EASTERN NILE TECHNICAL REGIONAL OFFICE

NBI – Institutional Strengthening Project
PROJECT DELINEATION AND PRIORITIZATION

ANNEX 4.1
CHEMOGA SUB-BASIN PROJECT
FINAL REPORT

10th Decemberr, 2012

CONTENTS

ABBREVIATIONS

ADLI	Agricultural Development Led Industrialization
AHI	African Highlands Initiative
BoWRM	Bureau of Water Resources & Mines
CBPWD	Community Based Participatory Watershed Development
CGIAR	Consultative Group for International Agricultural research
COSAERT	Commission for Sustainable Agriculture and Environmental Rehabilitation
CRA	Cooperative Regional Assessment
CSE	Conservation Strategy of Ethiopia
EEFPE	Environmental Economic Policy Forum for Ethiopia
EPA	Environmental Protection Agency
ENSAP	Eastern Nile Subsidiary Action Programme
ENTRO	Eastern Nile Technical regional Office
FAO	Food and Agricultural Organization
FDRE	Federal Democratic Republic of Ethiopia
GIS	Geographical Information System
IDEN	Integrated Development of the Eastern Nile
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
IUC	Inter University Cooperation
JMP	Joint Multi-Purpose Programme
Km	Kilometre
Km2	Square kilometre
LLPPA	Local Level Participatory Planning Approach
MoARD	Ministry of Agriculture and Rural Development
MoWR	Ministry of water Resources
MERET	Managing Environmental Resources to Enable
N	Nitrogen
NTEAP	Nile Trans-boundary Environmental Action Programme
PASDEP	Poverty Alleviation & Sustainable Development Programme
SCRP	Soil Conservation Research Project
SDPRP	Sustainable Development & Poverty Reduction Programme
SLM	Sustainable Land Management

SWC	Soil and Water Conservation
t	ton
UNDP	United Nations development Programme
USAID	United States Agency for International Development
USLE	Universal Soil Loss Equation
WB	World Bank
WBISPP	Woody Biomass Inventory and Strategic Planning Project
WFP	World Food Programme
WM	Watershed Management

DISCLAIMER

The maps in this Report are provided for the convenience of the reader. The designations employed and the presentation of the material in these maps do not imply the expression of any opinion whatsoever on the part of the Eastern Nile Technical Office (ENTRO) concerning the legal or constitutional status of any Administrative Region, State or Governorate, Country, Territory or Sea Area, or concerning the delimitation of any frontier.

1. BACKGROUND

1.1 Introduction

The results of the Trans-boundary, Distributive and Cooperative Mechanisms Analyses of Eastern Nile Watershed Management Cooperative Regional Assessment (CRA) provided a broad understanding of:

- the baseline conditions in each watershed, root causes of land degradation on national level and lessons from past experience in watershed management,
- each of the selected sub-basins as "*integrated"* watershed systems,
- the challenges and opportunities for cooperative watershed management,
- the cumulative costs and benefits of alternative watershed management interventions,
- the potential distribution of costs and benefits under alternative benefit sharing scenarios, and
- the nature and scope for generating regional public goods[1] through the watershed management project(s).

The Eastern Nile Watershed Management CRA identified a number of potential projects for subsequent implementation within the framework of the Eastern Nile Subsidiary Action Programme (ENSAP).

The Watershed Management CRA terms of reference called for the identification:

> *through analysis, the next round of watershed management projects, that are promising from a local livelihoods as well as a regional benefits point of view and are rational in view of anticipated multipurpose developments in the Eastern Nile region .*

The Distributive Analysis identified a comprehensive set of watershed management interventions to be implemented within Ethiopia, Sudan and Egypt. The majority of these had substantial in-country benefits in terms of reducing poverty, sustaining livelihoods and arresting the decline in the integrity of the natural resource and environmental base of the countries concerned. A number

[1] A regional public good here can be seen as the positive 'spill-over' effects of a country-level activity or asset in neighbouring countries.

of these had regional and global benefits. Many of the interventions identified were, or were likely to be in the future, integral parts of on-going development programmes.

The Cooperative Mechanisms Analysis examined a continuum of increasing levels of potential cooperation amongst the three riparian countries of the Eastern Nile Basin. These ranged from uni-lateral action with no cooperation through coordination (e.g. of information collection and sharing), collaboration (e.g. collaborative research or collaborative Watershed Management Planning) to Joint Activities (e.g. administration of Trans-boundary National Parks). With-in this framework many of the interventions outlined in the Distributive Analysis required a relatively low level of cooperation between the riparian countries, notwithstanding downstream (i.e. regional or Global benefits that could accrue to them.

A number of criteria were identified to enable a selection to be made of a first round set of potential projects from those identified in the Trans-boundary Analysis and outlined in the Distributive Analysis.

- Support and enhance cooperation among the three Riparian Countries in sustainable watershed management,
- Local, National, Regional and where possible Global benefits would accrue to the projects, and
- The projects would where possible support other IDEN Projects, the JMP and other NBI projects.
- The projects would address threats to Environmental and Natural Resource Hotspots

The "Benefits" criterion is broad in its interpretation. Benefits include positive impacts on (i) poverty reduction, (ii) support to sustainable livelihoods and reducing vulnerability, (iii) reducing or arresting natural resource degradation. Benefits accruing to these development goals are inextricably linked and are thus, considered together. Benefits were also assessed at the local/national, Regional/Eastern Nile Basin and the Global scales. All selected Projects have benefits at all three levels. All Projects selected also support to a greater or lesser extent on-going or proposed Projects within the NBI or ENSAP framework.

Two sets of follow-on projects were identified:

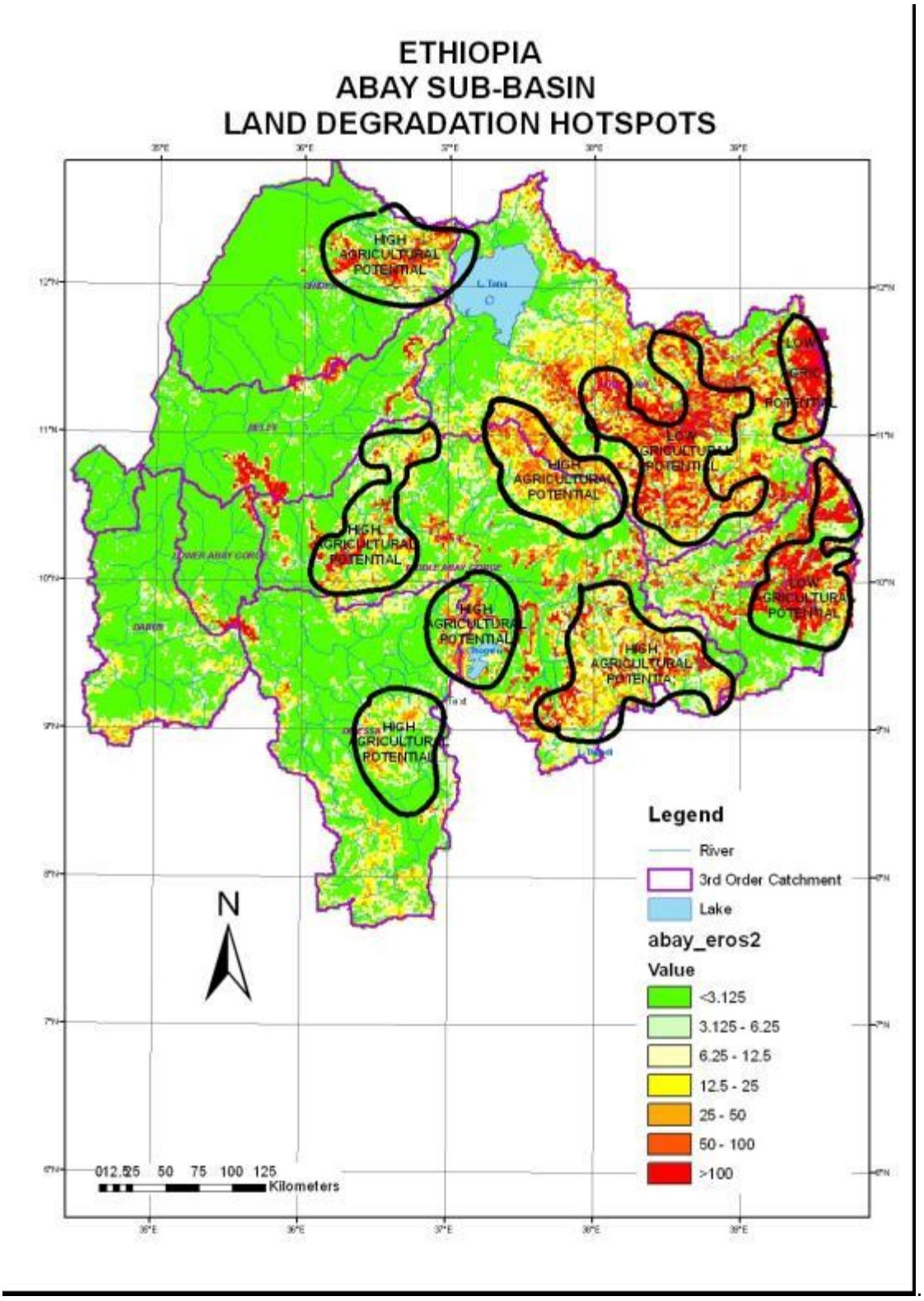
- National Investment Projects
- Cooperative Knowledge Development Projects.

The main criteria for the selection of the Investment Projects was that they addressed current threats to natural resource degradation in ways that negatively impacted on local household livelihoods and also negatively impacted on downstream river users.

This Report is concerned with four of the Investment Projects located within the Abbay Sub-basin within Ethiopia. This Project document is concerned with the Chemoga Sub-basin.

1.2 Primary Objectives of the Project

The Watershed Management CRA identified a number of land degradation hotspots in the Abbay Basin. These are areas of increasing population pressure on a degrading natural resource base, increasing food insecurity, with increasing household inability to invest in sustainable land management practices due to declining household and community natural, physical, social and human capital assets. The selected hotspots are located in areas of low agricultural potential where land degradation processes (erosion and soil nutrient depletion) are severe and of long standing.



Map 1. Abbay Basin: Land Degradation Hotspots

The objective of this Project is to provide support to the Regional Government to arrest severe land degradation hotspots within areas of high agricultural potential

in the Chemoga Sub-basin of the Abbay Basin, strengthen household and community livelihood strategies and contribute to the alleviation of poverty.

1.3 The Scope and Elements of Sustainable Sub-basin Management

River basins, Sub-basins, watersheds and sub watersheds and their hydrological processes operate in systemic way within a nested hierarchy but often in complex spatial and temporal patterns. For example, the linkages (or coupling) between vegetation cover, soil erosion (or soil conservation) and sediment yield at the micro-watershed level and the sediment load and sedimentation downstream at the macro-watershed level often do not have simple linear relationships. Terminology is generally based on area (although this is of necessity rather arbitrary).

Table 1. Watershed Management Units and Hydrological Characteristics

Management Unit	Typical area (km2)	Example	Degree of coupling
Micro-watershed	0.1 -5km^2	Typical watershed adopted by MERET interventions (Ethiopia)	Very strong
Sub-watershed	5 – 25km^2		Strong
Watershed	25 -2,500km^2	Chemoga, Tesher, Yega	Moderate
Sub-basin	2,500 – 10,000km2	Guder, Anger	Weak
Basin	10,000 – 250,000km2	Abay-Blue Nile	Very weak

After World Bank (2005)

In the present context the Basin level is the Abbay within Ethiopia; the Sub-basin level comprises the three Watersheds of the Tesher, Chemoga and Yega. The Watershed is the next level with each Watershed comprising a number of Sub-watersheds. Sub-watershed is the next level and each Sub-watershed comprises a number of Micro-watersheds as used for Soil and water conservation planning.

In micro and sub-watersheds there is a strong coupling between the watershed area and the channel. Vegetation and land management practices closely control the runoff and the export of water, sediment and dissolved load into the stream channel. There is also a close coupling between groundwater and the river. In medium to large basins coupling between the watershed and the river is weak. The dominant process in basins of this size is transfer of material through the channel network and there is often temporary storage of sediment. Thus, the channel acts as a conveyor belt intermittently moving pulses of sediment during flood events. There is additional sediment from stream bank erosion and drifting sand.

Clearly, the approach to be adopted in developing a framework for watershed management for the Eastern Nile Basin needs to be very broad in order to address a wide-range of objectives based on stakeholder perspectives across

multiple levels and countries. The objectives to be addressed go beyond developing and conserving land, water and vegetation in the four sub-basins in the three countries. They include but are not limited to:

- Improving the management of land and water, their interactions and externalities;
- Linking upstream and downstream areas, and integrating environmental concerns with economic and social goals;
- supporting rural livelihoods by linking interventions in other "non-watershed" sectors (e.g. health in pond development, training in non-farm employment activities);
- addressing equity and gender concerns in the distribution of costs and benefits of watershed interventions (e.g. positive and negative externalities at various levels);
- identifying opportunities for incremental benefits accruing to cross-border coordinated interventions, including those being developed for the other IDEN CRA's and the Joint Multi-purpose programme (JMP);
- identifying global benefits (e.g. conservation of tropical forests, biodiversity and carbon sequestration) that accrue from national and regional level interventions.

At the same time it will be important to maintain a "Watershed Perspective". This is necessary to avoid losing focus on the unique upstream-downstream characteristics of watersheds and river basins. Maintaining such a perspective will avoid the danger of the analysis failing to develop a "system-wide" understanding of the issues and thus the identification of trans-boundary opportunities to improve livelihoods and achieve poverty reduction. Finally, a Watershed perspective will enable the identification of basin-wide synergies from cooperative trans-boundary interventions.

Strategic watershed planning needs to take into account different temporal and spatial scales and accept a degree of uncertainty. It can be implemented at scales ranging from small upland watershed to entire trans-boundary river basins. Whilst small-scale projects have the advantage of face-to-face interaction with stakeholders they have limited impact at the watershed or river basin level. The design and operation of local programmes must consider upstream-downstream linkages and a methodology for multi-level watershed, sub-watershed and micro-watershed planning needs to be developed. Scaling-up of successful local experience is critical for the new generation of watershed management programmes.

2. NATIONAL SETTING - ETHIOPIA

2.1 Bio-physical and Socio-economic Setting

With a surface area of 1.1 million square kilometers, Ethiopia is located in the northeastern part of Sub-Saharan Africa between latitudes 3° and 15° north. The estimated population in 2010 was 79.8 million, the second highest in Sub-Saharan Africa. Some 84 percent of the population are rural (Population Census Commission, 2010). The estimated rural population growth rate (1995-2007) was 2.6 percent per annum and the urban rate was 4.5 percent. These growth rates are projected to decline between 2000 and 2030 (figure 1). Nevertheless the total population is projected to rise to 129 million by 2030 (see figure 2).

Figure 1. Changes in Rural, Urban and Total Population Growth Rates 1995- 2030 (Source CSA, 1999)

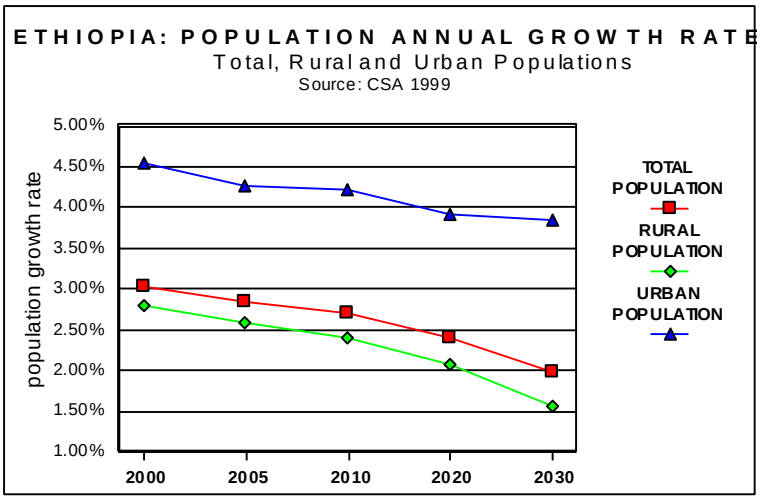
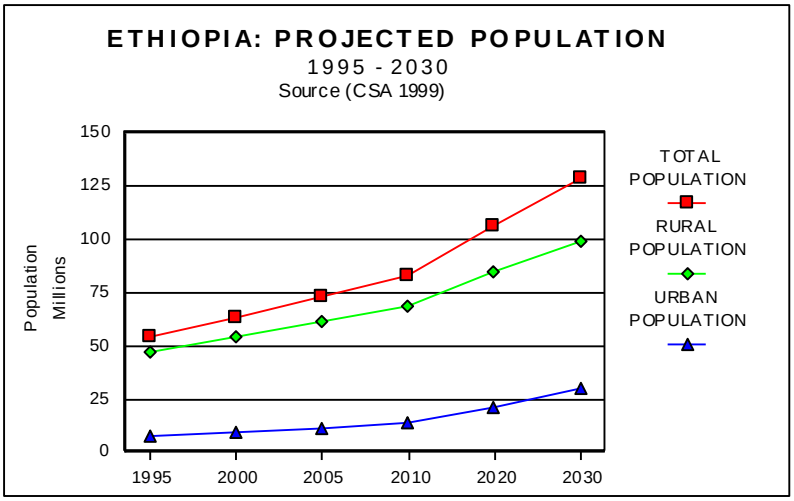
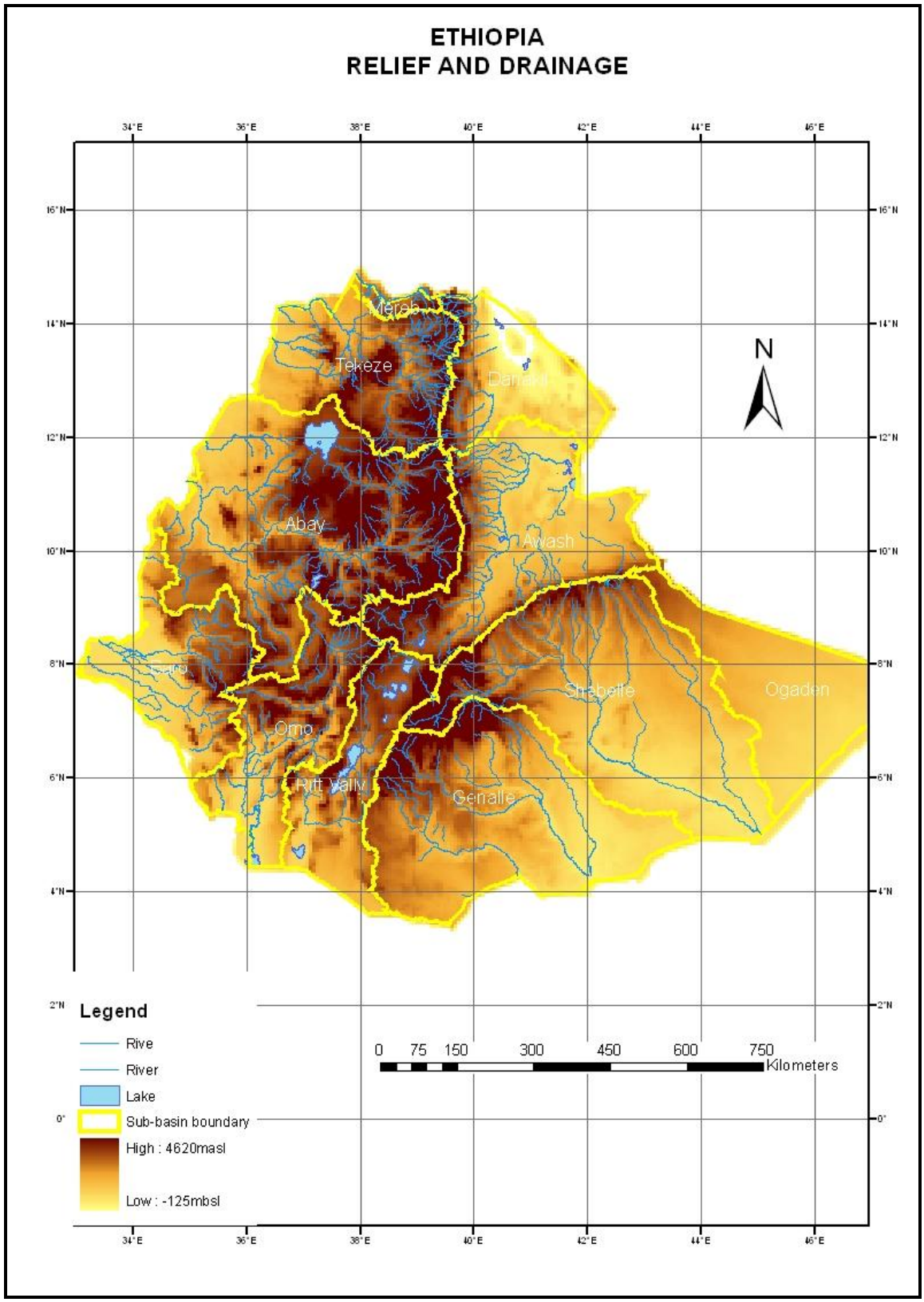


Figure 2. Rural, Urban and Total Population (1995 - 2030)





Map 2. Ethiopia: Relief and Drainage

The Highlands[2] form a broad plateau between 1,500 and 2,500 masl with isolated peaks rising as high as 4,600 masl. They cover 43 percent of the total area. The favorable climatic conditions of the Highlands sustain 88 percent of the population (Map 2). The Highlands account for 95 percent of the cultivated land, and also support 75 percent of the cattle population of 33 million. Most crop cultivation in the Highlands uses the plough and has a history stretching over many millennia. Ethiopia is one of the 12 Vavilov centres of crop genetic diversity, being a main genetic diversity center for crops such as aribica coffee, enset, niger seed, sorghum, finger millet, durum wheat, barley and many others. Given the erosion of genetic material elsewhere in the world, this diversity is assuming an increasing global importance.

Surrounding the highlands on all sides are the lowlands. To the east, southeast and south they are semi-arid to arid with an annual rainfall below 600 mm. These lowlands are inhabited by transhumant pastoralists who herd cattle and sheep (mainly grazers), and goats and camels (mainly browsers). In the Western Lowlands rainfall is much higher but the prevalence of trypanosomiasis precludes livestock production. This factor, together with the prevalence of human tropical diseases not found in the Highlands, has meant that until recently these areas were sparsely populated. However, under increasing population pressure in the Highlands these areas are now increasingly being settled.

In the high rainfall areas of the southwest and southeast highlands the original vegetation of the highlands was broad-leaved montane high forest. Further north with lower rainfall this changed to a mixed coniferous forest (Podocarpus spp. and Juniperus spp.) and woodland. In the driest parts of the north this in turn gave y to low Juniperus woodland. However, millennia of expanding settlement and clearing for agriculture has left only 3.6 percent of the Highlands covered with forest. The semi-arid lowlands of the east, southeast and south support a cover of Acacia-Commiphora woodland and shrubland. Increasingly these Lowlands are the source of fuelwood and charcoal for the highlands. In the wetter western lowlands this is replaced by Combretum-Terminalia woodland, with extensive areas of Lowland Bamboo (*Oxytenanthera abyssinica*).

In the Highlands severe population pressure, poor cultivation practices, steep lands and overgrazing by livestock has led to accelerated soil erosion that now affects more than 50 percent of the cultivated area. Some 95 percent of the cultivated area is farmed by smallholder farmers with average holdings of less than 2 hectares. In many areas an increasing proportion of the rural population have no land. With frequent droughts, each year more than 6 million people require food assistance.

