EASTERN NILE TECHNICAL REGIONAL OFFICE

NBI – Institutional Strengthening Project
PROJECT DELINEATION AND PRIORITIZATION
MAIN REPORT
ANNEX 4: PROJECT REPORTS
(FINAL REPORT)

4th June, 2011

EASTERN NILE TECHNICAL REGIONAL OFFICE




NBI – Institutional Strengthening Project

PROJECT DELINEATION AND PRIORITIZATION

ANNEX 4.1

ZAMRA-ARAQUA WATERSHED PROJECT

(FINAL)

7th June, 2011

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 of these had regional and global benefits. Many of the

[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.

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.

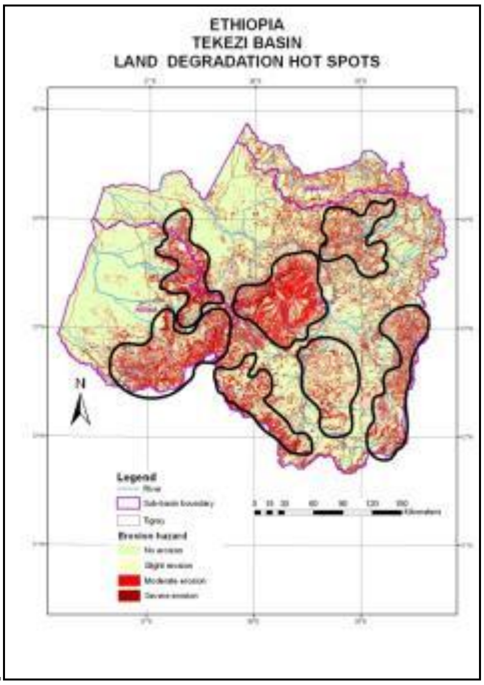
The main criteria for the selection of the Investment Projects was that they addressed current threats to natural resource degradation in ways that negatively impacted on local household livelihoods and also negatively impacted on downstream river users.

This Report is concerned with nine of the Investment Projects located within the Main Nile Sub-basin, the Tekeze-Atbara Sub-basin and the Baro-Akobo-

Sobat Sub-basin. Those Projects identified in the Abay-Blue Nile Sub-basin are being considered separately. This Project document is concerned with the Zamra-Araqua Watershed located in the Tekeze-Atbara Sub-basin in Ethiopia.

1.2 Primary Objectives of the Project

The Watershed Management CRA identified a number of land degradation hotspots in the Tekeze Sub-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. Tekeze 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 low agricultural potential in the Zamra and Arequa Watersheds of the Tekeze Sub-basin, strengthen household and community livelihood strategies and contribute to the alleviation of poverty.

1.3 The Scope and Elements of Sustainable Watershed Management

River 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	Zamra	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 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)

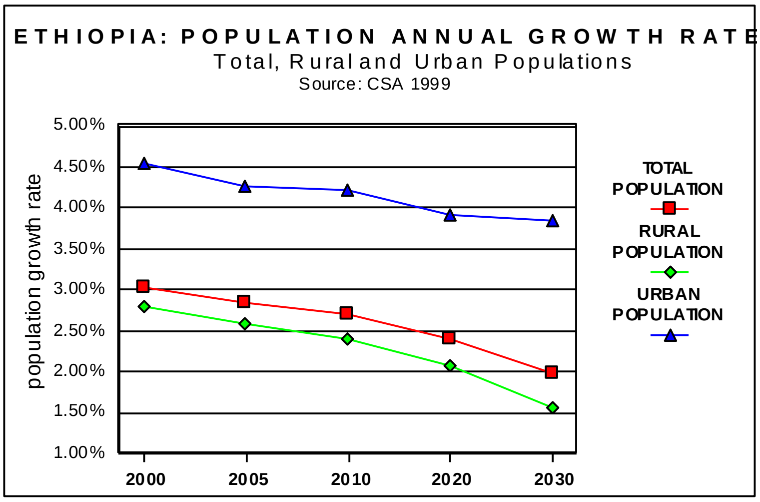
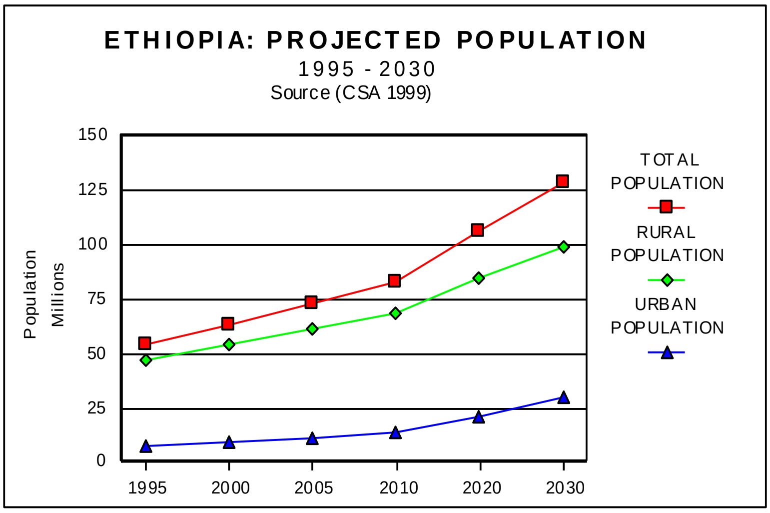
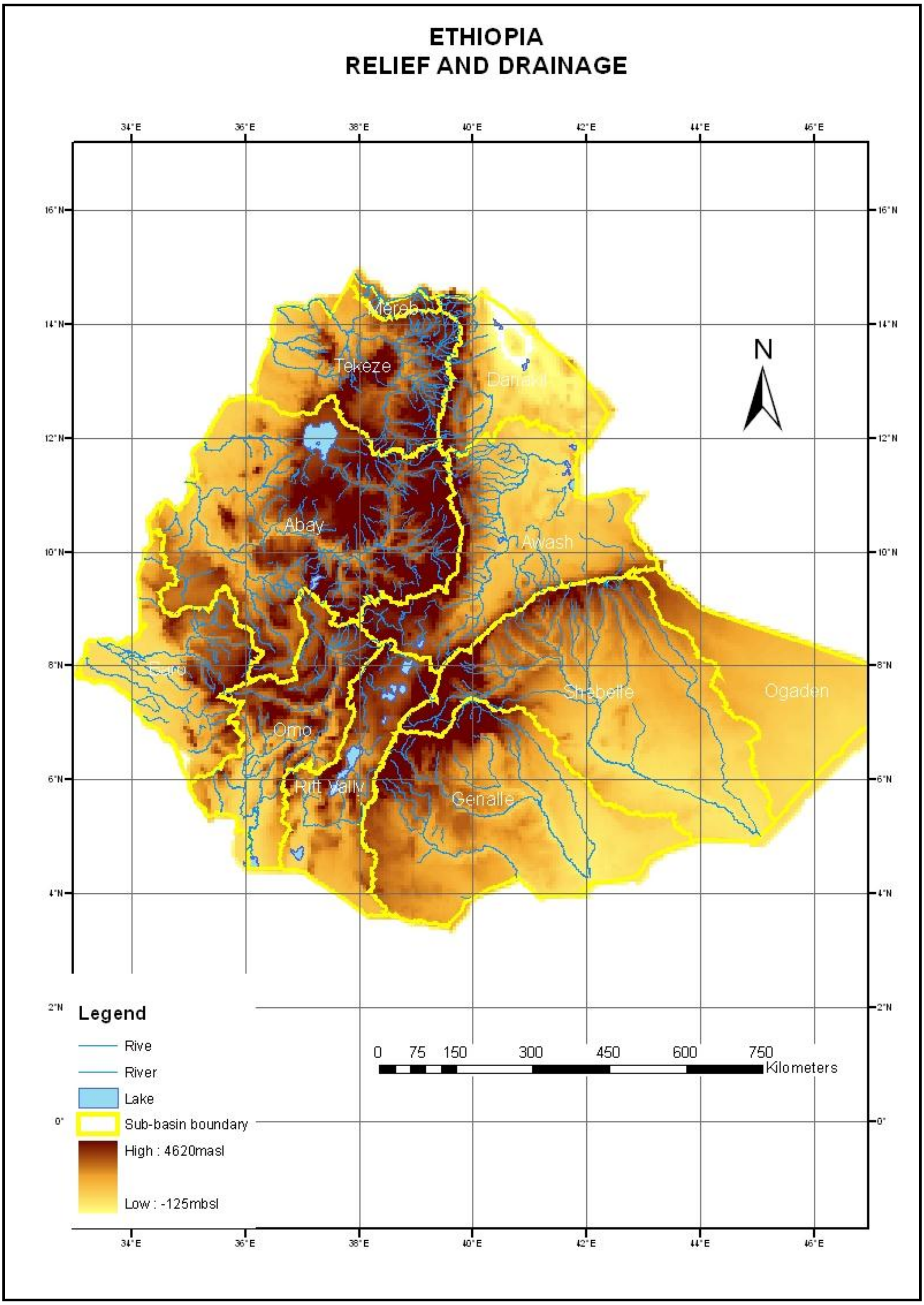


Figure 2. Rural, Urban and Total Population (1995 - 2030)





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

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

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.

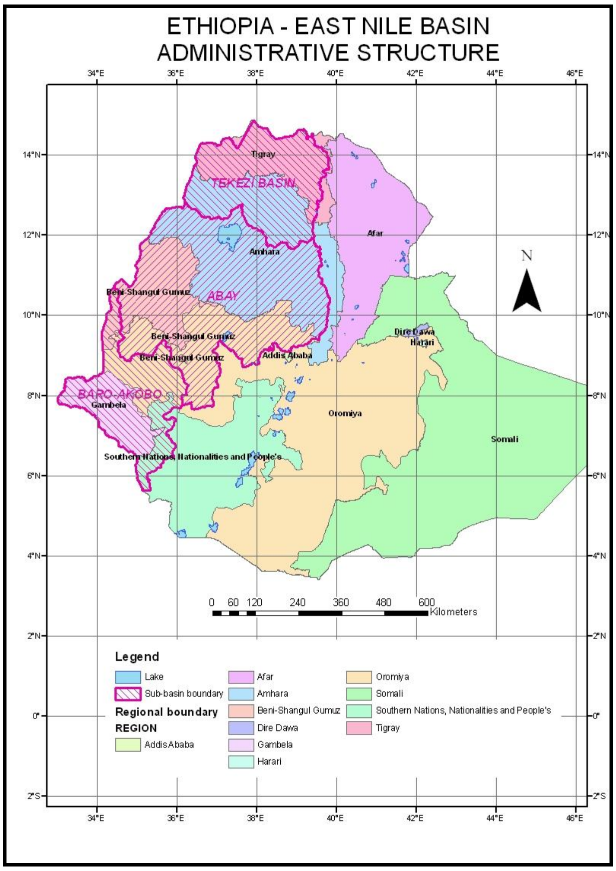
In the high rainfall areas of the southwest and southeast highlands the original vegetation of the highlands was broad-leaved montane high forest. Further north with lower rainfall this changed to a mixed coniferous forest (Podocarpus spp. and Juniperus spp.) and woodland. In the driest parts of the 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 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)
- (a similar proclamation has been issued for Tigray but is not available in English).

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:

- Water Resources Development: water harvesting

- 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 Oromiya 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 Oromiya 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 Tekezi 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). Nevertheless, in recent years the uptake of soil and water conservation measures has been impressive and in many areas of Tigray the rate of adoption exceeds 40 percent of farmers[3]. This has been mainly due to the visible impacts of the increase in soil-water conservation, risk reduction and significant crop yield increases. 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:

[3] See figure 3 “Terracing in the Ethiopian Highlands”, in Mahmud Yesuf & J. Pender “Determinants and Impacts of land management Technologies in the Ethiopian Highlands: A Literature Review - Draft”, EEPFE and IFPRI.

- 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).

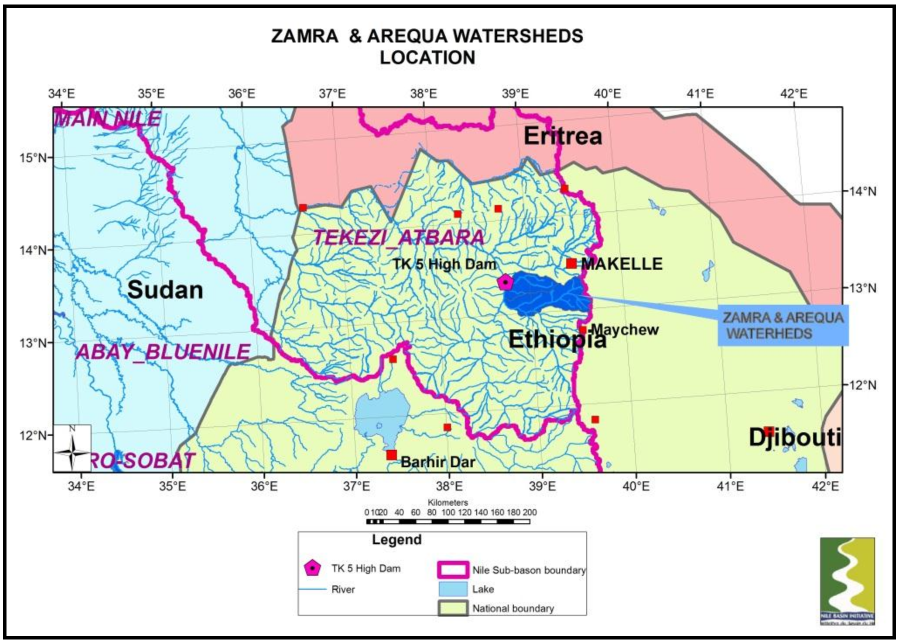
3. ZAMRA-ARAQUA WATERSHEDS - BIOPHYSICAL AND SOCIO-ECONOMIC SITUATION

3.1 Biophysical Characteristics

3.1.1 Location and Extent

The Zamra and Arequa Watersheds are located in the opper part of the Tekeze-Atbara Sub-basin (See Map 5). The area of each watershed is is 3,733ha and 1,288 ha respectivey. They are sub0-divided into 10 sub-catchemets as follows:

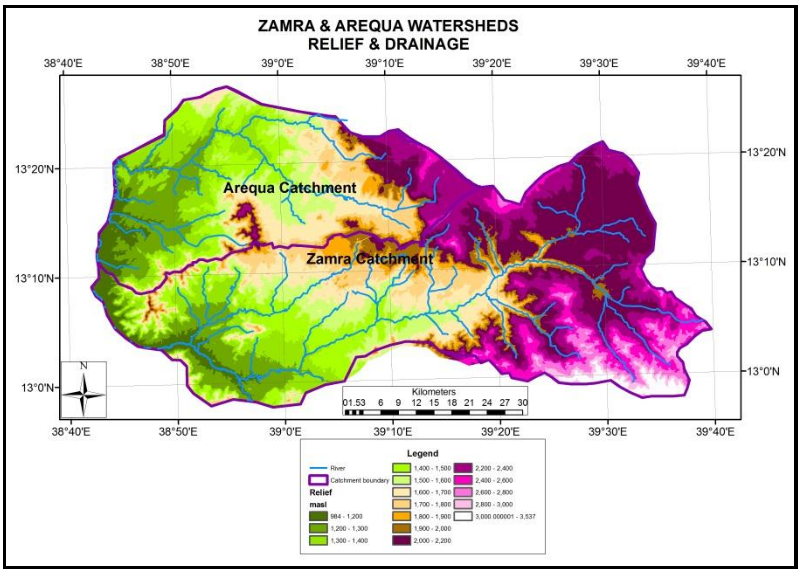
Sub-watershed	Area (km2)
Zilu	350
Nebri	426
Shaho	128
Kurkura	250
Lower Tirare	552
Lower Zamra	419
Neway Terera	371
Upper Arequa	729
Lower Arequa	299
Upper Tirare	215
	3,739



Map 4. Location of Zamra and Arequa Watersheds

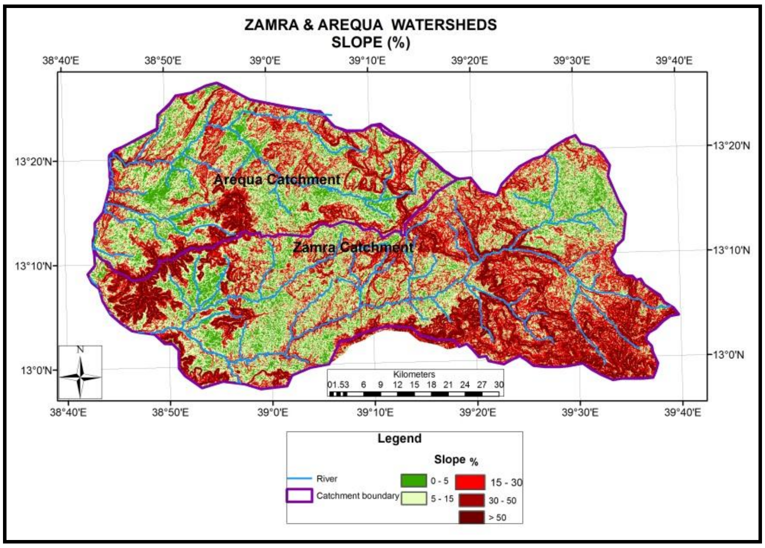
3.1.2 Relief and Drainage

An undulating plateau is found in the upper Zamra Watershed above 2,000masl with isolated ridges reaching upto 3,000masl in the upper Zamra watershed (see Map 5). Below the plateau are undulating sandstone plains and low hills on ancient meta-sediments below 1,500 masl. The sandstone plains have a series of steep ridges rising to 1,900 masl.



Map 5. Relief and Drainage

The two Watersheds are separated by a steep-sided sandstone ridge. The high plateau and the Lowland plains and hills are separated by a steep escarpment (see Map 6). Very steep slopes are found in the southeastern part of the Zamra Watershed

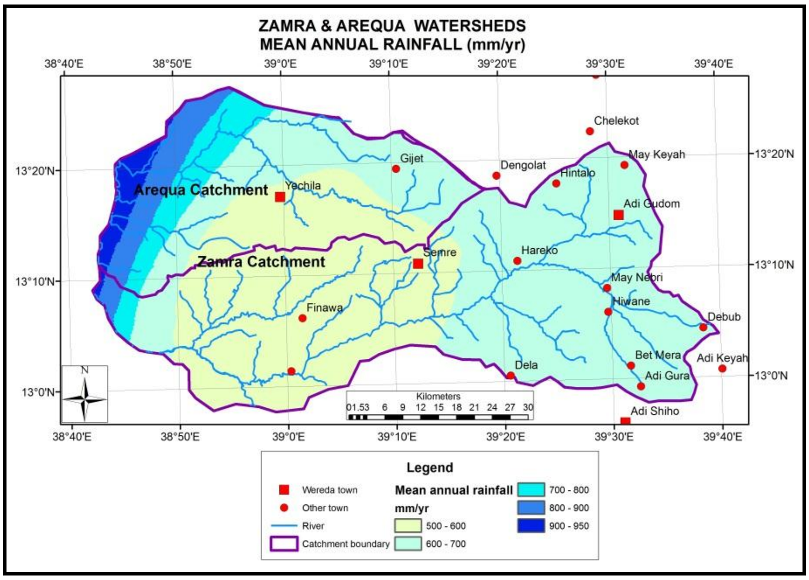


Map 6. Slope Map (%)

3.1.2 Climate

(I) Rainfall

Mean annual rainfall over most of the two watersheds is between 500 and 700 mm/yr with considerable inter-annual variability. Rainfall increases in the west towards to Simien mountains (Map 7).

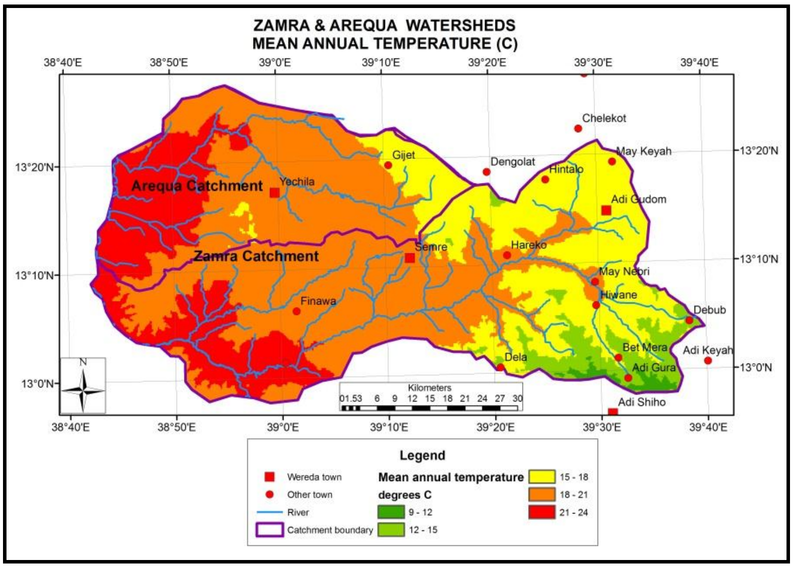


Map 7. Mean annual rainfall

The rainfall pattern is bi –modal with the short (*Belg*) rains between February and April, and the main (Krempt) rains from July to September.

(ii) Mean annual temperature

Mean annual temperature is inversely related to altitude. Thus, the lowest temperatures (12 - 15°C) are found at higher altitudes on the eastern side of the Watersheds, whilst the highest temperatures (21 - 24°C) are found in the lowest part of the Tekeze valley.

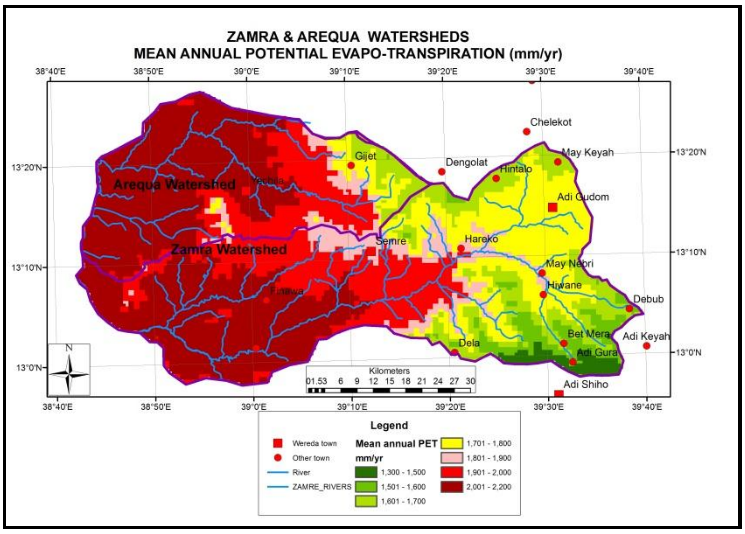


Map 8. Mean annual temperature (degrees C)

(iii) Mean Annual Evapotranspiration

The pattern of mean annual evapotranspiration follows that of mean annual temperature and closely related to altitude (Map 10) with lowest rates (1,300 –

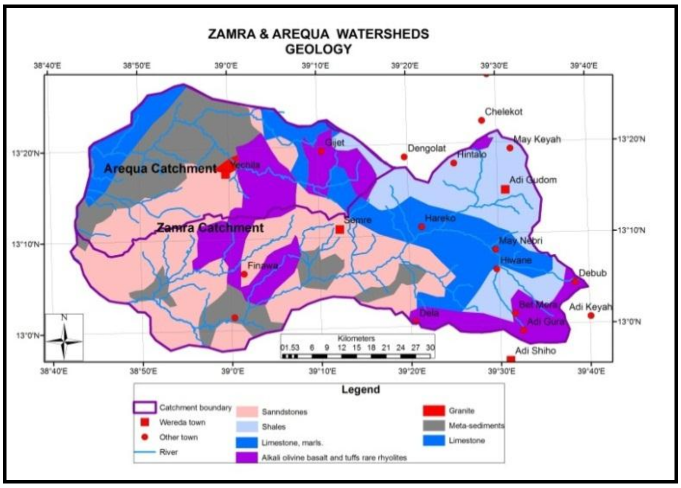
1,600mm/yr) in the upper Watershed and highest rates (2,000 – 2,200 mm/yr) close to the Tekeze River.



Map 9. **Mean annual evapo-transpiration.**

3.1.3 Geology

The upper parts of the Watersheds are underlain by shales and limestones, with the limestones forming the distinctive relief and the shales the plains (Map 10). Below the main escarpment the southwestern lowlands are underlain by red sandstones, which form extensive plains with isolated ridges and steep sided hills. The northwestern lowlands are underlain by meta-sediments (slates, shales, schists) which gives rise to rounded hills.

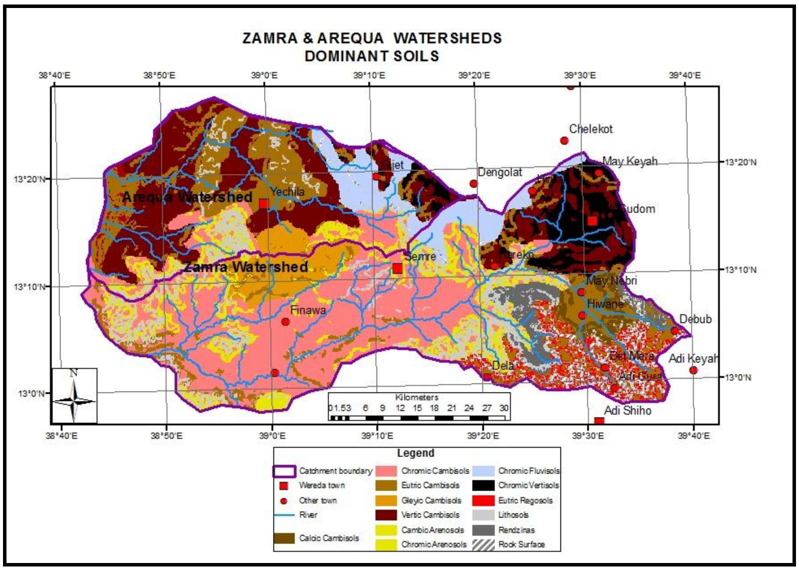


Map 10. **Geology**

3.1.4 Soils

Soils strongly reflect the underlying geology (Map 11). Chromic Cambisols overlie the red sandstones of the lower Watershed and whilst eutric and vertic Cambisols overlie the dark coloured shales and meta-sediments of the northwestern part of the Watershed. Vertisols and vertic Cambisols are found on the very flat slopes over the dark coloured shales of the northeastern part of the Watersheds.

Fluvisols are derived from river alluvium and are found in the wide valleys of the upper Watershed. Arenosols (very sandy), lithosols (shallow and stony) and Regosols (shallow and poorly developed) are all found on the very steep slopes of the meta-sediments, sandstones and limestones in association with bare rock surfaces.



Map 11. Dominant Soils (FAO Classification)

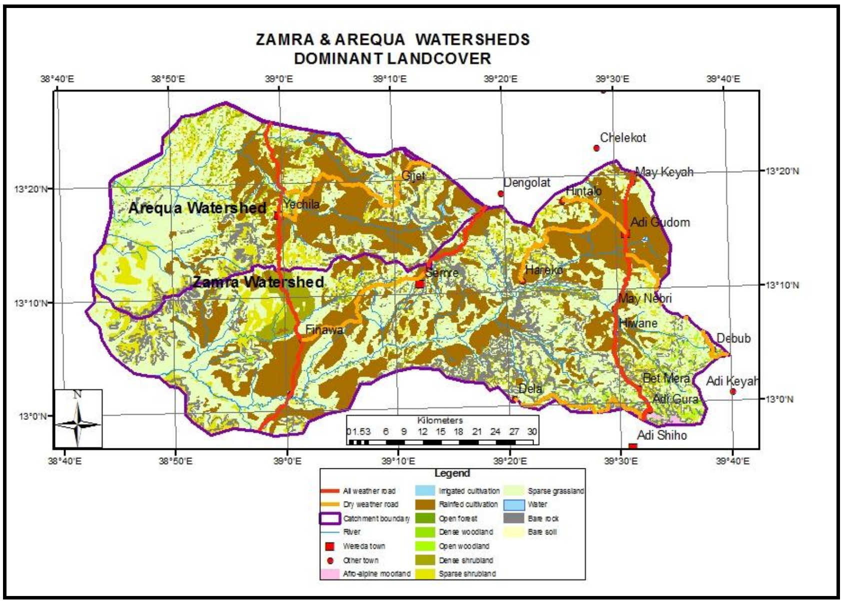
Vertisols have a high clay content and thus the highest water holding capacity (150mm per meter), although they are difficult to work when dry. Their fertility is high although with a phosphorous deficiency. Vertic Cambisols can be found in close association with Vertisols and have very similar features. Fluvisols have medium textures with a water holding capacity of 100mm per meter and are of high fertility and are often used for small-scale irrigation.

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 12. The most widespread (53% of the area) landcover is sparse grassland, which covers the steeper slopes and the low rainfall area near the Tekeze river. Rainfed cultivation covers 21% of the area followed by sparse shrubland. Bare rock covers 6% of the area) and dense shrubland some 5% of the area). These landcover types constitute 98% of the total watershed area.

Table 2. Zamra and Arequa Watersheds: Dominant Landcover (km2)

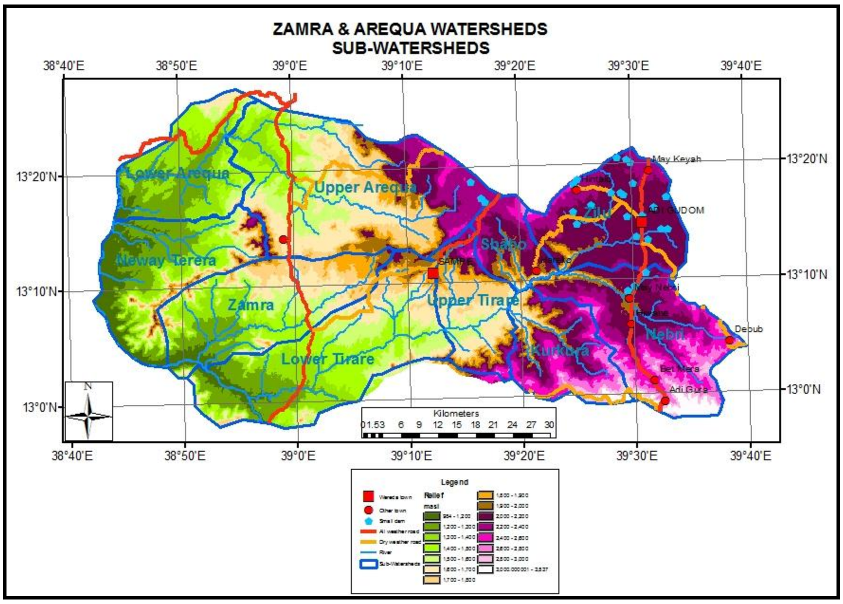
LANDCOVER	AREA_KM2	AREA_%
Sparse grassland	2,741	53.3%
Rainfed cultivation	1,093	21.2%
Sparse shrubland	506	9.8%
Bare rock	437	6.2%
Dense shrubland	264	5.1%
Open woodland	72	1.4%
Irrigated cultivation	10	0.1%
Afro-alpine morrland	6	0.1%
Bare soil	5	0.1%
Water	4	0.1%
Open forest	4	0.1%
Dense woodland	3	0.1%
TOTAL	**5,145**	



Map 12. Dominant Landcover

3.1.6 Water Resources

The two main Watersheds have been divided into ten Sub-watersheds: three are located in the Arequa Watershed and seven in the Zamra watershed (Map 13). There are three main rivers: Arequa, Zamra and Tirare. In the EMA 1:250,000 topographic map sheet the name “Zamra” appears on a three separate streams, including a tributary of the Tirare River. The name “Zamra” has been retained for the Sub-Watershed located between the Arequa and the Tirare Sub-watersheds.



Map 13. Sub-Watersheds

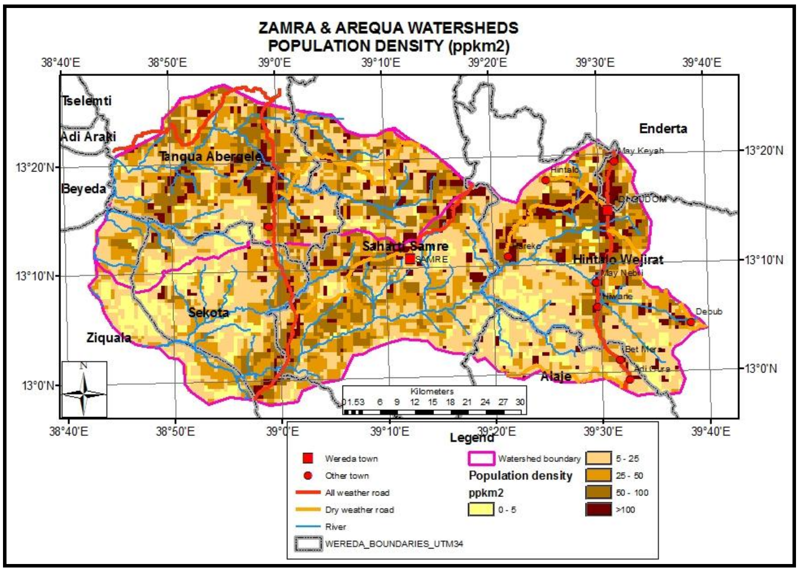
3.2 Population Distribution

The two watersheds fall within (but not wholly within) five Woredas: Alaje, Enderta, Hintalo-Wajirat, Seharti-Samre and Tanqua-Abergele. The 2007 rural populations (PCC, 2010) of these woredas are shown in table 3.

Table 3. Total population, households, population density and household size within Zamra and Arequa Watersheds.

WOREDA	TOT_POP	HH	HECTARES	POP_DEN	HH SIZE	NO KEBELLES
ALAJE	47,904	10,811	23,582	203	4.43	8
ENDERTA	13,529	2,984	1,870	723	4.53	2
HINTALO WAJIRAT	99,925	22,441	61,361	163	4.45	13
SEHARTI SAMRE	95,538	20,465	58,700	163	4.67	15
TANQUA ABERGELE	44,279	9,569	24,605	180	4.63	7
TOTAL	**301,175**	**66,270**	**170,118**	**177**	**4.54**	**45**

The spatial distribution is shown in Map 14.



Map 14. Population Density and Distribution

A noticeable feature is that the roads follow the highest population densities. In addition densities are higher along the Tirare river and on the plains in the northwest part of the Arequa Waterhsed.

3.3 Farming Systems

Three farming systems have been recognized within the two Watersheds (WBISPP, 2003) based mainly on their cropping systems. These in turn are mainly related to altitude and mean temperatures during the growing periods. These are as follows:

Wheat – Barley Farming System: is found mainly above 2,500 masl. Only barley is found above 2,900 masl. Average farm size ranges from 0.9 ha in Tigray to 1.3 ha in Amhara Region, although the distribution is skewed to the smaller farm size. More than 80 percent of households have 2 or more plots, although where there is considerable variation in land quality this helps to spread risk. Rainfall is extremely variable and soils are generally of low fertility and as a consequence crop yields are lower and more variable than the national average. There is a major structural (i.e. permanent) grain deficit in this farming system ranging between 240 and 580 kgs of grain per family. Some grain is purchased from sales of livestock. Increasingly, deficits are being made up from food aid and food for work. Cattle are important as providers of draught power and manure, and small stock ready sources of quick cash.

Teff-Maize-Sorghum-Finger millet Farming System: is found between 1,500 – 2,500 masl. Average farm sizes are 1.22 ha. Crop yields are low and households generally have a deficit of 96kgs. As in the previous farming system some grain is purchased from sales of livestock. Increasingly, deficits are being made up from food aid and food for work.

Ox:cow ratios vary between 1.35 to 1.47 indicating an emphasis on draught power. Cattle herd sizes are between 3.6 and 4.2 animals. Sheep to goat ratios are lower at 1.7 indicating a larger proportion of goats. In many areas hay on private plots is an important source of livestock feed.

With respect to on-farm tree planting 53 percent of trees are indigenous and only 46 percent Eucalyptus, with 78 Eucalyptus trees per farmer. Over the past 15 years Eucalyptus planting started much later than in Amhara region but has since steadily increased, although at much lower rates to a current 14 trees/annum.

Lowland Sorghum – Millet – Teff Farming System: This system is found below 1,500 masl. Sorghum dominates the crop mix, followed by finger millet and teff. Sesame dominates the pulses. Crop production in an average year provides a daily per capita calorie supply of 1,912 Kcals a deficit (of the 2000 Kcals minimum requirement) of 88 Kcals. This is equivalent to a deficit in grain equivalent of 51 kgs per annum per farm family.

More households own cows than own oxen. The ox: cow ratio is 0.82 indicating an emphasis on milk in this farming system. The goat:sheep ratio of 43.2 indicates a clear preference for goats in the system.

3.4 Social Infrastructure

The data of health infrastructure and health status for the whole of the Tekeze 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. Tekeze Basin: Details of health Infrastructure and Workers.

BASIN/REGION	Health Professional/'000 pop.	No. Health Professionals	Health Infrastructure (hospitals, clinics, dispensaries/'000 pop.	No. of health infrastructures
TEKEZI BASIN	2.53	7,499	0.08	**24**

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 3 where there is a very high rate of immunization in Tigray region.

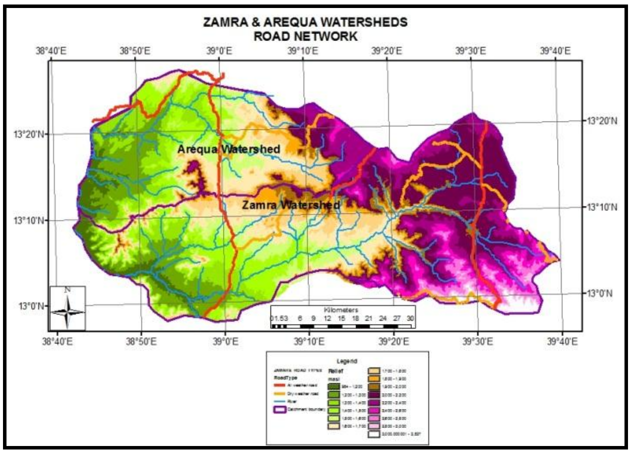
Malaria is prevalent below 1,500 masl and possibly in areas just above this altitude. The percent area exposed to and the percent of the population vulnerable to malaria are also indicated in table 4. A study (Ersado, 2005) has shown that the incidence of malaria is higher in those villages with dams and reservoirs than those without. The impact on households with higher malaria rates has been reduced number of days at work and higher medical expenses.

Table 4. Tekezi Sub-basin: Percent Population Immunized, Percent Population vulnerable to and Area Exposed to Malaria.

BASIN/Region	% Pop. Immunized	% Pop. vulnerable to malaria	% Area exposed to malaria
TEKEZI BASIN	90%	69%	**85%**

3.5 Transport Infrastructure and Markets

Given the extreme dissection of the Zamra and Arequa Watersheds by the Tekezi River and its tributaries road infrastructure is not well developed. As can be seen on map 15 the all-weather roads tend to be confined to the ridges and plateaus between the deeply incised rivers. The main exception is the south-north the runs between Sokota and Adua.



Map 15. Road network.

There are approximately 164 kms of All weather road and 155 kms of Dry weather road, although many sections of this type are of ‘All’ weather standard. Some 75 percent of the Watersheds are within 10 kms of an all-weather or dry-weather road.

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.

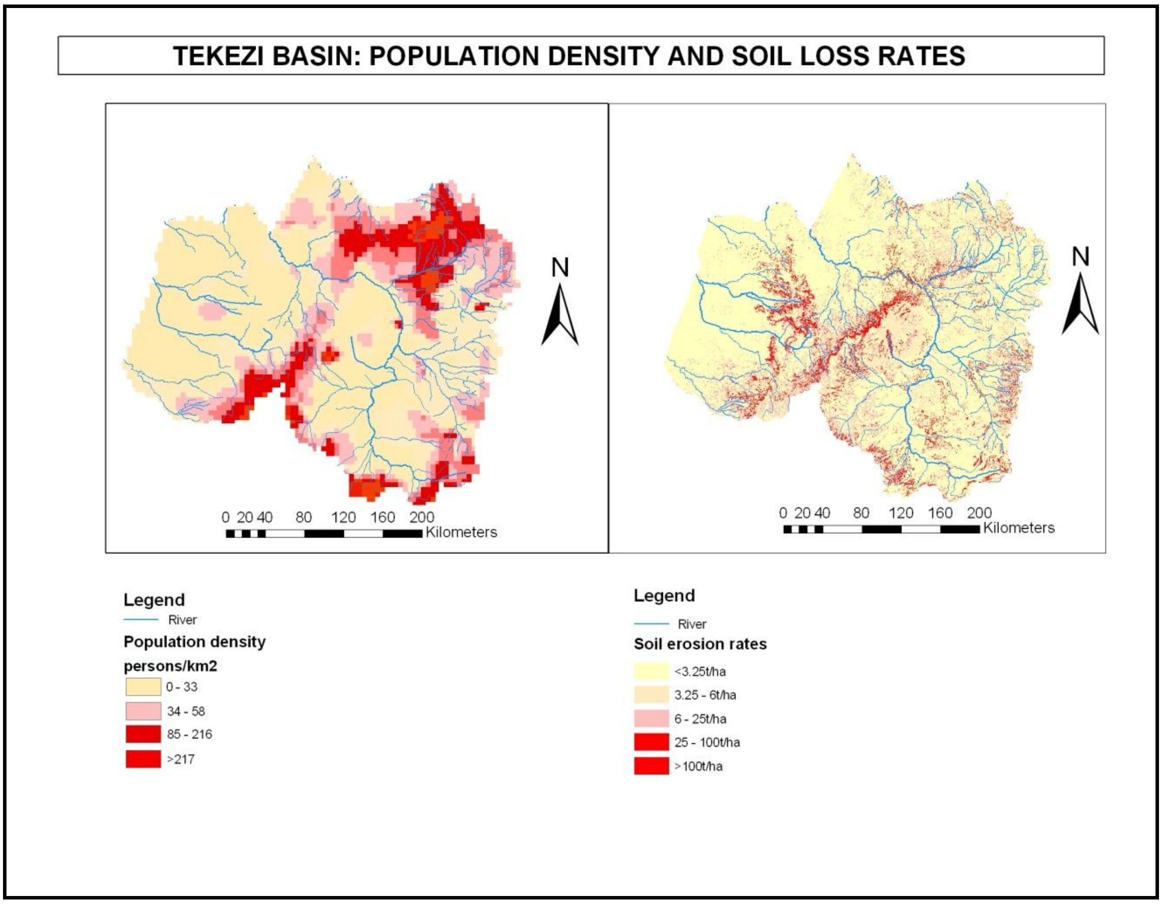
Related to poverty and household assets are the concepts of profitability of the improved land management technology, the farmers’ perceptions of risk and farmers’ private discount rates. Private discount rates are a measure of a person’s time preference or time horizon. The shorter the time horizon 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 Tekezi basin is shown in Map 16.



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

Whilst there is some similarity in pattern along the southwestern, southern and southeastern edges of the basin, elsewhere the patterns are not directly coincident. For example, the areas of Eastern Zone in Tigray that have very high population densities are located on basalt derived soils that are less erodible than those derived from basement complex rocks and sandstones. 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. Tigray has 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.

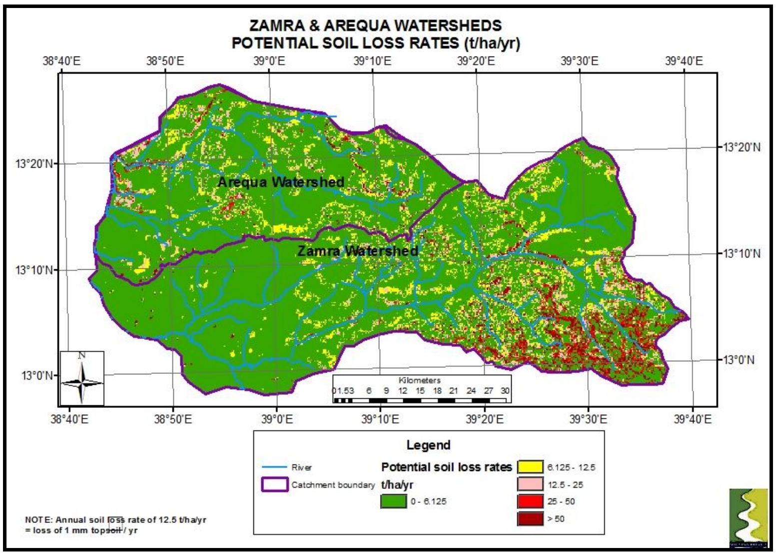
Benefits to physical structures were low where soils were deep (more than 1 meter) or very shallow where yields were already very low. This finding suggests targeting areas with rapidly degrading but still productive soils.

4.2 Zamra and Arequa Watersheds

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)

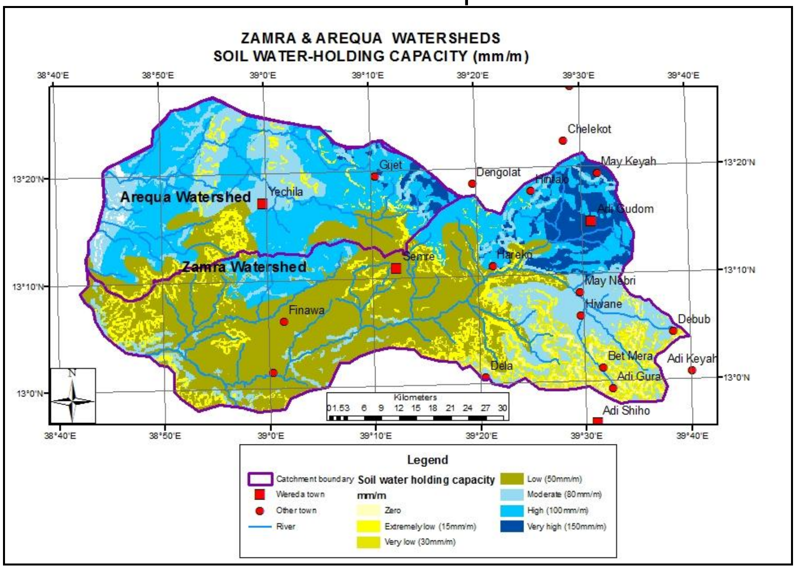
The highest soil loss rates are found in the southeastern part of the Zamra Watershed where slopes are steepest (see Map 7). Locally, high soil loss rates are found in the lower Arequa Watershed on steep rounded hills on the meta-sediment rocks. Slopes on the sandstones are very shallow, and although the soils are very erodible, soil loss rates are relatively low.

(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 for Hintalo-Wejirat, Saharti-Samre and Tanqua-Abergele were estimated (WBISPP, 2003) to be 220 tons, 178 tons and 119 tons. Using a nutrient:yield ratio of 6, this occasions annual potential crop losses 1102 tons, 330 tons and 594 tons annually.

(iii) Soil water holding capacity

However, given the low and variable rainfall within the Watersheds, rainfall runoff is likely to be a more important constraint to crop production than high potential soil loss rates. 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. Sandy soils are prevalent over the red sandstone rocks in the lower Zamra watershed as shown in map 18.



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

The high water holding capacities of the Vertisols and vertic Cambisols found in the upper Zamra watershed can be clearly seen, as are the low water holding capacities of the deep but very sandy soils overlying the red sandstones in the lower Zamra Watershed. The heavier textured soils derived from the meta-sediments (gneisses and shales) in the lower Arequa Watershed have higher water holding capacities. The soils of the southeastern Zamra Watershed have steep slopes and shallow soils, with consequently low water holding capacities as well as high potential erodibility.

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

Dense shrubland, open woodland and open forest cover less than 7 percent of the area of the two Watersheds. Cultivation and sparse grassland cover cover some 75 percent of the total area. The remainder of the area is bare rock, bare soil or sparse shrubland.

(i) Deforestation

Following the cessation of the civil war and return of large numbers of refugees from Sudan there was some expansion of agriculture in the Tigray region of the Tekezi basin. However, over the past ten years there has been little expansion of agriculture, and thus complete clearing of woody vegetation has taken place in the highland areas of the Watersheds as agricultural expansion has reached the limits of cultivable land. An area of continued although limited agricultural expansion continues at lower altitudes in lower parts of the Zamra and Arequa Watersheds.

(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 three woredas in the Zamra and Arequa Watersheds of Hintalo-Wejirat and Saharti-Samre fuelwood consumption exceed sustainable supply by 208 percent, 311 percent respectively. Consumption in Tanqua-Aberle woreda (largely in the Arequa Watershed) was only 90 percent, still within the sustainable supply, although locally consumption almost certainly exceeds supply. These figures suggest that degradation of woody biomass in the Zamra Watershed is taking place, and locally around settlements in the Arequa Watershed.

(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 three woredas of Hintalo-Wejirat, Saharti-Samre and Tanqua-Abergele to be 96 percent, 75 percent and 49 percent. However stocking rates (TLU's

54 and 59 TLU's/ha) are below the average (56and 78 TLUs/ha) for Hintalo Wejirat and Saharti Samre respectively. This indicates a shortage of water rather than livestock feed. Thus herbaceous biomass away from water supplies will tend to be under-utilized, increasing pressure on the remaining forage resources.

4.2.3 Assessment of the Extent Reforestation and Increases of Vegetation Cover in the Zamra and Arequa 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 Tigray 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 Zamra-Arequa Watersheds most tree planting has taken place in the upper Watersheds in the higher rainfall areas closer to the Main Road to Makelle. Scherr (2003) found that survival rates of Communal woodlots were higher at the lower administrative level village level than at the higher "tabia" administrative level.

(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 just the north of the Zamra-Areqa Watersheds, 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.

In a very detailed village study in the upper Zamra Watershed in Hintalo-Wejirat Woreda, 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 (ENTRO, 2008) indicated that for 1 hectare of closed area produced a financial rate of return of 68 percent and a B: C ratio of 13. The payback period is short – 3 years.

As an overall map of closed areas has not been completed it is not possible to say what proportion of the two Watersheds has been closed.

4.2.3 Trends in Soil and Vegetation Degradation

(i) Soil 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.

As indicated above, it is likely that there has been little expansion of cropland in the highlands of the Tekezi Basin after the return of refugees between 1991 and 1995. Most expansion has occurred in the inner parts of the middle Tekezi valley. In the present cause this would be the lower parts of the Zamra and Arequa Watersheds in Saharte-Samre and Tanqua-Abergele woredas.

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. Adoption has been particularly successful in the Tekeze Basin where the positive impacts on soil-water conservation are more successful than in the wetter areas in Abay Basin. The WBISPP (2003) GIS assessment indicated that the proportion of cropland requiring SWC measures (i.e. cropland losing more than 0.1mm of topsoil per year) for Tanqha-Abergele, Hintalo-Wejirat and Saharti-Samre woredas was 40 percent, 55 percent and 36 percent respectively. The CSA Agricultural Census (2003) indicates that approximately 57 percent of farmers in the woredas in the two Watersheds 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, tree planting and contour ploughing by woreda

WOREDA	TERRACE	WATER CATCH	TREES	CONT PLOUGH
ALAJE	59%	15%	0%	22%
ENDERTA	59%	13%	0%	20%
HINTALO WAJIRAT	65%	21%	0%	7%
SEHARTI SAMRE	45%	9%	0%	43%
TANQUA ABERGELE	54%	12%	0%	27%
TOTAL	**57%**	**15%**	**0%**	**23%**

An average of 57 percent use terraces, 15 percent water harvesting and 23 percent contour ploughing. The 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 WBISPP Woody Biomass Strategic Plan for Tigray reported that between 1984 and 2000 consumption of resides and dung has increased by about 3 percent per annum. 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.

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. All three woredas in the Zamra and Arequa watersheds are included in this programme.

Watershed protection for some of the small dams has been undertaken by REST. "Watershed management" must be seen here as straight-forward watershed protection without provisions for future management or maintenance or utilization of resources created.

In Tigray Region, Chinese experts, under the FAO Special Programme for Food Security (SPFS) South-South Cooperation (SSC) initiative, have carried out two **watershed studies** to design level:

- Hadnet watershed, in Wukro, Atsbi Wemberta and Enderta Woredas;
- Adikesandid watershed, in Atsbi-Wonberta and Kilte-Awlaelo Woredas.

Another watershed, in the Tserare sub-basin, has also been studied by a Chinese consulting firm. It is understood that there are similar project designs elsewhere.

From the study reports, it appears that these studies are essentially technical and directional (top-down), with little or any participation of the concerned communities (although socio-economic studies were conducted). While it is assumed that the basic data are good, the designs do not appear to be implementable in their current form; they would need complete re-design based on the participation of the concerned communities. The target areas, although small, both cross Woreda boundaries, which is likely to complicate implementation.

Small-scale **watershed development in micro-watersheds** is practiced by the Regional bureaus and 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 in all regions, and, in terms of areas covered, are most advanced in Tigray. The Tigray Region claims that some 560 micro-watersheds have been treated, mostly with MERET/WFP support.
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.

The Relief Society of Tigray (REST), another local NGO, is also active in watershed activities. REST used to practice “integrated watershed management” in 78 micro-watersheds in 9 woredas in the Central Zone, 1 in the Southern Zone and 1 in the Eastern Zone. In the last three years, working under the PSNP (Productive Safety Net Programme), activities are more scattered and include SWC, tree plantations, gully stabilisation and water harvesting. A new technique introduced from India to Ethiopia is the check dam for combined water/sediment retention (21 units built in 2005).

5.1.3 Irrigation development

A considerable number of small dams have been constructed for irrigation development during the previous decade by COSAERT and REST in Tigray. In the Zamra and Arequa Watersheds some 26 dams have been constructed. (see Map 14).

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).

In Tigray, as a result of these problems, and because of a shift in government focus to micro-irrigation, construction of small dams (i.e. dams for irrigation purposes, with a storage capacity of 0.5-3 million m3, equipped with a spillway) stopped in 2001. Construction of ponds (up to 0.5 million m3, for water supply or micro-irrigation, without a spillway) has continued although facing similar problems.

COSAERT has been dismantled and responsibility for medium scale irrigation development remains solely with MoWR. The focus of REST activities is now on local level water supply, water-harvesting, micro-watershed development and other fields of rural development.

According to the BoWR & Mines in Tigray, around 30 small dams out of the constructed 54, are still functional, partly with help of the IFAD–financed, federally based, Small-Scale Irrigation Support Project.

In Tigray, the irrigation department has plans to restart construction of small dams. It has identified 5 new dams, for two of which feasibility studies are ongoing and construction is scheduled for next year. Improved harmonization with MoARD, through joint participation in Cabinet discussions, are designed to ensure better sustainability of the projects.

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 in Tekeze basin), 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. An example is the case of Abraha Atsbaha Tabia, in the Northern Zone of Tigray, where long term activities in separate Kebeles have now resulted in an aggregated protection of almost the entire watershed (of some 3,000 hectares).

(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 Tigray. The NRM Department in Tigray admits that “impacts are not yet in relation to the efforts made through time”, but that the achievements are considerable:

- about 25 % of cultivated land treated,
- 200,000 hectares under area closure,
- 300,000 hectares of natural forest being exploited in a proper way.

Improved crop transformation and improved livelihood conditions are also mentioned as main achievements.
Research activities (Mekele University, project’s own evaluations, and in earlier days, the SCRP) have shown that SWC has a positive impact in terms of erosion control, moisture retention and land rehabilitation. The Inter-University Cooperation project (IUC) of Mekele University estimates that terracing on cropland produces an average net increase in crop production (including the loss of land) of 3%. Revival of natural springs is also mentioned as an important indicator.
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 Zamra Watershed with land holdings for cropping and access to communal grazing and forested lands;
- Landless rural households residing within the Zamra 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 TK5 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.

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

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.

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 three Sub-basins 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 Makelle. Enderta, Hintalo Wajirat and the higher parts of Seharte Samre Woredas are within this range. The lower parts of Seharte Samre and Tanqua Abergele woredas are outside 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 three Development Domains and three farming systems:

(i) Highland: Medium Agricultural Potential: High Market Access (Seharte Samre and Enderte Woredas)

- Wheat-Barley System above 2,500masl
- Teff-Maize-Sorghum-Finger Millet System between 1,500 and 2,500 masl

(ii) Highland: Medium Agricultural Potential: Low Market Access (Alaje and Hintalo Wojirat Woredas)

- Wheat-Barley System above 2,500masl
- Teff-Maize-Sorghum-Finger Millet System between 1,500 and 2,500 masl

(iii) Lowland: Low Agricultural Potential: Low Market Access (Tanqua Abergele woreda)

- Sorghum-Finger Millet-Teff System

5.3.5 Technological Interventions by Development Domain

HIGHLAND: Medium Agricultural Potential (Medium 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 Makelle 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.

(c) 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.

Stone terraces: These are more efficient in retain soil moisture that bunds or grass strips. In many parts of the two Development Domains surface stones are readily available. The high rate of adoption indicates that many farmers appreciate their use for soil and soil moisture conservation.

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.

(d) 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).

(e) 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.

LOWLAND: Low Agricultural Potential (Moderate to high moisture stress risk) with Poor Market Access: Located mainly below 1,600 masl

(a) Overall Strategies:

A key strategy is the conservation of soil moisture to reduce risk of crop failure. Soil and water conservation structures should be integrated with other improved crop and soil husbandry measures. The opportunities for agricultural development for marketable produce in these areas are much more limited. The strategy for own-consumption agricultural production should be to ensure food security. 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. The long-term Government strategy is to improve accessibility to markets through feeder road and farm to market road construction and this will improve market access.

(b) On-farm Interventions

Improved Soil Husbandry: The use of manure and compost requires sufficient quantities of manure, residues and labour. Given the poor accessibility to markets, the strategy for improved livestock production is to focus on small ruminants. Quantities of manure are likely to be limited and reserved for marketable products such as onions and peppers grown on backyard gardens or in-fields.

Improved tillage: Contour ploughing assists in reducing runoff and soil movement and is already widely practiced.

Grass strips: Given the low and variable rainfall grass strips are not likely to be successful on their own, but might be used to supplement physical structures.

Stone terraces: These are more efficient in retain soil moisture than bunds or grass strips. In many parts of the Development Domain surface stones are readily available. The high rate of adoption indicates that many farmers appreciate their use for soil and soil moisture conservation.

Soil Bunds: In areas of sandstones there are very few surface stones. In these areas soil bunds on the contour should be constructed. These can be stabilized using Vetiver grass.

On-farm Forage Development: tree legumes (*Gliricidia sepium*) which could be used to supplement low quality native grasses, grasses (e.g. including but not limited to *Pennisitum purpureum*, *Cenchrus ciliaris*) and pigeon pea for supplementary feeding of oxen and small ruminants for sale.

On-farm Tree development: In Tigray Region land on degraded hillsides is being allocated to Landless Households for tree production (tree planting on cropland is prohibited). As the pole markets are inaccessible the focus should be on cultivation of tree legumes (*Leucaena leucocephala*, *Sesbania sesban*) on these individual hillside plots (as dual purpose forage and fuelwood trees).and of *Stylosanthes spp*. (Stylo). Stylos are very hardy and resistant.

(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.

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 multi-purpose 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).

Water-harvesting: This refers to the collection of water into small ponds or micro-dams for small-scale irrigation, human and/or livestock water supplies.

(d) Other Interventions

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. Except in some parts of Tigray Region, there is virtually no consumption of charcoal by rural households in Ethiopia.

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. The evaluation report of Irish Aid activities in Tigray mentioned access to credit as the best secondary project benefit to farmers. The Report suggests using part of the compensation in cash for community work for the creation of revolving funds for credit supply services.

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).

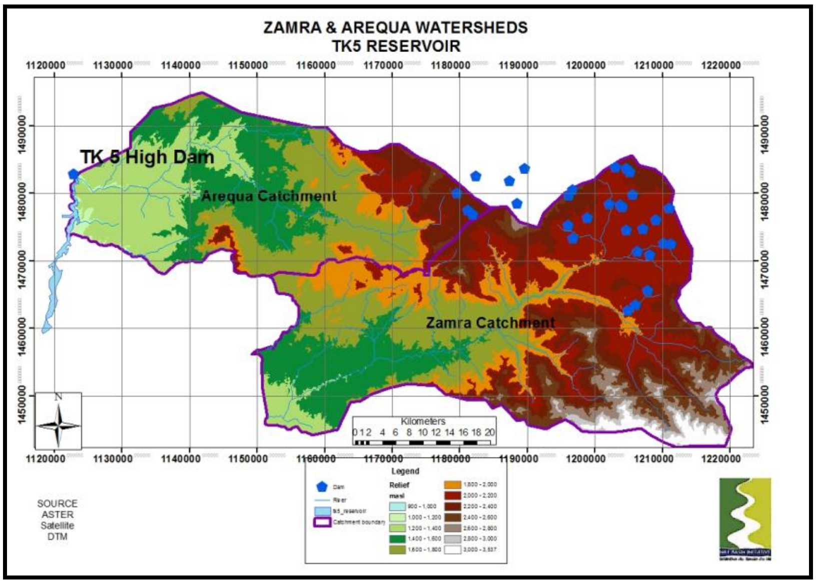
Successful examples of credit supply (e.g. by Menschen für Menschen in Merhabete, Mida and Dera weredas in Abbay basin) are based on short term inputs, like providing a starting capital, with appropriate institutional arrangements for long term application. Institutional arrangements need to be based 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.

5.4.3 Promotion of Fisheries in the TK5 Reservoir

The northeastern shores of the TK5 Reservoir are located in Tanqua Abegele woreda (Map 19). This offers the potential for developing fisheries enterprises. Support will be required for the initial provision of boats, nets and storage facilities. In addition, training in fishing techniques would be required. The latter could be provided by fishermen on Lake Tana.



Map 19. Location of the TK5 Reservoir

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) estimated can made at the micro watershed level on sediment delivery to the drainage system.

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 <u>priority sites</u>/areas for watershed treatment
    . formulation and initial implementation of a <u>sustainable watershed management programme</u>
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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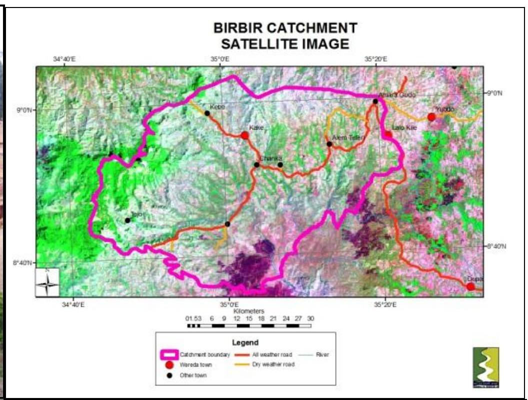
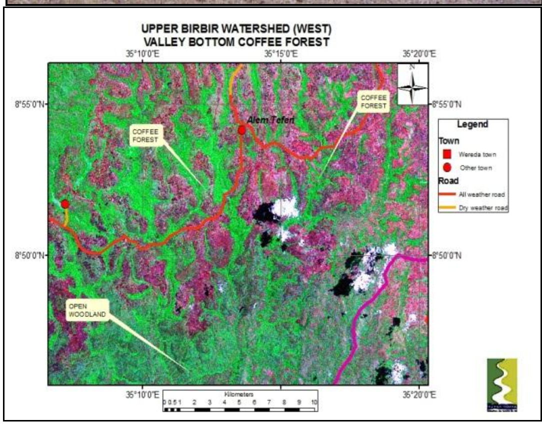




NBI – Institutional Strengthening Project
PROJECT DELINEATION AND PRIORITIZATION
ANNEX 4.2 UPPER BIRBIR (WEST) WATERSHED PROJECT
(FINAL REPORT)

8th June, 2011

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[5] 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 of these had regional and global benefits. Many of the

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

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 ten of the Investment Projects located within the Main Nile Sub-basin, the Tekeze-Atbara Sub-basin and the Baro-Akobo-Sobat Sub-basin. Those Projects identified in the Abay-Blue Nile Sub-basin are being considered separately. This Project document is concerned with the Upper Birbir (West) Watershed located in the Baro-Akobo Sub-basin in Ethiopia.

1.2 Primary Objectives of the Project

The Watershed Management CRA identified a number of land degradation hotspots in the Baro-Akobo Sub-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.

The objective of this Project is to provide support to the Regional Government to arrest land degradation hotspots in the Upper Birbir Watershed of the Baro-Akobo Sub-basin, strengthen household and community livelihood strategies and contribute to the alleviation of poverty.

1.3 The Scope and Elements of Sustainable Watershed Management

River 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.

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);
- dentifying 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)

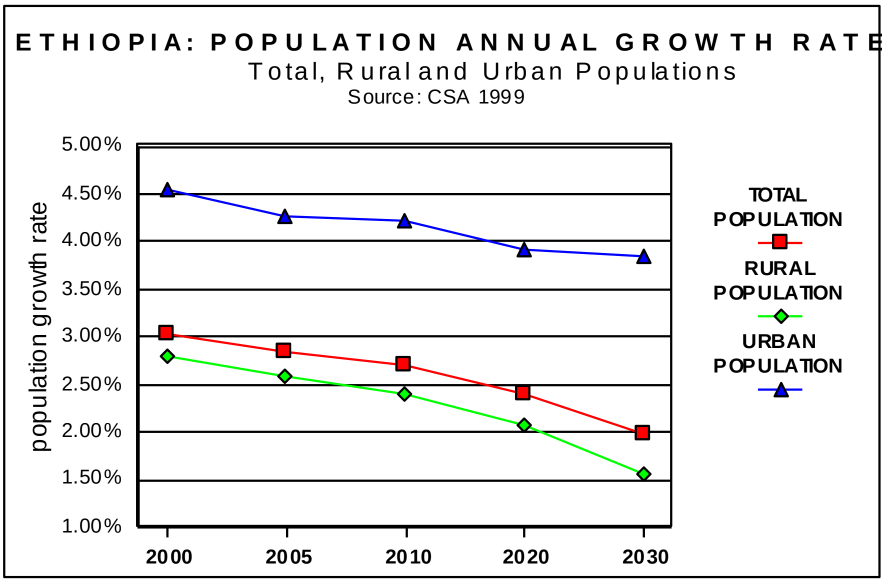
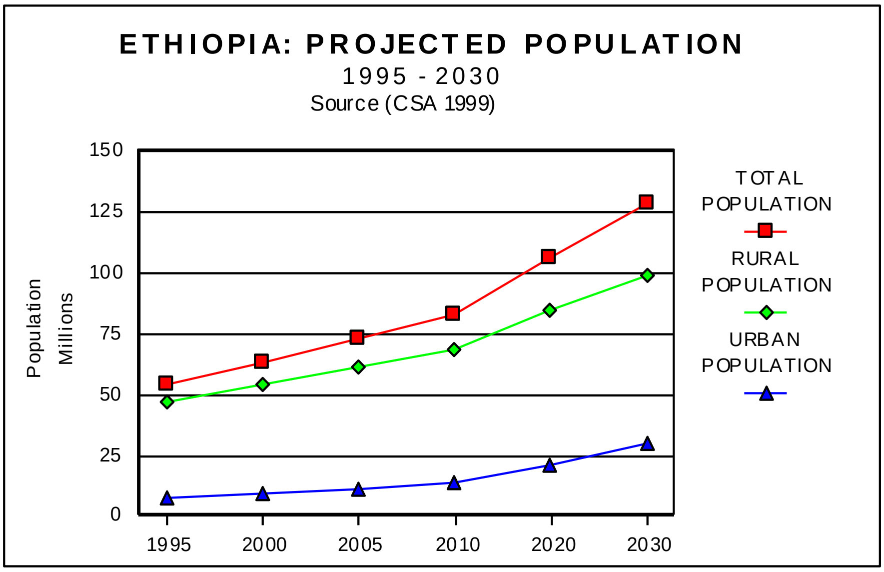
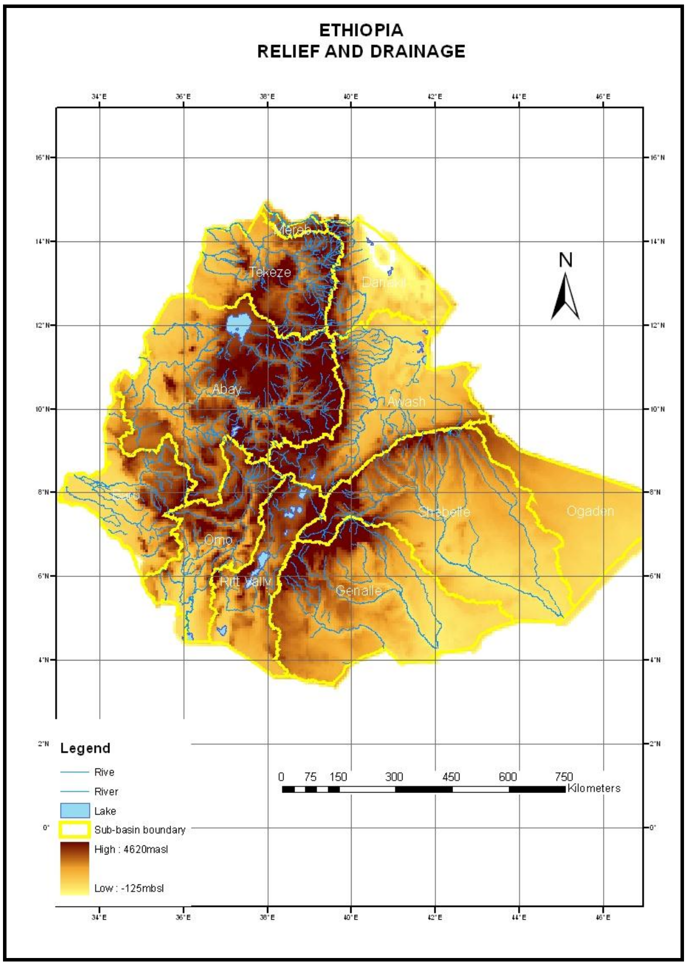


figure 2. Rural, Urban and Total Population (1995





Map 2. Ethiopia: Relief and Drainage

The Highlands[6] 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).

[6] “Highlands” in Ethiopia is land over 1,500 meters above sea level.

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.

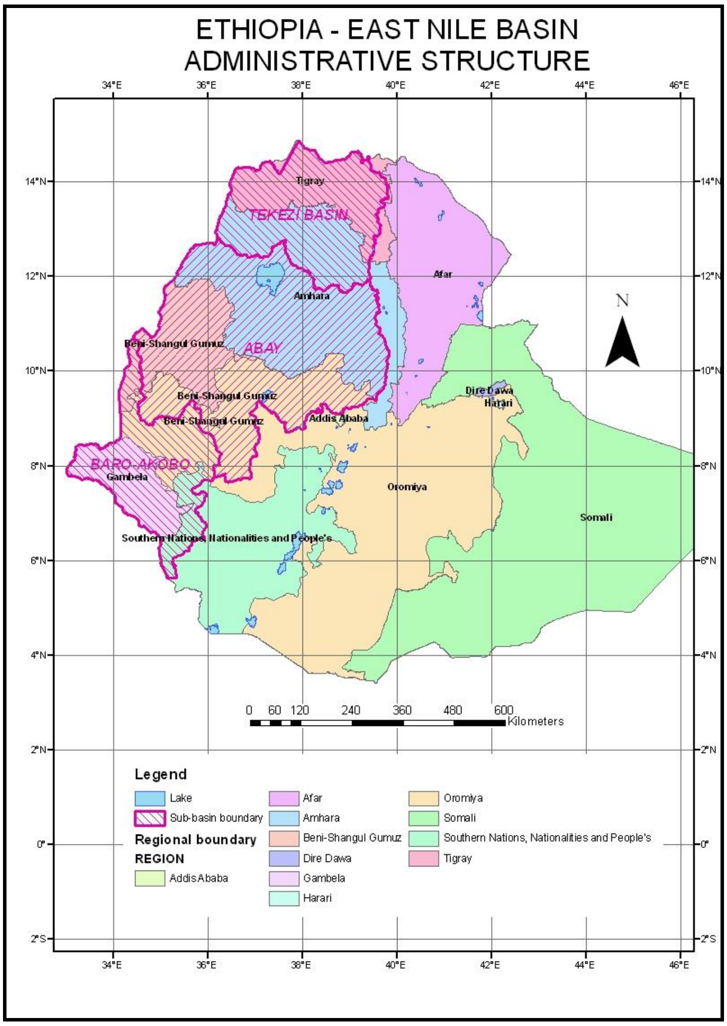
In the high rainfall areas of the southwest and southeast highlands the original vegetation of the highlands was broad-leaved montane high forest. Further north with lower rainfall this changed to a mixed coniferous forest (Podocarpus spp. and Juniperus spp.) and woodland. In the driest parts of the 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 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 Poverty Reduction Strategies

(i) 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, and 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).

(ii) Growth and Transformation Plan (2011)

This is the third phase of the PRSP strategy (2011 - 2016) and follows the previous strategies but places greater emphasis on farmer produced inputs, improved value added chains, improved input/output market linkages.

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)
- Regional Proclamations issued to determine the Administration and Use of the Rural Land have been issued in all Regions.

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 Oromiya 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 Oromiya 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.

2.4 Overview of Situation and Issues

From the 2007 census and a growth rate of 2.7 percent the 2010 population is estimated to be 80.007 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 83.8 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 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).

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.

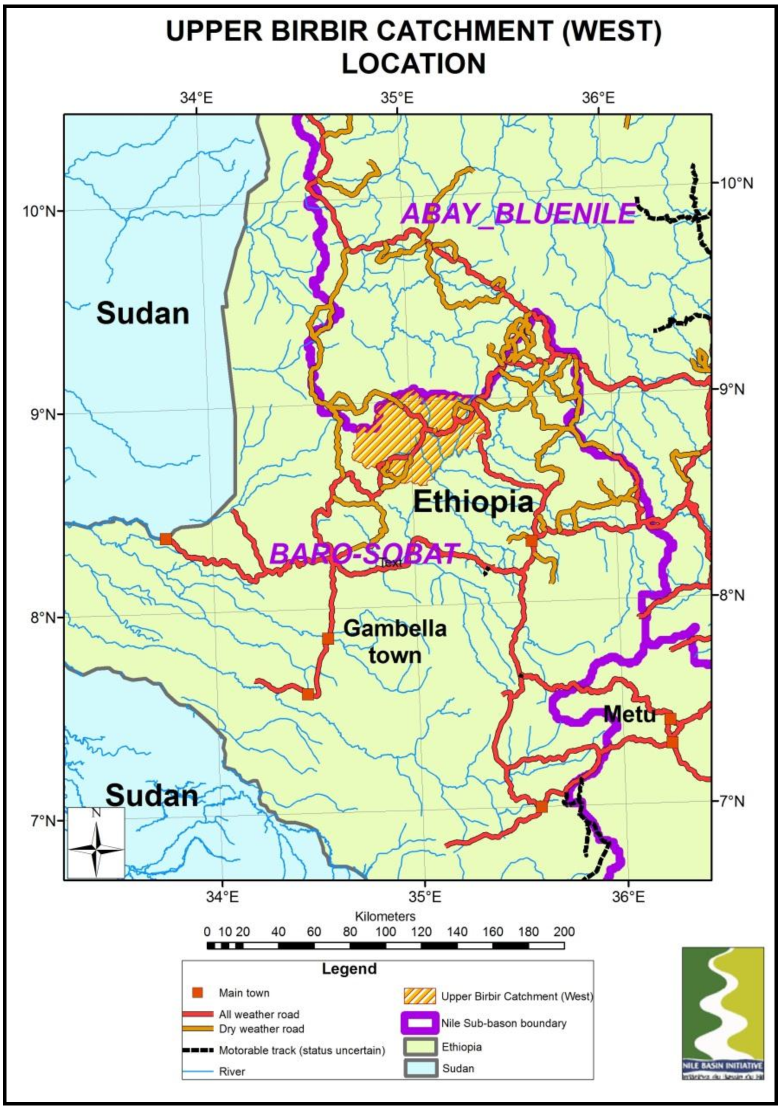
- The Malthusian argument of the negative impacts caused increasing population pressure, and Boserup argument for population induced agricultural intensification may both be correct in the Ethiopian situation. Farmers do respond to population pressure with intensified production, but this may not be 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. UPPER BIRBIR WATERSHED - BIOPHYSICAL AND SOCIO-ECONOMIC SITUATION

3.1 Biophysical Characteristics

3.1.1 Location and Extent

The Upper Birbir Watershed is located in the opper part of the Baro-Akobo-Sobat Sub-basin (See Map 1). The area of the watershed is 2,567 km2.

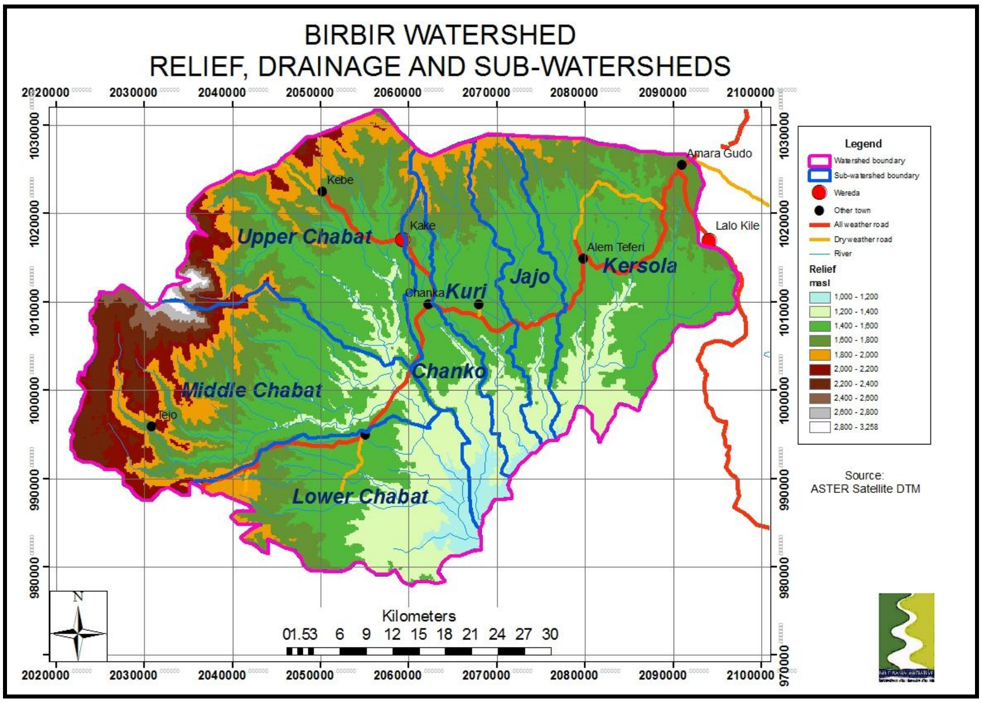


Map 1. Location of Upper Birbir Watershed

3.1.2 Relief and Drainage

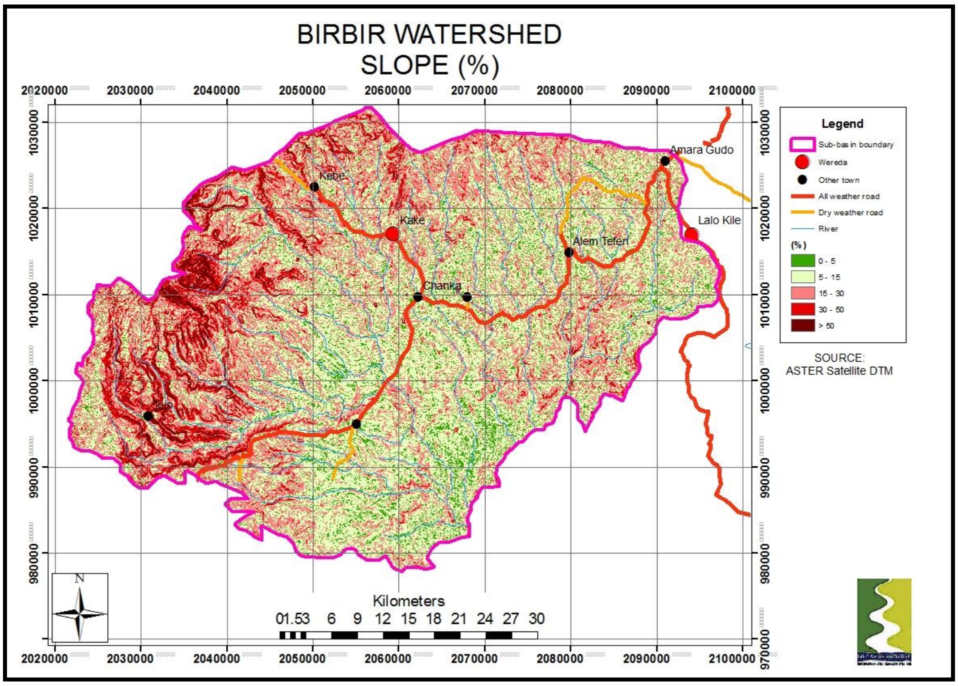
The Project area is located on the southeastern slopes of Mount Tulu Welel (3,273masl). The relief comprises the isolated mountain of Tulu Welel and an eastward trending ridge between 1,500 and 2,000 masl along the northern boundary. This gives way to a deeply dissected plain between 1,000 and

1,500 masl. Drainage is to the southeast until the southwestward flowing Birbir is reached.



Map 2. Relief, Drainage and Sub-watersheds

The rivers are very deeply incised into Mount Tulu Welwel as seen on the slope map (Map 3). On the plains below the mountain the rivers are incided some 100 – 200 meters and have flat valley bottoms some 0.5 to 2 kms wide.

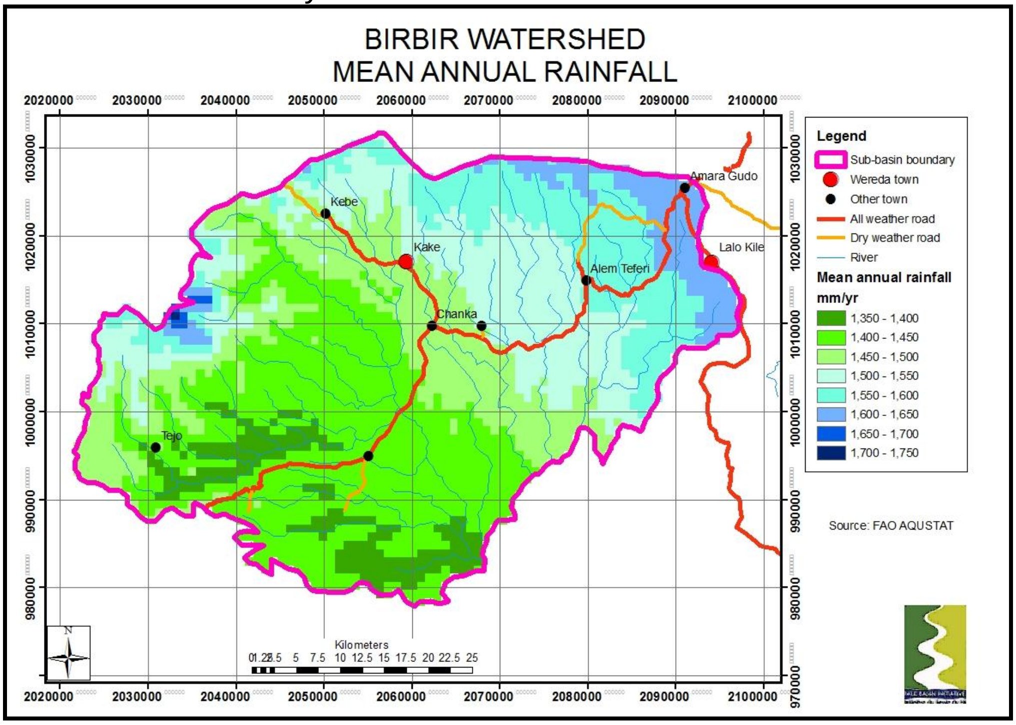


Map 3. Slope Map (%)

3.1.2 Climate

(I) Rainfall

Mean annual rainfall over the Watershed is between 1,400 and 1,700 mm/yr increasing from west to east and with increasing altitude (Map 4). The southeast slopes of Mount Tulu Welel lie in a rain shadow. The rainfall pattern is uni-modal and the rainy season lasts from June to October.

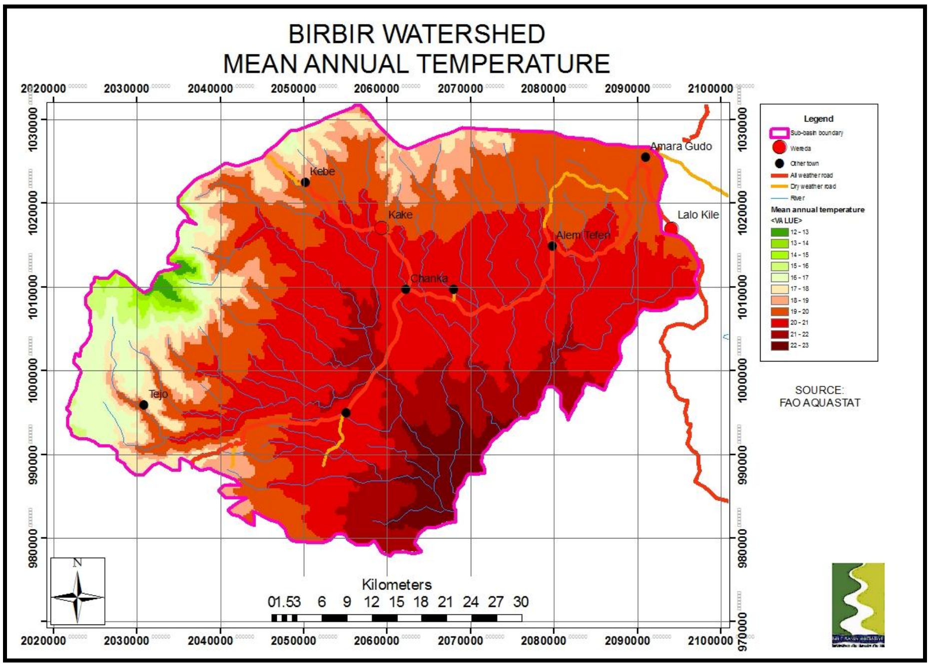


Map 4. Mean annual rainfall

The rainfall pattern is bi –modal with the short (*Belg*) rains between February and April, and the main (Krempt) rains from July to September.

