye that were gathered during a time of poor crop yields. Biodiversity conservation and indigenous knowledge are essential to ensure that these adaptation measures remain viable.

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PART 3

Environmental Governance, Now and in the Future

CHAPTER 11

Valley, Photo by Sosten Chiotha

EXPLORING THE FUTURE OF MALAWI'S ENVIRONMENT USING SCENARIOS

Solar and Wind Energy, Photo by Geoffrey Kumboyo

11.1 Introduction

Throughout its history Malawi has been unusually privileged ecologically. The country's fertile soil and reliable water sources (from rainfall, lakes, rivers, and wetlands) have continually sustained some of the highest population densities in South-Eastern Africa (McCracken, 1999). The work of ecological historians such as Webster and McCracken illustrates that the richness of the country's natural resource base historically rendered pastoralism unnecessary. This is unusual in the region, and encouraged high levels of human migration from neighboring countries by those in search of basic natural resources. Environmental resources were also integral to economic growth and trade; a century and a half ago, the Shire-Zambezi waterway was used as a transport system, with a port in Nsanje (Mzembe, 2010).

Over time, the use of the waterway decreased to the point where Malawi was regarded as a land-locked country. Moreover, the demographic changes described above (increasing population density due to migration, as well as high fertility) led to unsustainable resource use and significant environmental degradation.

Trade in the waterway will soon flourish again due to the opening of the Nsanje Port. However, for this trade to continue in future, the flow of the Shire River must be managed through well-enforced environmental policies. Sound policies are also necessary to mitigate the effects of population pressures and climate change, which could together force the abandonment of traditional livelihoods and the adoption of historically unprecedented pastoralism. In order to prevent this situation from occurring, policies must be based on consideration of future scenarios for the environment. Chapter 11 aims to fill this need by out-lining potential scenarios that show how population, economy, and infrastructural development impact on the environment, and how effective governance can preserve Malawi's natural resources.

The Brundtland Report emphasizes that all development endeavors should be preceded by a clear understanding of the path to a sustainable future. In reality, humankind's ability to foresee a sustainable development path is obscured by uncertainties in a host of variables. These variables include, and are by no means limited to: climate change, socioeconomic factors, political dispensations, rule of law, traditional and global economies, demographic trends, and changes in consumer behaviour. Traditional approaches to environmental policy planning failed to effectively describe how these variables interlink to affect natural resource use, and subsequently our society, environment, and economy.

As such, it was our desire to find a more comprehensive approach to current and future environmental planning. Using the modeling system developed for the African Environmental Outlook (UNEP, 2006), we opted to use scenarios to explore the conditions that are conducive to enhancing natural resource stewardship. The "scenarios approach" allows for exploration of proactive policies and strategies that will ensure that the country is prepared to deal with future eventualities.

UNEP (2002) defines scenarios as "descriptions of journeys to possible futures" which reflect different assumptions about how current trends will unfold, how critical uncertainties will play out, and what new factors will come into play. Scenarios include an interpretation of the present, a vision of the future and an internally consistent account of paths from the present to various futures. Ultimately, scenarios are intended to provide better policy or decision support, and stimulate engagement in the process of change (UNEP, 2002). However, scenarios are not predictions, but rather plausible stories of how the future might unfold, based on known information about current trends.

A number of scenario exercises have been carried out in environmental assessments and policy analysis. Some of the notable examples are: Millennium Ecosystems Assessment Report (MA, 2005), which discusses various outlooks on different issues; IPCC Special Report on Emission Scenarios (2007), which highlights four global emissions/climate change scenarios; World Water Vision (2000), which provides information on three global scenarios on water resources; Africa Environment Outlook (2006), which discusses four regional scenarios on environment and economy; and UNEP Global Environment Outlook (2007), which describes four global scenarios on the environment.

The overall goal of the current Malawi environment scenario building process was to present insights into the national outlook, up to the year 2025. Specifically, the process was intended to:

- Combine qualitative and quantitative information about the future evolution of environmental challenges and opportunities in Malawi;
- Identify the robustness of environment policies under different future conditions;
- Illustrate how alternative policy pathways can achieve the environmental targets and aspirations contained in the Malawi Growth and Development Strategy (MGDS), Millennium Development Goals (MGDs) and Vision 2020;
- Describe future alternative states of the environment with/without various policies, thereby illustrating the impact of society on the natural environment

and the need for formulation and implementation of environmental policies, and;

- Raise awareness about the future relationship between different environmental challenges and threats to the natural environment and human well-being.

11.2 Developing the Scenarios

The process of scenario building for Malawi's State of Environment and Outlook Report (SEOR) was done in a participatory and consultative manner. Key stakeholders were involved, including: thematic chapter authors, officials from the Environmental Affairs Department, Ministry of Development Planning and Cooperation, University of Malawi, and LEAD-SEA. The process commenced with the selection of a target year, 2025, which was arrived at after taking into consideration the corresponding end-dates of the Malawi Vision 2020, the MDGs, the MGDS, and the NEPAD Environmental Action Plan. There was consensus among the participants on the selected target year due to the understanding that it would make the State of Environment and Outlook Report relevant to the country's development needs and aspirations in the short and medium term.

Secondly, participants identified key drivers of environmental change in Malawi. These were: economic development, demography, governance, environment and climate change, social change, technology, culture and tradition. Indicators for each of the drivers are described in Box 11.1. From this list of drivers, participants then selected two highly uncertain drivers with the greatest potential impact on the environment as "critical uncertainties". A critical uncertainty is defined as "a driver that is especially

Box 11.1: Set of Drivers for Malawi Environmental Scenarios and Their Elements

Demography Population growth Population density Population distribution Urbanization Fertility rate Mortality rate Population structure (age - gender) Migration patterns (internal and external) Life expectancy	**Economy** Sector based production Infrastructure development Changes in GDP Growth rate Markets and prices Economic development goals International cooperation Foreign investment Consumption patterns Globalization
Governance Political Will Democratic Dispensation Decentralization Public Awareness and Environmental Education Regional Treaties and Conventions Multilateral Agreements Economic Policies Community Participation Rule of Law Civil Society Involvement	**Environment and Climate Change** Land Degradation Pollution levels Extreme Environmental Events(droughts, floods, earthquakes) Global Stress Temperature changes Lake Level Rise
Social Change Education Consumption Patterns Refugees status Brain Drain and Brain Gain Improved Human Health Land Reforms	**Technology** Indigenous Knowledge ITC status Clean Development Mechanisms Green Economy Land Management Technologies Mechanization Construction Industry Technologies Agro-forestry Practices
Culture and Tradition Beliefs, Traditional Ceremonies, Cultural Heritage, Extraction of Medicinal Plants, Religion, Customary Land Tenure and Free-range grazing of livestock	

Figure 11.1: Scenario Building Process.

Source: UNEP, 2007.

important in determining how the future will evolve, but whose future development is highly unpredictable."

The five step procedure highlighted below was adopted in choosing Malawi's critical uncertainties (UNEP, 2007):

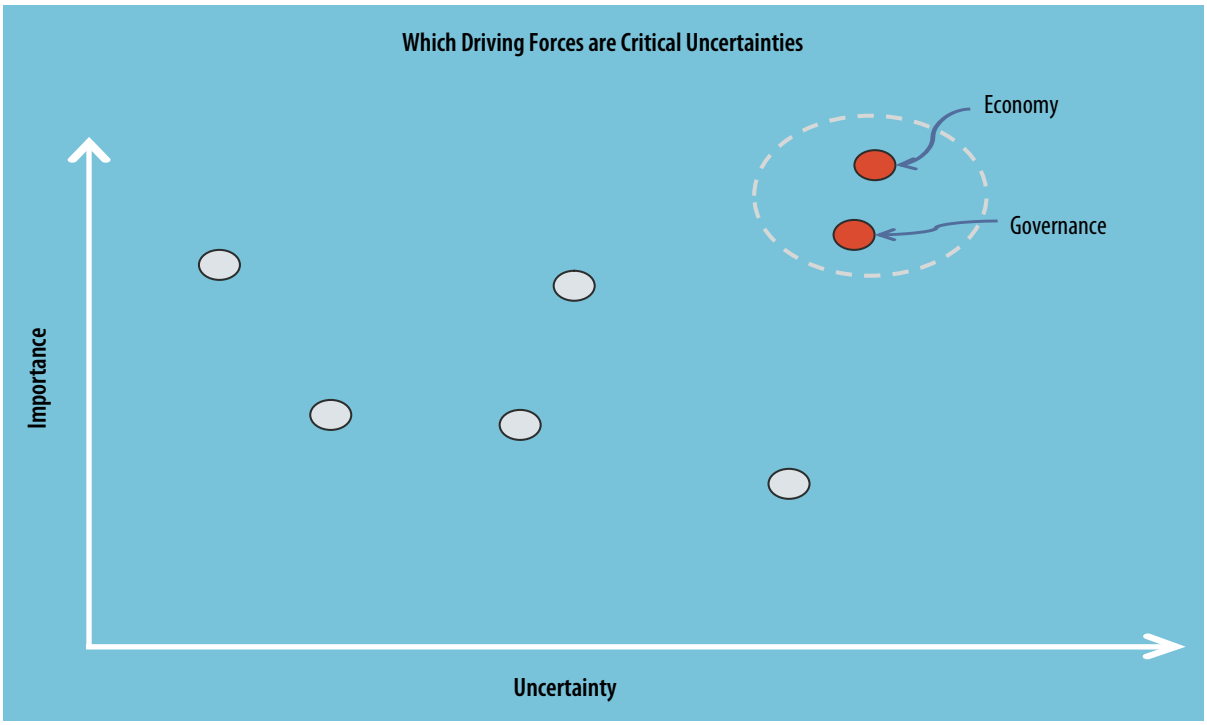
1. Consider each driver in turn, and recall the range of possible ways it could evolve;
2. Consider the degree of uncertainty in each driver. How much variation is there in the range of possible ways it could evolve? Is there a great deal of uncertainty, or relatively little?
3. Consider the relative importance of each driver into the future. Does the way it evolves make a major difference in the vision for the future, or does it make relatively minor difference?
4. Plot each driver on the chart of importance versus uncertainty. The further the dot on the X axis, the greater the uncertainty in how that driver will develop. The further the dot on the Y axis, the more significant is the impact of the driver;
5. Identify the drivers that have the highest importance and uncertainty.

The selection procedure for the critical uncertainties is shown in Figure 11.2: the graph plots drivers on an axis of importance (Y) and uncertainty (X).

Through this process, economy and governance emerged as the two most critical uncertainty factors influencing environmental health in Malawi.

Economy and governance were subsequently used as axes when plotting the scenarios on a graph. The economy axis was defined in terms of change in total production and consumption of goods and services, as measured by the Gross Domestic Product. Positive values on the Y axis indicate high growth in GDP, while negative values indicate low or negative growth rates. The governance (X) axis was defined in terms of political will and commitment at all levels to engage in activities that protect natural resources. This includes the health of democracy and observance of the rule of law. Positive X values indicate that leaders from government and civil society are committed to developing appropriate environmental protection policies, strategies and legal instruments, and maintaining adequate capacity to enforce regulations. Through public awareness programmes, individuals, communities and organizations

Figure 11.2: Determining Critical Uncertainties.



cooperate to support government initiatives to address environmental challenges. As the value of X becomes negative, government becomes indifferent or even hostile to matters of environmental protection. The society at large is uninformed about environmental challenges facing the nation and as such there is no concerted effort to protect the environment. In the absence of public awareness campaigns, effective environmental protection regulations and enforcement mechanisms, environmental degradation is unchecked. On communal and publicly-held lands, a classic "tragedy of the commons" develops due to individualistic over-exploitation. In the absence of a regulatory framework, access to and exploitation of the country's natural resources becomes a source of potentially violent conflict.