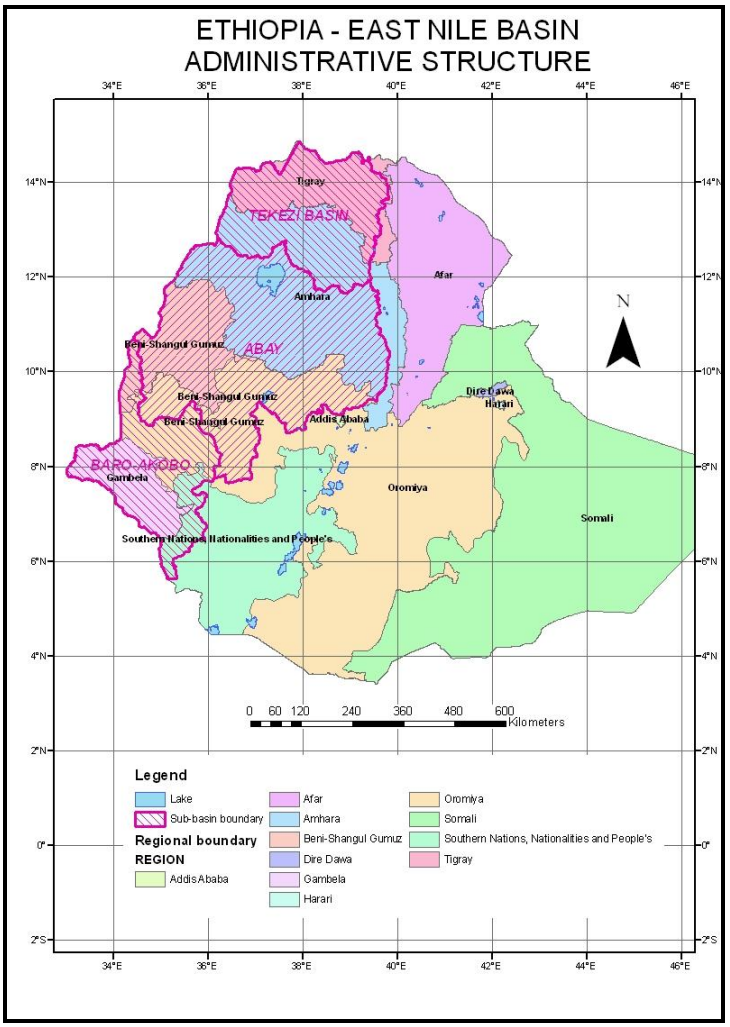
The household energy requirements of this large and fast growing population are supplied almost entirely from traditional energy sources. Biomass energy at the national level provides more than 96.9 percent of the total domestic energy

[2] "Highlands" in Ethiopia is land over 1,500 meters above sea level.

consumption: 78 percent from woody biomass, 8 percent from crop residues, and 11 percent from animal dung. Modern energy provides only 3.1 percent of energy consumption. This has serious implications for the natural resource base. Because of the scarcity of fuelwood many households burn dung and crop residues. The use of dung precludes its contribution of the soil nutrient pool, exacerbating declining crop yields due to soil erosion. The burning of crop residues precludes their use as livestock feed for a livestock population barely meeting its energy requirements for maintenance.

2.2 Administrative Structure

In 1991 Ethiopia adopted a federal structure of government with 9 Regional States, the City Administration of Addis Ababa and the Dire Dawa Administrative Council (see map 3).



Map 3. Ethiopia: Administrative Structure and East Nile Sub-basins

Many fiscal and administrative powers of the central government were devolved to the Regions. Within the Baro-Akobo, Abay and Tekezi River Basins there are six Regional States:

- Tigray
- Amhara
- Beneshangul-Gumuz
- Oromiya
- Southern Nations, Nationalities and Peoples (SNNP)
- Gambela

Within each Region there is a three tiered structure of Government:
- Region
- Wereda
- Rural Farmers Association (Kebele)

In Oromiya and SNNP Regions there is a fourth tier - the Zone. The area of the Farmers Association may be sub-divided into smaller areas for the administration of natural resources (e.g. Development Team).

The ministries at the federal level are generally mirrored at the Regional level and to a lesser extent at the woreda level. Ministries at Regional are referred to as "Bureaus" and Wereda levels to "Offices". The most relevant ministries/bureaus for watershed management include:

- Agriculture and Rural Development
- Water Resources
- Finance and Economic Planning
- Federal Environmental Protection Authority and Regional Environmental Protection, Land Administration and Use Authorities
- National Disaster Prevention and Preparedness Commission and Regional Food Security Programme Coordination and Disaster Prevention Offices

2.3 National and Regional Policy Framework

2.3.1 Introduction

A substantial body of policies and policy instruments are already in place with a direct or potential bearing on natural resource management and watershed management. In general, these have been adopted at the regional level.

The main policies and proclamations are:

- Conservation Strategy of Ethiopia (CSE) (1997)

- Agricultural Development Led Industrialisation (ADLI) (1992)
- Ethiopian Water Resources Management Policy (1999)
- Subscription to the Millennium Development Goals (2000)
- Sustainable Development and Poverty Reduction Programme (SDPRP) (2002)
- Food Security Strategy (2002)
- New Coalition for Food Security Programme (2004)
- Rural Development Policy and Strategies (2003)
- Productive Safety Net Programme – Programme Implementation Manual (2009)
- Plan for Accelerated and Sustainable Development to End Poverty (2005) more recently superseded by the National Growth and Transformation Programme (2009)
- Water resources policies and legislation
- Environmental Policy and legislation
- Rural Land Administration and Land Use Proclamations

2.3.2 Conservation Strategy of Ethiopia

The Conservation Strategy of Ethiopia (CSE), formulated in 1995, is at the basis of all environmental efforts and considerations in subsequent policies.

The CSE documentation consists of five volumes: Vol. I the Natural Resource Base; Vol. II Policy and Strategy; Vol. III Institutional Framework; Vol. IV the Action Plan and Vol. V Compilation of Investment Programmes.

The Environmental Policy of Ethiopia has emanated from Vol. II of the Conservation Strategy and was approved by the Council of Ministers of the Federal Democratic Republic of Ethiopia on April 2, 1997.

2.3.3 Agricultural Development Led Industrialisation (ADLI)

ADLI, i.e. using agricultural development as an engine for economic diversification and industrialization is still the government's core policy for rural development as well as overall economic development. Implementation of this policy has focussed on provision of agricultural inputs. Although agricultural production has increased in certain areas, increases in overall agricultural production at the national level are very limited. The modest expansion in the volume of real agricultural output over 1992-2002 was driven by policy measures – liberalization of input and output markets leading to increased use of inputs (fertilizer, and to a lesser extent improved seeds) and expansion of cultivated areas. As a result, yields have slightly improved on average although this masks diverging trends in favourable and less favourable areas. The increased

utilization of fertilizers and improved seeds has allowed turning some areas previously in food deficit into food exporters. This was achieved by activist policies in the context of the ambitious agricultural extension programme.

After initial success, the effect of ADLI seemed to stagnate, and has increasingly became the subject of debate. Questions raised are not only related to the way ADLI is implemented, but whether the theoretical basis of ADLI is correct. Central in the debate is the current strong focus on the supply side and the relative neglect of the demand side. It is now increasingly recognized in policy debates in the country that an efficient, low-cost, agricultural marketing system is required in order to close the national food security gap and increase per capita income. In addition, it is considered that there is need for structural change in the agricultural sector towards a more export market orientation that can only be achieved with reducing transport costs to world markets.

2.3.4 Millennium Development Goals (2000)

The document on a needs assessment related to the Millennium Development Goals (Millennium Development Goals Need Assessment: The Rural Development and Food Security Sector in Ethiopia – 2004), mentions important interventions for the period 2005-2015 to respond to the MDG, and focuses on:

- integration of environmental management in the implementation of Rural Development and Food Security programmes (environmental laws, EIA)

- watershed-based natural resource management for sustainable development and mitigation of resource degradation (proper land use, soil conservation, water/forest resource management, irrigation, biodiversity conservation).

2.3.5 Sustainable Development and Poverty Reduction Strategy (2002)

The Ethiopian Sustainable Development and Poverty Reduction Strategy (SDPRS) also focuses on agriculture centred rural development in order to achieve:

- rapid overall development
- liberation from dependency
- promotion of a market economy

It explicitly builds on ADLI by mentioning “an overriding and intentional focus on agriculture as a potential source to generate primary surplus to fuel the growth of other sectors of the economy (industry)” as one of its main thrusts.

Other broad thrusts are:

- Strengthening private sector growth and development especially in industry as means of achieving off-farm employment and output growth (including investment in necessary infrastructure),
- Rapid export growth through production of high value agricultural products,
- Undertake major investment in education and capacity building to overcome critical constraints to implementation of development programs,
- Deepen and strengthen the decentralization process to shift decision-making closer to the grass root population, to improve responsiveness and service delivery,
- Agricultural research, water harvesting and small scale irrigation,
- Focus on increased water resource utilization to ensure food security.

Some of the proposed measures in the agricultural sector are:

- Introduce menu based extension packages to enhance farmers choice of technologies,
- Expand borrowers' coverage of micro-financing institutions,
- Establish an institute for diploma-level training of extension agents and expand agricultural Technical Vocational Education Training (TVET),
- Measures for the improved functioning of markets for agricultural inputs (fertilizer, seed) and outputs,
- Organize, strengthen and diversify autonomous cooperatives to provide better marketing services and serve as bridges between small farmers (peasants) and the non-peasant private sector.

The number of farming households to be covered by the Extension Package Program is expected to increase from the current 4 million (2000/01) to 6 million by the end of the program period.

With regard to food security, the SDPRS takes into account a transition period where there will be continued reliance on food aid. The SDPRS is subscribing the concept of linking relief (*read: food aid*) with development as it has been applied since the late 1980s and is stating that "Various activities of environmental protection such as soil and water conservation, terracing and afforestation carried out over the years have shown positive results, and will be improved and continued in the future."

The latter statement has to be treated with care as it may have an important unwanted bearing on implementation modules in watershed management in which SWC and afforestation are key components. New initiatives of watershed management such those as within the framework of the ENSAP should be more critical with regard to the almost automatic connection between SLM, watershed

protection activities and food aid. It is particularly in the field of SWC where food aid has had some negative impacts on planning and effectiveness of implementation, and its disconnection need to be sought very seriously. A more detailed discussion on this subject is given in chapter 9.

2.3.6 Food security strategy (2002)

The Food security strategy equally underlines the importance of sustainable use and management of natural resources, mentioning more or less the same fields of attention as the SDPRS.

2.3.7 New Coalition for Food Security Programme (2003)

The New Coalition for Food Security Programme document outlines what it considers as the main causes of land degradation, which are actually symptoms of improper management of natural resources: a) cultivation of steep slopes, without conservation practices, poor, nutrient mining farming practices and b) using crop residues and dung for household energy instead of for ameliorating soil fertility c) biodiversity losses due to land degradation and deforestation.

The document suggests participatory watershed management planning as supportive of food security interventions.

2.3.8 Plan for Accelerated and Sustainable Development to End Poverty (2005)

The Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) represents the second phase of the PRSP process (2005-2010) that began under SDPRP. PASDEP pursues initiatives under SDPRP and ADLI but with important enhancements to capture the private initiative of farmers and support the shift to diversification and commercialization of agriculture. It is realized in PASDEP that, “parallel to this shift to commercialized agriculture, improvement of pro-poor subsistence farming still needs to take place as the main welfare improvement for several million households still depends on achieving higher yields of basic food grains.

This second main orientation will be pursued through a combination of intensified extension support at the kebele level, establishment of a network of demonstration centres, increased low-level veterinary services, support for small-scale irrigation, better use of ground water, complemented by productive safety net and off-farm income generating initiatives supported under the Food Security Program. Both approaches need to be pursued with measures to manage the natural resource base and protect the environment.”

PASDEP distinguishes between the three main economic and agro-climatic zones: the traditionally settled semi-arid/sub-humid highlands, the potentially productive semi-tropical valley areas, and the hot semi-arid lowlands. This particularly applies to agriculture but also to the private sector development agenda. Instruments are infrastructural improvement (roads, telecommunication, electric power supply), strengthening of financial and administrative development capacity, and control of malaria and tsetse and special efforts for pastoral areas in the lowlands.

Watershed management related elements are mentioned under the sectors water management and irrigation (water harvesting) and crop production (water harvesting, soil and water conservation).

2.3.9 Federal Policy on Rural Development

The federal Rural Development Policy promotes, among others:

- intensification in high rainfall areas,
- livestock improvement and water resource development and marketing facilities in pastoral areas,
- irrigation and overall development of basic facilities/infrastructure in the western lowlands,
- water harvesting and land conversion in drought prone areas,
- livestock improvement through improved breeds and technology.

In its rural development policy it proposes voluntary resettlement programmes to alleviate land shortages as well as helping to develop hitherto uncultivated lands. The Strategic Policy Memorandum (SPM) of the Oromiya Bureau of Agricultural also assumes in the near future movement of people from degraded subsistence areas.

The Rural Development Policy promotes replacement, where possible, of food aid by financial support (Cash-for-work instead of food-for-work). In cases where food aid is to be preferred, food should be purchased from local sources.

Livestock improvement is to be sought through improved breeds and technology and technologies are to be disseminated through training centres for DA's.

Apart from the integrated rural development and agricultural development aspects, also covered in the SDPRS, the Rural Development Strategy also pays attention to the land tenure issue and the proper use of land. Important changes such as the moratorium on land re-distribution and the distribution of land

certificates are given a legal basis in a number of federal and regional proclamations.

Protecting user rights of the farmer definitely mitigates an important facet of the problem of tenure security, but does not solve the problem of non-availability of land for young farmers. This will be addressed by improving land use and productivity as well as employing technologies that use more labour resources and thus creating on farm job opportunities. Several measures are already successfully applied to this regard. Gully stabilization and plantation followed by allocation to landless youth is one example; rights of landless people to exploit rehabilitated hill slopes (after hillside closure and/or plantation) are another example. In the long-term, accelerated economic development should hold out the promise of increased job opportunities to the landless.

The more recent Main Report of the **National Livestock Development Project** – NLDP (1999-2003) confirms the pressure on land and forage resources by stating that, at a national scale, natural pastures in the mixed highland farming areas are taken over for cropping and crop residues (7-8 % at a national scale) and agro-industrial by-products are becoming major sources of feed although not adequately used. In these circumstances, the cultivation of fodder crops and forages becomes a serious option for increasing feed resources. Tremendous opportunities are reported for introducing forages into the cropping system through undersowing, intercropping and the use of leguminous shrubs as backyard hedges. The NLDP report further confirms that the need to intensify and integrate livestock production into more profitable farming systems is central to environmentally sustainable land use.

The NLDP project area touches parts of the ENB in ANRS, TNRS as well as in ORNS. It focuses on upgrading genetic resources, improved animal health and increased forage production. The latter is, among others, concerned with forage development in smallholder fattening and dairy production systems, development of local capacity for perennial legume seed production by small holder contract system. It is estimated that forage development may give a net benefit of ETB 6,000/ha (US$ 690/ha).

2.3.10 Productive Safety Net Programme – Programme Implementation Manual

The change from subsistence farming to a more diversified economy can only be made if the Government guarantees a safety net to farmers. Recently, a country-wide safety net programme has been prepared with the help of the World Bank. Distribution of food aid should be minimised as much as possible, and be replaced with cash aid, in order not to distort food cereal prices, which inhibits investments in agriculture and maintains low agricultural productivity. Many activities of natural resource management and watershed treatment (soil and water conservation, water harvesting, construction of feeder roads) are now

financed through the Safety Net Programme. Reportedly, the programme is more or less replacing the previous Employment Generation Schemes (EGS).

2.3.11 Rural Land Administration and Land Use Proclamations

Several federal and regional proclamations have been issued, among which:

- Federal Rural Land Administration Proclamation (No 89/1997)
- Federal Rural Land Administration and Land Use Proclamation (No 456/2005)
- Amharic Proclamation issued to determine the Administration and Use of the Rural Land (No. 46/2000)

The federal proclamation focuses on tasks of land management to be taken up by the regions. All proclamations (federal and regional) describe the rights and obligations of users of rural land, including traditional subsistence farmers, and in the more recent proclamations, also of private commercial farmers.

A breakthrough in land use rights has started in ANRS, where the proclamation stipulates that

- “a book of ownership shall be prepared by the relevant organ”,
- “peasants (individual or in communal holding) have the obligation to have a book of ownership”,
- “redistribution of land shall not be effective unless otherwise the land distribution does not affect the productive capacity, requested by the community, supported by the study and decided by law”.

The recent (2005) federal proclamation demonstrates the government’s concern about land degradation and its commitment to combating the problem. Most importantly in the current context, it defines obligations of rural land users, and land use restrictions. Thus, protection of land becomes an obligation and failure to protect can lead to loss of title. Free grazing in areas with SWC is prohibited and appropriate SWC measures are required for all lands of <30% slope. Cultivation on slopes of 31-60% slope requires bench terraces. Closure of degraded lands, and compensation for prior users is provided for. A minimum holding size is referred to, but is to be determined by the Regions.

In principle, the proclamation is a positive move; the possibility to enforce it in practice is yet to be seen. Some rules for proper use of land are defined in a simplified but yet rather rigid way. For example, the rule that “degraded lands of any slope shall be closed from human and animal interference” would preclude future exploitation on a more sustainable basis (cut and carry). Others are very general and need further specification, e.g. “users should protect and develop the productive capacity, biodiversity in rural wetlands shall be conserved”.

2.3.12 Ethiopian Water Resources Management Policy (1999)

The overall goals of the national water resources management policy of Ethiopia is to enhance and promote efforts towards an efficient, equitable, and optimum utilization of the available water resources and contribute to the country's socioeconomic development on sustainable basis.

The Water Resources Management Policy includes a Water Sector Strategy, which covers certain elements of watershed management under its different components:

- under Water Resources Development: water harvesting
- under Water Resource management: soil and water conservation measures to reduce soil erosion and reservoir siltation; local community participation in watershed management and water conservation measures and practices; a recognition of wetlands as a key feature in watershed management.

2.3.13 Water Resources Management Laws

(i) The National Proclamation on Water Resources Management (2002)

The basic thrust of this proclamation is that water resources management and administration in the country should be based on the National Water Policy, the Integrated River Basin Master Plan Studies (IRBMPs) and the Water Resources Laws of the country. MoWR is clearly identified as 'supervising body' in charge of enforcing the provisions of the proclamation. It is entrusted with broad powers of 'planning, management, utilisation administration and protection of water resources'.

Among MoWR's duties are inventory of water resources, allocation of water resources, establishing standards for design and construction of waterworks, issuing guidelines and directives for the prevention of pollution of water resources as well as for water quality and health standards, establishing water users' associations, and settlement of disputes. Details of most of the provisions of the Proclamation are expected to be provided in Regulations to be issued in the future. Issues that still need to be tackled are e.g. the integrated cross-sectoral approach to water resources management including environment, agriculture, economic activities at large, health, legal and planning considerations, as well as a specific participation of water users. This is a necessary step towards 'integration' in WRM.

(ii) Water Resources Management Regulations (2004)

The regulations contains a further elaboration of the Proclamation providing in detail the main requirements for the issuance of permits for different uses of water and the conditions for the issuance, as well as the level of water charge and procedure for licensing water operators.

(iii) Regional Water Resources Management Policies and Laws

In 2002, the Amhara Regional State has issued a Regional water resources policy. A draft regulation for the management of water resources has also already been prepared by that Region. By and large, both the water resources policy and draft regulations for water resources management of the Amhara Regional State are in line and similar in their content to those issued by the Federal Government.

2.3.14 Environmental laws

Environmental issues are given more and more emphasis in Ethiopia, with the recent development of a set of laws, following up on several new policies and strategies (such as the National Conservation Strategy and the SDPRP). The Ethiopian Environmental Protection Authority (EPA) has drafted three major laws regarding Environmental Pollution Control, Environmental Impact Assessment and Establishment of Environmental Protection Organs.

Although quite general, these laws, and particularly the “Environmental Pollution Control Proclamation” specifies clearly the function of law enforcement of the EPA and the Regional environmental agencies, in charge of taking administrative or legal measures against violations.

These laws are concerned mainly with pollution, and broader issues such as watershed management are not addressed yet. The need for a more integrated legal framework in line with IWRM or sustainable use of natural resources is noticeable.

According to the 2005 PASDEP document, EPA has now also developed EIA guidelines for agriculture, mining, industry, and road construction. It has assisted all regions to establish a regional EPA.

A key issue is how to get some action on the ground by agencies at the wereda level using a collaborative and not a "legal enforcement" approach.

2.5 Overview of Situation and Issues

The country's population is currently approximately 64 million. The rate of population growth is expected to decline from 3 to close to 2 percent per annum by 2030, when the country's population will reach between 120 to 130million people. Some 85 percent reside in the rural areas and most are dependent on agriculture or pastoralism for their livelihoods (Alemneh Dejene, 2003).

The high seasonality of rainfall over the Ethiopian Highlands, which is confined to a period of three to five months results in commensurate seasonality in river flows. The peak flows are able to transport very high sediment loads during these periods and lead to the high sedimentation rates in Sudan and Egypt.

The highlands of the Abbay River Basin contain many areas with structural food deficits which suffer frequent reductions in crop production due to low rainfall. The key issues are soil degradation, livestock feed deficits, fuelwood wood consumption rates in excess of sustainable yield, burning of dung and accelerated soil nutrient breaches and poor non-farm employment opportunities (Hagos, Pender and Gebreselassie, 1999). Communal grazing land management systems are in place in 80 percent of the villages. On-farm tree planting however lags behind that in the Amhara Region, possibly due to a ban on tree planting in croplands.

The proximate causes of infield soil erosion are reasonably well known although the science of the linkages between erosion and deposition in the landscape, sediment delivery to streams and total sediment yields with increasing basin size is less certain. An understanding of the underlying causes is still imperfectly understood, notwithstanding the impressive amount of research work undertaken over the past decade, particularly with the African Highlands Initiative (Pender, 2005). Underlying many of these is the almost total dependence on the natural resource base by the rural population. The results of research to-date may be briefly summarized as:

- The profitability of land management technologies is very important, though not the only factor influencing adoption or non-adoption.

- Risk is also a very important consideration. Profitability becomes more important for technologies that are risk increasing (e.g. chemical fertilizer) than those that are risk reducing (SWC investments in moisture stressed areas).

- In the context of imperfect markets and institutions the suitability and feasibility of land management interventions in different locations and farmer circumstances are very context dependant making generalisations difficult. The numerous potential factors include: agro-ecological conditions; nature of the technology; land

tenure relations; household endowments of natural, human, social and financial assets. Better market access appears to be associated with less SWC investment but more use of fertilizer.

- Land tenure insecurity and limited transfer rights appear to discourage land management investments, but the results are mixed. It appears to have less impact on the adoption of inputs (e.g. fertilizer) than long-term investments (e.g. SWC structures).

- The impact of the degree and type of household livelihood assets on investment decisions is mixed.

- The Malthusian argument of the negative impacts caused increasing population pressure, and Boserup argument for population induced agricultural intensification may both be correct in the Ethiopian situation. Farmers do respond to population pressure with intensified production, but this may not be sufficient to prevent resource degradation and increasing poverty. In this respect, Ethiopia compares poorly with the situation in Machakos, Kenya described by Tiffen et al (1994).