(ii) Mean annual temperature

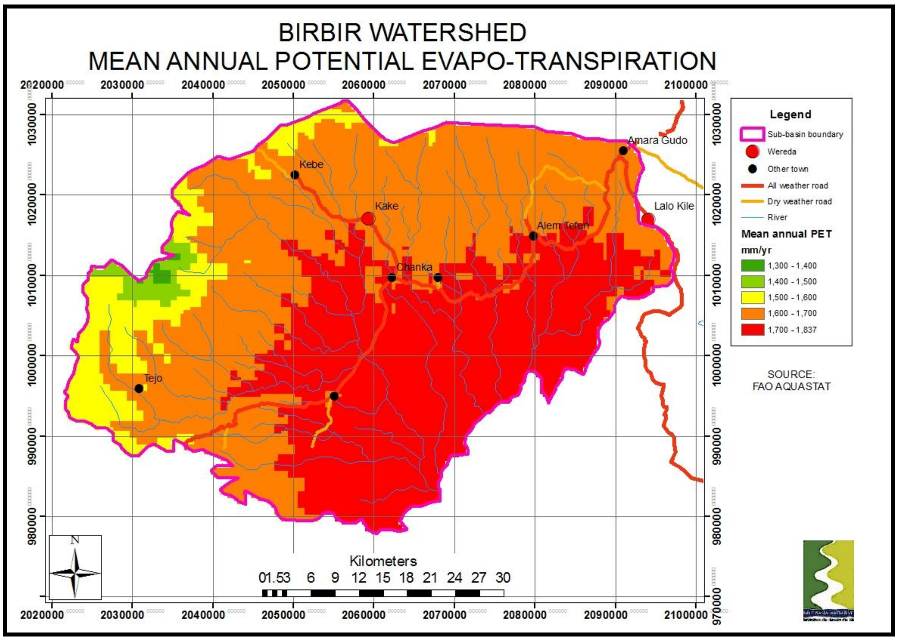
Mean annual temperature is inversely related to altitude. Thus, the lowest temperatures (12 - 14°C) around the summit of Tule Welel and the highest temperatures (21 - 23°C) are found in the lowest part of the Birbir Valley.



Map 5. Mean annual temperature (degrees C)

(iii) Mean Annual Evapotranspiration

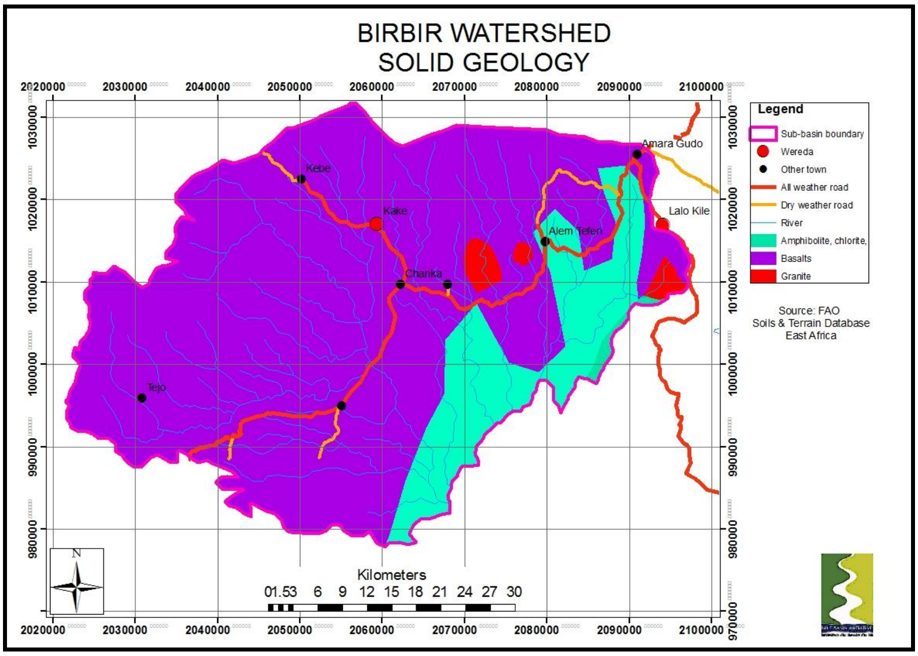
The pattern of mean annual evapotranspiration follows that of mean annual temperature and closely related to altitude (Map 10) with lowest rates (1,300 – 1,500mm/yr) in the upper Watershed and highest rates (1,700 – 1,900 mm/yr) close to the Birbir River.



Map 6. Mean annual evapo-transpiration.

3.1.3 Geology

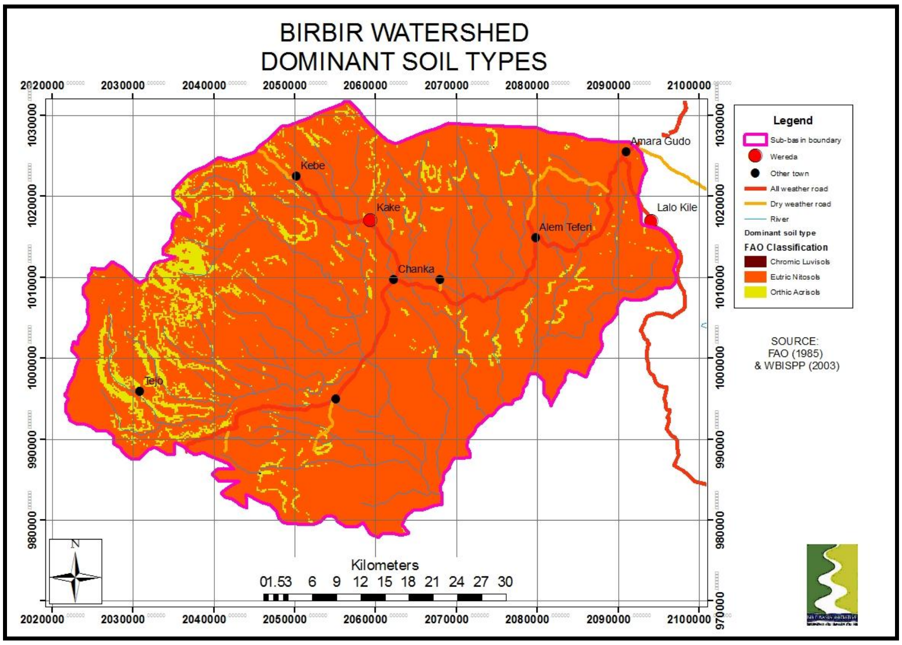
Most of the Watershed is underlain by Trapp basalts, except schists and chlorites which outcrop in the lowest part of the watershed along the Birbir River (Map 7). There are two small outcrops of granite.



Map 7. Geology

3.1.4 Soils

The dominant soils are dystric Nitosols, These are deep, well drained soils moderately good structure and a base saturation of less than 50 percent. Given the relatively high rainfall they are leached of bases, with a lower pH and a severe Phosphorous deficiency. Acrisols are even more leached and very acid and with a very low base saturation. Luvisols are similar to Nitosols being deep with a higher clay content in the sub-soil than the top soil.



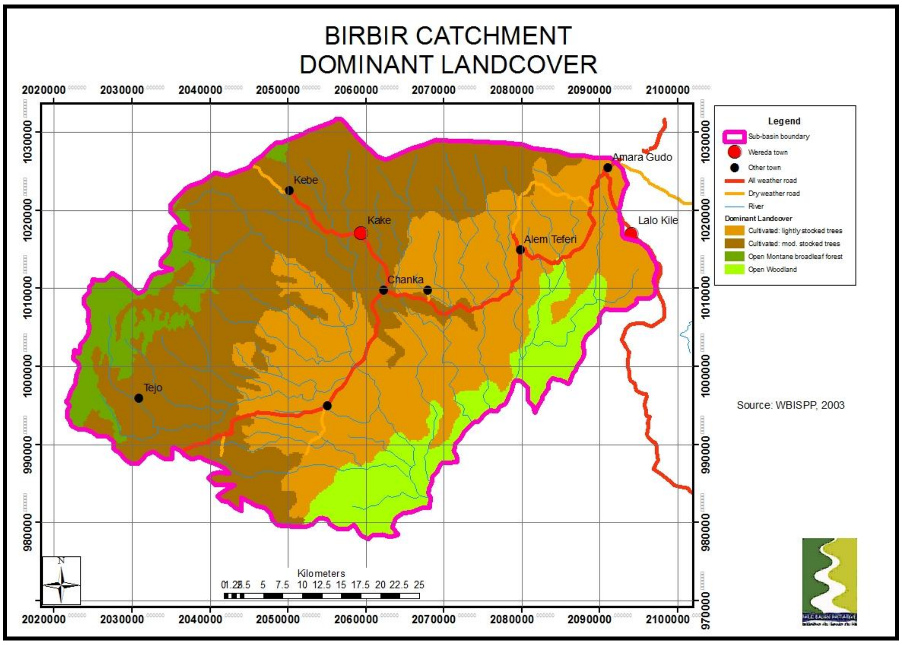
Map 8. Dominant Soils (FAO Classification)

3.1.5 Land Cover / Land Use

The areas and percent of total area of the dominant landcover classes are shown in table 1 and their distribution in Map 9. The most widespread is Tainfed Cultivation almost equally divided between light tree cover (39 percent) and moderatel tree cover (43 percent). Open montane Forest arounbd the summit of mout Tule Welel covers only 0.2 percent of the area with open woodland along the Birbir River covering 6 percent.

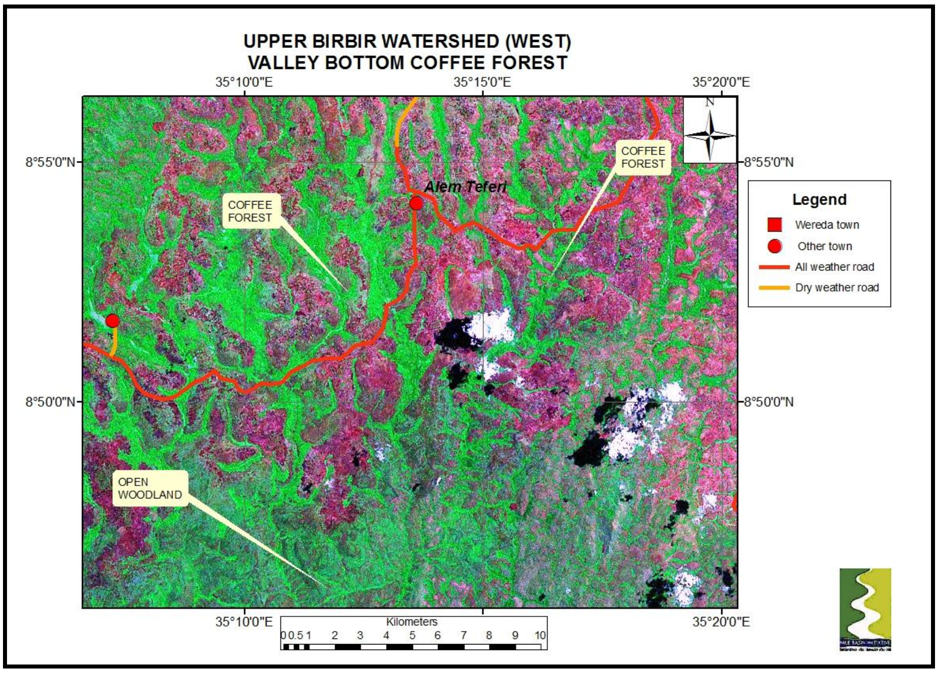
Table 1. Upper birbir (West) Watershed: Dominant Landcover (km2)

LANDCOVER	AREA (KM2)	%
Woodland; Open (20-50% tree cover)	287	11%
Cultivated Land; Rainfed; Cereal Land Cover System; lightly stocked	1011	39%
Cultivated Land; Rainfed; Cereal Land Cover System; moderately stocked	1098	43%
Forest; Montane broadleaf; Open (20-50% crown cover)	6	0%
Forest; Montane broadleaf; Open (20-50% crown cover)	164	6%



Map 9. Dominant Landcover

At the very detailed level very often have Open Montane/Riverine Forest that has been converted to foffee forest. This is seen more clearly Landsat ETM satellite image in Map 10.



Map 10. Coffee Forest along Valley Bottoms

3.1.6 Water Resources

(i) Surface Water

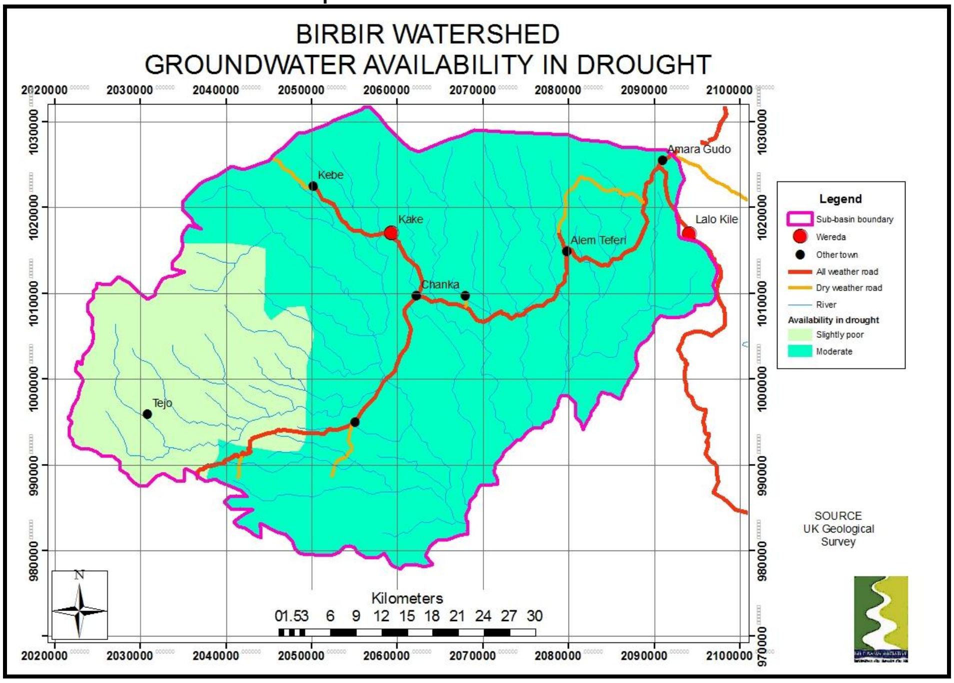
The Watershed has been divided into seven Sub-watersheds It has been sub-divided into seven sub-watersheds as follows:

NAME	AREA (km2)
Chanko	153
Kuri	212
Jajo	174
Kersola	515
Lower Chabat	397
Middle Chabat	616
Upper Chabat	499

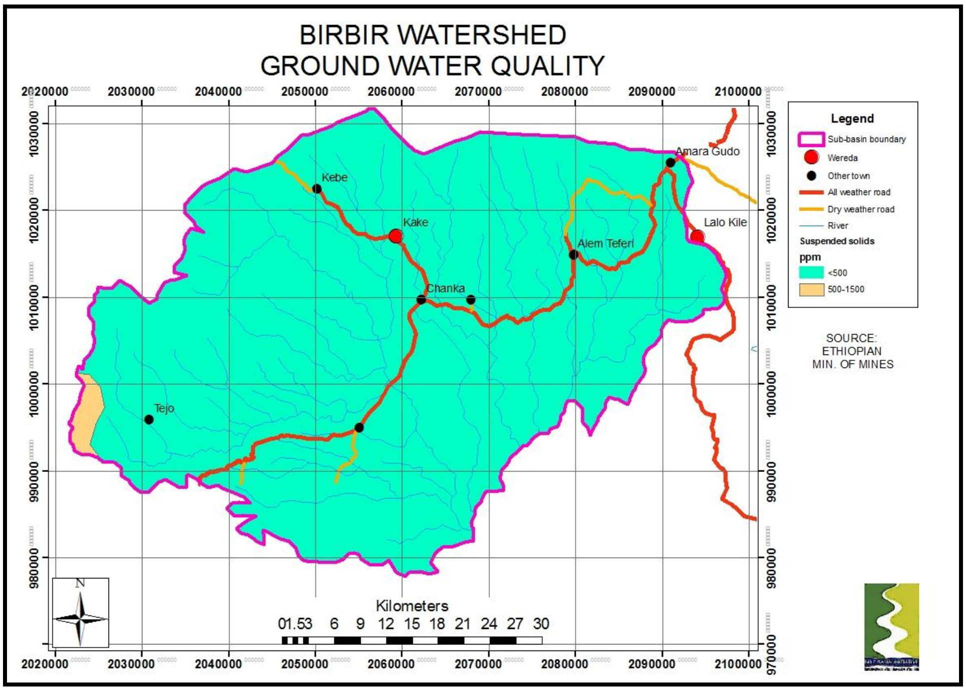
(ii) Groundwater Resources

The potential groundwater resources of Ethiopia have been mapped by the British Geological Survey (MacDonald et al., 2001) in conjuction with the University of Addis Ababa. The results for the Upper Birbir Watershed are shown in map 12. Generally, the Watershed has a Low to moderate potential for groundwater availability during drought periods.

The Ethiopian Ministry of Mines have mapped the hydrogeology and ground water quality (total dissolved solid/litre). The results for the Upper Birbir Watershed are shown in Map 13.



Map 12. Availability of groundwater during Drought



Map 13 Groundwater Quality

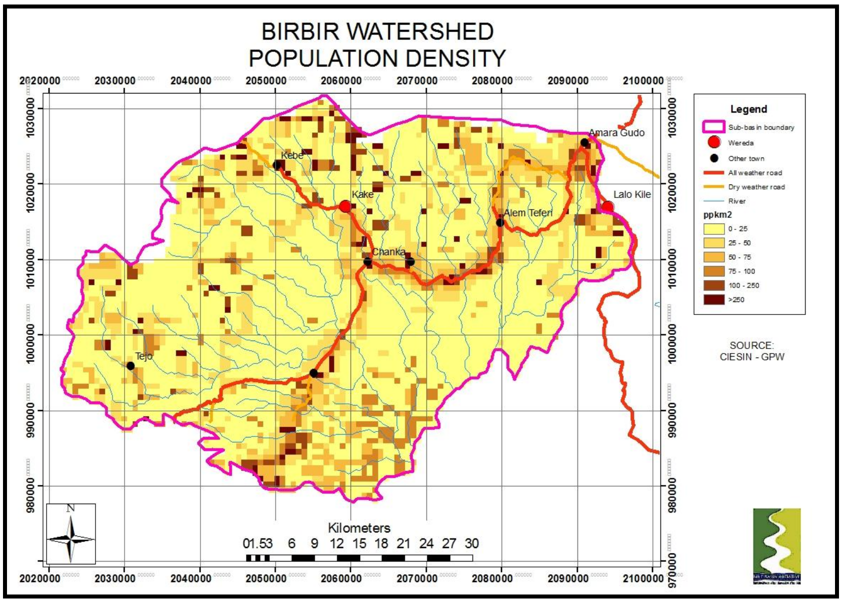
3.2 Population Distribution

The Watershed encompasses three woredas: Hawa Welel. Gawa Dale and Dile Lalo. A small portion of Jima Dale is also included. The estimated 2010 population of these woredas is as follows:

Table 2. Estimated 2010 population of Woredas in Upper Birbir Watershed (West)

WOREDA	TOTAL POP	RURAL POP %	RURAL HOUSEHOLDS
Gawa Dale	169,031	92%	26,587
Dile Lalo	144,123	95%	23,027
Hawa Welel	123,710	96%	20,137
TOTAL	**436,865**		**69,752**

The spatial distribution is shown in Map 14.



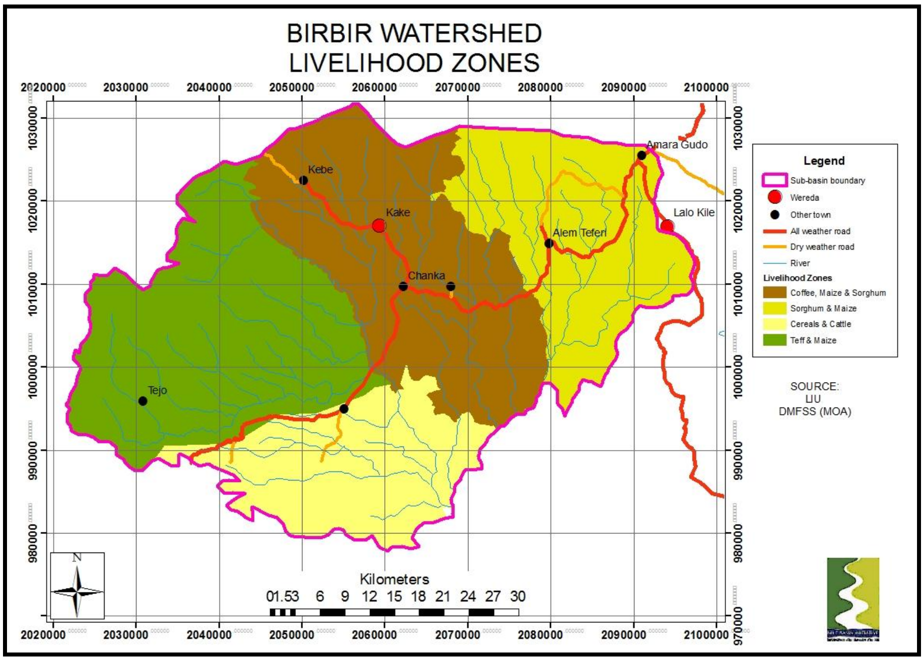
Map 14. Population Density and Distribution

Population densities are lowest on the upper slopes of Mount Tule Welel and highest in the Chanko, Kuri and Jajo sub-Watersheds. Elsewhere densities are between 75 – 100 persons per km2. At the woreda level densities are 61, 99 and 68 ppkm2 in Gawa Dale, Dile lalo and Hawa Welel woredas, confirming that densities are highest in the central part of the watershed.

3.3 Farming Systems

The Upper Birbir Watershed falls within the Cereal Farming Systems of the Central Highlands (WBISPP, 2003). Below 2,600 masl the dominant crops are maize and teff and some sorghum. Above 2, 600 masl wheat and barley replace maize and teff. Maize is the main crop both for subsistence and cash. According to the CSA Agricultural survey only 3 to 4 percent of farmers are using improved maize seed. A similar proportion of farmers are using chemical fertilizer (DAP and/or Urea), almost all of this on maize. The other cash crop, coffee, is not fertilized.

The Livelihoods Integration Unit (LIU) of the Disaster Preparation and Preparedness Department of the MoA (DPPD, 2010) has identified four Livelihood Zones falling within the Upper Birbir Watershed. These constitute separate cropping systems (Map 16).



Map 15. Farming Systems/Livelihood Zones

(i) Cropping Systems

(a) Teff-Maize Unit

The Unit is found in the higher parts of Hawa Welel and Gawa Dale woredas. The main crops are teff and maize. Coffee is grown below 1,900 masl either under shade in the homestead garden or in remnant forests and woodlands.

(b) Coffee-Maize-Sorghum

In this unit sorghum increases in importance in the crop mix. Coffee is also more important in this unit because are greater part of the unit is below 1,900 masl. Most coffee is grown under shade in remnant riverine forest and woodland.

(c) Sorghum-Maize

In this unit teff and coffee are largely un-important. Maize and sorghum are the main crops.

(d) Cereal-Livestock

This unit is found below 1,500 masl towards the Birbir River. Maize and sorghum are the main cereal crops with livestock assuming a greater importance within the Farming System.

(ii) Livestock husbandry

Livestock include cattle, sheep and goats. Cattle are important for draught power, milk and as a store of wealth. In the Cereal-Livestock system cattle rearing for milk and sale are more important than the other systems. Sheep become increasingly important above 2,600 masl. Livestock feed supply comprises open grazing, crop residues and grass hay.

(iii)Tree planting, management and tree products

Tree planting, mainly of Eucalyptus, is relatively common around homesteads, and more rarely on field boundaries. In areas near to Addis Ababa (e.g. around Holletta) small Eucalyptus woodlots occur. Indigenous trees are not managed.

(iv) Interactions between crops, livestock and trees

Because open grazing is still available (although decreasing rapidly), cropping, livestock production and tree growing are not closely integrated.

(v) Bio-energy: Sources and Use

Fuel wood stocks are relatively plentiful but are being harvested well above their sustainable yield. Annual per capita consumption rates are 900 to 1,100 kgs. In the sorghum growing areas stalk residues are used as fuel, however, elsewhere little or no residues or dung are being used as fuel.

(vi) Agricultural Landscape

Cropland and grazing land occur in well-defined blocks. Grazing land is found on the steepest slopes and also on flat and poorly drained valley floors. Indigenous trees are scattered throughout the landscape with exotics (mainly Eucalyptus) commonly planted around homesteads. Open shrubland is found on the grazing lands on very steep slopes. Open mixed forest occurs around the summit of Mount Tulu Welel and the high ridge, as well as along the flat valley bottoms. .

(vii) Dynamics of change

The main land use change is the encroachment of cropping onto open grazing lands. On the highest slopes of Mount Tulu Welel agricultural expansion into the High Forest is also taking place. Remnant forests and woodland used for coffee production remain intact because of their value as shade.

3.4 Social Infrastructure: Health and Education

3.4.1 Health Infrastructure and Health

The data of health infrastructure and health status for West Wellega Zone and the whole of the Oromiya Region were 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. Oromiya Region: Details of health Infrastructure and Workers.

REGION/ZONE	Health Professional/'000 pop.	Potential Health Coverage (%)	Health Infrastructure (hospitals, clinics, dispensaries/'000 pop.
OROMIYA - WEST WELLEGA	0.22	74%	0.14
OROMIYA REGION	0.26	65%	0.11

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 4 where there is a very high rate of immunization in Tigray region. 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 3. With a lower than regional average of Health Professionals per thousand head of population it has a lower than regional average percent of population who are immunized.

Table 4. Oromiya Region: Percent Population Immunized, Percent Population vulnerable to and Area Exposed to Malaria.

Region	% Pop. Immunized	% Pop. vulnerable to malaria	% Area exposed to malaria
OROMIYA - WEST WELLEGA	26%	70%	78%
OROMIYA REGION	40%	49%	59%

The Zone has a higher than Regional average percent of population vulnerable and higher percent of area exposed to malaria. A study (Ersado, 2005) has shown that the incidence of malaria is higher in those villages with dams and reservoirs than those without. The impact on households with higher malaria rates has been reduced number of days at work and higher medical expenses.

3.4.2 Education

Zonal rates of Primary and Secondary school enrollment are significantly higher than the Regional average, considering the relative remoteness of the Zone.

Table 6. Oromiya Region: Literacy rates: Primary and Secondary School enrollment (%)

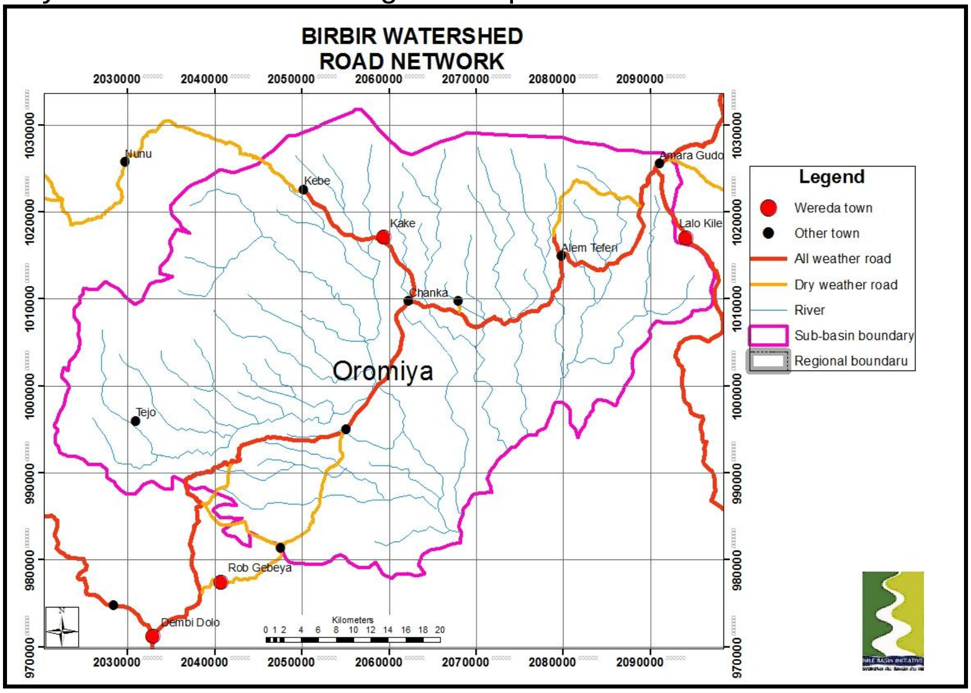
State	Literacy >15yrs % Average	Literacy >15yrs % Male	Literacy > 15yrs % Female	Total Primary school enrol. %	Total Secondary school enrollment %
West Wellega Zone				78%	23%
Oromiya	**22.4**	**29.3**	**15.6**	**64%**	**5%**

Source: Ethiopia: World Bank, 2004.

3.5 Transport Infrastructure and Markets

3.5.1 Transport Infrastructure

The Zonal town of Dembidolo is served by an all-weather gravel road some 160 kms from Gimbi, which is located on a tarred road to Addis Ababa. Dembidolo is some 500kms from Addis Ababa. The Watershed is thus relatively inaccessible to the Regional capita.



Map 16. Road network.

There are approximately 298 kms of All weather road and 35 kms of Dry weather road and 48 kms of dirt tracks Some 72 percent of the Watershed is within 10 kms of an all-weather road.

3.5.2 Agricultural marketing

(i) Crop Marketing

The State has withdrawn totally from agricultural marketing. Farmers bring their grain to markets 5 to 20 kms from their villages, with about 80 percent of their cash sales occurring immediately after harvest. There is little or no information available to farmers to enable them to determine what crops to plant and hoe much. Farmers sell to the small merchants or assemblers in the market towns. Given the very high transport costs due to the very poor road network cereal crop marketing is very limited. Cash crop marketing in the Watershed is mainly concentrated on the marketing of coffee.

(ii) Livestock Marketing

Livestock markets function at three levels: primary, secondary and terminal markets. Primary markets are located at the village level with a supply of less than 500 head, where producers (farmers and pastoralists) sell to small traders, other farmers and pastoralists (replacement animals) and local butchers (Yakob Aklilu, 2002). In the Watershed, as with cereal crop trading livestock marketing is limited to sales to local centres.

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.

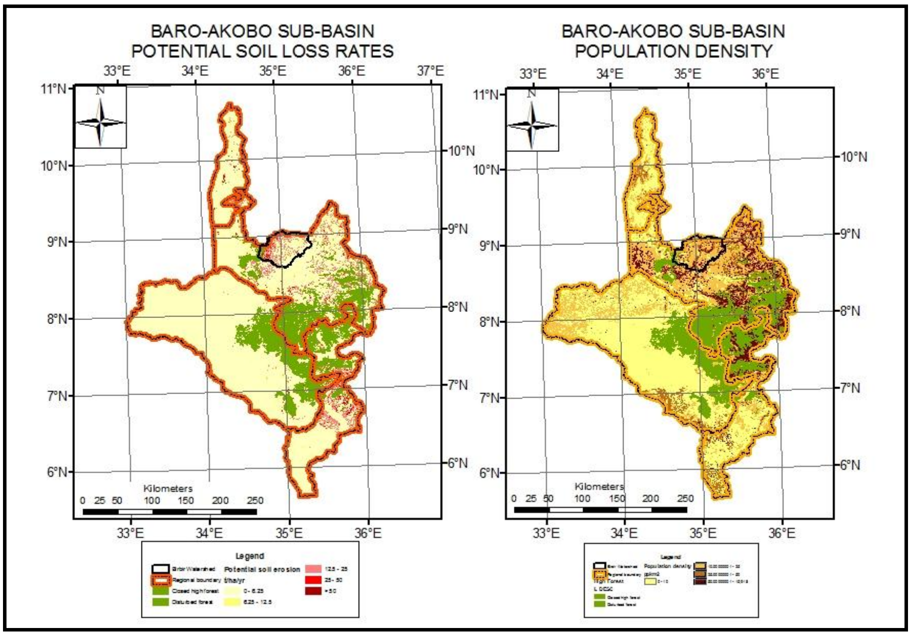
Related to poverty and household assets are the concepts of profitability of the improved land management technology, the farmers' perceptions of risk and farmers' private discount rates. Private discount rates are a measure of a person's time preference or time horizon. The shorter the time horizon 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 Baro-Akobo basin is shown in Map 17



Map 17. Baro-Akobo Basin: A comparison between the pattern of population density and soil loss rates.

Whilst there is some similarity in pattern along the northeastern and southeastern of the basin, elsewhere the patterns are not directly coincident. For example, the area to the west of the Birbir Watershed has high population densities but is located in an area with low potential soil erosion. 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. Oromiya has 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 (soil and stone bunds) are positive in moisture stressed areas but negative in higher rainfall areas. However, the SCRP (Herweg, 2003) has shown that grass strips are 60 percent effective in reducing soil erosion, almost as effective as soil bunds (65 percent effective). There has been a rapid adoption of grass strips by farmers in the Sor watershed just to the south of the Birbir Watershed. Returns from fertilizer use show the opposite trend: with higher returns in high rainfall areas and lower in moisture stressed areas.

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 Upper Birbir (West) Watershed

4.2.1 An Over-view of Watershed Management Challenges and Potentials

The Upper Birbir watershed lies within the Baro-Akobo sub-basin, which is one part of Ethiopia which is still relatively well endowed with natural resources as has been outlined in the previous section. In many ways it is as yet an only partially exploited resource frontier, with good land in many places, plentiful and reliable rainfall - especially in the upper basin, a major cash crop resource in the form of coffee, major biodiversity and genetic resources in the form of wild forest coffee, forests, wetland resources and some wildlife, and plentiful water for irrigation and hydro-power development. Overall population pressure is not severe and communications are improving with roads bringing about 75% of the Watershed within 10 kilometres of an all-weather road.

However, there are some major constraints to development. These include malaria below 1,500masl, trypanosomiasis in the woodland parts of the lower Watershed, the remoteness of the Watershed from major urban centres and markets.

As well as these specific constraints to development, there are a number of problems appearing which relate to development in the Watershed and to watershed and natural resource management in particular. These include deforestation, land degradation, wetland loss and wildlife loss. In some parts of the Watershed fragile environments are being degraded by inappropriate farming systems. Overall there is growing evidence that the resource base of the Watershed is declining.

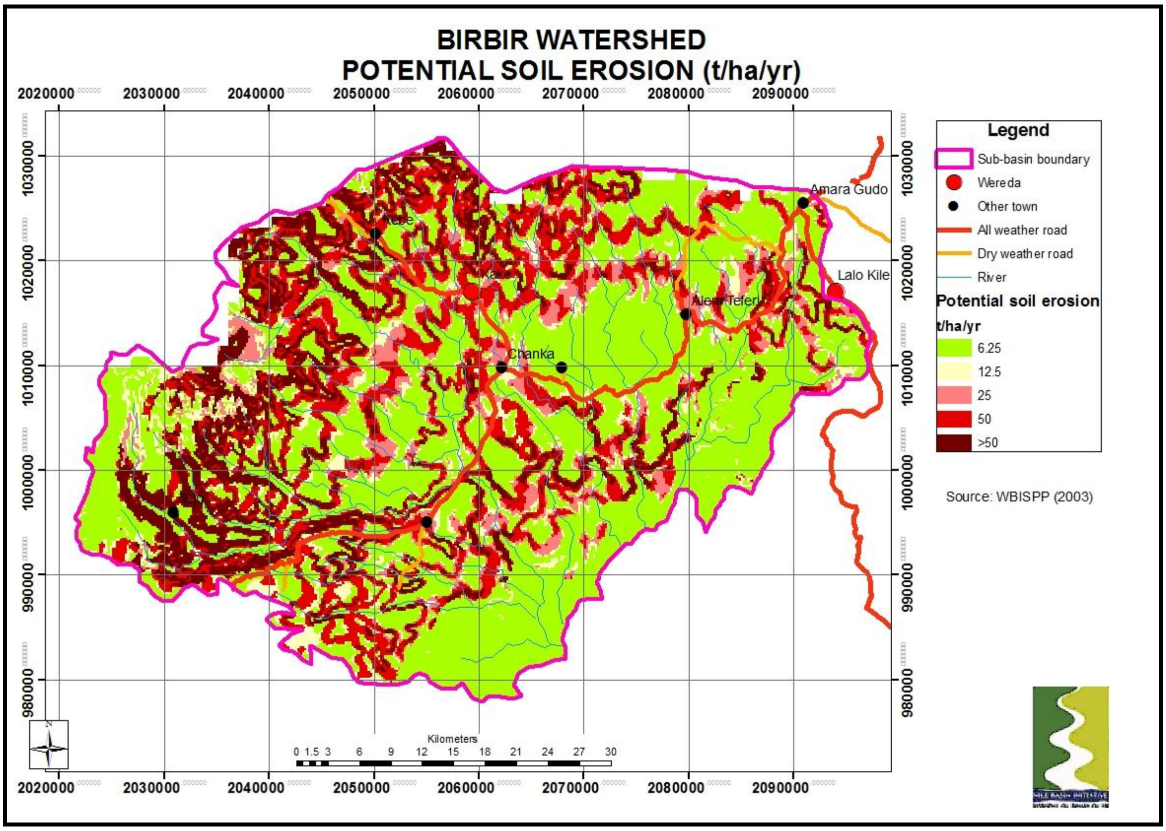
The causes of this resource degradation are predominantly due to population growth, problems with farming system development, the loss of land to settlers and the fluctuating presence of refugees in specific locations. However, these proximate causes are usually the result of other underlying drivers which include government policies, poverty and the competition for resources.

This section will explore these issues through the analysis of a number of key land use and development problems in the Watershed and their drivers (4.2 above).

4.2.2 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 18.



Map 18. Potential Soil Erosion (t/ha/yr)

The highest soil loss rates are found on the middle to lower slopes of Mount Tulu Welel (below the Forest) and on the steeper slopes leading down to the incised river valleys.

(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. In the Upper Birbir Catchment little if any dung is used as fuel, so nutrient losses are due mainly to removal of grain and crop residues.

Annual soil nitrogen losses caused by crop residue removal from fields for Dile Lalo, Gawa Dale and Hawa Welel woredas were estimated (WBISPP, 2003) to be 44tons, 48 tons and 37 tons. Using a nutrient:yield ratio of 6, this occasions annual potential crop losses 220 tons, 240 tons and 184 tons annually.

The moderately high water holding capacities of the Luvisols and Nitosols offset to some extent their high erodibility, which together with their depth of over 1 meter make soil moisture deficits very rare.

4.2.2 Assessment of the Extent Deforestation and Degradation of Vegetation Cover in the Upper Birbir Watershed

(i) Deforestation

The WBISPP (2003) estimated that the area of High Forest in Hawa Welel woreda in 1990 was 11,048ha. Using 2000 Landsat imagery it is estimated that this has been reduced to 9,165 ha, an annual rate of deforestation of 2.1 percent. The rate of change in woodland is difficult to estimate as there appears to be areas of woodland in the river valleys (see Map 13) that were mapped by WBISPP as “Cultivation”. Much of the remaining forest and woodland used for coffee planting remains intact because of their value as shade.

However, Hawa Welel and Gawa dale woredas are the receiving site for the Government’s Voluntary Resettlement Programme. In 2003 and 2004 a total of 76,700 people in 18,375 households were resettled in the woreda (DPPC, 2003, 2004). Estimating 2 hectares per family for agricultural land would involve clearing some 36,750ha.

(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 three woredas in the Upper Birbir Watershed of Dile Lalo, Gawa Dale and Hawa Welel fuelwood consumption exceed sustainable supply by 230, 140 and 150 percent respectively.

(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 stocking rates to carrying capacity was estimated for Dile Lalo, Gawa Dale and Hawa Welel woredas as 135, 82 and 116 percent respectively. This indicates that for two of the woredas there is a livestock feed deficit. Crop residues provide between 30 and 45 percent of the livestock feed supply and are thus competing for residues as an important household fuel for cooking.

4.2.4 Assessment of the Extent Reforestation and Increases of Vegetation Cover in the Upper Birbir Watershed

(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

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.

(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 the Tekeze Sub-basin 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 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.

As an overall map of closed areas has not been completed it is not possible to say what proportion of the Upper Birbir Watershed has been closed.

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 and the follow-on projects of the WSM-CRA (including this project) are a first step towards implementation at this level.

Productive Safety Net Programme (PSNP): This programme is not being implemented in the Upper Birbir Watershed as none of the woredas are chronically food insecure.

Sustainable Land Management (SLM) Project: This project adopts an integrated WSM approach and focuses on Watersheds between 4,000 and 15,000ha in area. None of the woredas located in the Upper Birbir Watershed are currently included in this programme.

Watershed protection: Small-scale **watershed development in micro-watersheds** is practiced by the woreda offices of agriculture in the Upper Birbir Watershed. However, this programme has no support from donors or NGO's.

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 in all regions, and, in terms of areas covered, are most advanced in Tigray. The Tigray Region claims that some 560 micro-watersheds have been treated, mostly with MERET/WFP support.

The Local Level Participatory Planning Approach (LLPPA) developed within the MERET 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.

5.1.3 Irrigation development

Currently, only 4 ha is under irrigation (CSA, 200().

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 in Tekeze basin), 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 (Tucker, 2009).

(iii) 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 Tigray. The NRM Department in Tigray admits that “impacts are not yet in relation to the efforts made through time”, but that the achievements are considerable:

- about 25 % of cultivated land treated,
- 200,000 hectares under area closure,
- 300,000 hectares of natural forest being exploited in a proper way.

Improved crop transformation and improved livelihood conditions are also mentioned as main achievements.

Research activities (Mekele University, project's own evaluations, and in earlier days, the SCRP) have shown that SWC has a positive impact in terms of erosion control, moisture retention and land rehabilitation. The Inter-University Cooperation project (IUC) of Mekele University estimates that terracing on cropland produces an average net increase in crop production (including the loss of land) of 3%. Revival of natural springs is also mentioned as an important indicator.

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.

(iv) Some selected cost figures

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

- MoWR (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.

(v) 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.

(vi) 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).

(vii) 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 Watershed Management Planning Framework

The Highlands of the upper Baro-Akobo are a mosaic of forest patches, upland cropland and grazing land and valley-bottom swamps – many of which are being drained for crop production. The area is under increasing population pressure and has varying, but growing, levels of food-insecurity. With mean annual rainfall exceeding 1,500 mm/yr the area has been identified as having good micro-hydro power potential. The valley-bottom swamps are located in micro-catchments at the top of a nested-hierarchy of hydrologically linked micro-catchments and sub-catchments that comprise the Upper Baro-Akobo Sub-basin. Whilst, currently only 5-15 percent of these swamps have been drained for crop production with increasing land pressure and food-insecurity the pace of swamp conversion is likely to accelerate.

A sustainable approach to swamp development for multiple uses has been developed by a local NGO based on traditional practices, a scientific study of ecological succession and governed by local institutions. On the uplands, community-based approaches to participatory forest management have also been developed. Related developments have taken place with respect to sustainable harvesting, improved marketing and quality control of non-timber forest products. In particular, the development of the production, quality control, certification and improved marketing of organically produced coffee is also receiving attention. There is a need to bring all these separate development initiatives together through a process of participatory land use planning at the micro-watershed level but which then integrates these into the overall planning and development at the Sub-catchment level to ensure equitable access to water across the Sub-catchment. This process would be linked to the proposed land use zoning of the remaining High Forest areas.

This two tiered level of watershed management planning would ensure that larger investments such as mini hydro power developments and lowland irrigation would be assured of sufficient water. Additionally, infrastructural developments such as improved road access to markets and crop processing plants would form an integral part of the overall Sub-catchment development. This two tiered approach to watershed management is only just now beginning to receive attention. Previous approaches initially used the Sub-catchment as the only level of development, which were then changed to the micro-catchment approach. There is a need to integrate the two approaches and increase the role for community participation with market incentives.

5.3 Project Stakeholders

5.3.1 Primary Project Stakeholders

Primary stakeholders include the following:

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

5.3.2 Secondary Project Stakeholders

Secondary Project Stakeholders include:

- Downstream water users within and below the Upper Birbir Watershed who will benefit from reduced sediment loads;

5.4 Proposed Project Interventions

5.4.1 Participatory Land Use Planning

The Project would provide support to the Project by providing funds for participatory land use planning at the micro-watershed level and for the water and other infrastructural planning at the Sub-Watershed level; for physical and human capacity building in terms of logistics, equipment and training in survey techniques; in participatory planning, knowledge sharing and dissemination of the survey finding and the Micro-watershed and Sub-watershed Plans.

5.4.2 Sustainable Wetland Management

The project would undertake detailed survey and assessment of the valley bottom wetland systems, undertake specialised training in Sustainable Wetland Management Systems for Wereda/Kebelle Extension Staff; establish Water User Groups (WUG's) on a sub-watershed basis and undertake Farmer training. Each WUG would develop participatory wetland management plans for the wetland area within their kebelle. Where a wetland extended across two or more kebelles regular meetings of all WUG’s would take place to agree on sustainable management practices for the whole wetland. Wetland management plans would be integrated into the overall kebelle Land use plan.

5.4.3 Participatory Forest Management (PFM)

The Project would support communities with substantial blocks of forest within their Kebelle area to develop sustainable forest management plans. These plans would articulate community agreed management practices, harvesting rates for wood and non-wood forest products. These forest management plans would be integrated into the overall kebelle level land use plans

5.4.4 Sustainable Land Management

Considerable experience has been gain within the Sor watershed in the use of biological soil conservation measures. Given the high rainfall in the watershed physical structures tend to cause water-logging.

(i) 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.

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

Grass Strips: Using Vetiver grass, these have proved very popular with farmers in the watershed. Research has shown that they are 60 percent effective in retaining sediment, but by slowly releasing water through the strip do not cause water-logging. As with physical soil conservation structures it is important that livestock movements should reduced to a minimum if the strips are not to suffer trampling. The interventions to increase forage supply on farm and communal lands for reduced grazing support this.

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.

(ii) 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 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, valley bottom wetlands 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).

(iii) Other Strategies

Honey production: Given the abundance of forest bee forage this activity is very popular. Improved hive can substantially increase production, from 5 to 35 kgs.

Improved Coffee Production: Coffee production is an important livelihood activity in the Watershed. The project would support the supply of improved coffee seedlings and improvements to coffee washing and drying. The potential for Organic Coffee markets would be explored.

5.4.5 Community Development Fund

A **Community Development Fund** would be an essential component of the Project. The fund would be utilized to realize implementation of sustainable development and natural resource management activities identified in the process of Community Level land Use Planning.

5.4.6 Payment for Environmental Services

The use of **Payment for Environmental Services** would be explored in relation to the implementation of sustainable development of Wetlands and Community Forests and the positive impacts on river flows reducing sediment loads for **Mini Hydro Power** development.

In addition the potential for Carbon Offsets from reduced deforestation and degradation (REDD) will also be explored as part of the participatory forest management and the sustainable wetland management activities.

5.5 Other Strategic Interventions

5.5.1 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. Except in some parts of Tigray Region, there is virtually no consumption of charcoal by rural households in Ethiopia.

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. This has a fuel saving of 40%.
- **Improved ceramic '*gounziye*' Stove** with an annual fuelwood saving of 30%.

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

The proportion of households dependent 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. The evaluation report of Irish Aid activities in Tigray mentioned access to credit as the best secondary project benefit to farmers. The Report suggests using part of the compensation in cash for community work for the creation of revolving funds for credit supply services.

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 on-going 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.

5.6 Monitoring and Evaluation

5.6.1 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 MoWR 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.

5.6.2 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) estimates can made at the micro watershed level on sediment delivery to the drainage system.

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.

5.6.4 Erosion and Sedimentation Control

The MoWR 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 <u>priority sites</u>/areas for watershed treatment
    . formulation and initial implementation of a <u>sustainable watershed management programme</u>
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 that would accrue to the Project.

At the local level an integrated system of natural resource management would be established that would diversity and sustainably increase agricultural production thereby increasing food security, supporting sustainable livelihoods and reducing poverty.

At the micro-watershed and Sub-watershed levels equitable access to water resources by downstream irrigators and mini-hydro power developments would be assured. Sediment loads would be reduced.

At the Global level sustainable management and use of the forest and wetland resources would ensure the conservation of biodiversity and in particular the wild coffee gene pool.

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EASTERN NILE TECHNICAL REGIONAL OFFICE

NBI – Institutional Strengthening Project
PROJECT DELINEATION AND PRIORITIZATION
ANNEX 4.3
SOR WATERSHED PROJECT

7th June, 2011

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[7] 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 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.

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

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 woredaor 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 nine of the Investment Projects located within the Main Nile Sub-basin, the Tekeze-Atbara Sub-basin and the Baro-Akobo-Sobat Sub-basin. Those Projects identified in the Abay-Blue Nile Sub-basin are being considered separately. This Project document is concerned with the Sor Watershed located in the Baro-Akobo Sub-basin in Ethiopia.

1.2 Primary Objectives of the Project

The Watershed Management CRA identified a number of land degradation hotspots in the Baro-Akobo Sub-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.

The objective of this project is to provide support to developing a participatory two tier approach to sustainable development and management of Sub-catchments and their Micro-catchments in the Southwestern Ethiopian Highlands of the Sor Watershed and through the utilization of Community Development Funds implement Community level Micro-catchment Management Plans. The project would also support the establishment of the higher level institutional procedures and organization to facilitate coordination at the Sub-catchment level. These interventions will support sustainable livelihoods and contribute to poverty alleviation.

1.3 The Scope and Elements of Sustainable Watershed Management

River 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).

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.

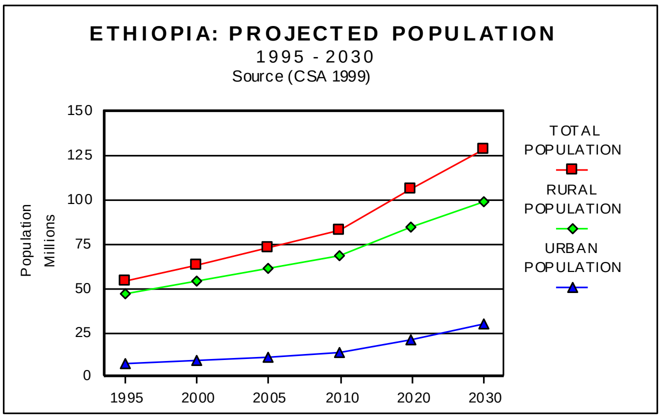
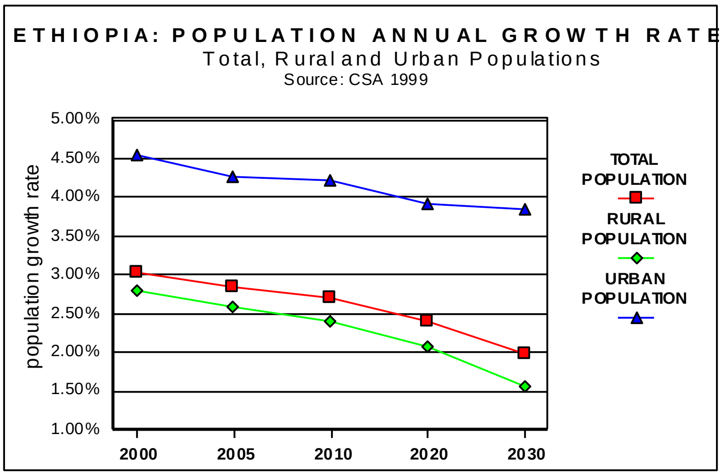
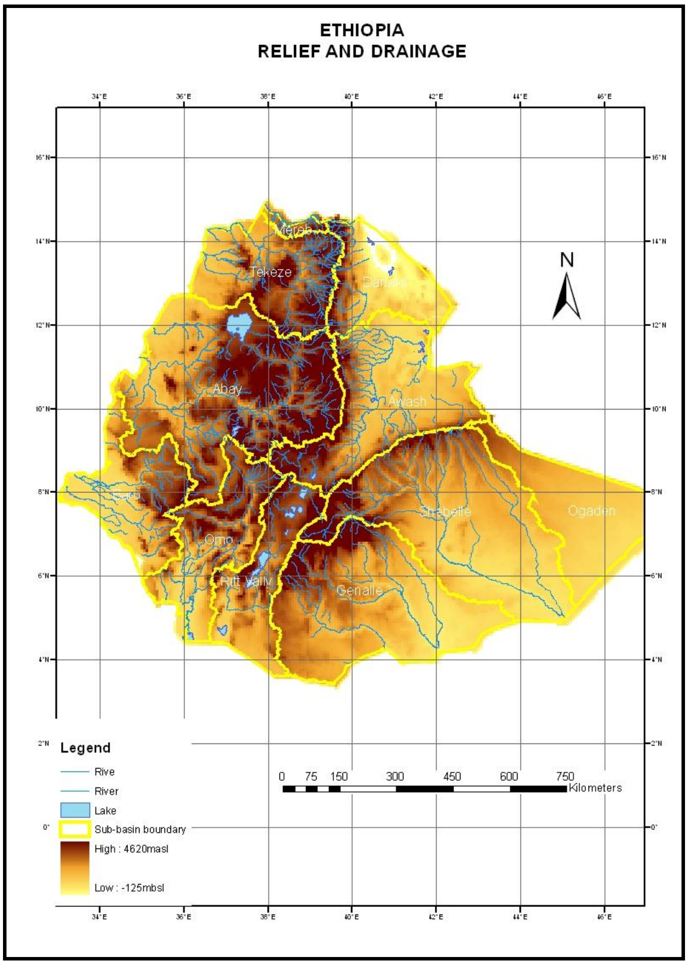


Figure 2. Rural, Urban and Total Population (1995





Map 2. Ethiopia: Relief and Drainage

The Highlands[8] 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

[8] “Highlands” in Ethiopia is land over 1,500 meters above sea level.

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.

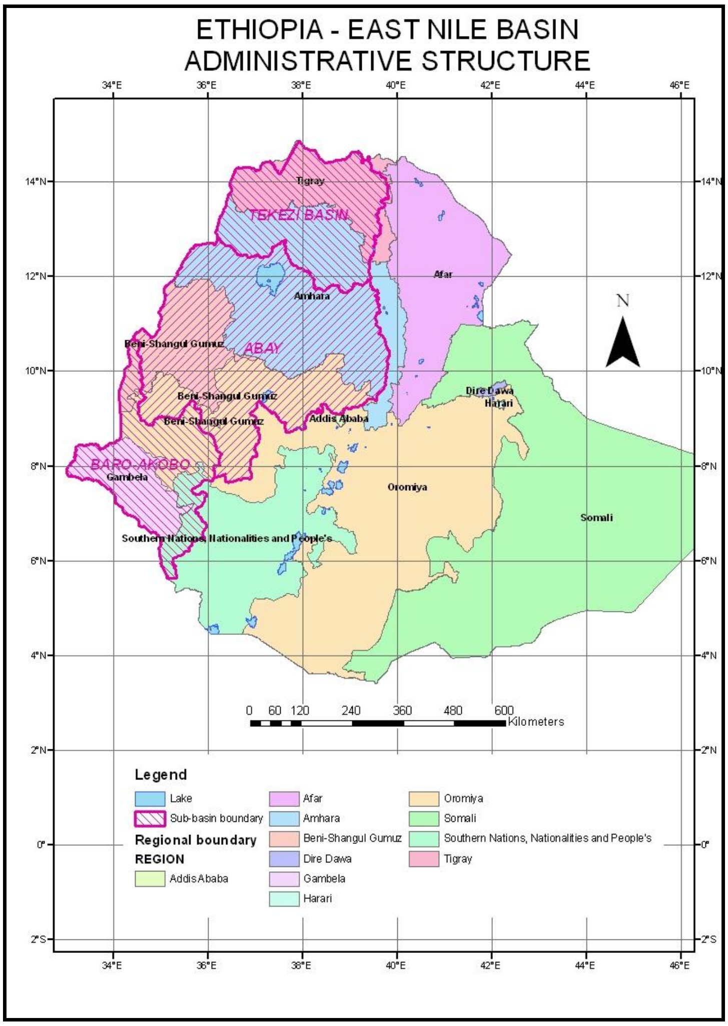
In the high rainfall areas of the southwest and southeast highlands the original vegetation of the highlands was broad-leaved montane high forest. Further north with lower rainfall this changed to a mixed coniferous forest (Podocarpus spp. and Juniperus spp.) and woodland. In the driest parts of the 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 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
- Woreda
- 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 Woreda 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 Poverty Reduction Strategies

(i) 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).

(ii) Growth and Transformation Programme (2011-2016)

This is the third phase of the PRSP strategy (2011 - 2016) and follows the previous strategies but places greater emphasis on Commercial agriculture, farmer produced inputs, improved value added chains, improved input/output market linkages.

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)
- (a similar proclamation has been issued for Tigray but is not available in English).

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 Oromiya 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 Oromiya 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 woreda level using a collaborative and not a "legal enforcement" approach.

2.4 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 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). Nevertheless, in recent years the uptake of soil and water conservation measures has been impressive and in many areas of Tigray the rate of adoption exceeds 40 percent of farmers[9]. This has been mainly due to the visible impacts of the increase in soil-water conservation, risk reduction and significant crop yield increases. 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

[9] See figure 3 "Terracing in the Ethiopian Highlands", in Mahmud Yesuf & J. Pender "Determinants and Impacts of land management Technologies in the Ethiopian Highlands: A Literature Review - Draft", EEPFE and IFPRI.

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.

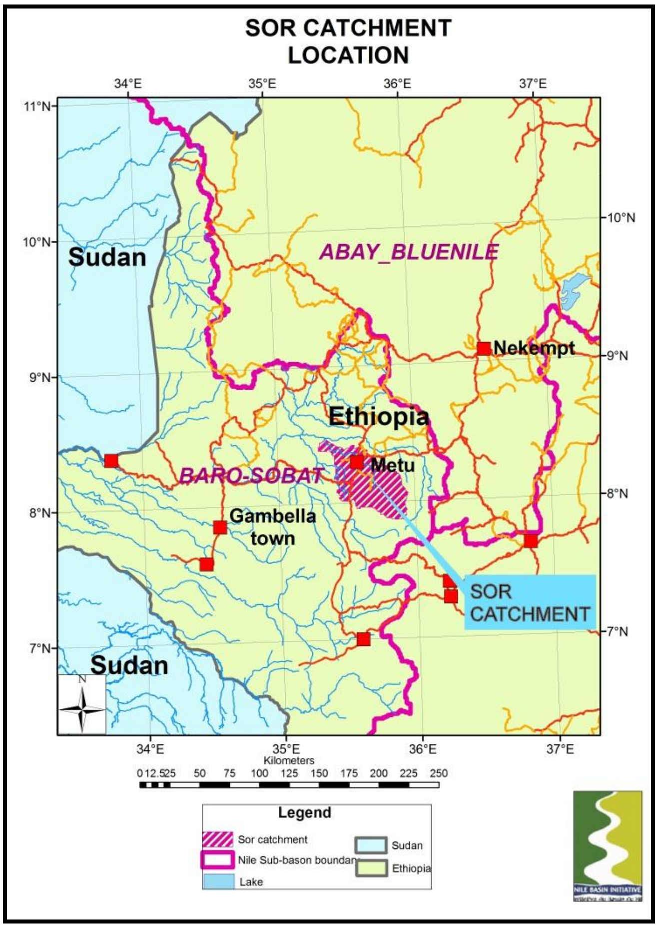
- The Malthusian argument of the negative impacts caused increasing population pressure, and Boserup argument for population induced agricultural intensification may both be correct in the Ethiopian situation. Farmers do respond to population pressure with intensified production, but this may not be 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. SOR WATERSHED - BIOPHYSICAL AND SOCIO-ECONOMIC SITUATION

3.1 Biophysical Characteristics

3.1.1 Location and Extent

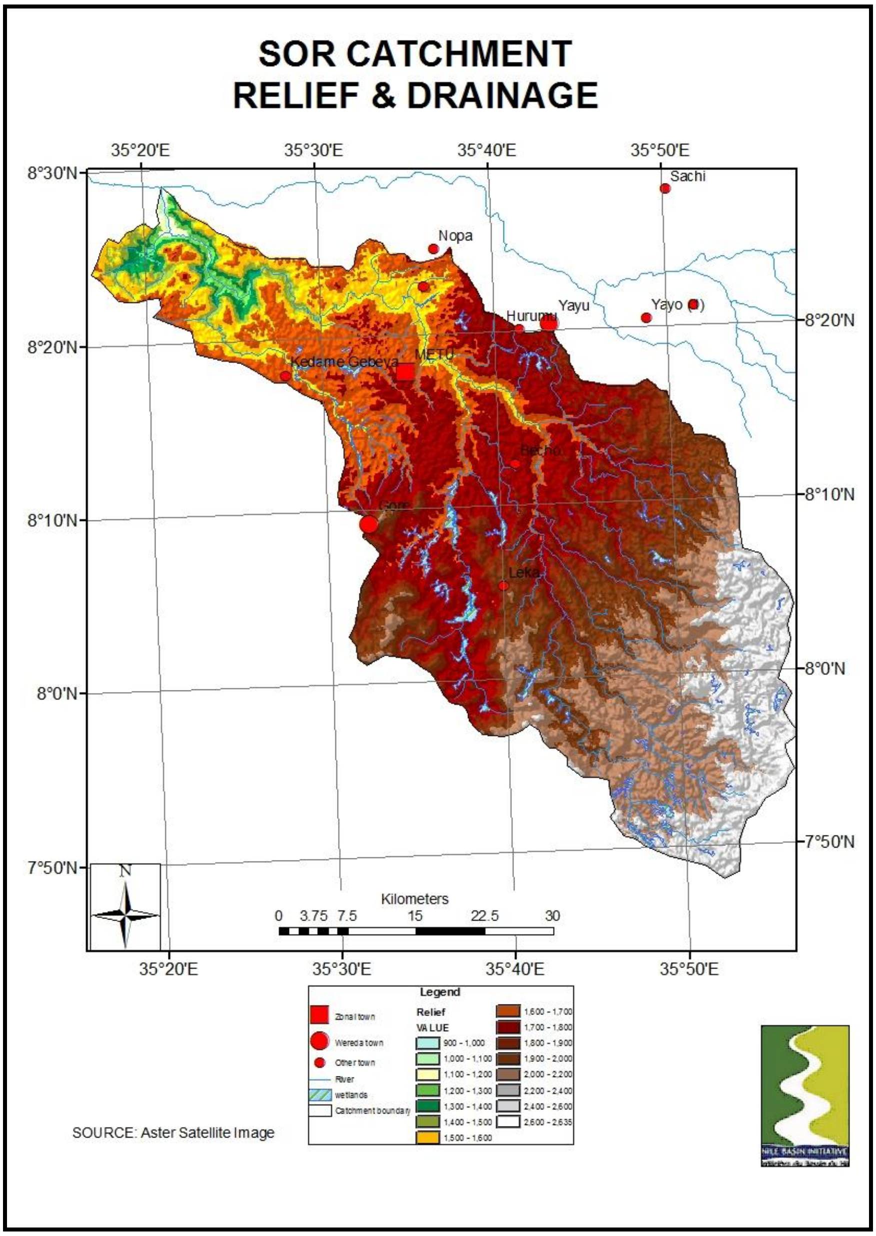
The Sor Watershed is located in the opper part of the Baro-Akobo-Sobat Sub-basin (See Map 5). The area of the watershed is 2,567 km2.



Map 1. Location of Sor Watershed

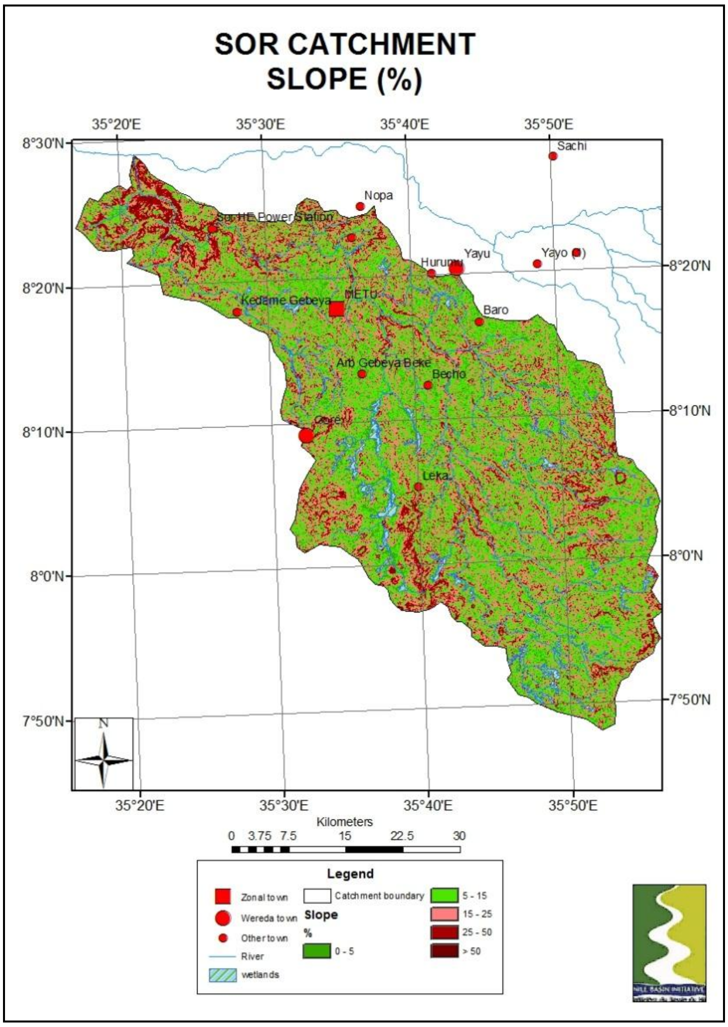
3.1.2 Relief and Drainage

The Project area is located in the Upper Baro Sub-basin, the Sor River being a south bank tributary that rises in the Montane Forests of the highlands of Illubabor Administrative Zone of Oromiya Regional State and of Kaffa Administrative Zone in Southern Nations, Nationalities and Peoples regional State (SNNPRS) (Map 6).



Map 2. Relief, Drainage and Sub-watersheds

The Sor River in its middle and lower reaches is deeply incised into an undulating plateau between 1,600 masl and 2,000masl.

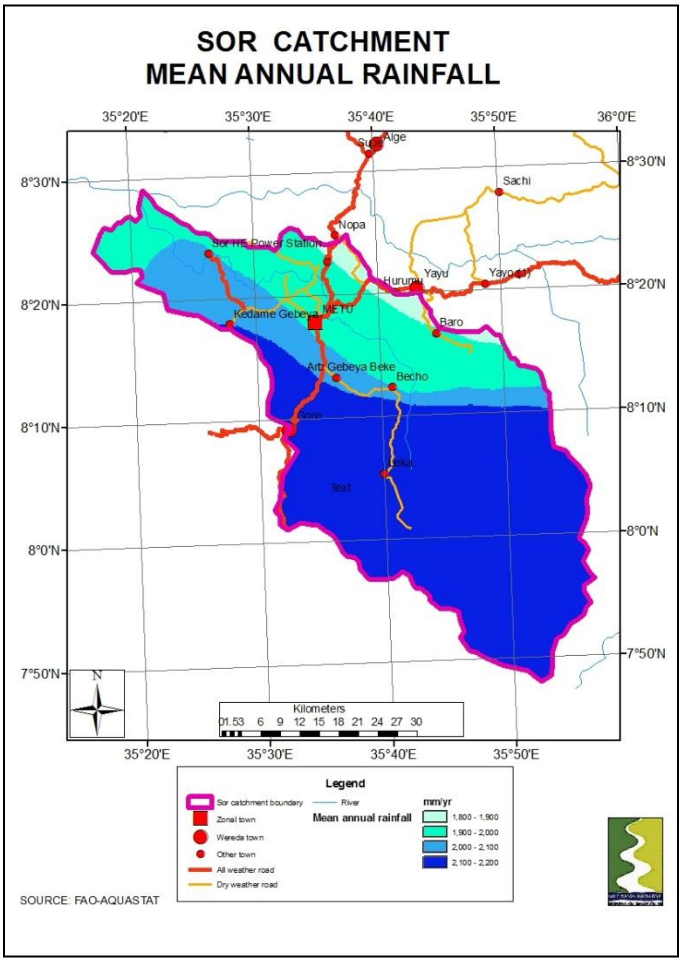


Map 3. **Slope Map (%)**

3.1.2 Climate

(II) Rainfall

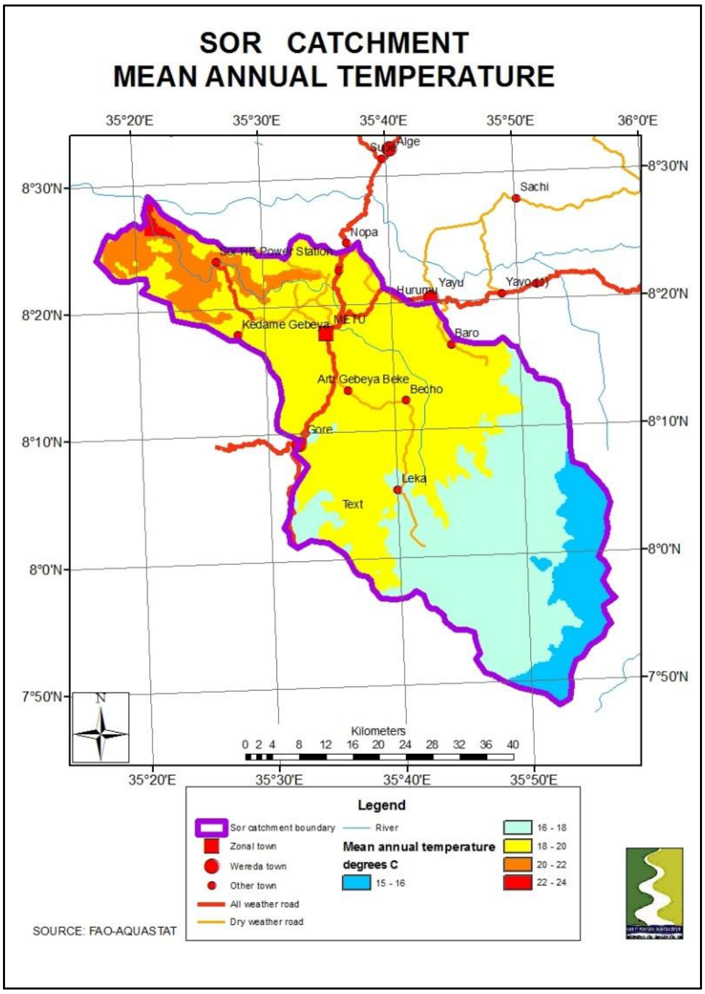
Mean annual rainfall over the Watershed is between 1,800 and 2,000 mm/yr increasing from north-east to south-west, broadly in line with increasing altitude but also reflecting the south-westerly direction of the monsoon. The rainfall pattern is uni-modal and the rainy season lasts from June to October.



Map 4. **Mean annual rainfall**

(ii) Mean annual temperature

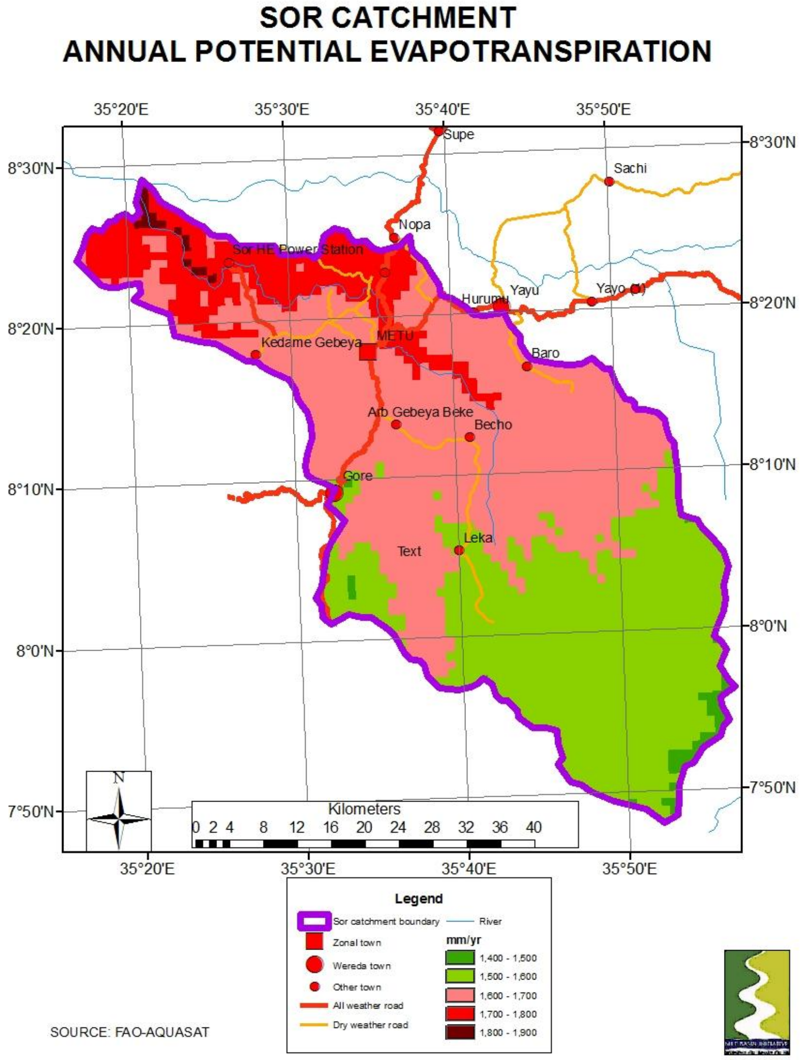
Mean annual temperature is inversely related to altitude. Thus, the lowest temperatures (13 - 15°C) on the highest forest area in the upper Watershed and the highest temperatures (21 - 23°C) are found in the lowest part of the Watershed near the junction of the Sor with the Baro River.



Map 5. Mean annual temperature (degrees C)

(iii) Mean Annual Evapotranspiration

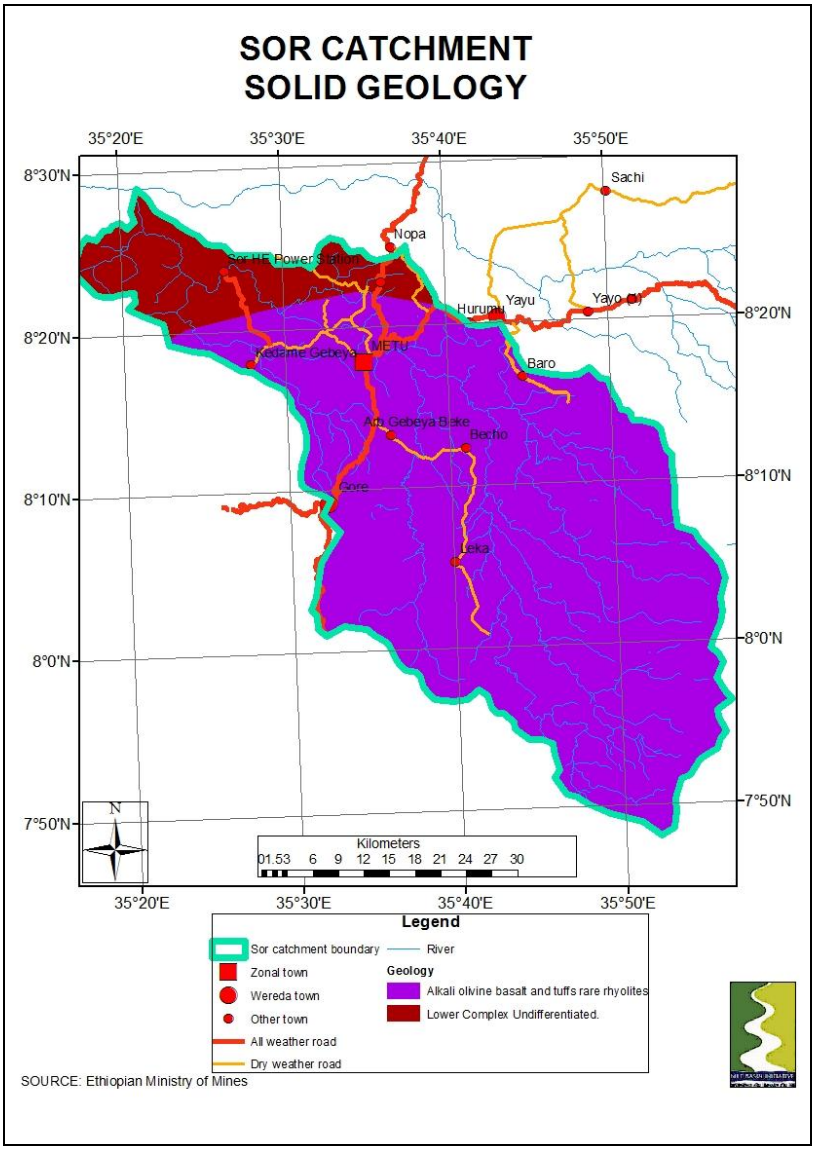
The pattern of mean annual evapotranspiration follows that of mean annual temperature and closely related to altitude (Map 10) with lowest rates (1,200mm/yr) in the upper Watershed and highest rates (1,600 mm/yr) close to the Baro River.



Map 6. Mean annual evapo-transpiration.

3.1.3 Geology

Most of the Watershed is underlain by Trapp basalts, with Basement Complex rocks (Schists, gneisses) which outcrop in the lowest part of the watershed (Map 11).

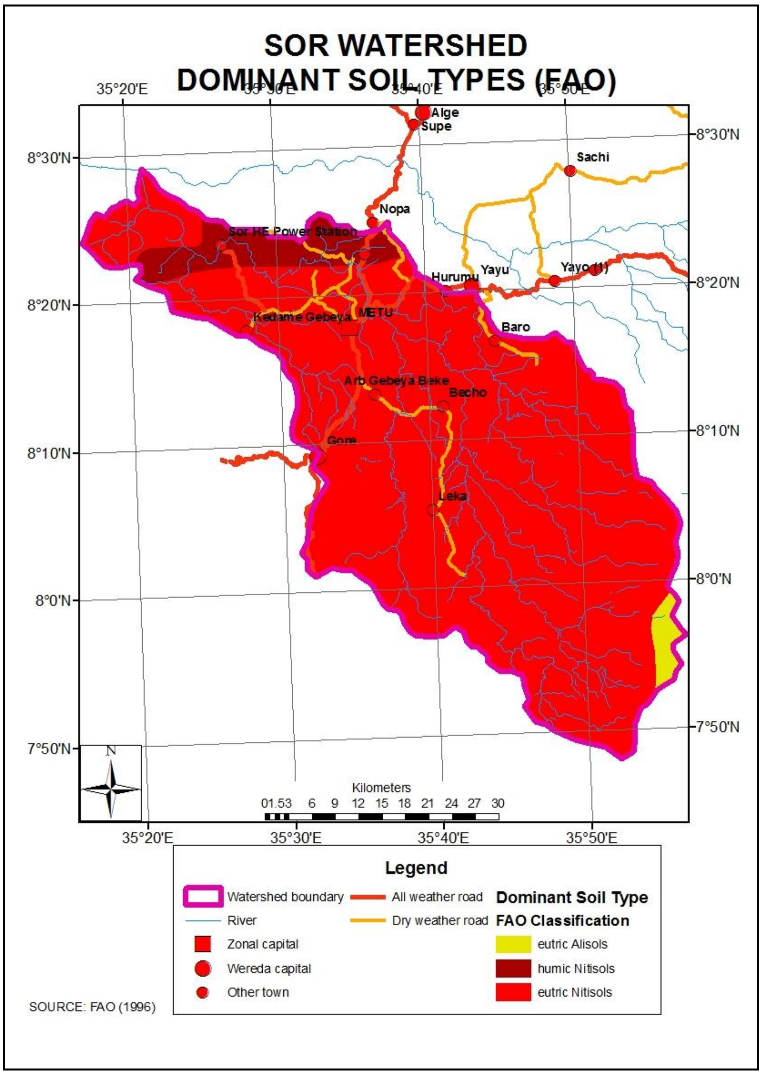


Map 7. Geology

3.1.4 Soils

Soils strongly reflect the underlying geology (Map 12) with the dominant soils being eutric Nitosols. They are deep, well drained soils moderately good structure and a base saturation of less than 50 percent. Given the relatively high rainfall they are leached of bases, with a lower pH and a severe Phosphorous deficiency.

In areas of the highest rainfall are humic Alisols. These are soils where clay has been washed down the profile resulting in a argilic or clay horizon at depth. These soils are even more leached than the Nitosols and with a low pH there is the danger of Aluminium toxicity.



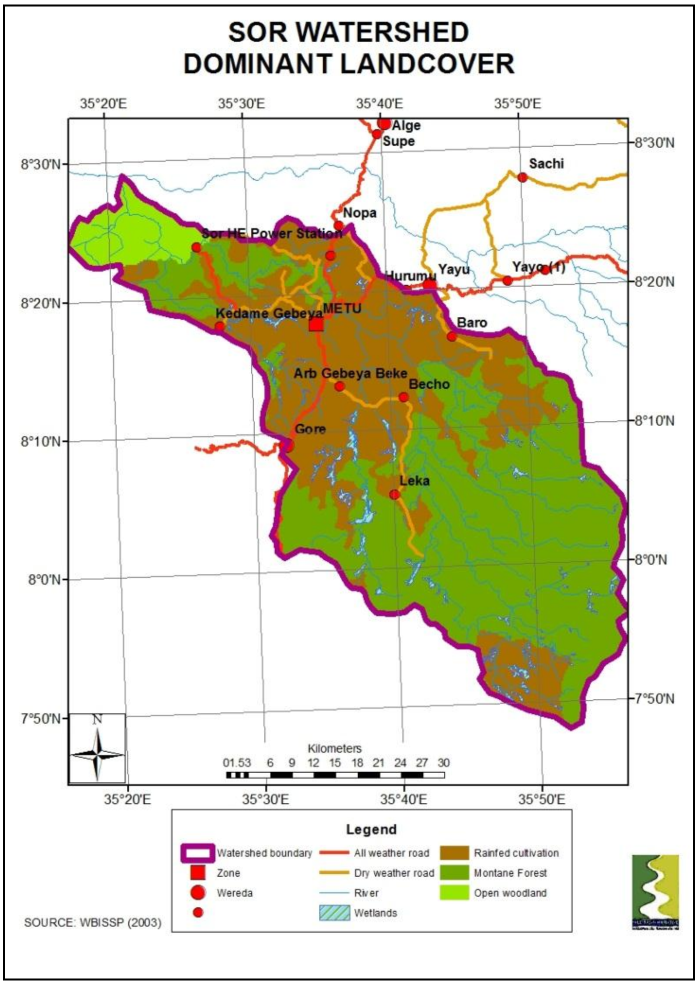
Map 8. Dominant Soils (FAO Classification)

3.1.5 Land Cover / Land Use

The areas and percent of total area of the dominant landcover classes are shown in table 3 and their distribution in Map 11. The most widespread is Open Montane Forest (53 percent), followed by Rainfed cereal cultivation whose fields are moderately stocked with trees (42 percent). Open woodland vovers just 5 percent of the Watershed.

Table 2. Sor Watershed: Dominant Landcover (km2)

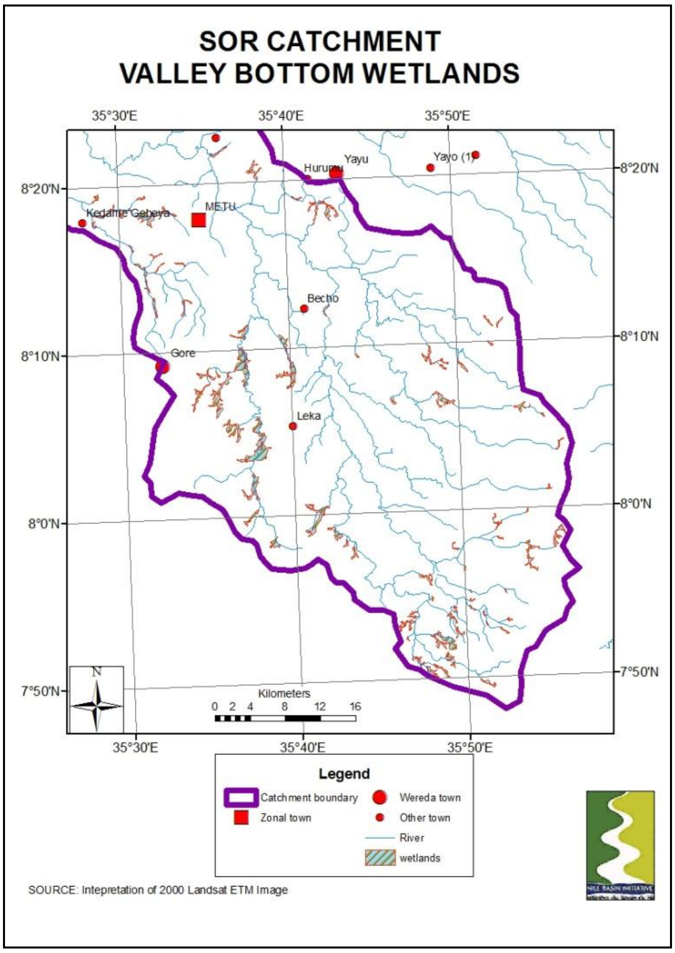
LANDCOVER	AREA (KM2)	%
Woodland; Open (20-80% tree cover)	133	5%
Forest; Montane broadleaf; Open (20-80% crown cover)	1,291	53%
Cultivated Land; Rainfed; Cereal System (with enset); moderately stocked with trees	1,025	42%



Map 9. Dominant Landcover

Because of the scale of mapping wetland has not been mapped by WBISPP (2003). Using the 2000 Landsat ETM imagery this has been mapped. Using this method some 4,220 ha of valley bottom wetland have been mapped. Some of the very narrow wetlands (i.e. less than 100 meters wide) may have been missed.