The two critical uncertainties interact in 4 possible combinations, each of which represents a possible environmental scenario for Malawi. These scenarios have been given Chichewa names (below, with English translations), and are shown in their respective quadrants in Figure 11.3:

Scenario 1 – Mkaka ndi Uchi (Milk and honey)

Scenario 2 – Pendapenda (Staggering along)

Scenario 3 – Wafawafa (Beyond redemption)

Scenario 4 – Chonchobe (Managing with very little)

11.2.1 The Scenarios

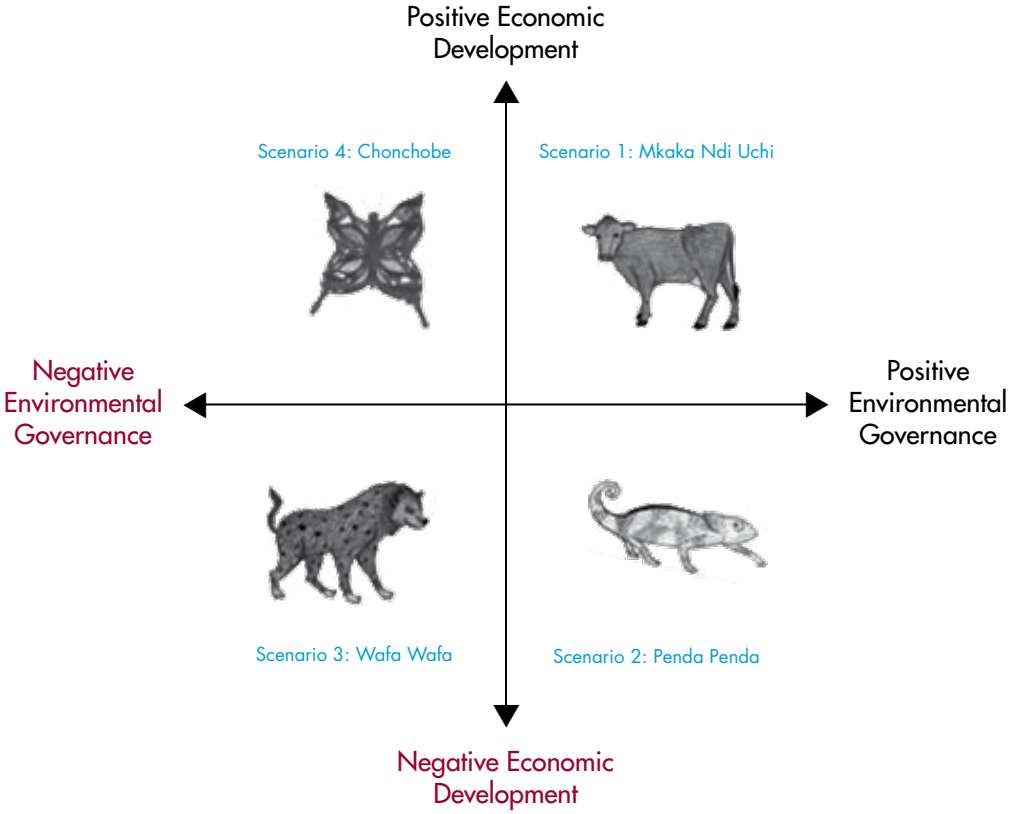
Scenario 1 (Mkaka ndi Uchi) depicts a situation in which Malawi experiences good governance and economic prosperity. Such a situation would enable the country to attain environmentally sustainable development. This is symbolized by a Cow which is a sign of prosperity as well as good environmental governance, as a cow provides milk and dung.

Scenario 2 (Pendapenda) describes a situation in which Malawi experiences good governance but dismal economic growth, resulting in unsustainable development. Under this scenario, environmental protections would not be secure in Malawi. This is signified by a drunk man, who is staggering along and does not contribute any economic gain to a household.

Scenario 3 (Wafawafa) is the converse of Mkaka ndi Uchi. It depicts the prevalence of a chaotic situation in Malawi, in which the country experiences both poor economic growth and poor governance. Under this scenario there will be cut-throat competition for the country's over-exploited and dwindling resources. Corrupt individuals will prosper at the expense of the majority of Malawians. This is signified by a Hyena, which is considered an illomened animal.

Scenario 4 (Chonchobe) depicts a situation of similar gravity to Pendapenda. However, the source of instability is poor governance rather than poor economic performance. High economic growth comes at the cost of future prosperity, as resources are unsustainably exploited. Dictators who accumulate wealth and enhance income disparity might emerge. This is signified by a Butterfly that can survive on very little nectar.

Figure 11.3: Using Sustainable Economic Development and Environmental Governance to Develop Scenarios.



11.2.2 The Drivers

The drivers summarized in Box 11.1 are a set of direct and indirect factors that can (singly or collectively) affect the future state of the country's environment. These drivers influence the state of, and trends in, environmental resources by dictating the level of production (supply) and consumption (demand) of environmental goods and services.

11.3 Exploring Malawi's Alternative Environmental Futures

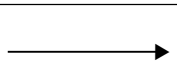
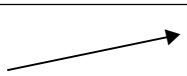
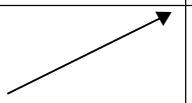
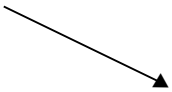
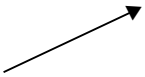
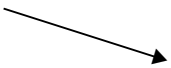
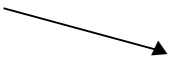
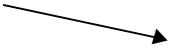
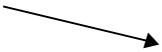
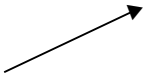
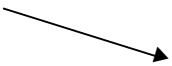
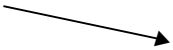
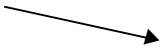
Scenario 1: Sustainable Economic Development and Good Governance (Mkaka ndi Uchi)

The year is 2025. For the past 15 years, Malawi has experienced unprecedented economic development, characterised by substantial increases in sector based production and vigorous growth in GDP. This economic triumph was the result of massive public investment in infrastructure development, which attracted extensive foreign investments, as well as improvements in the performance of the international economy. Successful policy responses to address the problem of over dependence on tobacco for export led to diversification in the agricultural sector and increased off-farm income generating activities. The expansion of the manufacturing and service sectors led to the expansion of the export base of the country with a concomitant improvement in balance of payment.

During this period the country matured as a democracy committed to good governance, with systems in place to enforce environmental policies, strategies and regulations. The political leadership displayed unwavering support for eco-efficient technologies, coupled with impressive improvements in capacity across economic and environmental sectors. This enabled the sustainable exploitation of the country's natural resources for the benefit all sections of the population. The country decisively and effectively responded to critical environmental issues in the priority areas of water, land and agriculture, health and environment, and human settlements, inculcating a culture of eco-efficiency and emphasizing collective responsible for sustainable production and consumption. Use of water saving technologies was the impetus for advances in agriculture and other sectors of the economy. Advancements in industrial engineering led to the designing of industrial projects and factories committed to reducing, reusing, and recycling. Advanced technologies allowed industries to do more with less, thereby using the country's natural resources more efficiently and sustainably.

In this period, there was a dramatic increase in agricultural intensification and productivity, which enabled crop diversification from maize into high value crops for export and to support the domestic manufacturing

Figure 11.4: Relative Qualitative and Quantitative Assumptions of the Trends of the Drivers in Each Scenario.

Driver/Scenario Issue	Qualitative/Quantitative Assumption on Future Trends			
	Scenario 1 Mkaka Ndi Uchi	Scenario 2 Penda Penda	Scenario 3 Wafa Wafa	Scenario 4 Ndaonera Momwemo
Demography				
Economy				
Governance				
Environment and Climate Change				
Social Change				
Technology				
Culture and Tradition				

industry. As a result of intensification, cultivation on marginal lands such as riverbanks and steep slopes was discontinued. Successful reforestation programmes saw a dramatic reversal of the trend in deforestation, reducing soil erosion and improving soil fertility. Energy saving technologies were widely adopted, which reduced dependency on biomass energy and resulted in impressive re-generation of indigenous forests. Additional clean energy sources became available, and new sites were found for hydroelectric generation. This decreased the economic and environmental cost of electricity at the industrial and domestic level. The urban transportation system experienced a revolution as the use of the private cars and minibuses was replaced by rapid mass transit. This resulted in a substantial decrease in water and air pollution and the emission of greenhouse gases, and a subsequent improvement in the health and well-being of the population. Traffic patterns that use less time and energy were developed (such as roundabouts and overtake lanes), improving pedestrian safety and reducing fossil fuel use.

The advances in eco-efficient designs reduced the environmental impact from a wave of economic development that swept the country. The advances enhanced the benefits that accrued to Malawians from the rapid economic development. The technologies supported the creation of an abundance of well paying green jobs by both the public and the private sector. Viable and vibrant partnerships were established between the government, private sector, and civil society in developing environmental efficient technologies in all sectors of the economy.

Issues of environmental protection increasingly took a centre stage in all short and medium term development policies strategies and of the country. The environment became the major thrust for all government supported development programmes designed to spur economic development of the country, achieve greater equity and other social goals. An important aspect of the strategy was the greater involvement of communities in deciding their destiny within the framework of the overall government sustainable development strategy. In this regard, all community led initiatives were conceived to achieve the sustainable development agenda. Community awareness and training programmes opened up new avenues for public dialogue and community empowerment in the management of government and natural resources. The shift in approach from government-led to community-led development resulted in well entrenched decentralised leadership structures.

Under this scenario, the country experiences a reversal of negative trends in the integrity of the environment and made significant gains in its restoration. Significant gains were also evidenced in natural resource productivity. Productivity in the agricultural sector was driven by an increase in the use of organic fertilisers and biological pest control approaches. The country's food security situation reached sustainable levels with smallholder farmers less dependent on subsidised fertilizers and other agro-inputs. Food security was achieved through increased intensification (and so productivity) of maize, bananas, tubers and roots. This is in response to government's deliberate policies and strategies to encourage farmers in different ecological zones to produce crops that offer them a comparative advantage and a change in consumption pattern of the country as whole. The land used for tobacco production shrunk remarkably as government put in place more robust policies and strategies in response to the global anti-smoking campaign that intensified between 2015 and 2020. The drive to diversify the economy saw a shift from over reliance on tobacco as a cash crop to increase in areas growing non traditional export crops such as pulses and high value export crops such as flowers and vegetables.

Although under this scenario, the demographic pressures eased only slightly as a result of declining fertility rates, the pressure on land resources would have been significant had it not been for the advances in environmental conservation spear-headed by the land reforms which accorded customary land free-hold status. Intensification of out-reach services and preparation and enforcement of village land use plans played a significant part arresting cultivation on environmentally fragile lands such as river banks, steep slopes and wetlands. This resulted in a remarkable reduction in soil erosion and nutrient loading of the county's drainage system. The country experienced uninterrupted supply of electricity as the rivers were less burdened by silt and debris from riverbanks and the wider catchment areas.

Under this scenario, the Government of Malawi has put in place measures for conserving biodiversity by adhering to the tenets of the Convention on Biological Biodiversity (CBD) and the Addis Ababa Principles and Guidelines. As a result, the country has been able to counter factors which have hitherto been responsible for biodiversity degradation in Malawi, namely: high human population growth, overharvesting, destruction of habitats, agricultural expansion, poverty, invasive alien species, and illegal hunting and trade of biological resources (EAD, 2010).

In the 2013 Annual Economic Report, all sectors in the MDG subtheme of 'sustainable economic growth' were performing well above the average in achieving indicator targets.

Water

- Increase in demand for water resources and per capita water supply declines, however, water efficient technologies counter the negative effects of the rising demand for water
- Levels of pollution in river systems are closely monitored and a strong enforcement regime is in place against water pollution
- Cultural practices and traditions are integrated into the overall water management putting emphasis on combining science and Indigenous Knowledge Systems (IKS)
- Rivers maintain regular flows and ground water recharge is maximized
- Advanced technologies lead to better understanding of water resource through research and facilitates better management of river basins.
- Service providers and consumers put in practice water demand management principles and hence there is virtually no loss of water through pipe distribution networks and wastage at the user end (no leakage, no pipe bursts, prudent use of water by the user, etc.)

Land and Agriculture

- The integrity of the environment gets a major boost from widespread use of agro forestry technologies which leads to improved water holding capacity and increase in organic matter
- The country experiences an improvement in production per unit area through adoption of sustainable farming practices and appropriate technology
- The country achieves self sufficiency in food on a sustainable basis through increase in maize production and improvements in non-traditional food crops such as bananas and ground provisions.
- The country has adopted adaptive strategies for averting adverse effects of climate change on agricultural production, resulting in improved crop yields and enhanced food security at household level.
- Because Malawi has developed the mining and industrial production sectors, thereby creating off-farm employment opportunities, the amount of land devoted to agriculture is reduced. This allowed for forest regeneration and arrested soil erosion and land degradation.

Health and Environment

- An ecosystems approach to health was adopted. The resulting improvements in eco-system management lead automatically to a reduction in environmentally linked diseases
- Intense public awareness progress result in phasing out of cultural practices and traditions that fuel the spread of HIV/AIDS and other sexually transmitted diseases
- Increase in the health budget improve the health and well being of all Malawians and results into substantial gains in productivity
- Investment in human resource development in the health sector improves health services and capacity to deal with environmentally-related diseases.