3. CHEMOGA SUB-BASIN - BIOPHYSICAL AND SOCIO-ECONOMIC SITUATION

3.1 Delineation of the Sub-basin by Stakeholders

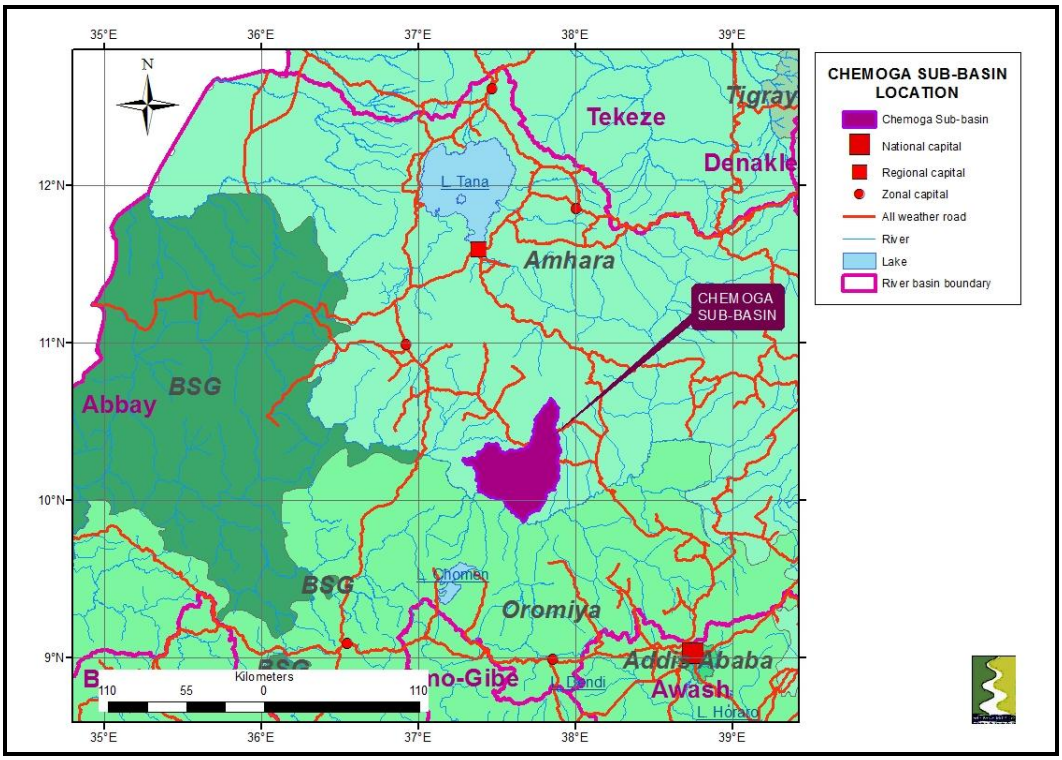
A Field Visit wa undertaken in November 2012 to delineated exactly the Watershed for Watershed Management activities under the Project (persons contacted are listed in Annex 1). The delineated Watershed comprised the Tesher,Chemoga and Yeda Watersheds. An area below the escarpment which has been allocated for large-scale farming has been excluded from the target Watershed.

3.2 Biophysical Characteristics

3.2.1 Location and Extent

The Chemoga Sub-basin is located in the central part of the Abbay Sub-basin (See Map 5). The area of the Sub-basin is 2,738km^2. It is sub-divided into 3 Watersheds

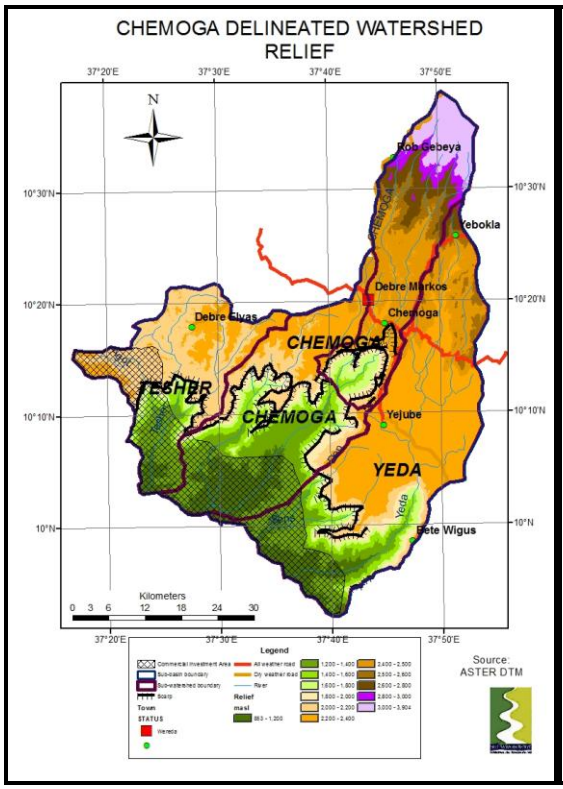
WATERSHED	AREA (HA)
CHEMOGA	120,875
TESHER	49,708
YEDA	103,006
TOTAL	**273,589**
LESS COMMERCIAL FARM AREA	71,200
NET WATERSHED AREA	**202,389**

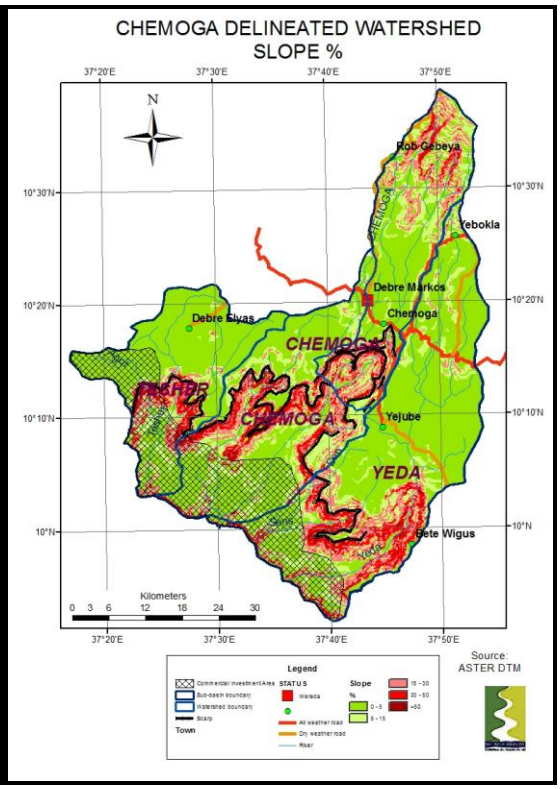


Map 4. Location of Chemoga Sub-basin

3.1.2 Relief and Drainage

The upper part of the watershed is part of the Mount Choke mountain range and rises to 3,900masl (Map 5a). This falls to a wide plateau between 2,000 and 2,400masl, which terminates abruptly at the edge of the Abbay gorge. The gorge is between 2,000masl falling to 850masl at the Abbay River. The steepest slopes are found in the upper parts of the Sub-basin above the flat plateau and in the gorge below the plateau (Map 5b).





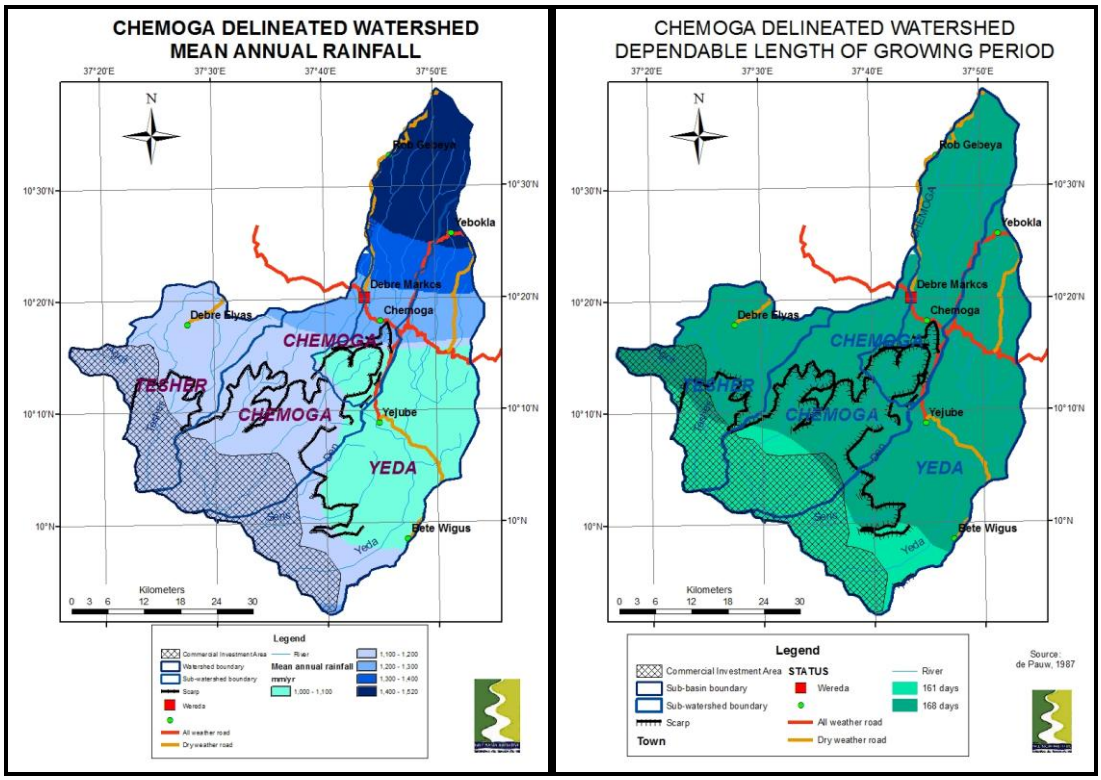
Map 5a Relief. **Map 5b. Slope (%)**

3.1.2 Climate

(i) Rainfall and Length of Growing Period

Mean annual rainfall over (Map 6a) is closely related to altitude with the highest rainfall located in the upper Sub-basin (1,500mm/yr). Rainfall over the plateau and gorge declines from west to east. The rainfall pattern is uni-modal with the peak falling between July and September.

The dependable (4 years in 5) length of growing period is between 160 and 170 days.

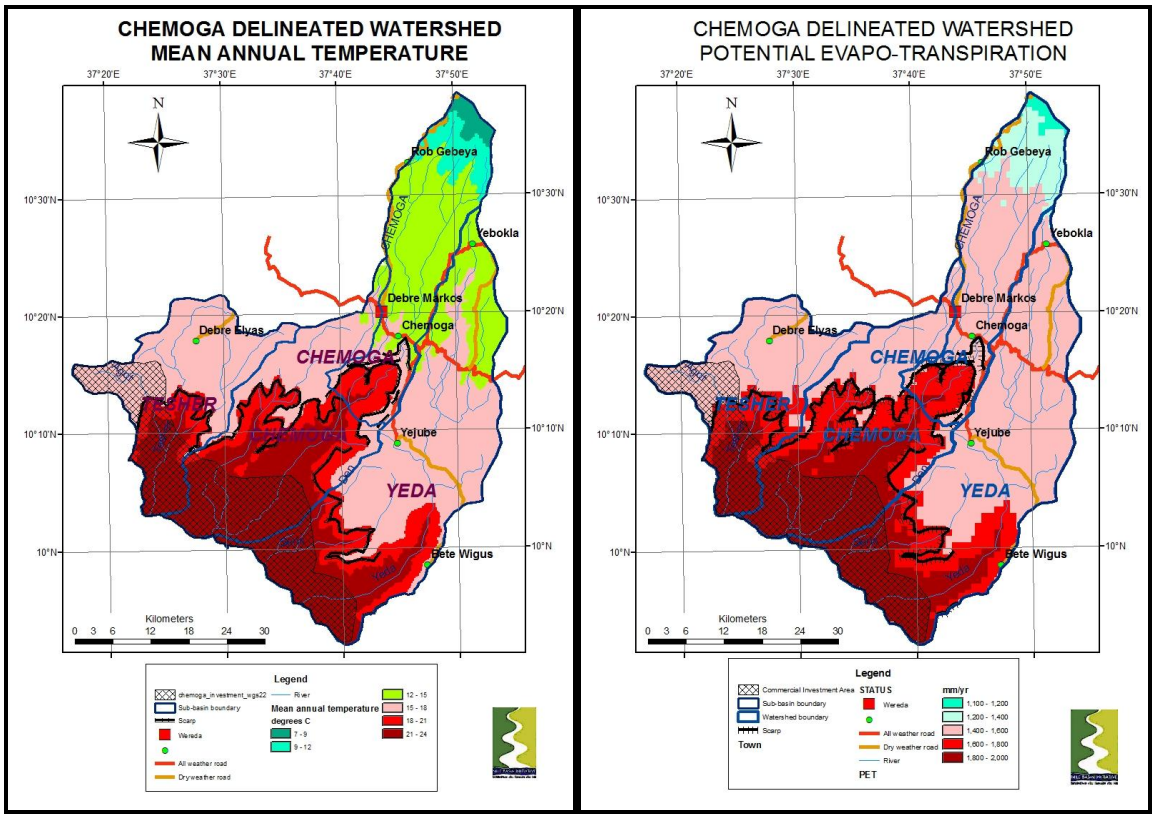


Map 6 (a) Mean annual rainfall **Map 6(b) Length of Growing Period**

(ii) Mean annual temperature and Potential Evapo-transpiration

Mean annual temperature (Map 7(a)) is inversely related to altitude. Thus, the lowest temperatures (7 - 10°C) are found at highest altitudes on the Mount Choke mountain range rising to 11° to 15°C on the lower slopes. Temperatures on the plateau 15° to 18°C rising to 24°C in the lower parts of the gorge.

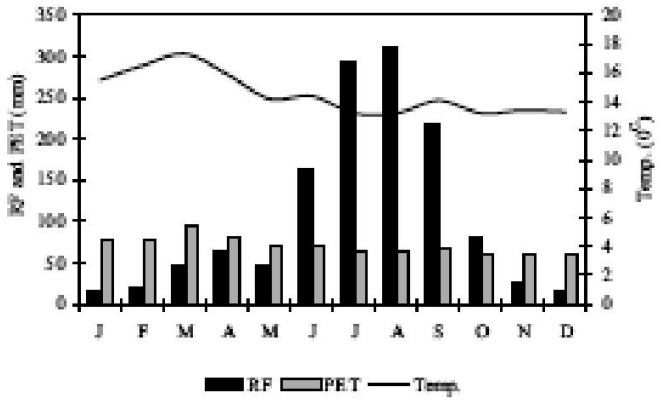
The pattern of mean annual evapotranspiration (Map 7 (b)) follows that of mean annual temperature and closely related to altitude with lowest rates on the highlands of the upper Sub-basin and the highest rates in the Abbay gorge.

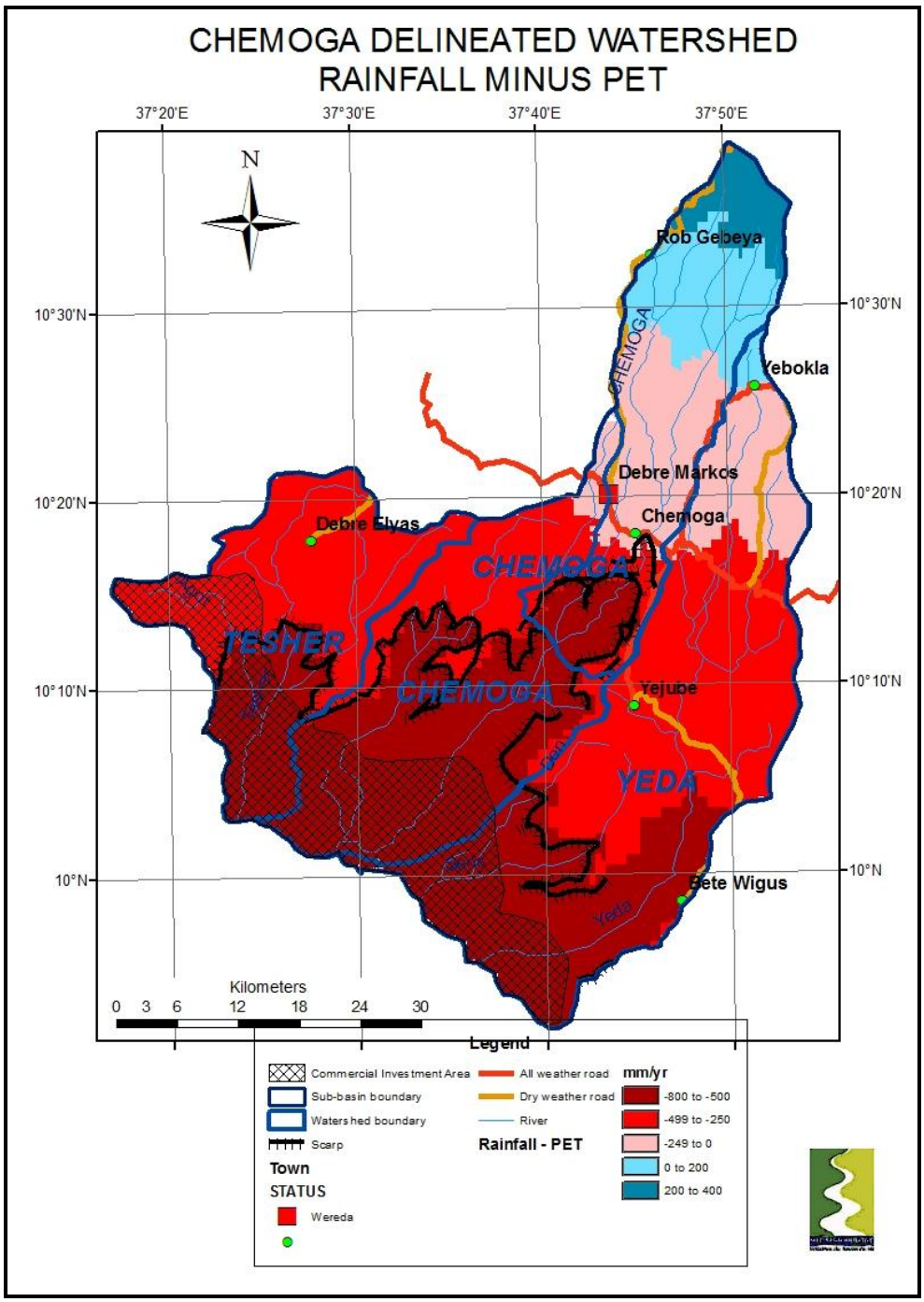


Map 7 (a) Mean annual temperature (C). Map 6 (B) Mean annual evapo-transpiration.

Whilst the annual rainfall levels are moderately high so too are the potential evapotranspiration (PET) rates. Plotting mean annual rainfall minus annual PET indicates negative values over the plateau and the gorge (Map 7). On a monthly basis rainfall exceeds PET in the months June to October(Figure 1)

Figure 1. Chemoga Sub-basin: Monthly rainfall and PET (mm).



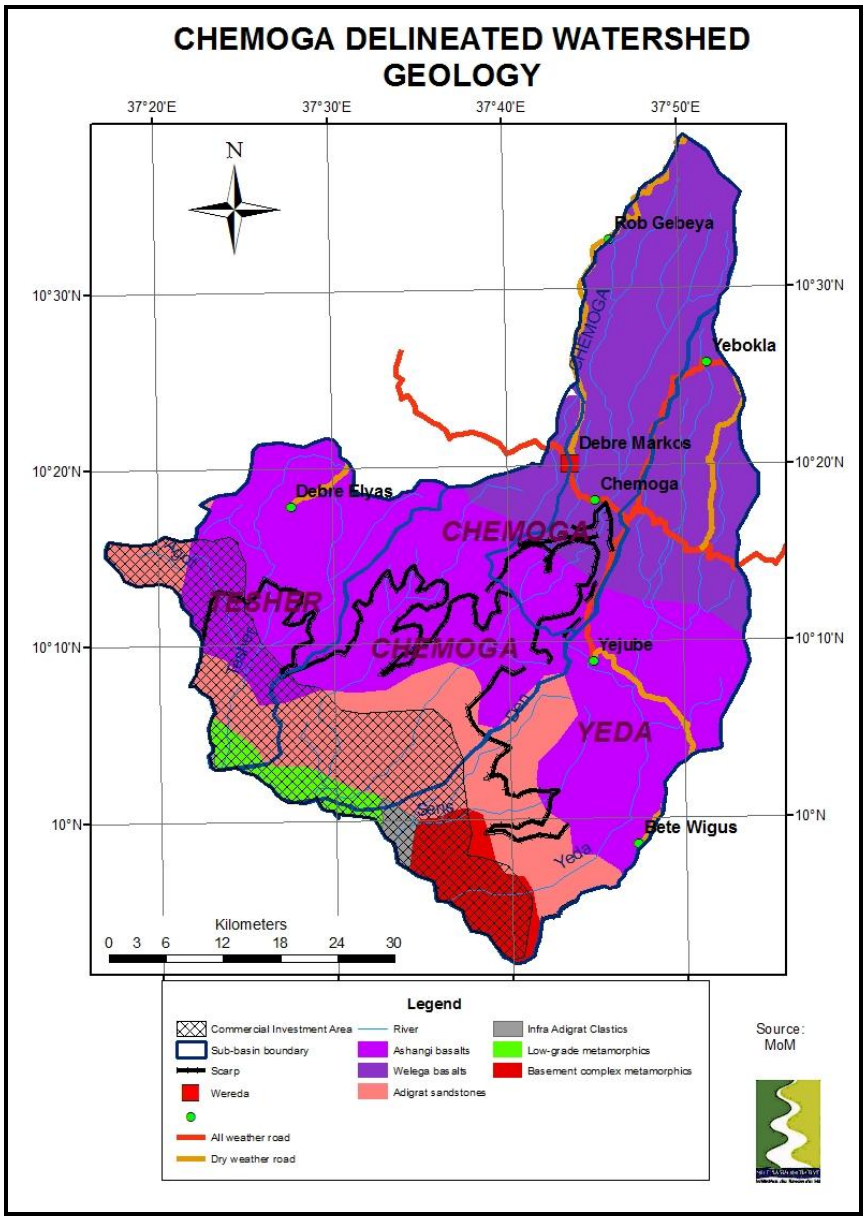


Map 7. Mean annual rainfall minus Potential Evapo-transpiration

3.1.3 Geology

The highland areas and the plateau are underlain by Ashangi and Wellega basalts (Map 8). Below the escarpment in the gorge are the Adigrat sandstones with the limestone that occurs elsewhere in the gorge layer missing at this

location. Below the sandstones is the Basement complex of metamorphic and granite type rocks.



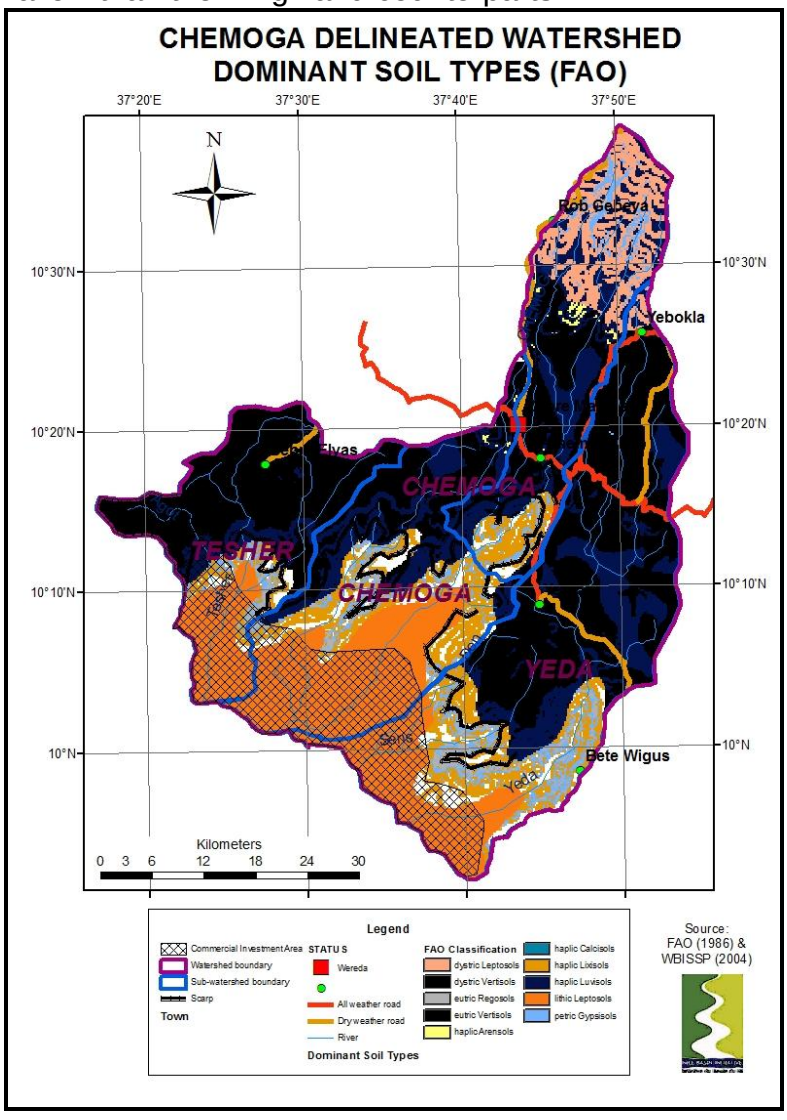
Map 7. Geology

3.1.4 Soils

Soils strongly reflect the underlying geology (Map 8). The Highland areas above the plateau are underlain by Leptosols, which are shallow and often gravelly with low water holding capacity. They are very prone to erosion.