Many wetlands have been developed for crop production and for dry season grazing. Initial attempts at draining these wetlands failed because they were over-drained leading to invasion of weeds and loss of soil fertility. Sustainable systems of utilization of these wetlands have been developed in participation with local communities by the Project managed by the Ethiopian Wetlands and Natural Resources Association (EWNRA).



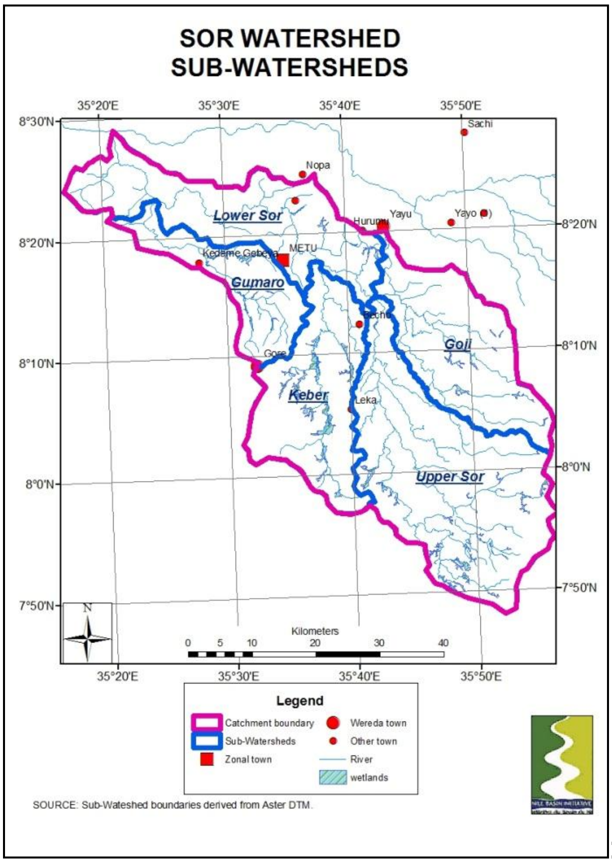
Map 10. Valley Bottom Wetlands

3.1.6 Water Resources

(iii)Surface Water

The Watershed has been divided into five Sub-watersheds (Map 11) as follows:

NAME	AREA (HA)	AREA (KM2)
Gumaro	25,483	255
Keber	44,102	441
Upper Sor	80,724	807
Lower Sor	50,467	505
Goji	44,113	441

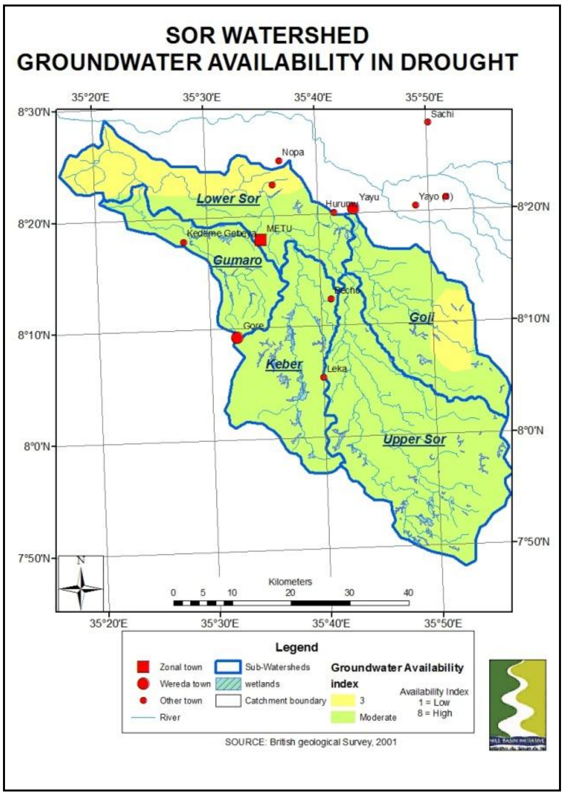


Map 11. Sub-Watersheds

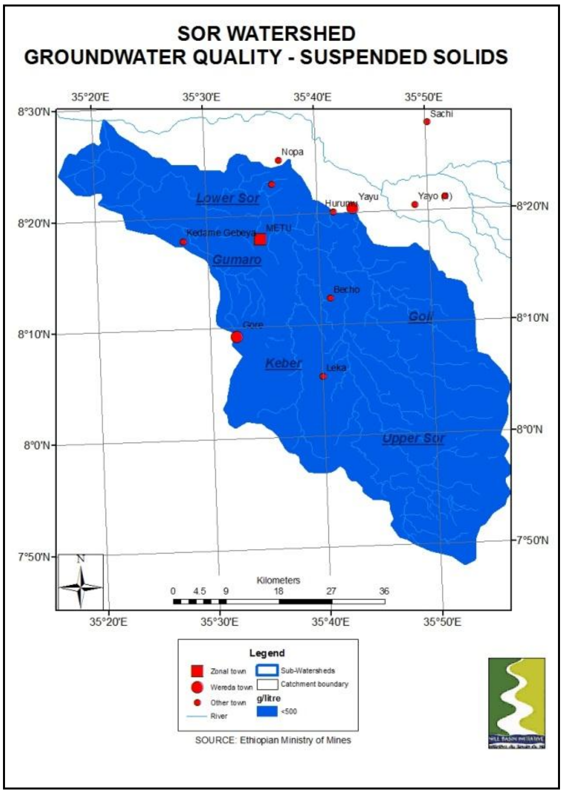
(iv) Groundwater Resources

The potential groundwater resources of Ethiopia have been mapped by the British Geological Survey (MacDonald et al., 2001) in conjuction with the University of Addis Ababa. The results for the Sor Watershed are shown in map 16. Generally, the Watershed has a Low to moderate potential for groundwater availability during drought periods.

The Ethiopian Ministry of Mines have mapped the hydrogeology and ground water quality (total dissolved solid/litre). The results for the Sor Watershed are shown in Map 17.



Map 12. **Availability of groundwater during Drought**



Map 13. **Groundwater Quality**

3.2 Population Distribution

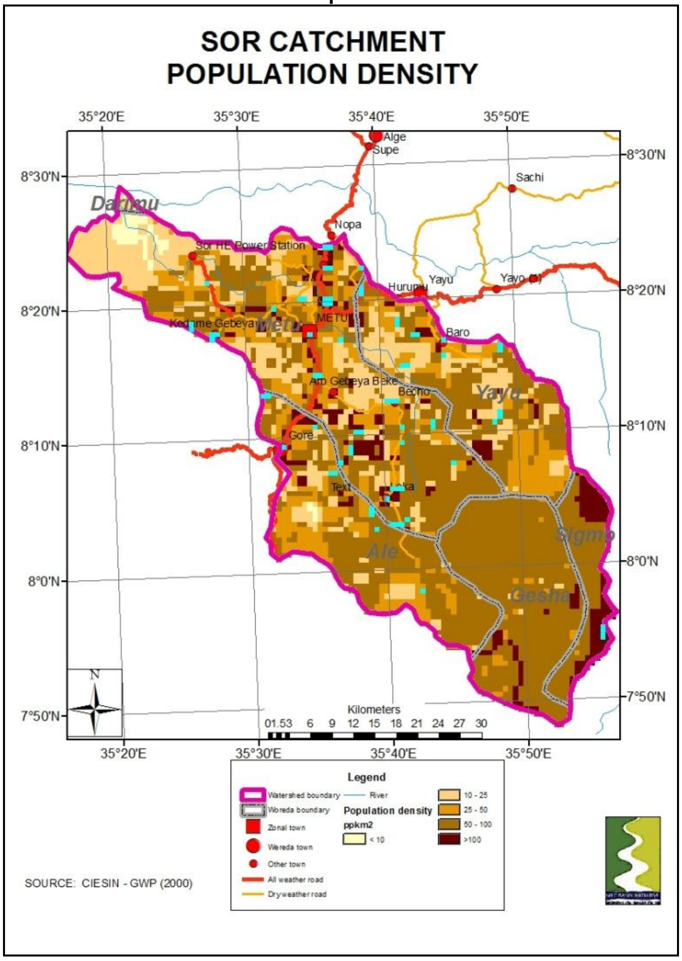
The Watershed encompasses five woredas: Metu Zuria, Yayu and Ale woredas in Illu Ababa Zone and Sigmo woreda in Jimma Zone of Oromiya region and Gesha Deka woreda in Kaffa Zone of SNNPR . A small portion (7 percent OF Watershed area) of Darimu woreda is also included. The estimated 2007 population of these woredas is as follows:

Table 3. Estimated 2007 population of Woredas in Sor Watershed

REGION	ZONE_NAME	WER_NAME	AREA (KM2)	% of Woreda in Watershed	TOTAL POP	RURAL POP	RUR. POP DENSITY (PPKM2)
Oromiya	Illu Ababa	Darimu	7	1%	146,447	142,202	106
Oromiya	Illu Ababa	Metu	990	70%	60,642	60,642	43
Oromiya	Illu Ababa	Yayu	434	31%	52,829	45,276	32
Oromiya	Illu Ababa	Ale	452	34%	64,251	55,207	41
Oromiya	Jimma	Sigmo	150	15%	92,722	87,193	86
SNNPR	Kaffa	Gesha Deka	415	17%	85,063	81,630	34

Population data source: CSA, 2010

The spatial distribution is shown in Map 14.



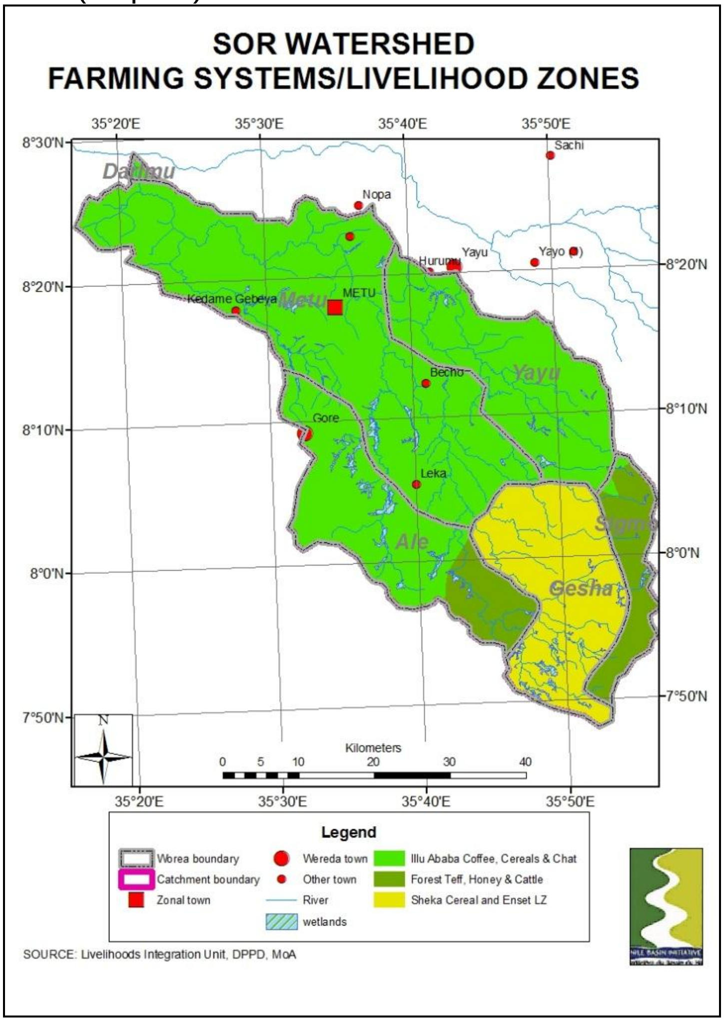
Map 14. Population Density and Distribution

Population densities are lowest in the areas of high forest. A tendency to concentrate along roads can also be observed. They are lowest in the incised valley of the Sor and its juncton with the baro.

3.3 Farming Systems

The Sor Watershed falls within the Enset-Root complex with Cereal Dominant Farming System (WBISPP, 2003).. Maize is the main crop both for subsistence and cash. According to the CSA Agricultural survey only 3 to 4 percent of farmers are using improved maize seed. A similar proportion of farmers are using chemical fertilizer (DAP and/or Urea), almost all of this on maize. The other cash crop, coffee, is not fertilized.

The Livelihoods Integration Unit (LIU) of the Disaster Preparation and Preparedness Department of the MoA (DPPD, 2010) have identified four Livelihood Zones falling within the Sor Watershed. These constitute separate cropping systems (Map 15).



Map 16. Farming Systems/Livelihood Zones

(i) Crop production

(a) Ilu Ababa Coffee and Cereals

This cropping system is found over most of the Sor Watershed. Cereals are dominant and enset and tubers only play a minor role. Teff is dominant with maize and sorghum, wheat and barley are only minor crops, except above 2,500 masl. Other field crops are lentils, chick pea and taro. Around the homestead are enset, Oromo and sweet potato, yams and vegetables. Coffee is a very important cash crop below 2,000 masl. Valley bottoms are used for maize cultivation after the main rains using falling watertables.

(b) Forest Teff, Honey and Cattle

This cropping system is found in the High Forests area above 2,00 masl in the upper parts of the Sor Watershed. Teff is the main cereal with some maize and wheat. Honey is a very important activities and source of cash income. Cattle are maintained mainly for milk and milk products.

(c) Sheka Cereal and Enset

This cropping system is found mainly in Sheka woreda where forest clearing is very advanced. The main cereals are teff, maize and wheat. Enset is an important homestead garden (*guaro*) crop.

(ii) Livestock husbandry

Livestock densities are very high. Cattle are important for draught, milk and manure.

(iii) Tree planting, management and tree products

Tree planting is not important. Some Eucalyptus may be planted around homesteads and only rarely on field boundaries. Many scattered trees remain in the fields and remnant forest or woodland on hillsides. Coffee is important in areas below 2,000 masl.

(iv) Interactions between crops, livestock and trees

Integration between crops and livestock is only moderate, but is closer in areas of high population density. Cattle are important for mainly for milk production but also for draught purposes.

(v) Bio-energy: Sources and Use

The annual per capita fuel wood consumption rates are the high, between 1,180 to 1,400 kgs. A proportion of this amount is obtained during clearing of forest and woodland for agriculture. A small quantity of crop residues is used as fuel: 25-75 kgs per capita.

(vi) Agricultural Landscape

The landscape is one of scattered homesteads that are not normally enclosed. Each homestead has a small home garden with or without enset. Coffee trees may be planted away from homesteads in the remnant forest patches. Outfields are large with no trees on the boundaries. Blocks of cropland are interspersed by large blocks of communal grazing areas under open bush and grassland. In narrow valleys small remnants of natural forest may be found. Some valley bottom swamps are being used for crop production and grazing, as well as sources of thatching grass.

(vii) Dynamics of change

The main change in land use is the encroachment of cropland into the natural forest, woodlands, and the communal grazing areas. Increasingly, bottomland wetlands are being used for crop production and grazing.

3.4 Social Infrastructure: Health and Education

3.4.1 Health Infrastructure and Health

The data of health infrastructure and health status for Illubabor Zone and the whole of the Oromiya Region were taken from the data base of the World Bank's Country Economic memorandum. Details of health infrastructure and health workers are shown in table 4.

Table 4. Oromiya Region: Details of health Infrastructure and Workers.

REGION/ZONE	Health Professional/'000 pop.	Potential Health Coverage (%)	Health Infrastructure (hospitals, clinics, dispensaries/'000 pop.
OROMIYA – ILLUBABAOR	0.44	94%	0.13
OROMIYA REGION	0.26	65%	0.11

Accessibility and the ratio of health workers to the population are key determinants in the number of people who are immunized. In Illubabor Zone only 34 percent of the population are immunized. This compares with 90 percent in Tigray and 62 percent in Amhara region.
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 5. With a lower than regional average of Health Professionals per thousand head of population it has a lower than regional average percent of population who are immunized.

Table 5. Oromiya Region: Percent Population Immunized, Percent Population vulnerable to and Area Exposed to Malaria.

Region	% Pop. Immunized	% Pop. vulnerable to malaria	% Area exposed to malaria
OROMIYA - ILLUBABOR	34%	95%	94%
OROMIYA REGION	40%	49%	59%

The Zone has a higher than Regional average percent of population vulnerable and higher percent of area exposed to malaria. A study (Ersado, 2005) has shown that the incidence of malaria is higher in those villages with dams and reservoirs than those without. The impact on households with higher malaria rates has been reduced number of days at work and higher medical expenses.

3.5 Transport Infrastructure and Markets

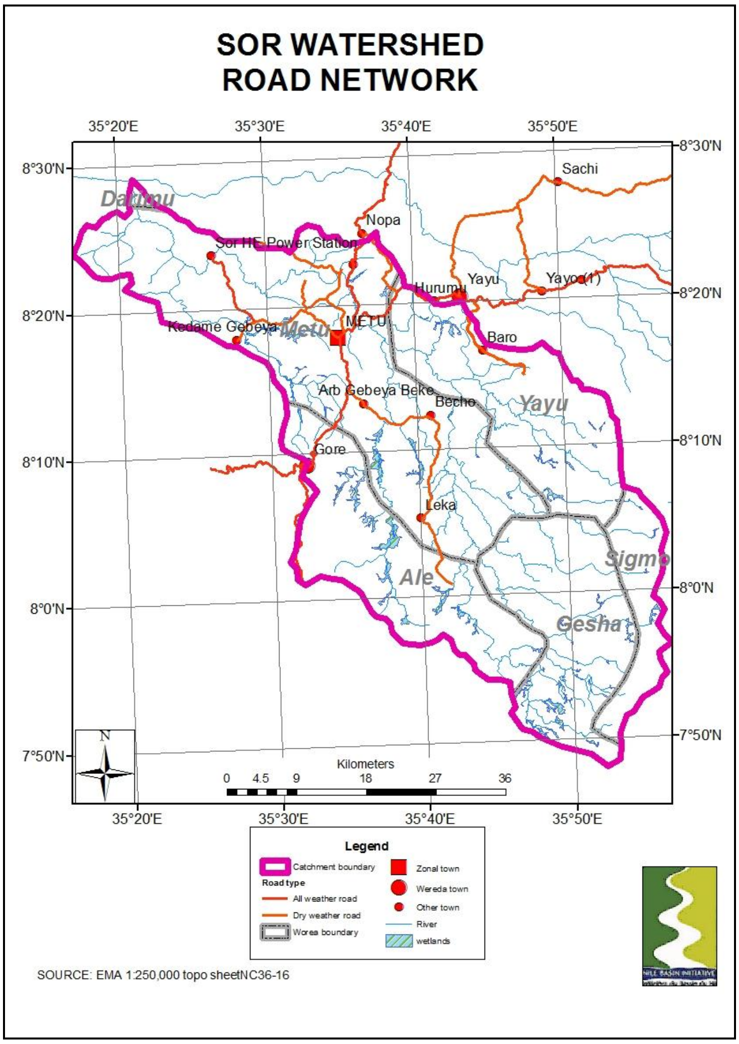
3.5.1 Transport Infrastructure

The Zonal town of Metu is served by an all-weather road to Jimma via Bedele and thence to Addis Ababa. An all-weather gravel road links Bedele to Nekemte, and thence a metalled road to Addis Ababa. The road to Bedele is metalled but in poor condition in a number of places. The distances to these towns are as follows :

Metu – Bedele :	118 kms
Bedele – Jimma	137 kms
Jimma – Addis Ababa	344 kms
Bedele – Nekemte	105 kms
Nekemte – Addis Ababa	328 kms

Thus Addis Ababa is 599 kms via Jimma and 551 kms via Nekemte.

In the lower part of the Watershed an all-weather road passes through Metu to Gambella town via Gore. Dry weather roads link Metu with the towns of Kedame Gebaya and Leka. However, most of the middle and upper parts of the Watershed are without road access.



Map 17. Road network.

There are approximately 268 kms of All weather road and 234 kms of Dry weather road. Only 48 percent of the Watershed is within 10 kms of an all-weather road.

3.5.2 Agricultural marketing

(i) Crop Marketing

The State has withdrawn totally from agricultural marketing. Farmers bring their grain to markets 5 to 20 kms from their villages, with about 80 percent of their cash sales occurring immediately after harvest. There is little or no information available to farmers to enable them to determine what crops to plant and hoe much. Farmers sell to the small merchants or assemblers in the market towns. Given the very high transport costs due to the very poor road network cereal crop marketing is very limited. Cash crop marketing in the Watershed is mainly concentrated on the marketing of coffee.

(ii) Livestock Marketing

Livestock markets function at three levels: primary, secondary and terminal markets. Primary markets are located at the village level with a supply of less than 500 head, where producers (farmers and pastoralists) sell to small traders, other farmers and pastoralists (replacement animals) and local butchers (Yakob Aklilu, 2002). In the Watershed, as with cereal crop trading livestock marketing is limited to sales to local centres.

4. KEY ISSUES, CHALLENGES AND POTENTIALS

4.1 he 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.

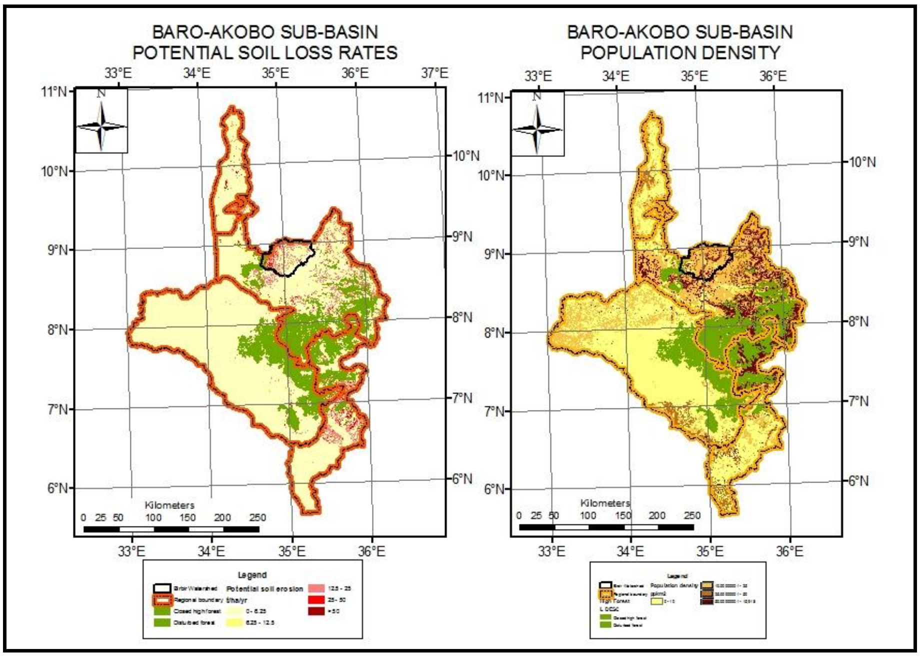
Related to poverty and household assets are the concepts of profitability of the improved land management technology, the farmers’ perceptions of risk and farmers’ private discount rates. Private discount rates are a measure of a person’s time preference or time horizon. The shorter the time horizon 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 Baro-Akobo basin is shown in Map 18.



Map 18. Baro-Akobo Basin: A comparison between the pattern of population density with soil loss rates.

Whilst there is some similarity in pattern along the northeastern and southeastern of the basin, elsewhere the patterns are not directly coincident. For example, the area to the west of the Birbir Watershed has high population densities but is located in an area with low potential soil erosion. 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. Oromiya has 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 (soil and stone bunds) are positive in moisture stressed areas but negative in higher rainfall areas. However, Herweg (2002) has shown that grass strips are 60 percent effective in reducing soil erosion, almost as effective as soil bunds (65 percent effective). There has been a rapid adoption of grass strips by farmers in the Sor watershed just to the south of the Birbir Watershed. Returns from fertilizer use show the opposite trend: with higher returns in high rainfall areas and lower in moisture stressed areas.

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 Sor Watershed

4.2.1 An Over-view of Watershed Management Challenges and Potentials

The Sor watershed lies within the Baro-Akobo sub-basin, which is one part of Ethiopia which is still relatively well endowed with natural resources as has been outlined in the previous section. In many ways it is as yet an only partially exploited resource frontier, with good land in many places, plentiful and reliable rainfall - especially in the upper basin, a major cash crop resource in the form of coffee, major biodiversity and genetic resources in the form of wild forest coffee, forests, wetland resources and some wildlife, and plentiful water for irrigation and hydro-power development. Overall population pressure is not severe and communications are improving with roads bringing about 75% of the Watershed within 10 kilometres of an all-weather road.

However, there are some major constraints to development. These include malaria below 1,500masl, trypanosomiasis in the woodland parts of the lower Watershed, the remoteness of the Watershed from major urban centres and markets.

As well as these specific constraints to development, there are a number of problems appearing which relate to development in the Watershed and to watershed and natural resource management in particular. These include deforestation, land degradation, wetland loss and wildlife loss. In some parts of the Watershed fragile environments are being degraded by inappropriate farming systems. Overall there is growing evidence that the resource base of the Watershed is declining.

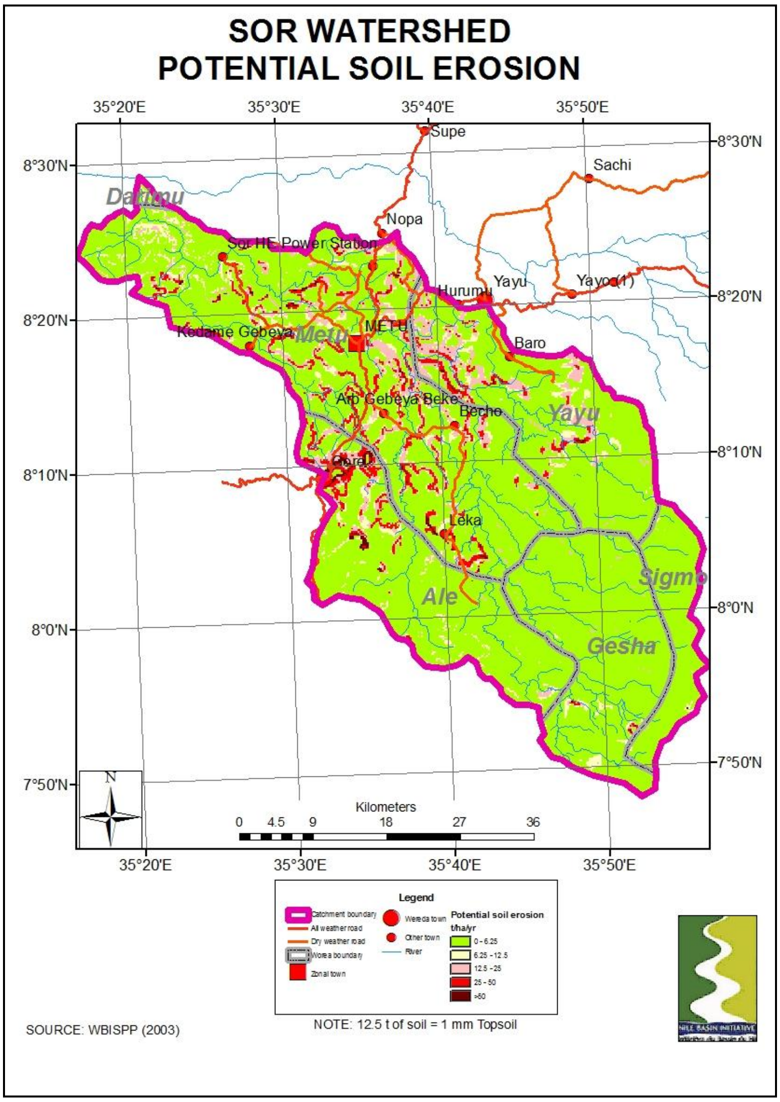
The causes of this resource degradation are predominantly due to population growth, problems with farming system development, the loss of land to settlers and the fluctuating presence of refugees in specific locations. However, these proximate causes are usually the result of other underlying drivers which include government policies, poverty and the competition for resources.

This section will explore these issues through the analysis of a number of key land use and development problems in the Watershed and their drivers (4.2 above).

4.2.2 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 19.



Map 19. **Potential Soil Erosion (t/ha/yr)**

The highest soil loss rates are found in the middle to lower parts of the watershed (outside the Forest) and on the steeper slopes leading down to the incised river valleys. Overall, soil erosion rates are low, with less than 9 percent of the Watershed experiencing severe (> 50 tons/ha/yr) soil loss rates. The Watershed is relatively free of gully erosion.

There are two estimates for sediment yield (tons/km2/yr) of the Sor Watershed at Metu. That of the Baro-Akobo Master Plan quotes 124 tons/km2/yr whilst the Study for Baro 1 and 2 dams quotes 169 tons/km2/yr. Using woreda soil erosion data calculated by WBISPP (2003) and using the above sediment yield rates allows the calculation of the estimated sediment delivery ratio (SDR[10]). These are shown in Table 6. The estimated SDR is between 1 and 28%.

Table 6. **Estimated Sediment Delivery Ratio (SDR) for the Sor Watershed**

[10] Ratio of sediment suspended in river at Watershed outlet to soil eroded within watershed.

WOREDA	Total soil loss (tons/yr)	Soil losstons /km2/yr	SDR (sed. Yield 124t/km2)	SDR (sed. Yield 169t/km2)
Ale	615,721	461	27%	37%
Metu	955,618	674	18%	25%
Yayu	1,263,083	898	14%	19%
Sigmo	247,598	263	47%	64%
TOTAL	**3,082,021**	**604**	**21%**	**28%**

With an estimated annual mean suspended sediment load at Gambela of 9.48 million tons and an estimated 43.7 million tons of soil eroded, this gives an estimated sediment delivery ratio (SDR) for the whole Baro-Akobo Sub-basin of only 22 percent, considerable less than the Tekeze (about 60 percent) and the Abay (about 49 percent).

(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. In the Sor Catchment little if any dung is used as fuel, so nutrient losses are due mainly to removal of grain and crop residues.

Annual soil nitrogen losses caused by crop residue removal from fields for Ale, Metu, Yayu and Sigmo woredas were estimated (WBISPP, 2003) to be 32tons, 40 tons, 37 tons and 20 tons respectively. Using a nutrient:yield ratio of 6, this results in annual crop losses of 158 tons, 201 tons, 186 tons and 98 tons annually[11].

Another source of soil nutrient losses at the field level is soil erosion. Hashim et al (2000) estimate nutrient loss as:

*Nut Loss = Soil loss * Nutrient concentration of topsoil * Enrichment ratio*
where the enrichment ratio refers to the ratio of the additional minerals and organic matter in eroded soil compared with the original soil. Barber (1983) estimated enrichment ratios of 2 for N and organic matter. Using Barber's estimated annual nutrient losses from different soil erosion rates, losses of available N on cultivated land for the four woredas would be:

[11] This compares with an annual crop loss per woreda in Arsi Zone of 700 tons/yr.

Table 7. Annual N Losses on cropland due to soil erosion and gains from rainfall and dust

WOREDA	N losses (tons/yr)	P losses (tons/yr)	Cultivated area (ha)	External N (tons/yr)
Ale	16	1	32,824	131
Metu	49	2	71,364	285
Yayu	54	2	60,652	243
Sigmo	10	1	35,209	141
TOTAL	**128**	**6**	**200,049**	**800**

Against these N losses are annual increments of N from rainfall and dust. Sanchez (1995) quotes lower order estimates of 4 kgs/ha/yr. From these external sources there is an annual increment of 800 tons of N on the cultivated land. Although some of this would be lost through leaching, it would appear that there is a net gain of N of about 670 tons. This is in contrast to the net losses incurred in the Tekeze and the Abay Sub-basins (ENTRO, 2007). However it is important to note, as Barber comments, "the prediction of soil nutrient losses is a very dubious and precarious exercise based on very limited amount of "hard" data and involving many estimates".

(iii) Soil water holding capacity

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.

The dominant soils in the Sor Watershed are humic and dystric Nitosols and humic Alisols, which are deep soils with a high clay content. Their water holding capacities are estimated (EHRS, 1986) to be 100mm/meter.

The moderately high water holding capacities of the Nitosols offset to some extent their high erodibility, which together with their depth of over 1 meter make soil moisture deficits very rare.

4.2.3 Assessment of the Extent Deforestation and Degradation of Vegetation Cover in the Sor Watershed

(i) Deforestation

The WBISPP (2003) estimated that the area of High Forest in the three woredas of Metu, Ale, Yayu and Sigmo in 1989 was 283,245 ha. It estimated the forest lost to agriculture was about 10,500 ha /yr (3.7 percent/yr).

(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 four woredas (Ale, Metu, Yayu and Sigmo) in the Sor Watershed of fuelwood consumption exceed sustainable supply by 49, 97, 67 and 64 percent respectively. These estimates are at the woreda level and it is likely that locally rates exceed these.

(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 woreda 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 stocking rates to carrying capacity were estimated for Ale, Metu, Yau and Sigmo woredas as 47, 83, 123 and 120 percent respectively. This indicates that for two of the woredas there is a livestock feed deficit. Crop residues provide between 30 and 45 percent of the livestock feed supply and are thus competing for residues as an important household fuel for cooking.

4.2.4 Assessment of the Extent Reforestation and Increases of Vegetation Cover in the Sor Watershed

(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

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.

(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 the Tekeze Sub-basin 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 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.

As an overall map of closed areas has not been completed it is not possible to say what proportion of the Sor Watershed has been closed.

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 and the follow-on projects of the WSM-CRA (including this project) are a first step towards implementation at this level.

Productive Safety Net Programme (PSNP): This programme is not being implemented in the Sor Watershed as none of the woredas are chronically food insecure.

Sustainable Land Management (SLM) Project: This project adopts an integrated WSM approach and focuses on Watersheds between 4,000 and 15,000ha in area. None of the woredas located in the Sor Watershed are currently included in this programme.

Watershed protection Small-scale **watershed development in micro-watersheds** is practiced by the woreda offices of agriculture in the Sor Watershed,

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 in all regions, and, in terms of areas covered, are most advanced in Tigray. The Tigray Region claims that some 560 micro-watersheds have been treated, mostly with MERET/WFP support.

The Local Level Participatory Planning Approach (LLPPA) developed within the MERET 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.

5.1.2 Irrigation development

Currently, about 180 ha is under irrigation (CSA, 200().

5.1.3 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 in Tekeze basin), and in a project of SOS-Sahel in Meket woreda 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 (Tucker, 2009).

(iii) 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 Tigray. The NRM Department in Tigray admits that “impacts are not yet in relation to the efforts made through time”, but that the achievements are considerable:

- about 25 % of cultivated land treated,
- 200,000 hectares under area closure,
- 300,000 hectares of natural forest being exploited in a proper way.

Improved crop transformation and improved livelihood conditions are also mentioned as main achievements.

Research activities (Mekele University, project's own evaluations, and in earlier days, the SCRP) have shown that SWC has a positive impact in terms of erosion control, moisture retention and land rehabilitation. The Inter-University Cooperation project (IUC) of Mekele University estimates that terracing on cropland produces an average net increase in crop production (including the loss of land) of 3%. Revival of natural springs is also mentioned as an important indicator.

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.

(iv) Some selected cost figures

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

- MoWR (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 MoWR.

- 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.

(v) 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.

(vi) 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, Woreda 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 Woredas, 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).

(vii) 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 Watershed Management Planning Framework

The Highlands of the upper Baro-Akobo are a mosaic of forest patches, upland cropland and grazing land and valley-bottom swamps – many of which are being drained for crop production. The area is under increasing population pressure and has varying, but growing, levels of food-insecurity. With mean annual rainfall exceeding 1,500 mm/yr the area has been identified as having good micro-hydro power potential. The valley-bottom swamps are located in micro-catchments at the top of a nested-hierarchy of hydrologically linked micro-catchments and sub-catchments that comprise the Upper Baro-Akobo Sub-basin. Whilst, currently only 5-15 percent of these swamps have been drained for crop production with increasing land pressure and food-insecurity the pace of swamp conversion is likely to accelerate.

A sustainable approach to swamp development for multiple uses has been developed by a local NGO based on traditional practices, a scientific study of ecological succession and governed by local institutions. On the uplands, community-based approaches to participatory forest management have also been developed. Related developments have taken place with respect to sustainable harvesting, improved marketing and quality control of non-timber forest products. In particular, the development of the production, quality control, certification and improved marketing of organically produced coffee is also receiving attention. There is a need to bring all these separate development initiatives together through a process of participatory land use planning at the micro-watershed level but which then integrates these into the overall planning and development at the Sub-catchment level to ensure equitable access to water across the Sub-catchment. This process would be linked to the proposed land use zoning of the remaining High Forest areas.

This two tiered level of watershed management planning would ensure that larger investments such as mini hydro power developments and lowland irrigation would be assured of sufficient water. Additionally, infrastructural developments such as improved road access to markets and crop processing plants would form an integral part of the overall Sub-catchment development. This two tiered approach to watershed management is only just now beginning to receive attention. Previous approaches initially used the Sub-catchment as the only level of development, which were then changed to the micro-catchment approach. There is a need to integrate the two approaches and increase the role for community participation with market incentives.

5.3 Project Stakeholders

5.3.1 Primary Project Stakeholders

Primary stakeholders include the following:

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

5.3.2 Secondary Project Stakeholders

Secondary Project Stakeholders include:

- Downstream water users within and below the Sor Watershed who will benefit from reduced sediment loads;

5.4 Proposed Project Interventions

5.4.1 Participatory Land Use Planning

The Project would provide support to the Project by providing funds for participatory land use planning at the micro-watershed level and for the water and other infrastructural planning at the Sub-Watershed level; for physical and human capacity building in terms of logistics, equipment and training in survey techniques; in participatory planning, knowledge sharing and dissemination of the survey finding and the Micro-watershed and Sub-watershed Plans.

5.4.2 Sustainable Wetland Management

The project would undertake detailed survey and assessment of the valley bottom wetland systems, undertake specialised training in Sustainable Wetland Management Systems for Woreda/Kebelle Extension Staff; establish Water User Groups (WUG's) on a sub-watershed basis and undertake Farmer training. Each WUG would develop participatory wetland management plans for the wetland area within their kebelle. Where a wetland extended across two or more kebelles regular meetings of all WUG’s would take place to agree on sustainable management practices for the whole wetland. Wetland management plans would be integrated into the overall kebelle Land use plan.

5.4.3 Participatory Forest Management (PFM)

The Project would support communities with substantial blocks of forest within their Kebelle area to develop sustainable forest management plans. These plans would articulate community agreed management practices, harvesting rates for wood and non-wood forest products. These forest management plans would be integrated into the overall kebelle level land use plans

5.4.4 Sustainable Land Management

Considerable experience has been gain within the Sor watershed in the use of biological soil conservation measures. Given the high rainfall in the watershed physical structures tend to cause water-logging.

(i) 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.

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

Grass Strips: Using Vetiver grass, these have proved very popular with farmers in the watershed. Research has shown that they are 60 percent effective in retaining sediment, but by slowly releasing water through the strip do not cause waterlogging. As with physical soil conservation structures it is important that livestock movements should be reduced to a minimum if the strips are not to suffer trampling. The interventions to increase forage supply on farm and communal lands for reduced grazing support this.

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.

(ii) 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 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, valley bottom wetlands 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).

(iii) Other Strategies

Honey production: Given the abundance of forest bee forage this activity is very popular. Improved hive can substantially increase production, from 5 to 35 kgs.

Improved Coffee Production: Coffee production is an important livelihood activity in the Watershed. The project would support the supply of improved coffee seedlings and improvements to coffee washing and drying. The potential for Organic Coffee markets would be explored.

5.4.5 Community Development Fund

A **Community Development Fund** would be an essential component of the Project. The fund would be utilized to realize implementation of sustainable development and natural resource management activities identified in the process of Community Level land Use Planning.

5.4.6 Payment for Environmental Services

The use of **Payment for Environmental Services** would be explored in relation to the implementation of sustainable development of Wetlands and Community Forests and the positive impacts on river flows reducing sediment loads for **Mini Hydro Power** development.

In addition the potential for Carbon Offsets from reduced deforestation and degradation (REDD) will also be explored as part of the participatory forest management and the sustainable wetland management activities.

5.5 Other Strategic Interventions

5.5.1 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. Except in some parts of Tigray Region, there is virtually no consumption of charcoal by rural households in Ethiopia.

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. This stove has a fuel saving of 40%.
- **Improved ceramic '*gounziye*' Stove** with an annual fuelwood saving of 30%.

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

The proportion of households dependent 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. The evaluation report of Irish Aid activities in Tigray mentioned access to credit as the best secondary project benefit to farmers. The Report suggests using part of the compensation in cash for community work for the creation of revolving funds for credit supply services.

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 woredas 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 on-going 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.

5.6 Monitoring and Evaluation

5.6.1 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 MoWR 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.

5.6.2 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) estimates can made at the micro watershed level on sediment delivery to the drainage system.

5.6.3 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.

5.6.4 Erosion and Sedimentation Control

The MoWR 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.

- 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
- Select, procure and supervise installation of equipment for modest network extension or intensification;
- Assist in preparation of Hydrological Yearbooks;
- Design monitoring devices, e.g. flumes, at the outlet of micro-watersheds/ inlet of reservoirs;
- Define related monitoring requirements such as basic meteorological stations, bathymetric surveys;
- Select and procure monitoring equipment for micro-watersheds;
- Supervise the installation of monitoring devices in pilot micro-watersheds;
- Identify qualified partners for monitoring activities in micro-watersheds;
- Develop and support the first phase of a monitoring programme using verifiable impact indicators;
- 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 <u>priority sites</u>/areas for watershed treatment
  . formulation and initial implementation of a <u>sustainable watershed management programme</u>
- 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);
- Train and coach staff at federal, regional and local level in network operation (tools and operation procedures), data collection and data dissemination;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
- Develop guidelines for national network operation, based on lessons learned;
- Develop procedures for dissemination of monitoring data;
- Assist in the development of guidelines for planning of WSM activities; and
- Prepare guidelines for monitoring the impact of watershed protection activities

6. Distribution of Benefits

There are a number of local, regional and global benefits that would accrue to the Project.

At the local level an integrated system of natural resource management would be established that would diversity and sustainably increase agricultural production thereby increasing food security, supporting sustainable livelihoods and reducing poverty.

At the micro-watershed and Sub-watershed levels equitable access to water resources by downstream irrigators and mini-hydro power developments would be assured.

At the Global level sustainable management and use of the forest and wetland resources would ensure the conservation of biodiversity and in particular the wild coffee gene pool.

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EASTERN NILE TECHNICAL REGIONAL OFFICE

NBI – Institutional Strengthening Project
PROJECT DELINEATION AND PRIORITIZATION

ANNEX 4.4
TELKUK WATER HAVESTING PROJECT

(FINAL REPORT)

7th June, 2011

CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ACT	African Country Almanac
CBD	Convention on Biological Diversity
CPA	Comprehensive Peace Agreement
CRA	Cooperative Regional Assessment
DFID	Department for International Development
ECC	Environmental Compliance Certificate
EIA	Environmental Impact Assessment
ENSAP	Eastern Nile Subsidiary Action Programme
FAO	Food and Agricultural Organization
FNC	Forest National Corporation
GEF	Global Environmental Fund
GAIL	Gross Annual Immediate Loss
GDCL	Gross Discounted Cumulative Loss
GDFL	Gross Discounted Future Loss
GDP	Gross Domestic Product
GIS	Geographic Information System
GOS	Government of Sudan
HCENR	Higher Council for Environment and Natural Resources
IDEN	Integrated Development of the Eastern Nile
IFPRI	International Food Policy Research Institute
IGADD	Inter Governmental Agency for Drought and Desertification
IIED	International Institute for Environment and Development
ILO	International Labour Office
IUCN	International Union for the Conservation of Nature
ITCZ	Inter Tropical Convergence Zone
IWMI	International Water Management Institute
JAM	Joint Assessment Mission
JMP	Joint Multipurpose Programme
Km	Kilometre
Km2	Square kilometre
MEA	Multilateral Environmental Agreement
MoA	Ministry of Agriculture
MEPD	Ministry of Environment and Physical Development
MIWR	Ministry of Irrigation and Water Resources
MCM	Million Cubic Meters
MW	Mega Watt
NBI	Nile basin initiative
NCS	National Comprehensive Strategy
NWP	National Water Policy
PERSGA	Strategic Action Plan for the Red Sea and Gulf of Aden
PRSP	Poverty Reduction Strategy Project
SIDA	Swedish International development Agency
SLM	Sustainable Land Management
SWC	Soil and Water Conservation
t	ton
UNDP	United Nations development Programme

UNFCCC	United National Framework Convention on Climatic Change
USAID	United States Agency for International Development
USLE	Universal Soil Loss Equation
WB	World Bank
WSM	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[12] 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 of these had regional and global benefits. Many of the

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

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 nine of the Investment Projects located within the Main Nile Sub-basin, the Tekeze-Atbara Sub-basin and the Baro-Akobo-Sobat Sub-basin. Those Projects identified in the Abay-Blue Nile Sub-basin are being considered separately. This Project document is concerned with the Telkuk Watershed located in the Telkuk Locality in Kassala State.

1.2 Primary Objectives of the Project

The Watershed Management CRA identified a number of land degradation hotspots in the Baro-Akobo Sub-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.

The objective of this Project is to provide support to the Regional Government to arrest land degradation hotspots in the Telkuk Locality of Kassala State, strengthen household and community livelihood strategies and contribute to the alleviation of poverty.

1.3 The Scope and Elements of Sustainable Watershed Management

River 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).

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 - SUDAN

2.1 Bio-physical and Socio-economic Setting

Sudan covers an area of approximately 2.5 million km2 and in 2002 an estimated population of 31.3 million with an annual growth rate (1998-2003) of 2.6 percent. The projected 2025 population is 49.6 million. The total, rural % and growth rates by region are shown in table 2.

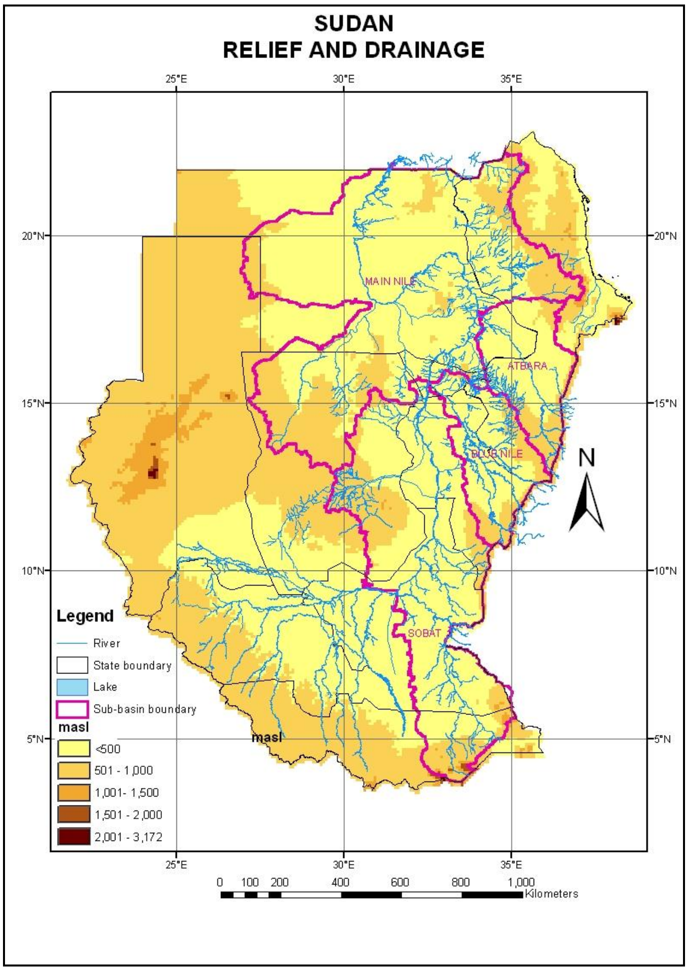
Table 2. Sudan: Total population, Rural % and growth rates by Region (2002)

REGION	TOTAL POP ('000) 2002	RURAL %	TOTAL GROWTH RATE
Eastern	3,360.5	57%	2.25%
Northern	1,392.5	75%	1.85%
Khartoum	5,301.3	14%	4.04%
Central	6,278.7	70%	2.80%
Kordofan	3,512.0	74%	1.50%
Darfur	6,212.6	82%	3.01%
N. Sudan	26,057.0	60%	2.58%
S.Sudan	5,283.3	79%	1.61%
SUDAN	31,340.0	65%	2.64%

Source: Y.A.Mohamed (2005)

Overall population density is 12.4 p.p.km2 but this masks considerable variations. Population tends to concentrate along the streams and rivers and other water sources.

The relief and drainage of Sudan are shown in Map 1.



Map 1. Sudan: Relief and Drainage

Land under 500 masl occupies the central White and Main Nile valleys as very gently sloping plains. Higher land is found along the eastern edge as outliers of the Ethiopian Highlands together with the Red Sea Hills. The southern and southwestern edges of the basin form the Congo-Nile watershed. The Jebel Marra forms the Nile-Lake Chad watershed along the western border. Locally hills and mountains rise above 1,500 masl (e.g. the Imatong Mountains being the country's highest point at 3,224 masl).

The Bahr el Jebel enters Sudan from Uganda with the Bahr el Ghazal forming on the northern slopes of the Congo-Nile Divide. They join at Lake No to be known as the White Nile. They both lose much water through evaporation in the Sudd. Just above Malakal the Sobat River, which rises in the southwestern Ethiopian Highlands, joins the White Nile. At Khartoum the White Nile is joined by the Blue Nile, which rises in the Central and Northern Ethiopian Highlands. Thence known as the Main Nile it is finally joined by its last tributary the Atbara, which also rises in the northern Ethiopian Highlands. There are many seasonal wadis and khors, which flow intermittently during the rainy season. Locally they are of considerable importance in small-scale irrigation, water harvesting and human and livestock water supplies.

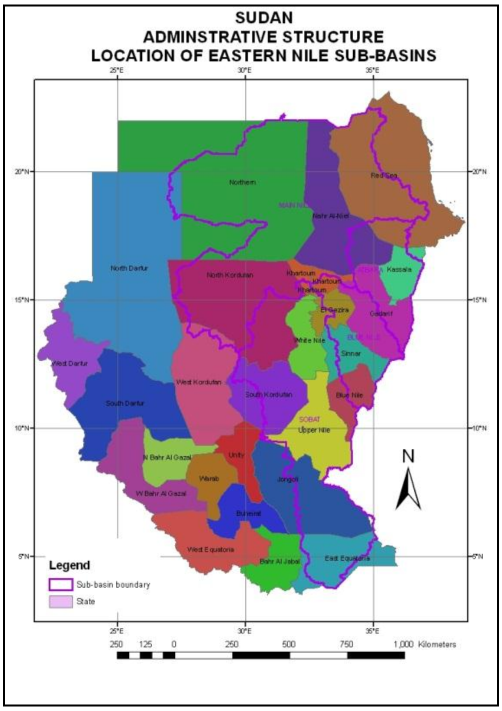
The country encompasses three major ecological zones: desert, semi-desert and savanna. Annual rainfall varies from less than 25 mm in the north to

1,500 mm in the south. Rains are erratic and variable, increasingly so in the north. Rains fall in a single season and are closely related to movements of the inter-tropical convergence zone (ITCZ).

Soils in the Sudan are commonly classified into four groups: (i) thin desert soils consisting of loose sand over bare rock in the north, (ii) fixed or shifting aeolean sands in the north and central parts, (ii) clay soil derived from old and recent alluvium over large areas of the central and eastern parts, and (iv) lateritic soils on the ironstone plateau in the southwestern part of the country.

Natural vegetation closely follows the rainfall patterns with local edaphic variations related to soil moisture conditions. Successively from the north are desert, semi-desert, woodland savanna on clay, woodland savanna on sands, high rainfall woodland and swamps. Large areas of the central woodlands on clay have been cleared for semi-mechanized farming and other areas of woodland are under severe pressure from traditional farming, and fuel wood and charcoal production for both urban and rural household consumption.

2.2 Administrative Structure



Map 2. Sudan: Adminstrative Structure with Eastern Nile Sub-Basin Boundaries.
Source:: ENTRO GIS data base:

In the past decade Sudan has embarked a policy of administrartive decentralization. According to the Local Government Act of 2003, the Sudan has been divided into 26 States, some 16 located in the north and 10 in the south (Map 3). Each State is divided into anumber of Localities (Mahaliyat). The aim of decentralization is to improve the delivery of basic social services and address the severe spatial disparitries in access to education, health, water, agricultural extension and other government services.

Decentralization and concommitant capacity building will be undertakenn over two pahses: Phase I (2005 – 2007) and Phase II (2008 – 2011). Priorities in the local government will be:

- Enhancing managment capacity by empowering suitable structures to lead reform;
- A broad consultation on organizational structures;
- Developing a comprehensive strategy for institutional arranbgement, polices and guidleines for public services and training;
- Improving systems and practices of local publicprivate partnerships in service delivery;
- Support to Locality development planning;
- Improving Locality information systems;
- Establishing Locality monitoring systems;
- Promoting civil society participation in planning and organization of governmenbt activities;
- Mobilizing local revenue generation for State and Local Government.

2.3 National and Regional Policy Framework

2.3.1 The National Comprehensive Strategy (NCS) (1992-2002)

Sudan's main objectives and priorities for sustainable development were spelt out in the National Comprehensive Strategy (NCS) which provided policy directions to all economic and social sectors. The NCS incorporates the country's environmental strategy, which states clearly that environmental issues must be embodied in all development projects. Within the NCS, the government manages the economy through a series of three years rolling plans and annual budget processes. The NCS has also served as a key reference document and basis for sectoral policies and measures.

A main weakness of the NCS is the lack of coherence as it was a result of work of different sectoral teams without emphasis on horizontal and vertical integration

2.3.2 Comprehensive Peace Agreement CPA

The Comprehensive Peace Agreement (CPA), signed between GoS and SPLMA on 9 January 2005, represents a remarkable event in the history of Sudan and is a major opportunity for restoring peace and the social contract between the state and society in the country.

The CPA provides for a socially informed land tenure policy and legislation as it accords specific reference to ownership of land and natural resource. It calls for competency in land administration, provides for incorporation of customary laws and practices and establishes an independent Land Commission for the purposes of arbitration, rights of claims in respect to land, land compensation and the possibility of recommending land reform policies.

The CPA is expected to have many implication (institutional and administrative) - e.g. the establishment of a Land Commission for the south parallel to existing central institutions responsible for land and natural resources management.

However, there is the question of the existing sectoral environmental legislation. Should that legislation remain federal as it is currently stands, or should it be amended and passed down to the states in accordance with the obligations given to them by the federal structure? (NBSAP,2002)

There is now a counterpart ministry of Environment and Wildlife in Southern Sudan and it is expected that the post CPA developments will witness greater decentralization on all levels. This will necessitate the initiation of a dialogue on developments in the sub-basins in Sudan as a basic requirement for sustainable development in the sub-region. Of special concern also are issues related to conflict resolution, internally displaced refugees, good governance, and the rights of the socially, economically and politically marginalized groups in post conflict Sudan

2.3.3 The Joint Assessment Mission (JAM) (2005)

The JAM Reports are the most recent documents which are guiding the economic development in post peace period in Sudan. The reports have developed the policy guide lines and interventions in eight clusters, including the economic policy cluster. The issue of environment has been classified as one of the cross-cutting issues. The report identified many environmental challenges Sudan is facing and need to be addressed during the short and medium term to enable the country make an equitable and sustainable development in the foreseen future.

The JAM report has stated that the foremost challenge is to minimize the negative environmental impacts that returning refugees and Internally Displaced Populations (IDPs) may pose on the natural resources base through increased deforestation and destructive agricultural practices

2.3.4 Poverty Reduction Strategy (2000)

Under the coordination and leadership of the Ministry of Finance and National Economy, Sudan is also in the process of formulating a national poverty reduction strategy. This strategy is expected part of the country’s long-term strategic plan and seeks to involve all groups of Sudanese society.

The preliminary draft of the PRSP was prepared in January 2004 with participation and contribution of a number of highly qualified national experts, The PRSP is considered to be the main available document of the government of the Sudan for poverty reduction. It covers the sixteen States of North Sudan for the period 2005-2007.

PRSP main objectives are:

- Maintain Economic Stability.
- Ensure Political Stability
- Social Stability.
- Environmental integrity
- Improve standards of living
- Assist in the flow of financial resources.

2.3.5 Environment Protection Act 2001

In 2001, the Higher Council for Environment and Natural Resources (HCENR) initiated the development of environmental regulations under the Environment Protection Act which was issued through a presidential decree. It established guidelines and requirements for environmental impact assessments and environmental conservation frameworks.

The Environmental Protection Policy (2001) requires that any new projects that are deemed to have an impact on the environment conduct an Environmental Impact Assessment (EIA). This must be done in order to obtain an Environmental Compliance Certificate (ECC) from the HCENR through the receipt of an Initial Environmental Impact Assessment (IEA) Report. This report should contain a Mitigation Plan or a description of the mitigation measures to be implemented to reduce the environmental impacts of the proposed project.

The EIA report is normally made available for viewing and comment by interested and affected parties prior to the HCENR giving the go ahead with the project. This legislation represents a major step in coordinating national developmental projects on an environmentally sustainable basis

2.3.6 National Water Policy (2001) - Draft

Through a process of consultations with stakeholders, a Draft National Water Policy was prepared. The policy builds on experiences of a wide range of experts and institutions involved in water sector. The draft policy document assesses the water situation in the country, existing policies and legislation and then provides the main policy principles and statements. These policy principles are considered under water resources, water utilization, water and environment, international issues, socio-economic issues, disaster management and institutions and capacity building. It also recommends development of strategic plan for the water sector.

The objectives of the NWP are to:

- Review and adapt water policy to meet changing circumstances within the country;
- Ensure that the water resources of Sudan are properly managed, protected and efficiently utilized for the benefit of all;

- Provide the basis for the on-going development of water related regulations and legislation, and
- Strengthen and clarify the functions and responsibilities of water related institutions in both the public and private sectors in Sudan

Part 3 of the Water Policy (2001) addresses issues related to water and environment. It examines at policy as it affects the environment and related matters such as pollution and catchments degradation.

2.3.7 National strategies in response to Multilateral Environmental Agreements (MEAs)

(i) Agenda 21 Project - Sudan

In response to Agenda 21 (Rio Earth Summit 1992) a project was implemented in Sudan to build the capacity needed to meet the challenges of the Twenty First Century. The project helped to build capacities of government institutions, the private sector and non-governmental organizations to implement sustainable development projects. The project played an important catalytic role in promoting community level environmental protection. The project succeeded in building the capacities of Two State Environmental Councils and in the preparation of Environmental Action Plans for 4 States. This provided the basis for a ground level identification of a National Agenda 21 and initiated the formulation of a National Sustainable Development Strategy.

(ii) National Biodiversity Strategy and Action Plan (NBSAP)

In 1995, the Sudan government has become party to the Convention on Biological Diversity (CBD). The Government developed with GEF support and technical assistance from World Conservation Union (IUCN) its first National Biodiversity Strategy and Action Plan in May 2000 and its first Country Study on Biological Diversity in April 2001. The NBSAP outlines strategies, priorities and actions for biodiversity conservation and protection of natural ecosystems

(iii) National implementation Strategy for the UN Framework Convention on Climate Change

In 1992, the government of Sudan signed the United Nations Framework Convention on Climate Change (UNFCCC), and ratification took place in 1993. An enabling activity for climate change funded by GEF/UNDP was implemented by the HCENR. The project conducted many activities including training, a Greenhouse Gas inventory, a vulnerability and adaptation assessment and mitigation analysis and an intensive awareness program. As part of complying with its commitments to the Climate Change Convention,

Sudan completed its National Communication under the UNFCCC in February 2003.
To fill the gaps and short comings of the vulnerability and adaptation assessment to climate change a three-year project is being implemented as part of the "Global Assessment of Impacts of and Adaptation to Climate Change (AIACC)" through GEF/UNEP. This project aims at enhancing the scientific and technical information, assessing the impact of climate change and designing cost-effective response measures needed to formulate national policy options.

(iv) National Action Plan (NAP) to Combat Desertification

In November 1995 Sudan ratified the United Nations Convention to Combat Desertification (UNCCD). The National Drought and Desertification Control Unit (NDDCU) has been designated as the national focal point to the UNCCD. The NDDCU identified the States that are affected by the desertification process. As part of its commitments under this convention, a National Action Programme (NAP) has been prepared in April 2002.
The challenges which face the implementation of NAP in Sudan include lack of a coherent national land use plan, dependence of household energy on forests products, expansion of mechanized rain fed agriculture and the civil war.

(v) Other International Environmental Obligations

Sudan is also involved in key GEF funded regional initiatives under the international waters operational programmes and is an active player in all these initiatives. These include the Kijani Initiative, the project for the Protection of Key "Bottleneck" Sites for Soaring Migratory Birds in the Rift Valley and Red Sea Flyway, the Nile Trans-boundary Environmental Action Project, the Strategic Action Programme for the Red Sea and Gulf of Aden (PERSGA) and the project for the Removal of Barriers to the Introduction of Cleaner Artisanal Gold Mining and Extraction Technologies.

2.4 Institutional Framework

2.4.1 Higher Council for Environment and Natural Resources (HCENR)

In recognition of the importance of environmental protection for the sustainable development of Sudan, as well as for the fulfillment of the various United Nations global environmental commitments, the government in 1992 established the Higher Council for Environment and Natural Resources (HCENR) as the central government organ co-ordinating efforts for sustainable development, use of natural resources and environmental protection. The Council includes a number of relevant ministries and places special emphasis on addressing degradation, resource depletion, and chronic pollution. A parliamentary committee on environment and natural resources was also established in 1992.

In 1995, the Government also created the Ministry of Environment and Tourism, now Ministry of Environment and Physical Development (MOEPD) to oversee overall environmental management and integrate environmental protection into national development strategies.

The mandate of the HCENR as stated in the Environment Protection Act 2001 includes inter alia:

- Formulation of general policies for Natural Resources, inventories and development to ensure the appropriate management of the resources and their conservation and sustainable use,

- Develop in co-operation with other government authorities strategies to encourage environmentally sound and sustainable activities; and

- Initiate measures for the co-ordination and enforcement of environmental protection legislation.

The HCENR is chaired by the Minister of the Environment and Physical Development. The HCENR discharges its functions by a General Secretariat with the following mandate:

- Draft general policies for Natural Resources Inventories and Development to ensure the appropriate management of the resources and their conservation and sustainable use.

- Environment conservation in coordination with the appropriate authorities in the States.

- Coordinate the work of the Council Branches and all efforts in natural resources inventories and conservation and efforts for the sustainable development of the resources, monitor changes in the natural resources;

- Specify areas subjected to depletion, desertification and pollution and decide on priorities for surveys and studies on natural resources.

- Make long-term plans for rational and balanced use of the natural resources and environment conservation and follow-up the execution of the plan with appropriate authorities.

- Periodically review legislation related to the natural resources and the environment, make sure that Laws are effective and introduce any necessary amendments to improve the Laws.

- Establishment of branches in the different States to help the Council in performing its responsibilities.

- Encourage support and coordinate scientific research in all fields of the environment and natural resources.

- Formulate a federal plan for environmental awareness and rational use of the natural resources and try to incorporate environmental education in school curricula.

The HCENR is Sudan's outlet to the international environmental arena. It acts as the technical focal point for most of the environmental the conventions emerged from the Earth Summit in Rio de Janeiro (1992) namely: Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC). In addition it is a party to the Convention on Persistent Organic Pollutants (POPs).

The cross-cutting nature of the environmental issues, which spread over different disciplines, has guided the HCENR to form steering and technical committees so as to bring all the concerned stakeholders together, and playing its coordinative role.

2.4.2 Other Government Institutions

In addition to the HCENR, other government ministries have significant roles and responsibilities in the areas of natural resource management, land use planning, and socio-economic development, including :

- Ministry of Agriculture and Forests;
- Ministry of Irrigation and Water Resources;
- Ministry of Finance
- Ministry of Technology and Scientific Research;
- Ministry of Industry and Commerce;
- Ministry of Energy and Mining
- National Council for Strategic Planning
- Ministry of Health;
- National Meteorological Authority
- Ministry of Culture and Information; and
- The General Directorate of Public Corporation for Investment

The **Ministry of Agriculture and Forests** is responsible for agricultural development and natural resources planning and policies, and the National Drought and Desertification Control Unit (NDDCU) in this Ministry has been designated as the national focal point (NFP) to the UNCCD.

In 1989 the **Forest National Corporation** (FNC) replaced the old Forest Administration (that was established in 1902) to be responsible for the protection and management of forest resources in the country. The FNC is a semi-autonomous corporate body that is attached to the Ministry of Agriculture and Forests. It has a Board of Directors constituted by the Council of Ministers and 10 representatives from related institutions. As such, the FNC is entrusted with the role of protection and conservation of forest resources.

The **Ministry of National Industry** is responsible for formulating industrial policies, strategies and programmes that fall within overall national objectives. The Ministry can orient the activities of many industrial activities that are directly related to the Biodiversity, Climate Change and Desertification issues, as the industrial sector is an important user of natural resources.

The **Ministry of Irrigation and Water Resources** is responsible for setting national water resources policies, strategies and plans, development of water resources to meet the needs, monitoring of ground water basins, and forging cooperation between the Nile basin countries. It also, contributes to the environmentally sound socio-economic development such as in big irrigated agriculture schemes.

The Wildlife Conservation General Administration (WCGA) was established in 1902 by the colonial authorities. The WCGA was part of the Game and Fisheries Department of the Ministry of Animal Resources. Today, it is administratively accountable to the Ministry of Interior while technically it is accountable to the Ministry of Environment and Tourism. It is entrusted with the conservation of wildlife in the Sudan. Wildlife includes also ecosystems and habitats where species are living. WCGA is also entrusted with the task of establishment and management of protected areas in Sudan. Among its main responsibilities are:

- Sustainable management and utilization of wildlife resources in the country.
- Origination of hunting (issuing licenses and setting by limits).
- Cropping of wildlife, trade in wildlife parts and live animals.
- Establishment of zoological gardens for wildlife public education.
- Control of wildlife damaging problems.
- Management of marine national parks and protected areas.

WCGA is the focal point for CITES (Convention on International Trade in Threatened and Endangered Species (includes botanical or animal species.) as well as for RAMSAR Convention for the protection of wetland.

The **Wildlife Research Center (WRC)** is a part of the Animal Resources Research Corporation. There are no official links between the WCGA and WRC. Research recommendations are not implemented, and the WCGA major approach to wildlife conservation is policing and licensing with no efforts in the area of involving the people in participatory wildlife management or applying scientific wildlife management practices (NBSAP, 2001). The WCGA lacks official link with the Fisheries Administration, Fisheries Research which is also under the Ministry of Animal Resource.

The Institute **of Environmental Studies (IES), University of Khartoum** was formally established in 1979. Although in fact it was created in 1972 following United Nations Conference on Human Environment in 1972 and the subsequent call by the Arab League Educational Cultural and Scientific Organization, (ALECSO) that universities should respond to environmental problems and challenges. Since then, he IES (the first in Africa and the

Middle East) has pursued a program that blends a) post-graduate education in environmental studies b) short-term training in natural resources c) research and consultancies in project design, environmental impact assessment and education.

IES executes projects funded by international organization e.g. i) Dry Land Husbandry project (OSSREA & EPOS) i) Environment Impact Assessment projects (UNEP, UNICEF,US-AID,CPECC UNSO) and iii) Acted as coordinators between Research Institutions and NGOs (Ford Foundation).Project proposals are coordinated through the IES pertaining to the field of coastal zone , arid lands, wetlands meteorology and urban planning. IES qualifies teaching assistants and lecturers to obtain M.Sc. and PhD degrees in environmental sciences.

2.4.3 Non-Government and Civil Society Institutions

Several national NGOs in Sudan have formed a network called the Network Committee for Combating Desertification (NCCD), NDDCU and NCCD worked in close collaboration throughout the NAP process. Organized forms of NGOs have become well known after 1975 (Mohamed, 1999). Many registered NGOs are actively working on different fields of the environment and rural development. Also there are some networks for coordination between NGOs e.g. the NGOs National Coordination Committee on Desertification (NCCD). The following are some examples of Sudanese NGOs working on environment-related work.

The Sudanese **Environmental Conservation Society (SECS)** is considered to be the most active NGO in promotion of environmental awareness and lobbying for better environmental policies and actions. It does so by initiating and supporting small projects with grassroots involvement designed to improve living conditions and wellbeing. Examples of these projects include tree planting, waste management and awareness-raising. SECS have more than 80 branches distributed all over Sudan, with more than 6000 members. The main objectives of SECS include:

- Conservation of the environment and mitigation of any action that may lead to environmental degradation.
- Dissemination of environmental awareness.
- Cooperation with the government in law enforcement for environmental conservation.
- Strengthening the links with the local, national, regional and international institutions endeavoring to conserve the environment.
- Encouraging scientific research and studies aiming at the conservation of the environment, in addition to writing of the natural history of the Sudan. (El Nour *et al* ., 2001)

The Sudanese Social Forestry Society (SSFS) is a charitable NGO with dedicated memberships who believe in social and multiple benefits of the forest. SSFS seeks promotion of concepts and practices of people involvement and social forestry in Sudan. The main objectives of SSFS are:

- To promote the concept and practices of social forestry, through networking and linkages between social forestry and extension units in Sudan.
- Enhance the standards of awareness of the community participation in social forestry.
- Encourage the scientific applied research in social forestry and promote the output of the same among the interested persons.
- Assist in the fund raising and appropriate resource funding of the social forestry projects.
- Facilitate and forward the technical consultancies in the field of social forestry projects.
- Cooperate with the concerned bodies, for the development of social forestry.
- Collect, authenticate and publish information regarding the social forestry activities.
- Establish advanced relation with international and national network.
- Preserve the natural forests as a natural heritage.

The Environmentalist Society is one of the active national NGO's in the field of environment. It aims at promoting environmental awareness and capacity building in environment related fields. All graduates from the Institutes of Environmental Studies are by default members in this society and could volunteer to provide services and contribute to environmental assessments and training programs whenever, it is required.

2.4.4 Traditional Institutions

These include traditional structures (local Administration, community leaders and other community-based organizations (CBOs). Traditional leaders are generally elected from the same families and thus, the holding is semi-hereditary one. These systems play important roles at the local community level. Their responsibilities include:

- Land allocation and settlement of conflicts;
- protection of the common natural resources;
- organization of usage of natural resources;
- construction of fire lines;
- keeping order of security and organization of foreign tribes presence in their areas, assigning nomadic routes;
- organization of communal public activities e.g. pest and bush fire control and settlement of tribal disputes

They have well identified roles in relation to resource conservation and management. According to Elnour the system of traditional management was supported by equity of use right and social customs governing common property resources. This flexibility facilitated resource conservation particularly under the dry conditions. Additionally, they play an important role in conflict resolution based on the indigenous mediation (*Judiyya*) system.

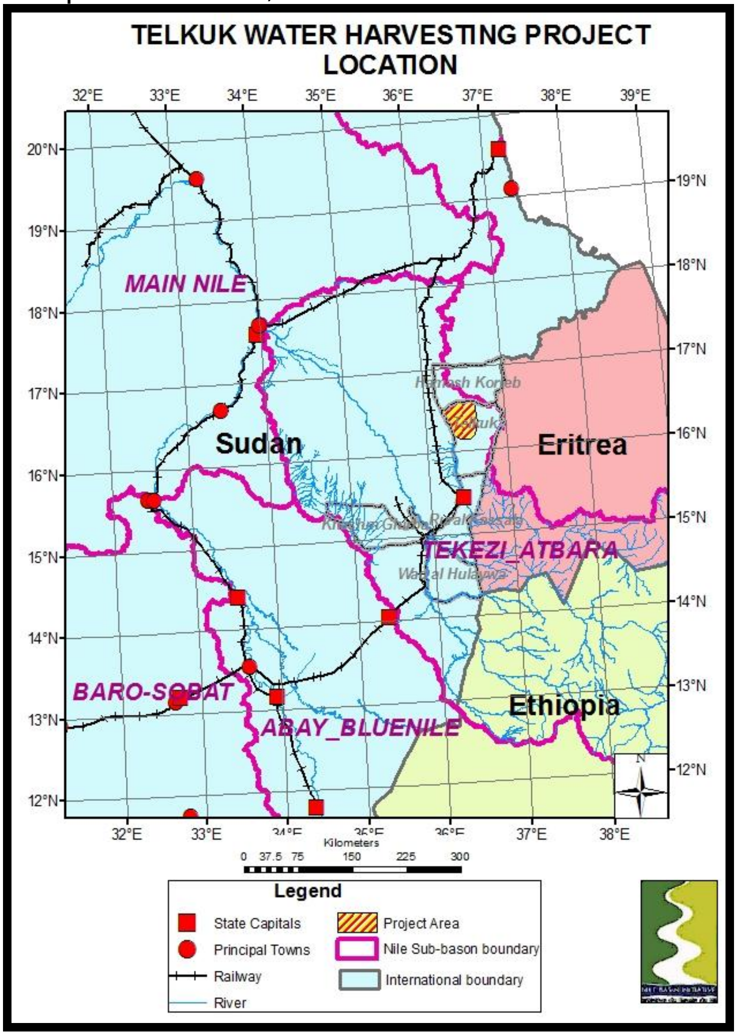
The "*Judiyya*" is established tradition in Sudan and can be initiated by a member of the local administration or a religious leader (Fagir) or a group consisting of representatives of all of them. They all represent mediating roles with the ultimate objective of reaching a consensus and peaceful settlement to their conflicts.

3. TELKUK WATERSHED - BIOPHYSICAL AND SOCIO-ECONOMIC SITUATION

3.1 Biophysical Characteristics

3.1.1 Location and Extent

The Project area is located in Kassala State in the northern part of Telkuk Locality and comrprises some 1,900km^2.

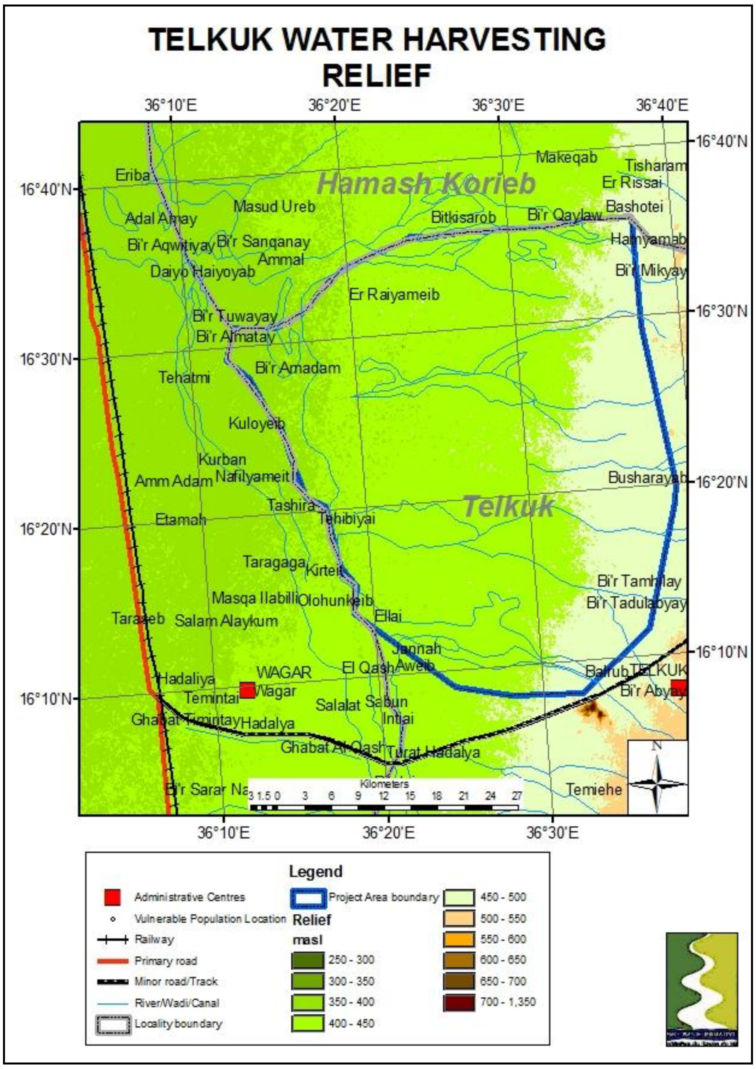


Map 1. Location of Telkuk Watershed

3.1.2 Relief and Drainage

(i) Relief

The Project area is located to the west of the hills that run northwest-southeast along the Sudan-Eritrean border. There are a series of *khors* running from the line of hills towards the Gash River delta. These khors run in spate after rains. Below the hills are a series of outwash plains with very low gradients.



Map 2. Relief and Drainage

(ii) Water Resources

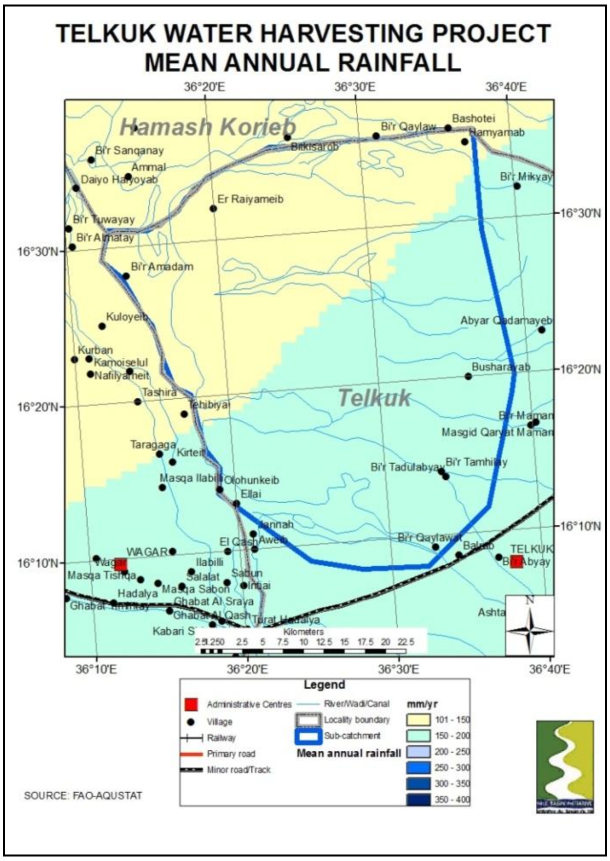
The main river is the Gash. Its catchment's area is 465 km long before reaching Kassala town. The average annual flow is 483 million cubic meters. The lowest record is 140 million cubic meters and the highest record is 1,260 million cubic meters. The average flow period is 88 days starting early July and ending late September. Its runoff is important for the recharging of the alluvial aquifers in the Gash Delta (Saeed, 1969).

Surface runoff including sheet flow, gullies, and stream flow exists mainly along border areas. Watercourses are many but small in size and carry small amount of water towards the Gash Delta.

3.1.2 Climate

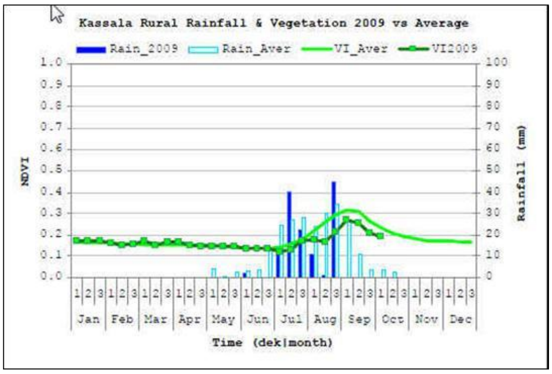
(I) Rainfall

Mean annual rainfall over the Watershed is between 150 to 200mm along the eastern border, but may reach higher in the hills. On the lower part of the plains annual rainfall is between 50 to 150mm.



Map 3. **Mean annual rainfall**

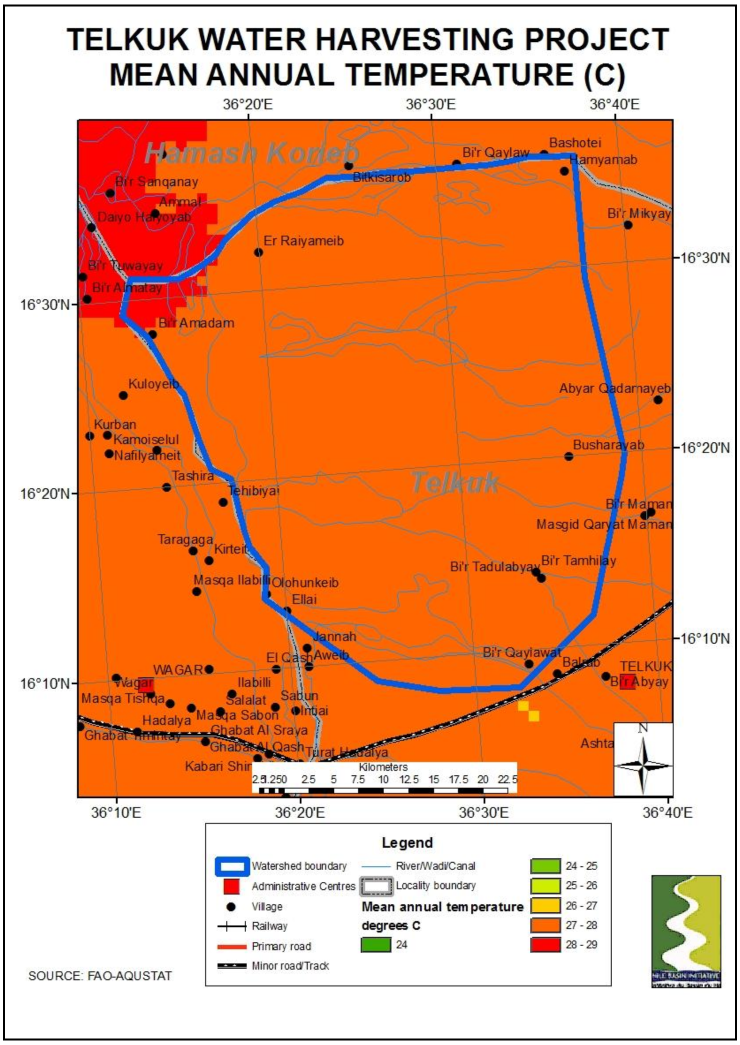
Figure 1. **Monthly rainfall and Vegetation Growth Pattern: 2009 vs. average**



Most rain falls in July and August (figure 1). The vegetation growth pattern lags by about one month.

(ii) Mean annual temperature

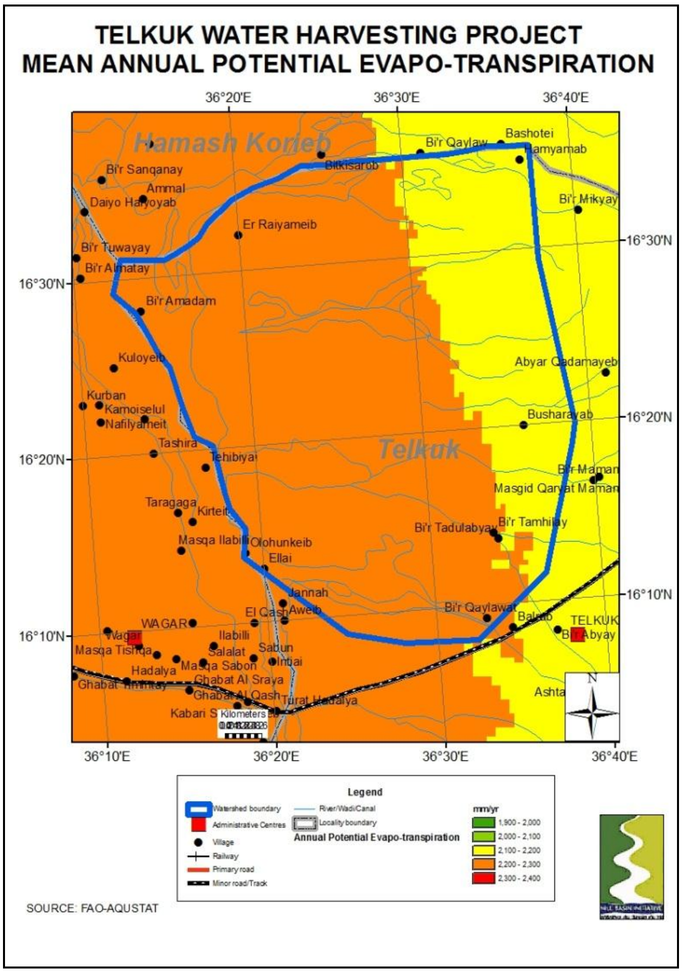
Mean annual temperature varies little across the Watershed, with a slight rise from 28°C to 29°C from southeast to northwest.