Human Settlements

- The country's population steadily moves towards replacement level as result of decreasing fertility rate brought about by formulation and implementation of robust and effective population policies.
- The rate of urbanization will continue to rise but will be better managed with the emergency of vibrant small and medium sized towns.
- A healthy urban environment was created through sound investments in housing, waste management and public transport.
- Pollution is checked due to popularization of public transport as a result of introduction of efficient mass transit systems and cleaner industrial processing systems.
- Widespread acceptance of planning controls as the whole country is a planning area
- A dramatic increase in the middle class and innovative housing policies lead to an increase of urban population living in high and medium density permanent housing areas with a corresponding decline people living in unplanned settlements.
- Rural planning was introduced to regulate the settlement and land use patterns of the rural population, currently over 80% of the total population.

Biodiversity

- Because the country has reduced its dependence on forest and land resources for the sustenance of rural livelihoods, the country experiences a resurgence of diversity of biological resources, and a recovery of degraded land.
- Better management of fish and wildlife resources through improved co-management arrangements results in an increase in fish and wildlife resources in the country.
- Because of increased intensification of agricultural production, hotspots of rich biological diversity are protected from destruction, thereby promoting biodiversity conservation.
- The adoption of sustainable harvesting of biological resources and stabilized human population growth enables Malawi to witness an increase in biodiversity
- The Malawi Government has put in place adaptive strategies for climate change that-promote biodiversity conservation

Scenario 2: Good Environmental Governance but Environmentally Unsustainable Economic Development (Penda Penda)

The period towards 2025 was characterised by substantial major strides in the environmental protection and restoration drive. After successive successful elections, culture of democracy deepened in all sections of the society. As a result of stability that the country enjoyed, the government was able to formulate policies and enforce regulations to correct negative impacts of economic development on the environment. A number of programmes were brought on board to harness community initiatives to address critical environmental issues. Representative democracy also takes root in urban areas with all grassroots structures functioning optimally. The available resources however only allow modest investment in infrastructure, housing and public health. Thus a substantial section of city dwellers still live in squalid conditions with no access to basic amenities.

Under scenario 2, the country experience a modest reversal of the gains recently made in the area of food security, infrastructure improvement and high rate of economic growth. Poverty continued to decline but only in the short term as a result of improvements in agricultural extension programs, targeted agricultural input subsidies. From 2020, it became apparent that the economic development being experienced could not be sustained. The targeted agricultural input subsidy programme was slowly phased out which resulted into a corresponding decline in agricultural productivity, notably maize. The use of organic manure was not widespread enough to counter the effect of the withdrawal of the fertilizer subsidy programme. This created new challenges in implementation of environmental protection and restoration measures as the country struggled to feed the ever increasing population. The inevitable was the opening up vast

expanses of land hitherto considered unsuitable for faming.

Despite vigorously pursuing environmental protection policies, it became obvious that this was not being translated into real change and prosperity to the people. Demographic pressure continued as benefits from the family planning services on offer will not be realised in the short term. The population structure is dominated by economically active persons and thus there are more people seeking employment than what the labour market can absorb.

While it is widely acknowledged that strengthening of governance structures is critical for deepening of democracy, invariably the levels of resources channelled to such institutions do not match with the tasks at hand. Development projects that would bring widespread and equitable prosperity are underfinanced and consequently poverty begins to resurface. Under this scenario, economic development is hampered by unsustainable resource dependence. The implementation of more robust monetary policies that would reduce poverty in the long-term are shelved over concerns of over inflation.

Water

- Water is widely understood as a finite resource and as result water conservation measures are enforced at all levels
- Communities are well organized and grass-roots structures are in place to promote and enforce water saving technologies, however, due to declining support, the structures begin to crumble and so do the environmental protection programmes.
- The threat of pollution from unsustainable production processes is countered by a strict regime of enforcement of environmental protection regulation

Land and Agriculture

- Improvement in soil conservation result in an initial improvement in agricultural productivity
- Due to sluggish economic performance, the gains in the integrity of the environment are slowly wiped out and the governance structures begin to collapse due to underfunding
- Soil conservation programmes are either downsized or discontinued altogether leading to slow but steady increase in soil erosion and loss of plant nutrients
- Agricultural input subsidy programmes are overtime withdrawn adversely affecting the per capita food availability

Health and Environment

- Inadequate funding for the health sector result in increase in child mortality and poor maternal health.
- Environmentally related diseases are on the increase due to the neglect of water and sanitation infrastructure, and the lack of integration of an ecosystems approach to healthcare
- The healthcare delivery system is unable to cope with the increase in diseases and the situation is made worse by resignation of health personnel in search of more lucrative job opportunities

Human Settlements

- Decline in absolute numbers and proportion of households living in unplanned settlement.
- General decline in the quality of housing but minimum standards are maintained.
- Industries struggle financially to comply with waste disposal regulations but due to strict controls, there is no rampant violation of environmental protection regulations.
- Use of unsustainable construction materials in the absence of affordable environmentally friendly technologies.

Biodiversity

- Decline in biodiversity as the country continues to depend on forest resources and agricultural production for the sustenance of rural livelihoods.
- General decline in fish and wildlife resources resulting from poor management of biological resources.
- Hot spots of rich biodiversity are wiped out as a result of increased agricultural production, with the consequent degradation of biological resources
- Because people do not practice sustainable harvesting of biological resources, there is a substantial decline of biodiversity resources. The problem is compounded by inadequate capacity of the Malawi Government to develop adaptive strategies for climate change in the biodiversity sector.

Scenario 3: Poor Governance and No Economic Prosperity (Wafa Wafa)

Under this scenario, all the governance and economic development indicators paint a very bleak picture of the present and future of the nation. It is abundantly evident that that the nation is barely able to stand on its feet as

the majority of its citizens are impoverished while a well connected minority is growing richer and richer, albeit at a great cost to the environment and the poor masses. The decentralisation drive advocated and vigorously supported by previous successive leaderships has taken a back seat. The system is once highly centralised and is grossly insensitive to the plight of the masses in rural and urban areas of the country. This state of affairs has seen the collapse of all governance structures and while the provisions for protection remain in the statute books, commitment to enforce these has declined to its lowest ebb. The ability to enforce environmental protection regulation is further complicated by corruption which has take root at all levels of the society.

A combination of demographic pressure and the lack of well crafted policies and strategies to deal with the upsurge in demand for energy and food has resulted into an unprecedented decline in the integrity of the environment and resource productivity. The population carrying capacity is exceeded in all the districts in the southern and central regions resulting into increased deforestation and soil erosion. Cultivation on steep slopes, riverbanks and other marginal lands is on the increase leading to choking of the country's drainage system with silt and debris. This led to persistent power outages which brought the manufacturing sector at the blink of collapsing. The unreliable supply of electricity resulted into creation of additional pressure on the country's forest reserves as households depended more and more on fuel wood for cooking. The situation also led to increase in foreign exchange losses and high commodity prices as businesses heavily relied on diesel generators to fill the energy gap.

The food insecurity of the 1990s and early 2000 resurfaced as serious food shortages and soaring prices of basic food items cause untold suffering to the poor masses. The elite took advantage of the food shortage to buy and withhold stocks which resulted in exaggerated food shortages on the market and escalation of prices. The development projects started in the later 2000s stalled, or were completed at a substandard level due to unscrupulous contractors and contract managers siphoning money to sustain their lavish, elite lifestyles. As the gap between the rich and the poor continued to widen, the poor became increasingly disillusioned and frustrated by empty promises of economic prosperity preached by the ruling elite. An atmosphere of tension developed between the two classes creating a fertile ground for lawlessness and anarchy. The feeling of helplessness among the poor destroyed the sense of community ownership instilled between 2005 and 2011. People became more individualistic as they focused only on their own survival under the prevailing harsh economic realities. Community environmental protection and restoration projects, such as community woodlots, that once flourished no longer enjoy the support of their communities and have all been abandoned or vandalised. The population of the country soared as family planning services collapsed due to inadequate funding as the country's development partners had withdrawn their assistance even to humanitarian causes. The country lost ground on advances made to contain the HIV/AIDS pandemic and the number of orphaned children had been on the rise from 2015. The demographic pressures in the rural area fuelled rural-urban migration resulting in proliferation of squatter settlements and further deterioration of the housing conditions of the urban poor because local authorities lack resources to implement long term strategies to deal with the population influx.

Under this scenario, the Government of Malawi did not put in place measures for conserving biodiversity as stipulated by the Convention on Biological Biodiversity (CBD) and the Addis Ababa Principles and Guidelines. The country dismally failed to conserve biodiversity because of high human population growth, over-harvesting, destruction of habitats, agricultural expansion, poverty, invasive alien species, and illegal hunting and trade of biological resources (EAD, 2010).

Water

- Levels of water pollution are on the increase as there are no appropriate policy responses to deal with the dumping of industrial waste in the country's river system
- Unsustainable use of water resources cause a decline in per capita water availability
- The country's capacity to meet its energy needs is highly compromised as a result of siltation and irregular river flow
- Due to poor community organisation, the shortage of water is more acute in rural areas and the majority of the households use unprotected water sources leading to persistent outbreaks of waterborne diseases

Land and Agriculture

- Unsustainable exploitation of land resources result in unprecedented land degradation
- Soils are highly degraded as people have no access to soil conservation technologies
- There is no incentive to maximize production because of lack of reliable markets and general decline of commodity prices
- Cultivation on marginal lands and areas along river banks is on the increase resulting in perennial

flooding of the lower shire and other low lying areas

- Extreme weather conditions set in and famine is a reality the majority of Malawians struggle with continually.
- Conflicts over land for livestock and crop production increase; neither form of production is sustainable

Health and Environment

- Dramatic increase in population puts enormous pressure on the health delivery system and lead to high mortality rates and low life expectancy
- Overcrowding and unhealthy living conditions in the urban area fuel the outbreak of diseases.
- The health delivery system fails to benefit from technological advances in the health sector and as such the rich seek treatment from outside the country resulting in foreign exchange losses.
- Cultural practices that fuel the spread of HIV/AIDs, sexually transmitted diseases, and other communicable diseases are widespread. The belief in witchcraft as an explanation for disease takes prominence.
- Poverty related disease is on the rise due to malnourishment.

Human Settlements

- The rivers in all the major industrial cities are choked with toxic industrial waste and the effects on the human population begin to show around 2020.
- Housing units for average income earners become unavailable to the majority of the city dwellers
- There is an emergency of large informal sector upon which the Informal housing sector thrives.
- A large informal housing sector emerges and little attention is paid to minimum health and sanitation standards, leading to frequent outbreaks of communicable diseases.

Biodiversity

- Total collapse of biodiversity resulting from poor management of resources, human population explosion, lack of alternative sources of rural livelihoods. This leaves Malawi literally bare and vulnerable to erosion because of the removal of vegetation cover.
- Fish and wildlife resources are very scarce.
- All hot spots of biodiversity in Malawi are completely destroyed.
- The problem of biodiversity degradation is exacerbated by the vagaries of climate change.

Scenario 4: Economic Prosperity but Poor Governance (Chonchobe)

By 2015, the Malawi economy had fully recovered from the effects of the global economic meltdown and successively achieved double digit GDP growth rate through to 2025. The emergency of new technologies saw rapid expansion in all productive sectors of the economy driven by profit maximization motive. Productivity gain in the agriculture sector was fuelled by the emergency of high yielding and disease resistant varieties, across the board agricultural input subsidy programmes and improved global commodity prices. To satisfy the ever increasing demand for agricultural products, land under agriculture dramatically increased extending to environmentally fragile areas. An important aspect of the increase in productivity of the agriculture sector was an increasingly important role played by large scale estates. This resulted in the displacement of subsistence farmers by the large estates from good arable land to less fertile areas which led to a wave of rural-urban migration. While the earlier success in the growth of the manufacturing sector resulted in creation of many jobs, the trend started to reverse as the country's natural resources started to dwindle as a result of unsustainable exploitation. Unemployment in the urban areas started to wear an ugly face. Investment into infrastructure development, public health and housing started to decline and it was no longer difficult to see the signs of urban decay in areas inhabited by the urban poor. The pollution of the rivers in the major industrial towns of Blantyre, Lilongwe and Mzuzu was in the increase due to discharge of toxic industrial waste. While the regulatory framework for discharge of industrial effluent into the rivers existed, there was no political will to enforce the regulations because of preoccupation with profit maximization drive that existed at the time.