On the plateau are extensive areas of Vertisols. Vertisols have a high clay content and thus the highest water holding capacity (150mm per meter), although they are difficult to work when dry. Their fertility is high although with a phosphorous deficiency. On the low ridges and hills above the flat Vertisol plains are Luvisols which are relative deep, well-structured with moderate water holding capacities (100mm per meter) and of moderate fertility. Again, these soils are deficient in phosphorous.

Regosols (very stoney), lithosols (shallow and stony), Lixisols, and petric Gypsisols are all found on the very steep slopes of the meta-sediments, sandstones and limestones in association with bare rock surfaces. On the less steep slopes of the lower gorge lithic Leptosols are found which are even more stoney and shallow than their Highland counterparts.



Map 8. Dominant Soils (FAO Classification)

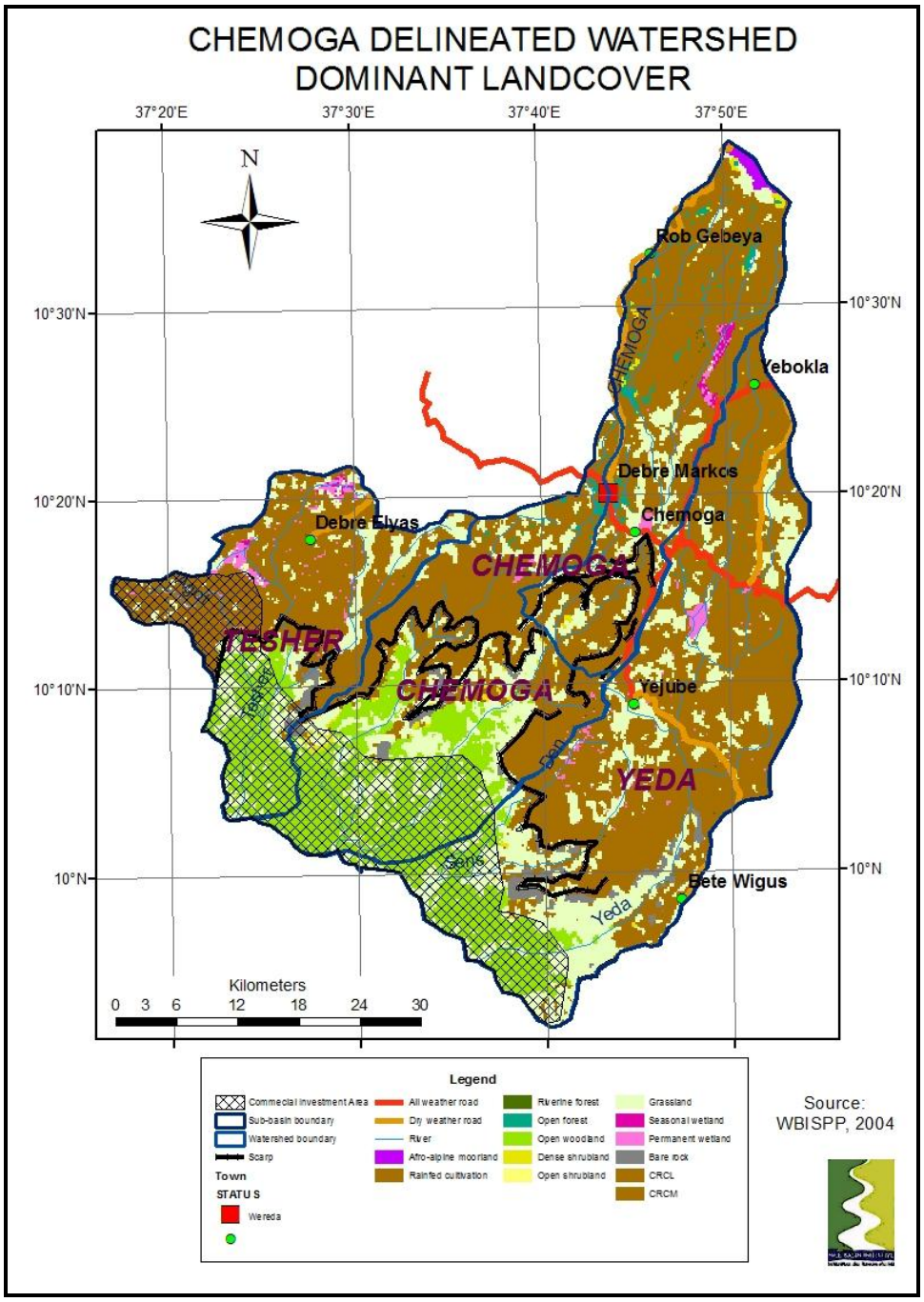
3.1.5 Land Cover / Land Use

The areas and percent of total area of the dominant landcover classes are shown in table 2 and their distribution in Map 9. The most widespread landcover is rainfed cultivation covering nearly 60 percent of the Sub-basin. Grassland and open woodland make up 21 and 15 percent of the area. The remaining 4 percent of the area is covered rock, wetland platation shrubland and riverine forest.

Table 2. Chemoga Sub-basins: Dominant Landcover (km2)

Landcover type	Ha	%
Rainfed cultivation	162,427	59.3%
Grassland	57,325	20.9%
Open woodland	40,967	14.9%
Bare rock	4,249	1.6%
Wetland	3,881	1.4%
Plantation	2,578	0.9%
Dense shrubland	1,569	0.6%
Afro-alpine moorland	737	0.3%
Open shrubland	204	0.1%
Riverine forest	156	0.1%
TOTAL	**274,093**	

The rainfed cultivation is confined to the highland and plateau areas with the grassland and woodland located in the Abbay gorge.



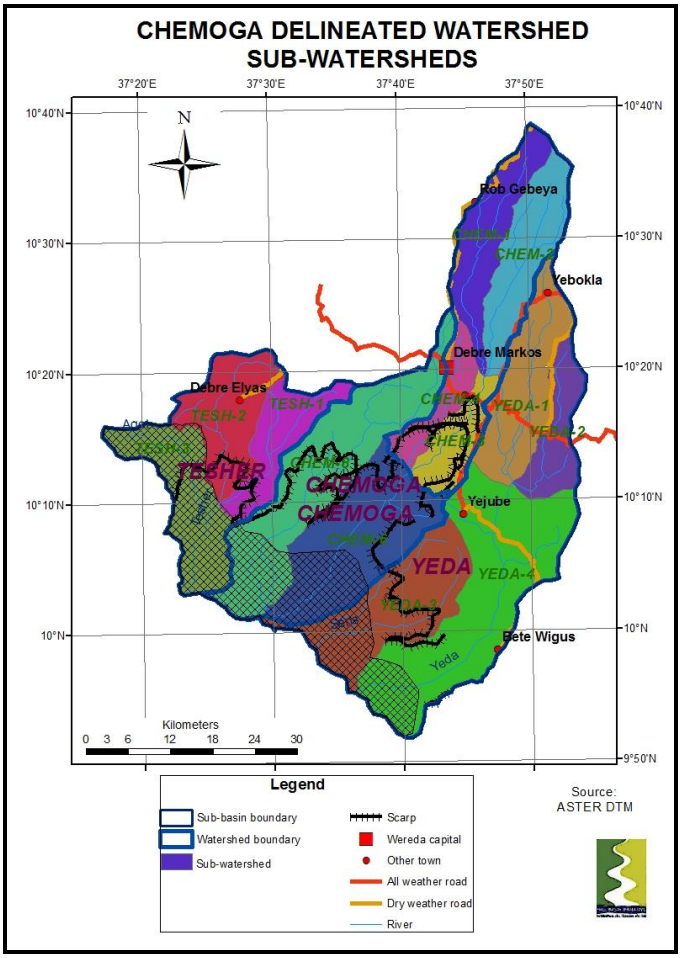
Map 9. Dominant Landcover

3.1.6 Water Resources

The watershed has been divided into three watersheds (Tesher, Chemoga and Yeda) and 13 Sub-watersheds (table 3, Map 10).

Table 3. Chemoga Sub-basin: Watersheds and Sub-watersheds

WATERSHED	SUB-WATERSHED	AREA (HA)
Chemoga	CHEM-1	16,587
Chemoga	CHEM-2	18,094
Chemoga	CHEM-3	9,582
Chemoga	CHEM-4	8,018
Chemoga	CHEM-6	30,826
Chemoga	CHEM-8	37,768
Sub-total		**120,875**
Tesher	TESH-1	12,574
Tesher	TESH-2	17,879
Tesher	TESH-3	19,255
Sub-total		**49,708**
Yeda	YEDA-1	21,066
Yeda	YEDA-2	10,907
Yeda	YEDA-3	25,403
Yeda	YEDA-4	45,630
Sub-total		**103,006**
TOTAL		**273,589**



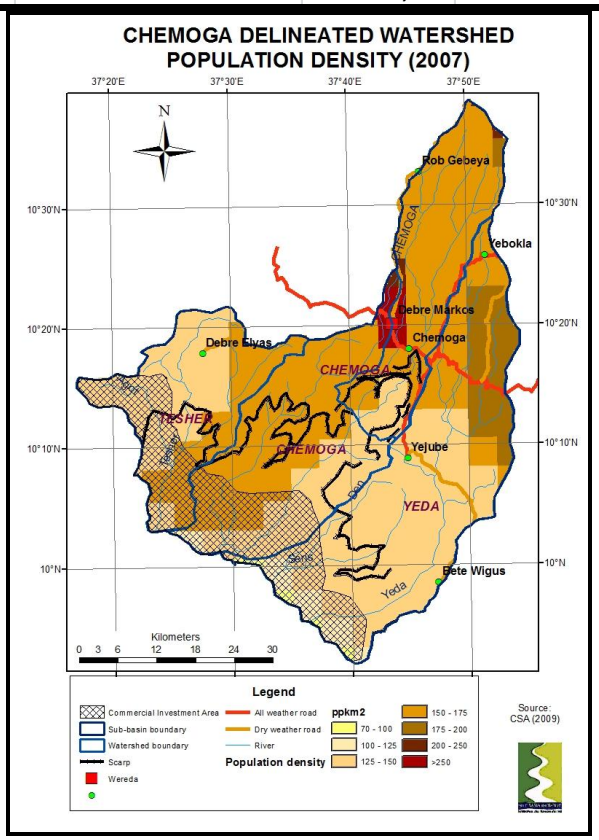
Map 10. Watersheds and Sub-watersheds

3.2 Population Distribution

The Sub-basins fall within (but not wholly within) 6 Woredas: Debre Elias, Gozamin, Baso Liben, Debre Markos town, Sinan and Aneded. The 2007 rural populations (PCC, 2010) of these woredas are shown in table 3 and the spatial distribution in Map 11. The population and population densities refer to the complete woreda, whilst the area figure refers only to that part of the woreda within the Chemoga Sub-basin. Rural woreda densities range from 75 to 242 ppkm2, whilst the urban woreda of Debre Markos has a density of 1,015ppkm2.

Table 3. Total population, households, population density and household size within Chemoga Sub-basins.

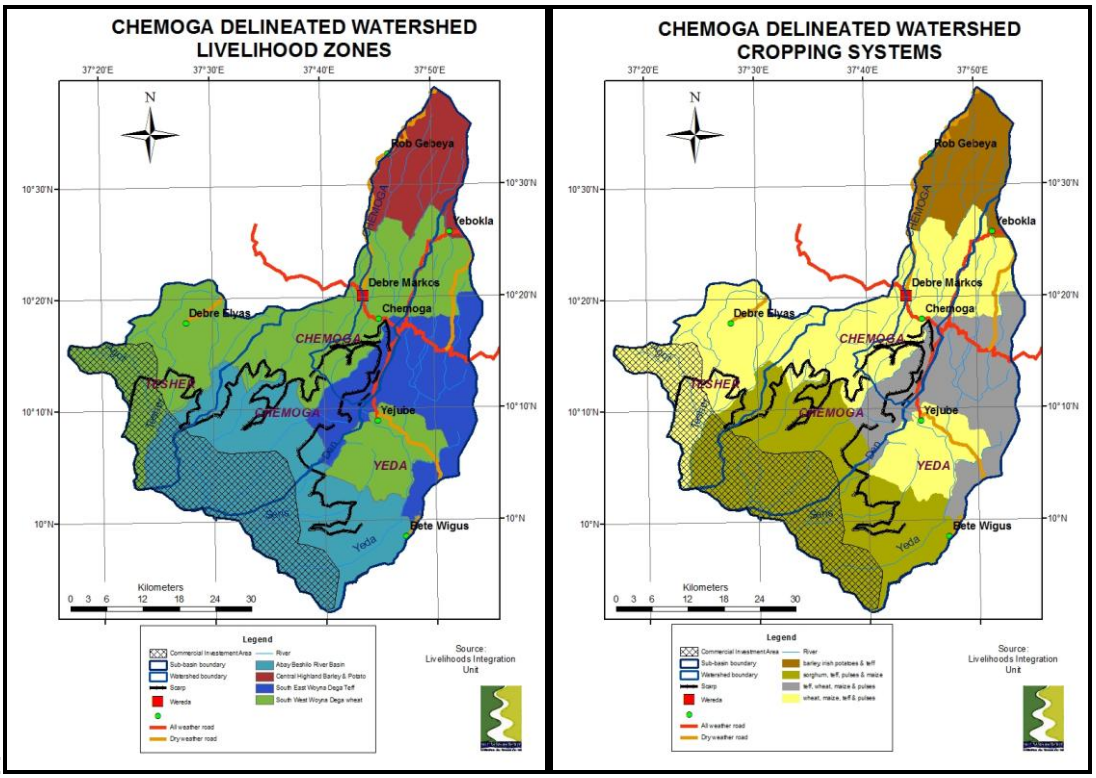
ZONE	WOREDA	POPULATION (2007)	PERSONS/KM2	AREA (KM2)*
East Gojjam	Debere Elias	93,991	75	350
East Gojjam	Gozamin	153,181	122	933
East Gojjam	Baso Liben	157,317	131	876
East Gojjam	Debre Markos Town	71,488	1,015	62
East Gojjam	Sinan	113,195	242	193
East Gojjam	Aneded	104,361	144	320
TOTAL		**693,533**		**2,734**



Map 11. Population Density and Distribution

3.3 Livelihood Zones

The Livelihoods Integration Unit (LIU) has identified four Livelihood Zones within the Chemoga Sub-basin. The Zones and major cropping systems are shown in Maps 12 (a) and 12 (b).



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Map 12(a) Livelihood Zones **Map 12 (b) Major Cropping Systems**

3.3.1 Abbay-Beshilo Livelihood Zone

The Abbay Beshilo Livelihood Zone is a food insecure area with a very long history of relief assistance. It is located within the Abbay Gorge below the main Plateau and is a long distance from major roads and towns. The population is relatively scattered. The vegetation is bush and shrubs. It is a mixed production system with crop and livestock production. The dominant crops of the Livelihood Zone include sorghum, teff, maize and haricot bean.

The area is characterized by high temperature, erratic rainfall and sandy soil. These factors contribute to the high rate of evapo-transpiration and poor water holding capacity. The combination of moisture stress and poor soil fertility is the limiting factor for agricultural production. There is high prevalence of pest and disease, no utilization of input and yield per hectare is very low.

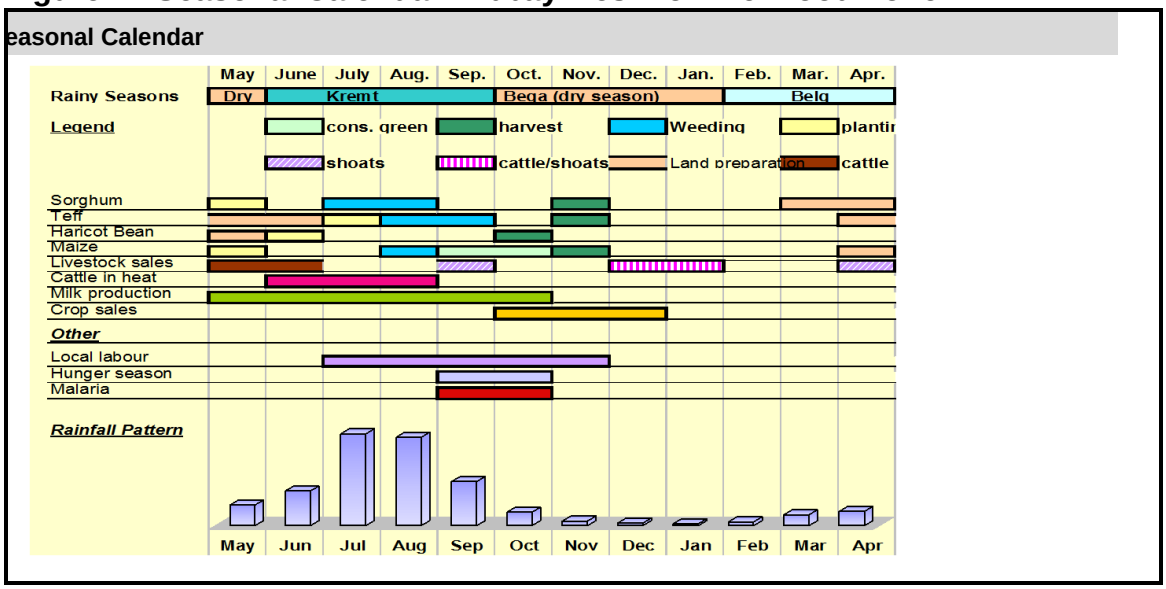
One of the most important determinants of wealth is the ownership livestock in general and ownership of plough oxen in particular. Ownership of a pair of oxen

allows better-off households to prepare their land on time and rent-in the land of poor and very poor households on a contractual basis. The most common livestock diseases include pasteurellosis (all livestock), black leg (cattle and equines) and liver fluke (sheep and cattle). Regarding livestock production, goats are dominant. There is high prevalence of livestock disease in the area and the intervention in this regard is very less. However, the area has uncultivated land that could be used for livestock production (grazing).

Poor physical infrastructure and complete obstruction of transportation during the rainy seasons also exasperate the problem of accessing food and cash income. Substantial part of the Livelihood Zone is completely inaccessible even during the dry season.

In a typical year, better-off and middle households have high reliance upon livestock and crop sales as a means of generating cash income. For the poor and the very poor safety net is the major source of cash income even in a typical year.

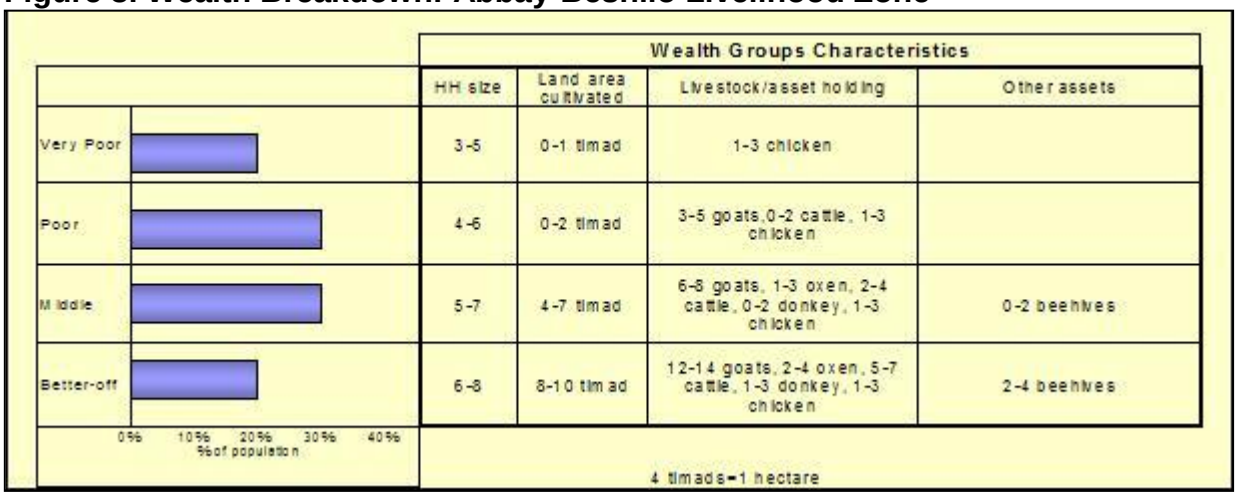
Figure 2. Seasonal Calendar: Abbay-Beshilo Livelihood Zone



Of all agricultural activities, land preparation (March-June) and weeding (July-September) are the most laborious and time-consuming activities. Agriculture is entirely dependent on kremt rains that last from June to September. Maize is harvested green from September to October and the main food crops: sorghum and teff are harvested in November.

Except in December and January when both cattle and shoats are sold, different types of livestock are sold at different times of the year. Shoats are sold around the major Christian Festivals (New Year, Christmas and Easter). Cattle are sold in the months when there is no need for cattle for agricultural activities.

Figure 3. Wealth Breakdown: Abbay-Beshilo Livelihood Zone



Wealth is determined by land owned and cultivated, livestock possession (plough oxen, cattle and goats) There is a big difference in the ownership of land with the better-off owning three times more land than the very poor. Differences in land cultivated are even greater ranging from 0-1 timad for the very poor to 8-10 timads for the better-off. This reflects the fact that the poor and very poor do not have oxen and so are unable to cultivate all their own land and so rent out part of their land to the middle and better off with an equal (half) crop sharing arrangement.

3.3.2 Southwest Woina-Dega Wheat Livelihood Zone

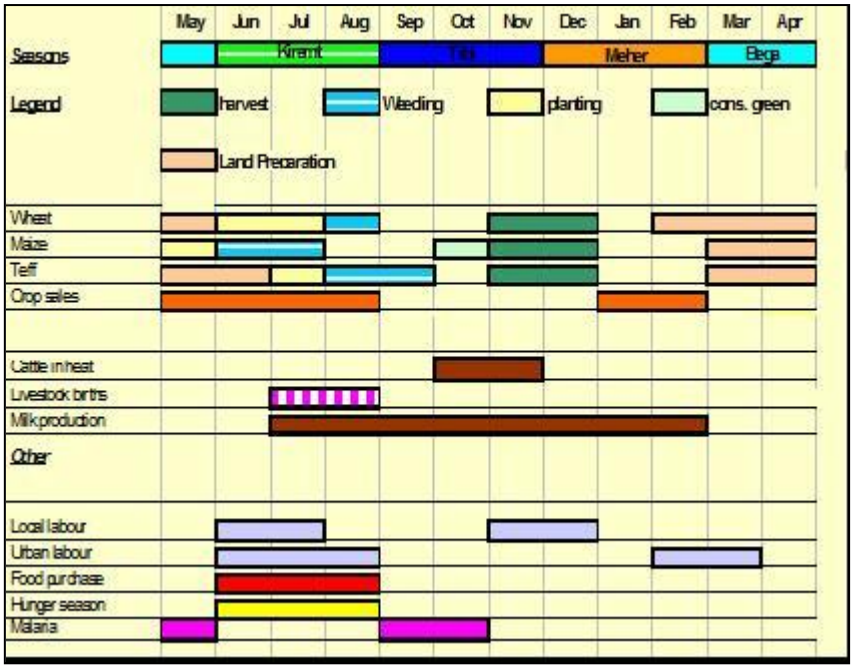
The south west *woina dega* wheat (SWW) livelihood zone is located in Baso Liben, Debre Elias, Guzamn, and Senan woredas in East Gojam. It borders the Abbay gorge along the Debre Markos-Injabara highway. Most of the zone is around Debre Markos. Fertiliser is used to boost production from the red, moderately fertile soils; the zone has a high potential for agriculture.