Map 4. Mean annual temperature (degrees C)

(iii) Mean Annual Evapo-transpiration

The pattern of mean annual evapotranspiration follows that of mean annual temperature and closely related to altitude (Map 10) with an east to west increasing trend from 2,100 to 2,300mm/yr.

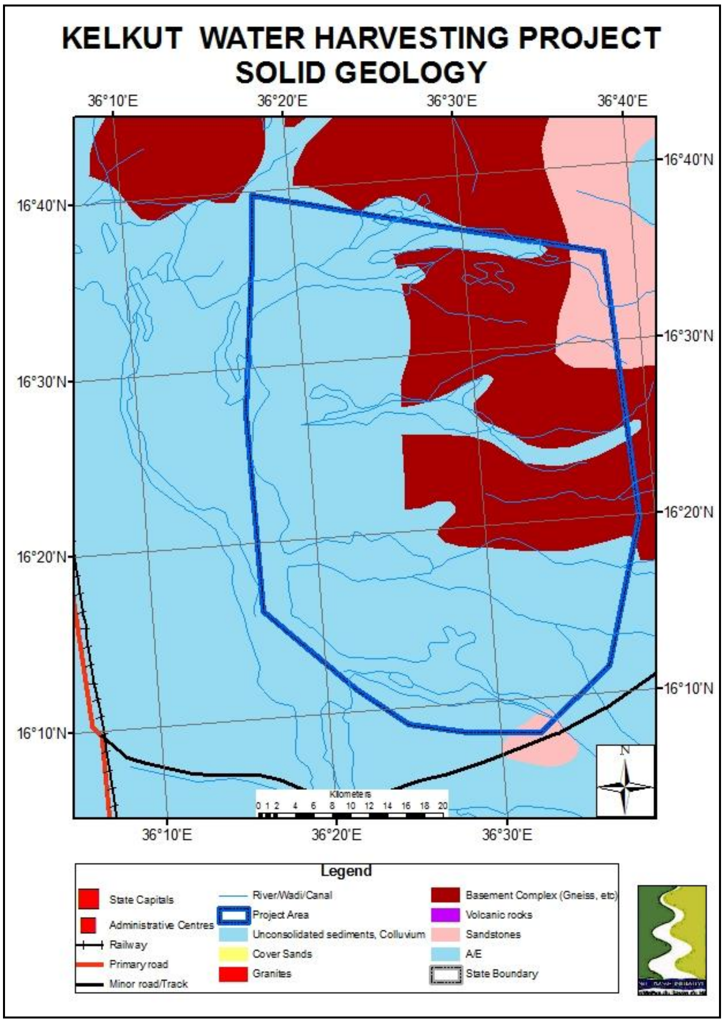


Map 5. Mean annual evapo-transpiration.

3.1.3 Geology

(i) Solid geology

The western part of the Watershed is covered by unconsolidated Colluvial sediments derived from the hills of Basement Complex rocks in the east (Map 6).



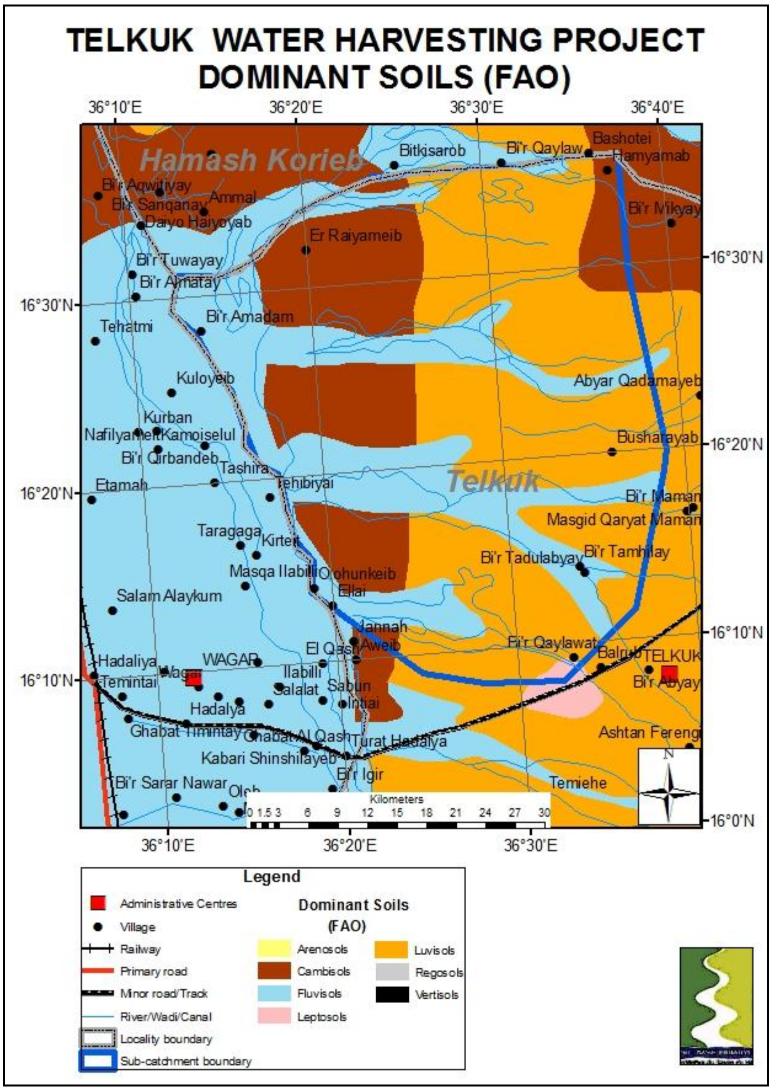
Map 6. Geology

(ii) Groundwater

The ground water sources are mainly confined to Gash basin. The storage capacity of the basin is about 5,000 million m_3 with an annual recharge of about 20 to 30 percent.

3.1.4 Soils

In the wadis and lower slopes of the Watershed Fluvisols are the dominant soil type. These soils are deep, often stratified but generally fertile. Textures vary from sandy clay loam to clay. On the lower interfluves are eutric Cambisols, which are deep sandy clay soils of lower fertility, being older and more leached. On the upper interfluves are eutric Luvisols, which are deep sandy clay soils, where the clay particles have been leached from the upper to the lower horizon. Around the rock outcrops are eutric Leptosols, which are shallow, gravelly soils of sandy loam texture. These soils are too shallow for cultivation.



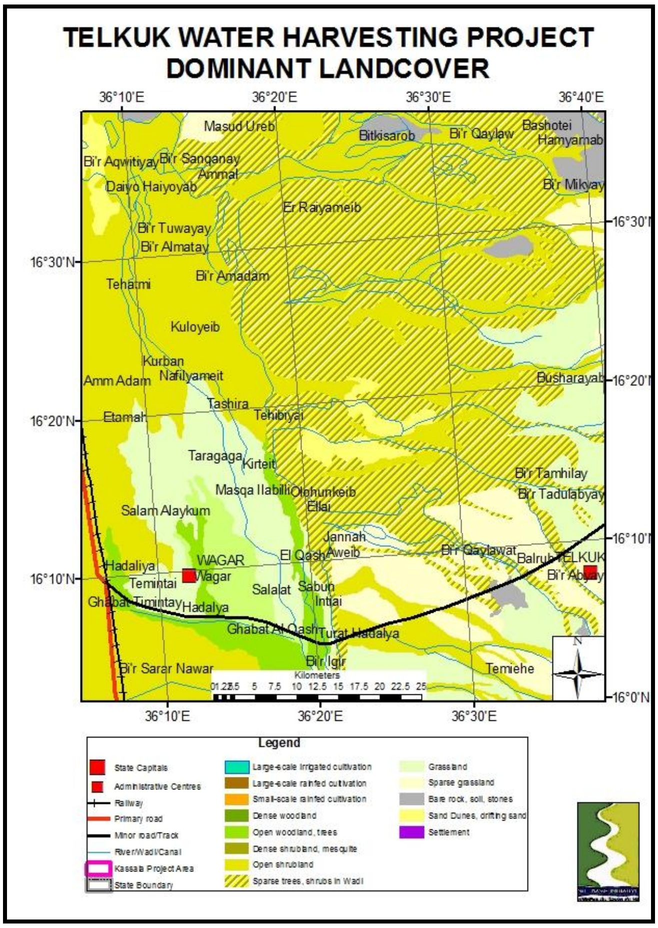
Map 7. **Dominant Soils (FAO Classification)**

3.1.5 Land Cover / Land Use

The areas and percent of total area of the dominant landcover classes are shown in table 1 and their distribution in Map 8. The most widespread is a cover of sparse trees and shrubs. These are very often found along the wadis becuase of the presense of groudwater at depth. This is followed by sparse shrubland (18 percent) and sparse grassland (13 percent). Lose drifting sand and bare stoney soil cover only 4 percent f the Watershed.

Table 1. Telkuk Watershed: Dominant Landcover (km2)

LANDCOVER	AREA (KM2)	%
Sparse trees and sparse shrubs (wadi)	1,212	66%
Open sparse shrubland	322	18%
Sparse grassland	229	13%
Loose and shifting sand	57	3%
Bare soil stony	11	1%
Very open trees	1	0%
TOTAL	**1,832**	

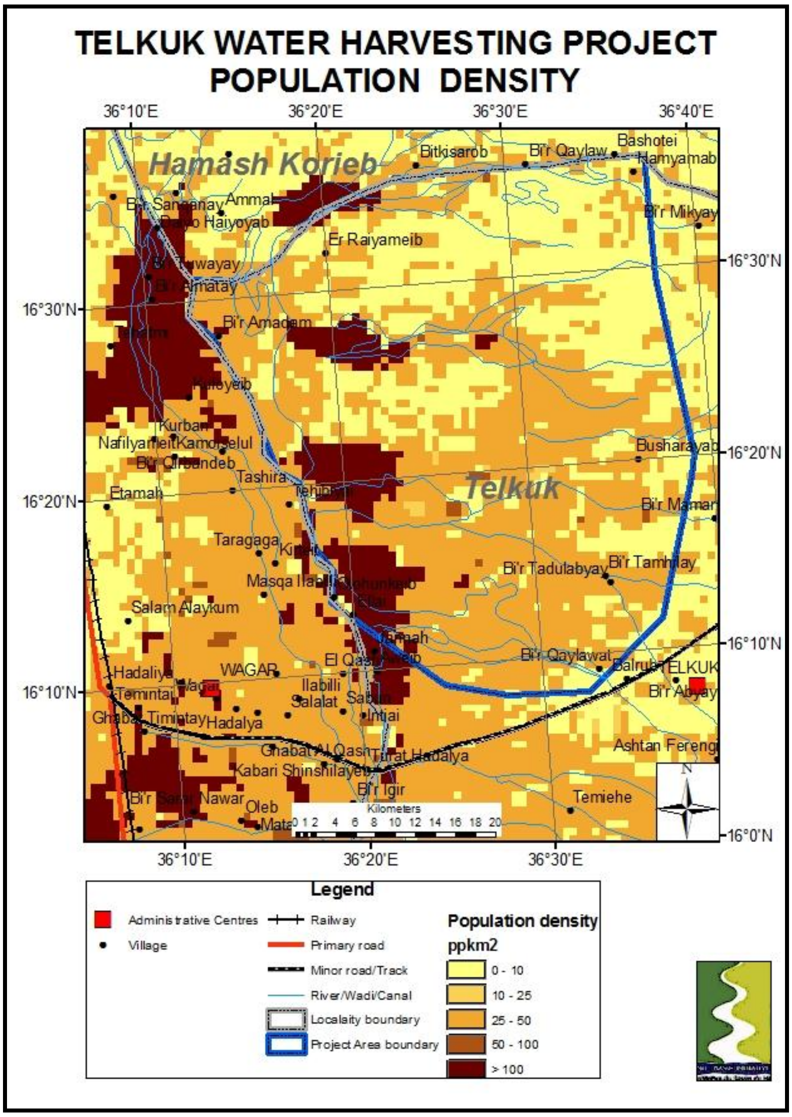


Map 8. Dominant Landcover

3.2 Population

3.2.1 Population Distribution

The Watershed is located in the northern part of Telkuk Locality. The spatial distribution of population is is shown in Map 9. The main concentrations of population are along the Gash River.



Map 9. Population Density and Distribution

There is no recent population data at the locality level. The estimated population growth per year is 4.73 percent as natural increase or approximately 5.6 percent when migration and refugee influx are included. The urban population is 19.3 percent while the rural people are 80.7 %. The pastoral people comprise 35% of rural people and 25% of the total population of Kassala State. A significant number of refugees are settled in transition camps along the eastern border and in selected areas near irrigated schemes and urban centres.

The main demographic features of Kasala State are shown in table 2.

Table 2. Main demographic Features of Kassala State

State	Gth rate %	Urban %	% <15yrs	% >60yrs	Sex ratio M/F	Crude birth rate	Crude death rate	Infant mort. male*	Infant mort. female*
Kassala	5.6	19.3	41.8	4.2	98.2	37.8	10.5	107	96
NORTH SUDAN	**2.80**	**37.3**	**42.8**	**4.1**	**100.4**	**37.8**	**11.0**	**116**	**98**

* per 1000 live births

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

3.2.2 Social-Cultural Aspects

The Locality is considered the homeland of the Beja, the numerically dominant group. The population includes Hadundowa, BeniAmer, Bishareenand Halanga, and the stock of Arab origin. The latter include Shukriya, Kawahla, Lahawaien, and Rashaidaas nomads, semi-nomads or settled. There are also other pastoral groups such as Kenana, Rufaaand Ambararo who move into the state from southern Gedaref during the rainy season.

The life of the Beja groups has been regulated by a customary law called *silif*, a complex but flexible body of rules based on Beja traditional values. *Silif* regulates access to and redistribution of resources, reciprocal use of environmental resources (grazing land, water points, arable land or firewood), conflict resolution and reciprocity around major social events (birth, marriage and death). Clear land rights codes embodied in the *silif* (*asl* and *amara*) have helped minimise conflict over land, supported by the mediation of the tribal authorities who were entrusted with the management of land rights. However, the resilience of this system has significantly weakened through drought and conflict.

3.3 Pastoral/Agro-pastoral Livelihood Systems

The Beja and other pastoral groups in the region have devised flexible and dynamic strategies to cope with the complexity and the variability of their eco-system and to recover from droughts and outbreaks of famine. Such strategies include mobility, herd diversification and redistribution[1], rules for environmental protection (e.g. the prohibition of cutting trees) and the development of a multi-resource economy where livestock keeping is complemented by a set of alternative livelihoods, including cultivation and labour migration to town.

3.3.1 Cropping Systems

The Pastoral/Agro-pastoral systems in the Project area have been described by van Dijk and Mohamed Hasan Ahmed (1993) from whom the following description is taken.

Sorghum (dura, *Sorghum bicolor*) is the dominant crop with some ten local known varieties. Millet (*Pennisetum typhoides*) is sometimes grown on lighter sandy soils. Sorghum grain yields are in the range of 250-850kg/ha, stalks used for fodder and in building and yield an additional 2000 kg/ha. Other crops grown on part of the holding include okra (*Hibiscus esculentus*), karkadeh (H. *sabdariffa*), watermelon, sometimes lubia (*Dolichos lablab*) or sesame. Okra and watermelon increasingly are also grown as cash-crops.

At present, land preparation is manual in most of the Project Area. Camel or oxen-drawn ploughs were used until a decade ago. Since the early 1970s, tractors hired from contractors have become more important near to Kassala town. Sowing is after the first favourable rains or spates, normally in July. Cropping densities are variable (row spacings of 60-100cm and usually more fixed plant spacings of “step-length” 80cm) and with high populations (5-10 seeds/hole). Thinning is not a regular practice but gap filling is, especially under wild-flooding systems. Quick-maturing varieties are used when such re-sowing is late in the season. Weeding in two or three rounds is by hoe but one round is usually skipped when lands are tractor-ploughed. Weed competition on scarce soil moisture can be severe and is occasionally reason to shift to adjacent land, or abandon the area completely.

There is no conscious manure application, but *khor* spates do wash animal droppings onto the arable lands. Crop and weed residues further improve the soil nutrient status. Activities of land preparation and increasingly also of harvest, transport and storage are carried out by hired labourers. Strict rules for gender relations in the Beja society make farming almost entirely a man’s job. Only young Beni Amer girls sometimes assist on the field during harvest time.

3.3.2 Wild Flooding and Water Harvesting

Agriculture performs better if additional run-off water is made available for cultivation. There are two types of indigenous techniques: (i) Wild Flooding and (ii) water harvesting.

(i) Wild Flooding

In wild-flooding the runoff is not collected or manipulated: unprepared land is sown directly after wetting by spate flow. The system easily mixes with water harvesting and frequently no clear boundaries can be drawn between the two.

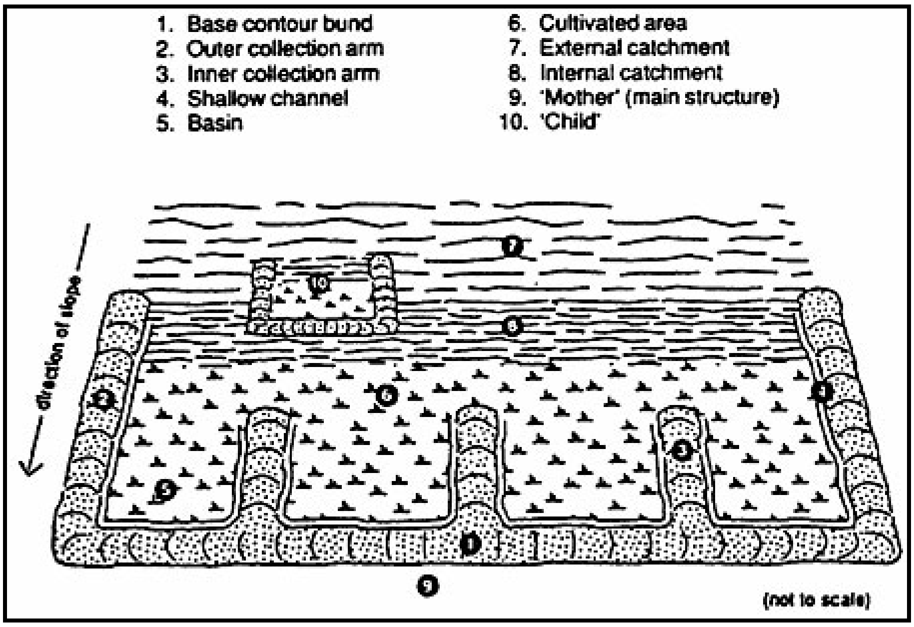
(ii) Water Harvesting on interfluves before reaching *khors*

Water harvesting is defined as the collection and concentration of surface run-off for plant production **before** it reaches seasonal streams. There are two local indigenous water harvesting variants. These include run-off manipulation by u-shaped earth bunds, or *teras* (harvesting rain or floodwater) and brushwood panels, or *libish* (harvesting floodwater).

(a) Teras

The *teras* are the most common water harvesting technique in the area.

Figure 2. Typical elements of the Teras water harvesting structure.



(Source: Dijk J.A. van, 1995)

Figure 3. Retaining Bund of Tera

The *teras* system includes two main elements: (i) the cultivated land which is bunded on three sides, and (ii) a rainwater collection area or "catchment" located at the open side upslope of the cultivated land. The basic system as used in a wide region of the Eastern State is discussed first before elaborating on more complex local variations.

Characteristic of the *teras* system is the base bund built approximately on the terrain contour. It impounds captured rainwater and allows it to infiltrate into the soil. The outer collection arms partly have the same function, but also act as conveyance structure. The arms at a right angle to the base direct the run-off to the cultivated land.

Shorter inner arms divide the land into smaller basins to effectively impound minor supplies of run-off. In certain areas run-off circulation is manipulated by changing the length of some of the inner arms. Individual basins in this way are given a thorough wetting before the spill is routed to neighbouring compartments.

The construction of *teras* bunds leaves shallow channels in the field. The excavation material is usually taken from the inside face of the structure. The resulting ditch supports the conveyance and circulation of run-off. Excess water normally is drained along the tips of the outer arms, which are reinforced for this purpose with virtually any material locally available: brushwood, small stones, worn out tires. In case of severe flooding of *teras* land, the contour bund is deliberately breached to avert the more devastating event of an uncontrolled burst. Bund height is usually 0.5m, with bases 2m wide. The dimensions vary with slope and amount of run-off expected in the area. Base bund lengths are between 50-300m (recorded maximum lengths up to 700m), with arms usually 20-100m (up to 200m). The ratios of base: arm dimensions are not fixed, but base bunds with lengths under 100m seem to have more constant ratios, i.e. 1: 0.6-0.7 which makes the *teras* relatively deep. Base bunds over 100 m generally go with shallow systems with ratios around 1: 0.3. Sizes of cultivated land accordingly usually range between 0.2-3 ha.

The rainwater catchment is external to the cultivated land. However, any land not under crops adds an additional internal catchment area. The entire catchment area is to a large extent defined by the configuration of *teras* in a given farming zone. A regular spacing is common with base bunds aligned on the contour and a slightly staggered pattern in the direction of the slope. When there are no upstream land users, run-off collection can be from an unbounded area.

(b) Libish

The brushwood panels, or *libish*, are built of bundled branches cut from Acacia spp., *Prosopis juliflora* and increasingly from low valued *Calatropis procera*. Branches are wattled and secured into the soil with hooked pools. Panels are 20-30cm (up to 75cm) high and are of variable lengths. When filled with debris captured from the run-off, the panels act as permeable barriers. The technique is used on level land for run-off collection (when built on downslope sections of the holding) or run-off spreading (on upslope sections). To a lesser extent, panels are also used for gully erosion control. The structures generally require seasonal rebuilding since they are prone to destruction for firewood use.

(iii) *Hafirs* and Protection Dykes in *khors*

Other run-off engineering techniques include the rectangular earth basin, or *hafir*, and protection dikes. The *hafir* is constructed by excavation and addition of a retaining wall. An earth dam in the *khor*, sometimes also a conveyance channel, diverts water to fill the reservoir for domestic use and the watering of cattle. Basins used to be hand-dug but since the 1950s, government programmes were started to mechanise construction and maintenance. *Hafirs* suffer from rapid siltation. In some areas, seasonal floodwaters menace the village built-up areas and earth dikes are built for protection.

(iv) Extra Large Hafirs

The Land Use and Desertification Control Department (LUDCD) of the Ministry of Agriculture, with support from the EU funded Eastern Rehabilitation and Development Project are promoting the construction of extra large tera type structures. The basin cropped area is some 400 feddans (160 ha). Where there is sufficient water from the khor an additional basin is constructed below the upper basin. To date three schemes have been constructed. Because of their size control of water movement within the basin is important. Any existing rills are closed with check dams. Basins are rip ploughed before planting. Bund are approximately 50 cms high. They are stabilized by first compacting then placing sacks of earth at the base of the bund. Small stones are also placed on the bunds. Bund extremities are treated with large stone rip-rap (Figure 4).

Figure 4. Bund extremities treated with stone rip-rap

The channel between an upper and lower basin is also treated with stone rip-rap.

Figure 5. Channel between an upper and lower basin showing stone protection.

Construction costs are estimated to be SDG 140,000 for a 400 sedan basin (approximately US$290/ha).

3.3.3 Crop Production Constraints

Households follow a strategy of spreading their holdings over these distinct zones while using different run-off farming techniques. In this way, risk of crop failure in any one zone, and under any one technique, is reduced. The average number of holdings per household in the area is 2.15. The strategy which may involve daily travel times of over two hours is labour-intensive. A shortage of labour therefore is a main bottleneck to the full exploitation of all holdings. This is significant for the *teras*, which has by far the highest construction and maintenance demands.

Neimejer (1998) has demonstrated that the construction of teras raises the nutrient-limited yield from some 150±250 kg haÿ1 to some 650 kg/ha through its nutrient harvesting effects. Soil fertility was found to be two to four times higher inside the field. However, calculated nutrient-limited yields are considerably higher than real yields, which points at other yield-limiting factors such as labour and water availability.

3.3.4 Crop Yields

Sorghum yields for wet and dry years by water harvesting types are indicated in table 3.

Table 3. Sorghum yields (kgs/ha) for wet and dry years by Water Harvesting Type (wet year 1988/89 and dry year 1983/84)

Teras		Libish		Wild flooding	
Wet year	**Dry year**	**Wet year**	**Dry year**	**Wet year**	**Dry year**
514	257	471	343	664	343

Source: van Dijk and Mohamed Hasan Ahmed (1993)

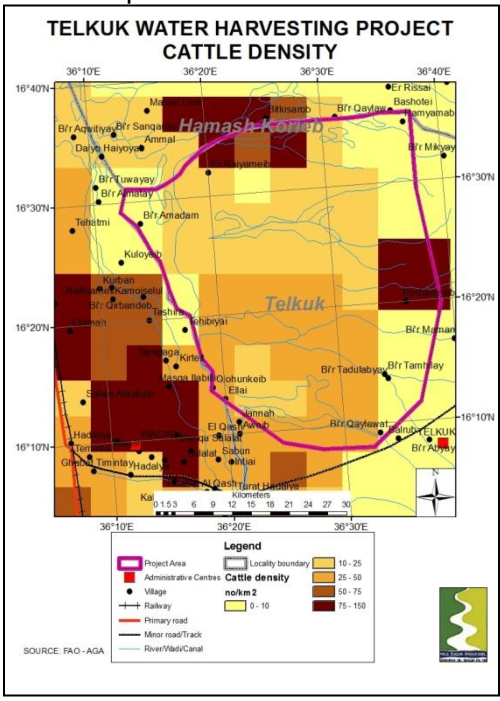
These yields are low when compared with the major farming systems in the region. Sorghum returns under controlled spate irrigation in the Gash Delta in the same wet and dry years are respectively 1190 and 620kg/ha. Rainfed mechanised farming around Gedaref under a more favourable rainfall regime produces an average 1000 and 470 kg/ha in wet and dry years (MANR 1987, 1991).

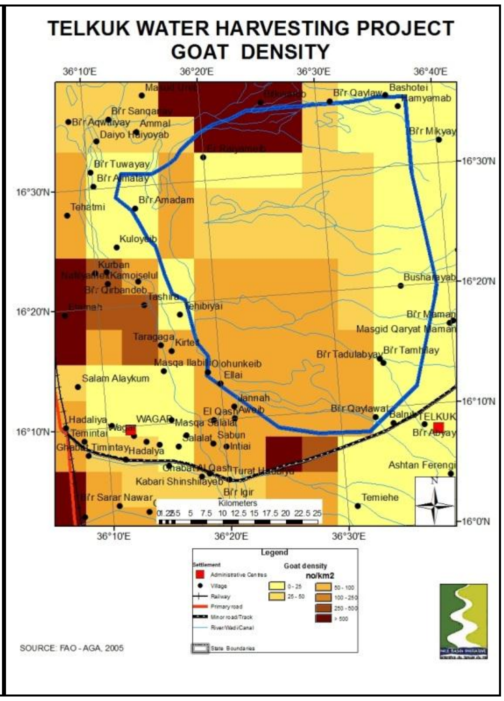
3.3.5 Livestock Production Systems

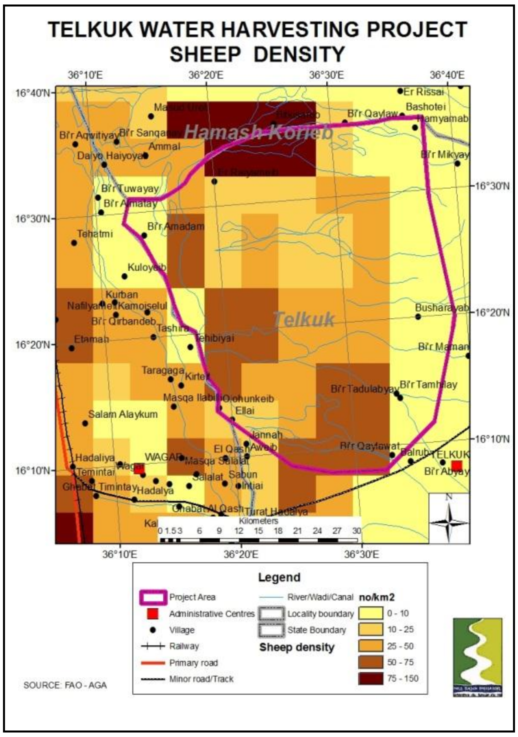
The total livestock data for Kassala state is as follows:

Camels	0.50 million
Goats	1.20 million
Sheep	0.92 million
Cattle	0.40 million

The distribution of within the Project Area of cattle, goats and sheep are shown in maps 10 – 12.







Maps 10 – 12. Cattle, Goats and Sheep Densities

The pastoralists migrate with their herds between the khors in the rainy season and the permanent wells in the dry season. In the dry season they split up into smaller groups in order to better utilise the very scarce pasture on the mountain tops.
The wet season pastures are not accessible during the dry season due to lack of drinking water. The wet season pasture forms an attractive grazing ground because of the good pasture quality and the unhealthy climate in the southern areas. Therefore, this natural pasture is the major wet season feed resource.

Camels have been the backbone of pastoralists' economy and culture. Camel milk is their basic subsistence food as the camel provides milk for many months after calving. Camels also provide meat, skins and fat. Beja are excellent camel breeders, selling camels to Egypt and Arabia. They are very skilled in camel riding. Camels are also used to carry grain, tents and household equipment when on the move. These camels compete with those of Oman as the best breeds of the Arab world. The three main breeds are: Shallagea, the sturdiest and best milk producers. Aririit, having great endurance and able to cover long distances at a steady pace without water, and Matiaat, the fastest camels used for raiding and racing.

Sheep and goats are kept for their milk and meat. In times of drought they die off faster than the camels but recover faster too. Some flocks are kept near the camp for everyday use but most are taken far away for grazing, drinking only every second day. Surplus sheep and goats are sold in the town markets and sometimes exported (or smuggled) into Saudi Arabia.

Milk and its products are the staple diet supplemented by cereals, especially durra (harob) or millet from which they cook a thick porridge called O'tam.

Eating it with milk or clarified butter is a characteristic of Beja culture. Sorghum is also used as a supplementary fodder for Beja animals. In good years it is stored in holes dug in the earth in special areas where it can keep for several years.

3.4 Social Infrastructure: Education and Water/Sanitation

3.4.1 Literacy and Education

The literacy and primary school enrollment rates for Kassala State are shown in table 4.

Table 4. Literacy and Primary School Enrollment Rates of Kassala State

State	Literacy >15yrs % Average	Literacy >15yrs % Male	Literacy > 15yrs % Female	Total Primary school enrol.	% enroll.
Kassala	44.7	52.9	35.8	103,131	37.5
NORTH SUDAN	**54.5**	**66.6**	**42.4**	**3,308,387**	**51.0**

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

There are significant differences in literacy and primary School enrollment rates between Kassala Nile State and north Sudan, with the former below the north Sudan national average.

3.4.2 Water and Sanitation

The percent population with access to drinking water and sanitation facilities are shown in table 5

Table 5. Kassala State (a) Percent Population Access to Drinking Water, (b) Sanitation Facilities

(a) Drinking Water by Source

State	Piped into		Deep Well/pump	Dug Well/ bucket	River/canal	Rainwater	Others
	dwelling	Public tap					
Kassala	22.6	16	21	6.4	23.1	1.5	8.7
NORTH SUDAN	**50.8**	**4.3**	**15.8**	**9.8**	**12.8**	**--**	**6.4**

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

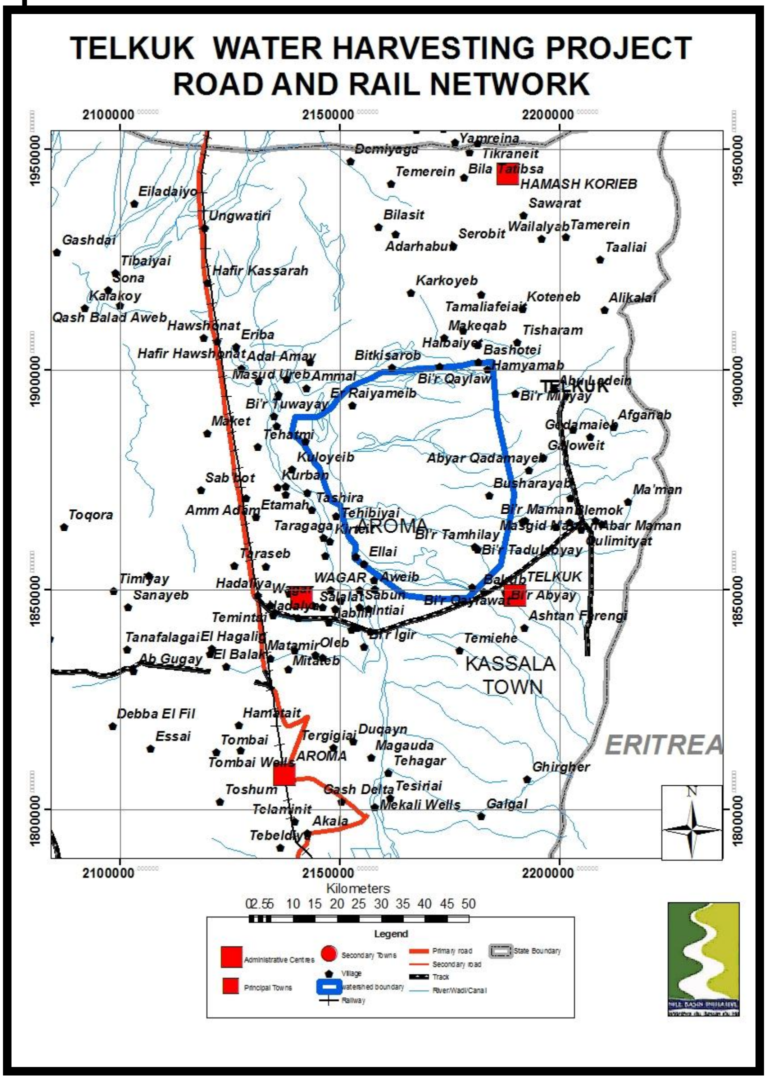
(b) Sanitation facility by type

State	Flush to Sewage System	Flush to septic tank	Traditional pit latrine	Soak away pit	Others	No facilities
Kassala	--	11.6	34.3	1.2	0.3	52.0
NORTH SUDAN	**--**	**7.7**	**69.2**	**1.6**	**1.6**	**19.9**

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

A similar distinction between Kassala State and north Sudan is apparent with respect to water and sanitation facilities. Kassala State is well below the national average with respect to piped water and sanitation facilities.

3.5 Transport Infrastructure



Map 13. Road network.

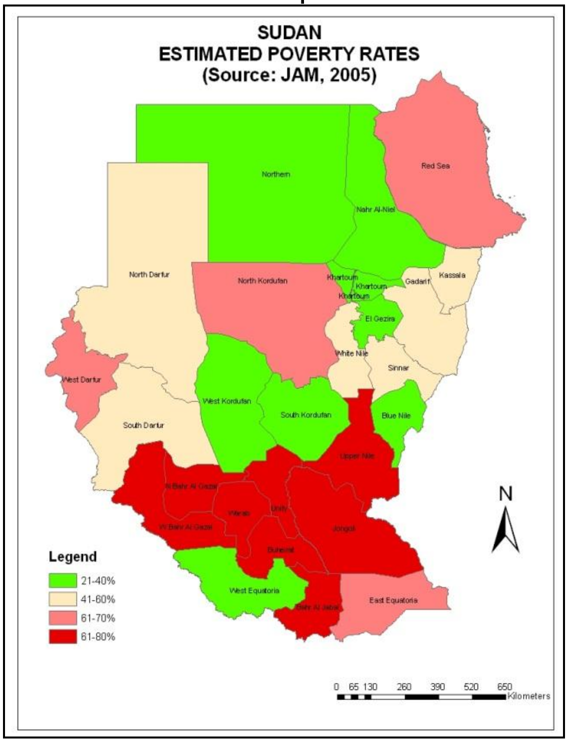
There are no roads or tracks within the Project Area. By 2012 a road will be constructed to Telkuk town.

4. KEY ISSUES, CHALLENGES AND POTENTIALS

4.1 Poverty

4.1.1 Extent

The extent and dynamics of poverty in the Sudan since the 1990's has been examined by the Joint Assessment Mission - JAM (2005). It is estimated that in Kassala State 41 to 60 percent of the population are below the poverty line. Map 14 shows the distribution of poverty by State. In this respect Kassala State stands below the northern States with rates below 40 percent, but above those States with rates above 60 percent.



Map 14. Sudan: Distribution of Poverty by State (JAM, 2005)

4.1.2 Loss of Livelihood Assets

Over the past three decades drought and conflict have led to a severe loss of livestock assets and an increasing reliance of crop production using a variety of water harvesting techniques.

Animal losses due to the 1984 drought were estimated (Muna Ahmed et al., 2004) as follows:

Cattle 20%
Sheep 40%
Goats 10%
Camels 5%

Animal losses due to the 1990-1991 drought were:
Cattle 10%

Sheep 15%
Goats 5%
Camels 2.5%

The recent droughts have severely affected camel herds and increased the reliance of the Beja on the faster growing goat and sheep herds. Many Beja have also been forced to migrate to the towns in search of employment.

4.1.3 Insecure Livelihoods Asset Base and High Vulnerability

The low rates of poverty from El Gezira to Northern State are a reflection of the assured access to generally low risk irrigated cropland along the Blue and Main Nile. In these areas land is generally held in freeholds and perceptions of tenure insecurity are low. Where leaseholds prevail the general secure natural asset base, the availability of physical (pumps, irrigation water) and financial (seasonal credit) assets creates an environment for secure and sustainable livelihoods and low vulnerability.

This is in direct contrast to situation in Kassala State where the pastoralists do not have secure tenure over their grazing lands (Faki et al, 2008). The Land Resettlement and Registration Ordinance that dates back to 1925 is still largely in force (De Wit, 2001). All unregistered land belongs to the Government, but community rights are recognized over its use under customary rules. Individual land registration is limited; while long land lease applies in public irrigation schemes and large semi-mechanized rainfed private holdings. Despite incentives to increase herds irrationally under communal land use, fairly balanced management and protection of natural resources and harnessing local conflicts had been practiced within the traditional leadership systems. But two legal developments in the 1970s had far-reaching implications on land use. First, the Unregistered Land Act of 1970 transferred all unregistered land to the Government from rural dwellers, especially pastoralists, compromising communal and tribal ownership (De Wit, 2001).

Second, the Local Government Act of 1971 dismantled traditional authorities and largely transferred their functions to local governments that have limited experience and resources to handle issues such as local conflicts. Thus, control over natural resources has undergone profound relaxation resulting in misuse through deforestation and overgrazing. Official regulations governing access to pasture and water in rainfed areas remain rudimentary, but 1984 legislation allowed for pasture land allocation to communities. Water use legislation has been confined to water-pumping from the Nile and its tributaries for irrigation purposes. The existing legal setting for land, pastureland, water, and forests has been diverse and contradictory, giving little or no attention to traditional land use systems, especially grazing (De Wit, 2001).

4.1.4 A High Risk Environment and the Alienation of Natural Resource Assets

An assured and low-risk production environment clearly reduces the incidence of poverty. It enables households to build up assets that reduce their vulnerability to sudden changes in circumstances.

Where livestock are the main livelihood capital assets these too depend on the same high risk environment as well as dwindling rangeland resources in the face of expansion of large semi-mechanized farms. The coping mechanisms that communities and groups have developed over millennia to deal with and recover from natural calamities have been insufficient in the face of insecurity and alienation of basic natural resources. Livestock assets provide a buffer in times of need. Where access to water and forage has becoming limiting for the reason set out above vulnerability to shocks and hazards such rainfall variability and drought becomes more acute.

In Sudan decisions to adopt sustainable land management technologies depend on households' asset endowments (human capital). This is especially true for pastoral families because of their need for herding different animal types (camels, cattle, sheep and goats) in different places and times. In efforts to maintain livelihoods some household members have had to leave the farm in order to seek wage employment. This has led to a reduction in households' human capital and the lack of labour for cultivation and herding.

4.2 Population Pressure

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 (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.

There are a number of constraints to sustainably increasing agricultural production. These include poor management practices, inefficient markets, low technology transfer and inadequate agricultural services, low ratio of extension agents/farmer, lack of adapted varieties and insufficient certified seed are responsible for low yields attained. Thus, it is apparent that in many areas there are a number of constraints to farmers breaking out of neo-Malthusian trap and that there will be a continuing negative impact of population pressure.

4.3 Environmental Policy and Institutional Issues

Despite the active role played by Secretariat of the HCENR, which is the focal point for all environmentally related conventions, the HCENR has not been able to perform all its mandated tasks. This is mainly due to the following constraints:

- Most of the state's councils have not been established and this has resulted in weak representation of the HCENR at the state level.

- The council members (ministers of relevant institutions) have never met since the establishment of the HCENR. This reflects the low priority and commitments of the governments towards environmental issues in Sudan. This situation could be explained by the fact that that the country has been weighed down by long years of war and many urgent pressures and that politicians could not allocate the necessary time or resources to cater for environment.

However, this situation is expected to change now after the CPA and the need to follow and adopt a sustainable course of development.

At the field level it was reported that there a lack of horizontal and vertical coordination between and among responsible agencies, organizations and ministries.

4.4 Land tenure and Resource Conflict

Issues of land tenure here include insecurity of tenure, ability to use land as collateral and 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 Sudan.

The World Bank Country Economic Memorandum (World Bank, 2003) outlined a number of problems relating to current land tenure and land policy in Sudan:

- it limits access to credit to the majority of farmers who cannot use land as a collateral,

- it does not provide incentives for sustainable land development and management, leading to continual cultivation and destruction of soils in the semi-mechanized farms,

- because land has not been demarcated, there are conflicting land use rights between pastoralists and sedentary crop farmers, which has led to civil strife,

- reform is inseparable from need for rural reconstruction and establishing agricultural credit institutions.

A key problem has been the lack of a National or Regional Land Use Plans that could strategically guide land development activities. Thus the expansion of the mechanized farm sector was largely uncontrolled. No assessments were made on the environmental, social or economic impacts of these very large developments.

It is understood that States are mandated to develop Regional land Use Plans but as yet no guidelines appear to have been issued. There is some debate as to whether there should be a national Land Use Plan that would provide at least a strategic framework for State Plans. A pre-requisite of any National or State Land Use Plans is a thorough reform of the Land Tenure Policy.

4.5 Agricultural Extension and Availability of Credit

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 higher the discount rate the shorter the time horizon. 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. A number of studies have found that adoption of natural resource conservation technologies is negatively related to high discount rates. However, where a technology is risk reducing (e.g. water harvesting, soil moisture conservation structures, small-scale irrigation) adoption is much more likely.

Currently credit and extension for the traditional agricultural sector are very weak. The extension worker-to-farmer ratios are very low indeed. Credit and input supply services have hitherto focused on the large-scale irrigation sector. The main problems are non-viable collateral, small loan levels, geographical distance and logistics of recovery. Attempts have been made to form cooperatives but without success. However, this situation may soon improve with the signing of a Micro-finance project between the GoS and the World Bank for a sum of US$ 269 million over 6 years. This will be aimed in part at the traditional agricultural sector (FAO/WFP, 2006).

5. IDENTIFICATION OF WATERSHED MANAGEMENT INTERVENTIONS

5.1 Review of Current Interventions

There are a number of on-going projects of relevance.

(i) The Eastern Rehabilitation and Development Project

This three years project is funded by the EU covers activities in Gedaref and Kassala States with total funding of EUR10 million. In Kassala State it is supporting Land Use and Desert Control Department of the MoA with the development of water harvesting structures. The project is due for completion in 2011. It has built up considerable experience in the development of the macro teras and farmer capacity building in water control and crop husbandry.

(ii) World Food Programme (WFP)

WFP is involved with supporting tera construction and hafir construction and rehabilitation. These activities are supported by food for work (WFP, 2008).

(iii)International Committee of the Red Cross and Red Crescent

ICRC is supporting the construction of check dams.

(iv) IFAD

IFAD is supporting the rehabilitation of the Gash Delta Irrigation Scheme. Whilst most activities are focused on the irrigation scheme there is a small component that supports rangeland improvement in the immediate vicinity of the scheme.

5.2 Project Stakeholders

5.2.1 Primary Stakeholders

The Primary Project Stakeholders include:

- Pastoral and Agro-pastoral households from the various ethnic groups from within and outside the Project Area who use the grazing lands within the Project Area.
- Agricultural households who focus mainly on crop production within the Project Area.
- Staff of the Kassala State Ministry of Agriculture, Ministry of Livestock Production and Ministry of Irrigation who will receive increased technical and logistical support.

5.2.2 Secondary Project Stakeholders

The Secondary Project Stakeholders include:

- Pastoral and agro-pastoral households from outside the Project Area who will benefit from reduced conflict over grazing resources because Group grazing areas have been clearly defined in the participatory Community and Strategic level land Use Planning.

5.3 Proposed Watershed Management Interventions

5.3.1 Selection of Project area

The Project Area has been defined in the Telkuk Locality on the advice of the Director General of Agriculture of the MoA. The selection was made on the basis that there are no Projects in the area north of Telkuk town. Additionally, because of security concerns in the past, the area has not had the development support that has the area to south. Within two years the area will be connected by an all-weather road.

5.3.2 Water Harvesting

The project will build on the experience gained in the implementation of the EU supported Eastern Rehabilitation and Development Project, particularly in the field of water harvesting structures. These will include traditional teras, libish, wild flooding and small dams. Support will be provided to:

- provision of machinery and equipment for field layout surveying, bund and dam construction, tree removal and chisel ploughing;
- farmer training in water management and crop husbandry;
- On-farm research into water management, improved crop variety selection (sorghum, cucumber, water melon and okra);
- Forage production, including seed multiplication;
- On-farm tree planting for fuelwood and forage.

5.3.3 Rangeland Development

The rangeland pastures within the Project area are utilized both by resident population and season migrating pastoralists from the south. Pasture resources in some areas are over-utilized leading to rangeland degradation and under-utilized in other areas that have no wet season water supplies. The project will support rangeland improvement activities and provision of carefully located water supplies to open under-utilized rangeland. Specifically the project will support:

- Seed multiplication of local grass varieties in fenced multiplication plots;
- Seed/seedling multiplication of valuable forage trees (e.g. *Balanites aegyptiaca, A. tortilis*)
- Rangeland re-seeding by pastoralists;
- New livestock water supplies in under-utilized areas of pasture;

- New water supplies along designated stock routes into the area;
- Re-habilitation of existing *hafirs*;
- Execution of a hydrological survey to determine ground-water potential of the Project area;
- Improvements to livestock market infrastructure;
- Training of para-vets and Community Livestock Health Workers.

5.3.4 Supporting Interventions

In addition to the support to water harvesting and rangeland improvement activities the project would provide assistance to a number of supporting activities. These would include:

- Mesquite eradication;
- Strategic and Community Level land Use Planning
- Training for selected off-farm employment opportunities (both men and women);
- Support to the establishment of Savings and Credit Cooperatives and Micro-finance Institutions for provision of production and marketing credit;
- Support to improvement and increase of value chain addition (product storage, improved processing) and to market linkages;
- Support to establishment and legal recognition of Farmer/Pastoralist Associations for improved access to inputs and markets.

6 Distribution of Benefits

There are a number of local, regional and global benefits that would accrue to the Project.

The support to traditional water harvesting rainfed systems in the Kassala area will increase crop and residue production, increase crop diversification and thus have a positive impact on farm income. Vulnerability of households to natural shocks in this difficult environment will be reduced.

At the global level sequestration of carbon would be increased in wood and herbaceous biomass and also in increased levels of soil carbon.

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EASTERN NILE TECHNICAL REGIONAL OFFICE

NBI – Institutional Strengthening Project
PROJECT DELINEATION AND PRIORITIZATION
ANNEX 4.5
ATBARA KERIB LAND REHABILITATION PROJECT
(FINAL REPORT)

7th June, 2011

CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ACT	African Country Almanac
CBD	Convention on Biological Diversity
CPA	Comprehensive Peace Agreement
CRA	Cooperative Regional Assessment
DFID	Department for International Development
EIA	Environmental Impact Assessment
ENSAP	Eastern Nile Subsidiary Action Programme
FAO	Food and Agricultural Organization
FNC	Forest National Corporation
GEF	Global Environmental Fund
GIS	Geographic Information System
GOS	Government of Sudan
HCENR	Higher Council for Environment and Natural Resources
IDEN	Integrated Development of the Eastern Nile
IFPRI	International Food Policy Research Institute
IGADD	Inter Governmental Agency for Drought and Desertification
IUCN	International Union for the Conservation of Nature
JAM	Joint Assessment Mission
JMP	Joint Multipurpose Programme
Km	Kilometre
Km2	Square kilometre
MEA	Multilateral Environmental Agreement
MoA	Ministry of Agriculture
MEPD	Ministry of Environment and Physical Development
MIWR	Ministry of Irrigation and Water Resources
MCM	Million Cubic Meters
MW	Mega Watt
NBI	Nile basin initiative
NWP	National Water Policy
SWC	Soil and Water Conservation
t	ton
UNDP	United Nations development Programme
UNFCCC	United National Framework Convention on Climatic Change
USAID	United States Agency for International Development
WB	World Bank
WSM	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[13] 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 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

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

(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 nine of the Investment Projects located within the Main Nile Sub-basin, the Tekeze-Atbara Sub-basin and the Baro-Akobo-Sobat Sub-basin. Those Projects identified in the Abay-Blue Nile Sub-basin are being considered separately. This Project document is concerned with the Kerib land located along the Atbara River within Gedaref State.

1.2 Primary Objectives of the Project

The Watershed Management CRA identified a number of land degradation hotspots in the Main Nile, Baro-Akobo-Sobat, Abbay-Blue Nile and Tekeze-Atbara Sub-basins. 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.

The objective of this Project is to provide support to the State Government to arrest and rehabilitate kerib badlands along the Atbara River in Gedaref State, strengthen household and community livelihood strategies and contribute to the alleviation of poverty.

1.3 The Scope and Elements of Sustainable Watershed Management

River 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)	Degree of coupling
Micro-watershed	0.1 -5km^2	Very strong
Sub-watershed	5 – 25km^2	Strong
Watershed	25 -2,500km^2	Moderate
Sub-basin	2,500 – 10,000km2	Weak
Basin	10,000 – 250,000km2	Very weak

After World Bank (2005)

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 - SUDAN

2.1 Bio-physical and Socio-economic Setting

Sudan covers an area of approximately 2.5 million km2 and in 2002 an estimated population of 31.3 million with an annual growth rate (1998-2003) of 2.6 percent. The projected 2025 population is 49.6 million. The total, rural % and growth rates by region are shown in table 2.

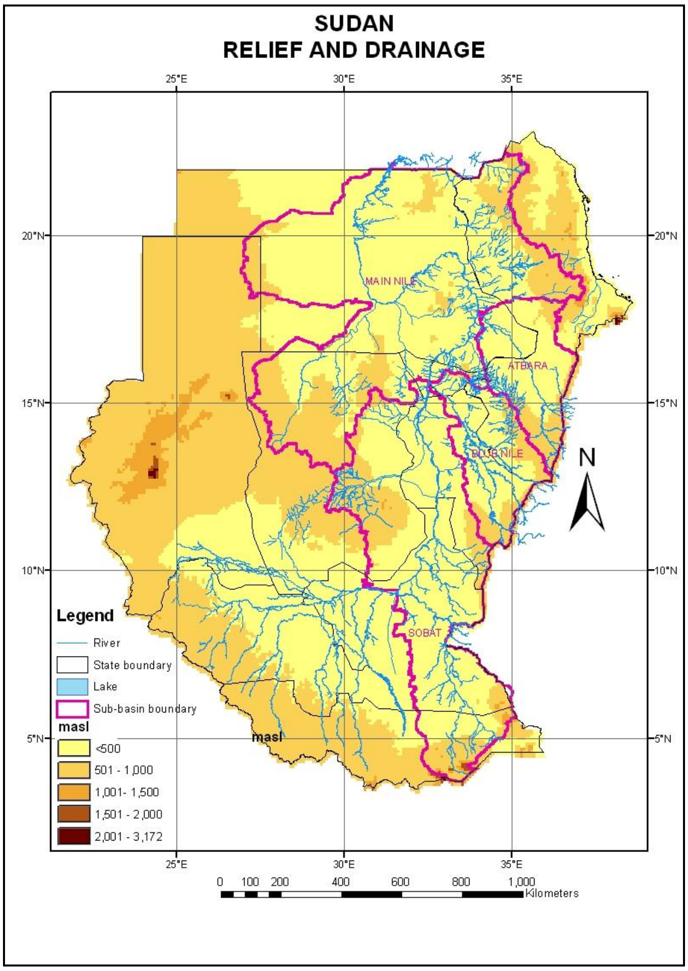
Table 2. Sudan: Total population, Rural % and growth rates by Region (2002)

REGION	TOTAL POP ('000) 2002	RURAL %	TOTAL GROWTH RATE
Eastern	3,360.5	57%	2.25%
Northern	1,392.5	75%	1.85%
Khartoum	5,301.3	14%	4.04%
Central	6,278.7	70%	2.80%
Kordofan	3,512.0	74%	1.50%
Darfur	6,212.6	82%	3.01%
N. Sudan	26,057.0	60%	2.58%
S.Sudan	5,283.3	79%	1.61%
SUDAN	31,340.0	65%	2.64%

Source: Y.A.Mohamed (2005)

Overall population density is 12.4 p.p.km2 but this masks considerable variations. Population tends to concentrate along the streams and rivers and other water sources.

The relief and drainage of Sudan are shown in Map 1.



Map 1. Sudan: Relief and Drainage

Land under 500 masl occupies the central White and Main Nile valleys as very gently sloping plains. Higher land is found along the eastern edge as outliers of the Ethiopian Highlands together with the Red Sea Hills. The southern and southwestern edges of the basin form the Congo-Nile watershed. The Jebel Marra forms the Nile-Lake Chad watershed along the western border. Locally hills and mountains rise above 1,500 masl (e.g. the Imatong Mountains being the country's highest point at 3,224 masl).

The Bahr el Jebel enters Sudan from Uganda with the Bahr el Ghazal forming on the northern slopes of the Congo-Nile Divide. They join at Lake No to be known as the White Nile. They both lose much water through evaporation in the Sudd. Just above Malakal the Sobat River, which rises in the southwestern Ethiopian Highlands, joins the White Nile. At Khartoum the White Nile is joined by the Blue Nile, which rises in the Central and Northern Ethiopian Highlands. Thence known as the Main Nile it is finally joined by its last tributary the Atbara, which also rises in the northern Ethiopian Highlands. There are many seasonal wadis and khors, which flow intermittently during the rainy season. Locally they are of considerable importance in small-scale irrigation, water harvesting and human and livestock water supplies.

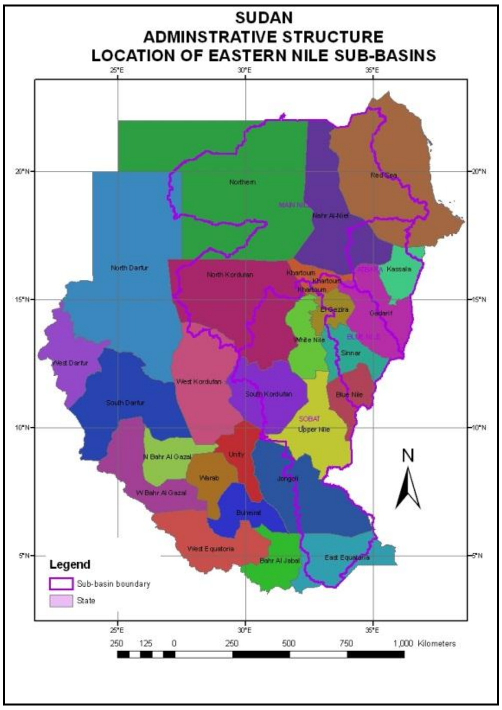
The country encompasses three major ecological zones: desert, semi-desert and savanna. Annual rainfall varies from less than 25 mm in the north to

1,500 mm in the south. Rains are erratic and variable, increasingly so in the north. Rains fall in a single season and are closely related to movements of the inter-tropical convergence zone (ITCZ).

Soils in the Sudan are commonly classified into four groups: (i) thin desert soils consisting of loose sand over bare rock in the north, (ii) fixed or shifting aeolean sands in the north and central parts, (ii) clay soil derived from old and recent alluvium over large areas of the central and eastern parts, and (iv) lateritic soils on the ironstone plateau in the southwestern part of the country.

Natural vegetation closely follows the rainfall patterns with local edaphic variations related to soil moisture conditions. Successively from the north are desert, semi-desert, woodland savanna on clay, woodland savanna on sands, high rainfall woodland and swamps. Large areas of the central woodlands on clay have been cleared for semi-mechanized farming and other areas of woodland are under severe pressure from traditional farming, and fuel wood and charcoal production for both urban and rural household consumption.

2.2 Administrative Structure



Map 2. Sudan: Adminstrative Structure with Eastern Nile Sub-Basin Boundaries.

Source:: ENTRO GIS data base:

In the past decade Sudan has embarked a policy of administrartive decentralization. According to the Local Government Act of 2003, the Sudan has been divided into 26 States, some 16 located in the north and 10 in the south (Map 3). Each State is divided into anumber of Localities (Mahaliyat). The aim of decentralization is to improve the delivery of basic social services and address the severe spatial disparitries in access to education, health, water, agricultural extension and other government services.

Decentralization and concommitant capacity building will be undertakenn over two pahses: Phase I (2005 – 2007) and Phase II (2008 – 2011). Priorities in the local government will be:

- Enhancing managment capacity by empowering suitable structures to lead reform;
- A broad consultation on organizational structures;
- Developing a comprehensive strategy for institutional arranbgement, polices and guidleines for public services and training;
- Improving systems and practices of local publicprivate partnerships in service delivery;
- Support to Locality development planning;
- Improving Locality information systems;
- Establishing Locality monitoring systems;
- Promoting civil society participation in planning and organization of governmenbt activities;
- Mobilizing local revenue generation for State and Local Government.

2.3 National and Regional Policy Framework

2.3.1 The National Comprehensive Strategy (NCS) (1992-2002)

Sudan's main objectives and priorities for sustainable development were spelt out in the National Comprehensive Strategy (NCS) which provided policy directions to all economic and social sectors. The NCS incorporates the country's environmental strategy, which states clearly that environmental issues must be embodied in all development projects. Within the NCS, the government manages the economy through a series of three years rolling plans and annual budget processes. The NCS has also served as a key reference document and basis for sectoral policies and measures.

A main weakness of the NCS is the lack of coherence as it was a result of work of different sectoral teams without emphasis on horizontal and vertical integration

2.3.2 Comprehensive Peace Agreement CPA

The Comprehensive Peace Agreement (CPA), signed between GoS and SPLMA on 9 January 2005, represents a remarkable event in the history of Sudan and is a major opportunity for restoring peace and the social contract between the state and society in the country.

The CPA provides for a socially informed land tenure policy and legislation as it accords specific reference to ownership of land and natural resource. It calls for competency in land administration, provides for incorporation of customary laws and practices and establishes an independent Land Commission for the purposes of arbitration, rights of claims in respect to land, land compensation and the possibility of recommending land reform policies.

The CPA is expected to have many implication (institutional and administrative) - e.g. the establishment of a Land Commission for the south parallel to existing central institutions responsible for land and natural resources management.

However, there is the question of the existing sectoral environmental legislation. Should that legislation remain federal as it is currently stands, or should it be amended and passed down to the states in accordance with the obligations given to them by the federal structure? (NBSAP,2002)

There is now a counterpart ministry of Environment and Wildlife in Southern Sudan and it is expected that the post CPA developments will witness greater decentralization on all levels. This will necessitate the initiation of a dialogue on developments in the sub-basins in Sudan as a basic requirement for sustainable development in the sub-region. Of special concern also are issues related to conflict resolution, internally displaced refugees, good governance, and the rights of the socially, economically and politically marginalized groups in post conflict Sudan

2.3.3 The Joint Assessment Mission (JAM) (2005)

The JAM Reports are the most recent documents which are guiding the economic development in post peace period in Sudan. The reports have developed the policy guide lines and interventions in eight clusters, including the economic policy cluster. The issue of environment has been classified as one of the cross-cutting issues. The report identified many environmental challenges Sudan is facing and need to be addressed during the short and medium term to enable the country make an equitable and sustainable development in the foreseen future.

The JAM report has stated that the foremost challenge is to minimize the negative environmental impacts that returning refugees and Internally Displaced Populations (IDPs) may pose on the natural resources base through increased deforestation and destructive agricultural practices

2.3.4 Poverty Reduction Strategy (2000)

Under the coordination and leadership of the Ministry of Finance and National Economy, Sudan is also in the process of formulating a national poverty reduction strategy. This strategy is expected part of the country’s long-term strategic plan and seeks to involve all groups of Sudanese society.

The preliminary draft of the PRSP was prepared in January 2004 with participation and contribution of a number of highly qualified national experts, The PRSP is considered to be the main available document of the government of the Sudan for poverty reduction. It covers the sixteen States of North Sudan for the period 2005-2007.

PRSP main objectives are:

- Maintain Economic Stability.
- Ensure Political Stability
- Social Stability.
- Environmental integrity
- Improve standards of living
- Assist in the flow of financial resources.

2.3.5 Environment Protection Act 2001

In 2001, the Higher Council for Environment and Natural Resources (HCENR) initiated the development of environmental regulations under the Environment Protection Act which was issued through a presidential decree. It established guidelines and requirements for environmental impact assessments and environmental conservation frameworks.

The Environmental Protection Policy (2001) requires that any new projects that are deemed to have an impact on the environment conduct an Environmental Impact Assessment (EIA). This must be done in order to obtain an Environmental Compliance Certificate (ECC) from the HCENR through the receipt of an Initial Environmental Impact Assessment (IEA) Report. This report should contain a Mitigation Plan or a description of the mitigation measures to be implemented to reduce the environmental impacts of the proposed project.

The EIA report is normally made available for viewing and comment by interested and affected parties prior to the HCENR giving the go ahead with the project. This legislation represents a major step in coordinating national developmental projects on an environmentally sustainable basis

2.3.6 National Water Policy (2001) - Draft

Through a process of consultations with stakeholders, a Draft National Water Policy was prepared. The policy builds on experiences of a wide range of experts and institutions involved in water sector. The draft policy document assesses the water situation in the country, existing policies and legislation and then provides the main policy principles and statements. These policy principles are considered under water resources, water utilization, water and environment, international issues, socio-economic issues, disaster management and institutions and capacity building. It also recommends development of strategic plan for the water sector.

The objectives of the NWP are to:

- Review and adapt water policy to meet changing circumstances within the country;
- Ensure that the water resources of Sudan are properly managed, protected and efficiently utilized for the benefit of all;
- Provide the basis for the on-going development of water related regulations and legislation, and

- Strengthen and clarify the functions and responsibilities of water related institutions in both the public and private sectors in Sudan

Part 3 of the Water Policy (2001) addresses issues related to water and environment. It examines at policy as it affects the environment and related matters such as pollution and catchments degradation.

2.3.7 National strategies in response to Multilateral Environmental Agreements (MEAs)

(i) Agenda 21 Project - Sudan

In response to Agenda 21 (Rio Earth Summit 1992) a project was implemented in Sudan to build the capacity needed to meet the challenges of the Twenty First Century. The project helped to build capacities of government institutions, the private sector and non-governmental organizations to implement sustainable development projects. The project played an important catalytic role in promoting community level environmental protection. The project succeeded in building the capacities of Two State Environmental Councils and in the preparation of Environmental Action Plans for 4 States. This provided the basis for a ground level identification of a National Agenda 21 and initiated the formulation of a National Sustainable Development Strategy.

(ii) National Biodiversity Strategy and Action Plan (NBSAP)

In 1995, the Sudan government has become party to the Convention on Biological Diversity (CBD). The Government developed with GEF support and technical assistance from World Conservation Union (IUCN) its first National Biodiversity Strategy and Action Plan in May 2000 and its first Country Study on Biological Diversity in April 2001. The NBSAP outlines strategies, priorities and actions for biodiversity conservation and protection of natural ecosystems

(iii) National implementation Strategy for the UN Framework Convention on Climate Change

In 1992, the government of Sudan signed the United Nations Framework Convention on Climate Change (UNFCCC), and ratification took place in 1993. An enabling activity for climate change funded by GEF/UNDP was implemented by the HCENR. The project conducted many activities including training, a Greenhouse Gas inventory, a vulnerability and adaptation assessment and mitigation analysis and an intensive awareness program. As part of complying with its commitments to the Climate Change Convention, Sudan completed its National Communication under the UNFCCC in February 2003.

To fill the gaps and short comings of the vulnerability and adaptation assessment to climate change a three-year project is being implemented as part of the "Global Assessment of Impacts of and Adaptation to Climate Change (AIACC)" through GEF/UNEP. This project aims at enhancing the scientific and technical information, assessing the impact of climate change and designing cost-effective response measures needed to formulate national policy options.

(iv) National Action Plan (NAP) to Combat Desertification

In November 1995 Sudan ratified the United Nations Convention to Combat Desertification (UNCCD). The National Drought and Desertification Control Unit (NDDCU) has been designated as the national focal point to the UNCCD. The NDDCU identified the States that are affected by the desertification process. As part of its commitments under this convention, a National Action Programme (NAP) has been prepared in April 2002.
The challenges which face the implementation of NAP in Sudan include lack of a coherent national land use plan, dependence of household energy on forests products, expansion of mechanized rain fed agriculture and the civil war.

(v) Other International Environmental Obligations

Sudan is also involved in key GEF funded regional initiatives under the international waters operational programmes and is an active player in all these initiatives. These include the Kijani Initiative, the project for the Protection of Key "Bottleneck" Sites for Soaring Migratory Birds in the Rift Valley and Red Sea Flyway, the Nile Trans-boundary Environmental Action Project, the Strategic Action Programme for the Red Sea and Gulf of Aden (PERSGA) and the project for the Removal of Barriers to the Introduction of Cleaner Artisanal Gold Mining and Extraction Technologies.

2.4 Institutional Framework

2.4.1 Higher Council for Environment and Natural Resources (HCENR)

In recognition of the importance of environmental protection for the sustainable development of Sudan, as well as for the fulfillment of the various United Nations global environmental commitments, the government in 1992 established the Higher Council for Environment and Natural Resources (HCENR) as the central government organ co-ordinating efforts for sustainable development, use of natural resources and environmental protection. The Council includes a number of relevant ministries and places special emphasis on addressing degradation, resource depletion, and chronic pollution. A parliamentary committee on environment and natural resources was also established in 1992.

In 1995, the Government also created the Ministry of Environment and Tourism, now Ministry of Environment and Physical Development (MOEPD) to oversee overall environmental management and integrate environmental protection into national development strategies.

The mandate of the HCENR as stated in the Environment Protection Act 2001 includes inter alia:

- Formulation of general policies for Natural Resources, inventories and development to ensure the appropriate management of the resources and their conservation and sustainable use,

- Develop in co-operation with other government authorities strategies to encourage environmentally sound and sustainable activities; and

- Initiate measures for the co-ordination and enforcement of environmental protection legislation.

The HCENR is chaired by the Minister of the Environment and Physical Development. The HCENR discharges its functions by a General Secretariat with the following mandate:

- Draft general policies for Natural Resources Inventories and Development to ensure the appropriate management of the resources and their conservation and sustainable use.

- Environment conservation in coordination with the appropriate authorities in the States.

- Coordinate the work of the Council Branches and all efforts in natural resources inventories and conservation and efforts for the sustainable development of the resources, monitor changes in the natural resources;

- Specify areas subjected to depletion, desertification and pollution and decide on priorities for surveys and studies on natural resources.

- Make long-term plans for rational and balanced use of the natural resources and environment conservation and follow-up the execution of the plan with appropriate authorities.

- Periodically review legislation related to the natural resources and the environment, make sure that Laws are effective and introduce any necessary amendments to improve the Laws.

- Establishment of branches in the different States to help the Council in performing its responsibilities.

- Encourage support and coordinate scientific research in all fields of the environment and natural resources.

- Formulate a federal plan for environmental awareness and rational use of the natural resources and try to incorporate environmental education in school curricula.

The HCENR is Sudan's outlet to the international environmental arena. It acts as the technical focal point for most of the environmental the conventions emerged from the Earth Summit in Rio de Janeiro (1992) namely: Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC). In addition it is a party to the Convention on Persistent Organic Pollutants (POPs).

The cross-cutting nature of the environmental issues, which spread over different disciplines, has guided the HCENR to form steering and technical committees so as to bring all the concerned stakeholders together, and playing its coordinative role.

2.4.2 Other Government Institutions

In addition to the HCENR, other government ministries have significant roles and responsibilities in the areas of natural resource management, land use planning, and socio-economic development, including :

- Ministry of Agriculture and Forests;
- Ministry of Irrigation and Water Resources;
- Ministry of Finance
- Ministry of Technology and Scientific Research;
- Ministry of Industry and Commerce;
- Ministry of Energy and Mining
- National Council for Strategic Planning
- Ministry of Health;
- National Meteorological Authority
- Ministry of Culture and Information; and
- The General Directorate of Public Corporation for Investment

The **Ministry of Agriculture and Forests** is responsible for agricultural development and natural resources planning and policies, and the National Drought and Desertification Control Unit (NDDCU) in this Ministry has been designated as the national focal point (NFP) to the UNCCD.

In 1989 the **Forest National Corporation** (FNC) replaced the old Forest Administration (that was established in 1902) to be responsible for the protection and management of forest resources in the country. The FNC is a semi-autonomous corporate body that is attached to the Ministry of Agriculture and Forests. It has a Board of Directors constituted by the Council of Ministers and 10 representatives from related institutions. As such, the FNC is entrusted with the role of protection and conservation of forest resources.

The **Ministry of National Industry** is responsible for formulating industrial policies, strategies and programmes that fall within overall national objectives. The Ministry can orient the activities of many industrial activities that are directly related to the Biodiversity, Climate Change and Desertification issues, as the industrial sector is an important user of natural resources.

The **Ministry of Irrigation and Water Resources** is responsible for setting national water resources policies, strategies and plans, development of water resources to meet the needs, monitoring of ground water basins, and forging cooperation between the Nile basin countries. It also, contributes to the environmentally sound socio-economic development such as in big irrigated agriculture schemes.

The Wildlife Conservation General Administration (WCGA) was established in 1902 by the colonial authorities. The WCGA was part of the Game and Fisheries Department of the Ministry of Animal Resources. Today, it is administratively accountable to the Ministry of Interior while technically it is accountable to the Ministry of Environment and Tourism. It is entrusted with the conservation of wildlife in the Sudan. Wildlife includes also ecosystems and habitats where species are living. WCGA is also entrusted with the task of establishment and management of protected areas in Sudan. Among its main responsibilities are:

- Sustainable management and utilization of wildlife resources in the country.
- Origination of hunting (issuing licenses and setting by limits).
- Cropping of wildlife, trade in wildlife parts and live animals.
- Establishment of zoological gardens for wildlife public education.
- Control of wildlife damaging problems.
- Management of marine national parks and protected areas.

WCGA is the focal point for CITES (Convention on International Trade in Threatened and Endangered Species (includes botanical or animal species.) as well as for RAMSAR Convention for the protection of wetland.

The **Wildlife Research Center (WRC)** is a part of the Animal Resources Research Corporation. There are no official links between the WCGA and WRC. Research recommendations are not implemented, and the WCGA major approach to wildlife conservation is policing and licensing with no efforts in the area of involving the people in participatory wildlife management or applying scientific wildlife management practices (NBSAP, 2001). The WCGA lacks official link with the Fisheries Administration, Fisheries Research which is also under the Ministry of Animal Resource.

The Institute **of Environmental Studies (IES), University of Khartoum** was formally established in 1979. Although in fact it was created in 1972 following United Nations Conference on Human Environment in 1972 and the subsequent call by the Arab League Educational Cultural and Scientific Organization, (ALECSO) that universities should respond to environmental problems and challenges. Since then, he IES (the first in Africa and the

Middle East) has pursued a program that blends a) post-graduate education in environmental studies b) short-term training in natural resources c) research and consultancies in project design, environmental impact assessment and education.

IES executes projects funded by international organization e.g. i) Dry Land Husbandry project (OSSREA & EPOS) i) Environment Impact Assessment projects (UNEP, UNICEF,US-AID,CPECC UNSO) and iii) Acted as coordinators between Research Institutions and NGOs (Ford Foundation).Project proposals are coordinated through the IES pertaining to the field of coastal zone , arid lands, wetlands meteorology and urban planning. IES qualifies teaching assistants and lecturers to obtain M.Sc. and PhD degrees in environmental sciences.

2.4.3 Non-Government and Civil Society Institutions

Several national NGOs in Sudan have formed a network called the Network Committee for Combating Desertification (NCCD), NDDCU and NCCD worked in close collaboration throughout the NAP process. Organized forms of NGOs have become well known after 1975 (Mohamed, 1999). Many registered NGOs are actively working on different fields of the environment and rural development. Also there are some networks for coordination between NGOs e.g. the NGOs National Coordination Committee on Desertification (NCCD). The following are some examples of Sudanese NGOs working on environment-related work.

The Sudanese **Environmental Conservation Society (SECS)** is considered to be the most active NGO in promotion of environmental awareness and lobbying for better environmental policies and actions. It does so by initiating and supporting small projects with grassroots involvement designed to improve living conditions and wellbeing. Examples of these projects include tree planting, waste management and awareness-raising. SECS have more than 80 branches distributed all over Sudan, with more than 6000 members. The main objectives of SECS include:

- Conservation of the environment and mitigation of any action that may lead to environmental degradation.
- Dissemination of environmental awareness.
- Cooperation with the government in law enforcement for environmental conservation.
- Strengthening the links with the local, national, regional and international institutions endeavoring to conserve the environment.
- Encouraging scientific research and studies aiming at the conservation of the environment, in addition to writing of the natural history of the Sudan. (El Nour *et al* ., 2001)

The Sudanese Social Forestry Society (SSFS) is a charitable NGO with dedicated memberships who believe in social and multiple benefits of the forest. SSFS seeks promotion of concepts and practices of people involvement and social forestry in Sudan. The main objectives of SSFS are:

- To promote the concept and practices of social forestry, through networking and linkages between social forestry and extension units in Sudan.
- Enhance the standards of awareness of the community participation in social forestry.
- Encourage the scientific applied research in social forestry and promote the output of the same among the interested persons.
- Assist in the fund raising and appropriate resource funding of the social forestry projects.
- Facilitate and forward the technical consultancies in the field of social forestry projects.
- Cooperate with the concerned bodies, for the development of social forestry.
- Collect, authenticate and publish information regarding the social forestry activities.
- Establish advanced relation with international and national network.
- Preserve the natural forests as a natural heritage.

The Environmentalist Society is one of the active national NGO's in the field of environment. It aims at promoting environmental awareness and capacity building in environment related fields. All graduates from the Institutes of Environmental Studies are by default members in this society and could volunteer to provide services and contribute to environmental assessments and training programs whenever, it is required.

2.4.4 Traditional Institutions

These include traditional structures (local Administration, community leaders and other community-based organizations (CBOs). Traditional leaders are generally elected from the same families and thus, the holding is semi-hereditary one. These systems play important roles at the local community level. Their responsibilities include:

- Land allocation and settlement of conflicts;
- protection of the common natural resources;
- organization of usage of natural resources;
- construction of fire lines;
- keeping order of security and organization of foreign tribes presence in their areas, assigning nomadic routes;
- organization of communal public activities e.g. pest and bush fire control and settlement of tribal disputes

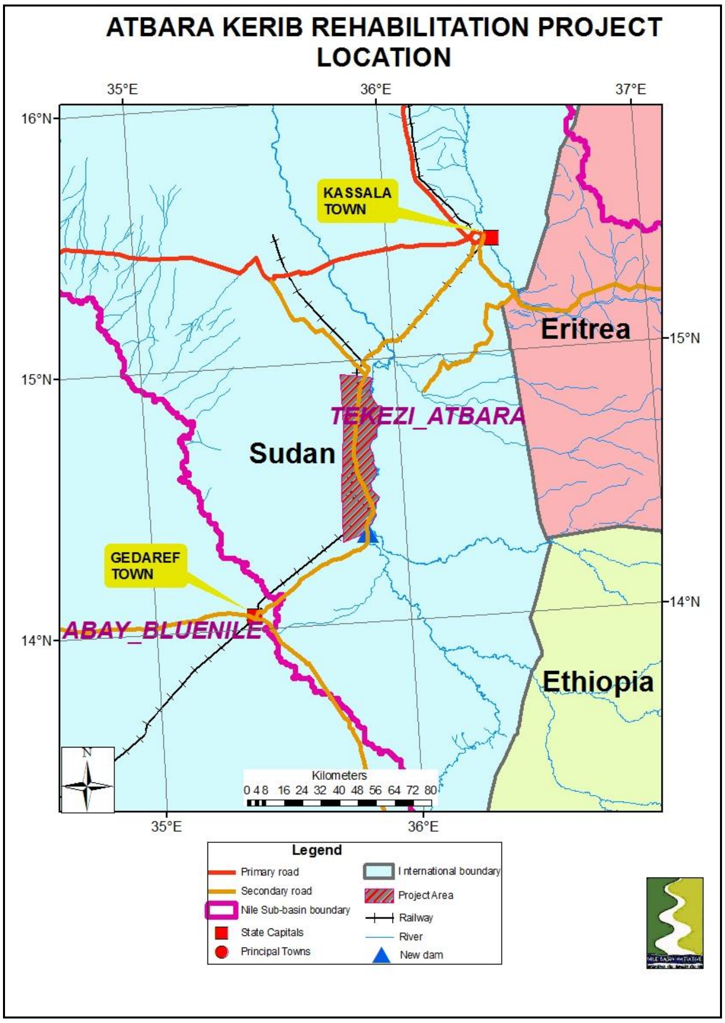
They have well identified roles in relation to resource conservation and management. According to Elnour the system of traditional management was supported by equity of use right and social customs governing common property resources. This flexibility facilitated resource conservation particularly under the dry conditions. Additionally, they play an important role in conflict resolution based on the indigenous mediation (*Judiyya*) system. The "*Judiyya*" is established tradition in Sudan and can be initiated by a member of the local administration or a religious leader (Fagir) or a group consisting of representatives of all of them. They all represent mediating roles with the ultimate objective of reaching a consensus and peaceful settlement to their conflicts.

3. ATBARA KERIB LAND - BIOPHYSICAL AND SOCIO-ECONOMIC SITUATION

3.1 Biophysical Characteristics

3.1.1 Location and Extent

The overall Project area comprises the kerib badlands located along the south bank (Gedaref State side) of the Atbara River between the Kashm el Girba dam and the proposed new dam to be located at the junction the the Setit and Barr as Salem Rivers.

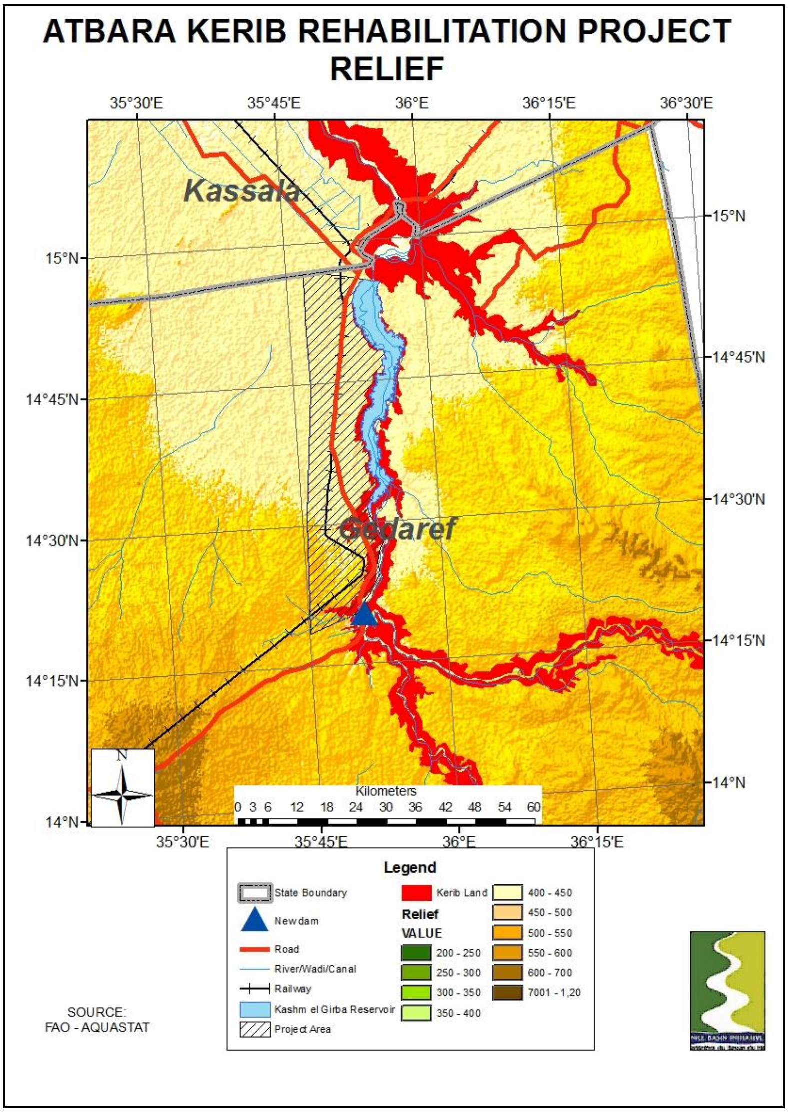


Map 3. Location of Atbara Kerib Land Rehabilitation Project

3.1.2 Relief and Drainage

(i) Relief

The Project area lies between 400 and 450 masl with little visible relief. The Atbara River is incised below the plain by about 20 to 50 meters.

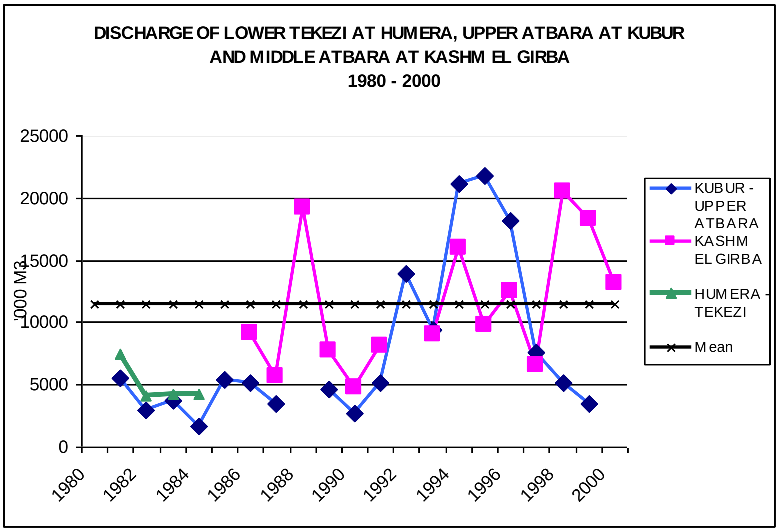


Map 4. Relief and Drainage

(ii) Drainage

The Atbara River exhibits considerable year-on-year variation about the mean as can be seen in figure 1, which shows annual discharges. The highest discharge of 20,468 Mm3 occurred in 1997 and the lowest of 4,778 Mm3 in 1990. The station for Kashm el Girba is located below the dam and discharge may be affected by the water release regime of the dam. Thus in 1993 to 1995 discharges on the Upper Atbara appear to be higher than the main Atbara (i.e. Atbara + Tekezi).

Figure 1. Annual discharge of the Middle Atbara (Kashm el Girba), Upper Atbara (Kubur), and the Tekeze (Humera) – 1980 -2000.



Source: Abdelsalem Ahmed (2006) and Ethiopian MWRI.

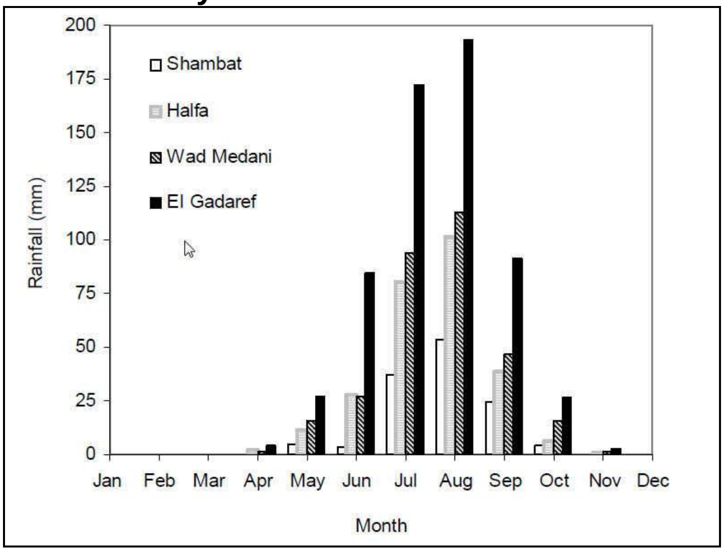
Within the Project area there is one deep wadi, with its own kerib land. Elsewhere rills in cultivated areas often become gullies as they accumulate more surface flow.