The negative trends in environmental integrity became widespread and affected all aspects of the daily lives of the citizens, yet the government failed to respond to the looming environmental crisis. Increased inflow of nutrients from farmlands resulted in deterioration of the water quality was increasingly becoming a threat to aquatic life while silt and debris had far reaching impact on the country's ability to meet its energy needs that had increased to unsustainable level. The proportion of urban dwellers living slums lacking in basic amenities was quickly on the rise again with attendant outbreaks of waterborne diseases. In the absence of functioning

grassroots environmental governance structure, and with no support being channelled to community led environmental protection and restoration initiatives, the rural landscape was stripped bare of the indigenous forest cover and even traditional construction materials became scarce. The water resources were waste affected by the neglect, ground water recharge decreased to dangerous levels and river discharge fluctuations between dry and rainy season widened remarkably.

Water

- Pressure on water resources peaks around 2020 due to rise in demand from all productive sectors of the economy and unsustainable use of the resource
- The country fails to take advantage of global advances in water efficient technologies
- Economic prosperity is under threat as the country is unable to meet its energy requirements from hydro plants which are performing at half capacity due to irregular river discharge
- Water resources suffer from increase in the discharge of toxic industrial wastes and its effects on the health of the affected people start to show around 2020.

Land and Agriculture

- Increase in agricultural production for both the domestic and export markets
- The motive to maximize production leads to depletion of essential soil nutrients and soil degradation
- Extensive farming coupled with uncontrolled use of pesticides result in loss of soil cover and pollution of rivers and lakes
- Loss of agricultural land due to the expansion of urban areas
- The collapse of governance structures lead to expansion of farmlands onto environmentally fragile environment leading to increase in soil erosion and loss of biodiversity

Health and Environment

- Environmental related diseases (malaria and cholera) are on the increase and yet no attention is paid to calls to incorporate ecohealth.
- Increase in the volume of waste chokes the already overstretched waste management system and its effects on the health of the affected people surfaces around 2022.
- Gains in improvement of the health status of the Malawian society start to diminish as a result of lack of environmental governance structures

Human Settlements

- Increased air pollution from industries and vehicles
- Loss of prime agricultural land to accommodate the ever increasing rate of urbanization
- Majority of the urban poor live under squalor conditions in unplanned settlements and environmentally fragile areas
- Increased storm flow rates and downstream flooding as a result of increase in surface run-off from paved surfaces
- Rivers are choked with toxic industrial and domestic waste leading to a spreading diseases
- Mushrooming of sub-standard and poorly designed buildings
- Increased stress from worsening traffic congestion
- The major cities experience unprecedented rural-urban migration because small and medium towns are neglected

Biodiversity

- Decline in biodiversity as the country continues to depend on forest resources and agricultural production for the sustenance of rural livelihoods.
- General decline in fish and wildlife resources resulting from poor management of biological resources.
- Hot spots of rich biodiversity are wiped out as a result of increased agricultural production, with the consequent degradation of biological resources
- Because people do not practice sustainable harvesting of biological resources, there is a drastic decline of biodiversity resources. The problem is compounded by inadequate capacity of the Malawi Government to develop adaptive strategies for climate change in the biodiversity sector.

11.4 Conclusion: The Inter-linkages and Policy Lessons

The four scenarios are presented to illustrate how alternative policy pathways can achieve environmental targets in the MDG and MGDS. The exercise helps us to understand how environmental governance and economic development combine to either enhance

Box 11.2: Strategic Economic Development from a Scenarios Perspective

The 2009 Malawi Millennium Development Goals Report is a comprehensive review of the of the Malawi's most recent socioeconomic performance. The findings of the report may be summarized as follows:

Where is Malawi?

The percentage of the people living below the nation poverty line decreased from 52.4 percent in 2005 to 39 percent in 2009. While the country is making progress in reducing poverty levels, the challenge still remains in reducing income inequality. Currently, under-five mortality rate is at 122 deaths per 1000 live births and infant mortality at 69 deaths per 1000 live births in 2008. Estimates of the national HIV prevalence rate among 15 to 24 year old pregnant women has been reduced by half from about 24 percent to 12 percent between 1998 to 2006. For other diseases like TB, the trend shows that Malawi is likely to reverse its incidence as evidenced by declining death rates associated with this disease. The land area covered by forest has declined steadily over the years, from 41.4 percent in 1990 to 36.2 percent in 2005. If this trend continues, Malawi's land area covered by forest will be less than 33 percent by 2015. The number of households with sustainable access to improved water sources has been increasing, such that if the current levels are maintained, this may surpass the MDG target by about 26 percent.

The goal of developing global partnership for development is also likely to be attained. The indicators for this include the rate of urban employment and telephone penetration. Data shows that urban unemployment had been on the increase from 1998, from 1 percent to 9.4 percent in 2007. The trend for cellular phone subscribers per 100 people indicates that there has been an increase in subscribers from around 0.4 percent in 2000 to about 2 percent in 2005.

Primary school education is free, but the net enrolment rate is not yet 100 percent. It stands at 79 percent, and the proportion of pupils starting grade one who reach grade five without repeating a grade has declined from 86 percent in 2006 to 75.7 percent in 2008. The youth literacy rate is currently at about 82 percent.

The country has been able to reduce maternal deaths from 984 per 100,000 live births in 2004 to 807 per 100,000 live births in 2006, but the desired target is almost six times below the desired rate. The country is also off track in reaching the target of births being attended by skilled birth personnel. Despite the projection showing an increase in deliveries conducted by a skilled attendant to 72 percent by 2015, Malawi still falls short of the MDG target. Currently, the ratio of girls to boys in primary school is 0.99. However the ratio of girls to boys in secondary school is meanwhile at 0.77.Malawi is experiencing an annual population growth rate of 2.8% with total fertility rate at 5.2 and an average household size of 4.6.Two million people reside in (15%) the urban areas. Of the total urban population, 11.9 percent resided in the four major cities 3.1 percent resided in the other urban areas.

Where does Malawi desire to be?

Malawi remains committed to achieving the millennium development goals (MDGs) by 2015 through the implementation of her own national development strategy, called the Malawi Growth and Development Strategy (MGDS). The Strategy covers the period 2006 to 2011, and a successor MGDS will be designed before the current one expires.

Where could Malawi be?

Based on the drivers described in this chapter and the four mutually exclusive pathways leading to the words of MKAKA NDI UCHI, PENDA PENDA, WAFA WAFA and CHONCHOBE, the country may or may not achieve its socioeconomic development aspirations. How progress might be achieved under each scenario is illustrated in table 11.1 using selected MDG targets.

or damage our environment. Through this scenario exploration exercise, it is clear that whatever pathway we opt into 2025, there will be environmental impacts. Under each scenario, there are a number of actions that could be undertaken in order to reduce environmental side effects of rapid economic development.

The Malawi Environmental Outlook scenarios work has come up with four possible future outcomes as follows:

Scenario 1 (Mkaka ndi Uchi) which is a combination of sustainable economic development and good environmental governance with the following characteristics:

- A positive investment climate largely due to improvements in infrastructure and presence of good corporate governance structures
- Higher growth rates as a result of increase in human capital

Table 11.1: A Futuristic Strategic Economic Development from a Scenarios Perspective

Selected MDG Indicator	Current Status (2009/2010)	2015 Target	Scenarios 2025			
			Mkaka Ndi Uchi Uchi	Penda Penda	Wafa Wafa	Ndaonera Momwemo
Proportion of population living below the national poverty line	39 %	27%	0%	50%	100%	50%
Proportion of population with sustainable access to an improved water source	80%	74%	100%	40%	10%	40%
Infant Mortality rate	69 per 1,000	44.7 per 1,000	0%	50%	90%	50%
Proportion of population with access to improved sanitation	94%	86.2%	100%	30%	10%	30%
Proportion of land covered by forest	36.2%	50%	50%	30%	3%	30%
Proportion of area protected to maintain biological diversity	0.16%	0.18%	2%	0.05%	0%	0.05%
Slum population as percentage of urban population	64.4%	-	0%	30%	60%	30%
Population growth rate	2.8%	-	1.5%	2%	6%	2%
Total Fertility rate (TFR)	5.2%	-	3%	4%	6%	4%
Population (Million)	13.1m	-	15 m	18 m	24 m	18 m

- Preservation of livelihoods through implementation of adaptation policies for climate change
- Advances in technologies for green energy and creation of green in jobs in the private sector
- A steady and significant decline in the proportion of the people living below the national poverty line achieved through several measures including increasing the productivity of agriculture and assisting and support to development of sustainable secondary and tertiary industries
- Vibrant community environmental governance structure leading to successful implementation of numerous communities led environmental protection and regeneration programmes.

Scenario 2 (Penda Penda) combines good environmental governance and unsustainable economic development with characteristics as follows:

- Limited infrastructure improvements with modest effect on the economy
- The economy grows but not in a sustainable way as eco-friendly technologies are not fully embraced
- The integrity of the environment remains the same or slightly declines due to under funding of environmental protection and regeneration programmes.

Scenario 3 (Wafa Wafa) combines poor environmental governance and economic downturn. This is the worst case scenario with the collapse of the governance structures and a national economic disaster. Some of the specific characteristics of this scenario are:

- Rapid population growth resulting in a huge labour force. Rising unemployment and under employment fuel poverty among the majority of Malawians
- Economic growth stagnates due to lack of lack of improvements in infrastructure and unfavourable economic policies
- Degradation of the natural resource base due to poor governance, resulting in increasing food insecurity
- Technology deteriorates without an economic or government economic framework leading to more unemployment and more poverty.

Scenario 4 (Chonchobe) is a combination of economic prosperity under poor environmental governance. The characteristics of thus scenario may be summarized as follows:

- Increased pressure on the natural resource base due rapid increase in population and decreasing human capital limits economic growth in the long term
- High consumer demand act as a driver for the economy and environmental protection and restoration ranks very low on government priority

list. There is a long term adverse effect on the economy as the resource base is degraded.

- Infrastructure starts to show starts to deteriorate as a result of lack of maintenance and corrupt awarding of contracts
- There are economic incentives to develop the economy. However, these technologies are not guided by government regulations and do not necessarily target the most pressing environmental problems.

Each one of the scenarios presents challenges and opportunities similar to those highlighted in the Millennium Development Goals which is implemented through the Malawi Growth and Development Strategy (MGDS) and Vision 2020 (Chapter 10: Natural Resources and Environmental Management and Chapter 2: Good Governance). Malawi will have to deal with the challenges in order to meet the targets set in the MGDS. The Malawi Vision 2020 gives strategic options in order to address the environmental challenges. Box 2 illustrates the current state, challenges and possibilities of meeting some selected targets of MDGs.

In order to move Malawi forward and meet the challenges ahead, we will have to reorganize ourselves and embrace these 'lessons from the future'. Malawi will have to formulate and implement, swiftly and in a decisive manner, a set of policies and strategic actions in order to achieve sustainable economic development. From the future lessons, the options include: investment in infrastructure development particularly the energy sector, to boost production, focus on shifting away from primary industries and create incentive programmes for environmentally-friendly business start-ups, invest in human capital to build economic resource for the future, build genuine political will at the highest level to support appropriate institutional and legal reforms for deepening of decentralization.

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Photo Essay - Models for the Future

The deforestation and environmental degradation that currently damages Malawi's economy, health status, and biodiversity can be reversed. The photograph above shows how effective systems of land protection and management have allowed for the conservation of indigenous vegetation. The land above the hydropower line has been clear-cut and over-exploited for agriculture. However, in the region below the hydropower line, which is managed by ESCOM at Nkula, the land is wooded with diverse plant species. Practitioners and policymakers can learn from such existing precedents for good management and conservation and extend that to the whole catchment of shire river not just for biodiversity conservation but for reliable water supply and hydro power generation.

Welton Phaliira

Geoffrey Kumboyo

Policies that encourage use of green technology such as use of straw briquettes for alternative fuels, hybrid systems using solar and wind energy can help in preserving the forest reserves in Malawi. Innovation and technology suited to local needs may be the answer to adapting to challenges such as climate change in the country.