This is a mixed farming economy mainly based on crop production activities. Wheat is the most important crop, serving as both the main food and cash crop. Other crops grown include maize and pulses. Crop sales make the largest contribution to household income. Oxen are used to provide traction power for the arduous land preparation activities. Land preparation, harvesting and weeding are carried out predominantly by men, with herbicides also being used for weeding. Better-off households regularly hire labor (mostly for cash) to assist with harvesting. Extensive use of fertiliser, reliable rainfall and relatively large land holdings contribute to make this zone a food surplus area.

Cattle, sheep and chicken are the most reared livestock. Cattle and sheep free graze on crop residue and/or grass whilst chicken feed on grain. Livestock are an important source of income. Most income from livestock is obtained from the sale

of sheep (at 9-12 months of age). Cattle are sold more rarely, at 2-3 years of age. The peak sheep trading period is during the religious festivals in April (*Fasika*/Easter), September (*Meskerem*/New Year), and December (Christmas/ *Gena*). Typically sold livestock products are eggs and skin. Meat is consumed only on special occasions and celebrations. The ownership of livestock is an integral part of households' strategy for coping with shock to livelihoods.

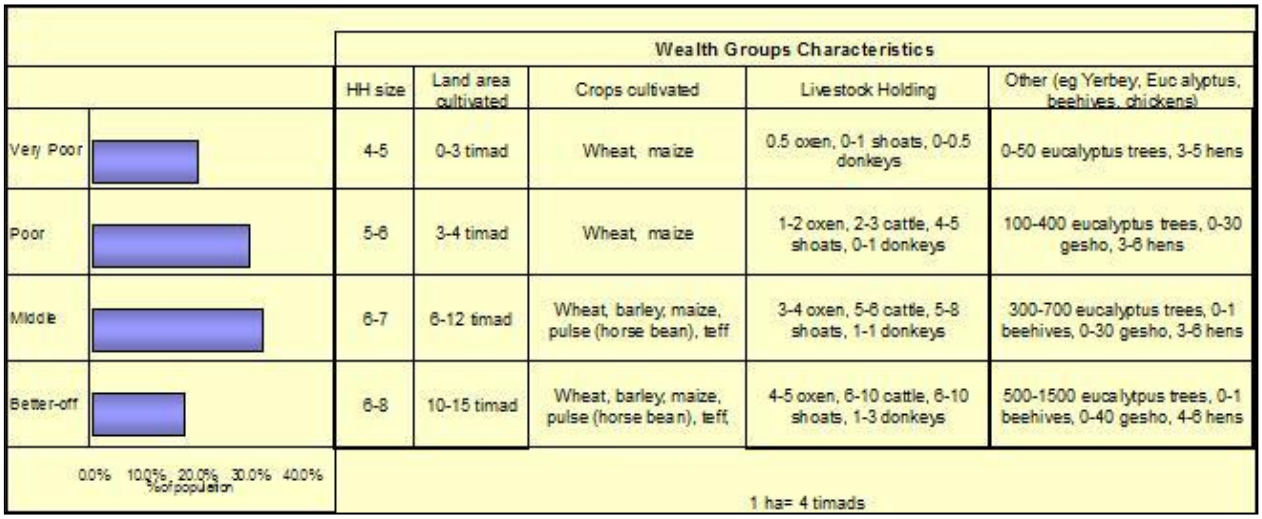
Figure 5. Seasonal Calendar: Southwest Woina-Dega Wheat Livelihood Zone



There are four main seasons in the zone, namely, *Tibi* from September to November, *Meher* from December to February, *Bega* from March to May, and *Kiremt* from June to August.

Agriculture activities are dependent on the *kirenti* rainy season. Land preparation for the short cycle wheat and teff crop begins in February, in preparation for planting in June and July. Maize is the long cycle crop and it is planted in May. The consumption year begins in November and ends in October The main harvest is from November to December. Livestock births start during the rainy season in July when pasture has been replenished. The wet lactation period stretches from July to October. Milk production begins to subside in November at the end of the rains and peters out by February.

Figure 6. Wealth Groups: Southwest Woina-Dega Wheat Livelihood Zone



	Wealth Groups Characteristics				
	HH size	Land area cultivated	Crops cultivated	Livestock Holding	Other (eg Yerbey, Eucalyptus, beehives, chickens)
Very Poor	4-5	0-3 timad	Wheat, maize	0.5 oxen, 0-1 shoats, 0-0.5 donkeys	0-50 eucalyptus trees, 3-5 hens
Poor	5-6	3-4 timad	Wheat, maize	1-2 oxen, 2-3 cattle, 4-5 shoats, 0-1 donkeys	100-400 eucalyptus trees, 0-30 gesho, 3-6 hens
Middle	6-7	6-12 timad	Wheat, barley, maize, pulse (horse bean), teff	3-4 oxen, 5-6 cattle, 5-8 shoats, 1-1 donkeys	300-700 eucalyptus trees, 0-1 beehives, 0-30 gesho, 3-6 hens
Better-off	6-8	10-15 timad	Wheat, barley, maize, pulse (horse bean), teff,	4-5 oxen, 6-10 cattle, 6-10 shoats, 1-3 donkeys	500-1500 eucalytpus trees, 0-1 beehives, 0-40 gesho, 4-6 hens
	1 ha= 4 timads				

Wealth is primarily determined by cultivable land size and livestock ownership (plow oxen, cattle and sheep). Land is the primary production asset, providing access to food and income. In addition to wheat and maize some among the middle and better off grow teff and more pulses, because they have sufficient land, labor, plow oxen and enough capacity to purchase inputs.

Livestock ownership is a key characteristic of wealth. Livestock provide access to cash and food for the household. The accumulation of livestock is the preferred means of storing wealth in the zone. Livestock are valued investments that build resilience into household livelihoods. Cattle are esteemed assets owned mainly by middle and better-off households. Mature female cows are highly valued for breeding and access to income from butter processed from milk. The sale of a single cow provides a better-off household with access to a significant amount of income. Shoat sales are also important contributors to income for the poor, middle and better-off. Poorer households with no livestock have little to protect them from the worst effects of a shock

3.3.3 South-east Woina Dega: Teff Livelihood Zone

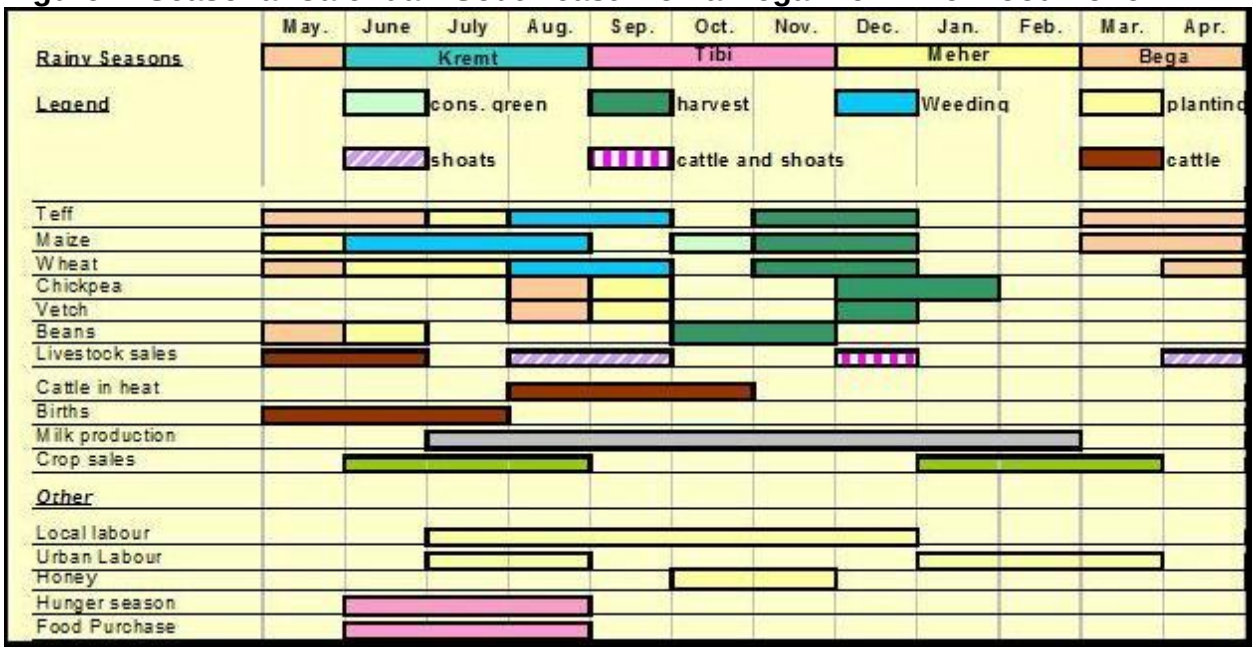
The South West Woina Dega Teff Livelihood Zone is one of the surplus producing areas in the Amhara Region. It incorporates part of Baso Liden woreda. It is in the woina dega agro-ecological zone and the topography is mostly plain. The zone often produces a food surplus and its overall production potential is moderate. Ox-plowing is used to prepare the land, whilst weeding and harvesting are the most labor intensive crop production activities, for which the middle and better-off groups pay labor in cash.

In most years the amount of rainfall is optimal for the cultivation of different crops the most important of which are teff, wheat and maize, grown for both consumption and sale. The zone often produces a food surplus and its overall production potential is moderate. Ox-plowing is used to prepare the land, whilst weeding and harvesting are the most labor intensive crop production activities, for which the middle and better-off groups pay labor in cash. The main pests and diseases are Wollo bush cricket, African boll worm, stalk borer, aphids and red teff worm.

The main types of livestock are sheep, cattle and horses which free graze and fee on crop residues and/or grass. The main pests and diseases affecting animals are black leg, anthrax, sheep and goat pox and pasteurellosis.

Water is obtained from both major and minor rivers, hand-dug wells and sometimes springs. Humans in some cases share water from the main rivers; in places where they don't share the river water they get it mostly from hand-dug wells and springs.

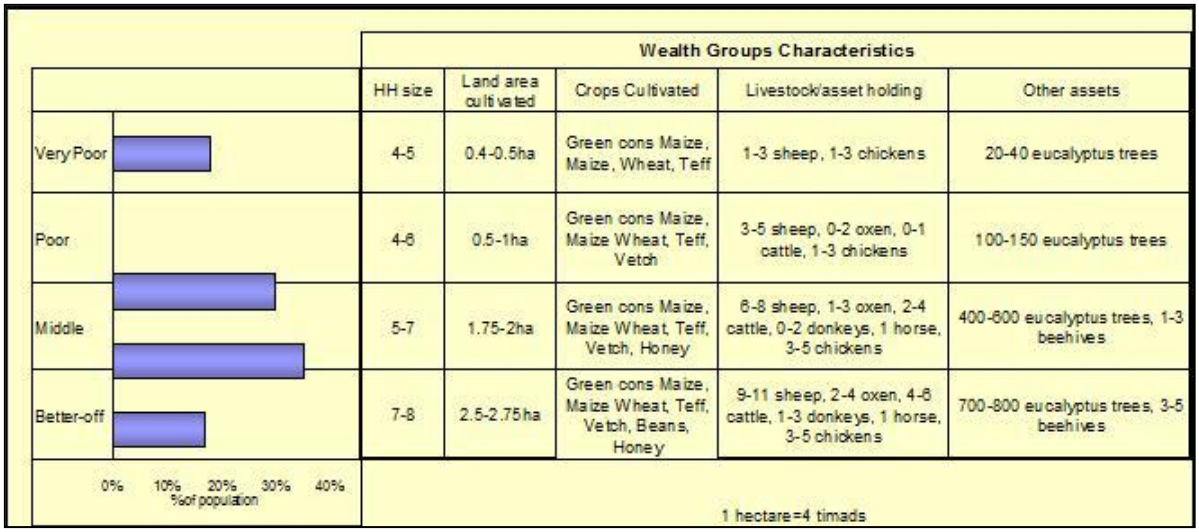
Figure 7. Seasonal Calendar: South-east Woina Dega: Teff Livelihood Zone



Land preparation from March to June, weeding from June to August and harvesting from October to January are the most laborious agricultural activities. Teff and wheat are the main short cycle crops grown whilst maize is the main long-cycle crop. There is no intercropping. Local agricultural employment is available from July to December. Debre Markos and other urban centers in the Livelihood Zone also offer urban employment from January to March. Poor and very poor households also migrate mainly to Humera (Tigray), Teppi

(Benshangul Gumz), Arsi Negelle and Wolega (Oromiya) in different seasons every year looking for employment opportunities.

Figure 8. Wealth Groups: South-east Woina Dega: Teff Livelihood Zone



	Wealth Groups Characteristics				
	HH size	Land area cultivated	Crops Cultivated	Livestock/asset holding	Other assets
Very Poor	4-5	0.4-0.5ha	Green cons Maize, Maize, Wheat, Teff	1-3 sheep, 1-3 chickens	20-40 eucalyptus trees
Poor	4-6	0.5-1ha	Green cons Maize, Maize Wheat, Teff, Vetch	3-5 sheep, 0-2 oxen, 0-1 cattle, 1-3 chickens	100-150 eucalyptus trees
Middle	5-7	1.75-2ha	Green cons Maize, Maize Wheat, Teff, Vetch, Honey	6-8 sheep, 1-3 oxen, 2-4 cattle, 0-2 donkeys, 1 horse, 3-5 chickens	400-600 eucalyptus trees, 1-3 beehives
Better-off	7-8	2.5-2.75ha	Green cons Maize, Maize Wheat, Teff, Vetch, Beans, Honey	9-11 sheep, 2-4 oxen, 4-6 cattle, 1-3 donkeys, 1 horse, 3-5 chickens	700-800 eucalyptus trees, 3-5 beehives
	1 hectare=4 timads				

Wealth is determined by the size of land owned by households as well as by herd size in general and ownership of plough oxen in particular. On the basis of these criteria, four distinct wealth groups (very poor, poor, middle and better-off) were identified. Households differ in the ownership eucalyptus trees and beehives. While beehives are owned by the better-off and middle households, eucalyptus trees are owned by all. However, the number of trees owned varies greatly between groups, as shown above. The better-off also grow beans which the poor do not; this is because they own enough land and plow-oxen and/or their economic status allows them to rent in enough land.

3.3.4 Central Highland Barley and Potato Livelihood Zone

The Central Highland Barley and Potato Livelihood Zone (CBP) is found in Senan woreda. The Choke mountain is a prominent feature of the mountainous and undulating terrain in this predominantly *dega* region.

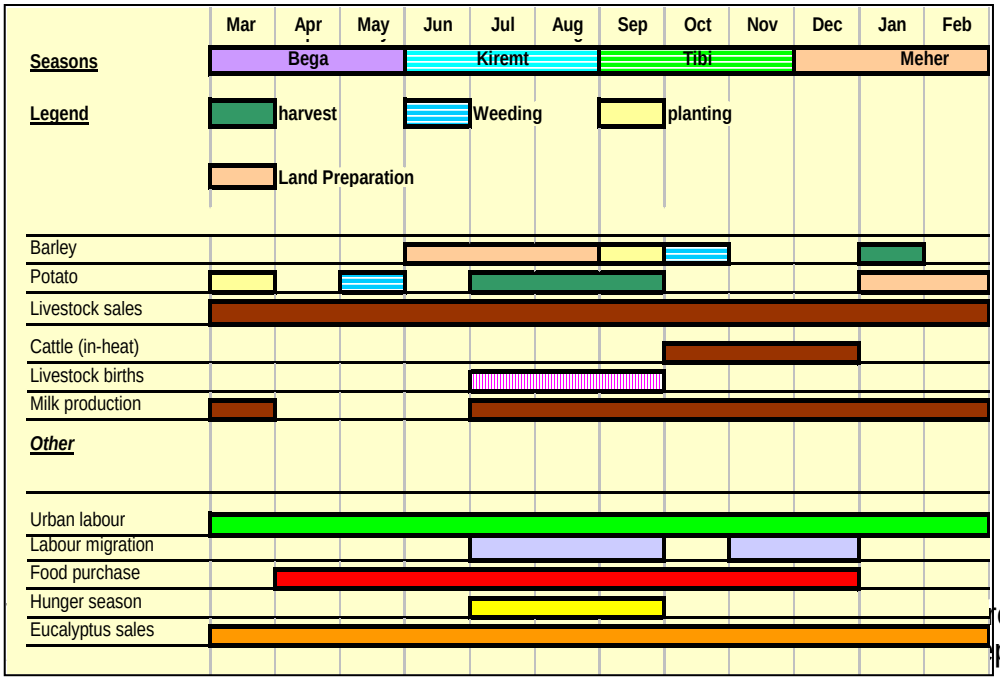
Mixed production of crops and livestock are the cornerstone of this zone's economy. Agriculture activities are dependent on the *kiremti* rains which fall from May to October. Some households use irrigation, particularly for potato production. The main crops cultivated are barley and potato, the bulk of it produced for household consumption. Extensive degradation and high soil acidity have reduced the agricultural potential of the region. Manure, produced by cattle, is an important agricultural input in this zone. Draught power is provided mainly by horses, which are a cheaper alternative to oxen. Land preparation is done by

men. Women assist with weeding and harvesting activities. No wealth group pays for these activities. The main hazards to crop production are late blight which affects potatoes, and smut and rust which affect barley. Traditional disease and pest control measures are used to prevent the spread of disease. This zone suffers from a food deficit every year.

Raising sheep, cattle and horses are a key economic strategy. Sheep are the more commonly sold livestock, usually between the ages of 4 to 12 months. The demand for sheep peaks during religious festivals in April (*Fasika*/Easter), September (Meskerem/New Year), and December (Christmas/*Gena*). Cattle are valuable possessions mostly owned by wealthier households, and serve as longer term investments. Few cattle are sold. Mature female cows are sometimes sold after 7 or 8 years of age, and thereafter replaced from within the herd. Livestock free graze and feed on crop residue and/or grass.

Other important economic activities are wage labour and the sale of eucalyptus trees. Migratory labour opportunities are available in Shindi, Humera, Wollega, and Metema for maize and sesame weeding and harvest. Migration is a male activity, undertaken from June to August and from November to December. Casual urban labour opportunities, predominantly for men, are available in neighbouring towns, peaking from June to August, though they are available throughout the year. The poor and very poor groups buy eucalyptus trees from the middle and better-off groups; this they split and sell as firewood and poles (for home construction).

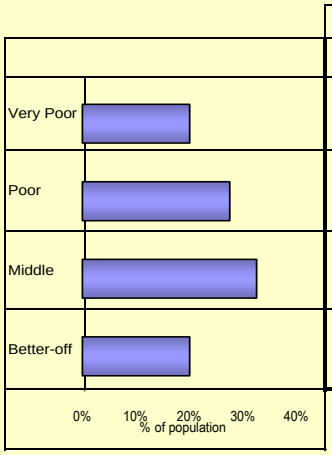
Figure 9. Seasonal Calendar: Central Highland Barley and Potato Livelihood Zone



rch to May, ptember to

November, and *Meher* from December to February (harvest season). Agricultural activities are planned around the *kiremti* rainy season.
Land preparation for short-cycle potato cultivation begins in January, whilst for long-cycle barley it begins in June. Eucalyptus sales peak in April, May and June. Urban labor is most common from June to August, whilst milking peaks from July to November. The food purchase season is relatively lengthy, peaking for 6 months from July to December.

Figure 10. Wealth groups: Central Highland Barley and Potato Livelihood Zone



	Wealth Groups Characteristics				
	HH size	Land area cultivated	Crops cultivated	Livestock Holding	Other
Very Poor	4-6	0-2 timad	barley, potato	0-2 sheep	0-3 hens, 0-40 eucalyptus trees
Poor	6-6	0-3 timad	barley, potato	2-4 sheep, 0-1 horse	1-3 hens, 70-200 eucalyptus trees
Middle	5-7	3-5 timad	barley, potato	1-3 cattle, 4-6 sheep, 1-1 horse	2-4 hens, 100-300 eucalyptus trees, 0-125 bamboo
Better-off	6-7	5-7.5 timad	barley, potato, teff	3-4 cattle, 6-12 sheep, 2-2 horses	2-4 hens, 250-750 eucalyptus trees, 0-200 bamboo

3.4 Social Infrastructure

The data of health infrastructure and health status for the whole of the Abbay Basin was taken from the data base of the World Bank's Country Economic memorandum. Details of health infrastructure and health workers are shown in table 3.

Table 3. Details of health Infrastructure and Workers in the Abay River Basin.

BASIN/REGION	Health Professional/'000 pop.	No. Health Professionals	Health Infrastructure (hospitals, clinics, dispensaries/'000 pop.	No. of health infrastructures
ABBAY BASIN				
Amhara	0.27	2,797	0.09	**913**
BSG	0.87	587	0.29	**192**
Oromiya	0.26	1,430	0.11	**619**
Total	**0.29**	**4,813**	**0.10**	**1,723**

1. [3] 1 timad equals 0.25 ha

The number of health professionals/'000 population is much higher in the Beneshangul-Gumuz Region. This figure is a reflection of the low population numbers. However, health infrastructure is much lower in that Region for the same reason.

Accessibility and the ratio of health workers to the population are key determinants in the number of people who are immunized. This is shown clearly in table 15 where the very low rate of immunization in BSG Region stand out clearly. Malaria is prevalent below 1,500 masl and possibly in areas just above this altitude. The percent area exposed to and the percent of the population vulnerable to malaria are also indicated in table 4.

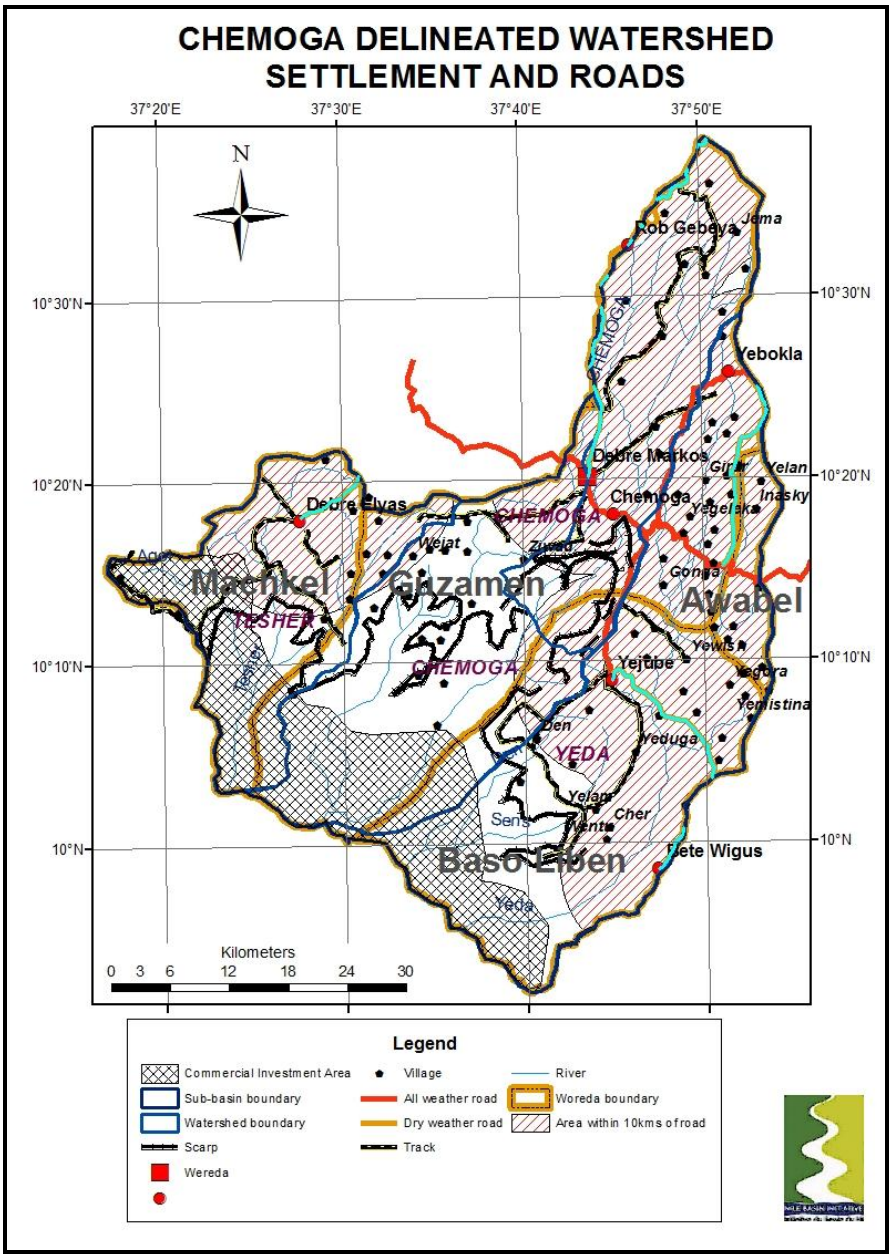
Table 4. Percent Population Immunized, Percent Population vulnerable to and Area Exposed to Malaria in the Abay River Basin.