3.1.2 Climate

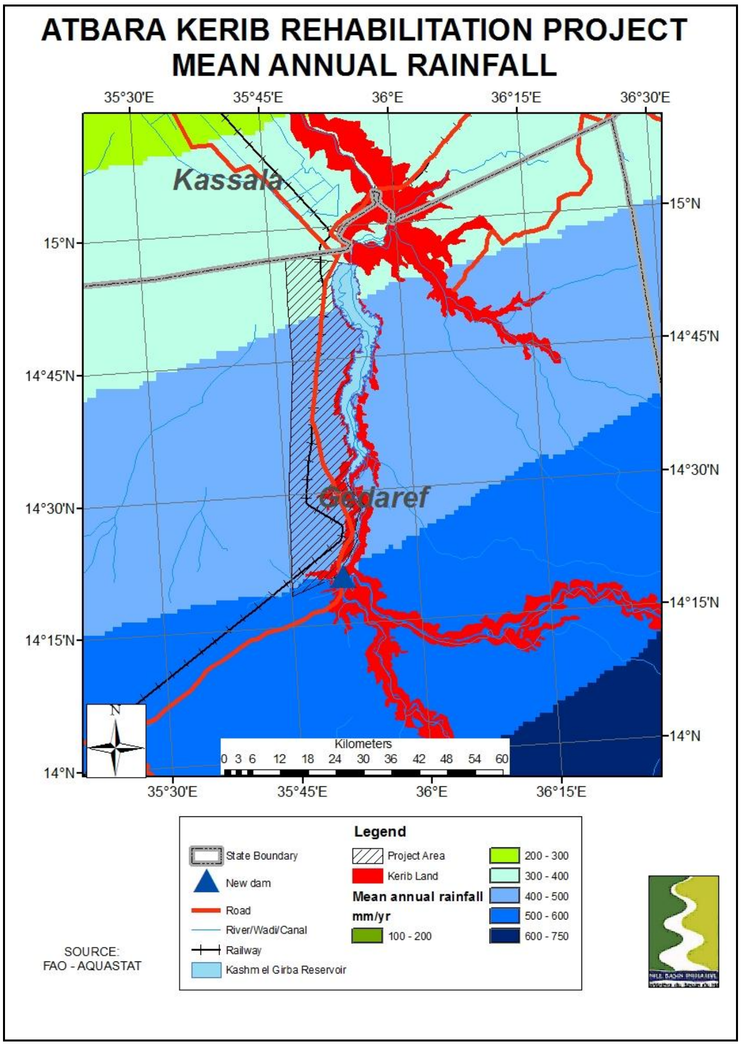
(i) Rainfall

Mean annual rainfall across the Project Area decreases from the southeast to northwest, from 500mm/yr to 300mm/yr. Most rain falls between June and September (figure 2). The vegetation growth pattern lags by about one month.

Figure 2. Mean Monthly Rainfall for Stations in Gedaref State



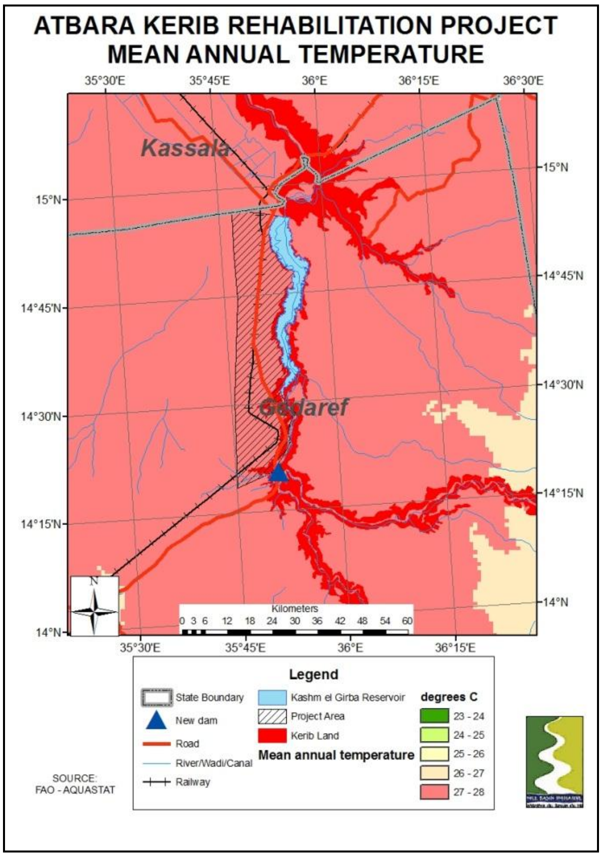
Source: Muna Mohamed Elhag (2006)



Map 5. Mean annual rainfall

(ii) Mean annual temperature

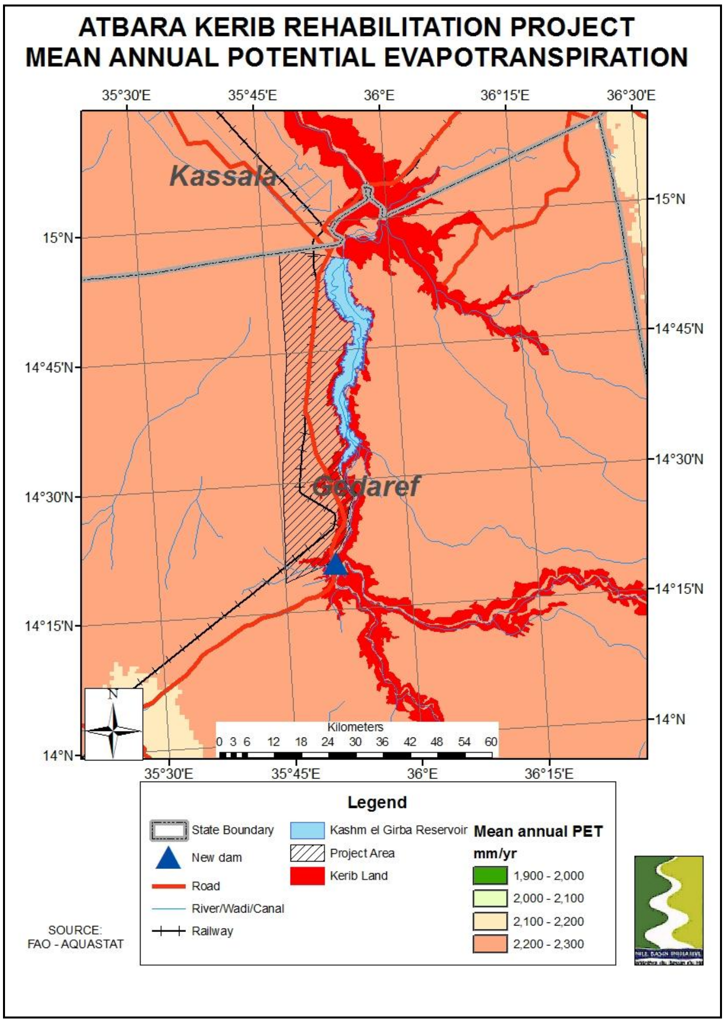
Mean annual temperature varies little across the Project Area, with a mean annual temperature of 28°C (Map 6).



Map 6. **Mean annual temperature (degrees C)**

(iii) Mean Annual Evapotranspiration

The pattern of mean annual evapotranspiration is very uniform across the Project Area between 2,200 and 2,300 mm/yr. It decreases slightly eastwards towards the Sudan-Ethiopian border. .

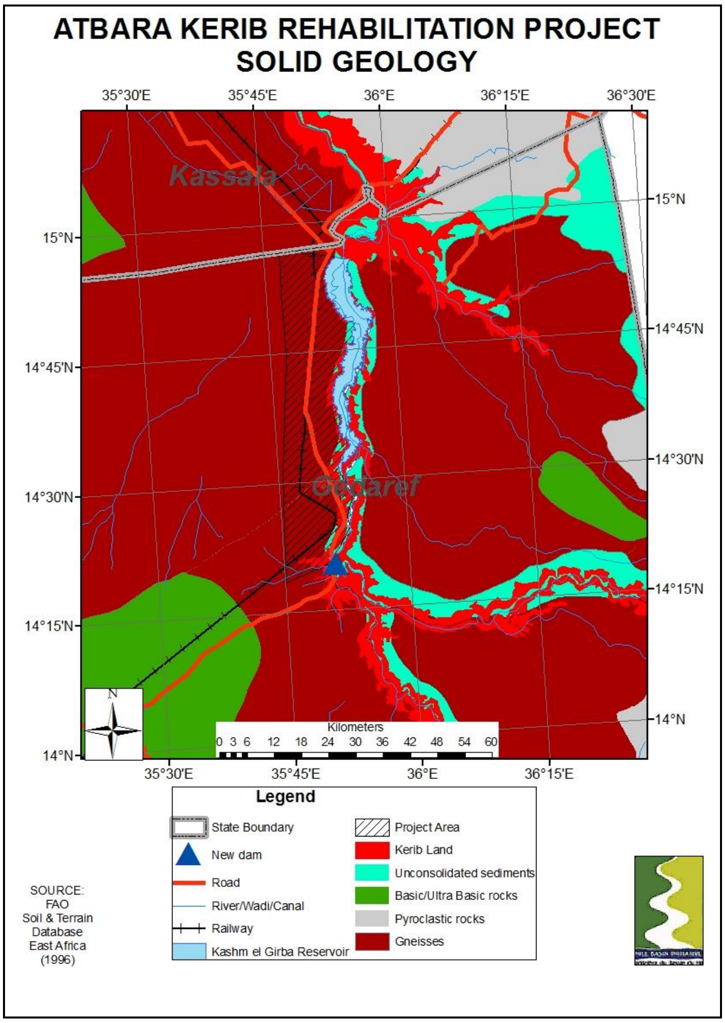


Map 7. Mean annual evapo-transpiration.

3.1.3 Geology

(ii) Solid geology

The main part of the Project Area is underlain by Basement Complex rocks (gneisses). Within the Atbara River trough are Unconsolidated Sediments said to be derived from a former lake (Map 8).



Map 8. Geology

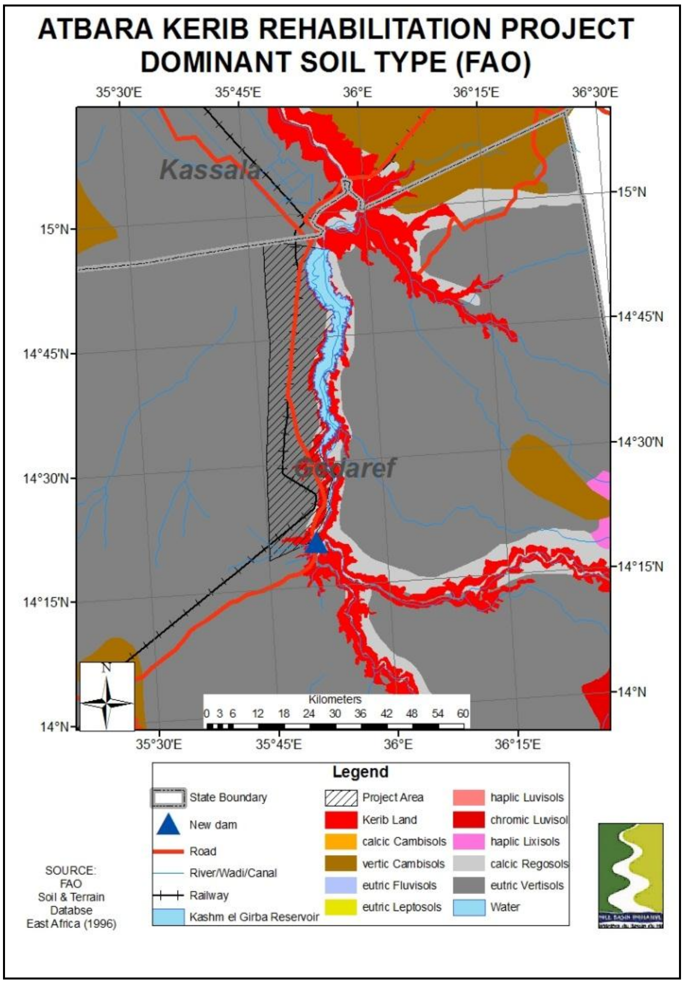
(ii) Groundwater

In the Lowlands a quantitative assessment of groundwater in the Showuk area (Ibrahim & Giddo, 1992) give a storage capacity of the upper Nubian aquifer as 840 million m^3 and the safe yield is estimated at 8.4 million m^3. In the second major aquifer located in the Neogene-Recent Deposits ("Unconsolidated Sediments" in Map 8) 1 km away from the banks of the Setit and Atbara Rivers the storage capacity is estimated at 222 million m^3 and the safe yield 11.2 million m^3.

3.1.4 Soils

Vertisols cover most of the Project Area. These are deep, black cracking clay soils of moderate fertility. Constant ploughing with heavy machinery has led to the formation of a plough pan, which impedes drainage of water down the soil profile. This in turn leads to excessive surface run-off.

The area of kerib land has been mapped as calcic Regosols. These soils often have calcium nodules in the profile. Little soil development has taken place because of the constant erosion.



Map 9. Dominant Soils (FAO Classification)

3.1.5 Land Cover / Vegetation

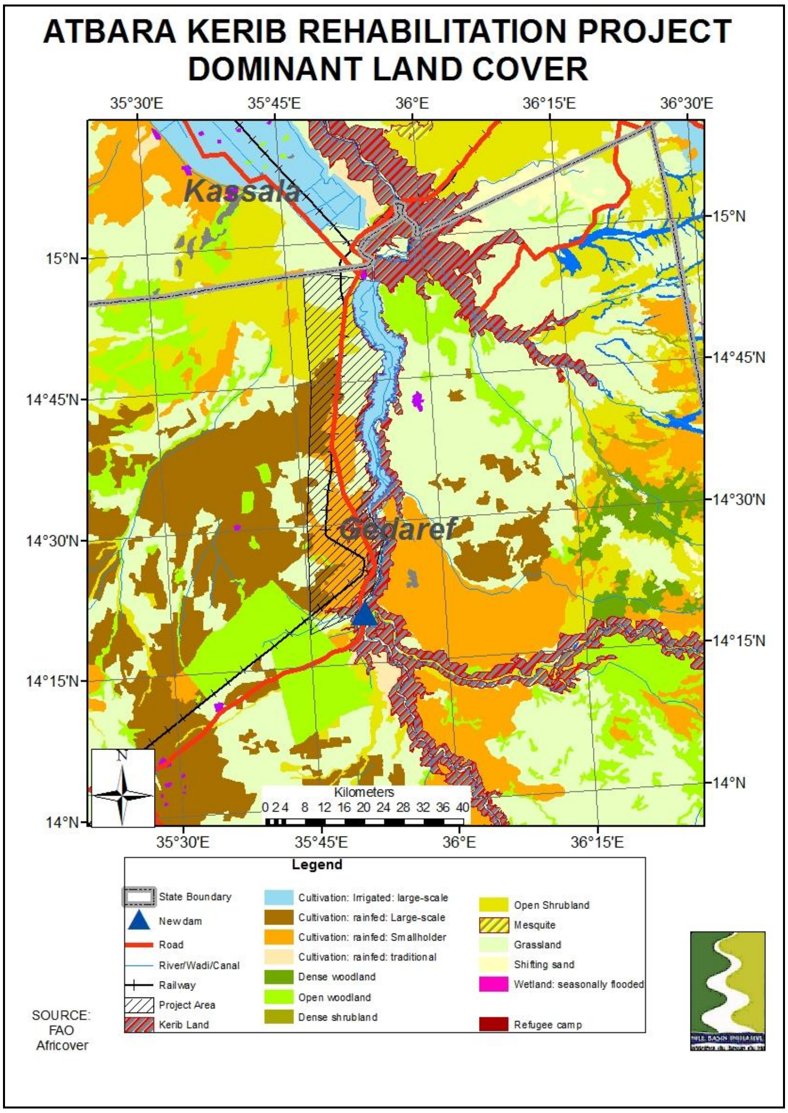
(i) Landcover

The most extensive landcover in the Project Area itself is grassland with sparse shrubs (36 percent). This is followed by small-scale rainfed cultivation (29 percent) and then by large-scale rainfed cultivation (13 percent). Open shrubland and woodland cover some 15 percent of the Project Area.

The landcover mapping was undertaken between 1995 and 2002 and it is possible that the area of Cultivation has increased. Much of the area mapped as grassland and shrubland is kerib land as identified on the Landsat ETM satellite image. Kerib land covers 10 percent of the project area or 22,380 feddans (9,400 ha).

Table 3. Buttana: Dominant Landcover (km2)

LANDCOVER	AREA_KM2	%
Grassland with sparse shrubs	332	36%
Sparse grassland	33	4%
Open shrubland	111	12%
Open woodland	30	3%
Water	14	2%
Bare sand	12	1%
Cultivation: Rainfed: Large-scale farms: Large Fields > 5 ha	124	13%
Rainfed Herbaceous: Small-scale farms: Medium Fields: 2 - 5ha	270	29%
TOTAL	**926**	



Map 10. Dominant Landcover

(ii) Vegetation

Acacia Thornland alternating with Grassland

Between the 360 mm and 570 mm isohyets on the heavy clays grassland merges into *A. mellifera* thornland. Other tree species include *A. nubica,* C. *decidua, Cadaba glandulosa, C. rotundifolia and Boscia senegalensis.* The last three species often persist after A. mellifera has been cleared. Much of this vegetation is being cleared for small-scale sedentary and large-scale semi mechanised agriculture.

Grass species include *Cymbopogan nervantus*, *Sorghum purpereo-sericeum*, *Hypparhenia ruffa*, *Tetropogan cenchriformis* and *Cenchrus cilliaris*. Sufficient grass dry matter is produced to provide material for annual burning.

Acacia seyal-Balanites Savanna Woodland

Above 570mm to the border with Ethiopia there is increasing dominance by *A. seyal* in association with *Balanites aegyptiaca*. *A. senegal* is retained for gum arabic harvesting whilst *A. seyal* is used for charcoal production. *B. aegyptiaca* becomes increasing prevalent because it is fire resistant, does not produce good charcoal and is hard to cut.

3.2 Administration

The State's political arrangements resemble those of Sudan's other States, and are based on the federal system of governance promulgated in 1994; the State is headed by the Governor (*Wali*), appointed by the President (Munzoul Assal and Samia Ali, 2007). The Governor, in consultation with federal authorities, appoints commissioners for the different localities.

In addition to these formal government structures there are traditional administrations known as *Nazaras*. The leader of the *Nazara* is known as a *Nazir*. He has no official authority over his people or the residents of his *Nazara* area, but he is instrumental in mediating between his followers and the government. The *Nazir* is also involved in solving problems and disputes between people. Only problems that he cannot address are dealt with by courts of law. This way, traditional authorities and government authorities seem to be parallel, but they collaborate; often the government co-opts traditional leadership and uses it for its own purposes. The *Nazir* practices his authorities through middle-ranking leaders known as *Omdas*. Table 4 shows the Nazaras of Gedaref State, their areas and the tribes under their administration.

Table 4. Nazaras of Gedaref State: their Areas and Peoples

Nazara	Area	Peoples under Umbrella
Bakur	South of the state	Four, Masaleet, Fallta other west Sudan tribes
Shukrya	Butana	Shukrya, Bataheen, Kawahla, Lahwin
Dabaina	East of the state	Dabaina and other minor groups.
Beni Amir	Gedaref city	Beni Amir
Nahal	Nahal and Hawata	Bargo and other minor groups

3.3 Population

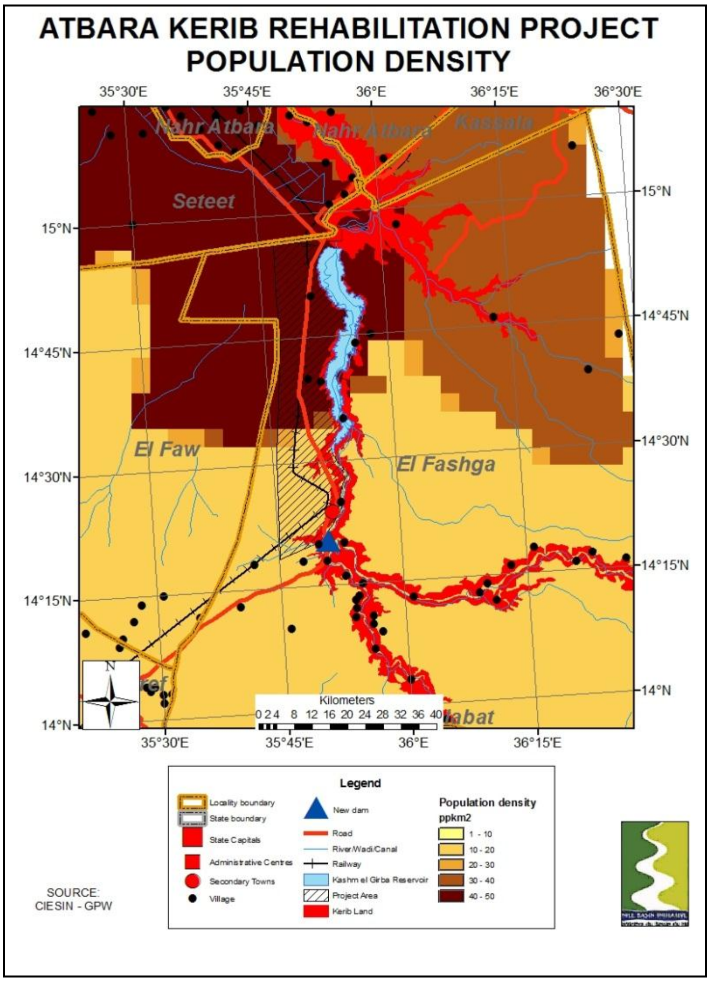
3.3.1 Population Distribution

The toal population of Gedaref State is 1.348 million spread across 10 Localities (Table 5). The population density of the Project Area is between 10 and 20 ppkm2. Densities increase to Kashm el Girba and the New halfa Irrigation Scheme. (Map 11). The project Area falls within El Fashaga Locality.

Table 5. Estaimated Population of Gedaref State by Locality

Locality	Male Population	Female Population	*Total Population*
Al Butana	38 375	32 990	*71 365*
Al Fashaga	60 005	60 830	*120 835*
Central Al Gedaref	56 239	55 430	*111 669*
Al Gedaref City	136 434	132 961	*269 395*
Al Faw	86 850	89 812	*176 662*
Al Rahad	96 671	99 767	*196 438*
Qalaa Al Nahal	31 373	34 749	*66 122*
Western Galabat	44 768	47 107	*91 875*
Al Goreisha	40 059	43 335	*83 394*
Eastern Galabat	79 043	81 580	*160 623*
TOTAL	**669 817**	**678 561**	***1 348 378***

Source: Sudan Population & Housing Census (2008)



Map 11. Population Density and Distribution

The estimated population growth per year for Gedaref State is 3.87 percent. The urban population is 28.9 percent while the rural people comprise71.1%. The pastoral people comprise 35% of rural people and 25% of the total population of Gedaref State. A small but reducing number of refugees are settled in transition camps along the eastern border and in selected areas near irrigated schemes and urban centres. The main demographic features of Gedaref State are shown in table 6.

Table 6. Main demographic Features of Gedaref State

State	Gth rate %	Urban %	% <15yrs	% >60yrs	Sex ratio M/F	Crude birth rate	Crude death rate	Infant mort. male*	Infant mort. female*
Gaderef	3.40	28.9	43.1	3.7	105.3	40.3	11.7	135	122
NORTH SUDAN	**2.80**	**37.3**	**42.8**	**4.1**	**100.4**	**37.8**	**11.0**	**116**	**98**

* per 1000 live births

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

3.3.2 Social-Cultural Aspects

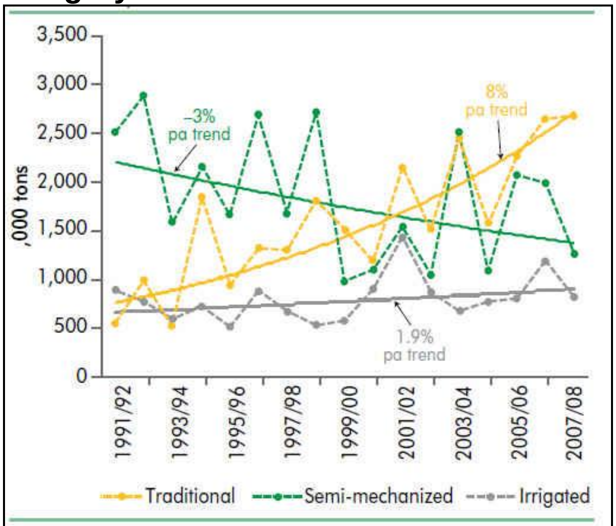
Gedaref state is characterized by high levels of social and ethnic diversity where the population groups include Shukriya, Lahawyien, Dabaina, Kawahla, Fur, and Bargo peoples along with northern and riverine peoples such as the Shaygiya and Ja'alyin in addition to Eastern Sudan peoples of Bani Amir, Rashaida and Beja and (although these latter groups make up a relatively small percentage of the population in contrast to Red Sea State and Kassala where the Beja and Rashaida constitute the majority). The multi-ethnic nature of Gedaref state is in large part a product of historically protracted waves of migration to the region (Assal 1997).

3.4 Agricultural and Pastoral/Agro-pastoral Livelihood Systems

3.4.1 Introduction

Agriculture in Sudan is classified under five main farming) systems: (i) Large scale irrigated schemes, (ii) small-scale irrigated farms, (iii) large scale semi-mechanized farms (> 1500 fed.), (iv) small scale sedentary farms (< 1500 fed.) and (v) pastoral and agro-pastoral systems. There have significant changes in crop production patterns of these farming systems over the past two decades. The production from traditional farming systems has grown at 8 percent/yr, the semi-mechanized farms has declined at 3 percent/yr whilst production from the irrigated systems has only grown at 1.9 percent/yr (figure 3).

Figure 3. Total crop production from Traditional, Semi-mechanized and Irrigated Farming Systems



Source: Data are from the Ministry of Agriculture and Forestry and the Central Bureau of Statistics.

Source: World Bank (2009)

In its Annual Economic Report for 2008, the Gedaref State Ministry of Finance indicates that contributions from agriculture would account for 75 – 78% of the state GDP with services contributing 17 – 20%. The centrality of agriculture to the state's economy finds parallel expression in the employment market with over 70% of the population working in this sector.

3.4.2 Large-scale Semi-Mechanised Farms

(i) Background

In the Project Area these cover some 93,810 fedddans 39,400 ha) (see map 13). Sorghum is the main crop. Each semi-mechanized farm is now usually well over 1,000 feddan (420 ha) as a result of amalgamations of leases and family partnerships. The government also allocated large tracts of land (between 50,000 and 1 million feddan) to Sudanese and foreign investors (mainly from the Gulf countries). Land preparation, seeding, and most threshing on these farms are mechanized, whereas weeding, harvesting, and some threshing are done by seasonal labor.

Land is leased by the State to individual investors whereby each individual is allotted “a farm”. These schemes are managed by both private and government sectors. Sometimes, rotation of dura, sesame and fallow with or without cotton are practiced, but often a piece of land is cropped with dura until the land loses its fertility and then abandoned completely.

The mechanized rainfed farming sector is criticized as being a major cause of environmental deterioration. To understand the role it played and to assess its impact a brief background is necessary.

The Mechanized Farming Corporation (M.F.C.) was established in 1968 (Act No. 14) to act as a main agency for the promotion of large scale rainfed agriculture.

In 1975, the M.F.C. came under a new Act which defined the responsibilities of the corporation as follows:

- Survey, allocate, demarcate and distribute schemes to farmers.
- Assist the private investors and direct their attention to the best agricultural techniques.
- Promo to agricultural research.
- Provide credit to farmers on reasonable terms.
- Operate state farms.
- Provide social services.

The emphasis over the past thirty years has been primarily on survey, demarcation and distribution of schemes as well as on the running of state farms. There had been very little activity in other aspects of responsibilities.

Since the introduction of mechanization more emphasis was given to horizontal expansion rather than to vertical expansion. For example, in the years from 1950 to 1952 the total area under mechanized rainfed farming in Gedaref state was 34,124 feddans. At present the area exceeds 3 million feddans, half of which is un-demarcated or unauthorized by the M.F.C. so, there is expansion without any control by concerned technical agencies i.e. M.F.C. or Land use department.

A general evaluation of these schemes indicates that there are many shortcomings in the planning of these schemes. They are often connected without site selection, or consideration of nomadic rights, stock routes and wildlife sanctuaries. The development of mechanized farming and its spread without proper control or appropriate environmental measures led to negative impacts on the environment and resulted in serious deterioration in the grazing resources, forest resources and soil fertility.

(ii) Impacts of mechanized rainfed farming:

The original advantages of a semi-mechanized farm sector were seen to be:

- Employment generation,
- Contributing to expanded food supply for domestic consumption and for export.
- Have a low demand for public services and support compared with peasant agriculture or large irrigation schemes.
- Mobilizes private investment.

In many ways these advantages have been realized. The SMF's provide employment opportunities that help to expand livelihood strategies for many rural families: particularly for agro-pastoral and pastoral families who have lost livestock assets as a result of drought. From the 1960's until the late 1980's the SMF's made an increasing contribution to the national food supply, although since the early 1990's this has begun to decline. Finally, by mobilizing private capital they made few demands on government resources.

However, the mechanized rainfed farms have had negative impacts on the resource base, environment and livelihood of the people. This can be seen in:

- Overgrazed areas and indications of soil erosion.
- Deforested areas for mechanized crop production results in gully erosion, degradation of soil structure, texture and fertility and hence a decrease in yields.
- Decreasing area of Gum Arabic trees.

In addition, the expansion of mechanized farming schemes in recent years has further jeopardised the position of Gedaref’s rural population creating land shortages among people engaged in subsistence farming. The enclosure of land has also led to the obstruction of traditional nomadic ‘corridors’ used by pastoralist communities during their seasonal movement. Efforts have been made at state-level to demarcate official migration corridors to minimize the potential of disruption and tension during migratory seasons. However, to date, these efforts have not been sufficient (there is still need to activate the Nomadic Corridors Act and to provide basic services at rest-points along the corridors) and clashes continue to erupt between mechanized farmers and nomadic peoples at certain points in the year.

Extensive cultivation in the absence of land-rotation techniques has also seen the reduction of crop yields and soil degradation – factors that spur further expansion of existing schemes and resultant effects/impact.

3.5 Basic Social Services and Human Development Indicators

3.5.1 Health Indicators

Infant and child mortality rates are significantly higher in Gedaref State than other states in northern Dudan (Table 7).

Table 7. Mortality and Nutrition Rates in Gedaref State

Indicator	Gedaref	Average (North Sudan)
Neonatal mortality rate (per 1000 live births)	43	37.3
Post-neonatal mortality rate (per 1000 live births)	43	34.7
Infant mortality rate (per 1000 live births)	86	71.2
Child mortality rate (per 1000 live births)	55	37.3
Under-5 mortality rate (per 1000 live births)	137	105.8
Underweight prevalence (% below -2 SD and -3 SD)	33.8 and 8.7	31.9 and 9.4
Stunting prevalence (% below -2 SD and -3 SD)	38.4 and 16.8	32.9 and 15.1
Wasting prevalence (% below -2 SD and -3 SD)	9.8 and 1.7	13.9 and 3.2
Children who received all vaccinations (DPT1-3, OPV-1-3, BCG and measles)	50.8%	50.3%
Houses with at least one mosquito net	43%	38.5%
Use of improved source of drinking water	37.3%	55.1%
Population using sanitary mean of excreta disposal	14.6%	38.0%
Using improved sources of water and sanitary means of excreta disposal	9.6%	27.7%

Source: Sudan Household Health Survey (2006)

The above picture is depicted by the last survey conducted at the national level, i.e. the Sudan Household Health Survey (2006). According to survey findings, although birth registration in the state (45.8%) was higher than the average for northern Sudan states (34.6%) and antenatal care by trained personnel (for deliveries during the two years preceding the survey) was (71.8%) not far from the average for northern Sudanese states (72.5%), doctor-assisted deliveries was only (3.5%) in Gedaref as compared to (15.2%) in other North Sudan states. Likewise, the percentages of still births and miscarriages in Gedaref stood below North Sudan average while maternal mortality ratio in Gedaref (609 in every 100 000 live births) was higher than in other North Sudan states (503 in every 100 000 live births).

Although no (national) survey data on the health situation after 2006 is available, available data from the State Ministry of Health (SMoH) indicates that some improvement on the situation was achieved during the last few years, a fact which should by no means be taken to mean that no challenges are currently being faced. Of course some challenges are still there probably with a difference in degree.

3.5.2 Literacy and Education

The literacy and primary school enrollment rates for Kassala State are shown in table 8.

Table 8. Literacy and Primary School Enrollment Rates of Gedaref State

State	Literacy >15yrs % Average	Literacy >15yrs % Male	Literacy > 15yrs % Female	Total Primary school enrol.	% enroll.
Gaderef	55.6	72.9	38.4	311,547	45.7
NORTH SUDAN	**54.5**	**66.6**	**42.4**	**3,308,387**	**51.0**

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

There are significant differences in literacy and primary School enrollment rates between Gedaref State and north Sudan. In terms of literacy Gedaref State is higher than the average except for females. However, primary school enrollment is lower than average.

3.5.3 Water and Sanitation

The percent population with access to drinking water and sanitation facilities are shown in table 9a and b.

Table 9. Gedaref State (a) Percent Population Access to Drinking Water, (b) Sanitation Facilities

(a) Drinking Water by Source

State	Piped into		Deep Well/pump	Dug Well/ bucket	River/canal	Rainwater	Others
	dwelling	Public tap					
Gedaref	12.6	18.8	27.7	13.9	13.8	9.4	3.6
NORTH SUDAN	**50.8**	**4.3**	**15.8**	**9.8**	**12.8**	**--**	**6.4**

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

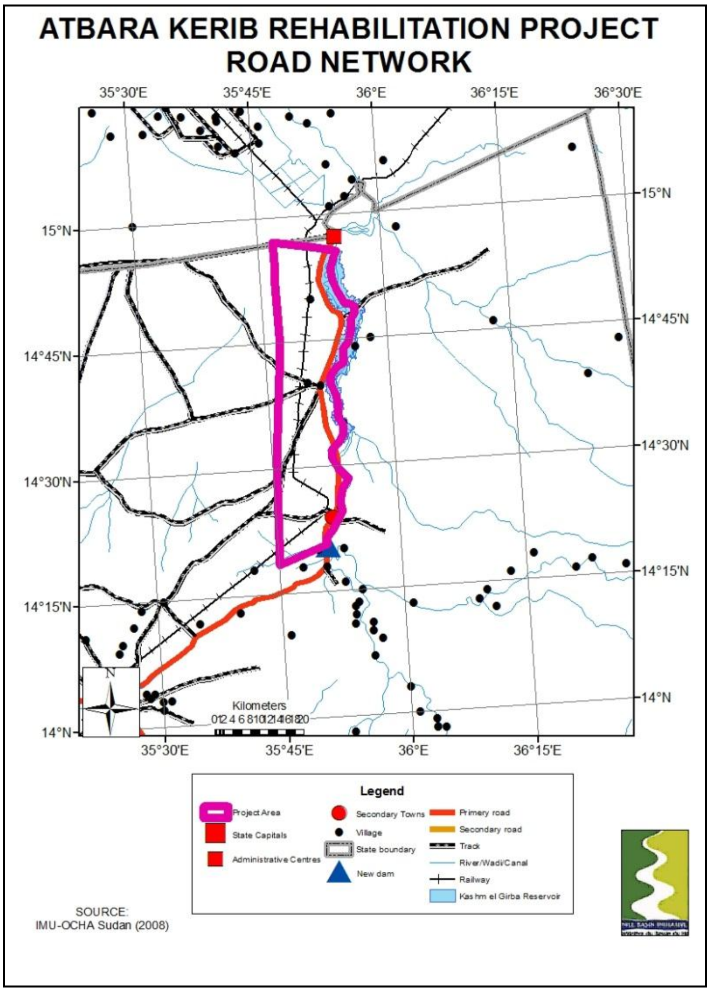
(b) Sanitation facility by type

State	Flush to Sewage System	Flush to septic tank	Traditional pit latrine	Soak away pit	Others	No facilities
Gedaref	--	5.0	31.7	3.1	0	60.1
NORTH SUDAN	**--**	**7.7**	**69.2**	**1.6**	**1.6**	**19.9**

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

With respect to water and sanitation facilities Gedaref State is well below the national average with respect to all types of sanitation facilities with 60 percent of households with no facilities.

3.6 Transport Infrastructure and Markets



Map 12. Road network.

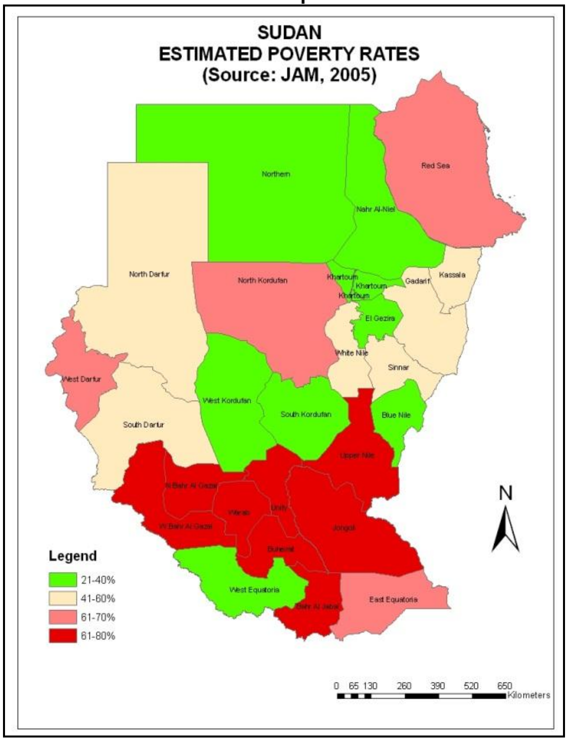
The main primary road passes through the Project Area. There are a number of tracks in the area of the Semi-mechanised Farms. In the rainy season and on the Vertisols these tracks will be impassable.

4. KEY ISSUES, CHALLENGES AND POTENTIALS

4.1 Poverty

4.1.1 Extent

The extent and dynamics of poverty in the Sudan since the 1990's has been examined by the Joint Assessment Mission - JAM (2005). It is estimated that in Gedaref State 41 to 60 percent of the population are below the poverty line. Map 13 shows the distribution of poverty by State. In this respect Gedaref State stands below the northern States with rates below 40 percent, but above those States with rates above 60 percent.



Map 13. Sudan: Distribution of Poverty by State (JAM, 2005)

4.1.2 Loss of Livelihood Assets

Over the past three decades drought and conflict have led to a severe loss of livestock assets and an increasing reliance of crop production using a variety of water harvesting techniques.

Animal losses due to the 1984 drought were estimated (Muna Ahmed et al., 2004) as follows:

Cattle 20%
Sheep 40%
Goats 10%
Camels 5%

Animal losses due to the 1990-1991 drought were:
Cattle 10%

Sheep 15%
Goats 5%
Camels 2.5%

The recent droughts have severely affected camel herds and increased the reliance of the Beja on the faster growing goat and sheep herds. Many pastoralists have also been forced to migrate to the towns in search of employment.

4.1.3 Insecure Livelihoods Asset Base and High Vulnerability

The low rates of poverty from El Gezira to Northern State are a reflection of the assured access to generally low risk irrigated cropland along the Blue and Main Nile. In these areas land is generally held in freehold and perceptions of tenure insecurity are low. Where leaseholds prevail the general secure natural asset base, the availability of physical (pumps, irrigation water) and financial (seasonal credit) assets creates an environment for secure and sustainable livelihoods and low vulnerability.

This is in direct contrast to situation in Gedaref State where the pastoralist do not have secure tenure over their grazing lands (Faki et al, 2008). The Land Resettlement and Registration Ordinance that dates back to 1925 is still largely in force (De Wit, 2001). All unregistered land belongs to the Government, but community rights are recognized over its use under customary rules. Individual land registration is limited; while long land lease applies in public irrigation schemes and large semi-mechanized rainfed private holdings. Despite incentives to increase herds irrationally under communal land use, fairly balanced management and protection of natural resources and harnessing local conflicts had been practiced within the traditional leadership systems. But two legal developments in the 1970s had far-reaching implications on land use. First, the Unregistered Land Act of 1970 transferred all unregistered land to the Government from rural dwellers, especially pastoralists, compromising communal and tribal ownership (De Wit, 2001).

Second, the Local Government Act of 1971 dismantled traditional authorities and largely transferred their functions to local governments that have limited experience and resources to handle issues such as local conflicts. Thus, control over natural resources has undergone profound relaxation resulting in misuse through deforestation and overgrazing. Official regulations governing access to pasture and water in rainfed areas remain rudimentary, but 1984 legislation allowed for pasture land allocation to communities. Water use legislation has been confined to water-pumping from the Nile and its tributaries for irrigation purposes. The existing legal setting for land, pastureland, water, and forests has been diverse and contradictory, giving little or no attention to traditional land use systems, especially grazing (De Wit, 2001).

4.1.4 A High Risk Environment and the Alienation of Natural Resource Assets

An assured and low-risk production environment clearly reduces the incidence of poverty. It enables households to build up assets that reduce their vulnerability to sudden changes in circumstances.

Where livestock are the main livelihood capital assets these too depend on the same high risk environment as well as dwindling rangeland resources in the face of expansion of large semi-mechanized farms. The coping mechanisms that communities and groups have developed over millennia to deal with and recover from natural calamities have been insufficient in the face of insecurity and alienation of basic natural resources. Livestock assets provide a buffer in times of need. Where access to water and forage has becoming limiting for the reason set out above vulnerability to shocks and hazards such rainfall variability and drought becomes more acute.

Decisions to adopt sustainable land management technologies depend on households' asset endowments (human capital). This is especially true for pastoral families because of their need for herding different animal types (camels, cattle, sheep and goats) in different places and times. In efforts to maintain livelihoods some household members have had to leave the farm in order to seek wage employment. This has led to a reduction in households' human capital and the lack of labour for cultivation and herding.

4.2 Population Pressure

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 (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.

There are a number of constraints to sustainably increasing agricultural production. These include poor management practices, inefficient markets, low technology transfer and inadequate agricultural services, low ratio of extension agents/farmer, lack of adapted varieties and insufficient certified seed are responsible for low yields attained. Thus, it is apparent that in many areas there are a number of constraints to farmers breaking out of neo-Malthusian trap and that there will be a continuing negative impact of population pressure.

4.3 Environmental Policy and Institutional Issues

Despite the active role played by Secretariat of the HCENR, which is the focal point for all environmentally related conventions, the HCENR has not been able to perform all its mandated tasks. This is mainly due to the following constraints:

- Most of the state's councils have not been established and this has resulted in weak representation of the HCENR at the state level.

- The council members (ministers of relevant institutions) have never met since the establishment of the HCENR. This reflects the low priority and commitments of the governments towards environmental issues in Sudan. This situation could be explained by the fact that that the country has been weighed down by long years of war and many urgent pressures and that politicians could not allocate the necessary time or resources to cater for environment.

However, this situation is expected to change now after the CPA and the need to follow and adopt a sustainable course of development.

At the field level it was reported that there a lack of horizontal and vertical coordination between and among responsible agencies, organizations and ministries.

4.4 Land tenure and Resource Conflict

Issues of land tenure here include insecurity of tenure, ability to use land as collateral and 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 Sudan. The World Bank Country Economic Memorandum (World Bank, 2003) outlined a number of problems relating to current land tenure and land policy in Sudan:

- it limits access to credit to the majority of farmers who cannot use land as a collateral,

- it does not provide incentives for sustainable land development and management, leading to continual cultivation and destruction of soils in the semi-mechanized farms,

- because land has not been demarcated, there are conflicting land use rights between pastoralists and sedentary crop farmers, which has led to civil strife,

- reform is inseparable from need for rural reconstruction and establishing agricultural credit institutions.

These problems have been re-iterated in the World Bank's latest Country Economic Memorandum (CEM) (World Bank, 2009). The issue has been addressed in the Agricultural Revival Programme (ARP) (2008-2010) as one of eight key success indicators. The World Bank's CEM concludes:

> *Until there is a land policy that transfers the wealth inherent in land from the state (the government) to the people on the basis of long-term tradable leases, be it through statutory or customary law, incentives to invest in agricultural and pastoral land will remain negligible. The consequences of low investment in arable land and rangelands are low productivity and hence high costs for domestic consumers and low competitiveness for agricultural exports and inevitably slow growth of the economy.*

Whilst Land Commissions have been established under the ARP no decisions have yet been made on a future land policy.

A key problem has been the lack of a National or Regional Land Use Plans that could strategically guide land development activities. Thus the expansion of the mechanized farm sector was largely uncontrolled. No assessments were made on the environmental, social or economic impacts of these very large developments.

It is understood that States are mandated to develop Regional land Use Plans but as yet no guidelines appear to have been issued. There is some debate as to whether there should be a national Land Use Plan that would provide at least a strategic framework for State Plans. A pre-requisite of any National or State Land Use Plans is a thorough reform of the Land Tenure Policy.

4.5 Agricultural Extension and Availability of Credit

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 higher the discount rate the shorter the time horizon. 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. A number of studies have found that adoption of natural resource conservation technologies is negatively related to high discount rates. However, where a technology is risk reducing (e.g. water harvesting, soil moisture conservation structures, small-scale irrigation) adoption is much more likely.

Currently credit and extension for the traditional agricultural sector are very weak. The extension worker-to-farmer ratios are very low indeed. Credit and input supply services have hitherto focused on the large-scale irrigation sector. The main problems are non-viable collateral, small loan levels, geographical distance and logistics of recovery. Attempts have been made to form cooperatives but without success. The main constraint to a successful resolution of a s*ustainable* credit system is a land policy that provides farmers and pastoralists with the equivalent of long-term tradable leases which can be used as collateral to stimulate commercialization of the traditional rainfed farming system (World Bank, 2009)

However, this situation may soon improve with the signing of a Micro-finance project between the GoS and the World Bank for a sum of US$ 269 million over 6 years. This will be aimed in part at the traditional agricultural sector (FAO/WFP, 2006).

4.6 Kerib Land Formation

The key problem with erosion in the Atbara Sub-basin is the gully erosion along the banks of the Atbara River. This erosion leaves behind land known as "kerib" land. The Setit and Atbara Rivers as they leave Ethiopia are incised below the adjoining plains by about 30 – 50 meters. The kerib land around Showuk can be seen on the Landsat TM image (Map 18) with the gullies reaching back into the cultivated land on the plains above the river. Along the river itself is irrigated or flood retreat cropping.

Kerib land is found adjoining both cropland and shrubland/woodland. There appear be two possible causes on gully initiation: (i) tunneling and (ii) rill formation.

(i) Tunneling

The plains are overlain with Vertisols (black cracking clays). The Vertisols develop very wide cracks during the dry season. At the onset of the rains water enters the cracks. Whilst the soils are covered with deep rooted vegetation there is no problem as roots take up any excess sub-soil water (Hassan M. Fadul et al. (1999)

However, once this vegetation is removed there is excess water in the subsoil and tunnels develop along the deep cracks. These eventually collapse leaving an incipient gulley. These gradually extend back into the plain stripping the soil away from the underlying weathered rock. The weathered rock is quickly gullied. This can occur on both cropland and shrubland/woodland which has sparse to no herbaceous cover at the beginning of the rains.

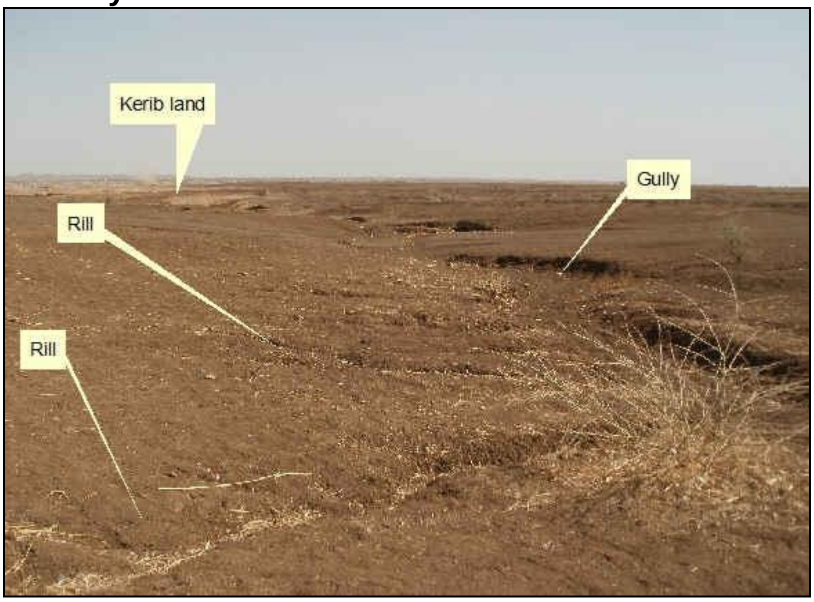
(ii) Rill Formation

Constant cultivation with heavy machinery causes a plough pan to develop. The plough pan restricts downward percolation of rain water. This surface ponding and where there is a very slight slope, to till formation (figure 4).

Figure 4. Rill formation on slight slope leading to river Atbara (Showuk)

The rills start to extent backwards through headward erosion and at the same time initiating new rills (see figure 4). As the rill expands its catchment area and thus water and its erosive power, a gully starts to form (see figure 5). This thesis was favoured by the agricultural staff at Kashm el Girba, who have initiated a trial of sub-dividing the cropland into large bunded basins (see below). This can also occur on shrubland/woodland, where overgrazing and surface soil compaction due to animals walking over the surface results in little or no infiltration and rapid surface runoff. It is possible that it is a combination of both processes.

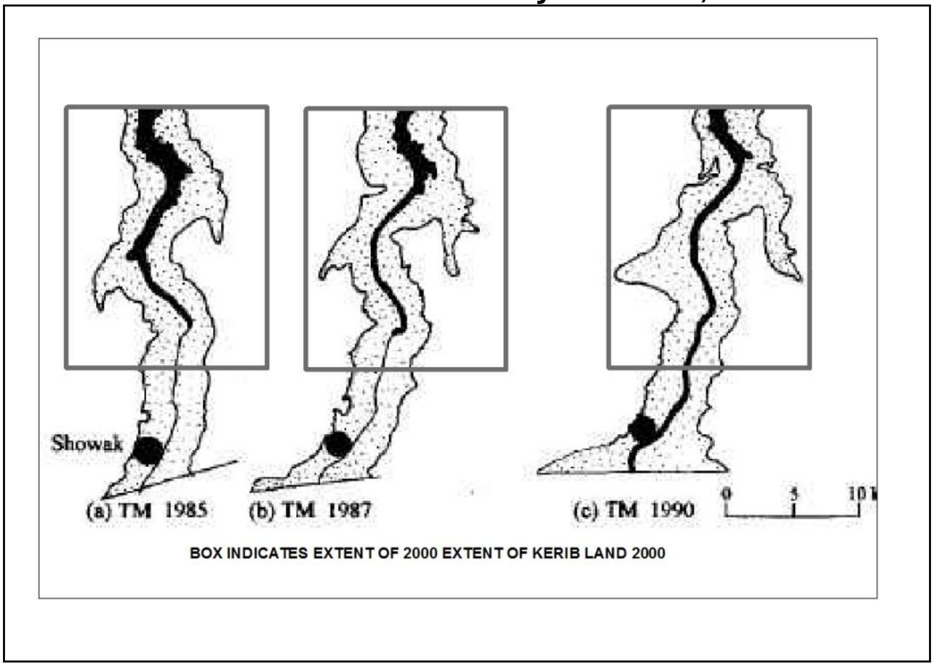
Figure 5. Gully formation from rills.



Hassan M. Fadul et al. (1999) studied kerib land development around Showuk from aerial photos and Landsat satellite images for 1985, 1987 and 1990.

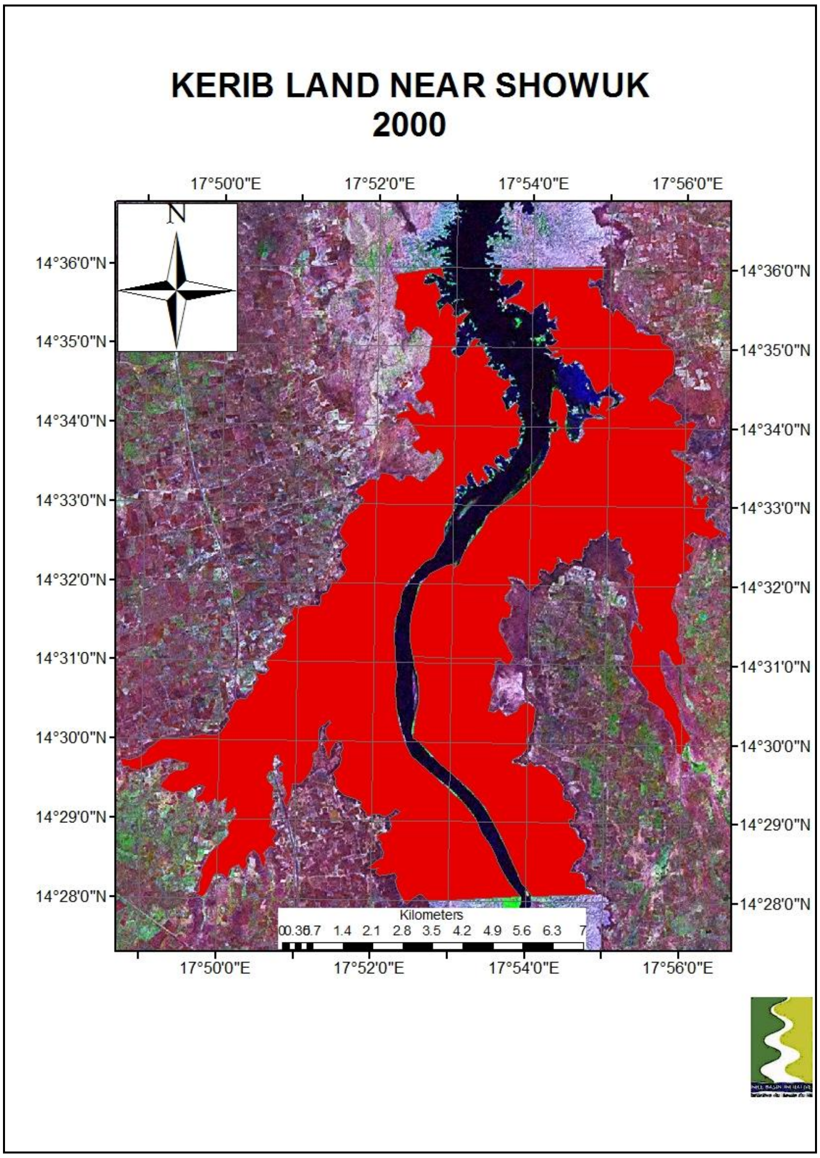
They estimated the kerib land was stripping back 13.4 km^2/yr between 1985 and 1987 and 9.8 kms^2/yr between 1987 and 1990 (figure 6).

Figure 6. Kerib land formation for the years 1985, 1987 and 1990



Source: Figure 8 from Hassan M. Fadul et al. (1999)

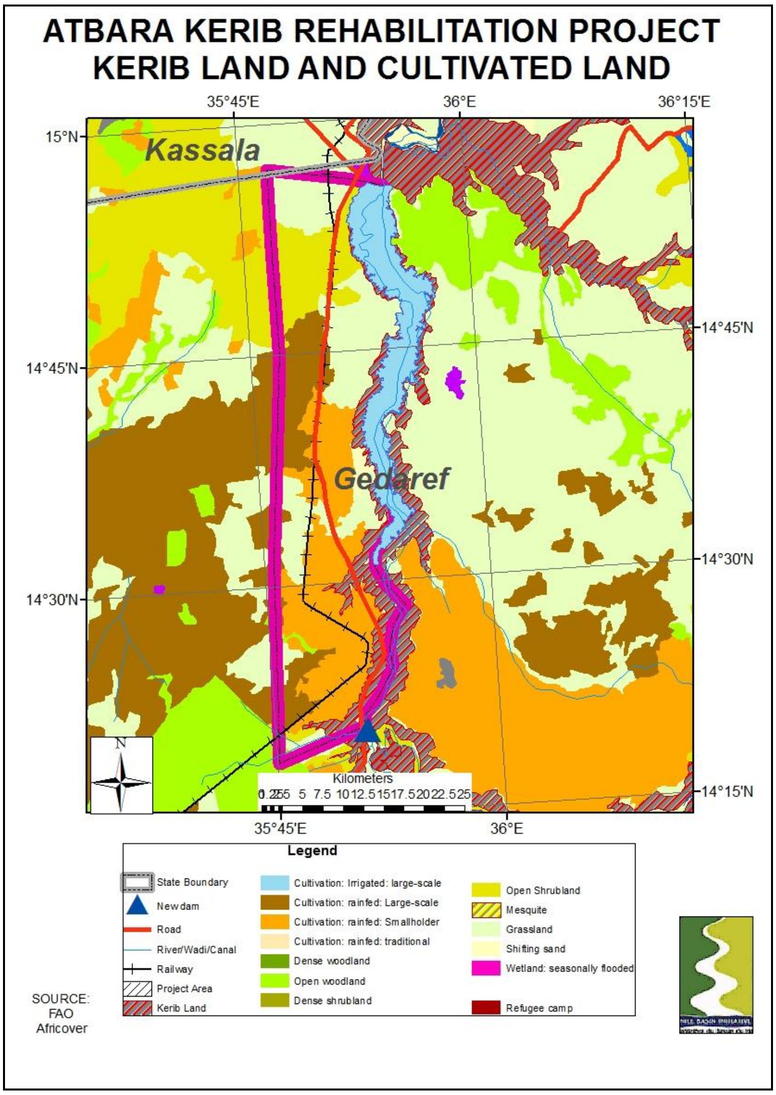
Note the development of the two side extensions on the east and the west sides of the river. Map 14 shows the extent of kerib land taken from a Landsat image of the year 2000. Both east and west extension have grown considerably in the 10 years since 1990.



Map 14. Kerib land extent near Showuk in 2000.

The WSM CRA Trans-boundary Report for the Tekezi-Atbara River estimates some 7.6 million tons of sediment reach the main river each year.

The 1990 survey estimated 300,000 feddans (1,680 km2) of kerib land. An interpretation of 2000 Landsat TM imagery gave an estimate of 359,286 feddans (2,012 km2), of which some 145,536 feddans (815 km2) are above the Kashm el Girba dam and 213,759 feddans (1,197 km2) below.



Map 15. Atbara Sub-basin: Kerib Land in Relation to Irrigated and Rainfed Cropland.
Source: Sudan FAO Africover, 2003

Map 14 shows the distribution of kerib land above the Kashm el Girba Dam in relation to the patterns of rainfed cropping. Two types of rainfed cropping are recognized: large and small farms. The former are the large semi-mechanized farms whilst the latter are small-scale farmers with farms of about 5 feddans each. It can be seen from the map that **the extending kerib land threatens the small farms rather than the large semi-mechanized farms**. These are people who can ill-afford to lose any land because their holding are so small.
At points along the river there are places where it directly abuts the New Halfa Irrigation land and there are signs that the gullies may be breaching the irrigated land.

5. IDENTIFICATION OF WATERSHED MANAGEMENT INTERVENTIONS

5.1 Review of Current Interventions

There are a number of on-going projects of relevance.

(i) The Eastern Rehabilitation and Development Project

This three years project is funded by the EU covers activities in Gedaref and Kassala States with total funding of EUR10 million. In Gedaref State it is supporting with the promotion of Community Forestry in the Showuk area. The project is due for completion in 2011. It has built up considerable experience in community forestry in the kerib land.

(ii) IFAD Butana Integrated Rural Development Project

The project operates in the five States that are found in the Butana Plains. It is not certain if it is operating in the El Fashaga Locality.

The overall project goal is to improve the livelihoods of poor rural households in the target area, and strengthen communities' resilience in the face of drought. The project targets smallholder pastoralist households in the sand dunes and clay plains of the region, households engaged in irrigated farming and smallholders who migrate seasonally with their herds. Open access to range and water resources in the region has led to severe environmental damage around water facilities and also led to acute water shortages.

The specific objectives of the project are to:
- support improvements in natural resource governance to ensure regulated access to land and water resources in the region for all;
- improve the access of women and men to livestock markets and strengthen their bargaining position within markets, by rehabilitating market infrastructure and by establishing market information systems and organizing producers' groups
- build the capacity of grass-roots organizations to design and implement environmentally sound development initiatives that include women and marginalized social groups

Total cost: **US$29.9 million,** Approved IFAD loan: **US$24.8 million,** Duration: **2008 – 2016**: Directly benefiting: **40,000 households**

5.2 Project Stakeholders

5.2.1 Primary Stakeholders

The Primary Project Stakeholders are the rural agricultural households who live within 10 kms of the Atbara River kerib land in El Fashaga Locality of

Gedaref State, between the Kashm el Girba dam and the proposed new dam at the confluence of the Setit and Bares Salem rivers. These can be divided into a number of sub-catagories as follows:

- Smallholder farmers whose crop land is in immediate or medium term danger of gullying and destruction;
- Rural households El Fashaga Locality whose crop land is not in immediate or medium danger of gullying but who depend on the kerib land for either grazing or fuelwood (or both);
- Rural households with no crop land but depend on the kerib land for either grazing or fuelwood (or both);

5.2.2 Secondary Stakeholders

Secondary Stakeholders include:

- Staff of the Gedaref State Ministry of Agriculture who require technical and logistical support based at Locality and at State levels.
- Ministry of Irrigation who are responsible for the Kashm el Girba dam and the New Halfa Irrigation Scheme.
- Irrigators on the New Halfa Scheme who are experiencing reduced water availability because loss of storage capacity in the Kashm el Girba reservoir.

5.3 Proposed Watershed Management Interventions

5.3.1 Selection of Project area

The Project Area has been delineated as follows:

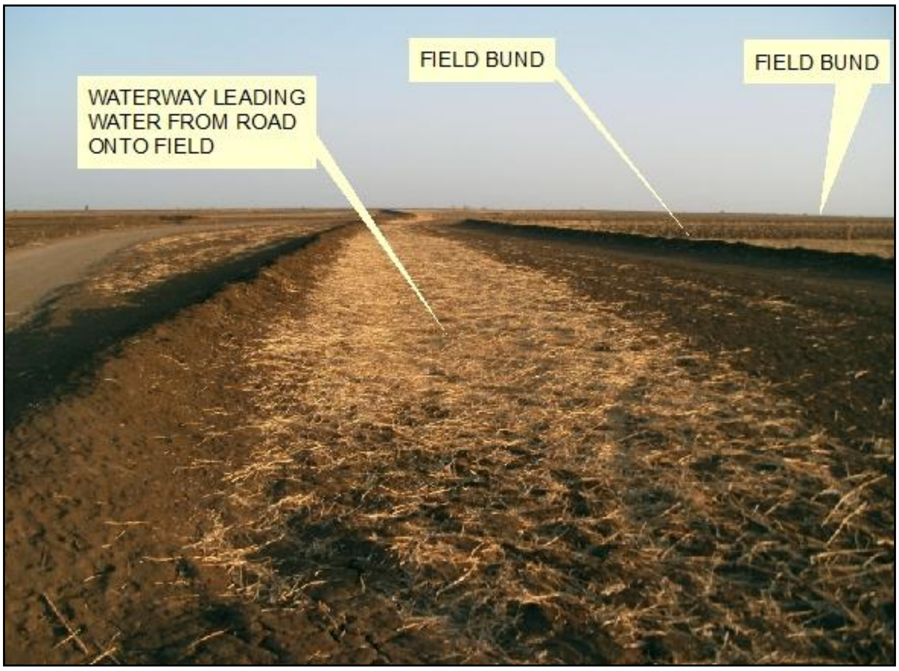
- encompasses the kerib land and the land away from the kerib edge upto 15 kms
- between the Kashm el Girba dam and the proposed new dam at the confluence of the
- within Gedaref State (i.e. on the west bank of the Atbara river)
- within El Fashaga Locality

5.3.2 Soil and Water Conservation

(i) Field Bunding

This activity builds on the activities being undertaken in the cropland above the kerib land. This involves constructing low (40 cms) soil bunds that enclose basins of about 5 – 10 feddans (2 – 4 ha). Prior to bund construction the fields were ripped using a chisel plough to break the plough-pan, significantly thus increasing infiltration. Crop yields were reported to have tripled. In one location a waterway had been constructed leading water off the adjoining road into the field as a water harvesting device (figure 7.

Figure 7. Field bunds and waterway



Support would be provided for equipment (chisel ploughs, ridgers) and for field survey equipment.

(ii) Check dams

This activity would take place within the kerib land and in rills and gullies leading into the kerib land. Use would be made of mesquite to construction “libish” type structures similar to the water harvesting structures found in the Kassala area. Support would be in the form of hand tools for the Communities undertaking this work.

5.3.3 Community Forestry

This component will build on the activities already started by the ESRD Project. Currently the project has started with one community who have developed rules regarding not cutting down trees within the kerib land. However, this has not been linked to soil conservation works (checks dams nor to livestock exclusion within the Community Forest area. Thus constant browsing by goats prevents any regeneration of existing trees and the planting of new stock.
It was observed that existing trees are almost all confined to the gully areas where soil moisture and ground water are more plentiful than on the interfluve areas (Figure 8).

Figure 8. Trees confined to gullies with bare interfluves

The Forestry Staff recommended using the gullies as the focus of tree protection and planting activities. These could be fenced and tree seedlings planted. Check dams in the gullies would trap sediment and provide a medium for planting trees seedlings. After about four years when the trees were 1 meter or more high the fences could be removed and moved to another set of gullies. In this way the area could be progressively re-vegetated.

The Forestry Department had identified suitable indigenous tree species for *kerib* land rehabilitation such as *Acacia tortilis*, *A. seyal*, *Balanites aegyptiaca*, *A. mellifera and Ziziphus spina-christi*.

The project would provide support for Community Tree Nurseries with water supply, hand tools for tree planting and fencing that could be moved every four years.

Communities would develop Participatory Community Forest Management (PCFM) Plans that would define the Community Forest area and include rights and responsibilities of Community members. In particular, the PCFM Plans would define harvesting rates of wood and non-wood tree products that would ensure both sustainability and equitable access.

Both the Federal and State Forestry Organizations have developed considerable experience in Community Forest management and would provide technical support in determining sustainable harvesting rates and tree planting techniques.

5.3.4 Supporting Interventions

In addition to the support to soil conservation and community forest activities the project would provide assistance to a number of supporting activities. These would include:

- Mesquite eradication;
- Training for selected off-farm employment opportunities (both men and women);
- Support to the establishment of Savings and Credit Cooperatives and Micro-finance Institutions for provision of production and marketing credit;
- Support to improvement and increase of value chain addition (product storage, improved processing) and to market linkages;
- Support to establishment and legal recognition of Farmer/Pastoralist Associations for improved access to inputs and markets.

6. Distribution of Benefits

There are a number of local, regional and global benefits that would accrue to the Project.

The support to kerib land restoration will arrest the loss of valuable rainfed cropland, increase fuelwood and forage production. This would in turn reduce fuelwood collection times for women and children and increase livestock productivity.

At the Regional level sediment to the Atbrara would be reduced thus reducing sedimentation downstream.

At the global level sequestration of carbon would be increased in wood and herbaceous biomass and also in increased levels of soil carbon.

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EASTERN NILE TECHNICAL REGIONAL OFFICE

NBI – Institutional Strengthening Project
PROJECT DELINEATION AND PRIORITIZATION

ANNEX 4.6
BUTANA PLAINS WATERSHED MANAGEMENT PROJECT
(FINAL)

7th June, 2011

CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ACT	African Country Almanac
AHD	Aswan High Dam
CBD	Convention on Biological Diversity
CPA	Comprehensive Peace Agreement
CRA	Cooperative Regional Assessment
DFID	Department for International Development
ECC	Environmental Compliance Certificate
EIA	Environmental Impact Assessment
ENSAP	Eastern Nile Subsidiary Action Programme
FAO	Food and Agricultural Organization
FNC	Forest National Corporation
GEF	Global Environmental Fund
GAIL	Gross Annual Immediate Loss
GDCL	Gross Discounted Cumulative Loss
GDFL	Gross Discounted Future Loss
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GIS	Geographic Information System
GOS	Government of Sudan
HCENR	Higher Council for Environment and Natural Resources
IDEN	Integrated Development of the Eastern Nile
IFPRI	International Food Policy Research Institute
IGADD	Inter Governmental Agency for Drought and Desertification
IIED	International Institute for Environment and Development
ILO	International Labour Office
IRR	Internal Rate of Return
IUCN	International Union for the Conservation of Nature
ITCZ	Inter Tropical Convergence Zone
IWMI	International Water Management Institute
JAM	Joint Assessment Mission
JMP	Joint Multipurpose Programme
Km	Kilometre
Km2	Square kilometre
MEA	Multilateral Environmental Agreement
MoA	Ministry of Agriculture
MEPD	Ministry of Environment and Physical Development
MIWR	Ministry of Irrigation and Water Resources
MCM	Million Cubic Meters
MW	Mega Watt
NBI	Nile basin initiative
NCS	National Comprehensive Strategy
NWP	National Water Policy
PERSGA	Strategic Action Plan for the Red Sea and Gulf of Aden
PRSP	Poverty Reduction Strategy Project
SIDA	Swedish International development Agency
SLM	Sustainable Land Management
SWC	Soil and Water Conservation

t	ton
UNDP	United Nations development Programme
UNFCCC	United National Framework Convention on Climatic Change
USAID	United States Agency for International Development
USLE	Universal Soil Loss Equation
WB	World Bank
WSM	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[14] 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 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

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

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.

The Watershed Management CRA identified a number of land degradation hotspots in the Main Nile, Baro-Akobo-Sobat, Abbay-Blue Nile and Tekeze-Atbara Sub-basins. 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.

The objective of this Project is to provide support to the State Government to arrest land degradation hotspots in the Butana Plains in Gedaref State, strengthen household and community livelihood strategies and contribute to the alleviation of poverty.

1.3 The Scope and Elements of Sustainable Watershed Management

River 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.

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 - SUDAN

2.1 Bio-physical and Socio-economic Setting

Sudan covers an area of approximately 2.5 million km2 and in 2002 an estimated population of 31.3 million with an annual growth rate (1998-2003) of 2.6 percent. The projected 2025 population is 49.6 million. The total, rural % and growth rates by region are shown in table 2.

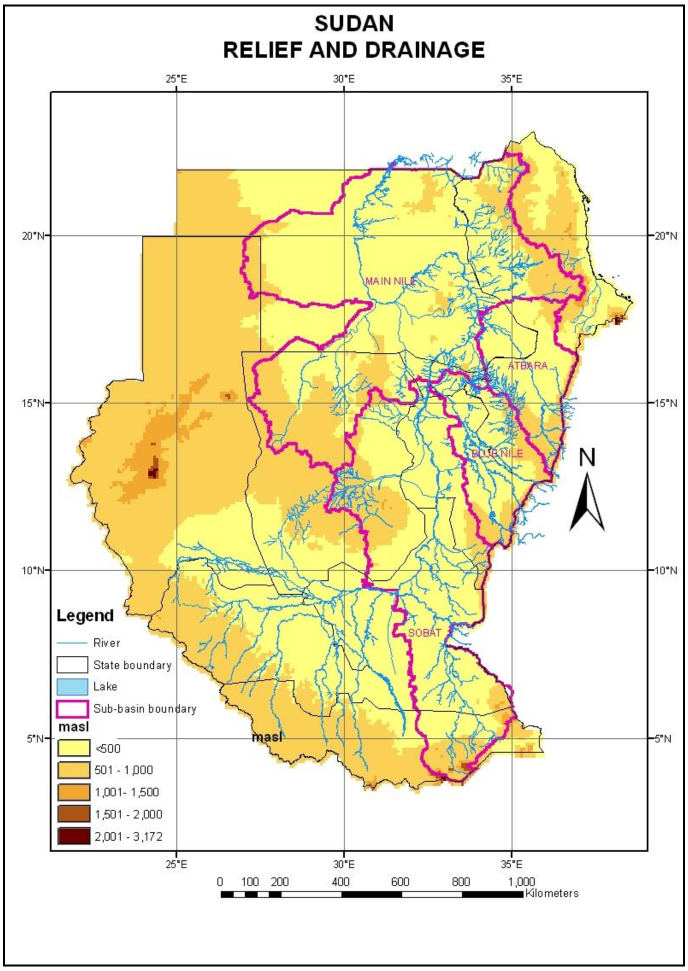
Table 2. Sudan: Total population, Rural % and growth rates by Region (2002)

REGION	TOTAL POP ('000) 2002	RURAL %	TOTAL GROWTH RATE
Eastern	3,360.5	57%	2.25%
Northern	1,392.5	75%	1.85%
Khartoum	5,301.3	14%	4.04%
Central	6,278.7	70%	2.80%
Kordofan	3,512.0	74%	1.50%
Darfur	6,212.6	82%	3.01%
N. Sudan	26,057.0	60%	2.58%
S.Sudan	5,283.3	79%	1.61%
SUDAN	31,340.0	65%	2.64%

Source: Y.A.Mohamed (2005)

Overall population density is 12.4 p.p.km2 but this masks considerable variations. Population tends to concentrate along the streams and rivers and other water sources.

The relief and drainage of Sudan are shown in Map 1.



Map 1. Sudan: Relief and Drainage

Land under 500 masl occupies the central White and Main Nile valleys as very gently sloping plains. Higher land is found along the eastern edge as outliers of the Ethiopian Highlands together with the Red Sea Hills. The southern and southwestern edges of the basin form the Congo-Nile watershed. The Jebel Marra forms the Nile-Lake Chad watershed along the western border. Locally hills and mountains rise above 1,500 masl (e.g. the Imatong Mountains being the country's highest point at 3,224 masl).

The Bahr el Jebel enters Sudan from Uganda with the Bahr el Ghazal forming on the northern slopes of the Congo-Nile Divide. They join at Lake No to be known as the White Nile. They both lose much water through evaporation in the Sudd. Just above Malakal the Sobat River, which rises in the southwestern Ethiopian Highlands, joins the White Nile. At Khartoum the White Nile is joined by the Blue Nile, which rises in the Central and Northern Ethiopian Highlands. Thence known as the Main Nile it is finally joined by its last tributary the Atbara, which also rises in the northern Ethiopian Highlands. There are many seasonal wadis and khors, which flow intermittently during the rainy season. Locally they are of considerable importance in small-scale irrigation, water harvesting and human and livestock water supplies.

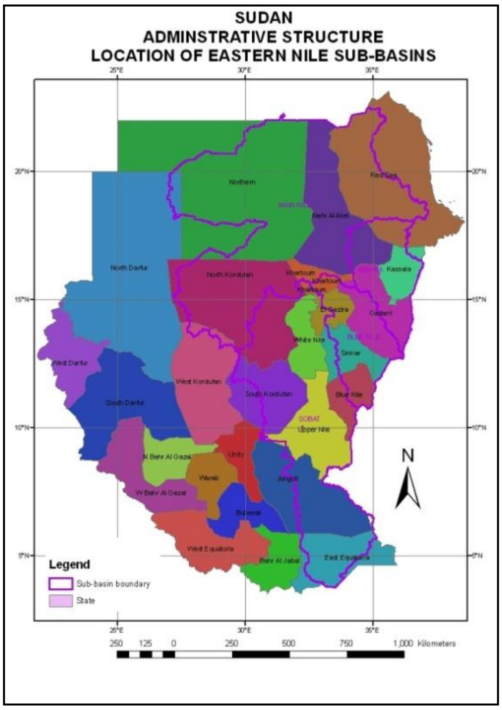
The country encompasses three major ecological zones: desert, semi-desert and savanna. Annual rainfall varies from less than 25 mm in the north to

1,500 mm in the south. Rains are erratic and variable, increasingly so in the north. Rains fall in a single season and are closely related to movements of the inter-tropical convergence zone (ITCZ).

Soils in the Sudan are commonly classified into four groups: (i) thin desert soils consisting of loose sand over bare rock in the north, (ii) fixed or shifting aeolean sands in the north and central parts, (ii) clay soil derived from old and recent alluvium over large areas of the central and eastern parts, and (iv) lateritic soils on the ironstone plateau in the southwestern part of the country.

Natural vegetation closely follows the rainfall patterns with local edaphic variations related to soil moisture conditions. Successively from the north are desert, semi-desert, woodland savanna on clay, woodland savanna on sands, high rainfall woodland and swamps. Large areas of the central woodlands on clay have been cleared for semi-mechanized farming and other areas of woodland are under severe pressure from traditional farming, and fuel wood and charcoal production for both urban and rural household consumption.

2.2 Administrative Structure



Map 2. Sudan: Adminstrative Structure with Eastern Nile Sub-Basin Boundaries.

Source: ENTRO GIS data base:

In the past decade Sudan has embarked a policy of administrartive decentralization. According to the Local Government Act of 2003, the Sudan has been divided into 26 States, some 16 located in the north and 10 in the south (Map 3). Each State is divided into anumber of Localities (Mahaliyat). The aim of decentralization is to improve the delivery of basic social services and address the severe spatial disparitries in access to education, health, water, agricultural extension and other government services.

Decentralization and concommitant capacity building will be undertakenn over two pahses: Phase I (2005 – 2007) and Phase II (2008 – 2011). Priorities in the local government will be:

- Enhancing managment capacity by empowering suitable structures to lead reform;
- A broad consultation on organizational structures;
- Developing a comprehensive strategy for institutional arranbgement, polices and guidleines for public services and training;
- Improving systems and practices of local publicprivate partnerships in service delivery;
- Support to Locality development planning;
- Improving Locality information systems;
- Establishing Locality monitoring systems;
- Promoting civil society participation in planning and organization of governmenbt activities;
- Mobilizing local revenue generation for State and Local Government.

2.3 National and Regional Policy Framework

2.3.1 The National Comprehensive Strategy (NCS) (1992-2002)

Sudan's main objectives and priorities for sustainable development were spelt out in the National Comprehensive Strategy (NCS) which provided policy directions to all economic and social sectors. The NCS incorporates the country's environmental strategy, which states clearly that environmental issues must be embodied in all development projects. Within the NCS, the government manages the economy through a series of three years rolling plans and annual budget processes. The NCS has also served as a key reference document and basis for sectoral policies and measures.

A main weakness of the NCS is the lack of coherence as it was a result of work of different sectoral teams without emphasis on horizontal and vertical integration

2.3.2 Comprehensive Peace Agreement CPA

The Comprehensive Peace Agreement (CPA), signed between GoS and SPLMA on 9 January 2005, represents a remarkable event in the history of Sudan and is a major opportunity for restoring peace and the social contract between the state and society in the country.

The CPA provides for a socially informed land tenure policy and legislation as it accords specific reference to ownership of land and natural resource. It calls for competency in land administration, provides for incorporation of customary laws and practices and establishes an independent Land Commission for the purposes of arbitration, rights of claims in respect to land, land compensation and the possibility of recommending land reform policies.

The CPA is expected to have many implication (institutional and administrative) - e.g. the establishment of a Land Commission for the south parallel to existing central institutions responsible for land and natural resources management.

However, there is the question of the existing sectoral environmental legislation. Should that legislation remain federal as it is currently stands, or should it be amended and passed down to the states in accordance with the obligations given to them by the federal structure? (NBSAP,2002)

There is now a counterpart ministry of Environment and Wildlife in Southern Sudan and it is expected that the post CPA developments will witness greater decentralization on all levels. This will necessitate the initiation of a dialogue on developments in the sub-basins in Sudan as a basic requirement for sustainable development in the sub-region. Of special concern also are issues related to conflict resolution, internally displaced refugees, good governance, and the rights of the socially, economically and politically marginalized groups in post conflict Sudan

2.3.3 The Joint Assessment Mission (JAM) (2005)

The JAM Reports are the most recent documents which are guiding the economic development in post peace period in Sudan. The reports have developed the policy guide lines and interventions in eight clusters, including the economic policy cluster. The issue of environment has been classified as one of the cross-cutting issues. The report identified many environmental challenges Sudan is facing and need to be addressed during the short and medium term to enable the country make an equitable and sustainable development in the foreseen future.

The JAM report has stated that the foremost challenge is to minimize the negative environmental impacts that returning refugees and Internally Displaced Populations (IDPs) may pose on the natural resources base through increased deforestation and destructive agricultural practices

2.3.4 Poverty Reduction Strategy (2000)

Under the coordination and leadership of the Ministry of Finance and National Economy, Sudan is also in the process of formulating a national poverty reduction strategy. This strategy is expected part of the country’s long-term strategic plan and seeks to involve all groups of Sudanese society.

The preliminary draft of the PRSP was prepared in January 2004 with participation and contribution of a number of highly qualified national experts, The PRSP is considered to be the main available document of the government of the Sudan for poverty reduction. It covers the sixteen States of North Sudan for the period 2005-2007.

PRSP main objectives are:

- Maintain Economic Stability.
- Ensure Political Stability
- Social Stability.
- Environmental integrity
- Improve standards of living
- Assist in the flow of financial resources.

2.3.5 Environment Protection Act 2001

In 2001, the Higher Council for Environment and Natural Resources (HCENR) initiated the development of environmental regulations under the Environment Protection Act which was issued through a presidential decree. It established guidelines and requirements for environmental impact assessments and environmental conservation frameworks.

The Environmental Protection Policy (2001) requires that any new projects that are deemed to have an impact on the environment conduct an Environmental Impact Assessment (EIA). This must be done in order to obtain an Environmental Compliance Certificate (ECC) from the HCENR through the receipt of an Initial Environmental Impact Assessment (IEA) Report. This report should contain a Mitigation Plan or a description of the mitigation measures to be implemented to reduce the environmental impacts of the proposed project.

The EIA report is normally made available for viewing and comment by interested and affected parties prior to the HCENR giving the go ahead with the project. This legislation represents a major step in coordinating national developmental projects on an environmentally sustainable basis

2.3.6 National Water Policy (2001) - Draft

Through a process of consultations with stakeholders, a Draft National Water Policy was prepared. The policy builds on experiences of a wide range of experts and institutions involved in water sector. The draft policy document assesses the water situation in the country, existing policies and legislation and then provides the main policy principles and statements. These policy principles are considered under water resources, water utilization, water and environment, international issues, socio-economic issues, disaster management and institutions and capacity building. It also recommends development of strategic plan for the water sector.

The objectives of the NWP are to:

- Review and adapt water policy to meet changing circumstances within the country;
- Ensure that the water resources of Sudan are properly managed, protected and efficiently utilized for the benefit of all;
- Provide the basis for the on-going development of water related regulations and legislation, and
- Strengthen and clarify the functions and responsibilities of water related institutions in both the public and private sectors in Sudan

Part 3 of the Water Policy (2001) addresses issues related to water and environment. It examines at policy as it affects the environment and related matters such as pollution and catchments degradation.

2.3.7 National strategies in response to Multilateral Environmental Agreements (MEAs)

(i) Agenda 21 Project - Sudan

In response to Agenda 21 (Rio Earth Summit 1992) a project was implemented in Sudan to build the capacity needed to meet the challenges of the Twenty First Century. The project helped to build capacities of government institutions, the private sector and non-governmental organizations to implement sustainable development projects. The project played an important catalytic role in promoting community level environmental protection. The project succeeded in building the capacities of Two State Environmental Councils and in the preparation of Environmental Action Plans for 4 States. This provided the basis for a ground level identification of a National Agenda 21 and initiated the formulation of a National Sustainable Development Strategy.

(ii) National Biodiversity Strategy and Action Plan (NBSAP)

In 1995, the Sudan government has become party to the Convention on Biological Diversity (CBD). The Government developed with GEF support and technical assistance from World Conservation Union (IUCN) its first National Biodiversity Strategy and Action Plan in May 2000 and its first Country Study on Biological Diversity in April 2001. The NBSAP outlines strategies, priorities and actions for biodiversity conservation and protection of natural ecosystems

(iii) National implementation Strategy for the UN Framework Convention on Climate Change

In 1992, the government of Sudan signed the United Nations Framework Convention on Climate Change (UNFCCC), and ratification took place in 1993. An enabling activity for climate change funded by GEF/UNDP was implemented by the HCENR. The project conducted many activities including training, a Greenhouse Gas inventory, a vulnerability and adaptation assessment and mitigation analysis and an intensive awareness program. As part of complying with its commitments to the Climate Change Convention, Sudan completed its National Communication under the UNFCCC in February 2003.

To fill the gaps and short comings of the vulnerability and adaptation assessment to climate change a three-year project is being implemented as part of the "Global Assessment of Impacts of and Adaptation to Climate Change (AIACC)" through GEF/UNEP. This project aims at enhancing the scientific and technical information, assessing the impact of climate change and designing cost-effective response measures needed to formulate national policy options.

(iv) National Action Plan (NAP) to Combat Desertification

In November 1995 Sudan ratified the United Nations Convention to Combat Desertification (UNCCD). The National Drought and Desertification Control Unit (NDDCU) has been designated as the national focal point to the UNCCD. The NDDCU identified the States that are affected by the desertification process. As part of its commitments under this convention, a National Action Programme (NAP) has been prepared in April 2002.
The challenges which face the implementation of NAP in Sudan include lack of a coherent national land use plan, dependence of household energy on forests products, expansion of mechanized rain fed agriculture and the civil war.

(v) Other International Environmental Obligations

Sudan is also involved in key GEF funded regional initiatives under the international waters operational programmes and is an active player in all these initiatives. These include the Kijani Initiative, the project for the Protection of Key "Bottleneck" Sites for Soaring Migratory Birds in the Rift Valley and Red Sea Flyway, the Nile Trans-boundary Environmental Action Project, the Strategic Action Programme for the Red Sea and Gulf of Aden (PERSGA) and the project for the Removal of Barriers to the Introduction of Cleaner Artisanal Gold Mining and Extraction Technologies.

2.4 Institutional Framework

2.4.1 Higher Council for Environment and Natural Resources (HCENR)

In recognition of the importance of environmental protection for the sustainable development of Sudan, as well as for the fulfillment of the various United Nations global environmental commitments, the government in 1992 established the Higher Council for Environment and Natural Resources (HCENR) as the central government organ co-ordinating efforts for sustainable development, use of natural resources and environmental protection. The Council includes a number of relevant ministries and places special emphasis on addressing degradation, resource depletion, and chronic pollution. A parliamentary committee on environment and natural resources was also established in 1992.