CHAPTER 12

Photo of Meandering Road, By Sosten Chiotha

POLICY ANALYSIS AND OPTIONS FOR ACTIONS

Photo of Thuta River at Kasinje in Ntcheu District, By Sosten Chiotha

12.1 Introduction

Preceding chapters have demonstrated Malawi's overdependence on natural resources endowment for economic development, poverty reduction and food security. The contribution of natural resources to the economy was affirmed by the recent economic valuation of natural resources which estimated the contribution of renewable natural resources excluding the value of ecosystem services to be about 12.8% of the total GDP (Yaron *et. al.*, 2010). The contribution of natural resources to poverty reduction when extrapolated from the role of natural resources in improving agricultural production is significant. For example, the cost of unsustainable natural resources (mainly from loss of agricultural productivity as a result of deforestation, soil degradation) is estimated to be equivalent to giving up 5.3% of the GDP (Yaron *et. al.*, 2010). Soil loss at national level has been estimated to be on average 20 tonnes per hectare per year. This is estimated to lead to a mean annual yield loss of 4–11%, or about 6% of agricultural yields, leading to an increase in people living below the poverty line. However if all the lost economic value from unsustainable resource use was converted into economic growth over a long period, the proportion in poverty would be halved from its 1990 level to 25.2% (Yaron *et. al.*, 2010).

Poverty is aggravated by the degradation of the environment. However, poverty itself is an important cause of environmental degradation. Rapid population growth in combination with the low productivity and the small land assets forces farmers to cultivate on marginal lands. Similarly, as agricultural livelihoods are threatened by declining soil fertility the pressure on other resources increases. This may lead to total collapse of the environmental function which may also affect economic growth and Malawi's efforts to achieve its aspirations as set out in the Vision 2020 and the Malawi Growth and Development Strategy (MGDS).

Malawi remains committed to achieving the millennium development goals (MDGs) by 2015 through the implementation of her own national development strategy, the MGDS. The Strategy covers the period 2006 to 2011, and a successor MGDS which is being developed will cover the period 2011 to 2016. The Strategy is backed by important initiatives such as the Greenbelt Initiative (BGI), Agricultural Sector Wide Approach Programme (ASWAp). To achieve growth, Malawi will have to commit investment into infrastructure development and human resources development which all have potential to contribute to environmental degradation. Thus to ensure that the environment continues to provide its services, planners and implementers of various programmes must be aware of environmental implications of their actions.

In recognition of the effects of environmental degradation on the economy and the desire to ensure that the environment continues to provide its services to generations to come, the chapter shall continue with the dialogue initiated in the National Strategy for Sustainable Development (NSSD) as regards what should be done in order to maintain environmental sustainability. The thematic chapters identified a broad set of priority issues affecting Malawi's environment. This chapter discusses options to change the current trend of environment for each thematic area by the year 2020. Options for addressing cross-cutting environmental issues related to environmental governance, HIV/AIDS and environmental main-streaming have also been discussed. It must be recognized that policy issues are dynamic and as a result options for action proposed in this chapter should not be regarded as the end point but rather a starting point and a reference point for future debates.

The year 2020 was chosen to coincide with the timeframe for Malawi's vision 2020 which is the overall medium term strategy for socio-economic development. The timeframe was also chosen because it gives Malawi time to implement the Millennium Development Goals and complex strategies such as the NBSAP and NAPA.

12.2 Priority Cross-cutting Options for Action

Drivers of environmental degradation are complex and interrelated such that they require cross-cutting solutions to be addressed. For example, poverty is the main cause of environmental degradation since it forces people to rely on natural resources for a living. This means that poverty should be addressed first if progress is to be made in environmental management. In this section options for action for three cross-cutting environmental issues related to environmental governance, environmental mainstreaming and implementation have been discussed.

12.2.1 Strengthening Implementation of Environmental Management Activities

Issues

Malawi has put in place a comprehensive policy and legislation framework to facilitate implementation of environmental management activities. Most of the policies and legislations were revised to take into consideration environmental concerns. Malawi is in

the process of revising the Environmental Management Act which when approved by Parliament will among other things improve coordination of environmental activities and law enforcement. However despite the existence of a comprehensive legal and policy framework environmental degradation is on the increase mainly due to lack of law enforcement. For example, although unlicensed charcoal making is prohibited by law, charcoal business is widespread mainly due to inadequate law enforcement.

Outlook

In recognition of the intrinsic connection between the environment and the social and economic fabric of the rural areas, sectoral policies have provisions for community participation. The Local Government Policy promotes community participation through local level committees such as Area Development Committees. The Forestry Department and the Department of National Parks and Wildlife have promoted community involvement through co-management arrangements with community groups around protected areas. For example, community participation is prominent through the NyikaVwaza Association in the co-management of Nyika National Park and Vwaza Wildlife Reserve. This has improved good working relationship such

that communities around Nyika and Vwaza participate in fence maintenance, boundary clearing, surrendering of muzzle loading guns and reduced rate of encroachment into the park. Community participation, however, is constrained by lack of incentives. As provided for in NEP, the outlook is that mechanisms for economic incentives for sustainable management of the environment receive greater focus to give true incentives in environmental management, like those related to benefit sharing in Community Based Natural Resources Management (CBNRM).

Possible Policy Actions

- Facilitate finalization of the revision of the Environmental Management Act and lobby Government for the creation of an independent Environmental Protection Authority.
- Build the capacity of local government committees in participatory environmental management, environmental governance and ecosystem approach.
- Develop short courses for the judiciary, law enforcers, community leaders in principles of environmental management.
- Provide a conducive environment and institutional framework to coordinate the work of environmental inspectors.
- Initiate a process to review and document incentive measures in Malawi and use the results to develop guidelines and procedures for incentive measures for environmental management.
- Investigate the potential of Payment for Ecosystem Services (PES) as incentive for both environmental management and economic growth that can instill responsibilities and obligations on conservation of environment by different stakeholders and partners.

12.2.2 Mainstreaming Environment

Issues

Mainstreaming in this report refers to inclusion or integration of actions related to environmental management into economic sectors whose main mandates are not environmental management. The need to mainstream is a complex challenge for Malawi especially considering that the responsibility of managing the environment is fragmented along different government departments and that most significant drivers of environmental change originate from sectors that are not responsible for environmental management. This means that effective implementation of environmental activities will require bringing aspects of environment into all governance, planning, decision making and operations.

Integration of environmental concerns in environmental governance started with development of a National Environmental Action Plan (NEAP) in 1994 which was followed by the inclusion of Section 13(d) in the Constitution which calls upon the State to manage the environment responsibly in order to prevent degradation of the environment. As required by EMA, sectoral policies and legislation in environment were revised to be consistent with EMA and NEP. The reviews were designed to address deficiencies and the over reliance on central government control over the use of natural resources and lack of community participation on natural resource management. The general observation, however, is that integration of environmental concerns into policies as related to trade, taxation, pricing has been limited.

Cross sectoral coordination of environmental activities is facilitated by the Environmental Affairs Department which is charged with harmonisation of national environmental policies and legislation and also coordinates environmental activities through a number of committees. The current institutional arrangement is inadequate because the EAD lacks the mandate to enforce the law across sectors. The situation will change when the revised Environmental Management

Act is approved by Parliament which proposes creation of a National Environmental Protection Authority to coordinate and monitor all activities concerning protection and management of the environment including law enforcement.

Implementation of environmental activities at the local level is guided by the Local Government Act of 1998. The Act unifies government and local authorities and facilitates community participation in the formulation, planning and implementation of development and environmental programmes through District Councils, for example, District level committees facilitate integration of biodiversity into District Assembly plans and programmes. As required by the Local Government Act there is need to strengthen existing planning tools and local level committees to ensure effective incorporation of community concerns into developmental programmes.

Outlook

The EMA is the primary mechanism or instrument at the national level for ensuring that environmental considerations are integrated in national plans and decision making across all sectors. By using the 1997 guidelines for Environmental Impact Assessments, Malawi has made good progress in using the EIA guidelines as a tool to integrate environmental considerations into land use planning and decision making. For example, based on EIA result, the National Environmental Council rejected an application for Central African Cattle Ranch to open a cattle ranch in Dzalanyama Forest Reserve on the basis that the activity would disturb the ecological balance of the forest reserve. Other tools that have been used to integrate environmental considerations into land use plans and decision making are the National Planning and Development Plan (NPDP) of 1987 and the National Land Resources Management Policy (2000). To guide integration of environmental considerations the outlook is that all projects are implemented only when an environmental impact assessment is carried out.

Possible Policy Actions

- Revise the NSSD and develop strategies to guide and facilitate its implementation.
- Lobby government and facilitate establishment of a National Environmental Protection Agency.
- Strengthen the existing process that promotes participatory planning and implementation of environmental activities at the local level.
- Facilitate mainstreaming of environmental financing through the national budget.
- Mainstream Gender and Youth into environmental management - Generally, women are the main custodians and users of environment. Therefore different gender roles and responsibilities should be taken into account when designing environmental programmes.

12.2.3 Improving Stakeholder Appreciation of the Importance of the Environment

Issues

Accurate and updated information and data is crucial for objective decision making in environmental management. However, judging from information provided in the thematic chapters, it would appear that some important information was collected a decade ago. For example, data on vegetation cover is based on the Forest Resource Mapping and Biomass Assessment of 1993. In the absence of an up-to-date biomass assessment, the 2007 trend in forest cover published by FAOSTAT (2010) which estimated land area under forest cover to be 36% may be contested.

Lack of a strong institution to monitor implementation of environmental activities and lack of a monitoring system has compromised availability of data and as a result institutions do not appreciate the value of collecting and updating environmental data on a regular basis. The only data that are generated regularly are those to do with population and housing census and nutrition. Lack of a monitoring system may be the reason why environmental data for the preparation of state of environment and national environmental action plans are not collected systematically. For example, despite the latest edition of the SOER being published in 2002 no efforts were made to update the data in preparation for the next edition. As a result most of the environmental information provided in thematic reports is outdated and sometimes not applicable for the current situation. Thus, there is a possibility that outdated data has been analysed for this report and this may mean that decisions may be taken based on insufficient and outdated data. Systematic data collection and development of a monitoring system is, therefore, highly recommended. This will ensure that policy planners and programme implementers recognise that the achievement of the MGDS goals depends on the supply of ecosystem services that depend on attributes of environment and its sustainable management.

Outlook

Generally environmental information and data exists in scientific papers and grey literature. The data is often used in policy formulation. However, the problem is that the data is scattered about and is not present in a format most appropriate to the users. This is made worse by the lack of human and infrastructure capacity to manage the data. The outlook is that availability of high quality

environmental data is made possible by designating and tasking one institution to collect and re-package the information.

Possible Policy Actions

- Undertake a comprehensive economic valuation of the environment and use the results to integrate environmental management into economic systems and policy formulation.
- Develop specific public information and outreach activities which should be accessible to many different groups including local communities in order to raise appreciation on the importance of environment.
- Provide mechanisms for undertaking studies on the trends and status of the environment on a regular basis by including an environmental module as part of national statistical surveys.

12.3 Options for Actions for Specific Environmental Issues

12.3.1 Environment and Economic Development

Issues

Although Malawi has registered a general increase in revenue from K42,754 million in the 2003/4 fiscal year to revised estimate of K171,135 million in the 2009/10 fiscal year, a small proportion of this has been used to expand recurrent budget connected to environmental protection. It has been reported that proportionally the amount of ODA allocation to activities that address environmental concerns is estimated to be 2% and most of it is not used in protecting the environment, or promoting activities that reduce pressure on the environment, or containing drivers of environmental degradation. The decline in relative share of the environmental sectors in the national budget shows that agriculture and livestock gets a larger share at the expense of environmental activities such as forestry, fisheries etc. Thus, despite Malawi being aware of the importance of the environment in economic development there is inadequate attention addressing public investment in the environmental sector.

Poverty is among the major causes of environmental degradation. However, due to good agricultural production this has steadily declined to 45% in 2006 and 40% in 2007. A recent UNDP report estimates incidences of poverty to be about 39%. Despite the reduction in incidences of poverty, environmental degradation is on the increase as evidenced by the rate of deforestation in protected areas e.g the Zomba-Malosa-Machinga Forest Reserve complex.

Outlook

Containing environmental degradation in Malawi requires measures to address the drivers of environmental degradation and pressures on the environment. In the medium term, the government continues to pursue monetary and fiscal policies that will maintain macroeconomic stability in terms of low inflation, low rates of interest, sustainable fiscal and current account deficits and a stable exchange rate. This policy stance will contribute towards the continued attainment of the policy objective of high rates of economic growth of at least six percent required to reduce poverty, which will in turn generate high rates of growth of national disposable income and aggregate demand. As such, economic growth continues to exert pressure on the environment, and therefore there is need for adopting stronger measures for protecting the environment.