BASIN/Region	% Pop. immunized	% Pop. vulnerable to malaria	% Area exposed to malaria
ABBAY BASIN			
Amhara	62%	47%	**55%**
BSG	28%	73%	**74%**
Oromiya	40%	49%	**52%**
Total	53%	49%	**55%**

The BSG Region in the Abay Basin has the highest proportion of the population vulnerable to malaria. Just fewer than half the populations in Amhara and Oromiya Regions are so vulnerable.

3.5 Transport Infrastructure and Markets

The main Addis Ababa to Bahir Dar passes across the Delineated Watershed through Debre Markos (Map 13). There are approximately 35 kms of All weather road and 140 kms of Dry weather road, although many sections of this type are of 'All' weather standard. Some 60 percent of the Sub-basin is within 10 kms of an all-weather or dry-weather road.



Map 15. Road network.

4. KEY ISSUES, CHALLENGES AND POTENTIALS

4.1 The Underlying Causes of Land Degradation and Investment in Sustainable Land Management Technologies

Mahmud Yesuf and Pender (2005) have undertaken a comprehensive review of research undertaken into identifying the determinants of the adoption or non-adoption of land management technologies in the Ethiopian highlands. This report and a number of IFPRI/ILRI reports on research undertaken between 2000 and 2004 provide a comprehensive picture of many of the underlying causes of

land degradation in Ethiopia. Other useful reviews include the NTEAP Study NTEAP, 2005), Alemayehu Tafesse (2005) and Herweg (1999).

4.1.1 Poverty and land Degradation

The poverty line in Ethiopia is set using a basket of food items sufficient to provide 2200kcals per adult per day. Together with a non-food component this represents Ebirr1,070 in 1995/96 prices. The proportion defined as poor in 1999/2000 was 45 percent in rural areas and 37 percent in urban areas. Per capita consumption expenditure of rural people in 1999/2000 was Ebirr 995 compared with 1,453Ebirr for urban people (FDR, 2002). However, income distribution is more evenly distributed than in other Sub-Saharan countries. The egalitarian land holding system may have contributed to this in rural Ethiopia. Between 1995/96 and 1999/2000 rural poverty declined by 4.2 percent, although it increased in urban areas (by 11.1 percent).

The dependency ratio is very important in determining poverty status in rural areas. Studies indicate that if the dependency ratio increases by one unit, a household's probability of falling below the poverty line increases by 31 percent. Households with more children under 15 years and those with people older than 65 years are particularly vulnerable to falling into poverty. This underscores the importance of adult labour in the welfare of rural households. Female headed rural households face a 9 percent higher probability of being poor than male-headed households although other factors such as age and education play an important role and need to be taken into consideration when targeting. Households cultivating exportable crops (chat, coffee) have a much lower probability of being poor. Living near towns and better access to markets has a poverty reducing effect. Farm assets such as oxen are important poverty reducing factors: an extra ox reduces poverty probability by 7 percent. Households involved with off-farm activities are 11 percent more likely to be poor. This is because such activities are seen as a coping mechanism for poor people rather than a way of accumulating wealth.

Reardon and Vosti's (1995) typology of poverty is linked to natural resources. They use a household asset approach in terms of:

- natural resource assets (soils, water, vegetation)
- human resource assets (education, health, nutrition, household labour, skills)
- on-farm resources (farm land, livestock, trees, equipment)
- off-farm resources (non-farm employment, remittances)
- community owned resources (grazing land, dams, roads)

- social and political capital (family ties, networks)

They use a measure of "conservation-investment poverty", the cut-off point is situation and site specific being a function of labour and input costs and the type of conservation investment needed.

In Ethiopia, decisions to adopt sustainable land management technologies depend on households' asset endowments. Labour availability has been found to be a positive determinant of chemical fertilizer adoption, trees and terrace construction. However, simply using family size to measure labour availability was found to be misleading. The results of studies into the effect of farm size on land management technologies have been mixed. Both positive, negative and no relationships have been found between farm size and fertilizer adoption. However, with those technologies that take up space (terraces, bunds, trees) a positive relationships were found between farm size and adoption.

Livestock assets have been found to be positively related to adoption of fertilizer, planting of perennial crops, use of manure and contour ploughing. Gender (a human capital variable) does affect adoption of land management technologies. Male headed households use more labour and oxen draught power and apply manure, reflecting a cultural constraint on women ploughing in Ethiopia. The results for fertilizer adoption were mixed, with female headed households in northern Ethiopia likely to use more fertilizer and the reverse in southern Ethiopia. Positive relationships were found between education and adoption of soil conservation measures although the results for fertilizer adoption were mixed.

Related to poverty and household assets are the concepts of profitability of the improved land management technology, the farmers' perceptions of risk and farmers' private discount rates. Private discount rates are a measure of a person's time preference or time horizon. The shorter the time horizon the higher is the discount rate. Short time horizons are the result of a number of factors, tenure insecurity, poverty, and high risk environment. Many farmers have high private discount rates – as high as 70 percent even in the high potential farming area around Debre Zeit near Addis Ababa (Holden et al., 1998). A number of studies have found that adoption of soil and water conservation technologies is negatively related to high discount rates. However, where a technology is risk reducing (e.g. terraces that conserve soil moisture) adoption is much more likely.

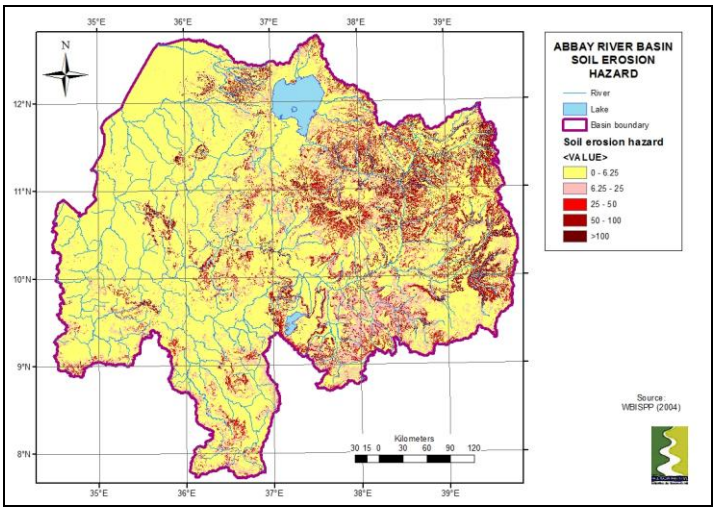
4.1.2 Population Pressure and Land Degradation

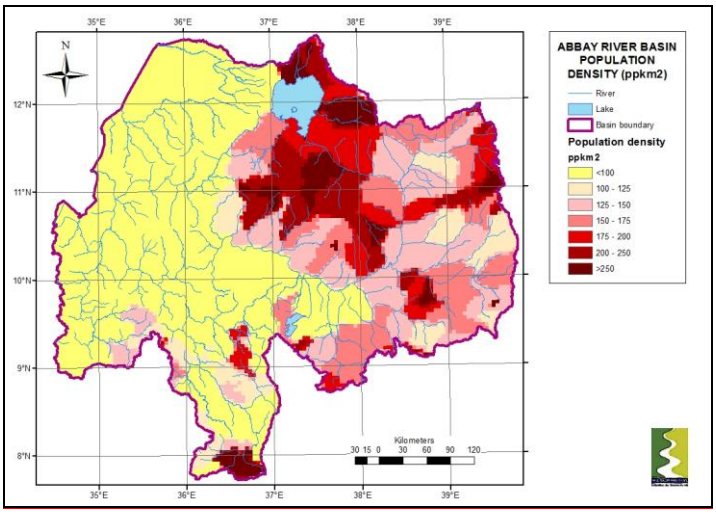
Currently there are two basic hypotheses regarding the relationship between population growth and land degradation. The "neo-Malthusian" hypothesis predicts that agricultural production is unable to keep pace with population growth leading to falling agricultural production per capita, and increasing negative impacts on natural resources including land, water, forests and

biodiversity. More recently, a more optimistic perspective has developed following from the work by Ester Boserup (1965) and others. This perspective emphasizes the responses of households and communities to population pressures that include a reduction in fallow periods, intensified use of labour and land, development of labour-intensive technologies and institutional changes. However, more recent evidence suggests that more specific conditions seem to be needed to get a Boserupian scenario to operate. These have been identified in the Machakos study as secure tenure, efficient markets, cash crops, supporting social organization and proven SWC measures. The evidence accrued so far in Ethiopia is mixed.

Grepperud (1996) tested the population pressure hypothesis for Ethiopia using econometric analysis, and found that when population and livestock pressures exceeded a specific threshold rapid degradation of land takes place. The threshold was the population and livestock carrying capacity of the land. Pender et al (2001) found in Amhara region of Ethiopia that high population densities were related to the decline in fallowing and manuring. They also found the high population densities were related to increasing land degradation and worsening household welfare conditions. In Tigray high population density was related to more intense use of resources (more fertilizer, manure and intercropping) at the household level but increased land degradation at the community level.

A comparison between population density and soil loss rates for the Abbay basin is shown in Map 16.





Map 16. Abbay Basin: A comparison between the pattern of population density with soil loss rates.

Whilst there is some similarity in pattern around the Mount Choke range and along the eastern edge of the Basin it is not everywhere exact. This suggests that the relationship between population density and erosion is not a simple one.

4.1.3 Poor Access to markets, roads and off-farm employment opportunities and Land Degradation

Better access to markets and roads mean lower transport costs for agricultural inputs and outputs and thus lower input costs and higher market prices. Thus better access is likely to lead to increased adoption of improved land management technologies, and poor access to lower adoption rates. However, better access may lead to better opportunities for off-farm employment. Here the potential impact on adopting or not adopting improved land management technologies is ambiguous as off-farm employment may reduce labour inputs but increase availability of financial capital for on-farm investment.

Howe and Garba (2005) found that reliance on traditional forms of transport pose considerable barriers to the development of an exchange economy and locks the farmers into subsistence form of livelihood. Pack animals offer a considerable advantage over human transport, with a cost reduction of approximately 50 percent. However, the average costs of mule transport of EBirr 16.7ton/km compare very unfavorably of EBirr 0.6-0.9 ton/km for local truck costs. With such high costs of transport for low value food crops such as maize ort sorghum makes a net return unlikely.

The evidence from Ethiopia of better access to markets and adoption of soil and water conservation technologies is mixed. In Tigray households with poor access were more likely to adopt labour intensive SWC structures than those with good

access. Declining fallows and increasing use of manure closer to towns suggested increasing intensification of agriculture where access was better. The use of fertilizer was everywhere positively associated with increased accessibility. The relationship between off-farm employment and the adoption of SWC structures appears to be very context specific. In many areas adoption of fertilizer and SWC adoption was negatively associated with off-farm employment.

4.1.4 Issues of Land Tenure

Issues of land tenure here include insecurity of tenure, ability to use land as collateral and the transferability of property rights and the impacts these have on land investment or factor (land, labour or capital) allocation. This is a complex subject in Ethiopia.

The Federal Rural Land Administration proclamation (No. 89/1997) defines in broad terms individual land use and disposal rights. It delegates responsibility for land administration to the Regions. Amhara and Oromiya Regions have also enacted Proclamations for the Administration and Use of Rural land. Currently a land registration programme is underway in the region. However, land redistribution has not been ruled out in both federal and regional proclamations. A US-AID Study (ARD, 2005) indicated that reports from kebelle administrations that redistribution is possible even with Land Registration Certificates.

Land tenure issues and their impacts on land management and technology investment in Ethiopia have been well studied over the past decade, and Mahmud Joseph and Pender (2005) provide a very comprehensive summary of the empirical evidence that is now available. Much of the evidence relating to impacts of tenure issues on land management and potential investment in improved land management is also of relevance to the situation in Sudan even if the context is somewhat different.

Tenure insecurity in Ethiopia emanates from a number of causes. A major source was periodic land redistribution to reallocation land to land-poor households. In northern Ethiopia the indications are that in areas where redistribution has occurred investment in terraces was lower, but that the use of fertilizer and tree planting was higher. This suggests that redistribution may favour short term investments in land management but hinder long term investments. The investment in tree planting (a short to medium term investment) may be due to a desire to increase tenure security or merely because trees are normally planted around the homestead.

A number of studies also found evidence that resource poverty had a much greater effect on farmer's decisions to adopt or maintain soil conservation structures.

In summary the effects of tenure insecurity on land investments appear to be mixed depending on whether the investments themselves affect security. Insecurity appears to hinder larger investments (e.g. terraces) than smaller and periodic investments (e.g. fertilizer, manuring). Redistribution is not the only source of insecurity, obligations to share land with younger family members is also an important source.

4.1.5 Impact of Agricultural Extension and Credit programmes on adoption of Land Management Technologies

The agricultural extension programme has strongly promoted fertilizer and improved seeds supported by credit. Studies indicate that greater access to credit increases farmers' likelihood of using fertilizer. However, risk is the crucial factor in the low rainfall areas in determining whether farmers will take credit for fertilizer even where it is readily available. The source can also determine the uptake of credit and specific use of the credit. This is probably a reflection of the technical advice that comes with the credit.

One study shows that credit uptake increased the adoption of fertilizer but reduced investments in soil and water conservation, contributing to increased soil erosion. The increase in fertilizer price since 2002 with the removal of the subsidy led farmers to increase the cultivation of crops requiring low fertilizer applications and reduce investment in soil conservation where the intervention was yield decreasing (e.g. soil bunds taking up cropland).

Studies indicate that the impact of extension on the uptake of improved land management is probably more positive in the high potential areas.

4.1.6 Economic Impacts of Land Management Technologies

Empirical studies on productivity and economic impacts of land management practices are few but consistent. Most studies show that short run returns from physical SWC structures are positive in moisture stressed areas but negative in higher rainfall areas. Returns from fertilizer use show the opposite trend: with higher returns in high rainfall areas and lower in moisture stressed areas.

In moisture stressed areas internal rates of return to stone terraces varied between 20 and 50 percent. Again in moisture stressed areas other land management practices demonstrated increased productivity: contour ploughing (25% higher productivity), reduced tillage (57% higher productivity), and manure and compost (15% higher productivity). The impact of chemical fertilizer was insignificant and showed a high variability in productivity response indicating a higher risk.

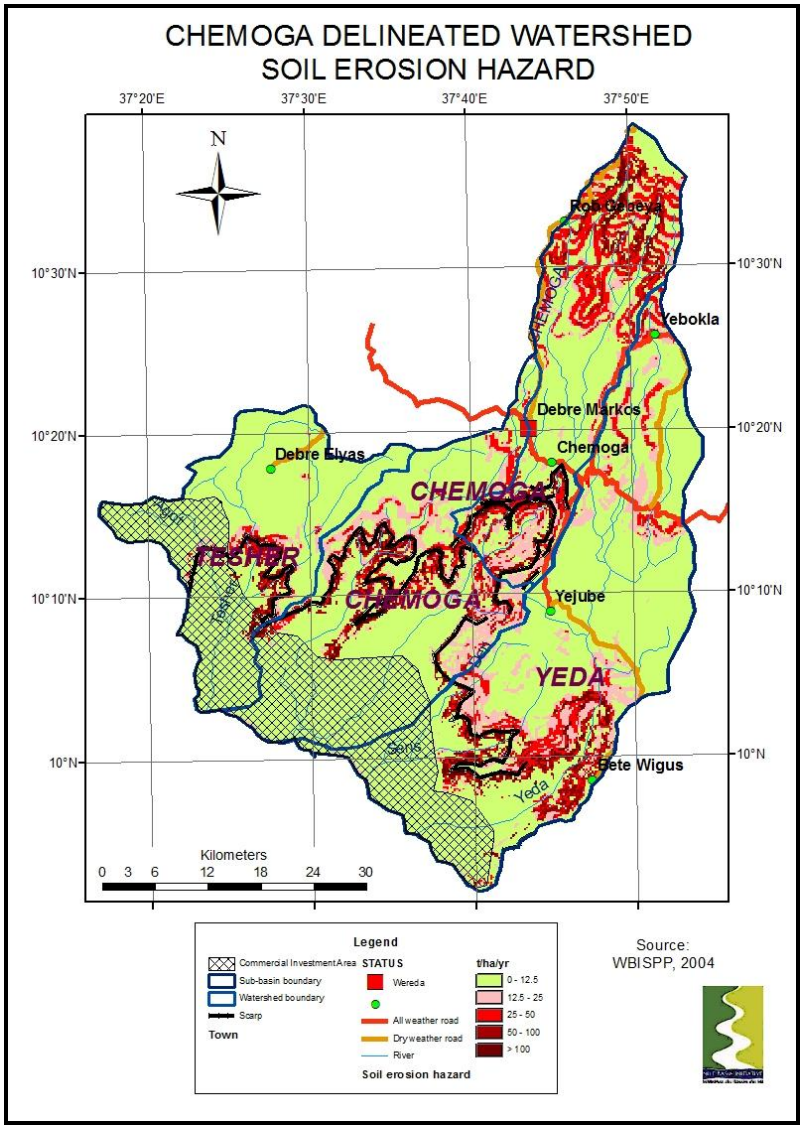
Benefits to physical structures were low where soils were deep (more than 1 meter) or very shallow where yields were already very low. This finding suggests targeting areas with rapidly degrading but still productive soils.

4.2 Chemoga Sub-basins

4.2.1 Assessment of the Extent Soil Degradation

(i) Sheet and Rill Erosion

The extent of the sheet erosion hazard using the USLE (as modified by Hurni, 1986) as a basis is shown in Map 17.



Map 17. Potential Soil Erosion (t/ha/yr)

The highest soil loss rates are found on the steep slopes of Mount Choke and along the escarpment above the Abbay Gorge. Locally, areas of high erosion are found on the ridges and foothills just above the plateau.

(ii) Biological Erosion

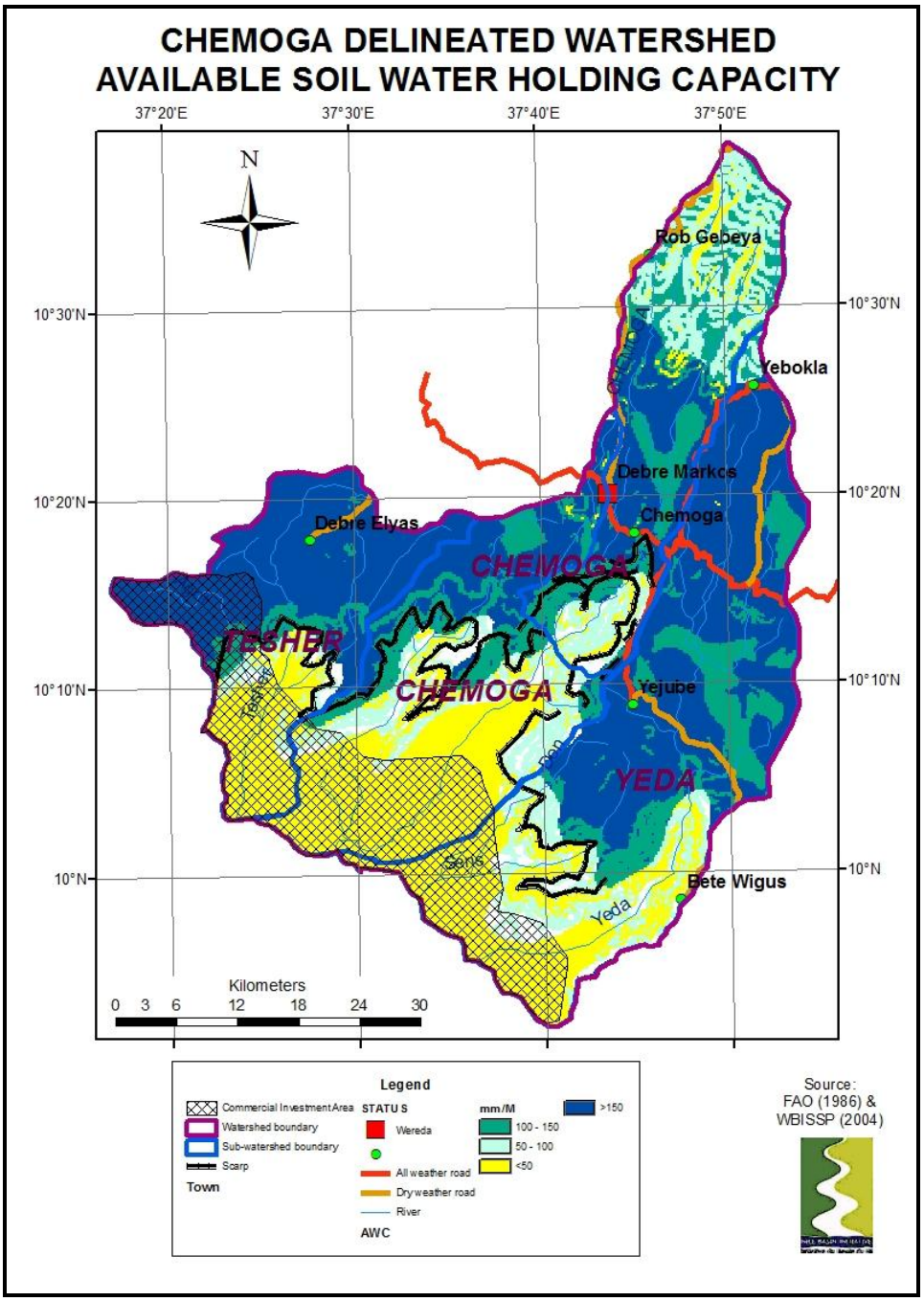
Biological erosion includes the loss of organic matter and soil nutrients. The former is caused by soil erosion and by the lack of replacement organic matter after cropping. Nutrient losses are caused by breaches in the nutrient cycle (particularly Nitrogen) caused by crop residue and grain removal from fields and the collection of dung from fields for fuel. Annual soil nitrogen losses caused by crop and dung removal from fields and grain losses using a nutrient:yield ratio of 6 were estimated (WBISPP, 2003) and are shown in table 5.

Table 5. Net Nitrogen losses and consequent grain losses due to lack of replacement from grain, residue and dung removal

Woreda	N loss (tons)	Grain (tons)
Debere Elias	37	220
Gozamin	144	865
Baso Liben	96	574
Sinan	30	179
Aneded	26	154
TOTAL	**332**	**1,991**

(iii) Soil water holding capacity

The soil water holding capacity (in mm of water per meter of soil) is largely a function of soil depth and soil texture. Deep soils with clay textures have a much higher water holding capacity than shallow and/or sandy soils. Shallow soils are found on the steep slopes of Mount Choke and the Abbay Gorge, with deep clay soils (Vertisols) on the Plateau (Map 18).



Map 18. Soil water holding capacity (mm/m)

The high water holding capacities of the Vertisols found on the Plateau can be clearly seen.

4.2.2 Assessment of the Extent Deforestation and Degradation of Vegetation Cover in the Chemoga Watersheds

Open woodland and shrubland cover some 16 percent of the area of the Watershed. Most of this is confinbed to the Abbay Gorge. Cultivation and grassland cover cover some 60 and 20 percent of the total area respectively. The remainder of the area is plantation, bare rock, bare soil or wetland.