In 1995, the Government also created the Ministry of Environment and Tourism, now Ministry of Environment and Physical Development (MOEPD) to oversee overall environmental management and integrate environmental protection into national development strategies.

The mandate of the HCENR as stated in the Environment Protection Act 2001 includes inter alia:

- Formulation of general policies for Natural Resources, inventories and development to ensure the appropriate management of the resources and their conservation and sustainable use,

- Develop in co-operation with other government authorities strategies to encourage environmentally sound and sustainable activities; and

- Initiate measures for the co-ordination and enforcement of environmental protection legislation.

The HCENR is chaired by the Minister of the Environment and Physical Development. The HCENR discharges its functions by a General Secretariat with the following mandate:

- Draft general policies for Natural Resources Inventories and Development to ensure the appropriate management of the resources and their conservation and sustainable use.

- Environment conservation in coordination with the appropriate authorities in the States.

- Coordinate the work of the Council Branches and all efforts in natural resources inventories and conservation and efforts for the sustainable development of the resources, monitor changes in the natural resources;

- Specify areas subjected to depletion, desertification and pollution and decide on priorities for surveys and studies on natural resources.

- Make long-term plans for rational and balanced use of the natural resources and environment conservation and follow-up the execution of the plan with appropriate authorities.

- Periodically review legislation related to the natural resources and the environment, make sure that Laws are effective and introduce any necessary amendments to improve the Laws.

- Establishment of branches in the different States to help the Council in performing its responsibilities.

- Encourage support and coordinate scientific research in all fields of the environment and natural resources.

- Formulate a federal plan for environmental awareness and rational use of the natural resources and try to incorporate environmental education in school curricula.

The HCENR is Sudan's outlet to the international environmental arena. It acts as the technical focal point for most of the environmental the conventions emerged from the Earth Summit in Rio de Janeiro (1992) namely: Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC). In addition it is a party to the Convention on Persistent Organic Pollutants (POPs).

The cross-cutting nature of the environmental issues, which spread over different disciplines, has guided the HCENR to form steering and technical committees so as to bring all the concerned stakeholders together, and playing its coordinative role.

2.4.2 Other Government Institutions

In addition to the HCENR, other government ministries have significant roles and responsibilities in the areas of natural resource management, land use planning, and socio-economic development, including :

- Ministry of Agriculture and Forests;
- Ministry of Irrigation and Water Resources;
- Ministry of Finance
- Ministry of Technology and Scientific Research;
- Ministry of Industry and Commerce;
- Ministry of Energy and Mining
- National Council for Strategic Planning
- Ministry of Health;
- National Meteorological Authority
- Ministry of Culture and Information; and
- The General Directorate of Public Corporation for Investment

The **Ministry of Agriculture and Forests** is responsible for agricultural development and natural resources planning and policies, and the National Drought and Desertification Control Unit (NDDCU) in this Ministry has been designated as the national focal point (NFP) to the UNCCD.

In 1989 the **Forest National Corporation** (FNC) replaced the old Forest Administration (that was established in 1902) to be responsible for the protection and management of forest resources in the country. The FNC is a semi-autonomous corporate body that is attached to the Ministry of Agriculture and Forests. It has a Board of Directors constituted by the Council of Ministers and 10 representatives from related institutions. As such, the FNC is entrusted with the role of protection and conservation of forest resources.

The **Ministry of National Industry** is responsible for formulating industrial policies, strategies and programmes that fall within overall national objectives. The Ministry can orient the activities of many industrial activities that are directly related to the Biodiversity, Climate Change and Desertification issues, as the industrial sector is an important user of natural resources.

The **Ministry of Irrigation and Water Resources** is responsible for setting national water resources policies, strategies and plans, development of water resources to meet the needs, monitoring of ground water basins, and forging cooperation between the Nile basin countries. It also, contributes to the environmentally sound socio-economic development such as in big irrigated agriculture schemes.

The Wildlife Conservation General Administration (WCGA) was established in 1902 by the colonial authorities. The WCGA was part of the Game and Fisheries Department of the Ministry of Animal Resources. Today, it is administratively accountable to the Ministry of Interior while technically it is accountable to the Ministry of Environment and Tourism. It is entrusted with the conservation of wildlife in the Sudan. Wildlife includes also ecosystems and habitats where species are living. WCGA is also entrusted with the task of establishment and management of protected areas in Sudan. Among its main responsibilities are:

- Sustainable management and utilization of wildlife resources in the country.
- Origination of hunting (issuing licenses and setting by limits).
- Cropping of wildlife, trade in wildlife parts and live animals.
- Establishment of zoological gardens for wildlife public education.
- Control of wildlife damaging problems.
- Management of marine national parks and protected areas.

WCGA is the focal point for CITES (Convention on International Trade in Threatened and Endangered Species (includes botanical or animal species.) as well as for RAMSAR Convention for the protection of wetland.

The **Wildlife Research Center (WRC)** is a part of the Animal Resources Research Corporation. There are no official links between the WCGA and WRC. Research recommendations are not implemented, and the WCGA major approach to wildlife conservation is policing and licensing with no efforts in the area of involving the people in participatory wildlife management or applying scientific wildlife management practices (NBSAP, 2001). The WCGA lacks official link with the Fisheries Administration, Fisheries Research which is also under the Ministry of Animal Resource.

The Institute **of Environmental Studies (IES), University of Khartoum** was formally established in 1979. Although in fact it was created in 1972 following United Nations Conference on Human Environment in 1972 and the subsequent call by the Arab League Educational Cultural and Scientific Organization, (ALECSO) that universities should respond to environmental problems and challenges. Since then, he IES (the first in Africa and the Middle East) has pursued a program that blends a) post-graduate education in environmental studies b) short-term training in natural resources c) research and consultancies in project design, environmental impact assessment and education.

IES executes projects funded by international organization e.g. i) Dry Land Husbandry project (OSSREA & EPOS) i) Environment Impact Assessment projects (UNEP, UNICEF, US-AID, CPECC, UNSO) and iii) Acted as coordinators between Research Institutions and NGOs (Ford Foundation).Project proposals are coordinated through the IES pertaining to the field of coastal zone , arid lands, wetlands meteorology and urban planning. IES qualifies teaching assistants and lecturers to obtain M.Sc. and PhD degrees in environmental sciences.

2.4.3 Non-Government and Civil Society Institutions

Several national NGOs in Sudan have formed a network called the Network Committee for Combating Desertification (NCCD), NDDCU and NCCD worked in close collaboration throughout the NAP process. Organized forms of NGOs have become well known after 1975 (Mohamed, 1999). Many registered NGOs are actively working on different fields of the environment and rural development. Also there are some networks for coordination between NGOs e.g. the NGOs National Coordination Committee on Desertification (NCCD). The following are some examples of Sudanese NGOs working on environment-related work.

The Sudanese **Environmental Conservation Society (SECS)** is considered to be the most active NGO in promotion of environmental awareness and lobbying for better environmental policies and actions. It does so by initiating and supporting small projects with grassroots involvement designed to improve living conditions and wellbeing. Examples of these projects include tree planting, waste management and awareness-raising. SECS have more than 80 branches distributed all over Sudan, with more than 6000 members. The main objectives of SECS include:

- Conservation of the environment and mitigation of any action that may lead to environmental degradation.
- Dissemination of environmental awareness.
- Cooperation with the government in law enforcement for environmental conservation.
- Strengthening the links with the local, national, regional and international institutions endeavoring to conserve the environment.

- Encouraging scientific research and studies aiming at the conservation of the environment, in addition to writing of the natural history of the Sudan. (El Nour *et al* ., 2001)

The Sudanese Social Forestry Society (SSFS) is a charitable NGO with dedicated memberships who believe in social and multiple benefits of the forest. SSFS seeks promotion of concepts and practices of people involvement and social forestry in Sudan. The main objectives of SSFS are:

- To promote the concept and practices of social forestry, through networking and linkages between social forestry and extension units in Sudan.
- Enhance the standards of awareness of the community participation in social forestry.
- Encourage the scientific applied research in social forestry and promote the output of the same among the interested persons.
- Assist in the fund raising and appropriate resource funding of the social forestry projects.
- Facilitate and forward the technical consultancies in the field of social forestry projects.
- Cooperate with the concerned bodies, for the development of social forestry.
- Collect, authenticate and publish information regarding the social forestry activities.
- Establish advanced relation with international and national network.
- Preserve the natural forests as a natural heritage.

The Environmentalist Society is one of the active national NGO's in the field of environment. It aims at promoting environmental awareness and capacity building in environment related fields. All graduates from the Institutes of Environmental Studies are by default members in this society and could volunteer to provide services and contribute to environmental assessments and training programs whenever, it is required.

2.4.4 Traditional Institutions

These include traditional structures (local Administration, community leaders and other community-based organizations (CBOs). Traditional leaders are generally elected from the same families and thus, the holding is semi-hereditary one. These systems play important roles at the local community level. Their responsibilities include:

- Land allocation and settlement of conflicts;
- protection of the common natural resources;
- organization of usage of natural resources;
- construction of fire lines;
- keeping order of security and organization of foreign tribes presence in their areas, assigning nomadic routes;

- organization of communal public activities e.g. pest and bush fire control and settlement of tribal disputes

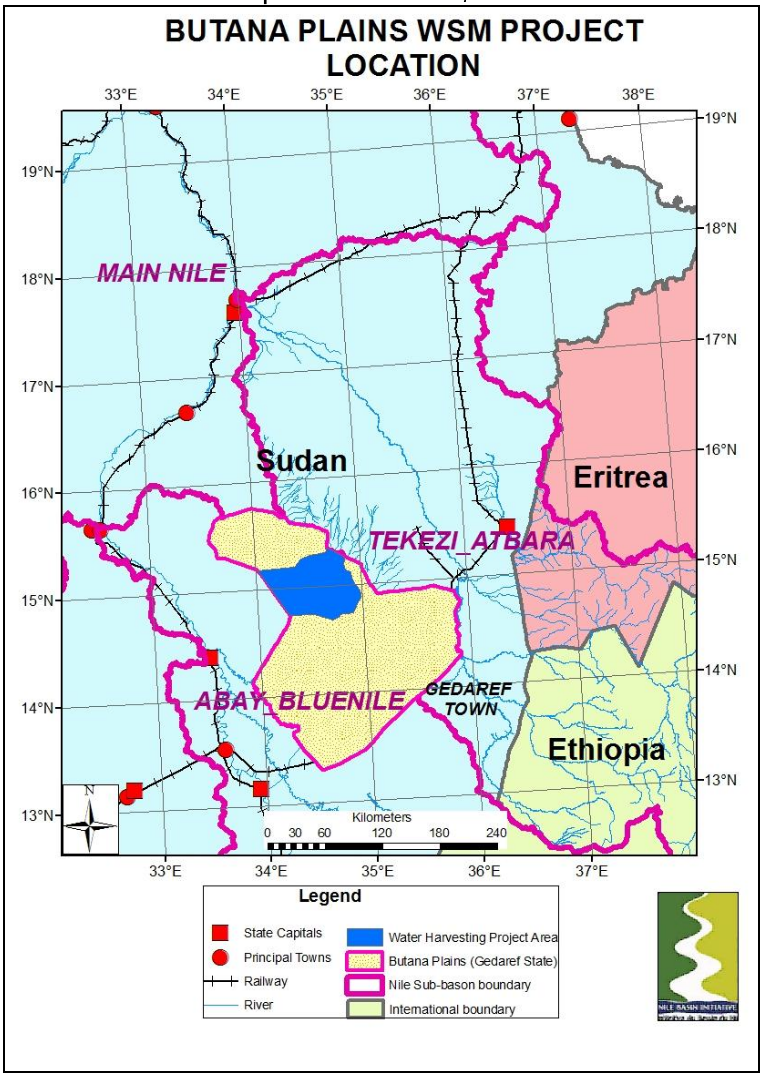
They have well identified roles in relation to resource conservation and management. According to Elnour the system of traditional management was supported by equity of use right and social customs governing common property resources. This flexibility facilitated resource conservation particularly under the dry conditions. Additionally, they play an important role in conflict resolution based on the indigenous mediation (*Judiyya*) system. The “*Judiyya*” is established tradition in Sudan and can be initiated by a member of the local administration or a religious leader (Fagir) or a group consisting of representatives of all of them. They all represent mediating roles with the ultimate objective of reaching a consensus and peaceful settlement to their conflicts.

3. BUTANA PLAINS - BIOPHYSICAL AND SOCIO-ECONOMIC SITUATION

3.1 Biophysical Characteristics

3.1.1 Location and Extent

The overall Project area comprises the Butana Plains within Gedaref State. Within this area a more focussed area has been defined for Water Harcesting activities. This latter area comrprises some 4,990 km^2.

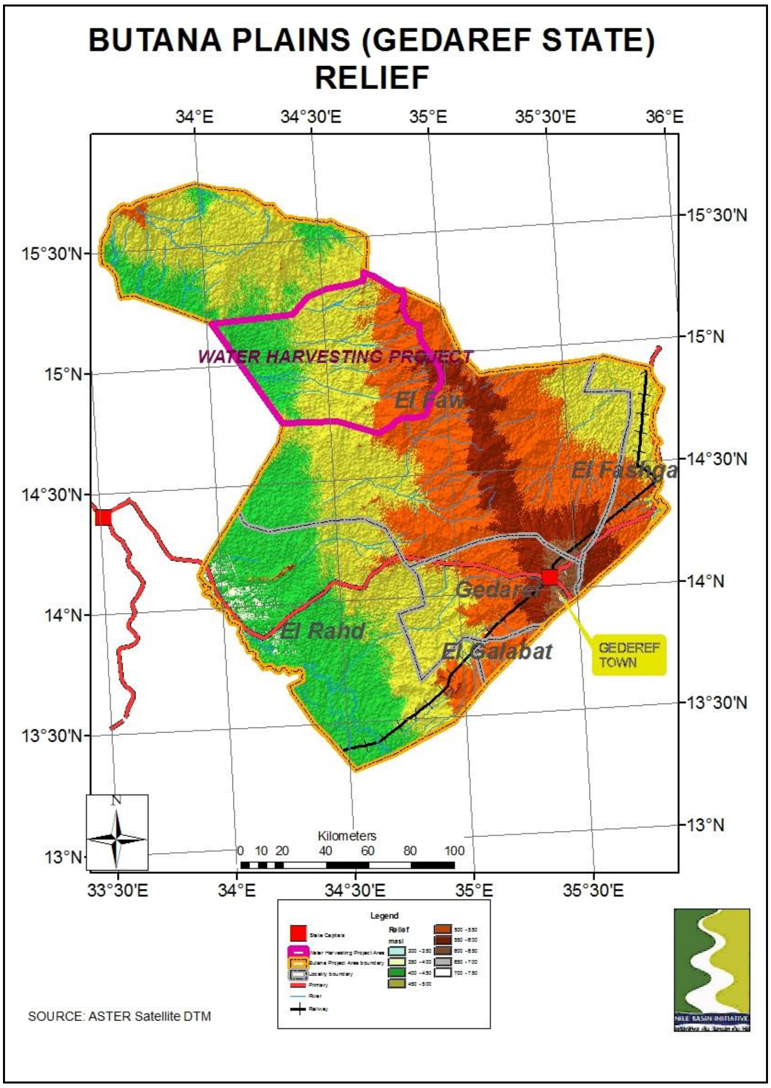


Map 1. Location of Butana Plains Watershed Project

3.1.2 Relief and Drainage

(i) Relief

The Butana Plains are divided by a central ridge, which forms the watershed between the Blue Nile and Atbara River basins. However, the relief is extremely gentle, the ridge rising only 150 meters from 450 masl to 600 masl.



Map 2. Relief and Drainage

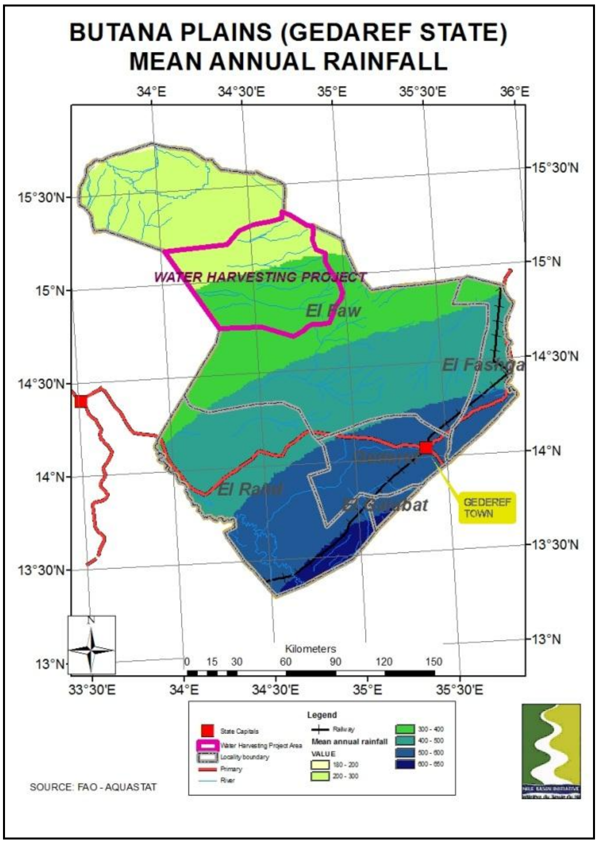
(ii) Drainage

A series of khors take runoff from the ridge both to the east to the Blue Nile and west to the Atbara. However, none reach the two rivers dissipating onto the plains below the ridge.

3.1.2 Climate

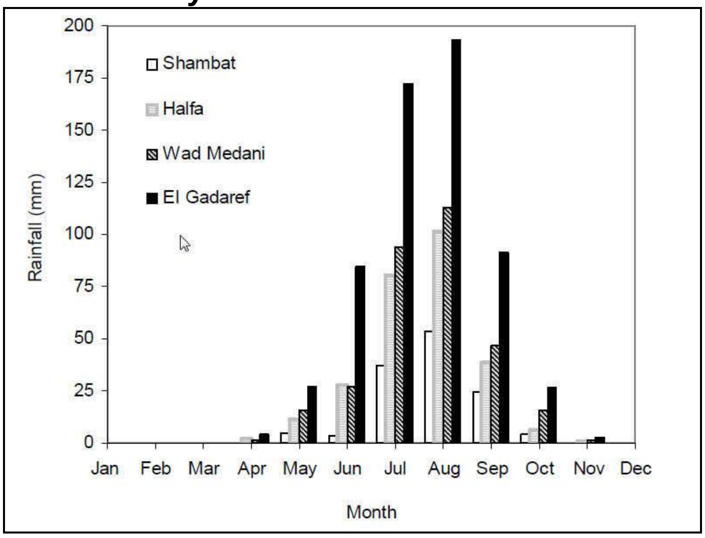
(III)Rainfall

Mean annual rainfall over the Butana Plains decreases from the southeast to northwest, from 600mm/yr to 200mm/yr.



Map 3. Mean annual rainfall

Figure 1. Mean Monthly Rainfall for Stations in the Butana Plains

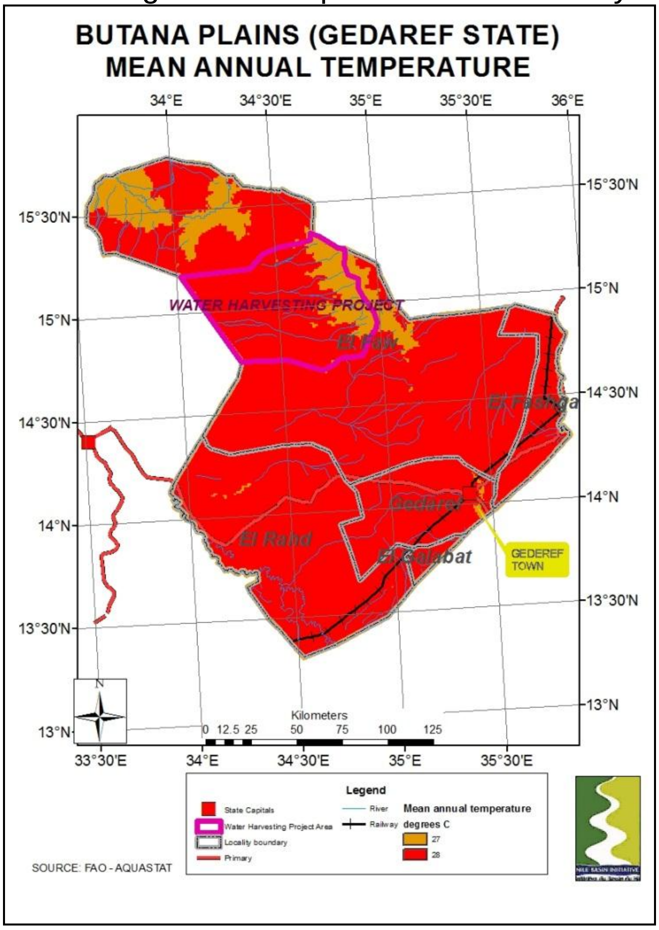


Source: Muna Mohamed Elhag (2006)

Most rain falls between June and September (figure 1). The vegetation growth pattern lags by about one month.

(ii) Mean annual temperature

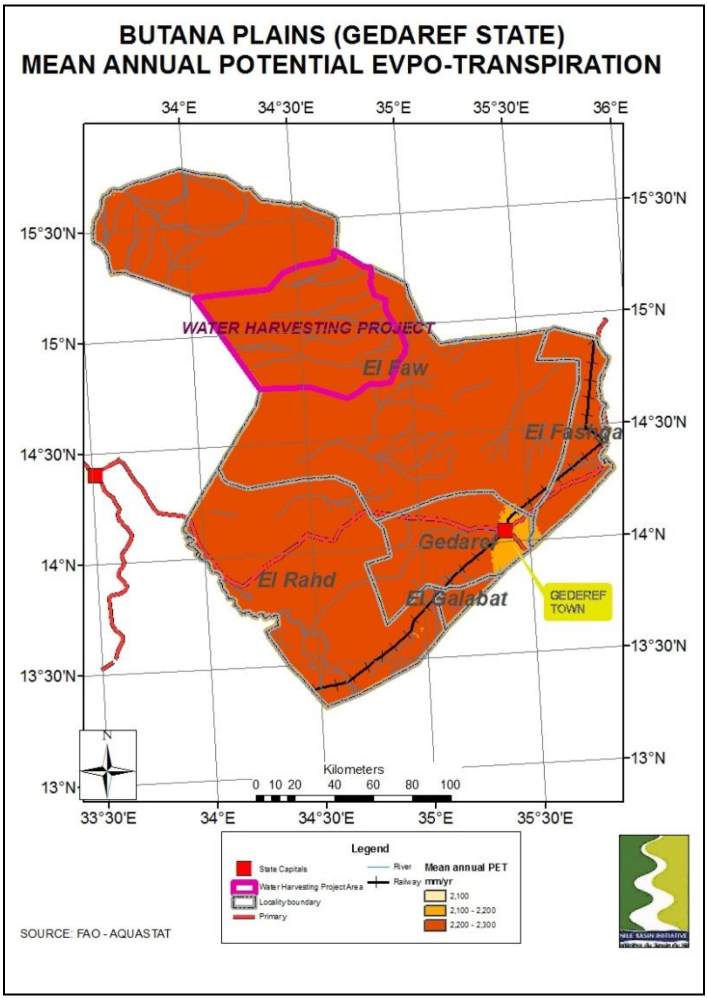
Mean annual temperature varies little across the Butana Plains, with 28°C across most of the plains and 27°C in some of the lower lying wadis in the northeast, where winter night-time temperatures can be very low.



Map 4. Mean annual temperature (degrees C)

(iii) Mean Annual Evapotranspiration

The pattern of mean annual evapotranspiration is very uniform across the Butana Plains between 2,100 and 2,200 mm/yr. It decreases slightly near to Gedaref town to 2,200 – 2,100 mm/yr.

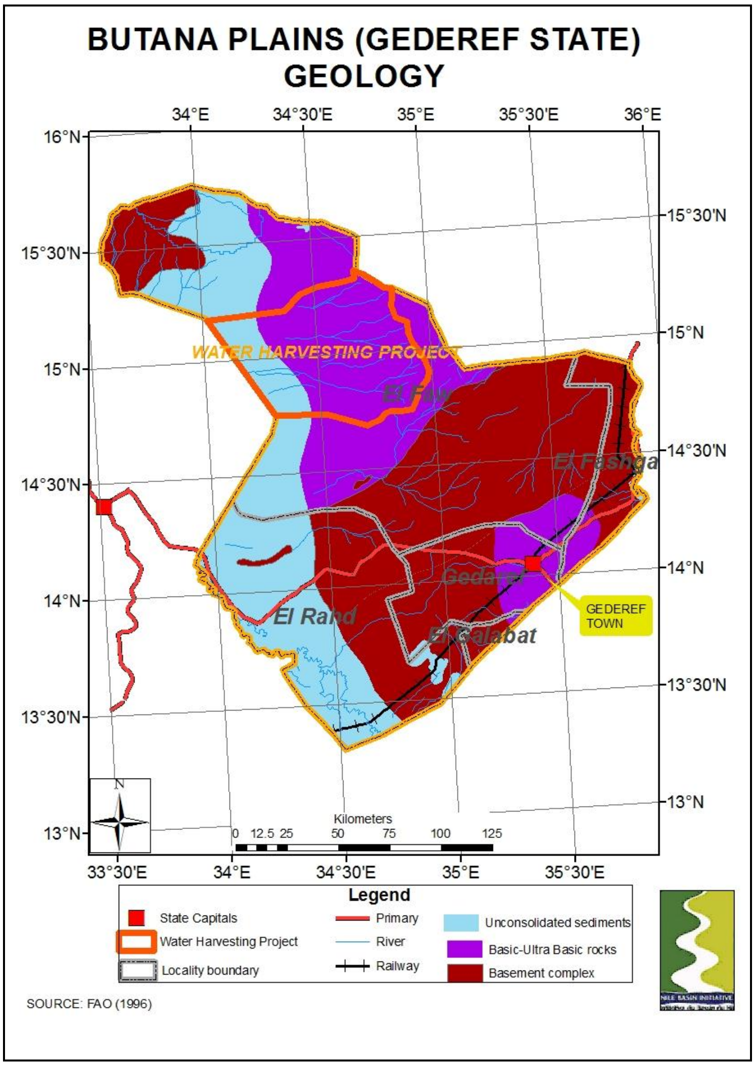


Map 5. Mean annual evapo-transpiration.

3.1.3 Geology

(iii)Solid geology

The southeast part of the Butana Plains is underlain by Basement Complex rocks (granites, gneisses). The northeastern area is underlain by basic – ultrabasic rocks. The area along the eastern side of the plains comprises unconsolidated sediment (alluvial/colluvial) (Map 6).



Map 6. Geology

(ii) Groundwater

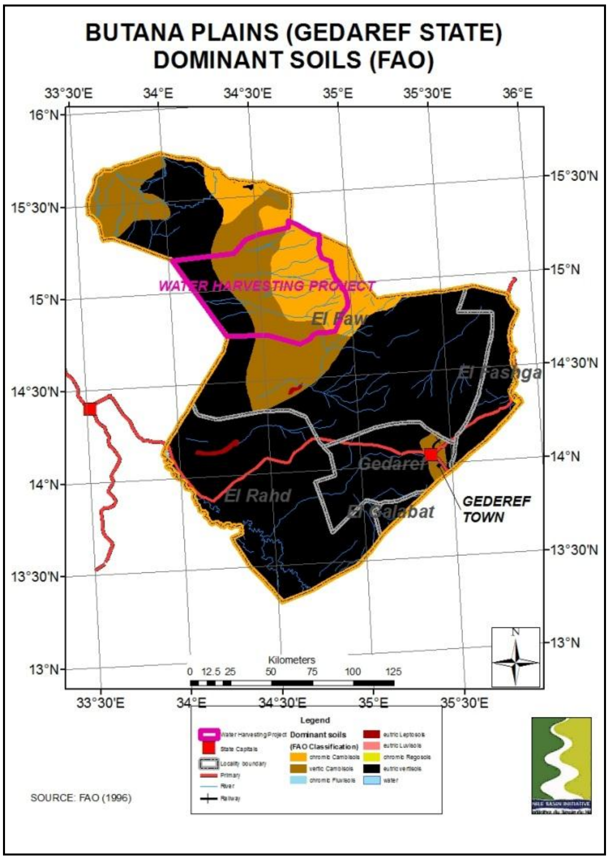
The hydro-geological system comprises two aquifers: an upper and a lower (Farah et al., 1997). The upper aquifer includes mainly the Upper Gezira Formation and the upper part of the Lower Omdurman Formation to the north of the Blue Nile. The lower aquifer is developed mainly in the deeper Nubian Sandstones.

The water storage in the lower aquifer is some eight times that of the upper aquifer. Except for a few isolated localities water quality is free from impurities for drinking and irrigation requirements.

3.1.4 Soils

Vertisols cover most of the Butana Plains. These are deep, black cracking clay soils of moderate fertility. Vertic Cambisols cover areas with slightly better drainage. These soils have some vertic features, seasonal cracking but with slightly better drainage. On the highest areas of the ridge are chromic Cambisols. These soils are relatively freely drained and have lighter textures.

The Water Harvesting area provides a topo-sequence of these three soil types.



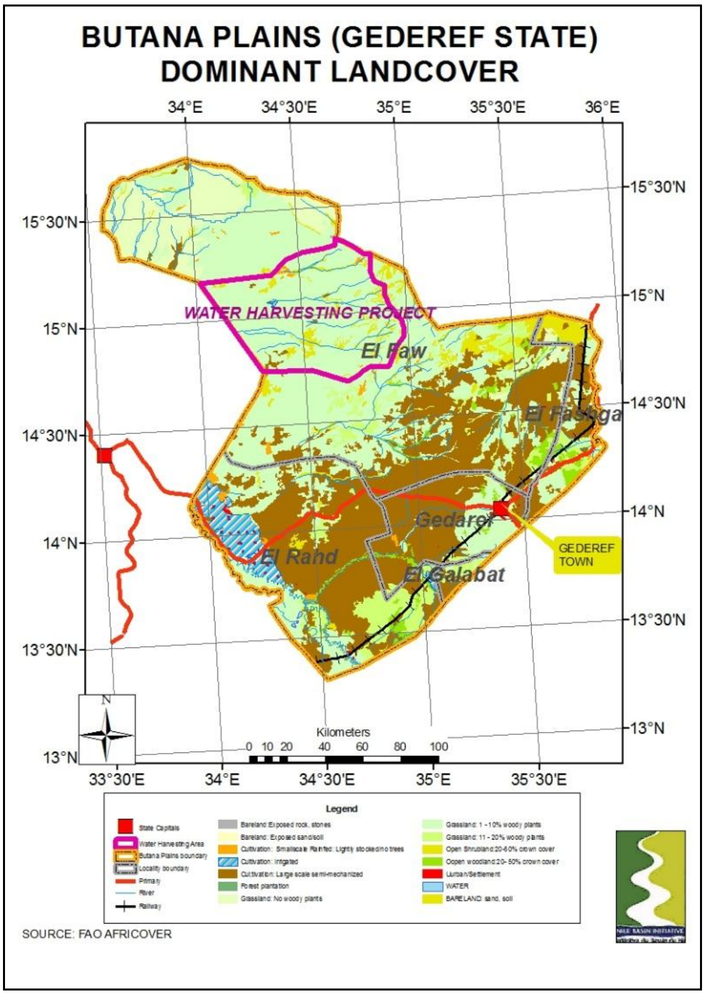
Map 7. Dominant Soils (FAO Classification)

3.1.5 Land Cover / Land Use

The most extensive landcover on the Butana Plains is grassland with 1 to 10 percent of tree cover (44 percent). This is followed by Large scale rainfed cultivation (the semi-mechanized farms) (31 percent). Grassland with various degrees of tree cover (from 0 to 20 percent) covers some 59 percent of the Plains. Open woodland and shrubland cover 6 percent. Small-scale cultivation covers just 1 percent of the area.

Table 1. Buttana: Dominant Landcover (km2)

LANDCOVER	AREA (KM2)	%
BARELAND: Exposed rock, stones	3	0.0%
BARELAND: Exposed sand/soil	25	0.1%
CULTIVATED: Small scale Rainfed	224	1%
CULTIVATED: Large scale Irrigated	902	3%
CULTIVATED: Large scale Rainfed	11,137	31%
FOREST: Plantation	89	0%
GRASSLAND: No woody plants	2,861	8%
GRASSLAND: 1 - 10% woody plants	15,665	44%
GRASSLAND: 11 - 20% woody plants	2,388	7%
OPEN SHRUBLAND:20-50% crown cover	1,492	4%
OPEN WOODLAND:20- 50% crown cover	741	2%
URBAN/SETTLEMENT	105	0.3%
WATER	9	0.0%
TOTAL	**35,641**	



Map 8. Dominant Landcover

3.2 Administration

The State's political arrangements resemble those of Sudan's other States, and are based on the federal system of governance promulgated in 1994; the State is headed by the Governor (*Wali*), appointed by the President (Munzoul Assal and Samia Ali, 2007). The Governor, in consultation with federal authorities, appoints commissioners for the different localities.

In addition to these formal government structures there are traditional administrations known as *Nazaras*. The leader of the *Nazara* is known as a *Nazir*. He has no official authority over his people or the residents of his *Nazara* area, but he is instrumental in mediating between his followers and the government. The *Nazir* is also involved in solving problems and disputes between people. Only problems that he cannot address are dealt with by courts of law. This way, traditional authorities and government authorities seem to be parallel, but they collaborate; often the government co-opts traditional leadership and uses it for its own purposes. The *Nazir* practices his authorities through middle-ranking leaders known as *Omdas*. Table 2 shows the Nazaras of Gedaref State, their areas and the tribes under their administration.

Table 2. Nazaras of Gedaref State: their Areas and Peoples

Nazara	Area	Peoples under Umbrella
Bakur	South of the state	Four, Masaleet, Fallta other west Sudan tribes
Shukrya	Butana	Shukrya, Bataheen, Kawahla, Lahwin
Dabaina	East of the state	Dabaina and other minor groups.
Beni Amir	Gedaref city	Beni Amir
Nahal	Nahal and Hawata	Bargo and other minor groups

3.3 Population

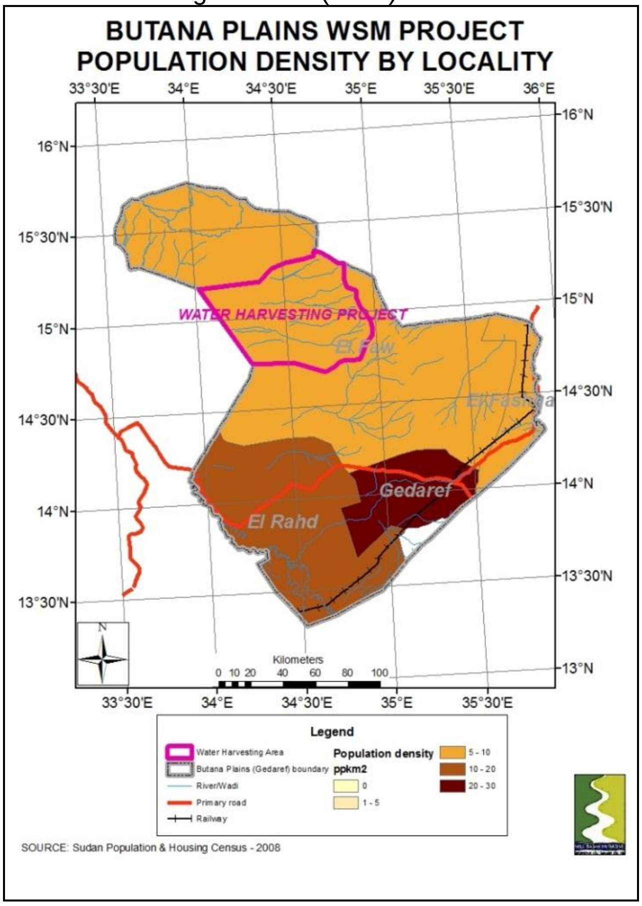
3.3.1 Population Distribution

The toal population of Gedaref State is 1.348 million spread across 10 Localities (Table 3). The population densities of the four localities in the Butana Plains project area varies between 10 and 30 persons per km2 (Map 9).

Table 3. Estaimated Population of Gedaref State by Locality

Locality	Male Population	Female Population	*Total Population*
Al Butana	38 375	32 990	*71 365*
Al Fashaga	60 005	60 830	*120 835*
Central Al Gedaref	56 239	55 430	*111 669*
Al Gedaref City	136 434	132 961	*269 395*
Al Faw	86 850	89 812	*176 662*
Al Rahad	96 671	99 767	*196 438*
Qalaa Al Nahal	31 373	34 749	*66 122*
Western Galabat	44 768	47 107	*91 875*
Al Goreisha	40 059	43 335	*83 394*
Eastern Galabat	79 043	81 580	*160 623*
TOTAL	**669 817**	**678 561**	***1 348 378***

Source: Sudan Population & Housing Census (2008)



Map 9. Population Density and Distribution

The estimated population growth per year is 3.87 percent. The urban population is 28.9 percent while the rural people comprise71.1%. The pastoral people comprise 35% of rural people and 25% of the total population of Kassala State. A small but reducing number of refugees are settled in transition camps along the eastern border and in selected areas near irrigated schemes and urban centres. The main demographic features of Gedaref State are shown in table 4.

Table 4. Main demographic Features of Gedaref State

State	Gth rate %	Urban %	% <15yrs	% >60yrs	Sex ratio M/F	Crude birth rate	Crude death rate	Infant mort. male*	**Infant mort. female ***
Gaderef	3.40	28.9	43.1	3.7	105.3	40.3	11.7	135	**122**
NORTH SUDAN	**2.80**	**37.3**	**42.8**	**4.1**	**100.4**	**37.8**	**11.0**	**116**	**98**

* per 1000 live births

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

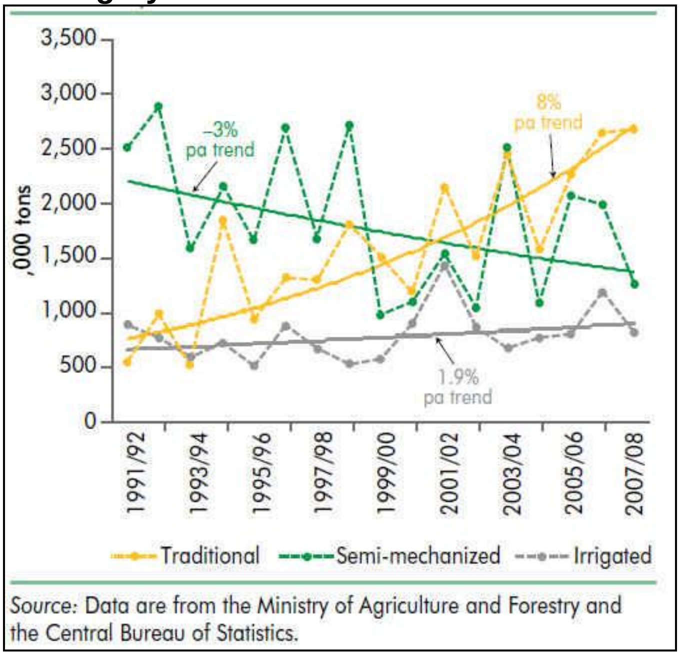
3.3.2 Social-Cultural Aspects

Gedaref state is characterized by high levels of social and ethnic diversity where the population groups include Shukriya, Lahawyien, Dabaina, Kawahla, Fur, and Bargo peopels along with northern and riverine tribes such as the Shaygiya and Ja'alyin in addition to Eastern Sudan peoples of Bani Amir, Rashaida and Beja and (although these latter groups make up a relatively small percentage of the population in contrast to Red Sea State and Kassala where the Beja and Rashaida constitute the majority). The multi-ethnic nature of Gedaref state is in large part a product of historically protracted waves of migration to the region (Assal 1997).

3.4 Agricultural and Pastoral/Agro-pastoral Livelihood Systems

Agriculture in Sudan is classified under five main farming) systems: (i) Large scale irrigated schemes, (ii) small-scale irrigated farms, (iii) large scale semi-mechanized farms (> 1500 fed.), (iv) small scale sedentary farms (< 1500 fed.) and (v) pastoral and agro-pastoral systems. There have significant changes in crop production patterns of these farming systems over the past two decades. The production from traditional farming systems has grown at 8 percent/yr, the semi-mechanized farms has declined at 3 percent/yr whilst production from the irrigated systems has only grown at 1.9 percent/yr.

Figure 2. Total crop production from Traditional, Semi-mechanized and Irrigated Farming Systems



Source: World Bank (2009)

In its Annual Economic Report for 2008, the Gedaref State Ministry of Finance indicates that contributions from agriculture would account for 75 – 78% of the state GDP with services contributing 17 – 20%. The centrality of agriculture to the state's economy finds parallel expression in the employment market with over 70% of the population working in this sector.

3.4.1 Large-scale Irrigation Scheme

The main scheme in the Butana Plains in Gedaref State is the Rahad Scheme which irrigates some 300,000 feddans (126,000ha), although some of this lies within Gezira State. The scheme is owned and managed by the central government and is significant in three respects:

- It is highly capital-intensive, requiring regular maintenance.
- It produces a considerable volume of commodities for domestic consumption and export;
- The scheme (and all other large schemes) has been subsidized by the federal government because of low productivity and excessive costs.

3.4.2 Small-scale Irrigation Scheme

There is one small-scale irrigation scheme on the Dinder River in El Galabat Locality covering some 7,715 feddans (3,240 ha).

3.4.3 Large-scale Semi-Mechanised Farms

(ii) Background

In the Butana Plains (Gedaref State) these cover some 2.65 million feddans (1.11 million ha) (see map 13). Sorghum is the main crop. The semi-mechanized farm is now usually well over 1,000 feddan (420 ha) as a result of amalgamations of leases and family partnerships. The government also allocated large tracts of land (between 50,000 and 1 million feddan) to Sudanese and foreign investors (mainly from the Gulf countries). Land preparation, seeding, and most threshing on these farms are mechanized, whereas weeding, harvesting, and some threshing are done by seasonal labor.

Land is leased by the State to individual investors whereby each individual is allotted “a farm”. These schemes are managed by both private and government sectors. Sometimes, rotation of dura, sesame and fallow with or without cotton are practiced, but often a piece of land is cropped with dura until the land loses its fertility and then abandoned completely.

The mechanized rainfed farming sector is criticized as being a major cause of environmental deterioration. To understand the role it played and to assess its impact a brief background is necessary.

The Mechanized Farming Corporation (M.F.C.) was established in 1968 (Act No. 14) to act as a main agency for the promotion of large scale rainfed agriculture.

In 1975, the M.F.C. came under a new Act which defined the responsibilities of the corporation as follows:

- Survey, allocate, demarcate and distribute schemes to farmers.
- Assist the private investors and direct their attention to the best agricultural techniques.
- Promo to agricultural research.
- Provide credit to farmers on reasonable terms.
- Operate state farms.
- Provide social services.

The emphasis over the past thirty years has been primarily on survey, demarcation and distribution of schemes as well as on the running of state farms. There had been very little activity in other aspects of responsibilities.

Since the introduction of mechanization more emphasis was given to horizontal expansion rather than to vertical expansion. For example, in the years from 1950 to 1952 the total area under mechanized rainfed farming in Gedaref state was 34,124 feddans. At present the area exceeds 3 million feddans, half of which is un-demarcated or unauthorized by the M.F.C. so, there is expansion without any control by concerned technical agencies i.e. M.F.C. or Land use department.

A general evaluation of these schemes indicates that there are many shortcomings in the planning of these schemes. They are often connected without site selection, or consideration of nomadic rights, stock routes and wildlife sanctuaries. The development of mechanized farming and its spread without proper control or appropriate environmental measures led to negative impacts on the environment and resulted in serious deterioration in the grazing resources, forest resources and soil fertility.

(ii) Impacts of mechanized rainfed farming:

The original advantages of a semi-mechanized farm sector were seen to be:

- Employment generation,
- Contributing to expanded food supply for domestic consumption and for export.
- Have a low demand for public services and support compared with peasant agriculture or large irrigation schemes.
- Mobilizes private investment.

In many ways these advantages have been realized. The SMF's provide employment opportunities that help to expand livelihood strategies for many rural families: particularly for agro-pastoral and pastoral families who have lost livestock assets as a result of drought. From the 1960's until the late 1980's the SMF's made an increasing contribution to the national food supply, although since the early 1990's this has begun to decline. Finally, by mobilizing private capital they made few demands on government resources.

However, the mechanized rainfed farms have had negative impacts on the resource base, environment and livelihood of the people. This can be seen in:

- Overgrazed areas and indications of soil erosion.
- Deforested areas for mechanized crop production results in gully erosion, degradation of soil structure, texture and fertility and hence a decrease in yields.
- Decreasing area of Gum Arabic trees.

In addition, the expansion of mechanized farming schemes in recent years has further jeopardised the position of Gedaref’s rural population creating land shortages among people engaged in subsistence farming. The enclosure of land has also led to the obstruction of traditional nomadic ‘corridors’ used by pastoralist communities during their seasonal movement. Efforts have been made at state-level to demarcate official migration corridors to minimize the potential of disruption and tension during migratory seasons. However, to date, these efforts have not been sufficient (there is still need to activate the Nomadic Corridors Act and to provide basic services at rest-points along the corridors) and clashes continue to erupt between mechanized farmers and nomadic peoples at certain points in the year.

Figure 3. Stock Route marker Post that has been up-rooted (Source: UNEP, 2008)

Extensive cultivation in the absence of land-rotation techniques has also seen the reduction of crop yields and soil degradation – factors that spur further expansion of existing schemes and resultant effects/impact.

3.4.4 Small-scale Rainfed Farming

The total area of small-scale rainfed farming in the Butana Area is 53,300 feddans (22,400ha). The sedentary small farmers typically have 10 to 15 feddan on which they produce food crops as well as cash crops such as karkade, sesame, and water melon seeds. The total cropped area in this system is estimated at 18 million feddan.

Production from the rainfed traditional farming is very low and many hazards are encountered such as drought and/or water logging, plant diseases, pests….etc. these, in addition to bad management-practices are responsible for the poor yield attained.

3.4.5 Pastoral and Agro-pastoral Systems

(i) Introduction.

In 1999 livestock production comprised 46.9 percent of agricultural GDP and between 1991 and 1999 grew at an annual rate of 15.9 percent. Between 2000 and 2009 it only grew at 3.6 percent and now constitutes 47.2 percent of agricultural GDP (World Bank, 2009).

“Pastoral” and “agro-pastoral” production systems are here defined as those systems where the livestock production component for subsistence and sale exceeds that of crop production. Many “pastoral” production systems are rarely totally reliant on livestock production and will include a crop production component although this may be very small and/or infrequent.

(ii) Changing Pastoral /Agro-pastoral production Systems

Since the drought of the early 1980's many households in what were predominantly “pastoral” ethnic groups have adopted livelihood strategies that include crop production, milk production for sale, wage labour and other non-agricultural activities. Many households no longer rely on livestock production as their main source of subsistence and are effectively sedentarised cultivators. Over the past two decades many households have and are still making the transition from pastoralism to agro-pastoralism to sedentarised crop cultivation and vice versa as household and external conditions change.

These changes in household production systems are the result of the massive losses in household and community livestock assets during the drought of the early 1980's exacerbated by the increasingly loss of wet season grazing areas and water resources from the big expansion of large-scale semi-mechanized farms during the 1980’s and 90’s.

Omer A. Egemi (2002) describes the emergence of two herding systems on the west Butana Plain from a previous mainly pastoral system that crashed during the drought. These are contract herding and village herding. Village herding is practised by former pastoralists who have lost most of their livestock during the drought. Their livestock holding are confined to sheep and goats. Crop cultivation is highly precarious and located in depressions and the major khors on share cropped land owned by the Gaalian people along the Nile. Seasonal migration for wage labour along the Nile Pump schemes is a major livelihood strategy. Contract herding is the dominant form. Herds comprise cattle, sheep and goats and comprise 80 percent or more of the livestock in the western Butana Plains. The animals are owned by farmers along the Nile, traders, and government officials. The herders are former pastoralists who have lost all their livestock during the drought through mortality or by having to sell the livestock assets to the riverine farmers.

Morton (1988) describes a similar decline in pastoralism among the Lahawin people who occupy the area in the upper Atbara and Setit valleys in Kassala Province. Here again the 1980's drought exacerbated by loss of the grazing land to semi-mechanized farming has left many former pastoral families with few or no livestock. Many have settled on the New Halfa Irrigation Scheme and others now practice sedentary agriculture along the Atbara and Setit rivers and engage in migratory wage labour.

(iii) The Pastoral/Agro-pastoral Production Systems

The Butana has been described as the best rangeland for camels and sheep. This was largely due to the occurrence of good grazing fodder. However, these areas have been heavily grazed and have almost lost some of its valuable plant species such as *Belpharis spp.* Butana is considered as a marginal for rainfed cultivation, although it is sporadically practiced there using *terus* water harvesting structures or on low-lying water receiving sites.

The main household livelihood assets are the livestock herds, grazing and browsing resources (wet and dry season areas), water resources (wet and dry season areas), land for crop cultivation (rainfed or irrigated), gum trees for harvesting and family and community labour. Social assets included accumulated group knowledge of natural resources and their distribution and mutual coping and assistance mechanisms.
The Shukriya other pastoral groups in the region have devised flexible and dynamic strategies to cope with the complexity and the variability of their eco-system and to recover from droughts and outbreaks of famine. Such strategies include mobility, herd diversification and redistribution[1], rules for environmental protection (e.g. the prohibition of cutting trees) and the development of a multi-resource economy where livestock keeping is complemented by a set of alternative livelihoods, including cultivation and labour migration to town.

The Livestock ecology and management procedures practiced by pastoralists utilizing the Butana were the subject of an extensive survey conducted by a team of researchers from the Sudan (Camel Research Unit) and France (IEMVT) (Darosa & Aghab, 2009). A total of 822 herds were surveyed during the rainy season and an interdisciplinary set of data was collected. Whereas 85% of the surveyed herds belonged to individual owners, 15% were multiple owners who practiced group herding .

There were at least four herding strategies adopted by the pastoralists utilizing Butana range (Abbas et al., 1992). The four systems differed significantly in several factors, notably, herd size moving as one group, level of sedentarisation, the use of labour, owner's supportive activities, camel uses, dry season feeding, and the variable species composition of the herd. The overall predominant feeding strategy was the use of Butana range in the rainy season and either crop residues or riverain habitat (Atbara River, Gash, Rahad) during the dry season. I

In this regard, 395 herds out of a total of 708 (56%) had come to Butana from outside (Red Sea region, Eritrea, Gash, Blue Nile and Gezira) of whom 269 (38%) were classified as transhumant and 126 (18%) were nomadic (Maillard, 1992). They left Butana around September-October because of lack of water. This leaves most of the rangeland for exploitation by Butana resident pastoralists who usually have much smaller herds of livestock (camel, sheep, goats and cattle). Butana residents obtain water from hafirs up to December-January in favourable years, shallow wells in stream beds, and a few tube wells throughout the year.

A clear trend towards specialization was noticed with increasing interest in feed-lotting of camels (and sheep) and the rearing of racer camels to make use of the growing demand for meat and sport animals in the Gulf and Saudi Arabia as well as Egypt. Thus there has been a decline in full nomadism and an increased in settled families (table 5).

Table 5. Status of Pastoral Families in the Butana (1984, 1994 and 2003)

Status of Families	Year		
	1984	1994	2003
Nomadic families	153 (73%)	69 (33%)	46 (22%)
Semi-nomadic families	21 (10%)	103 (49%)	73 (35%)
Settled families	35 (17%)	37 (18%)	90 (43%)

Source: Ahhab (2009)

Analysis of herder's age structure and owners' backgrounds disclosed that pastoralism is still found profitable by many tribes, attracting new investors, some of whom were former traders and expatriate farmers (Le Horgre, 1993).

The Butana breed of cattle has descended from the first zebu introduction into Africa from West Asia. This breed remained largely with nomadic pastoralists (Batahin, Shukria), but the Dongola and Shendi strains are kept by settled farmers. They are used for milk, draught power and meat. At birth male calf weighs 21-26kg and female weigh 20-24kg. Average adult live weight for males and females is 370 and 320kg, respectively. Average height at withers for males and females was 151cm and 144cm, respectively. Age at first calving ranged from 3.2-3.7 years (Ageeb and Hillers, no date; DAGRIS, accessed in Sept 2005). The same authors reported that calving interval for Butana cattle at 12.4-16.3 months. The breed is known for good milk yield in a rather harsh climate, the milk yield per lactation ranging from 1200 to 1800kg in an average lactation of 240 days.

Camels have been the backbone of pastoralists' economy and culture. Camel milk is their basic subsistence food as the camel provides milk for many months after calving. Camels also provide meat, skins and fat. The pastoralists are excellent camel breeders, selling camels to Egypt and Arabia. They are very skilled in camel riding. Camels are also used to carry grain, tents and household equipment when on the move. These camels compete with those of Oman as the best breeds of the Arab world. The three main breeds are: Shallagea, the sturdiest and best milk producers. Aririit, having great endurance and able to cover long distances at a steady pace without water, and Matiaat, the fastest camels used for raiding and racing.

Sheep and goats are kept for their milk and meat. In times of drought they die off faster than the camels but recover faster too. Some flocks are kept near the camp for everyday use but most are taken far away for grazing, drinking only every second day. Surplus sheep and goats are sold in the town markets and sometimes exported (or smuggled) into Saudi Arabia.

Milk and its products are the staple diet supplemented by cereals, especially durra (harob) or millet from which they cook a thick porridge called O'tam. Eating it with milk or clarified butter is a characteristic of Beja culture. Sorghum is also used as a supplementary fodder for Beja animals. In good years it is stored in holes dug in the earth in special areas where it can keep for several years.

There is a complicated system of division of labour depending on the particular composition of the livestock assets and in turn the herd splitting strategies. These include division of cattle holdings into wet (i.e. in milk) and dry herds. Milking animals tend to be kept close to the permanent camp or moved slowly behind the dry herd when trekking. As camels and goats can go for longer periods than sheep or cattle they are often herded separately and at greater distances from the main camps. In terms of labour division men undertake herding, cultivation and gum tapping, whilst women and children undertake domestic work, herding goats or sheep for milk and tending calves and cows in milk.

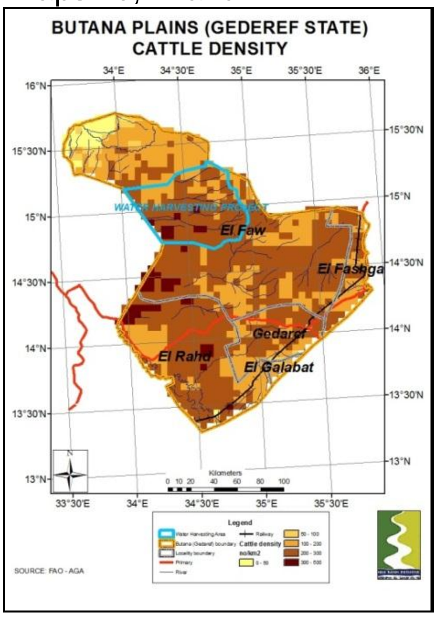
Overall herd composition differs between the more arid north and the wetter south, with camels and goats predominating in the north and west and cattle and sheep in the south and east. Specific productions systems have developed over the years in specific areas as results of natural agro-ecological conditions including droughts, socio-cultural factors, economic factors and changing accessibility to grazing and water resources.

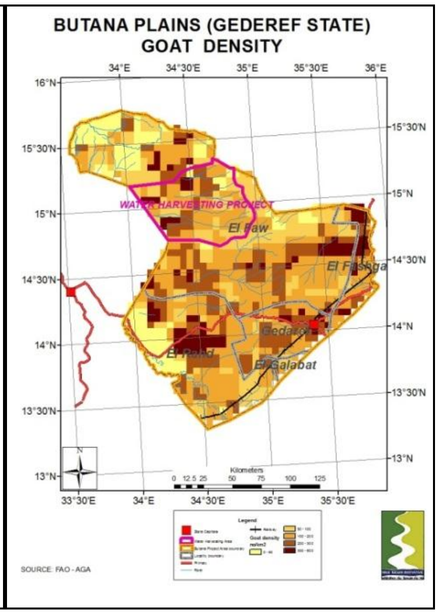
(iv) Livestock Numbers and Distribution

The total livestock data for Gedaref State is as follows:

Camels	0.19 million
Goats	1.03 million
Sheep	2.00 million
Cattle	0.99 million

The distribution of within the Project Area of cattle, goats and sheep are shown in Maps 10, 11and 12.





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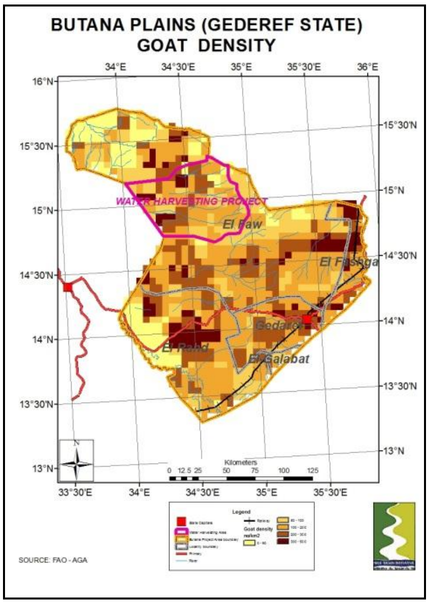
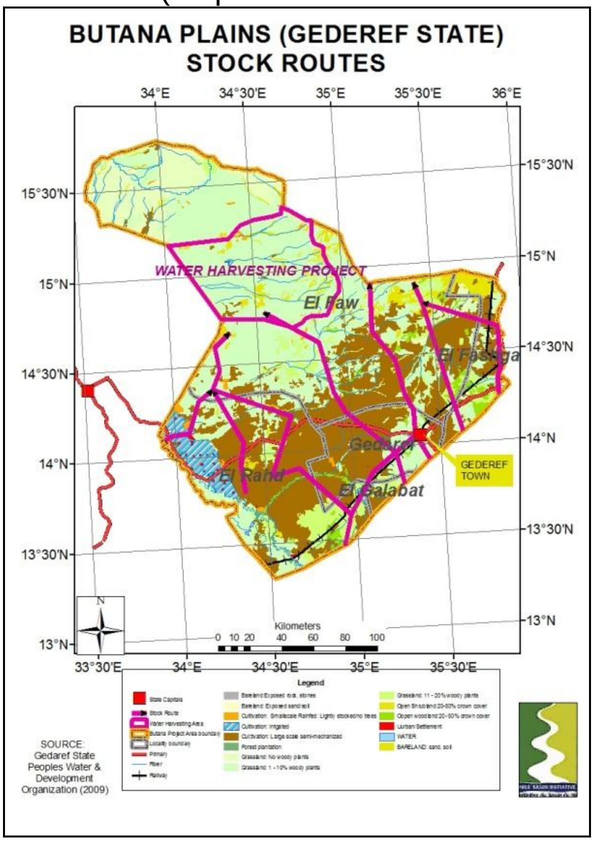


Maps 10 – 12. Distribution of Cattle, Goats and Sheep on the Butana (Gedaref)

(v) Stock Routes and water Supplies

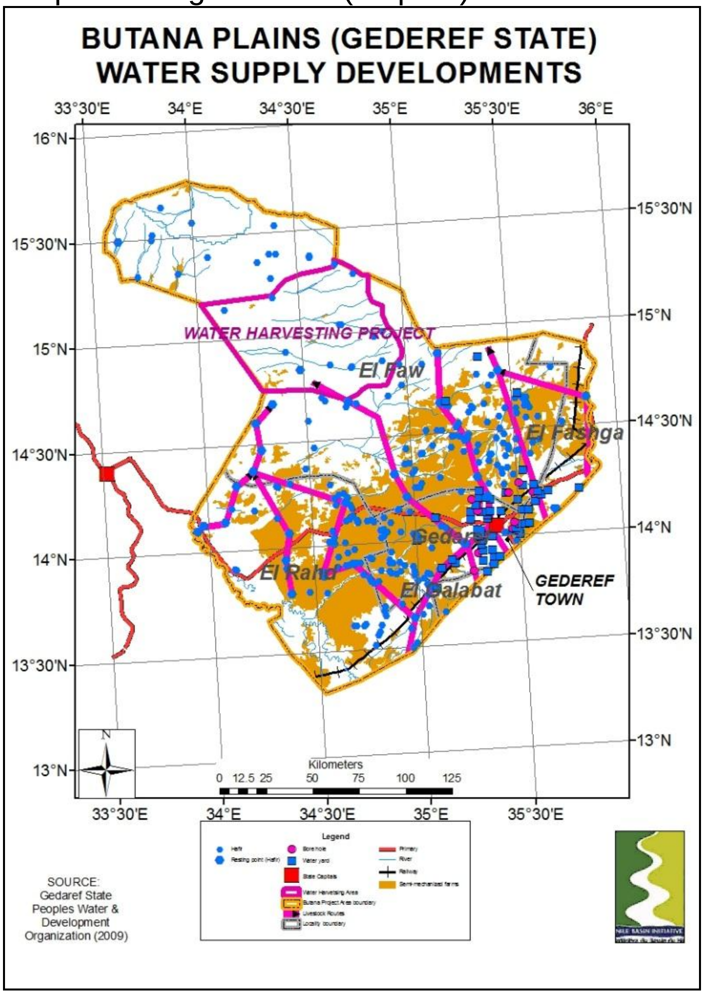
The Semi-Mechanised Farms present a barrier to the movement of livestock from the dry season grazing area in the southern part of the State to those of the Butana. A number of officially recognised stock routes have been delineated through the farms (Map 193.



Map 13. Official Stock Routes through the SMF Areas

As indicated above (See figure 3) there are often conflicts between pastoralists and farmers. There are thousands of tons of crop residues left in the fields after harvest, but farmers do not want livestock on their farms as they fear the animals bring in noxious weeds in their dung.

An additional problem is the poor supply of water points along the stocks routes. There are reported (MLP) that there are areas of wet season grazing that are not accessible due to the lack of water supplies. Livestock water supplies in Gedaref State have been mapped by the Gedaref State peoples Water and Development Organisation (Map 14).



Map 14. **Livestock Water Supplies in Gedaref State.**

3.4 Basic Social Services and Human Development Indicators

3.4.1 Health Indicators

Infant and child mortality rates are significantly higher in Gedaref State than other states in northern Sudan (Table 6).

Table 6. Mortality and Nutrition Rates in Gedaref State

Indicator	Gedaref	Average (North Sudan)
Neonatal mortality rate (per 1000 live births)	43	37.3
Post-neonatal mortality rate (per 1000 live births)	43	34.7
Infant mortality rate (per 1000 live births)	86	71.2
Child mortality rate (per 1000 live births)	55	37.3
Under-5 mortality rate (per 1000 live births)	137	105.8
Underweight prevalence (% below -2 SD and -3 SD)	33.8 and 8.7	31.9 and 9.4
Stunting prevalence (% below -2 SD and -3 SD)	38.4 and 16.8	32.9 and 15.1
Wasting prevalence (% below -2 SD and -3 SD)	9.8 and 1.7	13.9 and 3.2
Children who received all vaccinations (DPT1-3, OPV-1-3, BCG and measles)	50.8%	50.3%
Houses with at least one mosquito net	43%	38.5%
Use of improved source of drinking water	37.3%	55.1%
Population using sanitary mean of excreta disposal	14.6%	38.0%
Using improved sources of water and sanitary means of excreta disposal	9.6%	27.7%

Source: Sudan Household Health Survey (2006)

The above picture is depicted by the last survey conducted at the national level, i.e. the Sudan Household Health Survey (2006). According to survey findings, although birth registration in the state (45.8%) was higher than the average for northern Sudan states (34.6%) and antenatal care by trained personnel (for deliveries during the two years preceding the survey) was (71.8%) not far from the average for northern Sudanese states (72.5%), doctor-assisted deliveries was only (3.5%) in Gedaref as compared to (15.2%) in other North Sudan states. Likewise, the percentages of still births and miscarriages in Gedaref stood below North Sudan average while maternal mortality ratio in Gedaref (609 in every 100 000 live births) was higher than in other North Sudan states (503 in every 100 000 live births).

Although no (national) survey data on the health situation after 2006 is available, available data from the State Ministry of Health (SMoH) indicates that some improvement on the situation was achieved during the last few years, a fact which should by no means be taken to mean that no challenges are currently being faced. Of course some challenges are still there probably with a difference in degree.

3.4.2 Literacy and Education

The literacy and primary school enrollment rates for Gedaref State are shown in table 7.

Table 7. Literacy and Primary School Enrollment Rates of Gedaref State

State	Literacy >15yrs % Average	Literacy >15yrs % Male	Literacy > 15yrs % Female	Total Primary school enrol.	% enroll.
Gaderef	55.6	72.9	38.4	311,547	45.7
NORTH SUDAN	**54.5**	**66.6**	**42.4**	**3,308,387**	**51.0**

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

There are significant differences in literacy and primary School enrollment rates between Gedaref State and north Sudan. In terms of literacy Gedaref State is higher than the average except for females. However, primary school enrollment is lower than average.

3.4.3 Water and Sanitation

The percent population with access to drinking water and sanitation facilities are shown in table 8

Table 8. Gedaref State (a) Percent Population Access to Drinking Water, (b) Sanitation Facilities

(a) Drinking Water by Source

State	Piped into		Deep Well/pump	Dug Well/ bucket	River/canal	Rainwater	Others
	dwelling	Public tap					
Gedaref	12.6	18.8	27.7	13.9	13.8	9.4	3.6
NORTH SUDAN	**50.8**	**4.3**	**15.8**	**9.8**	**12.8**	**--**	**6.4**

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

(b) Sanitation facility by type

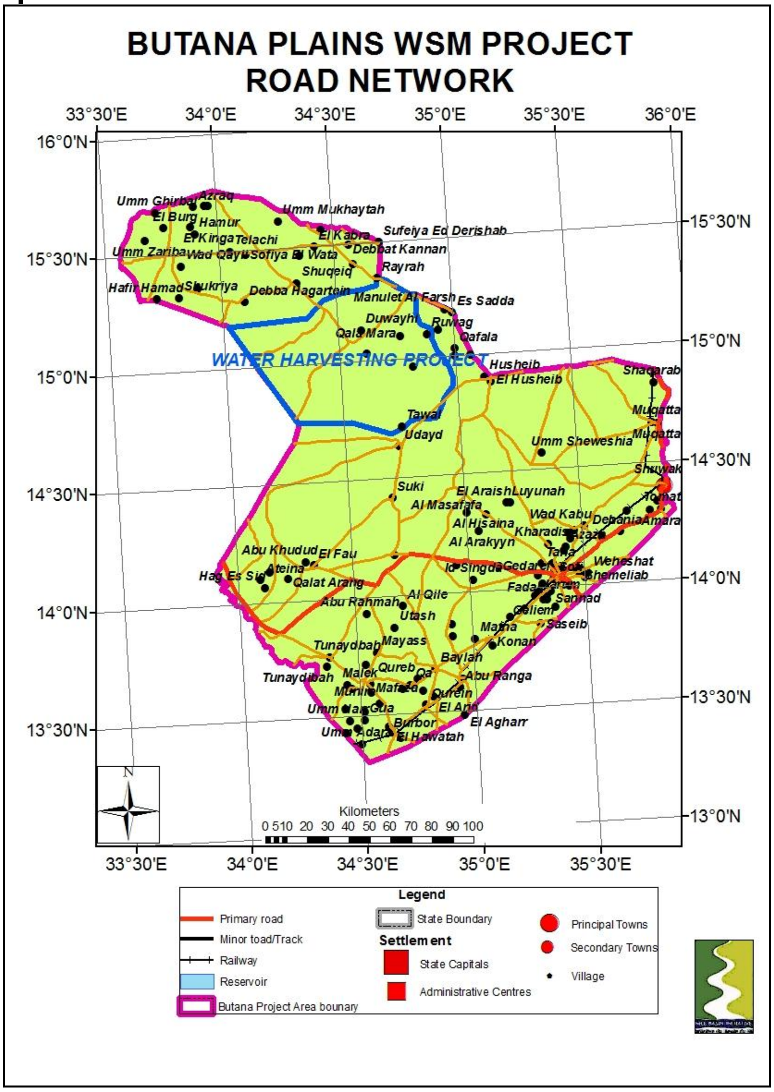
State	Flush to Sewage System	Flush to septic tank	Traditional pit latrine	Soak away pit	Others	No facilities
Gedaref	--	5.0	31.7	3.1	0	60.1
NORTH SUDAN	**--**	**7.7**	**69.2**	**1.6**	**1.6**	**19.9**

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

With respect to water and sanitation facilities Gedaref State is well below the national average with respect to all types of sanitation facilities with 60 percent of households with no facilities..

3.5 Transport Infrastructure and Markets

3.5.1 Transport Infrastructure



Map 15. Road network.

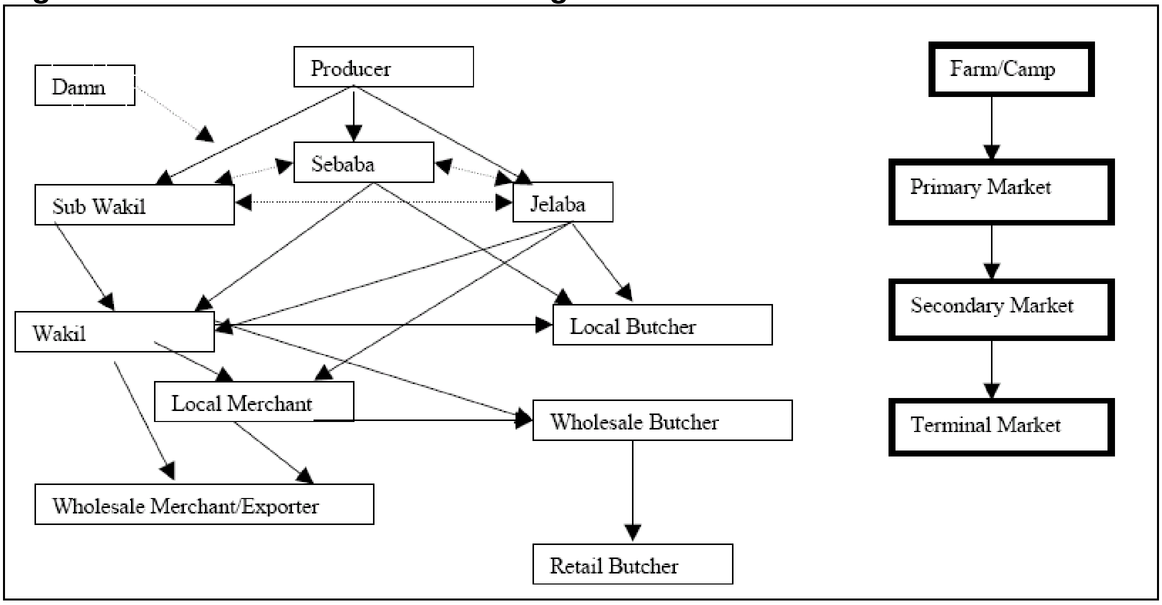
There are some 325 kms of Main Road and 2,677 kms of tracks. In the rainy season and on the Vertisols these tracks are impassable.

3.5.2 Livestock Marketing:

The livestock marketing structure is long established and is based on primary markets at the village level, secondary markets at the provincial level and five terminal markets. The largest terminal market is in Omdurman, which also has three other smaller terminal markets for domestic consumption. Terminal markets are also located at Kosti and El Gedaref.

The main livestock migratory movements are north-south in the dry season and south-north in the rain season, which brings livestock owners closer to the main markets in the wet season. The livestock marketing system is highly broker dominated (Yacob Aklilu, 2002). The brokers buy livestock from the villages and on-sell to brokers in the secondary markets who in turn sell to brokers in the terminal markets. Agents organize the trekking of animals up the marketing chain.

Figure 4. The Livestock Marketing Chain in Sudan.



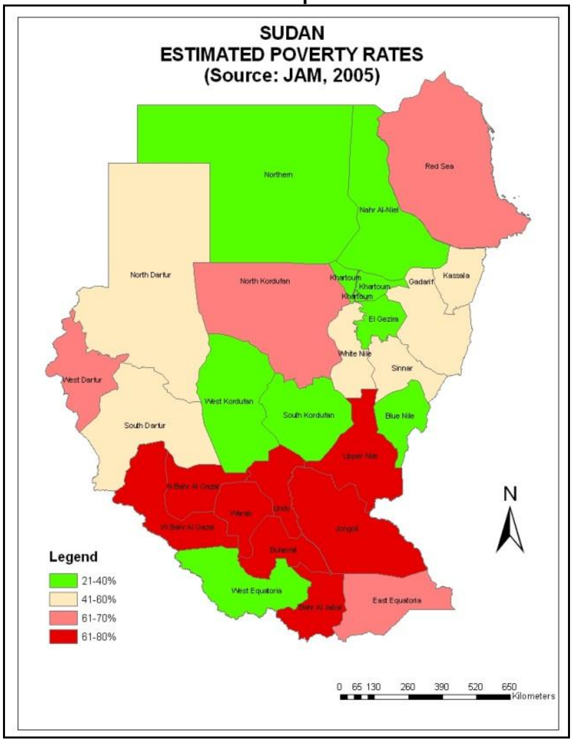
The seasonality in livestock purchasing has led to the practice of feedlots around major markets. Most livestock are purchased "on trust" with payments being made some time after the original purchase with the producer being paid last. Marketing margins are extremely high because of the long distances travelled, costs of trekking, watering, feeding and numerous taxes. In July 2002 the average price at the primary market was one-eighth of the f.o.b. price.

4. KEY ISSUES, CHALLENGES AND POTENTIALS

4.2 Poverty

4.2.1 Extent

The extent and dynamics of poverty in the Sudan since the 1990's has been examined by the Joint Assessment Mission - JAM (2005). It is estimated that in Kassala State 41 to 60 percent of the population are below the poverty line. Map 17 shows the distribution of poverty by State. In this respect Kassala State stands below the northern States with rates below 40 percent, but above those States with rates above 60 percent.



Map 16. Sudan: Distribution of Poverty by State (JAM, 2005)

4.2.2 Loss of Livelihood Assets

Over the past three decades drought and conflict have led to a severe loss of livestock assets and an increasing reliance of crop production using a variety of water harvesting techniques.

Animal losses due to the 1984 drought were estimated (Muna Ahmed et al., 2004) as follows:

Cattle 20%
Sheep 40%
Goats 10%
Camels 5%

Animal losses due to the 1990-1991 drought were:

Cattle 10%
Sheep 15%
Goats 5%
Camels 2.5%

The recent droughts have severely affected camel herds and increased the reliance of the Beja on the faster growing goat and sheep herds. Many pastoralists have also been forced to migrate to the towns in search of employment.

4.2.3 Insecure Livelihoods Asset Base and High Vulnerability

The low rates of poverty from El Gezira to Northern State are a reflection of the assured access to generally low risk irrigated cropland along the Blue and Main Nile. In these areas land is generally held in freehold and perceptions of tenure insecurity are low. Where leaseholds prevail the general secure natural asset base, the availability of physical (pumps, irrigation water) and financial (seasonal credit) assets creates an environment for secure and sustainable livelihoods and low vulnerability.

This is in direct contrast to situation in Gedaref State where the pastoralist do not have secure tenure over their grazing lands (Faki et al, 2008). The Land Resettlement and Registration Ordinance that dates back to 1925 is still largely in force (De Wit, 2001). All unregistered land belongs to the Government, but community rights are recognized over its use under customary rules. Individual land registration is limited; while long land lease applies in public irrigation schemes and large semi-mechanized rainfed private holdings. Despite incentives to increase herds irrationally under communal land use, fairly balanced management and protection of natural resources and harnessing local conflicts had been practiced within the traditional leadership systems. But two legal developments in the 1970s had far-reaching implications on land use. First, the Unregistered Land Act of 1970 transferred all unregistered land to the Government from rural dwellers, especially pastoralists, compromising communal and tribal ownership (De Wit, 2001).

Second, the Local Government Act of 1971 dismantled traditional authorities and largely transferred their functions to local governments that have limited experience and resources to handle issues such as local conflicts. Thus, control over natural resources has undergone profound relaxation resulting in misuse through deforestation and overgrazing. Official regulations governing access to pasture and water in rainfed areas remain rudimentary, but 1984 legislation allowed for pasture land allocation to communities. Water use legislation has been confined to water-pumping from the Nile and its tributaries for irrigation purposes. The existing legal setting for land, pastureland, water, and forests has been diverse and contradictory, giving little or no attention to traditional land use systems, especially grazing (De Wit, 2001).

4.2.4 A High Risk Environment and the Alienation of Natural Resource Assets

An assured and low-risk production environment clearly reduces the incidence of poverty. It enables households to build up assets that reduce their vulnerability to sudden changes in circumstances.

Where livestock are the main livelihood capital assets these too depend on the same high risk environment as well as dwindling rangeland resources in the face of expansion of large semi-mechanized farms. The coping mechanisms that communities and groups have developed over millennia to deal with and recover from natural calamities have been insufficient in the face of insecurity and alienation of basic natural resources. Livestock assets provide a buffer in times of need. Where access to water and forage has becoming limiting for the reason set out above vulnerability to shocks and hazards such rainfall variability and drought becomes more acute.

Decisions to adopt sustainable land management technologies depend on households' asset endowments (human capital). This is especially true for pastoral families because of their need for herding different animal types (camels, cattle, sheep and goats) in different places and times. In efforts to maintain livelihoods some household members have had to leave the farm in order to seek wage employment. This has led to a reduction in households' human capital and the lack of labour for cultivation and herding.

4.3 Population Pressure

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 (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.

There are a number of constraints to sustainably increasing agricultural production. These include poor management practices, inefficient markets, low technology transfer and inadequate agricultural services, low ratio of extension agents/farmer, lack of adapted varieties and insufficient certified seed are responsible for low yields attained. Thus, it is apparent that in many areas there are a number of constraints to farmers breaking out of neo-Malthusian trap and that there will be a continuing negative impact of population pressure.

4.4 Environmental Policy and Institutional Issues

Despite the active role played by Secretariat of the HCENR, which is the focal point for all environmentally related conventions, the HCENR has not been able to perform all its mandated tasks. This is mainly due to the following constraints:

- Most of the state's councils have not been established and this has resulted in weak representation of the HCENR at the state level.

- The council members (ministers of relevant institutions) have never met since the establishment of the HCENR. This reflects the low priority and commitments of the governments towards environmental issues in Sudan. This situation could be explained by the fact that that the country has been weighed down by long years of war and many urgent pressures and that politicians could not allocate the necessary time or resources to cater for environment.

However, this situation is expected to change now after the CPA and the need to follow and adopt a sustainable course of development.

At the field level it was reported that there a lack of horizontal and vertical coordination between and among responsible agencies, organizations and ministries.

4.5 Land tenure and Resource Conflict

Issues of land tenure here include insecurity of tenure, ability to use land as collateral and 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 Sudan. The World Bank Country Economic Memorandum (World Bank, 2003) outlined a number of problems relating to current land tenure and land policy in Sudan:

- it limits access to credit to the majority of farmers who cannot use land as a collateral,

- it does not provide incentives for sustainable land development and management, leading to continual cultivation and destruction of soils in the semi-mechanized farms,

- because land has not been demarcated, there are conflicting land use rights between pastoralists and sedentary crop farmers, which has led to civil strife,

- reform is inseparable from need for rural reconstruction and establishing agricultural credit institutions.

These problems have been re-iterated in the World Bank's latest Country Economic Memorandum (CEM) (World Bank, 2009). The issue has been addressed in the Agricultural Revival Programme (ARP) (2008-2010) as one of eight key success indicators. The World Bank's CEM concludes:

> *Until there is a land policy that transfers the wealth inherent in land from the state (the government) to the people on the basis of long-term tradable leases, be it through statutory or customary law, incentives to invest in agricultural and pastoral land will remain negligible. The consequences of low investment in arable land and rangelands are low productivity and hence high costs for domestic consumers and low competitiveness for agricultural exports and inevitably slow growth of the economy.*

Whilst Land Commissions have been established under the ARP no decisions have yet been made on a future land policy.

A key problem has been the lack of a National or Regional Land Use Plans that could strategically guide land development activities. Thus the expansion of the mechanized farm sector was largely uncontrolled. No assessments were made on the environmental, social or economic impacts of these very large developments.

It is understood that States are mandated to develop Regional land Use Plans but as yet no guidelines appear to have been issued. There is some debate as to whether there should be a national Land Use Plan that would provide at least a strategic framework for State Plans. A pre-requisite of any National or State Land Use Plans is a thorough reform of the Land Tenure Policy.

4.6 Agricultural Extension and Availability of Credit

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 higher the discount rate the shorter the time horizon. 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. A number of studies have found that adoption of natural resource conservation technologies is negatively related to high discount rates. However, where a technology is risk reducing (e.g. water harvesting, soil moisture conservation structures, small-scale irrigation) adoption is much more likely.

Currently credit and extension for the traditional agricultural sector are very weak. The extension worker-to-farmer ratios are very low indeed. Credit and input supply services have hitherto focused on the large-scale irrigation sector. The main problems are non-viable collateral, small loan levels, geographical distance and logistics of recovery. Attempts have been made to form cooperatives but without success. The main constraint to a successful resolution of a s*ustainable* credit system is a land policy that provides farmers and pastoralists with the equivalent of long-term tradable leases which can be used as collateral to stimulate commercialization of the traditional rainfed farming system (World Bank, 2009)

However, this situation may soon improve with the signing of a Micro-finance project between the GoS and the World Bank for a sum of US$ 269 million over 6 years. This will be aimed in part at the traditional agricultural sector (FAO/WFP, 2006).

4.7 Natural Resource Degradation

Natural Resource degradation in the Butana has been studied in detail by Mariam Akhter (1993) and Muna Mohamed Elhag (2006). The former study examined in particular changes in vegetation that were taking place as a result of over-grazing.

In general, the concentration of vegetation and variety of species decrease in all the ecosystems from southeast to northwest, reflecting the decline of rainfall towards the north (Map 8). In the north, vegetation is restricted to shallow depressions and wadis because of comparatively favourable ground water conditions. Irregular exploitation takes place in wetter years, when these areas provide rich grazing grounds leading herds to move northward from the central Butana almost up to the Atbara River.

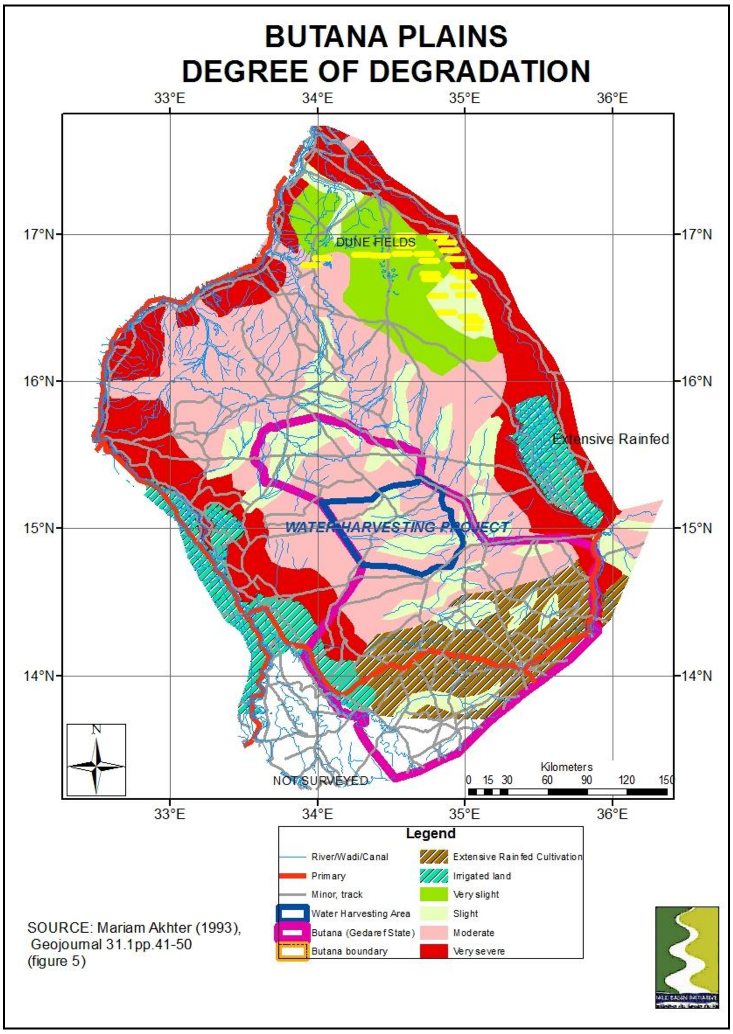
Over the Basement Complex rocks there are extensive grass areas with an estimated plant cover of 65 percent. Woody vegetation in this area is almost entirely found in wadis, in shallow basins and around inselbergs (*jebels*). This area represents the main grazing grounds for pastoralists' livestock. The extensive grass cover decreases to grassy patches with an estimated plant cover of 25% .

The dominant species in these extensive grass areas are as follows: *Schoenefeldia gracilis* (Dembelab), *Aristida* spp. (Gau), *Cymbopogon* spp. (Nal, Mahareb), *Ocimum basilicum* (Rehan) and *Urochloa trichopus* (Taffa). The latter, species only recorded formerly in northern areas of the Butana is not regarded highly by the herdsmen and has spread dramatically in the Butana after the drought of 1984. This is in the more traditional homelands of the Shukriya in the eastern Butana where sufficient water supplies in the wadis have led to a severe vegetation transformation due to selective overgrazing. During this time, species of higher nutritive value, such as *Ipomoea* spp. (Huntud) and *Blepharis* spp. (Siha) almost completely disappeared.