Possible Policy Actions

- Increase budgetary resource allocation to activities that protect the environment.
- Increase the supply of sustainable energy.
- Improve incentive programmes for reforestation, sustainable charcoal production, arresting soil degradation, and avoiding fishery depletion; and
- Improve compliance with environmental laws and policies.

12.3.2 Population and Human Settlements

Issues

Malawi's population is estimated to be 13 million people, has a density of 139 persons per square kilometer and has a population growth rate of 2.9%. Of this about 86% is rural and largely dependent on subsistence agriculture and natural resources endowment for a living. It is estimated by NSO that the population will be about 18 million by the year 2020. This means that the pressure exerted on natural resources by population will also increase by almost the same proportion and as a result the demand for fuelwood, water, electricity, land for cultivation and settlement will also increase. Malawi will therefore require a policy shift in the way it deals with population increase in order to contain the situation.

Malawi is the least urbanized country in southern African and also happens to have the highest rural–urban migration rate. The urban population growth is estimated to be 5.2%, the highest in southern Africa.

The urban population is growing faster than the rate of infrastructure development and this creates challenges in waste management, sanitation, disease control and control of establishment of squatters and slums. The increasing urban population is also accompanied by an increase in the number of vehicles which has resulted in congestion and an increase in the rate of emission of green house gases.

Malawi's policy framework on house and population and its relationship to the environment appear to be adequate. However, there appear to be no comprehensive policy guidelines to deal with the unplanned settlements and insecurity of tenure for the urban dwellers. In addition the available policies appear not to be adequately harmonized. For example, when the Government converts customary land to public land (say for expansion of city boundaries to accommodate the growing population and development) those displaced are sometimes not compensated. Another lack of harmonisation is between the NEP and the land policy. The NEP recognises the existence of slums but this is not provided for in the land policy. Another problem is that the existing policies do not provide for guidelines for rural settlement and this has resulted in settlement in fragile ecosystems such as wetlands and hill tops.

Outlook

In recent years, population growth and rapid urbanization has led to increased informal settlements and increased volumes of solid waste pollution; environmentally harmful construction methods; and growing numbers of vehicles and pollution from emissions. However, opportunities to address these challenges exist and linkages are seen to be formed and/or strengthened between government, Non-Governmental Organisations (NGOs), private sector and the communities to create sustainable settlements. Further review of settlement policies and laws will ensure that they are relevant to the Malawian context and are effectively enforced to achieve sustainable development which is environmentally friendly. The decentralization process continues to provide the opportunity to establish rural growth centres redirect rural populations to small urban areas to reduce urbanization and environmental degradation. This is pursued in the medium to long term. Policymakers can encourage the use of environmentally friendly building materials and methods through the creation of appropriate incentive programmes. Several land related laws have been reviewed and enacted to deal with the human settlements problems but some of the policies and legal instruments are outdated and inappropriate for Malawian settlements and this will be revisited.

Possible Policy Actions

Provide conducive mechanism for collaboration between the government, the private sector and the communities to participate in the provision and maintenance of services both in urban and rural areas. This collaboration should include the transport infrastructure and waste management. Improving waste management practices by encouraging partnership in funding and capacity required for management of waste, recycling and reuse of waste paper, plastic and water, encouraging conversion of organic waste into manure by encouraging separation of waste and scaling up awareness campaigns on hygiene and waste management practices are some of the actions the government can take.

With regard to land use, cumbersome land administration regulations should be streamlined to facilitate access to land through formal means. Land zoned for housing by the city planners should be released in good time to avoid land speculation and enable households of various income groups to access land within their means.

Financing institutions should be encouraged to assist households with housing loans. This can be done through employer guaranteed loans and employers could provide the 10% deposit required for accessing housing loans.

The government should come up with a comprehensive settlement policy that will promote integrated land development, guide settlement development and supply of services (assessed in the sub-sections below) especially in rural areas and small urban areas and ensure that rural and urban planning keeps pace with demographic change.

Establish rural growth centres to reduce urbanization (i.e. arrest rural to urban migration) and associated environmental degradation.

12.3.3 Energy, Industry, and Mining

Issues

Currently biomass is the major source of energy accounting for about 88.5% of total energy demand and is primarily used as fuelwood (fire wood and charcoal) by 95% of the rural house-holds and up to 55% of urban households (Yaron *et. al.*, 2010). This is a slight change from 2002 figures when biomass accounted for 93% of energy demands. Despite the decline, domestic use of fuelwood for energy is among the major causes of deforestation in Malawi. Generally

limited energy sources are under pressure due to the growing population, increasing demand from the industrial sector, and a degraded environment (which limits hydropower generation).

Electricity which contributes about 4% of total energy consumption in Malawi is used by about 6% on the population. Electricity is critical to the economy as almost all industries depend on it. Electricity is generated by hydro plants all installed along the Shire River. However, the Shire River basin is one of the heavily degraded catchments due to cultivation and fuelwood collection. Water weeds and accumulation of silt has affected electricity generation such that on average ESCOM uses about MK33 million a year to clear silt and water weeds. This has resulted is load shedding and power outages which push consumers to use fuelwood as an alternative source of energy.

The increase in mining activities is generally associated with increased environmental degradation, e.g. air and water pollution, large scale consumption of natural resources and electricity, and, land use changes. It also lead to changes in population dynamics and distribution of communities around mines which often times is accompanied by social conflicts and creates conducive environments for the spread of communicable diseases. Considering that the mining sector in Malawi is not well developed, sustainable development of the mining sector requires considerable capacity building and training, as well as significant scientific research and technological development.

Outlook

Energy resources have the potential to promote socio-economic development in Malawi, particularly in the sectors of industrial production, domestic use, agricultural production and processing, and transport. Currently, at household level, fuelwood and electricity are widely used for heating and cooking. In the medium to long term the Department of Energy continues with existing programmes to promote alternative methods of power generation through biogas, solar, small hydroelectric power plants and windmills, and these become areas of focus. The MGDS has laid down an excellent road map that would facilitate Malawi to move from being a primary producer to a secondary producer. The challenge is that the list of developmental needs is long and resources are inadequate. The Department of Development Planning, therefore, re-examine the list of priorities and take a deliberate effort to phase the plans into more implementable stages. For example, with the pressures against tobacco globally gaining momentum, the Ministry of Agriculture intensifies research to find and promote alternative cash crops to tobacco. The Mining sector is growing at a fast pace and continues to grow further. Efforts to gain good knowledge and rapidly increase capacity building in this sector with emphasis on management of environmental impacts of mining receive special attention as an essential component.

Possible Policy Actions

- Urgently develop alternative sustainable energy sources to meet demand and reduce dependency on firewood.
- Build capacity in government departments related to Energy and Mining. Environmentally sustainable growth in these sectors must be guided by well-trained policymakers and reliable scientific research.
- Integrate the social, economic and environmental policies that govern Energy, industry and Mining with other relevant policies (Water Policy, Land Policy, etc.).
- Ensure that Environmental Impact Assessments are conducted and consulted for all projects, in accordance with existing guidelines.
- Strengthen capacity to increase exports through improvements to infrastructure and economic policies and value adding.
- Develop policies that address the management of wastes from mines and industries.

12.3.4 Health and Environment

Issues

Environmental degradation has increased incidences of floods, pollution and poor sanitation and hygiene especially in the rural areas. In urban areas, high rates of rural-urban migration have resulted in over crowding and high populations living in slum like situations which are not provided with water and sanitation facilities. This has created an environment conductive for communicable diseases such as malaria, cholera etc. These diseases are among the major causes of admission in hospitals and deaths especially among under-five children.

With 12% HIV/AIDS prevalence rate, Malawi is considered to be one of the countries with highest rates of HIV infection in the world. The impact of HIV/AIDs on the environment is seen through loss of population in the active age group and aggravated poverty and unsustainable use of natural resources.

Malawi has a comprehensive national response programme for all major diseases such as malaria,

TB, HIV/AIDS. These programmes have helped the country to reduce incidences of some these diseases. For example, HIV/AIDS incidences were at 16.2% in 1999 but this has stabilized to 12%. Similarly cases of cholera have reduced in recent years from 33,150 in 2002/3 season to 264 in 2006/07 season. Despite this progress Malawi's health care system is constrained by shortage of resources caused by brain drain, low life expectancy and the aggravating HIV/AIDS prevalence.

Outlook

The existing environmental conditions influence Malawi's disease burden greatly and recent environmental conditions have changed the pattern of Malawi's disease burden dramatically. The outlook is for increasingly frequent flooding leading to increased breeding of mosquitoes that transmit malaria and elephantiasis. Water pollution due to flooding and rapid urbanization increase the risk of cholera outbreak and schistosomiasis. Expanding irrigation projects and unabated environmental degradation change the endemic pattern of bilharzias and river blindness. Tuberculosis is strongly linked to overcrowding mostly as a result of urban sprawl due to increase in population. In the short to medium term, therefore, Malawi continues with existing response programmes for all major diseases affecting the country.

Possible Policy Actions

- Mainstream environmental concerns into all health policies, programmes, strategies, laws and institutional framework responsible for the management of health services.
- Provide an effective coordination for disease control policies and promote strategies that promote joint planning and implementation of programmes that control the population of vectors for malaria, elephantiasis, sleeping sickness.
- Develop guidelines for projects to facilitate incorporation of a strong disease abatement component, improved sanitation, and increased access to clean drinking water..
- Develop an ecohealth policy as outlined in the 2008 Conference on Health and Environment in Africa.
- Strengthen and/or develop effective waste management policies and guidelines including a strong institutional framework to monitor and enforce the law. This will provide a healthy and hygienic environment and prevent disease causing agents from spreading.

12.3.5 Environmental Education and Public Awareness

Issues

In line with provisions of the current environmental policy framework, the education sector undertook comprehensive curriculum reviews which resulted in mainstreaming the environment in basic, secondary and tertiary education systems. However, environmental education is constrained by lack of trained environmental teachers mainly due to lack of environmental courses for teachers.

Malawi remains a country with low literacy levels. This, when coupled with the use of English as the official language, when it comes to communicating environmental policies and official reports, has affected mainstreaming of environmental issues into the informal education sector. This makes it difficult for rural communities to appreciate the importance of the environment in sustainable development.

Government departments, NGOs and the private sector are involved in formal and informal environmental education. Environmental education within government departments is coordinated by the EAD whilst NGOs are coordinated by CURE, although WESM has the most comprehensive environmental education programme. The general observation, however, is that the programmes are not well coordinated and integrated and, therefore, not most effective. A lot of NGOs' environment education programmes are not adequately linked to government environmental education programme.

Outlook

Many opportunities abound to improve awareness of environmental issues. The media and other non-formal institutions have made progress in broadcasting relevant environmental programmes. In the short to medium term, such programmes are made regular and their coverage is increased. Current efforts by the Ministry of Education, Science and Technology to incorporate environmental education into the curriculum for Secondary Teacher training is also extended to teacher training colleges and technical and vocational schools with the aim of building the capacity of educators. Efforts are made to incorporate environmental education into adult literacy education. Special efforts are made to encourage men to attend adult literacy classes, where they are under-represented, in order to improve general understanding of environmental issues. The Department of Environmental Affairs takes the lead to revise the

strategy on environmental education and public awareness, providing concrete strategies for building the capacity of media personnel and religious leaders on environmental aspects.

Possible Policy Actions

- Improve general education levels to reduce dependence on natural-resource based livelihoods in the long-term.
- Incorporate environmental education into secondary teacher training.
- Include environmental issues in school curricula and technical and vocational education curricula to improve appreciation of conserving habitats and protecting natural resources.
- Increase men's enrollment in adult literacy classes (where they are under-represented) to improve literacy and understanding of environmental issues.
- Encourage the development of science and wildlife clubs at secondary and tertiary institutions.

12.3.6 Land and Agriculture

Issues

Agriculture continues to be the mainstay of the economy, contributing 39% to the GDP and about 80% of the work force (GoM, 2007). The government ambition is to maintain 6% growth on agriculture for the next five years. This is being achieved through government programmes such as the Greenbelt Initiative, Agriculture Sector Wide Approach Programme (ASWAP) and the Farm Input Subsidy Programme. This means that for the next coming years there will be increased use of organic fertilizers, conversion of forest or wetlands into agricultural land and extensive use of water for irrigation. These activities if not properly planned have potential to contribute to environmental degradation.