(i) Changes in Tree Cover

Tree planting on household land started in earnest after 1991 and by 2002 each household had an average of 225 trees (WBISPP, 2002) It is likely that tree planting has continues at a slower rate. Woldeamlet Bewket (2002) has also described landuse dynamics in the Chemoga Watershed. He found that between 1957 and 1998 that forest (plantation) cover increased by 11ha per annum. Woodlands and shrublands stayed the same, whilst cultivation increased by 11 percent over the whole period.

(ii) Degradation of Woody Biomass

Degradation of woody biomass is caused in the main by the removal of wood for household fuel. Removal of wood in excess of the sustainable yield (after accounting for removal of dead wood and fallen branches, leaves and twigs) leads to declining stocks, which in turn leads to declining yields and so to permanent degradation of woody biomass.

The WBISPP (2003) estimated for the woredas in the Chemoga Watershed rural fuelwood consumption was only 57 – 63 percent of sustainable supply. However, these figure rose to 112 – 125 percent when the Urban consumption data was taken into consideration.

(iii) Degradation of Herbaceous Biomass

Degradation of herbaceous biomass is caused mainly by overgrazing of livestock. An indicator of overgrazing can be determined by examining the livestock feed energy balance at the wereda level. Energy requirements of all livestock were computed by WBISPP (2003) using energy requirements for maintenance, draught power and lactation, and balanced against estimates of energy supply from natural pastures and crop residues.

The ratio of stocking rates to carrying capacity was estimated for the Chemoga Watershed to be 71 to 91 percent (WBISSP, 2002)indicating that livestock

annual livestock feed deficits do not occur, although seasonal shortages may be expected between March and June.

4.2.3 Assessment of the Extent Reforestation and Increases of Vegetation Cover in the Chemoga WatershedS

(i) Communal and On-farm Tree Planting

Whilst there is evidence of the removal and degradation of natural vegetation cover, there is evidence that there has been an increase in on-farm tree planting and plantations, almost entirely of *Eucalyptus* species. Farm surveys of the numbers of trees owned and planted by farmers in Amhara Region has revealed that considerable planting of trees (mainly Eucalyptus) has taken place since 1991 (WBISPP, 2003).

Prior to 1991 there was very little on-farm tree planting. The reasons were firstly, that between 1975 and 1991 cutting of on-farm trees was prohibited, and secondly that between 1975 and 1989 there were frequent re-distributions of farmers plots. The net result was a strong feeling of insecurity of tree and land tenure that strongly discouraged farmers investing in tree planting. Following the change of Government in 1991 the prohibition on tree cutting was withdrawn and redistribution of holdings was much reduced and since 2000 had stopped. As a consequence perceptions of tree tenure security became stronger. This was coupled with a very large increase in the demand for construction poles following the surge in economic growth and the increase in building construction from 1992 onwards.

Household and Community surveys indicate that there has been an increase in the planting of trees on-farm and in Communal Areas (mainly Eucalyptus spp.) between 1993 and 2000, and that this continues. Generally, the rate of on-farm tree planting has been highest in areas where rainfall is adequate and also where road access to pole markets is good. In the Chemoga Watershed most tree planting has taken place in the plateau areas closer to the Main Road to Barhir Dar.

(ii) Enclosed or Livestock Exclusion Areas

Enclosed or livestock exclusion areas in Communal lands have clearly demonstrated that rapid natural regeneration of vegetation is possible. Research in Tigray on closed areas found they achieved trapping efficiencies approaching 100 percent. Closed areas were trapping sediment per unit area 3 to 4 times the rate of erosion (Descheemaeker et al., 2005). In most cases it was vegetation that controlled the rate of sedimentation rather than slope. Additional benefits include soil enrichment and increased infiltration of water.

Descheemaeker et al. (2005) found that soil organic matter in an enclosed area in Tigray had increased from between 0.2 percent to 1.3 and 0.5 percent to 3.4 percent in areas that had been enclosed for 4 to 5 years. These would indicate increases from 17 to 45 tons/ha. The Chemoga Watershed is located in a much higher rainfall area than that in Tigray, so these estimates are likely to be conservative.

Howard and Smith (2006) found that plants within the enclosed areas had considerable importance for traditional medicines (138 species), as wild food (30 species), as bee forage and for religious and cultural activities. Often there are gender differences in the value of these plants. The sale of some of these plants provides a vital source of livelihood for the most disadvantaged people in the community (e.g. female headed households). In the degraded areas many of these plants had disappeared. Clearly, these plants provide an important element in the broader livelihoods of rural (and urban) communities and their value has often not been recognized (Shackleton et al., 2000).

Financial analysis (World Bank, 2011) indicated benefits to increased forage production in the closed areas comprised 68 percent of the total quantifiable benefits. These are followed by the benefits to honey (32 percent) and spring initiated irrigation (8 percent). Benefits to tree production from plantations and the indigenous trees in the closed areas are relatively small. However, their contribution to carbon sequestration and increased biodiversity are not captured in the financial analysis. Benefits to increased medicinal plants although clearly positive have not been quantified due to the lack of comprehensive data. For 1 hectare of closed area produced net discounted benefits (10% discount rate over 25 years) ETB7,256 with a B:C ratio of 2.3. The payback period is short – 3 years.

4.2.3 Trends in Soil and Vegetation Degradation

In the absence of any widespread, consistent and long term monitoring it is difficult to estimate medium or long term trends of erosion or sedimentation. Any evidence must therefore be circumstantial.

In the absence of preventative measures, declining soil fertility and organic matter content are likely to increase soil erodibility. However, there have been impressive increases in the adoption of soil and water conservation and soil improvement measures over the past ten years. The WBISPP (2003) GIS assessment indicated that the proportion of cropland requiring SWC measures (i.e. cropland losing more than 12.5t/ha of topsoil per year) for the sub-basin is shown in table 5. This amounts to 33 percent of the watershed.

. The areas of each soil loss class are shown in table 4. Some 26 percent of the area is experiencing soil loss rates in excess of 25 tons (2mm of topsoil) per annum.

t/ha/yr	Area (ha)	% total area
<6.25	176,342	60%
6.25 - 12.5	20,949	7%
12.5-25.	20,937	7%
25-50	28,727	10%
50-100	30,038	10%
>100	16,148	6%
	293,141	

Table 5. Estimated areas subject to soil loss rates (t/ha/yr) in hectares.

The CSA Agricultural Census (2003) indicates that approximately 15 percent of farmers in the woredas in the watershed have adopted soil and water conservation measures on their farmland. The 2002 Agricultural Census reports the percent farmers undertaking terracing, water catchment (harvesting), tree planting and contour ploughing. These are shown in table 5.

Table 5. Percent farmers undertaking terracing, water catchment and contour ploughing by woreda

Woreda (old names)	Terracing	Water catchment	Contour ploughing
Awabel	15%	9%	60%
Baso Liben	19%	0%	67%
Guzamen	0%	2%	80%
Machkel	12%	2%	62%

An average of 1 percent use terraces, 3 percent water harvesting and 67 percent contour ploughing. The agricultural census records no farmers planting trees, whereas the WBISPP Socio-economic survey records substantial planting after 1991 (WBISSP, 2003).

However, one of the main causes of soil nutrient depletion: burning of dung and residues and grain removal from fields without replenishment continue. The impacts of this have been indicated in para. 4.3.1.(ii) and in the absence of any reduction in these consumption rates biological soil degradation will increase.

4.2.4 Key Issues Identified by Local Stakeholders

The key environmental issues identified by the local stakeholders are high rate of deforestation; cropland expansion, decreasing size of grassland cover; formation of gullies and bare land, depletion of surface water. The key challenges were identified as:

- High rate of population growth;
- Short and erratic rainfall;
- Crop failures;
- Massive land degradation due to soil erosion and absence of appropriate land management practices;
- Decreasing land productivity and production;
- Shortage of livestock feed, decreasing livestock population; Widening food insecurity;
- Rampant animal disease and pest, etc.

5. IDENTIFICATION OF WATERSHED MANAGEMENT INTERVENTIONS

5.1 Review of Current Interventions

5.1.1 Overview of current watershed management interventions

Watershed management for medium to large watersheds and sub-basins is a new activity currently being launched by MoWR. The ENSAP fast track watershed management projects are a first step towards implementation at this level.

Productive Safety Net Programme (PSNP): (FDRE, 2004) The objects of the PSNP are to provide transfers to the food insecure population in chronically food insecure woredas so as to prevent asset depletion at the household level and create assets at the community level. Through the programme block grants are provided to woredas for a range of activities including (i) soil and water conservation, (ii) water harvesting, (iii) irrigation, (iv) feeder roads, and (v) agricultural packages. The programme is complementary and has linkages to other programmes including the Food Security programme, Emergency Drought Recovery programme, Integrated Food Security projects. No woredas in the Chemoga watersheds are included in this programme.

Sustainable Land Management Programme (SLMP): (World Bank, 2012) The PDO is to reduce land degradation in agricultural landscapes and improve the agricultural productivity of smallholder farmers. The GEO is to reduce land

degradation, leading to the protection and restoration of ecosystem functions and diversity in agricultural landscapes. The specific objectives of the SLMP remain as follows: (i) to scale up best management practices in sustainable land management practices and technologies for smallholder farmers in the “high potential” or food secure areas that are increasingly becoming vulnerable to land degradation and food insecurity; and (ii) to expand the coverage and enhance the Government’s land certification program, with the aim of strengthening land tenure security for smallholder farmers. Currently one sub-watershed in the Chemoga Watershed is included in the SLMP in Machekel and Guzamen woredas.

Small-scale **watershed development in micro-watersheds** is practiced by the woreda offices of agriculture, with support from several donors, the main one being the WFP supported MERET (Managing Environmental Rehabilitation in Transition to Sustainable Livelihoods) project. This component is discussed in more detail in the following section.

5.1.2 Local Level Watershed Management

Watershed activities have long been centred on soil and water conservation (SWC) activities. More recently, a stronger link has been established with water harvesting, tree plantation and horticultural crop diversification.

Activities are always coordinated through the agricultural bureaus, implemented with help of the population and with donor support in various forms (budget support, financial support linked with technical support, food-aid) and from various parties. Contributions of the population are in the form of manual labour and are compensated in cash or in kind (food rations). Part of the work is still done on a voluntary basis, i.e. unpaid but in mass mobilization campaigns (20 days per year per able person).

The MoARD has designed and launched a **Community Based Participatory Watershed Development** Approach (CBPWD), intended to spearhead the process of rural transformation and the generation of multiple and mutually reinforcing assets. It is now general policy that interventions in soil conservation, water harvesting, afforestation and land rehabilitation should follow a watershed approach.

Local level watershed activities are carried out the in all woredas within the Chemoga Watershed.
The principal actor in watershed management is the WFP supported MERET project within the Ministry of Agriculture and Rural development (MoARD). This project, started in 2002, follows on from previous projects supported by the WFP

(Land Rehabilitation Project, Project ETH 2488). The project is concerned at farm level with conservation, intensification, expansion of cultivated land, and diversification of income opportunities (WFP, 2005). The Local Level Participatory Planning Approach (LLPPA) developed within this project has gained national acceptance and ownership. The Guidelines on Community Based Participatory Watershed Development (CBPWD) are commonly used, directly or in some modified version.

Vast areas have been 'treated' under this programme, usually supported by food-for-work, most particularly the Productive Safety Net programme. The area focus has been food insecure (and generally moisture deficit) Weredas; activities have been largely limited to soil and water conservation measures and area closures. The performance of the biological conservation measures (primarily forestry plantations) has generally not been satisfactory.

5.1.3 Irrigation development

Small dam construction has faced considerable problems of various kinds, both technical and organizational: low construction standards, no sediment monitoring, lack of coordination with MoARD resulting in delay or lack of watershed protection, severe siltation problems, lack of follow up by MoARD in irrigation management and extension, single-event watershed protection instead of long-term watershed management provisions.

Irrigation planning, dam site selection, implementation and watershed protection (if undertaken) have all followed a top down approach, with obvious consequences. Land users in the watershed and in downstream areas have no sense of project ownership and have no commitment to maintenance of watershed protection measures. Cases are also observed where the local population was strongly against construction of a dam (Mulder, 2002).

5.1.4 Observations and lessons learnt for Watershed Development

(i) Innovative approaches

The better linkage between SWC, water harvesting and agricultural diversification (based on micro-irrigation), introduced by the MERET project, was certainly innovative for the Ethiopian context.

Promising trials of genuine community participation have been practiced in a SNV supported project in Bugna woreda (N.Wolo) and in a project of SOS-Sahel in Meket wereda in the far north of the Abbay basin.

(ii) Technology innovation

Some important technology innovations have taken place in watershed treatment. Currently these are at a small scale. The former GTZ-supported Integrated Food Security Project in South Gondar, now coming under the SUN programme, had put the largest possible emphasis on biological measures, both for on-farm conservation and for gully stabilization. Introduction of Vetiver grass was strongly promoted there.

The most substantial change has been the greater emphasis on water resource development enabling the expansion of micro-irrigation, and thus agricultural/ horticultural diversification and commercialization. This change has been introduced by the MERET Project but has now been adopted by most actors. Water resource development (e.g. construction of shallow wells) is a logical step following improved water retention through SWC measures. It proves to be most productive in watersheds where SWC is widespread.

(iii) Water harvesting

Water-harvesting (e.g. ponds, small earth dams, river diversion) has become an essential ingredient of SWC programmes, although it has known limitations. The ENSAP Watershed management Study (ENTRO, 2003) reviewed water harvesting experiences in Ethiopia and concluded as follows:

- Pond and canal seepage are limiting factors, reflecting problems in design, construction and supervision.
- Inflows from harvesting areas have been less than expected due overly optimistic runoff coefficients.
- Excessive sedimentation is a problem, pointing to need to integrate water harvesting with the overall watershed management.
- Pond water is insufficient for dry season irrigation, and is often actually used for supplementary irrigation in the wet season.
- Water should be used on high value crops, but horticultural crops have high input costs and have limited storage capacity (where markets are thin).
- Water borne diseases (malaria and bilharzias) and safety need to be considered.

- Success was achieved where both technical and social aspects were adequately covered.

(iv) Impacts and implementation efficiency

Local level watershed protection has been undertaken for three decades, at enormous cost. Large areas have been treated now, particularly in Amhara Region.

However, the cost efficiency of all the work is rarely questioned. After many years of SWC practice, field observations still lead to similar conclusions:

- SWC implementation follows a blanket approach, structures are often over-designed; no flexibility or refinement in measures can be observed based on varying terrain conditions,
- maintenance is generally inadequate or lacking,
- there is a strong predominance of mechanical, loose rock structures which could be replaced in many places by cheaper, biological measures contributing in the same time to productivity,
- quality control is limited to target fulfilment and is not concerned with optimum impact of measures.

The type of data collected with regard to SWC implementation generally focuses on physical achievements (i.e. length of terracing, seedlings produced, etc). After three decades of massive soil conservation campaigns, it is possible to trace exactly how much food was spent, but it is not possible to say what the impact has been on agricultural production, farm incomes, which areas have been covered (and even covered how many times) and whether the work was carried out in an efficient way.

(v) Some selected cost figures

A few data on average overall costs of micro-watershed treatment are available:

- ENTRO (2006) estimate the average cost of micro-watershed treatment following the CBPWM approach, at about US$180,000 for a watershed of some 200-500 hectares, i.e. about US$ 360-900/ha or ETB 3,000-8,000/ha.
- GTZ has calculated an average cost of US$ 115,500 (ETB 1 million) per micro-watershed, which is in the same order of magnitude (two thirds) of the previous estimate by King and Kasahaye.

- The evaluation report of Irish Aid activities calculated a cost of ETB 3,000 /hectare (85 % of which is SWC and gully treatment) for investment cost only and excluding project overheads. The same document reports the possibility to recover the program investment costs of ETB 1.8 million within 3 years.

- The IUC project (Mekele University) gave as a rough estimate an average cost of about ETB 5,000/hectare, to be repeated every 10 years.

- The MDG needs assessment document estimated unit costs of watershed treatment to amount to an average of 2,500 – 3,000 ETB/ha (based on standard WFP work norms, including materials and equipment but excluding project overhead costs).

The above indicative figures all relate to activities compensated in food or in kind, and are probably based on the same standard work-norms developed by MoARD and WFP. The variation is probably related to different average intensity of works assumed, and different proportions e.g. of hillside closure (relatively cheap) and gully treatment (expensive).

The dominant role of food aid is also expressed in WFP project budgets. In the overall budget for the 2003-2006 MERET programme, the combined cost of food commodity and of local transport/storage/handling amounts to US$ 40.7 million, which is 94 %, of the total WFP contribution plus 92 % of GOE contribution. Other direct operational costs (staff, training, capacity building, M&E, equipment and materials) take only 6 % of the WFP contribution, and 8 % of the GOE contribution.

(vi) Positive experiences but limited up-scaling

The recent document on a joint EEFPE/IFPRI stakeholder analysis (Gete Zeleke et al., January 2006) reports that “enormous efforts in massive land rehabilitation were undertaken since the 1980s, with the aim of arresting land degradation and improving rural livelihoods in the country. Despite these efforts, there has been limited success in controlling land degradation, in comparison to the efforts applied, the organizational structure and the resources mobilized. The problems with past conservation efforts were largely rooted in a lack of understanding of the important interface between resource conservation and agriculture, and of the factors that motivate farmers to invest in sustainable land management (SLM) over the long run.

(vii) Building on the Past

The MERET/WFP project has been operating some 25 years (under different names), and offers a wealth of experience. The approach to this project has changed considerably over the years, reflecting experience of what does and does not work, and paralleling changes within government, as outlined above.

Over the last 10 years, paralleling the decentralization process, the project has been re-designed to a 'bottom-up' project, owned and driven by communities. Target areas have been reduced to micro-watersheds – or community watersheds – on a scale of 200 to 500 ha. And the focus has shifted from protection – conserving the resource base – to production and improvement in rural livelihoods. This is in line with national policies and with international experiences. Most organisations working in watershed management now follow similar practices.

Overall, the various experiences provide guidance on what is implementable and at what rate. The 2005 guidelines Community-Based Participatory Watershed Development build on local experience and provide a reference to the projects.

The experiences in watershed management (including water harvesting) suggest a few key considerations for future projects:

- Community ownership and institutional structures are basic to project success
- The 'building blocks' for watershed management should be community watersheds in the 200-500 ha range
- Larger projects (e.g. the current project) should be seen as target areas for coverage by 'micro-projects' at the 200-500 ha level i.e. should be assemblages of micro-watersheds grouped and linked at a broader scale
- Conversely, larger projects can 'add value' by allowing physical integration of the micro-projects and by allowing a more holistic approach than possible at the micro scale
- Projects benefit from an 'integrated' approach. However, concepts on 'integrated' vary and rarely extend beyond agricultural production
- Due to the diversity of landscape and socio-economic conditions in Ethiopia, interventions need to be adapted to local conditions rather than following standard models.
- Implementation is easiest in areas offering most immediate benefits, i.e. in moisture-stressed areas. By extension, water conservation offers more immediate and visible benefits than soil conservation.
- Extensive support by Development Agents is required for project implementation. Optimum support levels are around 3 diploma level development agents per development centre. This has important implications for project implementation and management. The scale of

the proposed projects will make major impositions on the capacity of the Regional Bureaux of Agriculture. Future projects may need to either provide support to these bureaux or to have a separate implementation management (albeit linked to the bureaux)

- Payment (food or cash for work) will most likely be required for a large part of project implementation.
- A key issue yet to be resolved is how to 'scale up' from the micro-watersheds to larger areas – a question to which upcoming watershed management projects should make an important contribution.
- It is difficult to sustain watershed management on increased productivity of food grains alone; diversification for cash crops adapted to local markets or other income generating activities is an essential part of the mix. This emphasizes the importance of markets and marketable products to offset the cost of investment in conservation.
- Key constraints are institutional capacity limitations at Regional, Wereda and Kebele/community levels; free grazing of livestock; the requirement of external support (generally food-for-work) to support community mobilisation; and lack of maintenance after completion of the project.
- There are no evaluation data available on post project benefits as compared to baseline situations. Most observers agree that, within the moisture deficit and food insecure Weredas, crop and forage production benefits are positive. MERET has undertaken an economic analysis which suggests that activities are economically viable.
- Despite the previous point, there is limited evidence of community driven watershed management and self-replication is limited. Efforts have been, and remain, primarily supply-driven by government and donor agencies, and supported by payment (food or cash for work).

(viii) Integrated watershed management

Considerable experience has been built up in the Region on the technological aspects of integrated watershed management. In particular there has been an increasing emphasis on biological measures using where possible locally available materials and away from physical structures. Biological measures include those under the headings of better "land husbandry", "crop husbandry" and "livestock husbandry".

At the small dam watershed level, technical interventions will need to be developed in an integrated manner that takes into account the nested nature of watersheds and the hydraulic system. Small dams need to be integrated into other components of the watershed management plan with watershed management interventions being implemented in the upper micro-watersheds and moving progressively downstream. Similarly, external water-harvesting measures will need to be similarly planned and executed. In-field water

harvesting measures will need to be integrated with soil fertility enhancing measures if full benefits are to be achieved.

Proposed interventions will need to range beyond soil and water conservation technologies and include inter-linked technologies related to crop, animal and tree husbandry.

A thorough understanding of the land use systems and their inter-linking components will ensure that any potential technical interventions will not adversely impact on and where possible support the other components in the system.

5.2 Project Stakeholders

Primary Project Stakeholders: **These include the following:**

- Rural agricultural households residing within the Chemoga Watershed with land holdings for cropping and access to communal grazing and forested lands;
- Landless rural households residing within the Chemoga Watershed who have access to communal lands for collection of fuelwood, medicinal herbs and water;
- Staff of the Bureau of Agriculture and Rural Development who will receive technical and logistical support.

Secondary Project Stakeholders: include:

- Operators of the Millenium dam who will benefit from reduced rates of sedimentation in the reservoir.

5.3 Watershed Management Planning Framework

5.3.1 Strategic Considerations

The principle of integrated watershed-based development is the declared policy of Government and thus provides a suitable guidance for watershed management. Rehabilitation and protection of land and water resources are at the centre providing the basis for sustainable development.

It is known from lessons learned that watershed management planning can be undertaken at various levels, but **implementation has to take place at grass root level**. The conventional options for purely administrative and regulative solutions to land and water use problems appear to have reached their limits. It is becoming increasingly apparent that a more consensual approach to natural resource management is a more attractive solution for harmonizing interests of

resource users, managers and regulators. Allowing and facilitating local communities to develop their own resource management systems is proving a more effective, economic and efficient approach than central or regional government control.

Sustainability of achievements requires ownership of its users and these are the local communities. A sense of ownership is created only through their **genuine participation** in planning and decision making. Decision making should not be the privilege of nominated leadership only. Motivation for genuine participation can only be based on **tangible benefits** and a sustained resource-base. Many benefits can be achieved through integrated watershed management for improvement of livelihoods.

The requirement of genuine participation sets preconditions to the organizational structure and approach of watershed management projects. Emerging lessons from watershed management projects in Ethiopia and elsewhere include the following:

- A participatory project cannot be target-driven right from its start. In its initial phase, the project design should focus on the process of establishing participation rather than on seeking to achieve physical targets. It also requires appropriate institutional development at community-level; appropriate in the sense that institutions are created (or strengthened if already existing) to respond to the emerging needs, and may therefore differ from place to place. Needs depend on priorities in watershed management activities, functionality of existing traditional institutions and prevailing group dynamics within a community. A standardized institution for all communities (such as a Kebele watershed committee) will be an imposed one and will undermine the feeling of project ownership in the community.

- It is important to strive for a simple organizational and coordination structure, based on existing structures and clearly stipulating linkages with higher levels (need for support.

- Institutional arrangements are required that allow for multi-disciplinary and multi-agency collaboration and across ministries, contributing to breaking through single sector approaches.