After a slight decrease, the variety of species starts increasing again towards the north indicating the survival of those species which were eliminated further south due to heavy grazing just north of the area of the Semi-mechanized farms. The quality of grazing grounds in the arid more north parts of the Butana is better than in the more humid south.

The study by M.M. Elhag used satellite imagery to determine changes in rainfall and vegetation patterns over a 15 years period. Five classes of land use were achieved using unsupervised classification. An image difference technique was applied for 1987-1996 and 1987-2000. This analysis showed that the bare soil and eroded land increased by 3-7% while the vegetated area decreased by 3-6%. Also when comparing the aerial photographs (1960s and 1980s) for Shareif Baraket, Kamlin and El Maseid with Landsat images (2000) severe degradation of the vegetation cover was visible at all the three sites.

The Moving Standard Deviation Index (MSDI) is calculated by performing a 3×3 moving standard deviation window across the band 3 Landsat images (1987, 2000). MSDI proved to be a powerful indicator of landscape condition for the study area. The MSDI increased considerably from 1987 to 2000, especially for Sufeiya, Sobagh and Banat areas, which are referred to as severely degraded sites in the literature. The Bare Soil Index (BSI) supports the finding from the MSDI. The BSI for the degraded sites Sufeiya, Sobagh and Banat increased from 0-8 in 1987 to 32-40 in 2000. The image difference of the BSI indicated that the index increased by about 14-43 over the 13 years.



Map 17. Degree of Land Degradation on the Butana Plains (Mariam Akhtar (1993)

5. IDENTIFICATION OF WATERSHED MANAGEMENT INTERVENTIONS

5.1 Review of Current Interventions

There are a number of on-going projects of relevance.

(v) The Eastern Rehabilitation and Development Project

This three years project is funded by the EU covers activities in Gedaref and Kassala States with total funding of EUR10 million. In Gedaref State it is supporting with the development of water harvesting structures. The project is due for completion in 2011. It has built up considerable experience in the development of the macro teras and farmer capacity building in water control and crop husbandry.

(vi) World Food Programme (WFP)

WFP is involved with supporting tera construction and hafir construction and rehabilitation. These activities are supported by food for work (WFP, 2008).

(vii) IFAD Butana Integrated Rural Development Project

The overall project goal is to improve the livelihoods of poor rural households in the target area, and strengthen communities' resilience in the face of drought. The project targets smallholder pastoralist households in the sand dunes and clay plains of the region, households engaged in irrigated farming and smallholders who migrate seasonally with their herds. Open access to range and water resources in the region has led to severe environmental damage around water facilities and also led to acute water shortages.

Livestock production and marketing is the most viable economic activity in the Butana region, and raising productivity is an effective way of creating lasting improvements in living conditions and household food security for the poorest farmers in the project area. It is also a good way of increasing women's economic status in the community and home. The project also helps develop crop production, and small off-farm enterprises, especially dairy processing.

The specific objectives of the project are to:

- support improvements in natural resource governance to ensure regulated access to land and water resources in the region for all;
- improve the access of women and men to livestock markets and strengthen their bargaining position within markets, by rehabilitating market infrastructure and by establishing market information systems and organizing producers' groups
- build the capacity of grass-roots organizations to design and implement environmentally sound development initiatives that include women and marginalized social groups

Total cost: **US$29.9 million**
Approved IFAD loan: **US$24.8 million**
Duration: **2008 – 2016**
Directly benefiting: **40,000 households**
Status: **Ongoing**

5.2 Project Stakeholders

5.2.1 Primary Stakeholders

The Primary Project Stakeholders include:

- Pastoral and Agro-pastoral households from the various ethnic groups from within and outside the Project Area who use the grazing lands within the Project Area.
- Agricultural households who focus mainly on crop production within the Project Area.
- Staff of the Gedaref State Ministry of Agriculture, Ministry of Livestock Production and Ministry of Irrigation who will receive increased technical and logistical support.

5.2.2 Secondary Project Stakeholders

The Secondary Project Stakeholders include:

- Pastoral and agro-pastoral households from outside the Project Area who will benefit from reduced conflict over grazing resources because Group grazing areas have been clearly defined in the participatory Community and Strategic level land Use Planning.

5.3 Proposed Watershed Management Interventions

5.3.1 Selection of Project area

The Project Area has been defined at two levels:

- The Butana Plains within Gedaref State (the Butana Plains being defined along their southern border by the railway line);
- Water Harvesting Watershed Area located in El Faw Locality

The selection of the Butana Plains for rangeland rehabilitation activities was made on the basis that the IFAD Project did not cover certain areas of the Butana within Gedaref State and that the current proposed project would complement the IFAD project and would make a substantial contribution to arresting and re-habilitating rangeland within the proposed area. The proposed area for water harvesting activities was made on the recommendations of the Gedaref Ministry of Irrigation. It provides a focused area for specific water harvesting activities for both crop and forage production.

5.3.2 Water Harvesting

The project will build on the experience gained in the implementation of the EU supported Eastern Rehabilitation and Development Project, particularly in the field of water harvesting structures. These will include traditional teras, libish, wild flooding and small dams. Support will be provided to:

- provision of machinery and equipment for field layout surveying, bund and dam construction, tree removal and chisel ploughing;
- farmer training in water management and crop husbandry;
- On-farm research into water management, improved crop variety selection (sorghum, cucumber, water melon and okra);
- Forage production, including seed multiplication;
- On-farm tree planting for fuelwood and forage.

5.3.3 Rangeland Development

The rangeland pastures within the Project area are utilized both by resident population and season migrating pastoralists from the south and the north. Pasture resources in some areas are over-utilized leading to rangeland degradation and under-utilized in other areas that have no wet season water supplies. The project will support rangeland improvement activities and provision of carefully located water supplies to open under-utilized rangeland. Specifically the project will support:

- Seed multiplication of local grass varieties in fenced multiplication plots;
- Seed/seedling multiplication of valuable forage trees (e.g. *Balanites aegyptiaca, A. tortilis*)
- Rangeland re-seeding by pastoralists;
- New livestock water supplies in under-utilized areas of pasture;
- New water supplies along designated stock routes into the area;
- Re-habilitation of existing *hafirs*;
- Execution of a hydrological survey to determine ground-water potential of the Project area;
- Improvements to livestock market infrastructure;
- Training of para-vets and Community Livestock Health Workers.

5.3.4 Supporting Interventions

In addition to the support to water harvesting and rangeland improvement activities the project would provide assistance to a number of supporting activities. These would include:

- Mesquite eradication;

- Training for selected off-farm employment opportunities (both men and women);
- Support to the establishment of Savings and Credit Cooperatives and Micro-finance Institutions for provision of production and marketing credit;
- Support to improvement and increase of value chain addition (product storage, improved processing) and to market linkages;
- Support to establishment and legal recognition of Farmer/Pastoralist Associations for improved access to inputs and markets.

6 Anticipated Benefits

There are a number of local, regional and global benefits that would accrue to the Project.

At the local level degradation of rangeland would be arrested, livestock feed supply increased with increases in livestock productivity. There would be a more equitable access to natural resources reducing conflict between resource users and reliving pressure on both the dry and wet season grazing areas. Households ability to withstand natural and socio-economic shocks would be strengthened. Household assets would be increased and there would be a widening of households' livelihood strategies.

At the regional level increased ground cover would increase infiltration to groundwater and raise ground water levels.

At the global level species and habitat biodiversity would be enhanced and carbon sequestered in woody and herbaceous biomass and in soil organic carbon.

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EASTERN NILE TECHNICAL REGIONAL OFFICE

NBI – Institutional Strengthening Project
PROJECT DELINEATION AND PRIORITIZATION

ANNEX 4.7
PIBOR WATER HARVESTING PROJECT

(FINAL)

7th June 2011

CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AHD	Aswan High Dam
AHDA	Aswan High Dam Authority
ARPA	Aswan regional Planning Authority
BCM	Billion Cubic Meters
C	Carbon
CAP	Compliance Action Plan
CAPMAS	Central Agency for Public Mobilization and Statistics
CIDA	Canadian International Development Agency
DRC	Desert Research Centre
DRI	Drainage Research Institute (NWRC)
EEAA	Egypt's Environmental Affairs Agency
EEIS	Egypt Environmental Information System (a CIDA project at EEAA)
EHD	Environmental Health Department (MOHP)
EIA	Environmental Impact Assessment
EIMP	Environmental Information and Monitoring Program
EMUs	Environmental Management Units
EOHC	Environmental and Occupational Health Center (MOHP)
ERC	Environmental Research Council
FAO	Food and Agriculture Organization of the United Nations
GOE	Government of Egypt
GOFI	General Organization for Industrialization
HAD	High Aswan Dam
IDRC	International Development Research Centre (Canada)
LCD	Liters per Capita per Day
LE	Egyptian Pound
MAB	Man and the Biosphere
MALR	Ministry of Agriculture and Land Reclamation
masl	meters above sea level
Mm^3	Millions of cubic meters
MSEA	Ministry of State for Environmental Affairs
MOHP	Ministry of Health and Population
MHUNC	Ministry of Housing, Utilities and New Communications
MOI	Ministry of Industry
MWRI	Ministry of Water Resources and Irrigation (previously MPWWR)
NAWQAM	National Water Quality and Availability Management (CIDA project)
NEAP	National Environmental Action Plan
NOPWASD	National Organization for Potable Water and Sanitary Drainage (MHUNC)
NRI	Nile Research Institute, NWRC (previously known as: HADSERI)

NWRC	National Water Research Center, MWRI
NWRP	National Water Resources Plan
PRIDE	Project in Development and the Environment (USAID)
RIGW	Research Institute for Groundwater (NWRC)
SLR	Sea level rise
TDS	Total Dissolved Solids
TSP	Total Suspended Particles
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
USAID	United States Agency for International Development
VOC	Volatile Organic Compounds
WFP	World Food Programme
WHO	World Health Organization
WPAU	Water Policy Advisory Unit (MWRI)

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[15] 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 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

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

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 Transboundary 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 Transboundary 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 Pibor Water Harvesting Project located in Pibor County in Jonglei State of southern Sudan.

1.2 Primary Objectives of the Project

The plains are drained by a network of very shallow water courses running northwards. The range Ecology Survey recommends that low bunds could be constructed across these to produce better and longer lasting pasture. The ditch in front of the bund would act as a hafir. The value of these bunds would be enhanced if they were coupled with a more systematic approach to burning. Burning should take place earlier to take advantage of soil moisture but not too early to destroy the economically important supplies of thatching grass.

Forage development would be implemented through fodder banks at the permanent homesteads for calves and lactating female stock. The Project would support this with the multiplication and supply of improved forage grass seed.

During the civil war an extremely successful large-scale community-based animal health worker system was established during hostilities and its important role in the eradication of rinderpest. The system is now in place for more routine animal health support.

The project would support the delineation and demarcation of stock routes ("Nomad Paths") with watering points and holding grounds together with quarantine arrangements with Uganda, Kenya and the Democratic republic of Congo.

Other supporting interventions would include:

(i) Capacity Building
(ii) Strengthening Extension Service
(iii) Support to State-wide Strategic Land Use Planning
(iv) Support to Community Level Land Use Planning

2. NATIONAL SETTING - SUDAN

2.1 Bio-physical and Socio-economic Setting

Sudan covers an area of approximately 2.5 million km2 and in 2002 an estimated population of 31.3 million with an annual growth rate (1998-2003) of 2.6 percent. The projected 2025 population is 49.6 million. The total, rural % and growth rates by region are shown in table 3.

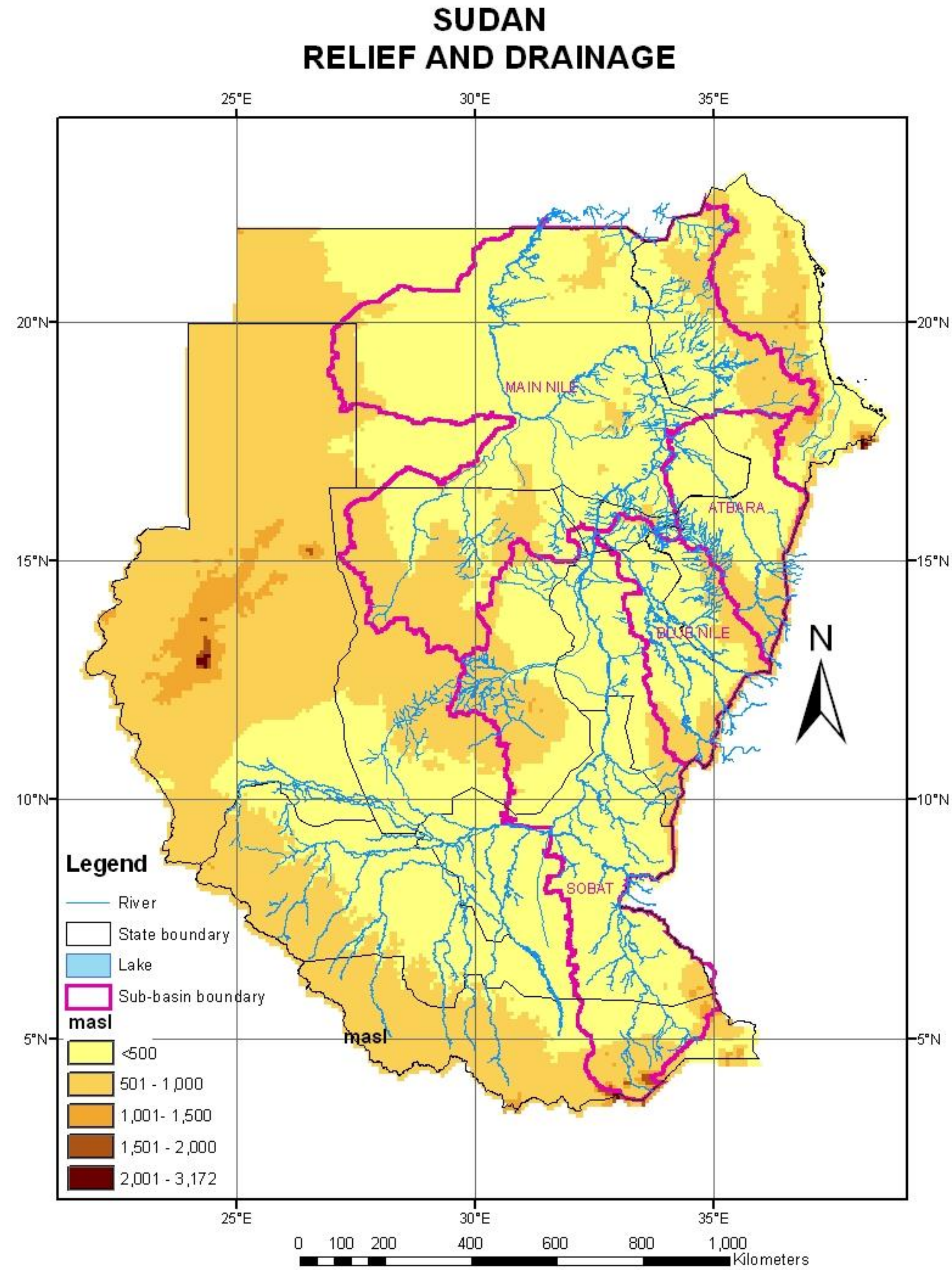
Table 3. Sudan: Total population, Rural % and growth rates by Region (2002)

REGION	TOTAL POP ('000) 2002	RURAL %	TOTAL GROWTH RATE
Eastern	3,360.5	57%	2.25%
Northern	1,392.5	75%	1.85%
Khartoum	5,301.3	14%	4.04%
Central	6,278.7	70%	2.80%
Kordofan	3,512.0	74%	1.50%
Darfur	6,212.6	82%	3.01%
N. Sudan	26,057.0	60%	2.58%
S.Sudan	5,283.3	79%	1.61%
SUDAN	31,340.0	65%	2.64%

Source: Y.A.Mohamed (2005)

Overall population density is 12.4 p.p.km2 but this masks considerable variations. Population tends to concentrate along the streams and rivers and other water sources.

The relief and drainage of Sudan are shown in Map 2.



Map 2. Sudan: Relief and Drainage.
Source: Shuttle Radar Terrain Mission (SRTM 90) digital terrain model.

Land under 500 masl occupies the central White and Main Nile valleys as very gently sloping plains. Higher land is found along the eastern edge as outliers of the Ethiopian Highlands together with the Red Sea Hills. The southern and southwestern edges of the basin form the Congo-Nile watershed. The Jebel Marra forms the Nile-Lake Chad watershed along the western border. Locally hills and mountains rise above 1,500 masl (e.g. the Imatong Mountains being the country's highest point at 3,224 masl).

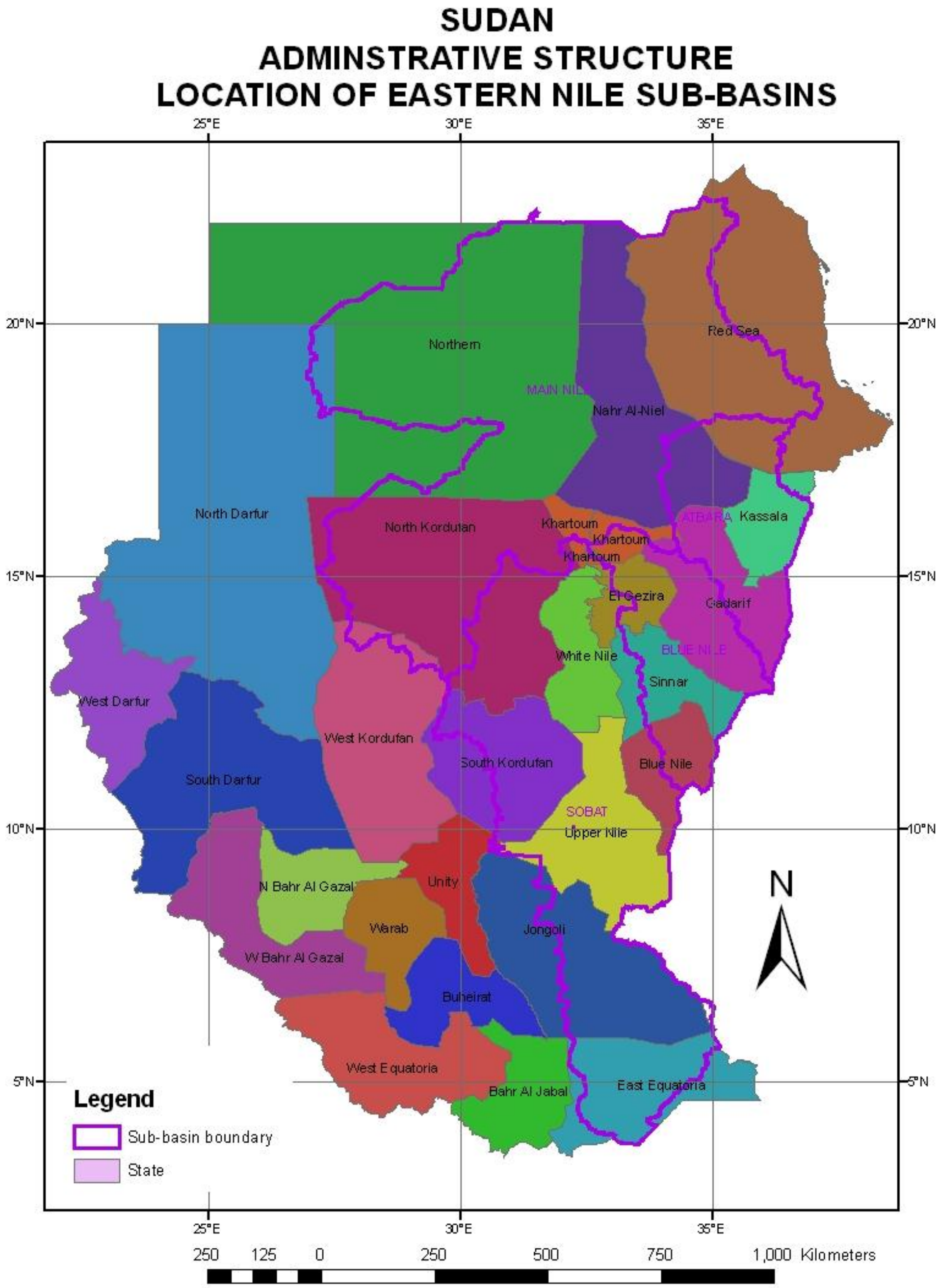
The Bahr el Jebel enters Sudan from Uganda with the Bahr el Ghazal forming on the northern slopes of the Congo-Nile Divide. They join at Lake No to be known as the White Nile. They both lose much water through evaporation in the Sudd. Just above Malakal the Sobat River, which rises in the southwestern Ethiopian Highlands, joins the White Nile. At Khartoum the White Nile is joined by the Blue Nile, which rises in the Central and Northern Ethiopian Highlands. Thence known as the Main Nile it is finally joined by its last tributary the Atbara, which also rises in the northern Ethiopian Highlands. There are many seasonal wadis and khors, which flow intermittently during the rainy season. Locally they are of considerable importance in small-scale irrigation, water harvesting and human and livestock water supplies.

The country encompasses three major ecological zones: desert, semi-desert and savanna. Annual rainfall varies from less than 25 mm in the north to 1,500 mm in the south. Rains are erratic and variable, increasingly so in the north. Rains fall in a single season and are closely related to movements of the inter-tropical convergence zone (ITCZ).

Soils in the Sudan are commonly classified into four groups: (i) thin desert soils consisting of loose sand over bare rock in the north, (ii) fixed or shifting aeolean sands in the north and central parts, (ii) clay soil derived from old and recent alluvium over large areas of the central and eastern parts, and (iv) lateritic soils on the ironstone plateau in the southwestern part of the country.

Natural vegetation closely follows the rainfall patterns with local edaphic variations related to soil moisture conditions. Successively from the north are desert, semi-desert, woodland savanna on clay, woodland savanna on sands, high rainfall woodland and swamps. Large areas of the central woodlands on clay have been cleared for semi-mechanized farming and other areas of woodland are under severe pressure from traditional farming, and fuelwood and charcoal production for both urban and rural household consumption.

2.2 Administrative Structure



Map 3. Sudan: Adminstrative Structure with Eastern Nile Sub-Basin Boundaries.
Source: ENTRO GIS data base:

In the past five years Sudan has embnarkled a policy of administrartive decentralization. According to the Local Government Act of 2003, the Sudan has been divided into 26 States, some 16 located in the north and 10 in the south (Map 3). Each State is divided into anumber of Localities (Mahaliyat). The aim of decentralization is to improve the delivery of basic social services and address the severe spatial disparitries in access to education, health, water, agricultural extension and other government services.

Decentralization and concommitant capacity building will be undertakenn over two pahses: Phase I (2005 – 2007) and Phase II (2008 – 2011). Priorities in the local government will be:

- Enhancing managment capacity by empowering suitable structures to lead reform;
- A broad consultation on organizational structures;
- Developing a comprehensive strategy for institutional arranbgement, polices and guidleines for public services and training;
- Improving systems and practices of local publicprivate partnerships in service delivery;
- Support to Locality development planning;
- Improving Locality information systems;
- Establishing Locality monitoring systems;
- Promoting civil society participation in planning and organization of governmenbt activities;
- Mobilizing local revenue generation for State and Local Government.

2.3 National and Regional Policy Framework

2.3.1 The National Comprehensive Strategy (NCS) (1992-2002)

Sudan's main objectives and priorities for sustainable development were spelt out in the National Comprehensive Strategy (NCS) which provided policy directions to all economic and social sectors. The NCS incorporates the country's environmental strategy, which states clearly that environmental issues must be embodied in all development projects. Within the NCS, the government manages the economy through a series of three years rolling plans and annual budget processes. The NCS has also served as a key reference document and basis for sectoral policies and measures.

A main weakness of the NCS is the lack of coherence as it was a result of work of different sectoral teams without emphasis on horizontal and vertical integration

2.3.2 Comprehensive Peace Agreement CPA

The Comprehensive Peace Agreement (CPA), signed between GoS and SPLMA on 9 January 2005, represents a remarkable event in the history of Sudan and is a major opportunity for restoring peace and the social contract between the state and society in the country.

The CPA provides for a socially informed land tenure policy and legislation as it accords specific reference to ownership of land and natural resource. It calls for competency in land administration, provides for incorporation of customary laws and practices and establishes an independent Land Commission for the purposes of arbitration, rights of claims in respect to land, land compensation and the possibility of recommending land reform policies.

The CPA is expected to have many implication (institutional and administrative) - e.g. the establishment of a Land Commission for the south parallel to existing central institutions responsible for land and natural resources management.

However, there is the question of the existing sectoral environmental legislation. Should that legislation remain federal as it is currently stands, or should it be amended and passed down to the states in accordance with the obligations given to them by the federal structure? (NBSAP,2002)

There is now a counterpart ministry of Environment and Wildlife in Southern Sudan and it is expected that the post CPA developments will witness greater decentralization on all levels. This will necessitate the initiation of a dialogue on developments in the sub-basins in Sudan as a basic requirement for sustainable development in the sub-region. Of special concern also are issues related to conflict resolution, internally displaced refugees, good governance, and the rights of the socially, economically and politically marginalized groups in post conflict Sudan

2.3.3 The Joint Assessment Mission (JAM) (2005)

The JAM Reports are the most recent documents which are guiding the economic development in post peace period in Sudan. The reports have developed the policy guide lines and interventions in eight clusters, including the economic policy cluster. The issue of environment has been classified as one of the cross-cutting issues. The report identified many environmental challenges Sudan is facing and need to be addressed during the short and medium term to enable the country make an equitable and sustainable development in the foreseen future.

The JAM report has stated that the foremost challenge is to minimize the negative environmental impacts that returning refugees and Internally Displaced

Populations (IDPs) may pose on the natural resources base through increased deforestation and destructive agricultural practices

2.3.4 Poverty Reduction Strategy (2000)

Under the coordination and leadership of the Ministry of Finance and National Economy, Sudan is also in the process of formulating a national poverty reduction strategy. This strategy is expected part of the country's long-term strategic plan and seeks to involve all groups of Sudanese society.

The preliminary draft of the PRSP was prepared in January 2004 with participation and contribution of a number of highly qualified national experts, The PRSP is considered to be the main available document of the government of the Sudan for poverty reduction. It covers the sixteen States of North Sudan for the period 2005-2007.

PRSP main objectives are:

- Maintain Economic Stability.
- Ensure Political Stability
- Social Stability.
- Environmental integrity
- Improve standards of living
- Assist in the flow of financial resources.

2.3.5 Environment Protection Act 2001

In 2001, the Higher Council for Environment and Natural Resources (HCENR) initiated the development of environmental regulations under the Environment Protection Act which was issued through a presidential decree. It established guidelines and requirements for environmental impact assessments and environmental conservation frameworks.

The Environmental Protection Policy (2001) requires that any new projects that are deemed to have an impact on the environment conduct an Environmental Impact Assessment (EIA). This must be done in order to obtain an Environmental Compliance Certificate (ECC) from the HCENR through the receipt of an Initial Environmental Impact Assessment (IEA) Report. This report should contain a Mitigation Plan or a description of the mitigation measures to be implemented to reduce the environmental impacts of the proposed project.

The EIA report is normally made available for viewing and comment by interested and affected parties prior to the HCENR giving the go ahead with the project.

This legislation represents a major step in coordinating national developmental projects on an environmentally sustainable basis

2.3.6 National Water Policy (2001) - Draft

Through a process of consultations with stakeholders, a Draft National Water Policy was prepared. The policy builds on experiences of a wide range of experts and institutions involved in water sector. The draft policy document assesses the water situation in the country, existing policies and legislation and then provides the main policy principles and statements. These policy principles are considered under water resources, water utilization, water and environment, international issues, socio-economic issues, disaster management and institutions and capacity building. It also recommends development of strategic plan for the water sector.

The objectives of the NWP are to:

- Review and adapt water policy to meet changing circumstances within the country;
- Ensure that the water resources of Sudan are properly managed, protected and efficiently utilized for the benefit of all;
- Provide the basis for the on-going development of water related regulations and legislation, and
- Strengthen and clarify the functions and responsibilities of water related institutions in both the public and private sectors in Sudan

Part 3 of the Water Policy (2001) addresses issues related to water and environment. It examines at policy as it affects the environment and related matters such as pollution and catchments degradation.

2.3.7 National strategies in response to Multilateral Environmental Agreements (MEAs)

(i) Agenda 21 Project - Sudan

In response to Agenda 21 (Rio Earth Summit 1992) a project was implemented in Sudan to build the capacity needed to meet the challenges of the Twenty First Century. The project helped to build capacities of government institutions, the private sector and non-governmental organizations to implement sustainable development projects. The project played an important catalytic role in promoting community level environmental protection. The project succeeded in building the capacities of Two State Environmental Councils and in the preparation of Environmental Action Plans for 4 States. This provided the basis for a ground level identification of a National Agenda 21 and initiated the formulation of a National Sustainable Development Strategy.

(ii) National Biodiversity Strategy and Action Plan (NBSAP)

In 1995, the Sudan government has become party to the Convention on Biological Diversity (CBD). The Government developed with GEF support and technical assistance from World Conservation Union (IUCN) its first National Biodiversity Strategy and Action Plan in May 2000 and its first Country Study on Biological Diversity in April 2001. The NBSAP outlines strategies, priorities and actions for biodiversity conservation and protection of natural ecosystems

(iii) National implementation Strategy for the UN Framework Convention on Climate Change

In 1992, the government of Sudan signed the United Nations Framework Convention on Climate Change (UNFCCC), and ratification took place in 1993. An enabling activity for climate change funded by GEF/UNDP was implemented by the HCENR. The project conducted many activities including training, a Greenhouse Gas inventory, a vulnerability and adaptation assessment and mitigation analysis and an intensive awareness program. As part of complying with its commitments to the Climate Change Convention, Sudan completed its National Communication under the UNFCCC in February 2003.

To fill the gaps and short comings of the vulnerability and adaptation assessment to climate change a three-year project is being implemented as part of the "Global Assessment of Impacts of and Adaptation to Climate Change (AIACC)" through GEF/UNEP. This project aims at enhancing the scientific and technical information, assessing the impact of climate change and designing cost-effective response measures needed to formulate national policy options.

(iv) National Action Plan (NAP) to Combat Desertification

In November 1995 Sudan ratified the United Nations Convention to Combat Desertification (UNCCD). The National Drought and Desertification Control Unit (NDDCU) has been designated as the national focal point to the UNCCD. The NDDCU identified the States that are affected by the desertification process. As part of its commitments under this convention, a National Action Programme (NAP) has been prepared in April 2002.

The challenges which face the implementation of NAP in Sudan include lack of a coherent national land use plan, dependence of household energy on forests products, expansion of mechanized rain fed agriculture and the civil war.

(v) Other International Environmental Obligations

Sudan is also involved in key GEF funded regional initiatives under the international waters operational programmes and is an active player in all these initiatives. These include the Kijani Initiative, the project for the Protection of Key "Bottleneck" Sites for Soaring Migratory Birds in the Rift Valley and Red Sea Flyway, the Nile Transboundary Environmental Action Project, the Strategic Action Programme for the Red Sea and Gulf of Aden (PERSGA) and the project for the Removal of Barriers to the Introduction of Cleaner Artisanal Gold Mining and Extraction Technologies.

2.3.8 Policy Issues in Southern Sudan

(i) Land Policy Issues in Southern Sudan

Land Policy in the South is currently based on customary law, and there are considerable inconsistencies in how customary laws are applied in different Regions. One common principle is that "land belongs to the people" which is different from the North where nearly all land has been declared government land. It is generally agreed that land laws in the South are not sound because of the lack of tenure security. In addition, the conditions for land utilization are not clear. This lack of tenure security and lack of clarity on land utilization conditions weaken incentives to invest. The JAM considers that a land law review is required. There is an upcoming Land Commission for Southern Sudan that will consider future land policy in detail for the South. It is anticipated that land policy in the future constitution will be based on the conclusions and recommendations of the Land Commission.

(ii) Natural Resource Development and Management Policy in Southern Sudan

A USAID assessment of environmental threats and opportunities in Southern Sudan (Catterson et al., 2003) noted with concern the views expressed by the Technical Committee on Natural Resources Management and Utilization that the wetlands in Southern Sudan "*represent prime agricultural lands in Southern Sudan. Although these wetlands can also be used for livestock watering and grazing, sanctuaries to thousands of bird species etc., their main function should be for the production of cereal crops such as maize, sorghum, rice, etc.*"

Howell et al. (1988) refer to a number of studies into the possibility of utilizing the seasonally flooded clay plains and in particular to the ILACO field trials into large-scale irrigated cropping. They enumerate the many technical problems encountered. At the end of a 9 year study (1976-1984) they concluded "...*any* *new programme of development must begin where others were forced to leave off and must preceded by a thorough examination of the experience gained in this interlude in the violent and damaging history of the area in the last 33 years.*"

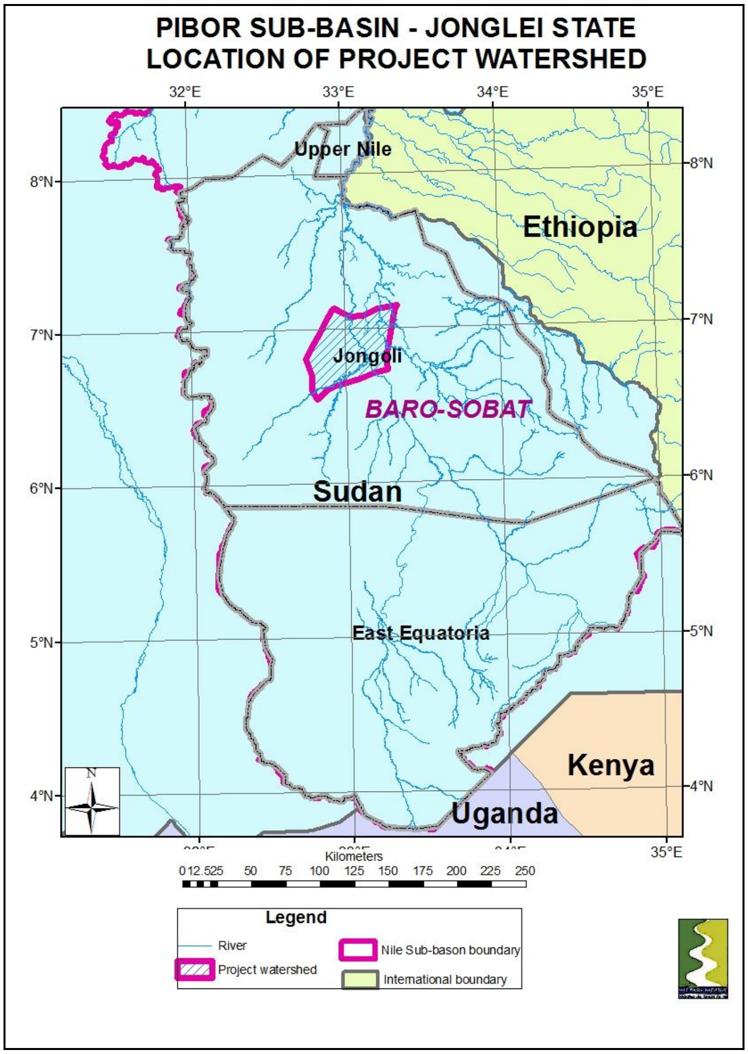
The USAID study states that whilst these development aspirations are understandable it hopes that they will be tempered by effective environmental review and any plans for development be formulated in close and well-informed consultation with affected communities.

3. PIBOR WATERSHED - BIOPHYSICAL AND SOCIO-ECONOMIC SITUATION

3.1 Biophysical Characteristics

3.1.1 Location and Extent

The Project Area is located in the upper reaches of the Pibor River in the Pibor Payam in Pibor County of Jonglei State. It encompasses the whole of Pibor Payam and is some 1,482 km2 in extent.

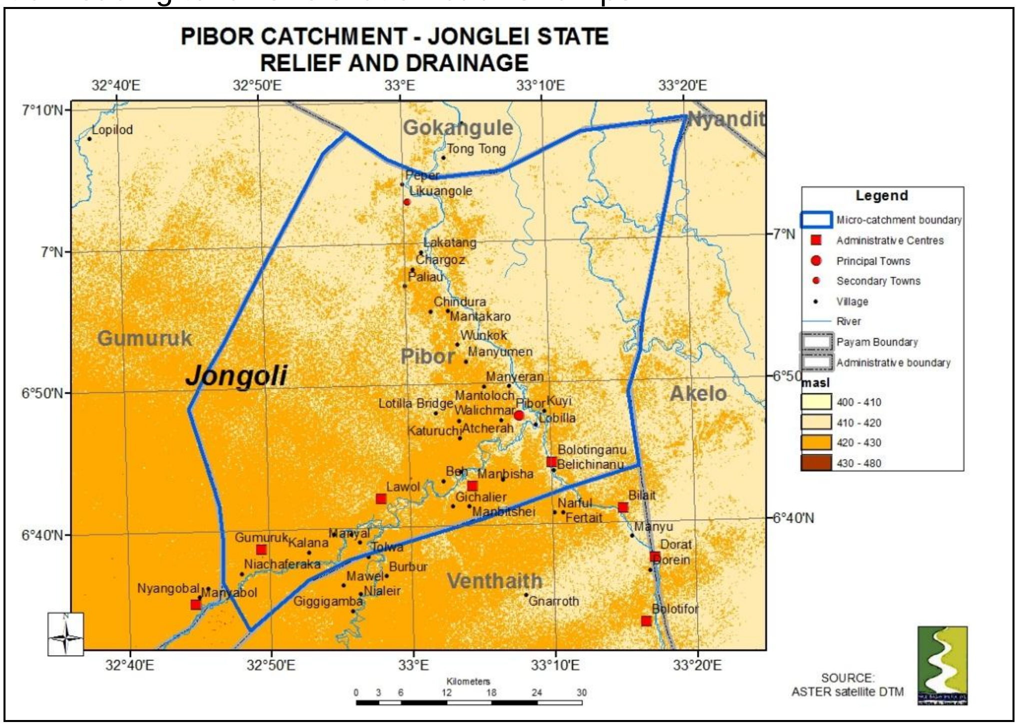


Map 1. Location of Project Watershed

3.1.2 Relief and Drainage

(i) Relief

There is little or no relief in the Project Area. Altitude ranges between 415 and 425 masl. Along the main river there appears to be a levee of slightly raised elevation leading to lower elevation back swamps.



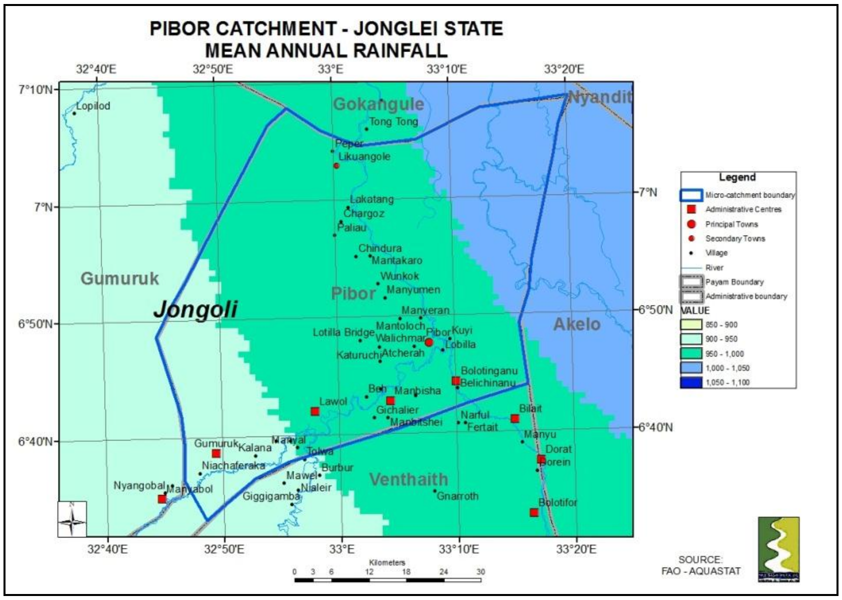
Map 2. Relief and Drainage

(ii) Ground water

3.1.2 Climate

(IV) Rainfall

Mean annual rainfall decreases rom the northeast to the southwest: from 1,050 mm/yr to 950 mm/yr. The rainy season lasts from May to October, with most rain falling between July and September.



Map 3. **Mean annual rainfall**

(ii) Mean annual temperature

Mean annual temperature is 27 °C across the project area.

(iii) Mean Annual Evapotranspiration

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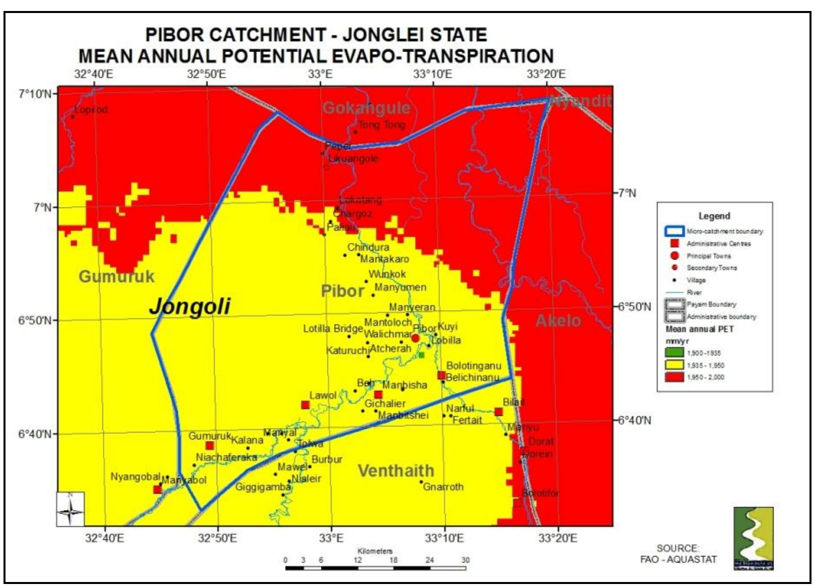
Mean annual evapo-transpiration decreases slightly from the northeast to the southwest: from 2,000mm/yr to 1,935 mm/yr.



Map 4. **Mean annual evapo-transpiration.**

3.1.3 Geology

The whole of the Pibor Sub-basin is underlain by Unconsolidated Sediments.

3.1.4 Soils

The whole of the project area is covered with Vertisols. These are very deep, black cracking clay soils.

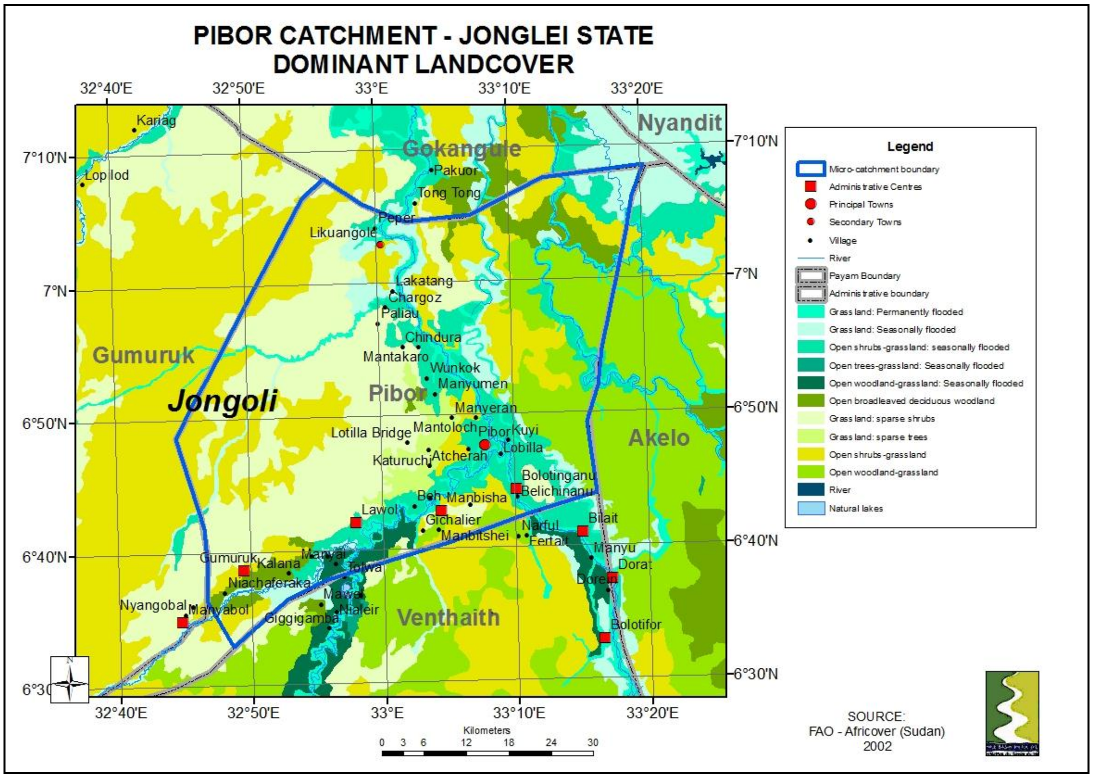
3.1.5 Land Cover / Vegetation

(iii)Landcover

Some 7 percent of the Project Area is covered with permanently flooded swamp land. Seasonally flooded grassland, open shrubland ad open woodland with grassland covers 19 percent of the area. It is the seasonally flooded land that provides the early to mid-dry season grazing, and which would be the subject of the water harvesting activities. Non-flooded grassland covers 35 percent of the area. The open broadleaf woodland is confined to the river edges and is riverine woodland.

Table 1. Wadi Allaqui (Sudan): Dominant Landcover (km2)

LANDCOVER	AREA (KM2)	%
Swamp: Permanently flooded	181	7%
Grassland: Seasonally flooded	226	8%
Open shrubs-grassland: seasonally flooded	291	10%
Open woodland-grassland: Seasonally flooded	40	1%
Grassland: sparse shrubs	886	32%
Grassland: sparse trees	78	3%
Open shrubs-grassland	664	24%
Open woodland-grassland	297	11%
Open broadleaved deciduous woodland	124	4%
TOTAL	**2787**	



Map 5. **Dominant Landcover**

(iv) Vegetation

(a) Acacia seyal-Balanites Savanna

Above 570 mm to about 1,500 masl there is increasing dominance by *A. seyal* in association with *Balanites aegyptiaca*. *A. senegal* is retained for gum arabic harvesting whilst *A. seyal* is used for charcoal production. *B. aegyptiaca* is becoming increasing prevalent because it is fire resistant, does not produce good charcoal and is hard to cut.

(b) Seasonally River-flooded Grasslands

These grasslands are flooded annually to varying depths and periods and form the *toich*, which yields dry season grazing essential to the agro-pastoralists. Two main types can be distinguished: (a) *Oryza longistaminata* dominant, and (b) *Echinochloa pyramidalis* dominant (Howell et al., 1988).

***Oryza longistaminata* Dominant Grassland:**

The dominant species constitutes 80-90 percent of the standing crop. Oryza does not flower or reach maximum production unless it has been deeply flooded for several months. It yield 1 ton/ha when not flooded to 7 tons/ha when deeply flooded for a long period. These grasslands are burnt each year early in the dry season. Although a perennial it can produce abundant seed. They provide high quality grazing for much of the year even into the dry season.

***Echinochloa pyramidalis* Dominant Grassland:**

These grasslands are further away from the river and thus flooded less frequently (although a tall variant grows close to the river). It occupies Vertisols with much *gilgai* micro-relief. The species produces growth even during the dry season and is thus a year-round pasture. Associated species include *O. longistaminata*, *Sporobulus pyramidalis*, *Digitaria debilis* and *Echinochloa haploclada*.

(c) Seasonally Rain-flooded Grasslands

Three types are recognized: (a) *Echinoochloa haploclada* grassland, (b) *Sporobolus pyramidalis* grassland, and (c) *Hyperhennia rufa* grassland.

***Echinochloa haploclada* Grassland:**

Between the river-flooded and the rain-flooded grasslands there is often a strip of land with light textured soils and slightly elevated, which is used for settlement and cultivation. As livestock are concentrated here for long periods this grassland is heavily grazed. Nutritionally the grassland is of very high quality during the wet season but quality falls off during the dry season.

***Sprobolus pyramidalis* Grassland:**

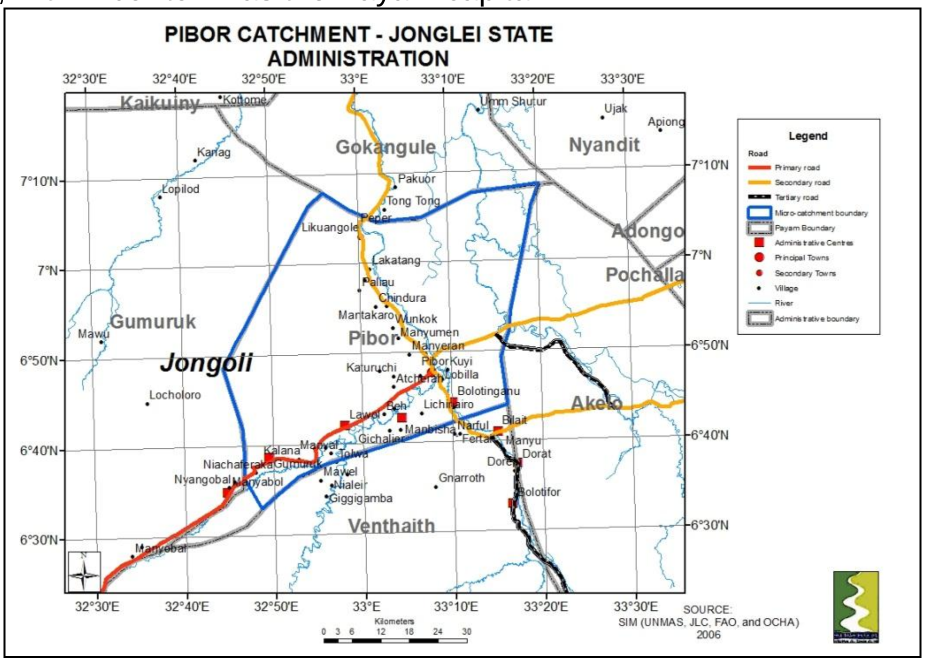
This tussock-forming species is not widespread. It is characteristic of heavily grazed areas. It makes no growth during the dry season, is low in protein and during the dry season nutrient levels fall below those needed for maintenance. It is used to make string used in house construction.

***Hyperrhenia rufa* Grassland:**

These grasslands occupy level ground out of reach of river-flooding but are inundated by rain for varying periods. In some northern areas Hyperrhenia may be replaced by *Setaria incrassata*. Although biomass attains 6-7 tons/ha at the end of the wet season, 90 percent of this is stem and contains little of value to livestock. A high proportion of these grasslands are burnt each year. They are generally used at the beginning of the wet season and at the beginning of the dry season after burning. The grass provides a major source of thatching material.

3.2 Administration

The Project Area is located in Pibor Payam, in Pibor County in Jonglei State (Map 6), with Pibor town as the Payam capital.



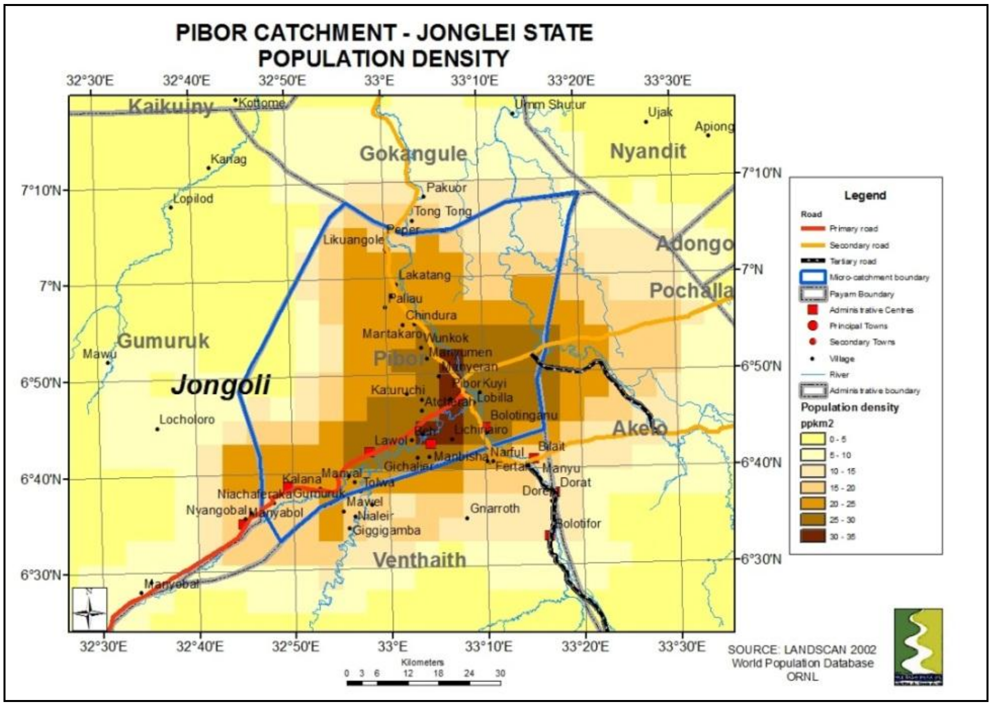
Map 6. Administration

3.3 Population and Settlement

(i) Population

The population of Pibor County is 148,475 in 22,741 households (Sudan Census, 2008). The people are Murle, mainly pastoralists/agro-pastoralists.

The overall population density for the County is 4.5 ppkm2. Population densities are highest along the roads and rivers (Map13). Pibor Payam has a much higher population density (20- 35 ppkm2) than the surrounding Payams (0 - 10 ppkm2).

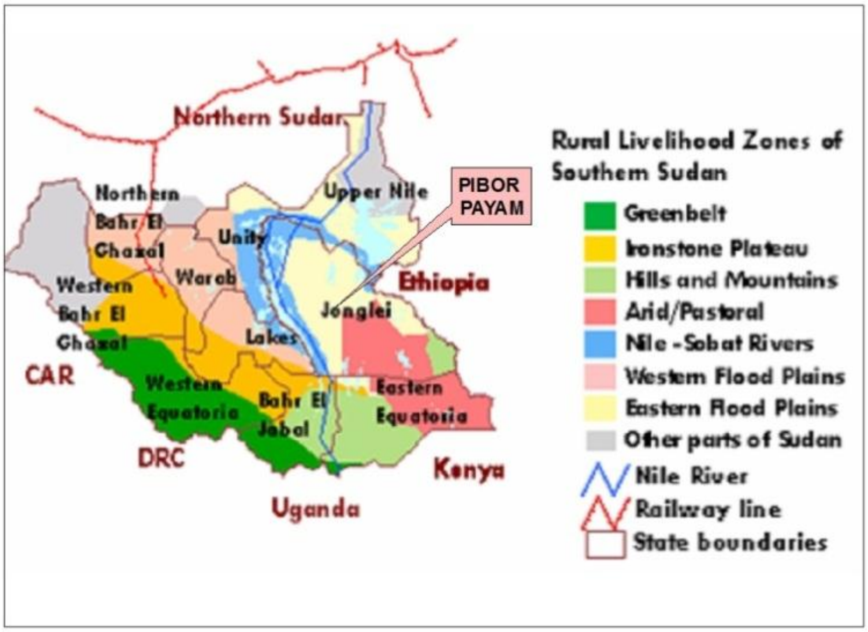


Map 7. Population density

3.4 Livelihood Systems

3.4.1 Introduction

The Southern Sudan Centre for Census, Statistics and Evaluation (SSCCSE) with SCUK and the FEWS Early Warning System have mapped and described seven main Livelihood Systems in southern Sudan (SSCCSE et al., 2006) from which the following is taken. The study follows the Household Economy Analysis methodology (FEG, 2010), which is based on the Livelihoods Framework (DFID, 2007). It provides a quantified account of p[eoples livelihood strategies, which is disaggregated and linked to specific geographical areas and a particular weath group.



Map 8. Livelihood Zones of Southern Sudan (SSCCSE et al., 2006)

The Project Area appears to fall within Zone 2 Eastern Flood Plains Zone becuase of high rainfall (900 – 1,000mm/yrhe natual resourcce base (wide plains underlain by Vertisols) notwithstanding that it is the plains Murle people that occupy it.

The Murle are divided into two groups: the plains Murle (Lotilla) and the Hills Murle (Ngalan) who occupy the Boma Plateau. The Plains Murle, who occupy the area in Pibor Payam, are essentially Agro-pastoralists. However, although cattle are their main source of livelihood they do cultivate some maize and sorghum.

3.4.2 Cropping

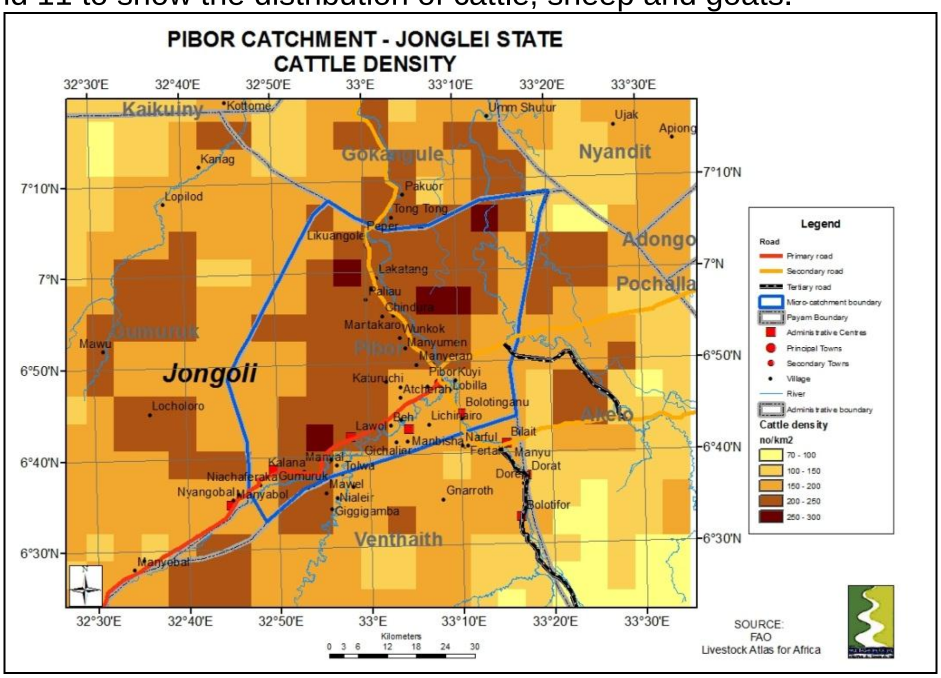
Sorghum (short- and long-cycle) is the most common crop grown, followed by maize. The main harvest is normally between August/September and October but can sometimes stretch into November if rains and planting are delayed. Other crops grown in this zone include simsim (sesame), pumpkins, beans, millet and some root crops. Crop production takes place in various parts of the landscape (lowlands, interfluves) in order to mitigate against frequent floods and drought.

A greater emphasis is placed on cattle than on crop production in this zone, and as a result, middle and better-off groups cultivate less than their counterparts in the Western Flood Plains Zone. Drought, floods, pest and bird infestations, and the need to maintain household mobility, act as important constraints to production. Quick growing crops, including short-cycle sorghum, maize, okra and pumpkin, and sometimes also peas, beans and other short-term greens, are planted close to the homestead, where they help to ease the effects of the hunger season. The contribution of these crops, which are commonly consumed in their 'green' state, can be as much as 5-10% of annual food needs

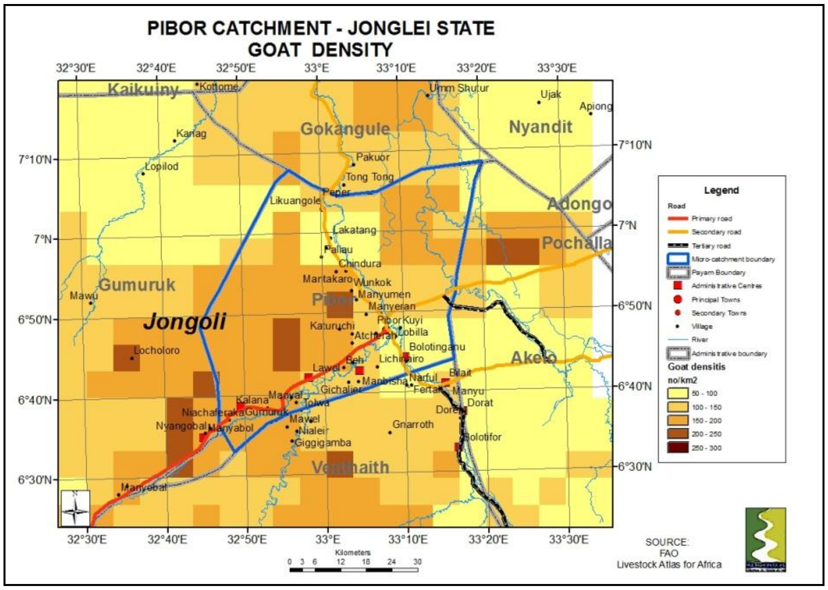
3.4.3 Livestock Production

During the rains the cattle are close to the settlement. At the cessation of the rains the cattle are moved to extensive grass plains until about January when both grass and water are finished. Then with the crops harvested all the people and livestock move to the "*toich*" (seasonally flooded) grasslands along the rivers. Here the grazing and fishing is excellent. At the beginning of the rains in May women and children move back to the villages to clear the land for cultivation, whilst the cattle slowly follow.

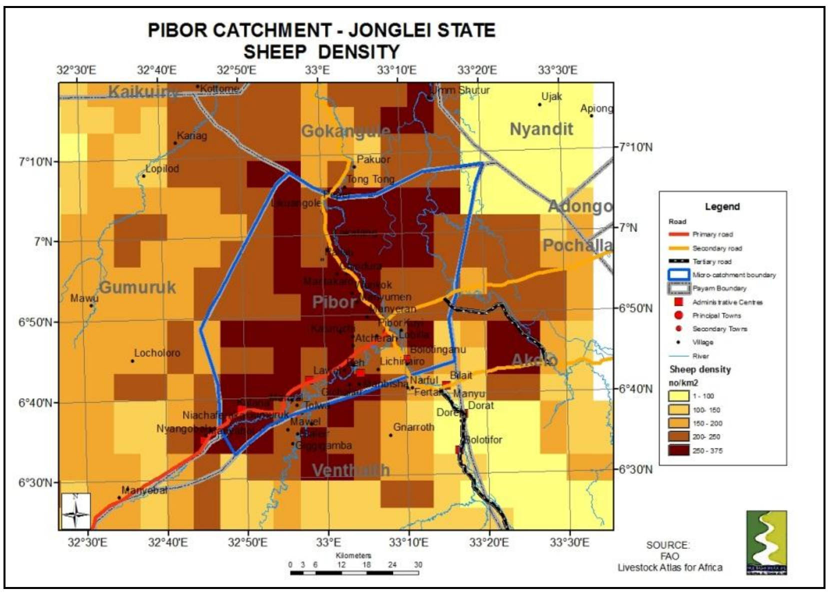
They engage in both the northern livestock marketing system and also a southern marketing system. The southern system caters for a relatively small domestic market centred on Juba, but export markets to the south in Kenya, Uganda and the Democratic Republic of Congo. There is also a substantial local market for breeding stock catering for young returning migrants establishing their own herds. Data from the FAO Livestock Atlas for Africa are used to derive Maps 9, 10 and 11 to show the distribution of cattle, sheep and goats.



Map 9. **Cattle densities**



Map 10. **Goat densities**



Map 11. **Sheep densities**

Cattle and sheep densities appear higher than goat densities. In all cases the highest densities are higher within the boundary of Pibor Payam, general in the order of 150 to 250 head/km2.

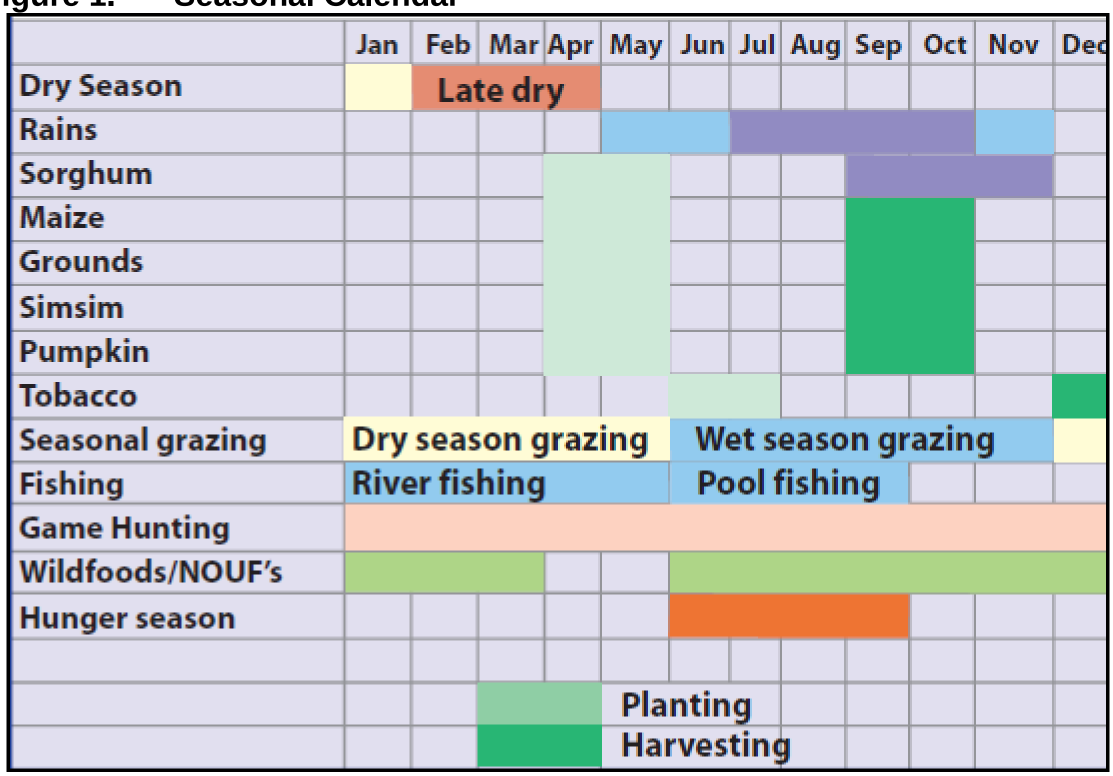
3.4.4 Fishing

Fishing is a particularly important source of food for poor households in every year, and an expandable option for all socioeconomic groups during times of stress. For poor groups, a combination of fish, wild plants and game meat regularly contributes close to half of annual food requirements. Most fishing takes place in the dry season, when yields are highest. Fish catches are consumed while fresh and surpluses are dried for later consumption and/ or sale. In a poor year, up to four members of a household may be expected to fish. When water levels are high, hooks, nets and spears are used; as the water recedes, baskets and traps are used. In very wet years, fishing also takes place in streams and pools. After the dry season, lung fish that have been buried since the previous year emerge from the ground and are also caught.

3.4.5 Seasonal Activity Calendar

The seasonal calendar (Figure 1) depicts the seasonality of a range of livelihood activities, including crop production, fishing, livestock activities and wild food collection. Contained within these activities is the critical seasonality of household decision making. For example, for the poor, crucial decisions need to be made about how the household will manage to make ends meet during the hunger season. How many people will be sent to dry season grazing areas, how many will remain at home, will employment be sought outside the zone: these are just a few of the decisions that must be made. The decisions made by other wealth groups, such as whether they plan to hire extra help or farm out some of their herds to poorer households, will also help to determine poor households' decisions - making for a complicated set of possible choices.

Figure 1. Seasonal Calendar



Source: SSCCSE et al., 2006.

3.6 Social Infrastructure

3.6.1 Water

Human productivity is seriously undermined on a periodic basis by dry season water shortages, which are a predominant and chronic feature of this zone. As water becomes scarce, people have to move increasingly long distances, and residents have been known to walk up to five days to find water. In addition to extended migration patterns, water shortages also give rise to a high incidence of waterborne illnesses and malnutrition during the dry season. Insecurity worsens the health and water situations for those who do not migrate: during conflict, more members of the family stay at the homestead, increasing pressure on local water sources.

3.6.2 Health Services

Health service coverage (primary health care centres and units) is low both by global standards and by the already low standards of southern Sudan. Services have been repeatedly constrained by insecurity. Guinea worm infections are endemic, with most transmissions occurring just prior to the rains. Eradication of lieshmaniasis (kala azar) is often cited as a priority by both communities and health agencies. Nutrition surveys conducted at various locations in this zone, particularly from 2000-04, demonstrate average prevalence rates of 27.1% global acute malnutrition (GAM), and about 5.6% severe acute malnutrition (SAM).

4. IDENTIFICATION OF PROJECT COMPONENTS

4.1 Review of Current Projects

(i) Norwegian Peoples Aid (NPA)

The project has established grant reimbursement mechanisms in five states and twenty seven counties in Southern Sudan to channel small grant to agriculture and forestry producer groups. With the budget of 4.934 Million US dollars for the first phase, this two - year project is funded by the Multi donor trust fund and the Government of South Sudan and administered by the World Bank.
Partners: Ministry of Agriculture, local CBOs
Place: Sentral-Ekvatoria, Øst-Ekvatoria, Jonglei, Upper Nile og Unity
Target group: agriculture and forestry producer groups
Budget: $4,934,000 June 2008 – Dec 2009 (blir forlenget)
Donor: Multi Donor Trust Fund

(ii) CARE

Jonglei State Rural Women Food Security Project

Strengthen food security and livelihood opportunities for 2,000 women, girls and male youths among the returnees, displaced and vulnerable host communities in order to increase food availability and access to 10,000 persons by 2012. This project relates to Food Security and Livelihood (FS&L)
Help at-risk populations, including IDPs and returnees, re-enter the production cycle by providing livelihood inputs.
Help at-risk communities and /or small holder producers mitigate disaster risks.

(iii)Borlaug Institute

The Borlaug Institute has been cooperating with the Dr. John Garang University of Science and Technology in Bor, Jonglei State. The Borlaug Institute will support the Garang University and work closely with the state government and he private sector to insure the natural resources of Jonglei State are managed for the good of the people of Jonglei.

(iv) Polish Humanitarian Action

The project supports sustainable income generating and agriculture opportunities for vulnerable population of northern counties of Jonglei state.

(v) UN Sudan Recovery Fund – South Sudan (SRF-SS)

Supports a wide range of projects aimed at supporting stabilization and recovery in Jonglei and Lakes.

(vi) World Bank: Livestock and Fisheries Development Project

The overall aim is to assist recovery of rural livelihoods based on livestock and fisheries. The specific objective of this project is to improve the performance of the livestock and fisheries sectors in five selected States of Southern Sudan through capacity building, improving animal health, reducing post-harvest losses and improving market infrastructure

4.2 Project Stakeholders

The Primary Project Stakeholders include the following:

- Pastoral and agro-pastoral households located with Pibor Payam;
- Staff of the State Ministry of Agriculture and Ministry of Livestock production who will receive technical and logistical support.

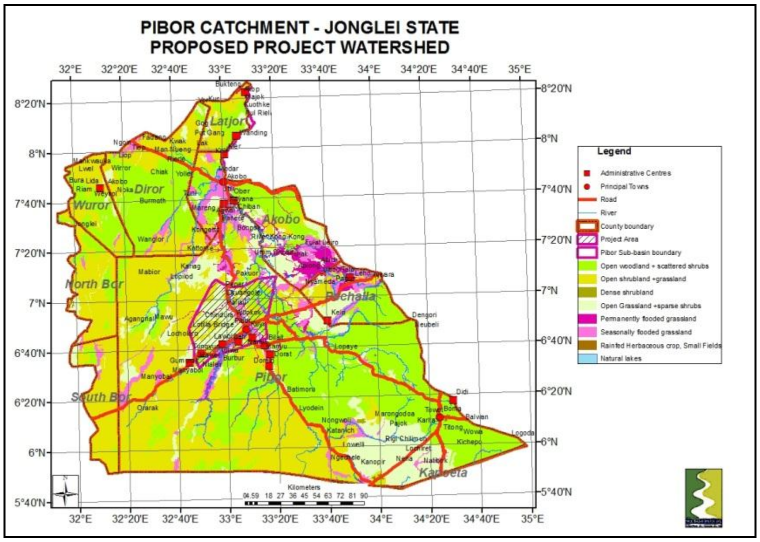
The Secondary Project Stakeholders include:

- Pastoral and agro-pastoral households in the surrounding payams who will benefit from reduced conflict over grazing resources because Group grazing areas have been clearly defined in the participatory Community and Strategic level land Use Planning.

4.3 Proposed Activities

4.3.1 Selection of Project area

The Project Area is defined by the boundary of Pibor Payam in Pibor County and Jonglei State. It lies in the middle part of the Pibor Sub-basin in an area of clay plains subject to seasonal inundation. It has road linkage to Bor, the state capital.



Map 12. The selected watershed in in Pibor Payam.

4.3.2 Proposed Components

(i) Water harvesting or Capture

The plains are drained by a network of very shallow water courses running northwards. The Range Ecology Survey (1983) undertaken in 1980 as part of the studies into the feasibility of the Jonglei Canal recommended that low bunds could be constructed across these to produce better and longer lasting pasture. The ditch in front of the bund would act as a hafir. The value of these bunds would be enhanced if they were coupled with a more systematic approach to burning. Burning should take place earlier to take advantage of soil moisture but not too early to destroy the economically important supplies of thatching grass.

The technique was tried as part of the FAO/UNDP Kongor Rural development Project but were interrupted by the war in 1984. The project would support small scale experiments into this technique within the project area. These would be linked to a more systematic approach to burning near the bunds.

(ii) Improved Fodder Production

Forage development would implemented through fodder banks at the permanent homesteads for calves and lactating female stock. The Project would support this with the multiplication and supply of improved forage grass seed.

(iii) Community-based Animal Health Workers

During the civil war an extremely successful large-scale community-based animal health worker system was established during hostilities and its important role in the eradication of rinderpest. The system is now in place for more routine animal health support.

(iv) Delineation of Stock Routes

The project would support the delineation and demarcation of stock routes ("Nomad Paths") with watering points and holding grounds together with quarantine arrangements with Uganda, Kenya and the Democratic republic of Congo.

(v) Capacity Building

The project would support capacity building in the Extension Service with respect to animal husbandry, water harvesting/capture, forage production and marketing.

(vi) Support to State-wide Strategic and to Community Level Land Use Planning

The proposals for State-wide Strategic land Use Planning, Local level Community Land Use Planning and the harmonization of the traditional land allocation and the modern land allocation systems would be vitally important to ensure equitable access to the rangeland resource base.

5 Distribution of Benefits

There are a number of local, regional and global benefits that would accrue to the Project.

At the local level livestock feed supply increased with increases in livestock productivity. There would be a more equitable access to natural resources reducing conflict between resource users and reliving pressure on both the dry and wet season grazing areas. Households' ability to withstand natural and socio-economic shocks would be strengthened. Household assets would be increased and there would be a widening of households' livelihood strategies.

At the global level species and habitat biodiversity would be enhanced and carbon sequestered in woody and herbaceous biomass and in soil organic carbon increased.

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EASTERN NILE TECHNICAL REGIONAL OFFICE

NBI – Institutional Strengthening Project
PROJECT DELINEATION AND PRIORITIZATION

ANNEX 4.8
WADI ALLAQI LIVELIHOODS SUPPORT PROJECT
(FINAL)

7th June, 2011

CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AHD	Aswan High Dam
AHDA	Aswan High Dam Authority
ARPA	Aswan regional Planning Authority
BCM	Billion Cubic Meters
C	Carbon
CAP	Compliance Action Plan
CAPMAS	Central Agency for Public Mobilization and Statistics
CIDA	Canadian International Development Agency
DRC	Desert Research Centre
DRI	Drainage Research Institute (NWRC)
EEAA	Egypt's Environmental Affairs Agency
EEIS	Egypt Environmental Information System (a CIDA project at EEAA)
EHD	Environmental Health Department (MOHP)
EIA	Environmental Impact Assessment
EIMP	Environmental Information and Monitoring Program
EMUs	Environmental Management Units
EOHC	Environmental and Occupational Health Center (MOHP)
ERC	Environmental Research Council
FAO	Food and Agriculture Organization of the United Nations
GOE	Government of Egypt
GOFI	General Organization for Industrialization
HAD	High Aswan Dam
IDRC	International Development Research Centre (Canada)
LCD	Liters per Capita per Day
LE	Egyptian Pound
MAB	Man and the Biosphere
MALR	Ministry of Agriculture and Land Reclamation
masl	meters above sea level
Mm^3	Millions of cubic meters
MSEA	Ministry of State for Environmental Affairs
MOHP	Ministry of Health and Population
MHUNC	Ministry of Housing, Utilities and New Communications
MOI	Ministry of Industry
MWRI	Ministry of Water Resources and Irrigation (previously MPWWR)
NAWQAM	National Water Quality and Availability Management (CIDA project)
NEAP	National Environmental Action Plan
NOPWASD	National Organization for Potable Water and Sanitary Drainage (MHUNC)
NRI	Nile Research Institute, NWRC (previously known as: HADSERI)

NWRC	National Water Research Center, MWRI
NWRP	National Water Resources Plan
PRIDE	Project in Development and the Environment (USAID)
RIGW	Research Institute for Groundwater (NWRC)
SLR	Sea level rise
TDS	Total Dissolved Solids
TSP	Total Suspended Particles
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
USAID	United States Agency for International Development
VOC	Volatile Organic Compounds
WFP	World Food Programme
WHO	World Health Organization
WPAU	Water Policy Advisory Unit (MWRI)

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[16] 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 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

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

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 Transboundary 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 Transboundary 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 nine of the Investment Projects located within the Main Nile Sub-basin, the Tekeze-Atbara Sub-basin and the Baro-Akobo-Sobat Sub-basin. Those Projects identified in the Abay-Blue Nile Sub-basin are being considered separately. This Project document is concerned with the Kerib land located along the Atbara River within Gedaref State.

1.2 Primary Objectives of the Project

The Watershed Management CRA identified a number of land degradation hotspots in the Main Nile, Baro-Akobo-Sobat, Abbay-Blue Nile and Tekeze-Atbara Sub-basins. 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.

The objective of this Project is to provide support to the Communities who inhabit the Wadi Allaqi, strengthen household and community livelihood strategies and contribute to the alleviation of poverty.

2. NATIONAL SETTING - EGYPT

2.1. Role of the agriculture sector:

The Egyptian economy has traditionally relied heavily on the agriculture sector as a source of growth, both in terms of contribution to GDP as well as a source of employment to a significant part of the Egyptian labour force. It accounts for about 16 percent of both growth domestic product GDP and total exports and about 34 percent of employment. Following the completion of the High Aswan Dam (HAD) in 1968, the agriculture sector, in 1974, accounted for 30% of GDP, 25% of export earnings and 47% of employment. However, this dominance has declined gradually over the years and the share of agriculture in GDP and export was each about 20% in 1990. This share now accounts for 16% in GDP, 20% in export and about 34% employment (World Bank' 2003).

While average growth rates for the sector have been modest during the past decade, more recent indicators point towards progress. For example the production of wheat, maize, rice, sugar, fruits and vegetables have recorded significant increases over the past decade. The cotton sub-sector is beginning to show signs of revival, and horticultural production having increased significantly, the sector will continue to support agro-industrial growth in the country. Development in the agricultural sector is expected to lead the nation's efforts to achieve equitable and balanced growth in the rural economy. Despite the decline in the share of sector's contribution to the national GDP, as shown above, the sector remains crucial for the future of Egypt's economy.
Agriculture in Egypt is entirely dependent on irrigation from the Nile which is the main source of water supply. The Egypt-Sudan Nile Water Agreement of 1959 gives Egypt 55.5 km^3, representing more than 95% of the total developed water resources of Egypt. The Nile system has a single input from the AHD and only two outputs, namely, drainage to the sea and evapotranspiration.

2.2. Agricultural Economic Resources:

Land, water and human resources are the major foundations of Egyptian Agriculture. These three resources set the limits to future agricultural growth. Land and water are relatively scarce, and their use is governed by certain technical limitations.

2.2.1 Climate

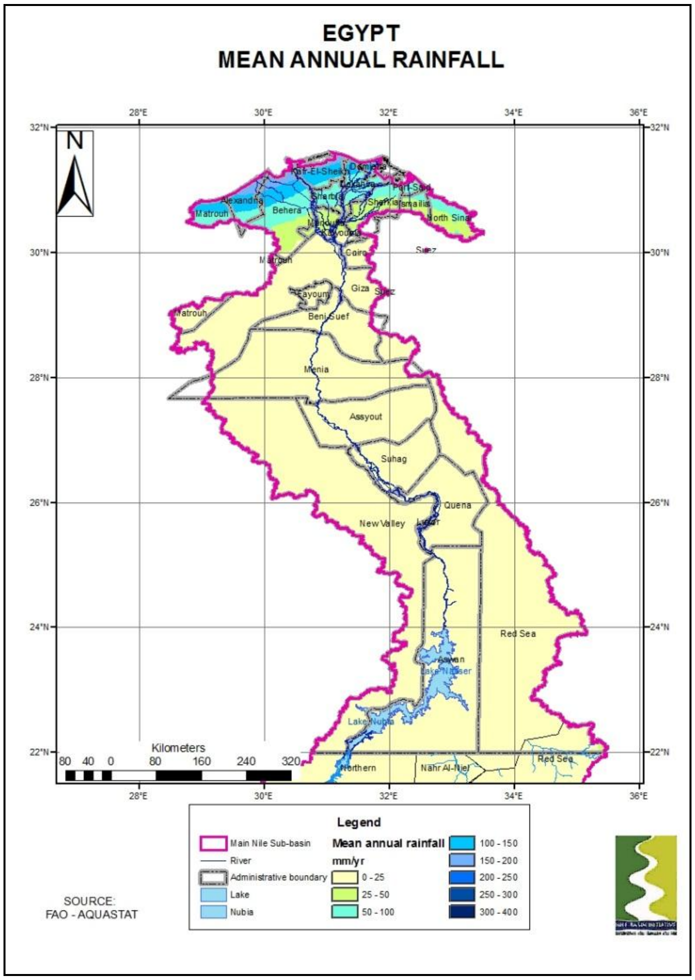
Egypt has two seasons: a mild winter from November to April and a hot summer from May to October. In the coastal regions, temperatures range between an average minimum of 14^o C in winter and an average maximum of 30 ^{o} C in summer. Temperatures vary widely in the inland desert areas, especially in summer, when they may range from 7 ^{o} C at night to 43 ^{o} C during the day. During winter, temperatures in the desert fluctuate less dramatically, but they can be as low as 0 ^{o} C at night and as high as 18 ^{o} C during the day.

The average annual temperature increases in the southward direction from the Delta to the Sudanese border, where temperatures are similar to those of the open deserts to east and west. Throughout the Delta and the northern Nile Valley, there are occasional winter cold spells accompanied by light frost and even snow. At Aswan June temperature can be as low as 10 ^{o} C at night and as high as 41 ^{o} C during the day when the sky in clear.

Most rain falls along the coast as indicated in Figure 1, but even the wettest area, around Alexandria, receives only about 200 millimeters of precipitation per year. Moving southward, the amount of precipitation decreases drastically. Cairo receives a little more than one centimeter of precipitation each year. The areas south of Cairo receive only traces of rainfall.

Some areas receive no rain at all during a number of years and then experience sudden downpours that result in flash floods. Sinai receives somewhat more rainfall than the other desert areas (about twelve centimeters annually in the north), and the region is dotted by numerous wells and oases, which support small population centers that formerly were focal points on trade routes.

A phenomenon of Egypt's climate is the hot spring wind that blows across the country. The winds, known as the *khamsin*, usually arrive in April but occasionally occur in March and May. The winds originate from small but vigorous low-pressure areas in the Isthmus of Suez and sweep across the northern coast of Africa. Unobstructed by geographical features, the winds reach high velocities and carry great quantities of sand and dust from the deserts. These sandstorms, often accompanied by winds of up to 140 kilometers per hour, Can cause temperatures to rise as much as 20 ^{o} C in two hours. The winds blow intermittently and may continue for days, cause illness in people and animals, harm crops, and occasionally damage houses and infrastructure.



Map 1. **Average annual rainfall in Egypt**

2.2.2 Water Resources

Egypt's water resource base mainly consists of:

- Egypt's quota from the Nile.
- Underground water.
- Effective rainfall and torrent water.
- Non traditional water resources which include:
  - Intermediate re-use of agricultural drainage water and treated wastewater;
  - Desalinated water.

The total water resources now available to Egypt is estimated at 73.663 km^3 per annum including the natural and non-traditional resources (table 1). Table 2.2 shows the distribution of water resources among various sectors. The agricultural sector consumes about 81% of total water available.

(i) Nile Water

The Nile is the major source of water in Egypt. Egypt is almost entirely dependent on irrigation. Consequently, agricultural development is closely linked to the Nile River and its management. The Nile Waters Agreement between Egypt and Sudan in 1959 gave Egypt 55.5 km^3, almost more than 90% of the country's developed water resources.

Table 1. Available Water (2000) (km^3/annum)

Source	Available Quantity	%
River Nile	55.500	76.0%
Renewable Groundwater	2.300	3.1%
Reuse of Agricultural Drainage Water (return flow to rivers)	4.840	6.6%
Reuse of groundwater (Seepage from agriculture)	6.127	8.3%
Treated Wastewater	2.971	4.0%
Desalinated water	0.100	0.1%
Use of fossil groundwater (non-renewable)	0.825	1.1%
Effective Rainfall	1.300	0.7%
Total	**73.963**	**100**

Source: FAO (2005) "Irrigation in Africa: AQUASTAT Survey 2005", Rome.