Due to population growth and rural-urban migration land is being converted from customary land to public land for settlements, urban and industrial expansions and agricultural expansion. The general observation is that the current land use changes have resulted in dwindling forests and the general decline of soil productivity. The results of land degradation have been a sharp decline in agricultural productivity and increasing dependence on costly artificial fertilizers. Environmental management follows a sectoral approach where each department has single sector policy. What is conspicuously obvious is the absence of an overall policy that would harmonize the different sectoral policies, arbitrate policy conflicts and tackle the cross-sectoral nature of the land degradation. There are also no formal coordination structures at policy and operational levels.

Factors that contribute to agricultural production are complex. Lack of land ownership and access to land are serious problems for women who are largely marginalized when it comes to land rights. Currently, under the private freehold system, women have the opportunity to purchase land but this is constrained by lack of resources. The customary land system gives women land through marriage, but as soon as the marriage breaks up they lose the right to use the land. Thus despite women accounting for the larger proportion of smallholder farmers their productivity is constrained by lack of access to land.

The importance of land and agriculture to Malawi's social, political and economic development, as well as sustainable resource management has been well articulated in Chapter 6. It is also important to note that land is the foothold of all economic sectors such as agriculture, water, forestry, and wildlife, all of which depend on sustainable management of land. Thus, the limited land available needs to be used sustainably to meet the demands of all economic sectors. This needs putting in place policies that guide ownership, secure tenure, promote investment and ensure sustainable long term use of this limited resource. The increasing cases of encroachments and land related disputes is a manifestation of the urgent need to implement the aspirations of the 2002 National Land Policy in totality and this requires building the requisite institutional and legal frameworks to support its implementation.

Outlook

Many opportunities exist from which policymakers quickly act to improve the situation. Proper land use planning is engaged to alleviate some of the problems. Reforestation is aggressively pursued to hinder nutrient and soil loss: farmers are incentivized to do so through international initiatives (REDD+, CDM) that fund the conservation of forest carbon sinks. Dependence on artificial fertilizer starts to be reduced by encouraging farmers to adopt conservation tillage, use of compost, and intercropping with nitrogen-producing legumes. To adapt to challenges of climate change and reduce over dependence on rain-fed agriculture, livestock farming is promoted as an alternative livelihood option. Existing irrigation projects are extended to many areas; water retention and management programs are implemented in areas with less water.

Possible Policy Actions

- Reforestation should be aggressively pursued to hinder nutrient and soil loss: international initiatives

that fund the conservation of forest carbon sinks (REDD+, CDM) are good incentives to promote community participation.

- Reduce the dependence on artificial fertilizer by encouraging farmers to adopt conservation agriculture. To adapt to challenges of climate change, programmes for adptation to climate change should be promoted through the implementation of the NAPA.
- Maintain agricultural production by aggressively pursuing reforestation and diversification into livestock production and other commercial crops.
- Irrigation has the potential to increase crop production although the uptake is only 22% of the total potential irrigable land. Green Belt Initiative will improve the situation. However, there is need to conduct a detailed irrigation potential for the various irrigation systems. In addition, proper Environmental Impact Assessment should be conducted for all irrigation projects to avoid or mitigate negative environmental impacts,
- Rapid population increase poses a serious threat to the ability of the land resources to provide and produce goods and services at sustainable levels. In order to accommodate this, land use planning should be taken seriously. Malawi should therefore develop a National Land Use Planning Policy to regulate the development of land resources.

12.3.7 Biodiversity and Ecosystems

Issues

Malawi's rich biodiversity provides countless ecosystem services, including the provision of food, timber and medicines; regulation of climate and water resources; and cultural and aesthetic value. However, biodiversity is threatened by various factors, including habitat over-exploitation, invasive alien species, and the increasing frequency of floods and droughts due to climate change. Poverty and loss of indigenous knowledge also lead to over-exploitation of biodiversity by people lacking other survival options. This has economic, social as well as environmental consequences. For example, siltation and water hyacinth invasion in the Shire River cause the loss of 140 megawatts of power per day; the resulting intermittent power supply causes industry and trade sectors to lose approximately thirty to forty million Kwacha per day (GOM, 2003).

Malawi has diverse biodiversity which is attributed to diverse topography, climatic conditions and soils. For example, Malawi's rich fish diversity contributes about 14% to world fresh water fish and 4% of world fishes whilst more than 6000 plant species together with high endemism is a significant contribution to the global biodiversity. It has been demonstrated in Chapter 7, however, that Malawi's knowledge of the extent of biodiversity is not well known mainly due to lack of institutional capacity and human resources which have affected the availability of up to date information and data. In turn, this means than biodiversity data and information is not packaged and disseminated to users in a format most appropriate to users.

In 2006, Malawi developed and published the National Biodiversity and Strategy Action Plan to guide implementation of biodiversity activities. The recent assessment on the progress of NBSAP implementation showed that the strategy was not used as a tool to guide implementation of biodiversity interventions at the national level mainly due to the fact that the NBSAP has not been disseminated widely. Weak coordination and lack of a national biodiversity policy may be the reasons for inadequate implementation of biodiversity interventions.

Outlook

Future trends and status of biodiversity in Malawi will depend on the impact of pressures or threats on biodiversity. In the short to medium term the NBSAP continues to guide management of the major threats to biodiversity identified in the NBSAP. In the medium to long term the EAD considers revising the NBSAP to focus on new and emerging threats posed by pollution and climate change to biodiversity.

Lake Malawi with its wide range of endemic fish and national parks which are populated by large mammals such as elephants, buffalos continue to contribute to the GDP through tourism in the medium to long term. Government intensifies current efforts to protect large mammals through the Transfrontier Conservation Areas programme. Similarly government efforts to protect endemic fish of lake Malawi through establishment of fish sanctuaries on Lake Malawi continue. In addition the proposal to extend benefit sharing programmes (which focus on resource use and revenue sharing with communities around national parks) to Lake Malawi within 2011 is fast tracked. There is also an opportunity to extent the benefit sharing programme to Forest Reserves through the proposed review of forestry policies and Act. This will facilitate continued protection of biodiversity in protected areas in the medium to long term.

Possible Policy Actions

- Biodiversity conservation policy and programme implementation require concerted efforts and the combined strength of all sectors of society in Malawi. There is need to have policy implementation alliances at local, national,

regional and international levels between policy makers, civil society, indigenous and local communities and business and the private sector. In order to maximize on economic opportunities that biodiversity has to offer, public and private agencies have to integrate biodiversity concerns into their planning and implementation for the simple reason that loss of biodiversity will mean loss of benefits derived from biodiversity.

- Other policy options include:
- Monitor biodiversity to effectively address species loss and habitat change.
- Develop public-private partnerships for protected areas management.
- Mainstream gender issues into conservation programmes in recognition of the fact that women are the predominant collectors of forest products.
- Extend and improve the Payment for Ecosystem Services program, in which businesses pay communities for maintenance of catchment area ecosystem services

12.3.8 Forests and Protected Areas

Issues

Forests are an important component of the environment as a habitat for diverse flora and fauna, they sequester and store carbon and thereby mitigate effects of global warming and control soil erosion. In addition, forests contribute about 1.8/ to the GDP (GoM, 2010). However, the Malawi Biomass Energy Strategy (BEST) (YEAR?) report identified an additional 4.4% from trade and collected fuelwood in urban and rural areas. This economic valuation does not take into account the role of forests in tobacco industry and protection of catchment areas for sustainable water supply and hydro-electric generation. Despite the importance of forests in economic and social development forests are on the decline due to deforestation which is estimated to be between 1% and 2.8% (FAO, 2010). In estimating forest cover, forest reserves and national parks are estimated to be intact but in actual fact they are degraded due to illegal cutting of trees for charcoal and firewood. Although there has not been a recent biomass assessment, it is estimated that forest cover is almost two thirds of what it used to be in 1990s.

The forestry policy and act provides for community participation and this has been the basis for signing of co management agreements between the department of forestry and community groups. The contribution of communities in forestry management has been mixed. In forest reserves such as Chimaliro Forest, co-management arrangements have contributed to improved forestry management whilst in Zomba-Malosa forest reserves co-management arrangements have not arrested and/or reduced the rate of deforestation. Lack of incentives and inadequate enforcement by the Forestry Department may be some of the contributing factors.

Outlook

The Department of Forestry is the sole manager for all the 88 Forest Reserves and 23 proposed Forest Reserves. Management of each forest reserves is not designated to a specific office. This is in contrast to the Department of National Parks and Wildlife which is responsible for five national parks and four wild life reserves. Each national park or wildlife reserve is under the management of a parks manager who is supported by a team of law enforcers and technical staff. To improve management of forest reserves, the Department of Forestry has proposed to decentralize management of forest reserve through establishment of Forest Management Boards for each forest reserve. The outlook is for this approach to be pursued in the short to medium term. In the long term, the Department of Forest explores the role of Public Private Partnership arrangement in forest management. The starting point would be the inclusion of provisions for PPPs in the forestry policy and legislation. Implementation of Payment for Ecosystem Services (PES), REDD+, and CDM in close collaboration with the private sector is also pursued in the medium term. In the short term the Department of Forestry initiates a process to review the forestry policy and Act to eliminate contradictions with other policies.

Possible Policy Actions

- Initiate the process for REDD readiness and apply for REDD+ and CDM funding for the carbon capture services provided by Malawi's woodlands.
- Incorporate the costs of reforestation and forest management into timber prices and use these funding sources to implement co-management initiatives with local communities.
- Provide for policy guidelines for regular collection of forest cover and biomass data. The starting point should be on updating the 1992 data which is often used as the basis to project on current trends in forest cover.
- Develop and implement programmes that will contribute to reduced over-dependency on forests for energy and livelihoods.
- Provide incentives for community participation and Public Private Partnerships in protected areas management; Payment for Ecosystem Services (PES) including carbon trading are possible incentive measures.

- Revise and strengthen existing policies and Act to provide for incentives and benefit sharing for participation in forest management, including clear policy guidelines for Public Private Partnerships.

12.3.9 Water Resources

Issues

About 22% of Malawi's total area is accounted for by water resources, comprising lakes, rivers and wetlands. Lake Malawi alone occupies about 20% of total surface area. Recent research has identified possible pollution in Lake Malawi due to accumulation of agricultural chemicals. In addition, human activities, especially deforestation and cultivation in marginal lands, has led to silting up of most rivers. Thus although Malawi boasts of significant water resources, per capita water availability continues to decline every year as a result of rising population and declining quality.

The current government policy on increasing food production and export orientation will put pressure on natural resources and will result in increased demand for water for agriculture, manufacturing, transport, fisheries and forestry. For example, the Greenbelt Initiative will put more pressure on water since it will result in additional abstraction from rivers and streams. The Shire-Zambezi waterway when operational will demand constant water flow in Shire River for ships to operate efficiently. Furthermore, the manufacturing sector will require constant power supply and this entails constant water flow in Shire River for power generation.

It is clear from the above that water is becoming scarce and is also on high demand. Thus for Malawi to achieve sustainable economic development, comprehensive plans for water management and catchment protection are urgently needed at local, district, and national levels.

Outlook

It is expected that demand for water will continue to increase in future to meet the needs of the rising population and industrial activities. The outlook is that institutions that supply water are faced with water quality issues and challenges from varying water quantity coupled with impacts of climate change. In order to address these challenges comprehensively, policymakers are seen to develop national and river basin Integrated Water Management Plans. Decentralisation provides a unique opportunity to involve water users at the basin level in the management of this shared resource.

Possible Policy Actions

- Revise and harmonize existing sectoral laws, regulations and policies dealing with water and provide mechanisms that promote joint planning, coordination, enforcement and monitoring of water resources.
- Develop and implement policies for the management of transboundary water bodies.
- Finalize the new water management act and facilitate establishment of Catchment Management Authorities to coordinate catchment management at the local level.
- Develop national and river basin Integrated Water Resource Management Plans that ensure the participation of communities in basin areas and co-management of transboundary water resources.
- Build the capacity of institutions responsible for water management to conduct surface and groundwater mapping to improve the quality of existing data.

12.3.10 Climate Change and Disaster Management

Issues

It is estimated that temperature would increase by 2.7°C by 2075. This will result in reduced precipitation in some areas resulting in the declining lake and river levels and affecting fish production and irrigation. The reduced precipitation will also affect availability and quality of water and this will have a direct impact on agricultural production resulting in increased food insecurity, increased incidences of communicable diseases (due to flood related outbreaks of malaria, cholera; malnutrition). Although climate change will affect all economic sectors of Malawi, the hardest hit by its impact will be the rural communities.