5.3.2 Technical Interventions: Levels and boundaries of analysis

It is often stated that a watershed approach to development conflicts with the administrative and political reality and that their boundaries rarely coincide. Implementation activities are initiated and carried out within an administrative jurisdiction. This argument is countered by pointing out that the physical world has no respect for administrative or political boundaries and activities in the

upper part of a watershed can serious impact on people in the lower parts in another administrative or political jurisdiction. In practice the two approaches need to be complementary and an administrative/political realism should be superimposed on watershed planning to obtain administrative support and action.

Watershed management is a system-orientated concept with a holistic approach to problems and potentials. For this reason it will be necessary to identify "bundles" of interventions that complement each other where possible in a synergistic way. Given the cross-sectoral, sustainable livelihoods and poverty focus of the Watershed Management CRA with its stated objective of tackling the underlying problems of natural resource degradation in the East Nile Sub-basins, many of these "bundles" will comprise technological, institutional and policy components.

Most technological interventions are targeted at the agricultural[4]/pastoral household and rural community level although some are targeted at medium scale watersheds. The organizational, institutional and policy interventions/recommendations are targeted at the higher administrative and political levels.

In addition, strategic choices in development have to be made to achieve the following:

- balanced identification of priority areas for watershed protection, based on an agreed set of criteria;

- dual attention for both rehabilitation of degraded food-insecure areas and timely protection of strongly eroding high potential areas,

5.3.3 Technological Interventions: Basic Considerations

Considerable experience has been built up in Ethiopia, the Eastern Nile Region and elsewhere in the world on the technological aspects of integrated watershed management. In particular there has been an increasing emphasis on biological measures using where possible locally available materials and away from physical structures.

A thorough understanding of the land use systems and their inter-linking components will ensure that any potential technical interventions will not adversely impact on and where possible support the other components in the system.

[4] Included here are tenant farms on government irrigation schemes, farm workers on large-scale mechanized farms and as well as smallholder farmers.

At the micro/mini watershed level technical interventions will need to be developed in an integrated manner that takes into account the nested nature of watersheds and the hydraulic system. For example the development of small dams should be integrated into other components of the watershed management plan with watershed management interventions being implemented in the upper micro-watersheds and moving progressively downstream. Similarly, external water-harvesting measures will need to be similarly planned and executed. In-field water harvesting measures will need to be integrated with soil fertility enhancing measures if full benefits are to be achieved. Proposed interventions should range beyond soil and water conservation technologies and include inter-linked technologies related to crop, animal and tree husbandry.

5.3.4 Targeting Interventions

(i) Development Domains

In Ethiopia the MoARD Guidelines for Watershed Management provide details of many land management options. The suitability of these options depends on the bio-physical and socio-economic characteristics of a particular area. Given the large number of agricultural/pastoral household units and their extremely wide range of environmental, social and economic circumstances, it is necessary to stratify households and communities into some form of spatial unit. For this reason it has been necessary to sub-divide the four Delineated Watersheds into spatial units of similar environmental, socio-economic (include market access) conditions and related problems and potentials. These form the basis of "**Development Domains**" (Pender et al. 1999). These have a common set of interventions, impacts, costs and benefits.

Three criteria have been used to define the Development Domain: (i) agricultural potential, (ii) accessibility to markets, and (iii) Highland or Lowland.

Agricultural potential is defined on length of growing period (LGP) and rainfall variability (CV). Thus high agricultural potential woredas have LGP >6 months or 4 months with rainfall CV <100 percent. Low agricultural potential woredas have an LGP <3 months or 4 months with rainfall CV >100 percent. Medium potential woredas lie between these values. With LGP of 150 to 179 days both watersheds lie within "Medium Potential" areas.

Access to markets is also a key factor in targeting interventions. Areas with good access to markets have advantages in terms of producing high value perishable crops, livestock intensification and greater possibilities for off-farm income. Conversely, areas remote from markets will need to focus more on higher value but easily transportable commodities such as small livestock and apiculture. Good market accessibility is defined as being within 4 hours vehicle travel time to a town of >50,000. In the Project Area this refers to Debre Markos as being within this range.

Highland and Lowland are defined as >1500 masl or <1,500 masl respectively. Pender at al. (1999) used population density as their third criterion. However, in Ethiopia the Highland/Lowland distinct covers not only population density but a range of socio-cultural and environmental factors.

Within each Development Domain are a number of Farming Systems that have been described in para 3.3. The distribution of In terms of targeting specific land management technologies the available evidence suggests that there is a clear distinction between frequently moisture stressed and areas that are infrequently stressed. The two Watersheds are located within “Frequently Moisture Stressed” areas.

The Project area lies within two Development Domains:

(i) Highland: High Agricultural Potential: High Market Access
(ii) Highland: High Agricultural Potential: Low Market Access

5.3.5 Technological Interventions by Development Domain

HIGHLAND: High Agricultural Potential (Low moisture stress risk) (a) Good Market Access (b) Poor market Access: Located above 1,600masl

(a) Overall Strategies: High Market Access

The opportunities for marketable agricultural development in this Domain are good with their good access to the Makelle market. Use of external inputs is likely to be profitable to farmers (Pender et al., 1999). Marketable agricultural products can include low value, high volume and perishable products. These could include crops such as tomatoes, potatoes, cabbage, milk and dairy products and honey production. The strategy for own-consumption agricultural production should be to ensure food security.

(b) Overall Strategies: Low Market Access

The opportunities for marketable agricultural development in this Domain are good with their good access to the Debre Markos market. Use of external inputs may be privately unprofitable (to farmers) but may be economically cheaper than importing food into the area (Pender et al., 1999). Marketable agricultural products will be limited to high value, low volume and non-perishable products. These could include crops such as onions and peppers, small livestock such as sheep and goats, and honey production. In parts of Ethiopia improved goat production by women has proved very successful, particularly for women-headed households. The strategy for own-consumption agricultural production should be to ensure food security. The long-term Government strategy is to improve

accessibility to markets through feeder road and farm to market road construction and market access will improve.

(b) On-farm Interventions

Improved Soil Husbandry: The use of manure and compost increases soil organic matter and nutrients and increases water holding capacity. This intervention requires sufficient quantities of manure and residues, and labour. These interventions need to integrate with improved animal husbandry interventions.

Chemical fertilizer: This will be confined to areas with good market access and to cash crops (teff, vegetables).

Improved tillage: Contour ploughing assists in reducing runoff and soil movement.

Grass Strips: The very high rainfall intensities and high overall rainfall cause waterlogging behind physical structures. Vetiver grass strips have proved very success in these high rainfall areas as they allow excess surface water to filter through slowly.

On-farm Forage Development: Backyard improved forage: forage grasses (e.g. including but not limited to *Pennisitum purpureum*, *Panicum maximum*), tree legumes (*Leucaena leucocephala*) and pigeon pea. The focus of the intervention is on improving small ruminant productivity.

On-farm Tree development: In areas with good market access trees for timber and fuelwood as well as fruit trees (citrus, avocado and mango) would be promoted. In areas with poor market access on-farm tree production for timber will be for own consumption only. However, there is the potential for fruit trees as citrus, avacados and mangos will bear transport costs.

On-farm Water Harvesting: Rainfall is variable and there is potential for water harvesting interventions to provide domestic and livestock water supplies as well as backyard irrigated vegetables.

(c) Interventions on Communal Lands

Cut-off Drains: A pre-requisite for in-farm soil conservation measures is a cut-off drain above cultivated areas. Even by themselves they can reduce in-field run-off and soil movement.

Road and track drains: run-off from roads needs to be controlled with small check dams and safe outlets to streams.

Gully Stabilization: This requires the integrated stabilization of both the gully and its watershed area. This will require a combination of livestock exclusion (in both watershed area and gully), and vegetative and structural measures (check dams, etc) within the gully. This intervention can be integrated with a communal forage development programme.

Communal Forage Development: To be effective and sustainable this best undertaken at the sub-kebelle (tabia) level. This intervention usually requires some form of area closure with cut-and-carry, or controlled grazing or controlled hay production and harvesting. The site of the intervention can vary from steep and degraded hillsides, poorly drained valley bottoms, and stream edge buffers. A key object is to reduce livestock movement. The process of natural re-generation can be supplemented with over-sowing of herbaceous (*Pennisitum purpureum*, *Panicum maximum*) or tree legumes (*Leucaena leucocephala*) and pigeon pea but this increases costs. The intervention can also be integrated with communal tree production.

Small-scale Supplementary Irrigation: For high value non-perishable marketable crops (onions, garlic, peppers) using supplementary irrigation for maximum area (given good storability season price fluctuations are small).

(d) Other Strategies

Honey production: In densely populated areas where land is short honey production is not affected by land or cash constraints. Improved hive can substantially increase production.

5.4 Other Strategic Interventions

5.4.1 Improving Rural and Urban Domestic (traditional/biomass) Energy Systems.

The focus here is on domestic biomass (or “traditional”) energy sources. “Modern” energy sources are considered only in respect of their role as substitutions for biomass sources.

The reason for this focus on biomass energy is because of its very large contribution to household energy consumption, even where modern energy

sources (electricity, LP gas, kerosene) are available. This is because a large proportion of household energy is used for cooking and the relative total costs of using biomass fuels for cooking is often lower than modern fuels, particularly when the capital costs of modern energy stoves are taken into account. The widespread and increasing total consumption (with rising population) of biomass fuels has obvious implications for vegetation cover and land degradation. The continued use of biomass fuels and emissions of smoke and corrosive gases in enclosed kitchen spaces also have very important implications for the health of women and children.

Many recent studies of rural (and to a much lesser extent urban) energy consumption have revealed an often complex spatial and seasonal patterns to the various biomass fuels consumed (wood, charcoal, crop residues and cattle dung). Generally there is a clear distinction between rural and urban household consumption patterns with the consumption of a higher proportion of modern energy, and within biomass fuels of charcoal.

WBISPP (2005) surveys indicate that women and girls are most involved in collecting biomass (mainly wood) fuels. They spend on average 6 and 3 hours per week respectively collecting biomass fuels, compared with one and half hours per week for men and boys. Women spend an additional 14 hours a week transporting biomass fuels. Boys and girls spend on average 6 hours and men 2 hours per week transporting biomass fuels. The burden of collecting and transporting biomass fuels involves considerable energy - most particularly on children and women. This has negative impacts on nutrition. The considerable time spent on collecting and transporting fuel means less time for other activities (child rearing) and rest. In addition, women and children are exposed to natural hazards and injury.

A number of strategies are proposed. In summary these are:

Improved Mitads: The annual reduction in wood use for mitad baking is 20%.

Lakech Charcoal Stove: publicity campaigns by Regional Bureaus of Rural Energy to maintain the momentum of stove adoption.

Improved ceramic '*gounziye'* Stove with an annual fuelwood saving of 30%.

5.4.2 Improving Rural-urban socio-economic linkages in the context alternative livelihoods.

The proportion of households dependant on agriculture in Ethiopia is 85 percent although the contribution of agriculture to the country's GDP is only 45 percent and declining, with the Service and Industrial sectors providing the remaining and

increasing proportions. Much of the latter's activities are taking place in the major urban centres, but also in the small and intermediate centres.

Experience in Ethiopia and elsewhere suggest a number of possibilities for small and medium sized urban centres (Barret et al. 2001, World Bank, 2004). These include:

- Increasing rural agricultural income by acting as demand and market nodes for agricultural produce from rural hinterlands.
- Reducing costs and improving access to a range of public and private services and goods from within and outside the immediate region by acting as a centre for production, processing and distribution of goods and services to rural hinterlands.
- Becoming centres for growth and consolidation of non-farm economic activities and employment for rural residents through the development of small and medium size enterprises or the relocation of branches of large private or public enterprises.
- Attracting rural migrants through the demand for non-farm labour.

A study on employment and labour mobility in Ethiopia RESAL-Ethiopia, 1999) concluded that migratory labour is an important source of additional income for poor rural households and likely to play an increasing role as a coping mechanism for households facing food insecurity. It noted that little attention has been devoted to this topic than hitherto. Another study in Ethiopia (Berhanu Nega, 2004) also noted that the development of the non-agricultural sector in general and the issue of urbanization in particular should be taken very seriously. The study questioned whether development of the agricultural sector by itself could serve as the engine of growth for industrialization.

A number of key strategies have been identified:

- Develop and improve access to markets through improved road and other forms of communication (e.g. telecommunications);
- Improve access to capital and credit sources;
- Provide basic technical skills (e.g. bricklaying, carpentry, etc.) to improve employability;
- Provide support to traders through improved working capital and credit (they provide the link between farmers and non-farm activities and between local, national and international markets).

Together with accessible markets, access to credit and input supplies are main ingredients for rural development. Despite a number of efforts in the past, all

three are poorly developed, let alone their appropriate linkage. The Millennium Development Goals Needs Assessment Report (Seme Debela et al., 2004) reports, that “consumption levels of fertilizers and pesticides are one of the lowest in the world, and that there is an enormous potential for agricultural development if inputs are made available timely and at affordable prices and acceptable quality and quantity, supported with favourable policy environment.”

As far as credit and inputs are concerned, it is very difficult to get out of the vicious circle of poor farmers, high interest rates of private credit providers, low reimbursement rates, limited government capacity to provide soft loans, and non-sustainability of incidental soft loan systems through projects/programmes with a limited duration. Bad experiences in the past (failures of blanket-wise input promotion not suited to all conditions) have made farmers even more reluctant to take credits for agricultural investments.

The importance of micro credit is emphasized by many. Ready-made solutions to the credit/supply issue do not exist but a number of preconditions need to be considered:

- more site-specific extension messages need to be developed as to replace previous blanket approaches,
- extension and input supply systems should become more problem-oriented and demand-driven,
- both the demand and supply side should develop in line with market-oriented agricultural development,
- supply systems should be developed by the private sector and not by government,
- institutional development at grassroots level should be promoted to better represent farmers' interests (appreciation of extension messages, knowledge of the market, negotiating interest rates).

Successful examples of credit supply (e.g. by Menschen für Menschen in Merhabete, Mida and Dera weredas in Abbay basin) are based on short term inputs, like providing a starting capital, with appropriate institutional arrangements for long term application. Institutional arrangements need to be based on existing (banking) structures. Revolving funds created and managed by some NGOs within the framework of their ongoing activities are likely to collapse after phasing out of the project.

A number of overall policy issues have been identified as of considerable importance in relation to local economic development in small and intermediate urban centres (Satterthwaite & Tacoli, 2003). These support and reinforce some of the issues previous identified. They include:

- Transport and communications infrastructure are very important although of themselves will not guarantee local economic development.

- Decentralization has great potential in terms of efficiency and accountability but there are a number of cost and other considerations. In particular there is a need to address: (i) access to adequate financial resources, (ii) a favourable climate for local institutions (e.g. land tenure systems, institutional structure of markets, a broader national development strategy that is export orientated).

- Better integration of local, regional and national planning.

- Capacity building of local institutions especially where decentralization is recent.

- Strengthening of local democracy and civil society to make it easier for poor groups to have their needs taken into consideration.

5.5 Monitoring and Evaluation

5.5.1 Data Gaps

During the preparation of this Report it has become apparent that there is a vast amount of data appropriate for watershed management planning available in Ethiopia. The work of the Soil Conservation Research Project laid the foundations of research into soil erosion. Work at the University of Makelle under the joint programme with the KU Leuven, Belgium is continuing this pioneering work. In the MWR the River Basin Master Plan Studies of the Abay, Tekezi and Baro-Akobo River Basins are a mine of data and information for watershed management. From the MARD the GIS and socio-economic database of the WBISSP also provide a substantial set of data.

However much of this data are quickly becoming out of date or the data which is available is fragmentary in time and place. Two main areas of data that require to be filled are (i) Aggregated maps of all Watershed Management Activities, (ii) detailed landcover mapping, and (ii) long-term and consistent sedimentation data at various scales. These are considered in more detail below.

A third area that requires more research (rather than monitoring) is in the field of poverty and livelihood strategies, and relationships between sustainable land management and determinants of farmers' investment decisions. The substantial work undertaken by Ethiopian Research organizations and the CGIAR group

over the past decade is to be continued and will provide much relevant data that will effectively inform policy and strategy development in sustainable watershed management.

5.5.2 Aggregated Maps of Watershed Management Activities

A key element in the success of the Loess Plateau Watershed Management Project in China was a series of maps that recorded areas that had been covered by WSM activities, allowing the effective programming the remaining areas and effective monitoring of areas already covered (ITAD, 2006)).

A key element missing from the WSM Projects in Ethiopia has been the lack of an over map indicating areas that have been covered by the various WSM interventions. Thus, whilst there is considerable data on the thousands of kilometres of bunds and terraces constructed this is never translated into areas of cropland and grazing land conserved with details of their located. There is anecdotal evidence of some areas being covered two and more times with SWC measures.

WSM Maps are generally constructed at the micro watershed level as part of the over micro watershed planning. Existing maps need to be geo-referenced and all future maps routinely geo-referenced. These can then be delineated on an overall Watershed Management Map that can clearly indicate progress to-date and allow critical areas requiring treatment to be prioritized. These maps can be subsequently used in a cost-benefit analysis to determine economic benefits accruing. Using sediment research data from Makelle University (Nigussie Haregeweyne et al., 2005) demonstrated that measurements can made at the micro watershed level on sediment delivery to the drainage system. The M&E Project within the Tana-Beles Project has clearly demonstrated that integrated livelihoods, WSM activities and Sediment/hydrology monitoring can be effectively implemented.

5.5.3 Land Use and land Cover

The objective of establishing a land use /land cover monitoring system is to capture the dynamics of landcover and land use in terms of location. Knowledge of the rates of conversion of forest, woodland and shrubland to agriculture and on the specific locations and extents of these conversions would also be a great value in evaluating and reformulating policies and plans on watershed management. In addition the results could be used for monitoring:

- agricultural and rural development;
- domestic bio-energy supply;

- forestry and woodland management and conservation:
- resettlement planning, implementation and monitoring;
- disaster preparedness planning and monitoring;
- water development;
- many other facets of natural resources management and conservation.

A reduction in the resources required could be achieved if a more focused assessment was made of landcover changes in key thematic and geographical priority areas. These might include but be not limited to:

- Assessing landcover changes in key Sub-watersheds as an input to analyzing household energy supply changes, sedimentation rates and changes in flood frequency and the need for developing micro-watershed management plans and activities;
- Assessing changes in forest cover in the forest and woodland areas on the frontiers of agricultural expansion;
- Assessing landcover and woody biomass changes in reception areas where voluntary resettlement is being undertaken;
- Assessing woody biomass changes in areas of high-intensity agriculture to monitor on and off farm tree and shrub cover;
- Assessing landcover and woody biomass changes in areas of active expansion of Commercial agriculture.

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- Assessing landcover changes in valley bottoms and impacts on food security, woody biomass, biodiversity and hydrology.

5.5.4 Erosion and Sedimentation Control

The MWR has an extensive network of gauging stations a substantial proportion of which are capable of obtaining data on sediment load. A three years project "Assessment and monitoring of erosion and sedimentation problems in Ethiopia" came to an end in June 2002. The main activities of the project aimed at establishment of "an operational erosion/sediment monitoring network".
A number of recommendations were made which are of relevance to the present project:

- appropriate monitoring in micro-watersheds still requires substantial, and partly specialised, inputs,

- monitoring should preferably cover the period before, during and after watershed treatment and dam construction,

- substantial capacity building is still required to allow MoWR to become a leading agency in guiding watershed management activities, and

The objectives of such a long-term monitoring programme would be to:

- To develop and test a monitoring methodology for micro-watersheds to provide information on erosion and sedimentation

- To improve MoWR's capacity in monitoring and in guiding watershed management, and

- to elaborate guidelines for monitoring, sustainable watershed management, and impact assessment;

In order to achieve these objectives a number of activities were proposed.

1. Develop a long-term monitoring strategy including
   - consolidation of hydro-sedimentological network operation
   - rational extension of network of benchmark station in large basins
   - integration of project data into national hydrological database
2. Select, procure and supervise installation of equipment for modest network extension or intensification
3. Assist in preparation of Hydrological Yearbooks
4. Design monitoring devices, e.g. flumes, at the outlet of micro-watersheds/ inlet of reservoirs
5. Define related monitoring requirements such as basic meteorological stations, bathymetric surveys
6. Select and procure monitoring equipment for micro-watersheds
7. Supervise the installation of monitoring devices in pilot micro-watersheds
8. Identify qualified partners for monitoring activities in micro-watersheds
9. Develop and support the first phase of a monitoring programme using verifiable impact indicators
10. Assist in the formulation and execution of a balanced pilot implementation programme in pilot watershed(s), including
    . selection and training of an implementation partner
    . implementation of priority sites/areas for watershed treatment
    . formulation and initial implementation of a sustainable watershed management programme
11. Identify possibilities for linking up monitoring of large basins with smaller watersheds (this would be most relevant within the framework of river

basin development, and not necessarily at the national level of river basin monitoring)

12. Train and coach staff at federal, regional and local level in network operation (tools and operation procedures), data collection and data dissemination
13. Propose/ carry out a training programme aiming at
    - general WSM capacity building in MoWR (internal workshops, seminars with other agencies, formal training, on-the-job training, field work training)
    - transfer of know-how in all activities carried out in micro-watersheds
14. Develop guidelines for national network operation, based on lessons learned
15. Develop procedures for dissemination of monitoring data
16. Assist in the development of guidelines for planning of WSM activities
17. Prepare guidelines for monitoring the impact of watershed protection activities

6. Distribution of Benefits

There are a number of local, regional and global benefits:

At the local level degradation of the natural resource base would be arrested, sustainable livelihood development would be supported and levels of poverty reduced.

At the regional level the soil and conservation measures would significantly reduce sediment loads in the river systems contributing to reduced sedimentation in dams and reservoirs downstream, reducing sedimentation in irrigation canals and reducing costs of water purification for domestic and industrial water supplies.

At the global level sequestration of carbon would be increased in wood and herbaceous biomass and also in increased levels of soil carbon. Plant genetic and plant species biodiversity would be enhanced.

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ANNEX 1. BASIC INFORMATION ON THE DELINEATED MICRO-WATERSHEDS

I. Chemoga Watershed

1	**Region:**	Amhara
2	**Zone:**	East Gojam
3	**Contact Location:**	East Gojam Office of Agriculture
4	**Persons contacted:**	• Fantahun Abita (Deputy Office Head); • Alene Goshu (SWC Expert • Assefa Reda'e (Livestock Coordinator); • Esmelalem Meheret (Forester)
5	**Contact address:**	Fantahun Abita. Mobile 0912 029717
6	**Micro-watersheds major land use/cover (estimate):**	• Cultivate land (60%); • Grass land (17%) • Forest-plantation & natural (3%); • Bush land (7%); • Bare land (10%) • Settlement (3%).
7	**Noticeable environmental trends since early 1980s:**	High rate of deforestation; cropland expansion, decreasing size of grassland cover; formation of gullies and bare land, depletion of surface water, etc
8	**Major challenges:**	• High rate of population growth; • Short and erratic rainfall; • Crop failures; • Massive land degradation due to soil erosion and absence of appropriate land management practices; • Decreasing land productivity and production; • Shortage of livestock feed, decreasing livestock population; Widening food insecurity; • Rampant animal disease and pest, etc.
9	**Interventions presently underway :**	• SWC (both physical and biological-at slower pace; • Area closure; • Reforestation; • Agro-forestry practices (planting highland lowland fruits); • Small scale irrigation.
10	**On-going investment projects:**	• Private agricultural investment in lowlands (sesame farms);; • Town dairy and fattening, • Small scale poultry.
11	**Existence of NGOs operation in the selected micro-**	Only one NGO called Migbare Senai in one Kebele (Gonzamin Enerata); SLM activities under implementation in Gonzamin and

	watersheds:	Aneded Weredas with limited scale of operation.
12	**Reasons for selecting the micro-watersheds:**	• For reduction of gully formation and reduction of soil loss and erosion rate; Areas key for expected positive impact on the Renaissance Dam if rehabilitated and protected; • Improvement of forage availability; • Improvement of livelihood systems in the area; • General bio-diversity improvement.
13	**Development potentials in the selected micro-watersheds:**	• Forest and general plantation cover; • Feed/forage; • Eco-tourism; • Small scale irrigation; • Livestock.