Climate change has been experienced in Malawi. However, institutional and human capacity to conduct climate research and implement climate change intervention is inadequate. This means that climate data that would facilitate objective decision making is either unavailable, irrelevant, outdated, scattered about or inaccurate. This may explain why Malawi is largely caught unawares by extreme weather events. Climate change research in Malawi is rudimentary and has focused on air quality studies and small scale lime makers (Fullerton *et. al.*, 2008; Gondwe, 2001; Dolozi and Krempp, 1998; Gondwe and Chipofya, 2003). Thus without documented evidence to support impacts of climate change, negative impacts on people's health and their sources of livelihoods pass unnoticed and, therefore, not captured in the national statistics.

Climate change issues have not been addressed adequately in the existing policies. In addition, institutional framework for climate change is also inadequate. Despite this the government has established

new institutions (e.g. MERA) and strategies to guide implementation of climate related interventions. Malawi has also raised climate change agenda at the national level by making climate change a priority area in the MGDS. This has promoted inclusion of climate change into the formal and informal education.

Outlook

Recognizing that climate change is both an economic and environmental issues, Malawi made deliberate efforts to raise climate change profile on the national agenda by including climate change issues in the national budget and by including climate change as one of the priority areas in the national growth strategy. This approach has prompted government departments, the private sector and NGOs to mainstream climate change into their programmes and strategies. The outlook is that in the medium term the government comes up with clear policy guidelines for climate mainstreaming.

The focus of the NAPA was to address priority adaptation measures. Although the national programme to guide implementation of the NAPA is lacking, there are a number of climate adaptation interventions being implemented by the government and NGOs. A limited number of mitigation interventions such as conservation agriculture and afforestation continue to be implemented, with improved coordination. There is an opportunity to address both mitigation and adaptation measures in the medium to long term through the national response programme on climate change being developed by the Department of Development Planning and Cooperation. This long term investment programme for handling climate change issues in Malawi receives strong support by both the government and development partners.

Currently, availability of climate change data is compromised by lack of research in the area and inadequate capacity to undertake research. The University of Malawi has started responding by introducing climate change as a subject at undergraduate and postgraduate levels. There is an opportunity at Bunda College, a constituent college of University of Malawi, to establish a centre for climate change studies under the proposed climate change programme. Chancellor College, another constituent college introduces the proposed degree programme in climate studies The human and institutional capacity building programme drive continues and extends to other tertiary institutions in the short to medium term. It is expected that improved infrastructure and human capacity improves exchange of high quality climate information and data at the regional and international levels. In addition this increases the capacity of environmental institutions to access funds for research and specific climate change interventions.

Possible Policy Actions

- Develop a unified climate change policy that is adequately harmonized with existing national environmental policies and international and regional protocols.
- Urgently seek alternative energy sources that can reduce the population's dependence on firewood and charcoal.
- Create subsidies or incentives for poor consumers to shift to green energy sources to reduce the risks of communities being exposed to indoor pollution.
- Strengthen and develop institutional network to coordinate adaptation programmes within government, the private sector and NGOs and facilitate community participation in planning and implementation of climate adaptation programmes.
- Strengthen the capacity of institutions and government departments to undertake meaningful research on climate change, monitor important climate change parameters such as air pollution and ensure that the information is packaged in a format most appropriate to the users and shared extensively.

12.4 Environmental Policies, Legislation and Institutional Arrangements

Issues

As an active member of UNCED agreements, Malawi has made significant progress towards achieving environmental sustainability. To facilitate implementation of environmental activities Malawi in 1994 established a government department (Environmental Affairs) to oversee environmental issues in Malawi. This was followed by the development of an action plan for the environment (NEAP) and the Environmental Support Programme whose overall objective was to integrate environmental concerns into socio-economic development of Malawi. The National Environmental Policy and the Environmental Management Act were approved in 1995 and 1996, respectively, as cross-cutting documents to provide structure and legal frameworks for the development and revision of sectoral environmental policies and laws. In line with NEP and EMA Malawi undertook a policy reform and a number of sectoral policies were revised to conform to the requirements of NEP and EMA. The existing environmental laws and policies also integrate issues from protocols and conventions that Malawi is party to, such as Convention on International Plant Protection; Convention on Wetlands of International Significance (the RAMSAR Convention); Convention on

the Conservation of Migratory Species of Wild Animals; Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); African Convention on Conservation of Nature and Natural Resources; FAO International Undertaking on Plant and Genetic Resources; Convention on Biological Diversity; Convention on Climate Change; and the Convention on Desertification. Despite Malawi having a comprehensive legal and policy framework, environmental degradation is on the increase mainly due to inadequate implementation and inadequate law enforcement.

Malawi has also made significant progress in mainstreaming environmental concerns into national programmes and strategies such as the MGDS, MDGs, and Vision 2020. The Malawi Growth and Development Strategy (2006–2011) has embraced environment as one of the issues that impinge on economic growth. Biodiversity is one of the many environmental areas that are included in the plan and these are budgeted for five years. The areas taking priority include agriculture, energy, infrastructure, water and HIV/ AIDS (National biodiversity strategy and action plan for Malawi, 2006–2011).

The MDGs are an international agreement binding 192 countries to the achievement of 8 goals by 2015. According to GOM (2009), "Five of the goals are likely to be achieved and these include eradication of extreme poverty, reducing infant mortality, combating HIV and AIDS, malaria and other diseases, ensuring environmental sustainability, and developing global partnership for development (Table 1). In order to achieve these targets, Malawi must take comprehensive action to protect its environmental resources. For example the reduction of poverty and hunger cannot be achieved without sustainable agricultural practices.

Vision 2020 is a policy framework for Malawi's development that was enacted in 2000 and will be used until 2020.The ambition of Vision 2020 is for Malawi to be "secure, democratically mature, environmentally sustainable, self-reliant with equal opportunities for and active participation by all" and to have "social services, vibrant cultural and religious values and a technologically driven middle-income economy". These objectives are dependent on sustainable environmental management.

It must be pointed out that the environment has not been adequately mainstreamed in all programmes and policies and this should be the focus in the medium term.

Outlook

Implementation of environmental activities follows a sectoral approach with Environmental Affairs Department providing cross sectoral coordination. This arrangement is inadequate since EAD has no mandate for law enforcement across sectors. It is envisaged, however, that the proposed Environmental Protection Management Authority will have mandate to enforce the law across sectors. The EAD is, therefore, seen to speed up the process of revise the EMA.

Possible Policy Actions

- Incorporate environmental matters in all major developmental policies.
- EcoHealth needs to gain special importance as it impinges on human rights issues.
- Climate change policies and programmes must be in the forefront to help vulnerable communities adapt effectively.
- Government must encourage participation of media and civil society in promoting environmental issues. Promote environmental awareness and understanding by sharing, circulation and transparency of environmental information and adapted explanatory material for the public.
- Involvement of influential partners such as faith community will help further the cause of environmental management.
- Identify simple standardised nationwide key indicators for environmental monitoring, and implement a National Environmental Information System able to translate the performance of sustainable development across all sectors.
- Promote social programs to reduce the population growth rate, through health, and family planning education.
- Incentivize green technology and improve its publicity to help in wider adoption of the technology.

Photo Essay - Examples of Good Environmental Management (Integrated infrastructure planning)

Seston Chiotha

Police checkpost with pay toilet facilities for general public. This is an example of integrating road infrastructure planning with health and the end result will be a cleaner environment.

Seston Chiotha

Above: Infrastructure development that does not impact negatively on the environment is possible as shown by road and communications tower built in this area while maintaining the flora.

Photo Essay - Examples of Good Environmental Management (Housing inspired by rural design)

Seston Chiotha

This house is designed with separate areas for kitchen and toilet and providing open spaces as well as space for a backyard garden. Houses such as these (built by Government for School teachers) is an example of provision of modern amenities and using traditional design in space planning.

Seston Chiotha

Inspiration for the improved housing shown in top picture comes from the rural setting (bottom picture) where separate areas are provided for the sleeping area, kitchen and toilet. Standard of living of communities can be improved by providing modern housing while maintaining traditional designs.

Photo Essay - Farming and Preservation of Trees

Seston Chiotha

Above: Communities living at the foot of this hill have preserved the trees on the hill while making a livelihood from farming in the plains.

Seston Chiotha

Seston Chiotha

Above: *Faidherbia albida* (also called Nsangu) is one of the fastest growing indigenous trees. It is deciduous and can grow up to 30 m tall and has multiple uses. It provides fodder for wild and domestic animals. It also sheds its leaves during planting season thus posing no competition for crops when planted in crop fields. The fallen leaves of this tree enriches the soil. Choice of the right tree is essential for agroforestry efforts to be effective.

Photo Essay - Adaptation to Climate Change

Seston Chiotha

Seston Chiotha

Left: Farmers are adapting to climate variability in many ways. Here a farmer has brought in new soil to enrich his farmland. This is an adaptation measure as soil fertility has been observed to decline. Right: This farmer is using his failed maize crop as compost to enrich his soil.

Seston Chiotha

Seston Chiotha

Above: In Sharpevale crops were lost from dry spells during the planting season. As an adaptation measure, communities have allowed goats to feed on the maize crops. There is need to document best practices for adaptation during periods of climate variability.

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Appendix

Malawi and the MDG goals—Are We on Target?

Goal/Target	Indicator	Current Status	2015 Target	Feasibility of Achieving the Goal
Eradicate Extreme Poverty and Hunger	Proportion of population living below US$1.00 per person per day	40 %	27%	Likely to be met
	Poverty Gap Ratio	17.8	0%	
	Poorest Quintile Share in National Consumption	10.1 %	20%	
	Prevalence of Underweight Children	16 %	14%	
	Proportion of population below minimum level of dietary energy consumption	15%	11.8%	
Achieve Universal Primary Education	Net Enrolment in Primary	79 %	100%	Unlikely to be met
	Proportion of Pupils Starting Grade1 Reaching Grade 5	75.7 %	100%	
	Literacy Rate (15–24yrs)	82 %	100%	
Promote Gender Equality and Empower Women	Ratio of Girls to Boys in Primary Education	0.99	1	Unlikely to be met
	Ratio of Girls to Boys in Secondary Education	0.77	1	
	Ratio of Literate Women to Men 15–24 Years Old	0.94	1	
	Share of Women in Wage Employment in non-Agriculture Sector	15%	50%	
	Proportion of Seats Held by Women in Parliament	22 %	50%	
Reduce Child Mortality	Under-five mortality rate	122 per 1,000	78 per 1,000	Likely to be met
	Infant Mortality rate	69 per 1,000	44.7 per 1,000	
	Proportion of 1 year children immunized against measles	84%	100%	
Improve Maternal Health	Maternal mortality ratio	807 per 100,000	155 per 100,000	Unlikely to be met
	Proportion of births attended to by skilled health personnel	67%	100%	
Combat HIV and AIDS, Malaria and other diseases	HIV prevalence among 15–24 year old pregnant women	12%	0%	Likely to be met
	Ratio of orphans to non-orphans in school	0.14	-	
	Deaths rates associated with Malaria	4%	-	
	Access to Malaria Treatment	21%	-	
	Proportion of Household with at least one ITN	37.8%	-	
	Death rates associated with Tuberculosis	9%	-	
	Proportion of TB Cases under DOTS	83%	100%	

Goal/Target	Indicator	Current Status	2015 Target	Feasibility of Achieving the Goal
Ensure Environmental Sustainability	Proportion of land covered by forest	36.2%	50%	Likely to be met
	Proportion of area protected to maintain biological diversity	0.16%	0.18%	
	Proportion of population using solid fuel	98.7%	0%	
	Proportion of population with sustainable access to an improved water source	80%	74%	
	Proportion of population with access to improved sanitation	94%	86.2%	
	Slum population as percentage of urban population	64.4%	-	
Develop Global Partnership for Development Likely to be met	Net ODA as a percentage of Real Gross Domestic Product	21%	-	Likely to be met
	Unemployment of 15–24 year old (urban)	9.4%	-	
	Telephone lines subscribers per 100 population	0.82%	-	
	Cellular subscribers per 100 population	11.17%	-	
	Internet users per 1,000 population	0.70	-	

Source: GOM, 2009.

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