Table 2. Distribution of Water Use by Sector (km^3/annum)

Sector	Consumptive Use	%
Agriculture	59.00	86%
Industrial & Municipal Uses	4.00	6%
Domestic	5.30	8%
Total	**68.3**	**100**

Source: FAO (2005) op. cite

In addition to the 68.3 km^3 an additional 4.0 km^3 was used for navigation and hydro-power generation.

A major feature of the strategy for agricultural development in Egypt is to benefit from a variety of improvements in the efficiency of the Nile system in order to increase the productivity per unit of water.

(ii) Underground Water

Egypt has three major reservoirs of underground water they are:

- Valley and Delta Reservoirs.
- The Nubian Sandy aquifer in the Eastern and the Western desert, around the High Dam's lake and in Sinai,

- Calcareous rocky aquifer scattered nationwide.

The Nile basin reservoir is highly efficient in storing water. Approximately 4.0 km3 of the total 7.5 km^3 are drawn annually from this reservoir to provide the surrounding towns and villages with potable water.

(iii) Rainfall and Torrents

Egypt has no effective rainfall except in a narrow band along the north coast area where an average of 120-200 mm annually is precipitated. The total torrent water is estimated at 1.5 km^3 annually. MWRI builds dams on certain valleys to store torrent waters for future uses and for feeding the underground reservoirs.

(iv) Non-traditional Water Resources:

Approximately 4.5 km^3/annum are reused in irrigation. There is a potential for intermediate reuse of about 5 km^3 annually, out of 12 km^3 being drained into the sea to maintain the salt balance of the Delta soils and the underground water. Treated wastewater reuse is currently estimated at 1.5 km^3 annually.

Desalination projects are planned at the coastal areas to meet the demand of the tourist projects under construction.

2.2.3 Potential for Developing Egypt's Water Resources

The per capita share of water is decreasing on annual basis due to the scarcity of fresh water resources for a population growing at 2% annually. Therefore, Egypt has embarked on a number of projects to rationalize water use.

i. Irrigation Improvement Program (IIP) IIP was designed to reduce losses by using modern control structures, lining of the *misqas* (on-farm aqua-duct), laser leveling, using one pump on the commonly shared misqa and installation of plastic (PVC) pipes.

ii. Develop short duration, high-yielding rice varieties in order to save rice consumptive water use.

iii. Weed control in the water streams to reduce water loss and abate environmental pollution.

iv. LASER Leveling and gated pipe irrigation of sugar cane. Rationalization of water use in the municipalities, industrial projects and infrastructure rehabilitation is expected to considerably increase water resources by 2017 as follows:

Table 3. Projected Increases in Water Supply from various Sources by 2017 (km^3)

1- Underground water in the Valley, the Delta and Deserts	6.1 km^3/annum
2- Reusable agricultural drainage water	5.0 km^3/annum
3- Reusable treated wastewater	1.5 km^3/annum
4- One million feddans grown to short duration rice	4.0 km^3/annum
5- IIP in old lands	2.0 km^3/annum
6- Egypt quota from Jonglei Canal adds	2.0 km^3/annum
Total	**20.6 km^3/annum**

Source: MWRI

These additional water resources are set against non-agricultural uses of about

4.0 km^3/annum, as stated below:

Municipal uses	1.5 km^3/annum
Industrial uses	2.5 km^3/annum
Total	**4.0 km^3/annum**

The surplus quantity amounting to 16.6 km^3/annum can be used in horizontal expansion since the present strategy up to 2017 aims at reclaiming 3.4 million feddans to increase the contribution of agriculture to the GDP.

2.2.4 Land Resources:

Egypt has an area of about one million square kilometers or 238 million feddans. According to the 1990's agricultural census, the total cultivated area was estimated at 7.5 million feddans, (Fed. = 4200 m^2) which consists of 5.5 million feddans of old land and 2.0 million feddans of new land.

Table 4. Reclaimable land in Egypt by regions

Potential land reclamation by Regions	Land categories (1,000 Feddans*)						**Priority areas (1,000 feddans)**
	I	**II**	**III**	**IV**	**V**	**Total**	
With Nile water							
East Delta	286.5		135.1	43.5	351.6	798.7	**612.0**
West Delta	41.5	171.2	49.1	65.0	358.1	684.9	**264.0**
Central Delta	59.0					59.0	**59.0**
Upper Egypt			31.5	6.2	186.2	223.9	**184.0**
High Aswan Dam		3.6	160.1	342.5	275.5	781.6	**195.0**
Lake Shores		9.0			41.0	50.0	**0.0**
Sinai	102.5			111.6	29.5	283.6	**212.0**
Total	**471.5**	**183.8**	**375.8**	**568.8**	**1,281.8**	**2881.7**	**1,526.0**
With Groundwater							
New Valley	1.5	62.5	14.2	5.2	484.5	562.7	
Sinai			2.0			7.2	
Total	**1.5**	**62.5**	**16.2**	**5.2**	**484.5**	**569.9**	**82.0**
Grand Total	**478.0**	**246.0**	**392.0**	**574.0**	**1,766**	**3,451.6**	**1,608.0**

Source: Master Land Use Plan of Egypt, 1984.
* Feddan = 4200m2 = 0.42 ha = 1.038 acres.

Table 4 gives the area of land that could be reclaimed using the Nile water and groundwater as 2.88 million feddans and 570,000 feddans, respectively. Therefore, the total area of re-claimable land, mainly in the Nile Valley and Delta, is of the order of 3.45 million feddans.

However, land reclamation has been a controversial issue because of the large investments in, and poor performance of, large-scale schemes during the 1970s. A World Bank report (1989) identified several reasons for the poor performance:

(a) lack of planning and project implementation,

(b) inadequate knowledge of the soils,

(c) need for a different construction technology for sandy soils,

(d) weak post-implementation assistance in extension, training, etc.

Thus, lands which were not fully reclaimed and developed were cultivated, giving rise to drainage and water-logging problems. The same report goes on to conclude: “A number of the problems which impacted on earlier land reclamation have been resolved. The implementation of physical land reclamation has become a relatively straight-forward, trouble-free technical exercise”.

Properly planned and executed land reclamation, which appears unavoidable in Egypt, is quite compatible with the concept of sustainable agriculture because of the extremely scarce and limited land resources.

2.2.5 Forest Resources

The FAO Forest Resource Assessment (FAO, 2005) estimated the extent of plantation forests in Egypt to be 67,000 ha representing 0.1% of the land area with 50% of this area as protection forests and 48% has a multiple function (i.e. protection and production function). This is of course quite natural when considering the fact that the whole country lies within the Great Sahara Region in Africa.

2.3 Human Resources:

Since man is the engine and aim of socio-economic development, Egypt focuses on investment in human capital through education training and extension to improve the knowledge, skills and abilities of the workforce.

Egypt’s population was estimated at 67.313 million people (2003) living on almost 5% of its national territory. Population density varies among the governorates. Approximately 17% of the Egyptian population lives in Upper Egypt. The rest are distributed between Lower and Middle Egypt. The strategy for socio-economic development up to 2017 aims at increasing the inhabited area up to 20-25% of the Egyptian land area through the implementation of the national projects including Lake Nasser areas which are currently under implementation.

The Egyptian rural population represents about 51% of the total population. By the year 2017, it is expected that they will represent 47% of the total population.

In 1995/1996, the Egyptian labor force was estimated at 16.7 million people, representing about 27% of the total population. Agriculture alone absorbs about 4.8 million workers, which constitutes about 31.3% of the total workforce.

2.4 Legal and Institutional Framework

2.4.1 Institutions with Responsibilities for Water Quality

The institutions involved with water quality management in Egypt are generally line-management ministries with responsibilities in areas that are related to, but not necessarily coincident with environmental protection. The Ministry of Health and the Ministry of Industry have many other functions, many of which conflict with water quality management. Egypt lacks such a relatively strong central coordinating or managing body, although the Egyptian Environmental Affairs Agency (EEAA) has some of the appropriate rules (coordination, studies and evaluation). The following outlines institutions with major roles in water quality management.

2.4.2 Ministry of Water Resources and Irrigation (MWRI)

The MWRI is formulating the national water policy to face the problem of water scarcity and water quality deterioration. The overall policy’s objective is to utilize the available conventional and non-conventional water resources to meet the socio-economic and environmental needs of the country. Under law No. 12 of 1984, MWRI retains the overall responsibility for the management of all water resources, including available surface water resources of the Nile system, irrigation water, drainage water and groundwater.

The MWRI is the central institution for water quality management. The main instrument for water quality management is Law 48. The MWRI is responsible to provide suitable water to all users but emphasis is put on irrigation. It has been given authority to issue licenses for domestic and industrial discharges. The responsibility to monitor compliance to these licenses through the analyses of discharges has been delegated to MOHP.

The National Water Research Centre (NWRC) supports the MWRI in its management. Within the NWRC, three institutes are focusing on the Nile, the irrigation and drainage canals and groundwater (NRI, DRI, RIGW). NWRC maintains a national water quality monitoring network and contracts portions of the monitoring activity to these institutes. NWRC also operates a database where all MWRI water quality data is consolidated. NWRC also operates a modern, well equipped water quality laboratory.

2.4.3 Egyptian Environmental Affairs Agency (EEAA)

The central organization for environmental protection is the EEAA. This agency has an advisory task to the Prime Minister and has prepared the National Environmental Action Plan of Egypt 2002/17 (2002). The Minister of State for Environment heads the agency. According to Law 4, it has the enforcing authority with respect to environmental pollution except for fresh water resources. Through Law 48, the MWRI remains the enforcing authority for inland waterways.

The EEAA is establishing an Egyptian environmental information system (EEIS) to give shape to its role as coordinator of environmental monitoring. Moreover, staff is being prepared to enforce environmental impact assessment (EIA). Major industries have been visited in view of their non-compliance with respect to wastewater treatment. Compliance Action Plans (CAP's) are being agreed upon to obtain a grace period for compliance. Additionally EEAA is monitoring waste from Nile ships and is responsible for coastal water monitoring. In cooperation with the MWRI, an action plan was implemented to reduce industrial pollution of the Nile.

2.4.4 Ministry of Health and Population (MOHP)

The MOHP is the main organization charged with safeguarding drinking water quality and is responsible for public health in general. Within the framework of Law 48/1982, this Ministry is involved in standard setting and compliance monitoring of wastewater discharges. The Environmental Health Department (EHD) is responsible for monitoring with respect to potable water resources (Nile River and canals). The MOHP samples and analyses all intakes and treated outflows of drinking water treatment plants. Also water from drinking water production wells is monitored. In case of non-compliance of drinking water quality, especially with respect to bacterial contamination, MOHP takes action.

Within the framework of Law 48 MOHP samples and analyses drain waters to be mixed with irrigation waters, industrial and domestic wastewater treatment plant effluents and wastes discharged from river vessels. In case of non-compliance of discharges, the MWRI generally takes action upon notification from the MOHP.

2.4.5 Ministry of Housing, Utilities and New Communities (MHUNC)

Within the Ministry of Housing, Utilities and New Communities, the National Organization for Potable Water and Sanitary Drainage (NOPWASD) has the responsibility for planning, design and construction of municipal drinking water purification plants, distribution systems, sewage collection systems, and municipal wastewater treatment plants. Once the facilities have been installed, NOPWASD organizes training and then transfers the responsibilities for operation and maintenance to the regional or local authorities.

2.4.6 Ministry of Agriculture and Land Reclamation (MALR)

MALR develops policies related to cropping patterns and farm production. Moreover they are in charge of water distribution at field level and reclamation of new agricultural land. With respect to water quality management issues, their policies on the use and subsidy reduction of fertilizers and pesticides is important. In addition, MALR is responsible for fisheries and fish farms (aquaculture).

The Soil, Water and Environment Research Institute is part of the MALR and is responsible for research on many subjects such as water and soil quality studies on pollution, bioconversion of agricultural wastes, reuse of sewage wastewater for irrigation, saline and saline-alkaline soils, fertilizer and pesticide use and effects.

2.5 Policy Framework

2.5.1 Egypt's Agricultural policy up to 2017

A Land Master Plan of Egypt was prepared in 1986. It concluded that the construction of AHD not only made the intensification of agriculture feasible in the old lands but also extended it to new "reclaimed" areas. Some 650 000 fedddans out of 805 000 feddans of land reclaimed during 1960-70 was made possible due to the increased supply of water from AHD. The total land that could be reclaimed is subject to water availability. The arable area per person declined by 75% from 0.51 feddan/person to 0.13 feddan/person during 1887-1990 (Abu Zeid and Rady 1991).

The strategy for agricultural development up to 2017 has a number of aims.

(i) To increase the annual rate growth in the agricultural production from 3.4% to 3.8% during the remaining period of the Fourth 5-Year Plan, and to 4.1% annually up to 2017. This goal is attainable only through vertical and horizontal expansion of plant and animal production, which will have a positive bearing on job creation, income to producers and the overall standard of living of the rural population.

(ii) To reclaim no less than 150,000 feddans annually, within the Master Plan of Egypt's Land and water resources which assesses the reclaimable and cultivable lands in the Delta, Southern Valley, East Owaynat, the area of and round Lake Nasser and East and West of Suez Canal by the year 2017 at about 3.4 million feddans. The inhabited area would reach 25% of the total area of Egypt.

(iii) To increase the agricultural production horizontally and vertically through the efficient allocation and use of soil and water resources. Maintenance and development of the natural resource base is an integral part of Egypt's sustainable agricultural development program.

(iv) To form a national strategic stock of basis food commodities by focusing on the efficient use of the available resources and redirecting investments to such areas that help fulfill the increasing food needs of the population. This shall be accompanied with rationalization of food consumption levels, reduction of post-harvest losses.

2.5.2 Water Policy

The Ministry of Water Resources and Irrigation (MWRI) has prepared a National Water Policy till the year 2017 including three main themes:

- optimal use of available water resources;
- development of water resources; and
- protection of water quality and pollution abatement.

At present, Egypt is addressing the issue of limited water quantity by managing the demand side. MWRI formulated a water master plan in 1981. This plan is currently updated. The process of updating the water master plan aims to allocate available water resources according to various needs and demands that are feasible from the economic perspective. It also aims to gain social acceptance and political support. The Water Master Plan is updated through the National Water Resources Plan (NWRP) project.

The NWRP has been operated since 1998 and jointly funded between MWRI and the Netherlands Government. This project is directed towards developing a National Water Resources Plan that describes how Egypt will safeguard its water resources both quantity and quality and how it will optimize the use these resources in response to the socio-economic and environmental conditions.

2.6 Non-Government Organisations working in the area of Lake Nasser

2.6.1 Centre for Development Services (CDS)/Desert Development Centre (DDC) – American University in Cairo

The CDS is a Cairo based NGO established in 1990 and together with the DDC of the American University in Cairo are the implementing agencies for the "Agro-

Ecology West of Lake Nasser - Towards a Sustainable Livelihoods Strategy" Project. The High Dam Lake Development Authority (HDLDA) is a strategic partner. The Canadian International Development Research Centre (IDRC) is the main funding agency.

The NGO is working in three of the settlement communities on the western shores of Lake Nasser: Khor Galal, Kalabsha, and Garf Hussein: numbered 4, 5 and 6 respectively of Map 8. The project is an Action Research project using a trans-disciplinary and multi-stakeholder approach to encourage sustainable improvements to household incomes and positive environmental actions that will enhance human health and community welfare. The project is being implemented over three years. It commenced in July 2004 and is due for completion in July 2007. Total funding is CAD$ 478,760.

They project is focusing on (i) action research into environmentally safe methods of pest control and fertilization, (ii) marketing and (iii) human and animal health.

The project is also working with the University of the South Valley and Suez Canal University.

2.6.2 Egyptian Swiss Development Fund (ESDF)

The ESDF is also working in other Settlement communities west of the Lake. It also covers agricultural extension and research and health aspects. It also supports capacity building for the Community Development Associations (CDA's) – the elected bodies that are involved with the day-to-day management of the Schemes.

2.6.3 World Food Programme (WFP)

WFP's Food Aid project directly supports the establishment of the Settlement Schemes from a physical perspective. It has its own field staff in the same areas as CDS and ESDF. As with CDS and ESDF they also provide capacity building support to the CDA's.

2.6.4 Wadi Allaqi Project: Universities of the South Valley in Aswan and Glasgow, U.K.

This project has been running since the late 1980's and is collaborative research link between the University of the South Valley in Aswan and the University of Glasgow in the UK. It is funded by UK DiFID's Academic Links and the Gender and Development programmes.

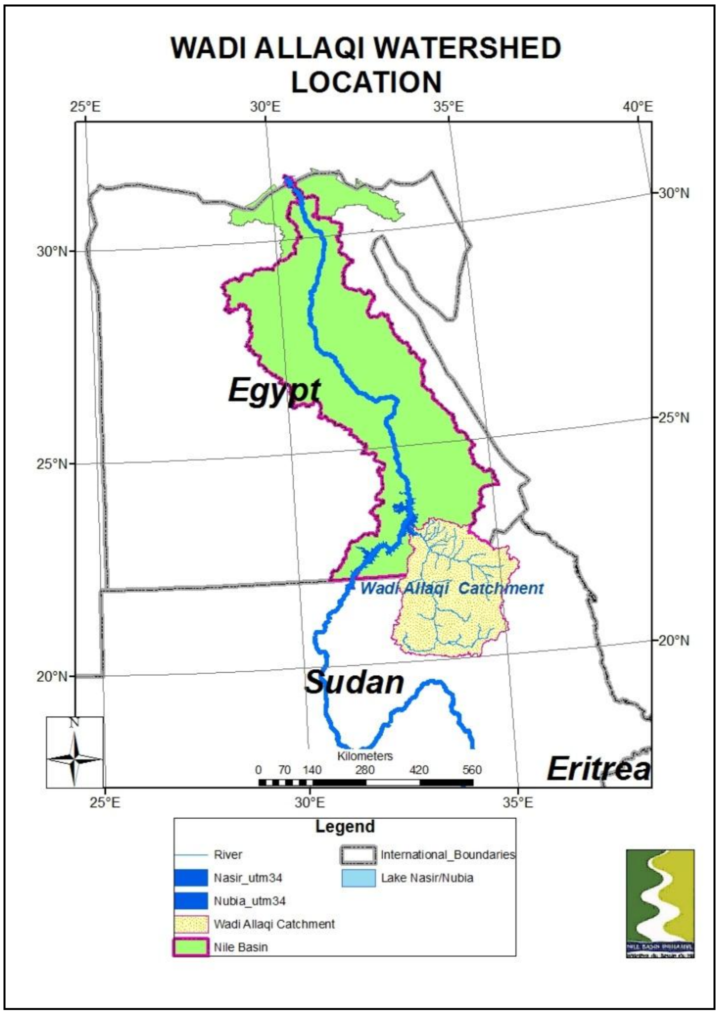
It focuses on the peoples' livelihoods in the Wadi Allaqi and studies the changes in their livelihood strategies under changing environmental conditions due to the formation of Lake Nasser. It has studied in depth indigenous knowledge of both men and women, livelihood strategies of women headed households and the natural resource management systems in the Wadi.

3. WADI ALLAQI - BIOPHYSICAL AND SOCIO-ECONOMIC SITUATION

3.1 Biophysical Characteristics

3.1.1 Location and Extent

Th Wadi Allaqi and its “sister” wadi, the Wadi Gabgaba, is located on the eastern side of Lake nasser and extends eastwards to the watershed along the Red Sea Hills and southwards well into the Sudan (Map 2). Its total area is 85,380 km2, with 28 percent of the area in Egypt and 72 percent in the Sudan..

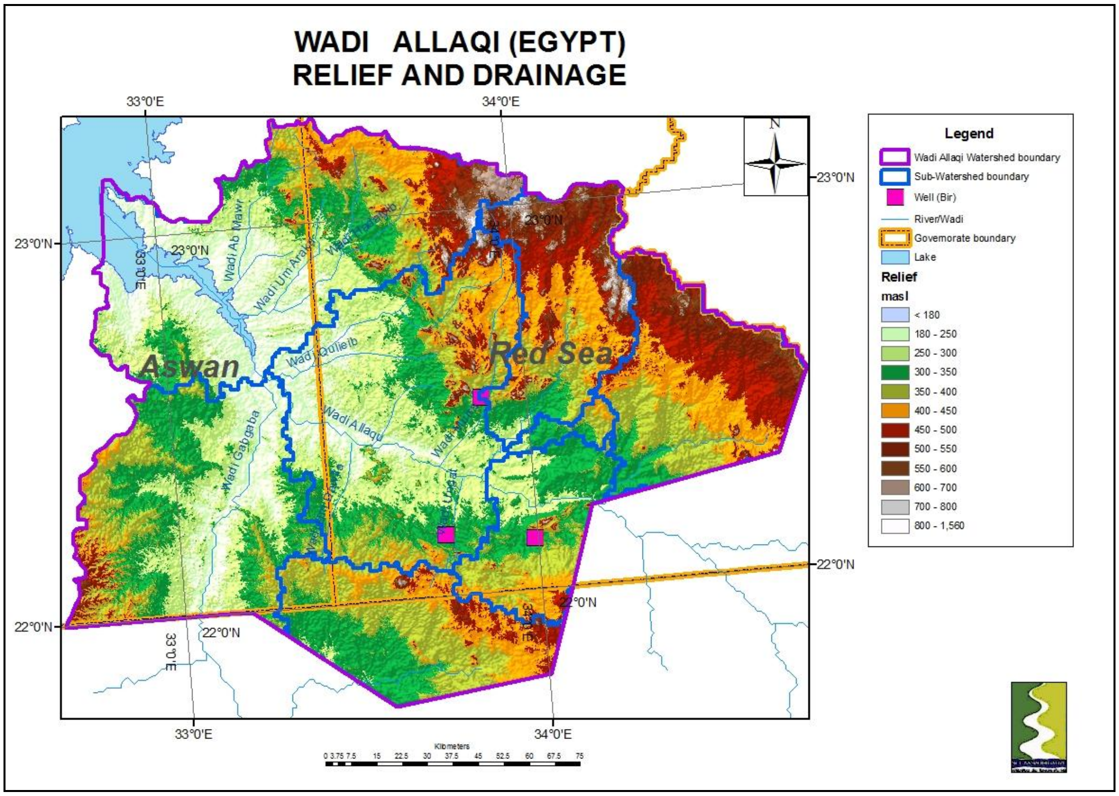


Map 2. Location of Wadi Allaqi Watershed

3.1.2 Relief and Drainage

(i) Relief

There are two wadis: the Wadi Allaqi which extends southeastwards into the Red Sea Hills and the Wadi Gabgada which extends southwards. The latter is said to be a Quaternary course of the main Nile River. The wadi floors lie between 180 and 250 masl. The hills to the north of the Wadi Allaqi rise to 800 masl, whilst those to the south only reach 500 masl.



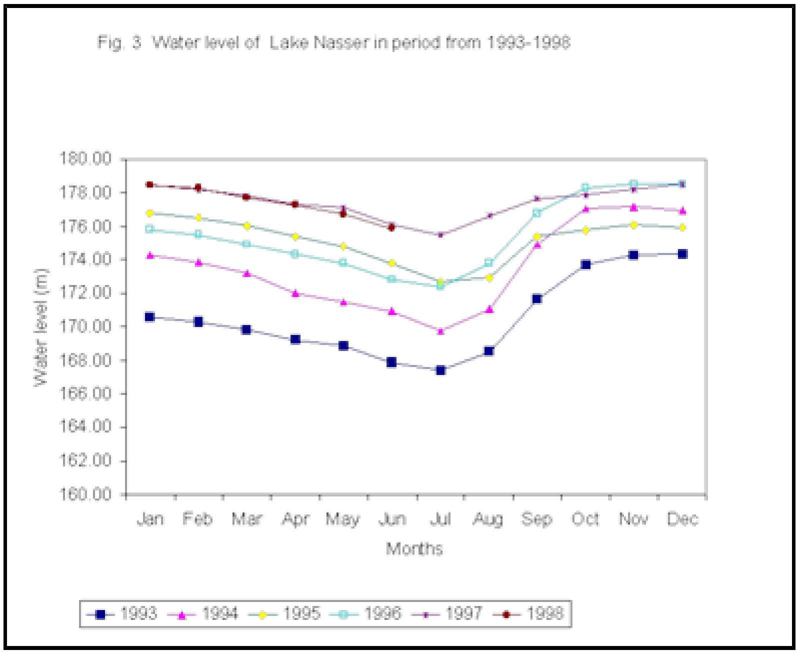
Map 3. Relief and Drainage

(ii) Lake Nasser and Drainage

Inundation from the Lake can penetrated the wadis deep into the Eastern Desert, a previously waterless hyperarid environment. Fluctuation in the water level of the Lake has led to temporary reductions in Lake levels have led to the exposure of about 40 km of the once inundated area of Wadi Allaqi, where a new ecosystem has been established. This ecosystem, generally known as an ecotone, represents a transitional zone between aquatic and desert land.

Water level fluctuations of the lake, both temporal and spatial, control life in downstream part of Allaqi. While the water level is low, vegetation flourishes on the lakeshore, while human access to water becomes quite difficult. Despite the attractive appearance of this land it is only temporarily available. When water levels are high, access to water is easy but little pasture is available.

Figure 1. Water Levels of Lake Nasser 1993 -1998



Source: Belal et al., 1998

Figure 2. The lowest part of the Wadi Allaqi during inundation

Source: Springuel and Belal, 2001

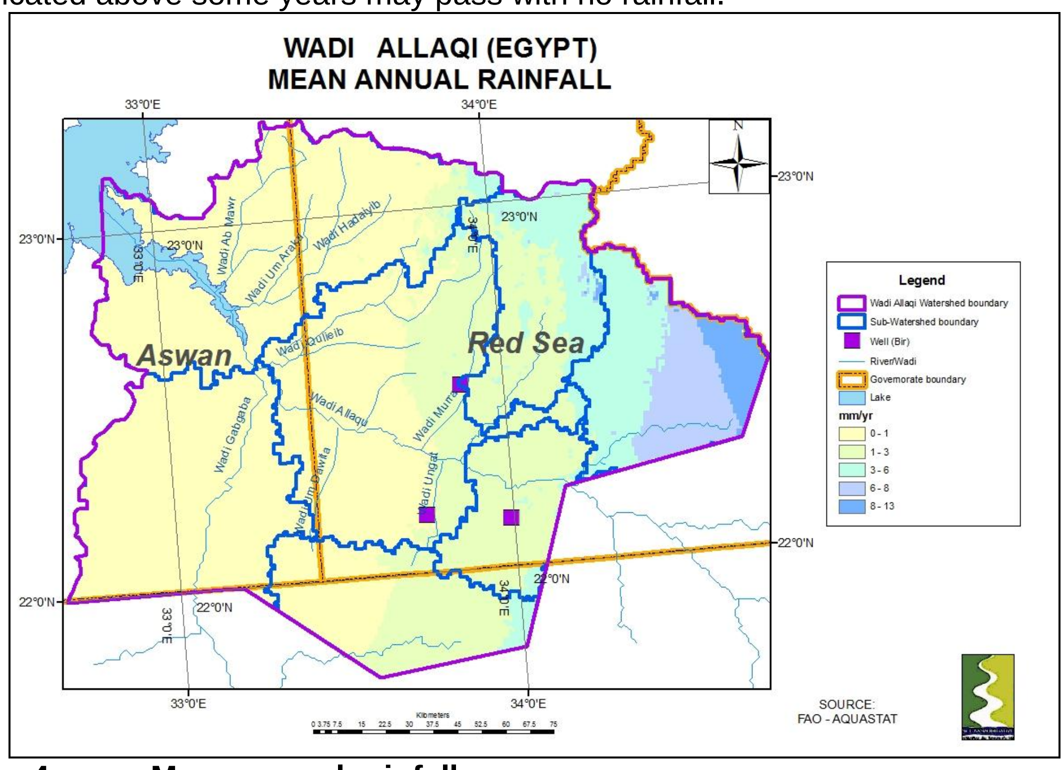
(iii) Ground water

The long axis of the Wadi Allaqi follows fault zone between the basement complex rocks to the northeast and the Nubian Sandstones to the southwest. These are overlain by unconsolidated wadi sediments of Holocene and Recent age when the local climate was wetter. The Wadi floor has a very gentle gradient of 0.5 degrees. Groundwater is from two sources. The first is deep percolating water from the Red Sea Hills over which there is varying amounts of rainfall annually. This is normally 30 meters below the surface and of poor quality. The second source of groundwater is from the Lake. This is usually available about 2 to 3 meters below the surface, and is extremely variable because changes in Lake level. (One meter change in Lake level causes a one kilometre change in inundation of the Wadi.) The quality of the water is good.

3.1.2 Climate

(V) Rainfall

Rainfall increases from zero at Lake Nasser to about 13 mm/yr. However, as indicated above some years may pass with no rainfall.

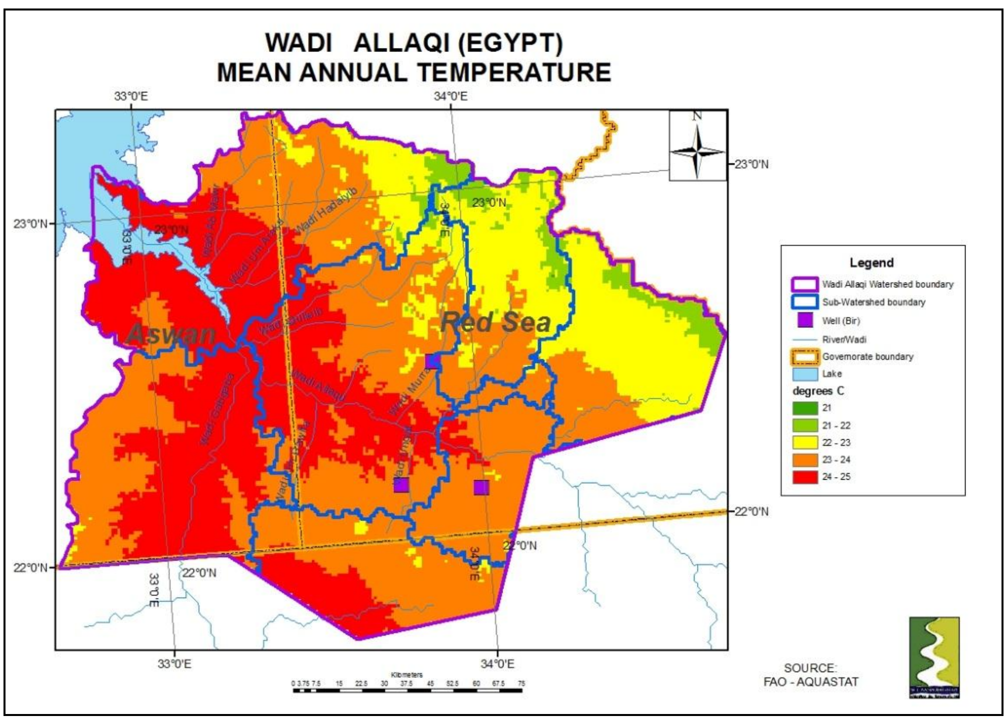


Map 4. Mean annual rainfall

During the past decade, 5 rain events were observed in the Wadi Allaqi basin, mainly during autumn (September - November), of which three in 1982, 1986, and 1994 were sufficiently large to affect biotic parts of the system. In 1994 the torrent (runoff) reached the downstream part of the Wadi, at the point of influx with Lake Nasser, and discharged a considerable quantity of water into the Lake Nasser. Water flow continued for 10 days from November 2 to November 12, 1994. This torrent was the result of series of rain events in the upstream part of the Wadi during September - October 1994. Another torrent occurred in Allaqi during May 1995. It originated on the Red Sea hills and reached the downstream part of the Wadi throughout its eastern tributaries. In the downstream part of Wadi Guileb (the eastern tributary of Wadi Allaqi) the water ran for 15 hours (Springuel and Belal, 2001).

(ii) Mean annual temperature

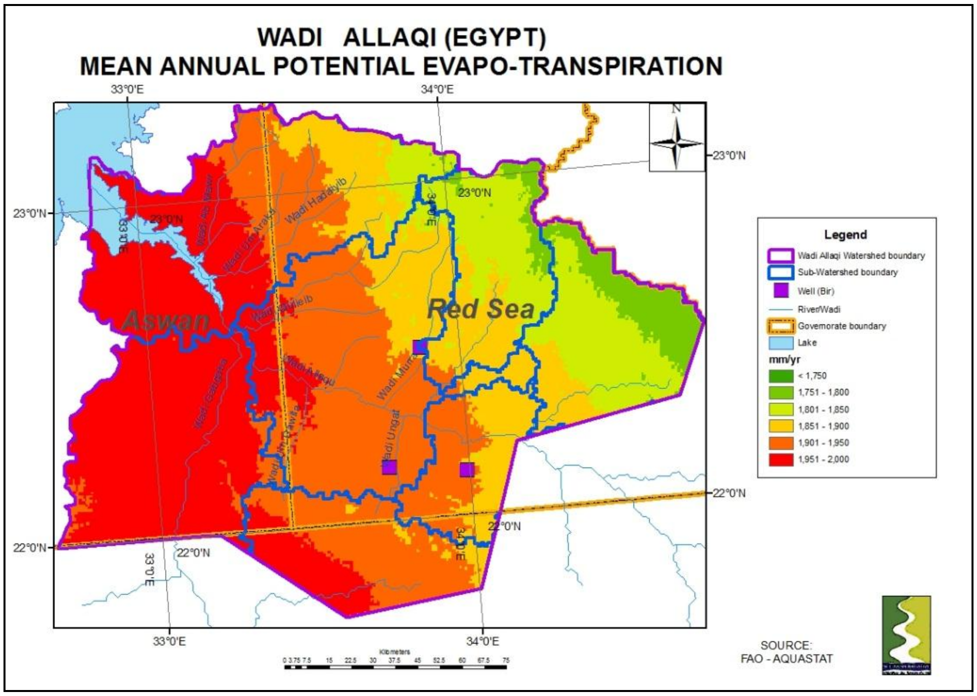
Mean annual temperature varies with altitude, ranging from 25°C at the Lake shore and in the wadi bottoms to 21°C along the tops of the northern hills (Map 7). A mean minimum temperature of + 8.1° C has been recorded for the month of January. However, it can be as low as -2° C (Wadi Allaqi records, January 1992). A mean maximum temperature of +41.8° C has been recorded for the month of July. However it can often reach above 45ºC especially in August (Allaqi Meteorological Station, August 1997). The Wadi Allaqi is characterized as a "hyperarid environment" with an aridity index of less than 0.05.



Map 5. Mean annual temperature (degrees C)

(iii) Mean Annual Evapotranspiration

The pattern of mean annual evapotranspiration varies strongly with temperature (and thus altitude ranging from 2,000mm/yr at the Lake to 1,750 mm/yr in the northern hills.

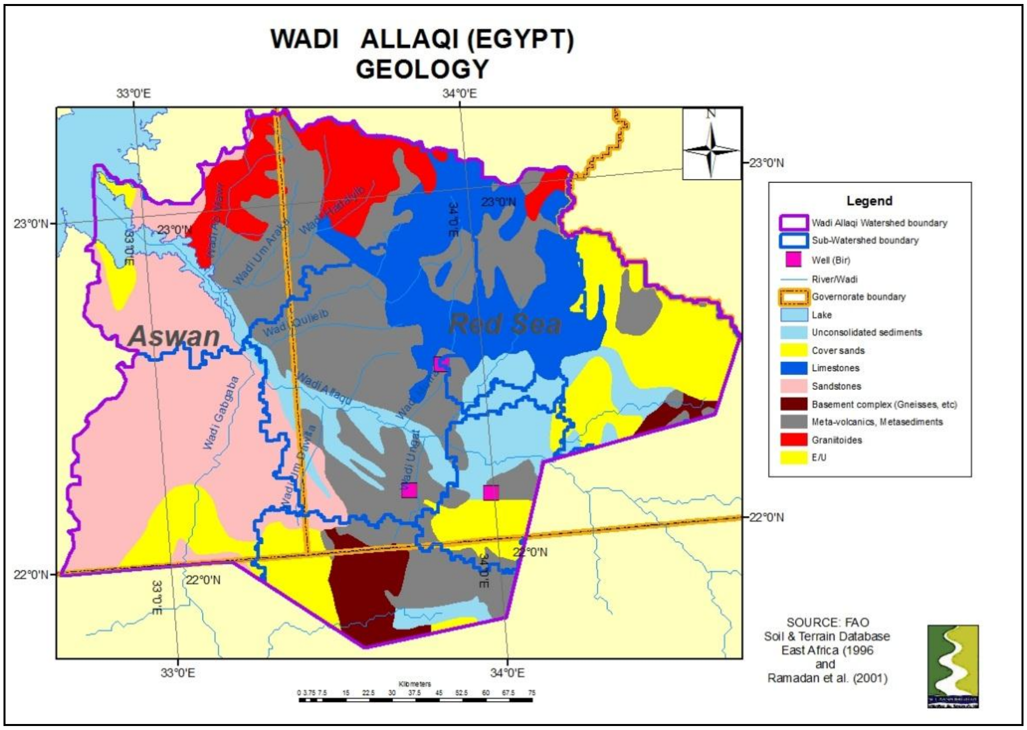


Map 6. Mean annual evapo-transpiration.

The data from the Aswan Meteorological Station showed the highest relative humidity in December (37%), lowest in May and June (13%). The meteorological station located in Wadi Allaqi field station, close to the shore of Lake Nasser, recorded relative humidity of min. 36% and max. 92% in December 1997 and a min. 22% and max. 80% in August 1997, indicating the significant effect of the Lake on the local climate

3.1.3 Geology

The northern part of the Wadi Allaqi are underlain by meta-sediments, meta volcanics and granitoides that are the subject of mineral prospecting (Ramadan et al, 2001) ((Map 7). The wadi itself is covered with unconsolidated sediments and cover sands. To the south and in the Wadi Gabgada are Nubian sandstones.



Map 7. Geology

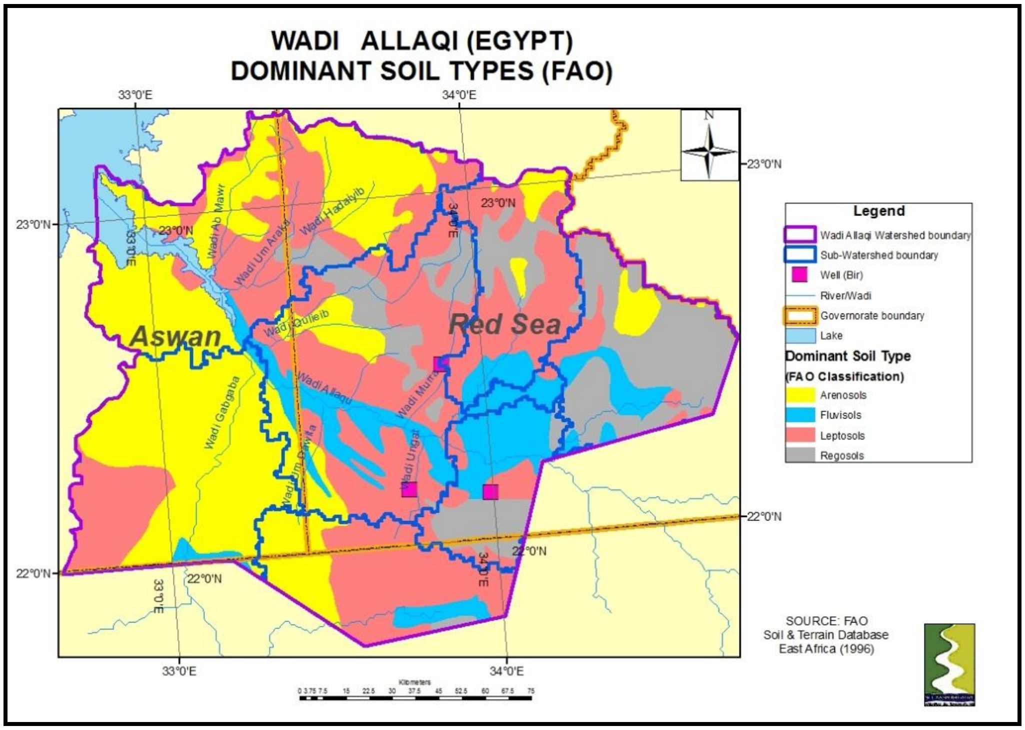
3.1.4 Soils

To the north of the Wadi Allaqi sandy Arenosols are found on the more gentle slopes derived from the thin layer of cover sands. Where slopes are moderately steep shallow and stony Leptosols occur. On the steepest slope even shallower Regosols occur.

In the wadi bottoms deep Fluvisols occur derived from alluvium, and which are being utilised for irrigation in the lower end of the Wadi. Their parent material is from one or more of three sources: sediment in the lake, wind-blown sand and flowing water. Laboratory analysis of the soils in the Wadi Allaqi indicated that wind-blown sand was the least significant although there is some reworking of fine sediment by wind. Running water (although extremely infrequent) represented the most important source of soil parent material.

The greatest effect on soil quality is the influence of lake water on soil properties. The position of the lake shore is highly variable depending on the annual variations superimposed on larger long-term variations. Annual variations are in the range of 6 to 7 meters, whilst the 1978 -1988 range was 27 meters. Two processes are important: deposition of silt from the lake during inundation and changes in chemistry of the surface soil layers during and immediately after inundation. The lake sediment is identifiable by its high content of shells and may contain high amounts of soil nutrients. Soils located at higher elevations and which are inundated less frequently have a lower pH – from 9.00 where the soil is frequently inundated to 8.00 where inundation is less frequent, whilst the subsoil remains constant at 8.8. Less frequently inundated soils also have high oxidized iron contents that could have important consequences of the soil's ability to supply phosphate and some trace elements.

There is little accumulation of organic matter except under Tamarix trees. Tamarix litter has high salt contents and these build up in the soil due to lack of leaching.



Map 8. Dominant Soils (FAO Classification)

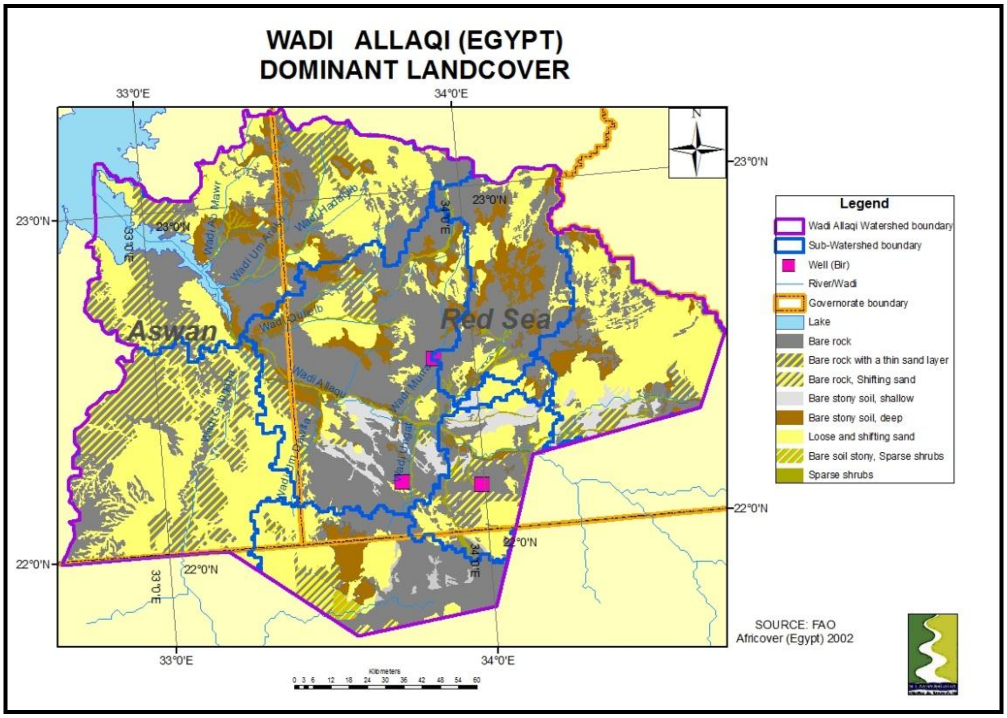
3.1.5 Land Cover / Vegetation

(i) Landcover

The two most extensive land cover types (35 percent each) are bare rock and loose and shifting sands. Bare rock with a thin sand layer covers 14 percent followed by bare deep stony soil (9 percent). Sparse shrubs with sparse grass are the only vegetation and cover just 2 percent of the area and located in the main wadi bottom.

Table 5. Wadi Allaqui (Egypt): Dominant Landcover (km2)

LANDCOVER	AREA (KM2)	%
Bare rock	7,929	35%
Loose and shifting sand	7,909	35%
Bare rock with a thin sand layer	3,260	14%
Bare very stony soil, deep	2,048	9%
Bare stony soil, shallow	709	3%
Sparse shrubs with sparse grass	428	2%
Water	308	1%
TOTAL	**22,591**	



Map 9. Dominant Landcover

(ii) Vegetation

There is a zoning of vegetation around the Lake from the water's edge. Normally, this stretches only tens to hundreds of meters from the Lake shore but along the Wadi Allaqi this zoning has been stretched over some 30 kms from the lowest water mark recorded to the highest (177.5 masl) (Briggs et al., 1993). Annuals characterize the zone closest to the water's edge typically dominated by *Glinus blitoides*, together with *Portulaca oleracea, Helianthemum spinum, Amaranthus blitoides* and the grasses *Erogrostis aegyptica, Fimbrystilis bis-umbellata* and *Crypsis schoenoides*.

In the middle zone *Tamarix nilotica* is dominant. In the central section the stands are mono-specific, and individual plants may be large, exceeding 5 meters (figure 3).

Figure 3. Tamarix Forest, Wadi Allaqi

Source: Springuel and Belal, 2001

The highest zone is characterized by a vegetative type dominated by the composite shrub *Pulicaria crispa* that replaces *T. nilotica*. It appears to mark the highest levels attained by Lake Nasser. Associated with *P. crispa* are *Acacia ahrenbergiana*, *A. raddiana*, *Cassia senna* and *Citrillus colocynthis*.

A recent study (Springuel, I. et al., 1997) suggests that the *Tamarix nilotica* community is both new and almost unique within this desert area. It has a clear affinity with the flora present in earlier pluvial periods in this area of North Africa. Evidence for this is provided in fossil plant remains found in sand hillocks of the upper wadi Allaqi dated to about 500-800 years BP. There is no record of *T. nilotica* being found in its present position prior to the filling of Lake Nasser other than along the river bank zone.

Burning and cutting of *T. nilotica* by local communities, as well mechanical clearing by the Aswan high Dam lake Authority are leading to its destruction. The upper Pulicaria community is being uprooted by machine and taken by the truck load as fuel.

3.2 Biodiversity and Natural Flora, Plant Cover and Genetic Resources:

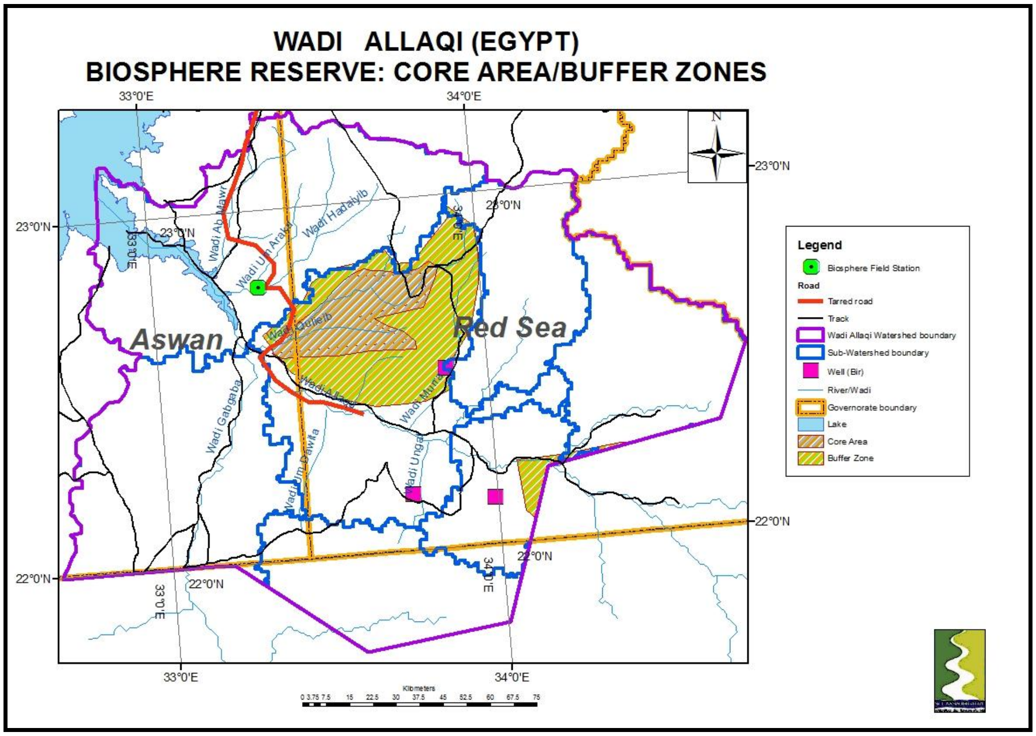
The natural flora and botanic cover of the areas of and around Lake Nasser encompasses a vast range of genetic resources both natural and improved by careful man-selection. Natural genetic resources include within species genetic differences in certain characteristics (i.e. sub-species) and the germplasm of selected species of considerable economic importance. For example medicine and aromatic plants are of major importance. Lake Nasser-Nubia and the main Nile River between Khartoum and Aswan provide important habitat for aquatic flora and fauna.

The Encyclopedia of Southern Valley and Tushka (Egypt, 1999) records about 390 plant species. They belong to different plant families as follows: 50 species belong to the legume family, 65 species of grasses, and about 275 species belongs to 55 different plant families. A description and listing of the plant species-ecosystem in the Nubian Nile and Lake Nasser area as well as their usage is shown in Annex 1.

It is important to conserve the Main Nile around Lake Nasser/ Lake Nubia species biodiversity. The conservation of species biodiversity is mainly dependent on the conservation and protection of habitats and the maintenance of ecosystems integrity. It is necessary to consider in-situ and ex-situ conservation. It is important to further study current ecosystems of natural resource base, use and management (formal and informal) and the role of the natural ecosystem in relation to agriculture. Pastoral systems of production should be studied in order to better manage the natural recourses in an effective sustainable way.

Part of the Wadi Allaqi was declared a Protected Area in 1989 by the under the auspices of the EEAA and a "Man and the Biosphere" (MAB) Biosphere Reserve in 1993. It has a core area of 63,850 ha, buffers zones of 131,095 ha and a transition zone of 2,184,200 ha (Map 12). From an ecological perspective, the reserve and its component zones form an integrated unit based on linear channels of the wadi system, which have physiographic, hydrological and ecological integrity. The small and scattered groups of Ababda and Bishari form an essential component of the Biosphere Reserve (UNESCO-MAB, 2005).

A plant biodiversity study undertaken within the Reserve (Springuel et al., 1997) found a total of 78 plant species and four principal groups, one of which was new to the area. This latter group is a result of the profound environmental changes occasioned by the flooding of Lake Nasser and its encroachment up the Wadi Allaqi. The new group was indicated by *Tamarix nilotica*. Ground-water dependence appeared to be important in defining a group indicated by *Acacia tortilis* as well as the Tamarix group. The two remaining groups, characterized respectively by *Acacia ehrenbergiana* and *Cullen plicatum* are precipitation-dependant and thus tolerate drier conditions within the Allaqi system.



Map 10. Wadi Allaqi UNESCO Biosphere Reserve: Core and Buffer Zones
Source: UNESCO-MAB, 2005

3.2 Administration

The Wadi Allaqi encompasses two Governorates: Aswan and Red Sea.

3.3 Population

There are two main ethnic groups who live in the eastern part of the Lake Sub-basin: the Ababda who comprise some two thirds of the population and the Bishari who make up the other third. The Ababda have live in the southern part of the Eastern Desert for centuries although since the end of the 19th century many have migrated to the towns of the Nile Valley. The current population is estimated to be 15,500.

The Bishari are more recent arrivals. Traditionally they lived in the Gebel Elba Region in the Red Sea Hills along the border with Sudan. Most have arrived since the 1970's to take advantage of the opportunities presented by the seasonal inundation.

3.4 Livelihood Systems

There is little difference between the livelihoods of the two groups. Their economy is based on five elements. In order of preference these are: (i) charcoal production, (ii) sheep herding, (iii) camel herding and (iv) collecting medicinal plants, and (v) residual moisture cultivation.

There are seasonal differences: with charcoal production and sheep herding taking place between December and April, cultivation between May and September, and camel herding and medicinal plant collection throughout the year. In the hill areas to the east winter rains are common and people migrate there for sheep herding and charcoal production. One person can produce five sacks of charcoal at £E50 (US$14 at 1993 prices) a sack. For a production unit of three people over a four month production season this can realize an income of E£3,000 per household. Overheads are negligible and harvesting is reported to be sustainable. Sacks are transported to Allaqi by camel and then either sold to truck drivers of a local quarry, AHDLA or WFP, or get lifts on such lorries.

In the summer they return to Lake shore to take advantage of the cooler temperatures near the lake and the retreating lake for cultivation of the residual moisture and the grasses that grow on the moisture. This system of seasonal transhumance allows the forage resources in the hills and in the lower Wadi Allaqi to recover. However, the attractions of the Lake shore and lower Wadi inundation area means that movements to the hills are getting shorted putting a strain of the forage resources near the lake.

Cultivation depends initially on residual moisture but as the season progresses on well water. Cultivation takes place in fenced plots 50 by 50 meters. Most plots have more than one well. Wells deeper than 3 meters are avoided because of the labour involved. Most wells are only used for one season as they are frequently inundated the following rise in Lake level. Small gardens of 5 by 5 meters are constructed within the plot and fed by small canals from the well. Crops include maize, water melon, okra, marrow, beans and millet.

Camels roam freely and are not herded and can roam for up to six years. Medicinal plant collection is carried out locally as and when time permits.

(ii) *Dabuka* (Camel trains)

Since inundation started in the early 1970's the Wadi Allaqi has become a major stopping over point for the *dabuka* (camel) trains from Sudan. Abu Hamed and Atbara are the main collecting points for the journey of 10 to 11 days following the Wadi Gabgaba for much of the way to Wadi Allaqi. The final journey of 3 to 4 days is to Daraw, north of Aswan where most camels are slaughtered for meat.

The Wadi Allaqi, because of the arm of Lake Nasser extending into the wadi fulfills a major role in this system. Although a healthy camel can go for 14 days without water, a ten day journey should present no problem. In practice the available water in the Wadi Allaqi is extremely important for the maintenance of camel and thus meat quality.

It is estimated that 100,000 camels in over 300 *dabuka* a year make the journey from Sudan by this route. Economically the dabuka drovers provide a source of trade, a means of transport to Aswan and Daraw and a source of information of the location and quality of pastures through the areas they have traversed.

(iii) Other Cultivators

After 1988 reservoir levels began to rise, with full storage levels again reached during the 1990s. In 1989 the World Food Program (WFP) agreed to launch a joint program with the High Dam Lake Development Authority whereby WFP would provide food for work to reclaim land along the lake shore for agriculture as well as for the eventual construction of 33,000 houses. By the mid-1990s 10,000 feddans had been reclaimed in three upper reservoir areas that Nubians had first attempted to pioneer in the late 1970s. Nubians, however, are only one of the people involved; others included non-Nubian fisher/farmers from Upper Egypt as well as Beja pastoralists from the eastern desert and the Red Sea coast who have begun to graze and water their stock around the edges of the reservoir. Whether or not the Nubians, as the former residents of the area, will be able to compete successfully against these other pioneers remains to be seen.

(iv) Fishing

To reduce conflicts among the fisher people the Egyptian portion of the reservoir was divided into five sections based on fishers' areas of origin. During the next six years numbers increased. By the end of the project fishers numbered approximately 5,000. These were Saiydis, (an upper Egyptian peasant population), from two governorates with a long history of fishing immediately north of Aswan and a few Nubians being fishers even in Old Nubia.

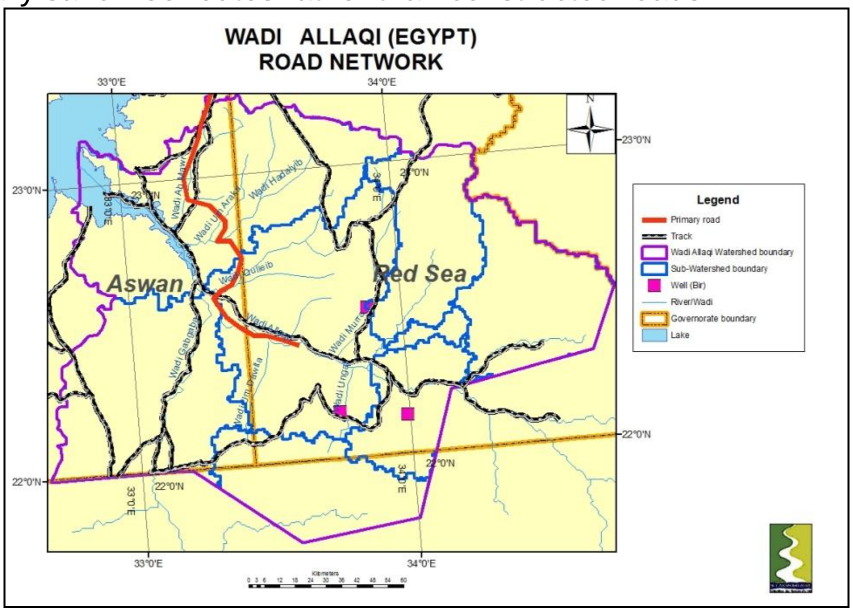
Though more transport boats had been added along with refrigerated railway cars to continue to Lower Egypt, the state of the fishery remained much undeveloped with fisher people living either in their boats or in temporary shelters in 150 fish camps. A Japanese study estimated that the lake potential is estimated at 80,000 tons per year. The information received from the Governorate of Aswan indicated that 60,000-70,000 tons of fish are yearly smuggled out of the lake although official Governorate Fisheries Department statistics for the years 2001 – 2005 indicated catches of between 12,000 and 22,000 tons per annum.

(v) Tourism

Adding Lake Nubia to tourist destinations around Aswan has considerable potential, especially during the winter months (Springuel and Belal, 2001).

3.5 Transport Infrastructure and Markets

There are 133 kms of Primary road and 828 kms of tracks within the Wadi Allaqi Biosphere Reserve. The primary road to the city of Aswan is tarred. The tracks are generally sand free routes rather than constructed roads.



Map 11. Road network.

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4. KEY ISSUES, CHALLENGES AND POTENTIALS

4.1 Poverty and Livelihoods

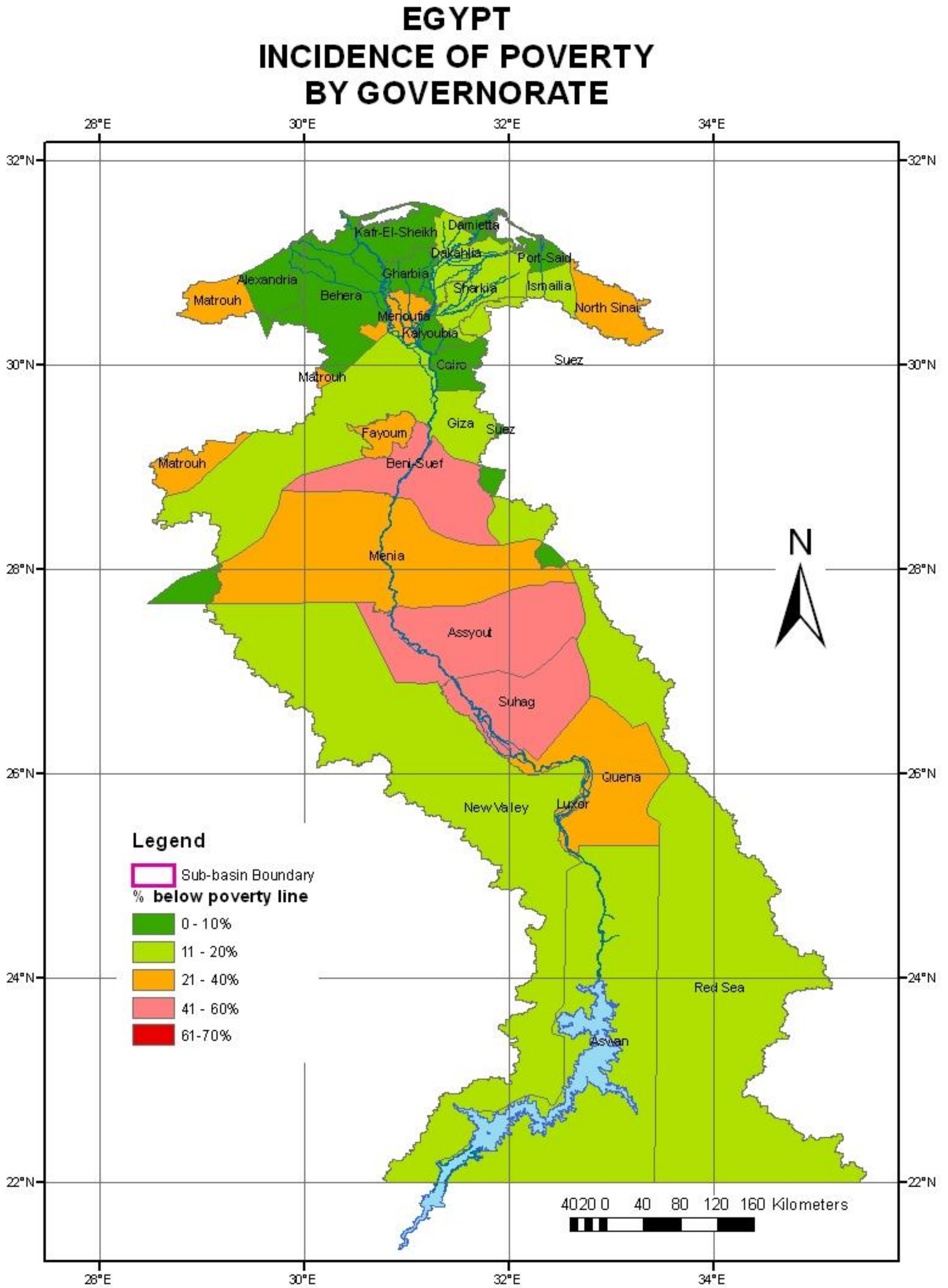
4.1.1 Incidence of Poverty in Egypt

Two recent studies by IFPRI (Lofgren, 2001) and by the World Bank (Heba El-Laithy et al., 2003) review the structure and distribution of poverty in Egypt over the recent past. Lofgren (2001) reviews development strategies adopted in Egypt since the 1970's to determine if alternative strategies could have done more to reduce poverty. The World Bank study (2003) uses two household expenditure surveys undertaken in 1995/96 and 1999/2000 to examine the evolution of poverty in Egypt between these years and reveals the structure and geographic patterns. This brief review focuses on rural poverty.

Lofgren examines natural resource and human assets of rural households. The 1952 Revolution effected land reform and expanded education and health facilities, which boosted incomes and reduced inequality and poverty. In recent years there has been some reversal of these developments. Land tenancy laws which under the 1952 land reform gave tenants formal contacts near-to full ownership have been reversed in favour of land owners. Public education has deteriorated and become more expensive. Other things being equal, these reduce the share of the poor in the skilled labour market and in labour and land incomes. Additionally, consumer subsidies to households have declined from 11 percent in 1979 to 2 percent in 1997.

The World Bank study by El-Laithy and colleagues took into account regional and rural-urban differences in prices and demographic composition of households when calculating poverty rates. It used a minimum food basket linked to normative nutritional requirements. This was costed using regional prices and compared with the poverty line defined as the second quintile of expenditure distribution. They found that whilst poverty declined as a whole in the study period there were significant differences in poverty alleviation across regions and across different employment sectors.

In 1999/20000 the poverty rate across Egypt stood at 16.7 percent (approximately 10.7 million people). However, urban rates were only 9.2 percent compared with 22.1 percent for rural areas. The distribution of rural poverty across the Governorates is shown in Map 11.



Map 11. Egypt: Rural Poverty Rates by Governorate (Source: World Bank 2003).

The Governorates with the highest rural rates are located between Luxor and El-Fayoum. The three Governorates around Lake Nasser have rates below the national average.

Across Egypt rates declined from 19.4 to 16.7 between 1995/96 and 1999/2000. But Upper Egypt rural rates increased from 29.3 to 34.2 percent in the same period. Key determinates of poverty in Egypt are education, employment status of the household head and large family size. Private sector employees were twice as likely to be poor than those employed in the public sector. The largest proportion of poor is concentrated in the agricultural and construction sectors.

Whilst the Aswan, New Valley and Red Sea Governorates have rural poverty rates below the national average there are three groups that have been identified who are likely to be below the poverty line. The first of these are the two tribes who live in the Wadi Allaqi on the eastern side of the Lake: the Ababda and the Bishari Bedouin (Briggs et al., 1993).

The second group are located in the new settlement areas west of Lake Nasser in three communities of Kalabsha, Khor Galal and Garf Hussien (IDRC, 2004). The IDRC project identified the settlers' lack of knowledge of desert agriculture and an undeveloped marketing system as hindering the agricultural development.

A third group comprise fisher people of the lake: the Saiydis, (an upper Egyptian peasant population) from two governorates with a long history of fishing immediately north of Aswan and a few Nubians being fishers even in Old Nubia. The state of the fishery has remained relatively undeveloped with fisher people living either in their boats or in temporary shelters in 150 fish camps.

4.1.2 Poverty and Livelihood Strategies

Livelihood assets include human, social, natural, physical and financial capital. Kishk (1994) pointed out that in Egypt less than 10 percent of land holders have more than 45 percent of the agricultural land whilst more than 57 percent of agricultural land holders have less than 25 percent of the land. More 90 percent of Egyptian farmers have less than 2 ha of agricultural land. His study in Middle Egypt found that given the very small plot sizes that many Egyptian farmers are barely able to make a living from current irrigated cropped area and cropping pattern. Although illegal, many small farmers resort to selling their land to builders. In 1987 net returns to food cropping were US$ 439 /ha/yr whereas land for building was selling for US$ 0.2 to US$ 5.0 million /ha. The FAO Aquastat Survey for Egypt found that farmland urbanization represented a serious threat to agriculture in Egypt (FAO, 2005).
The World Bank (2003) study found that key determinates of poverty in Egypt are education (human capital), employment status (financial capital) of the household

head and large family size. Private sector employees were twice as likely to be poor than those employed in the public sector because of the lack of security in employment. The largest proportion of poor is concentrated in the agricultural and construction sectors.

In the Wadi Allaqi and the Red Sea Hills where the Ababda and the Bishari adopt a number of livelihood strategies. These include sheep herding, camel herding, charcoal production, collecting medicinal plants and residual moisture crop cultivation. By adopting a range of strategies they reduce their vulnerability to natural and non-natural hazards and shocks. Similarly, many of the settlers on the Lake shore resettlement schemes adopt a strategy of leaving during the summer months to return to their home areas in Middle Egypt for wage employment and thus increasing family income.

4.2 The Macro Policy and Institutional Environment

4.2.1 Land Policy in Egypt

Lofgren (2001) has examined the natural resource and human assets of rural households in Egypt. The 1952 Revolution effected land reform and expanded education and health facilities, which boosted incomes and reduced inequality and poverty. In recent years there has been some reversal of these developments. Land tenancy laws, which under the 1952 land reform gave tenants formal contacts of near-to full ownership, have been reversed in favour of land owners. A conclusion in the same study is that a pro-poor redistribution of land assets by the Government over the past two decades could have improved the welfare of the poor and reduced inequality.

4.2.2 Institutional Issues: Complexity of the Institutional Framework

(i) International Cooperation between Egypt and Sudan

The Main Nile Sub-basin encompasses two countries: Egypt and the Sudan. Currently there are a number of collaborative mechanisms between Egypt and Sudan that partly emanate from the 1959 Water agreement and partly from a shared concern over Lake Nasser/Nubia. The latter cooperation is mainly in the field of sediment research, whilst the former relates to information sharing with respect to water utilization.

Given the substantial developments that are proposed for Lake Nasser/Nubia and its environs and its very fragile ecosystems there is clearly a need for a comprehensive and integrated framework for the sustainable management of its land and water resources. The area is within two countries, three Governorates and there are a number of central Government Ministries actively involved in current and planned development activities.

Both Sudan and Egypt have a proprietary interest in the Lake and the existing cooperative activities e.g. in monitoring sedimentation, need to be expanded to encompass a wide range of mutual concerns. These can include joint environmental monitoring of water in the Lake and the Nubian Aquifer, joint monitoring of river flows and suspended sediment and joint Lake planning and management.

(ii) Institutional and Capacity Issues in Egypt

(a) Agriculture, fisheries and forestry development

There are a number of organizational and Institutional Issues related to agriculture and fisheries development.

- Lack of effective coordination among the authorities concerned with land and water management. The two main Ministries are Ministry of Water Affairs and the Ministry of Agriculture and Land Reclamation.

- Lack of continuity in phases of implementation, which leads to delay in the accomplishment of the entire settlement.

- Lack of collective planning for project management by the real beneficiaries.
- Multiplicity of agencies supervising the reclamation and farming process (i.e., ministries of Agriculture, Water Resources and Irrigation, Housing and New Communities and the municipal authorities).

- Absence of an accurate data base with the executive authorities, and a well-defined chronological program for settlement and environmental impacts.

With respect to forestry, the current organizational setup is that The Lake Nasser Development Authority of the Ministry of Agriculture and Land Reclamation is responsible for all agricultural activities, research and extension work in the area. Though an excellent effort is presently being made with regard to forestry activities a specialized section or division with sufficient numbers of specialized personnel and labourers is needed as the expected work volume will increase.

Though agricultural companies and farmers working in the area have established or willing to establish tree shelterbelts, windbreaks and woodlots this needs to be made a legally binding policy. Forest products harvest and removals should be officially controlled to make the protection measures which are to be implemented more effective.

(b) Watershed Management and Water Quality Issues

In relation to water quality in its Charter and Law 48 of 1992, the MWRI is responsible for providing water of suitable quality to all users. To accomplish this goal, the Ministry has to ensure that appropriate measures are undertaken to protect both the quantity and the quality of Egypt's water resources. Included amongst its responsibilities are the issue and cancellation of discharge permits into Egyptian waterways; inspection of waste water treatment facilities; setting standards and regulations for water discharges into water bodies; monitoring municipal and industrial discharges; and ensuring the Ministry of Health carry out samples and analyses of discharges. The MWRI has delegated the water quality monitoring related tasks of both surface and groundwater to the National Water Research Centre (NWRC). NWRC, in turn, consists of the following institutes:

- Nile Research Institute (NRI).
- The Drainage Research Institute (DRI).
- Research Institute for Ground Water (RIGW).

In practice, very little has been done. Water quality management occupies a relatively small proportion of the overall activities of MWRI (NBI:NTEAP, 2006).

Law 93 of 1962 stipulates standards for wastewater discharge and gives responsibility for monitoring discharges of waste water to both the Ministry of Health (MOH) and Ministry of Housing, Public Utilities and New Communities (MHPUNC). Under Law 48 of 1992 the MOH is charged with setting standards for municipal, industrial and river vessels' effluent discharges into water bodies. The MHPUNC is responsible for planning and constructing sewerages and waste water treatment and disposal systems.

The legal framework for environmental protection has been established under Environmental Protection Law No. 4, 1994, which established the Egyptian Environmental Affairs Agency (EEAA). The Law authorizes EEAA to operate a national environmental monitoring network covering land, water and air; to undertake monitoring of existing establishments; and to develop alternative mechanisms for pollution control (e.g. water and sewerage disposal charges).

Until 1982 the Ministry of Scientific Research (MSR) through the National Research centre (NRC) undertook a large water quality monitoring programme of the Nile system but now due to financial constraints only monitors waste water treatment plants in the Great Cairo area.

It would appear that there is the potential for overlapping mandates and duplication of efforts between central Ministries with respect to water pollution control. The Country Paper for the Arab Republic of Egypt notes that water pollution control has "not been guided by a comprehensive assessment of Egypt's environmental needs" and that pollution control "has not received adequate attention". The One Source Inventory Environmental Theme Report cited the following issues with regard to water quality (Rifat Abdul Wahab, 2006):

All monitoring programs are focused only on the conventional parameters but do not cover the sediment and fish samples. Moreover, very limited data is available about the micro-pollutants (pesticides, heavy metals and hydrocarbons).

1. There is a high incidence of water-borne diseases in Egypt, especially in Delta region. In the same time, little attention is paid to pathogenic organisms & parasites in water in the current monitoring programs.

2. The essential components for effective environmental monitoring are consistency and continuity. If the database or collection system from one source is inconsistent with the base or system used by another source of data, conclusions cannot (or should not) be made based on comparison of the two data sets. In Egypt there are many governmental and academic bodies collecting data but it is rare to find full comparability between any two sources.
3. Furthermore, environmental data need consistency and continuity over time because it is generally changes, deterioration or improvement that is of interest. Many Egyptian data sets have begun as part of a development project supported by donor funds. Unfortunately many lapses once the foreign-assisted project is finished. For decision making purposes, monitoring the state of the environment over time needs to be supplemented with information concerning violations of the laws. Data concerning violations is not available because of lack of enforcement of existing laws.

4. There is a lack of inter-ministerial cooperation and data sharing. Many available reports related to water quality issues relied on old water quality data, which minimize the benefit of these studies.

5. Another important concern is the reliability and validity of the data. In view of the lack of uniformity among the various measurement programs, available data exhibit both random and systematic errors.

In terms of sedimentation, since 1973 the NRI has been undertaking intermittent monitoring of the delta development resulting from sedimentation in Lake Nasser/Nubia by undertaking bathymetric surveys using some 21 transverse cross-sections in Egypt and 19 in Sudan.

(c) Environmental Impact Assessment

Under Environmental law 4 of 1994 the EEAA is mandated to undertake Environmental Impact Assessments (EIA's). Environmental Management Units have been established in all Governorates. Both general and sectoral guidelines have been developed, which define the content of EIA Reports. Three types of projects are identified in a preliminary screening exercise:

- White List Projects: only minor environmental impacts anticipated.
- Grey List projects: proposed activities may lead to substantial environmental impacts and for which an EIA is required, and
- Black List projects: Activities for which a complete EIA is mandatory.

The EIA procedures are now well established but a number of specific issues have been identified (NBCBN-RE, 2005):

- there is a need for capacity building for Consultants (the EEAA currently relies on Consultants to review EIA Reports);
- the review process and quality of EIA Reports needs to be strengthened by providing clear and detailed guidelines and criteria;
- the environmental data required to undertake EIA's is limited and difficult to obtain, and at times costly. (EEAA is currently establishing a computerized environmental database); and
- public participation in EIA's is not mandatory and often ignored. There is need to develop participation in EIA's.

(d) Institutional Issues Relating to Settlement and Small-scale Irrigation around Lake Nasser

There are two key Government organizations of relevance to the implementation of the National master land Use Plan to settle 1 million people around the Shores of Lake Nasser: the first i the Ministry of Agriculture and Land Reclamation and the second is the High Dam Lake Development Authority (HDLDA). HDLDA is a semi-autonomous body of the Ministry of Agriculture and Land Reclamation (MALR). MALR is responsible for the civil engineering aspects of the land reclamation as well as agricultural production. HDLDA is responsible for promoting production, collecting quantitative data on agricultural activities assessing settlers qualifications, obtaining food aid (through World Food Programme), and establishing Agricultural Cooperatives.

HDLDA has an Agricultural Research Centre in Aswan and provides extension services to settlers. However despite impressive research results in the laboratories extension activity is minimal and sporadic due to limited resources and expertise in communicating with farmers. Until recently (2005) there had been years of no contact between the Directorate of Agriculture in Aswan and

HDLDA (CDS, 2006). This is lack of contact is now being rectified and is enabling direct contact to be made between the farmers and the Directorate of Agriculture.

(e) The Need for Integrated Lake Basin Development Planning and Implementation

Given the substantial developments that are proposed for Lake Nasser/Nubia and its environs and its very fragile ecosystems there is clearly a need for a comprehensive and integrated framework for the sustainable management of its land and water resources. The area is within two countries, three Governorates and there are a number of central Government Ministries actively involved in current and planned development activities.

Both Sudan and Egypt have a proprietary interest in the Lake and the existing cooperative activities e.g. in monitoring sedimentation, need to be expanded to encompass a wide range of mutual concerns. These can include joint environmental monitoring of water in the Lake and the Nubian Aquifer, joint monitoring of river flows and suspended sediment and joint Lake planning and management.

5. IDENTIFICATION OF WATERSHED MANAGEMENT INTERVENTIONS

5.1 Review of Current Projects

5.1.1 University of South Valley

There has been an ongoing adaptive research programme in the Wadi Allaqi with the Universities of the South Valley in Aswan, of Glasgow, U.K. and with support from IDRC of Canada for over a decade, which has developed an understanding of the livelihood strategies in the area (Briggs et al., 1993, Briggs et al., 2003). See also Annex 1 for a list of publications emanating from the research.

5.1.2 IDRC (Canada) Support to Settler Communities

An IDRC supported programme is working with three settler communities west of the lake. The project is an "Action Research" aimed at anticipating and developing ways of avoiding the experiences outlined above. The main thrust of the project is participatory research to improve incomes and mitigate environmental threats to human health. The project's strategic concept is "agro-ecology" with a focus on sustainability, enhancing household assets and increasing income from agriculture. Experience to date is that with the limited social, health and educational services (only primary schooling available) and lack of connection to the national grid dissuades permanent settlement. Many settlers follow a migratory pattern growing a short winter season crop and return to their home areas to earn additional income.

The High Dam Lake Development Authority (HDLDA), WFP and the Project are addressing these problems by identifying with the settlers the key social, legal, policy, cultural and environmental factors that either encourage or impede the adoption of sustainable agricultural practices and to develop a better understanding of the potential impacts both on the settlers' livelihoods and the environment. As with the development experience in the Wadi Allaqi the key lesson learnt is the need to work with the concerned communities and to develop development pathways that are appropriate and sustainable.

5.2 Observations and lessons learnt for Watershed Development in the Wadi Allaqi

The Ababda and the Bishari people have shown remarkable flexibility and adaptability in their livelihood systems to the changes in the environmental occasioned by the construction of the Aswan High Dam, the subsequent filling of the reservoir and its annual and decadal changes in water levels. Their livelihood strategies have expanded to include charcoal production and irrigated crop production.

The ephemeral pastures resulting from the annual inundations of the Wadi floor enable then to bring their sheep flocks from the Red Sea Hills during the summer months. They have been able to take advantage of the new road constructed (for quarrying) to ship their charcoal to Aswan. The wadi has also become an important stop over for the *dabuka* trains from Sudan providing yet another potential source in income from trade and another source of transport to Aswan.

Nevertheless, the adoption of irrigated cropping was supported initially by WFP Food for Work programme in 1990 for three years. Once the incentives ceased most households interest in irrigated plots waned and a survey in 1993 (Biggs et al. 1993) most households placed cultivation as a livelihood strategy last behind charcoal production, sheep-herding, camel-herding and collecting medicinal plants.

The conclusion from a study of the livelihood system in the Wadi Allaqi was that the most "ecologically and economically sound method of development in the area is to build from "below" within the existing framework of the Bedouin economy. Two potential pathways for development were identified as greater use of existing vegetation resources for charcoal production and livestock grazing.

5.3 Project Stakeholders

The **Primary Project Stakeholders** include:

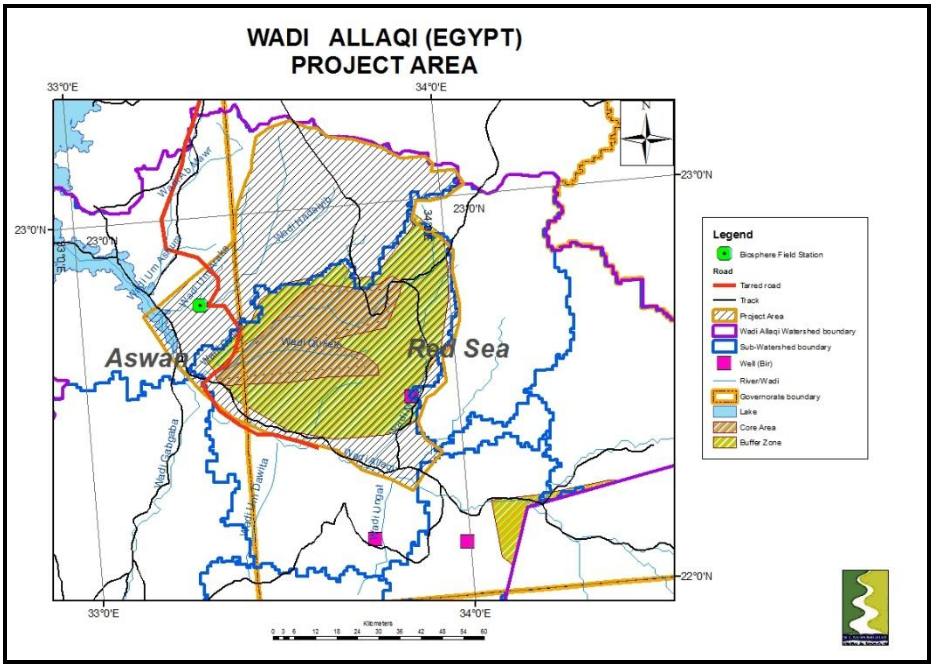
- The Ababda and Bishari households who live within the Project Area;
- Staff of the Aswan High dam Authority and the Aswan Regional Planning Authority who will receive technical and logistical support.

The **Secondary Project Stakeholders** will include the Eco Tourists who visit the Project Area to enjoy and appreciate the livelihood systems and culture of the Ababda and Bishari people and also the unique desert ecosystem in a pristine condition.

5.4 Proposed Watershed Management Interventions

5.4.1 Selection of Project area

The Project Area has been delineated so as to include the western Quleib Core Area and Buffer Zone as well as the Sub-watershed of the Wadi Hadaiyib. This encompasses the main biodiversity areas, the main permanent settlement areas of the Ababda and Bishari communities. It is also the area subject to annual inundations of Lake Nasser.



Map 12. Proposed Project Area

5.4.2 Potential Development Pathways

For the Ababda and the Bishari people three potential pathways for development were identified as greater use of existing vegetation resources for charcoal production and livestock grazing; a change from cash vegetable cropping to fodder production; the promotion of participatory eco-tourism.

(i) Use of existing vegetation resources for charcoal production and livestock grazing

Research indicates that an open-canopy *Acacia* woodland cover could be established fairly readily over the Wadi Allaqi providing shade and a sustainable source of fuelwood and charcoal . The trees would require irrigation or shallow groundwater for their initiation but thereafter could exploit deeper groundwater. Given the very good returns to charcoal production this would ensure that such production was sustainable in the long-term by increasing the amount of woody biomass in the area. Increased shade would benefit both humans and livestock in the hot summers. It would also reduce pressure on the Acacia trees in the Red Sea Hills.

(ii) Substitution of Fodder crops for vegetables

A second pathway would be to substitute fodder crops (Lucerne) for vegetables (currently grown as a cash crop for the Aswan market) that could be sold to the dabuka as well as providing feed for their own animals. This would be in-keeping with their traditional livelihood strategy of sheep and camel production.

There is recent evidence that amongst the poorest of the three Ababda Clans (the Sadenab) and the female headed households the latter strategy is being adopted. The main problems are shortage of labour and keeping livestock out of the fields. Sorghum and maize are grown in addition to lucerne.

(iii)Eco-tourism

Opportunities for ecotourism activities in Wadi Allaqi Biosphere Reserve include (Springuel and :

- Bird watching/wildlife tourism/photography;
- Geological/Historical tourism and visits to geological and archaeological sites. Tourists are eager to see traces of earlier culture and prehistoric sites such as rock drawings, outposts, and ruined fortresses. These are abundantly present all over Wadi Allaqi;
- A trek across the desert (e.g. journey to Gebel Elba through Wadi Allaqi);
- Health tourism – based on clean, quite environment, spiritual heritage and medicinal plant/herbal treatment;
- Scientific tourism: e.g. helping scientists conduct conservation research; Ethno-botanical studies, searching for and working with traditional groups to identify these properties;
- Education/adventure tourism: Educating visitors about the functions of a Biosphere Reserve, what it protects, why it exists, what the restrictions are, its boundaries, zonation and the ecological services are the key elements of environmental educational plan. There are three groups which should be considered: overseas visitors, national and local residents, university and school students.

The Wadi Allaqi Biosphere Reserve is relatively undisturbed natural area in which indigenous communities play a significant role. This is why **mass tourism** should be avoided because they are more likely to cause damage to the ecosystem directly or indirectly, as well as affect the social structure of indigenous communities.

5.4.3 Proposed Components

(i) Tree Planting for Charcoal Production and Forage

In areas subject to frequent inundations of Lake Nasser planting of *Faidherbia albida, Tamrix aphylla* and *Acaca nilotica* would be promoted as these species are able to withstand long periods of being submerged. *Balanites aegyptiaca* would be planted on the edges of the wadi which are not subject to inundation.

Sub-surface irrigation via a 50 cm diameter and 150 cm long tube would be used in the first year to enable establishment.

F. albida and *A. nilotica* both produce good quality charcoal and forage of livestock. *B. aegyptiaca* is very drought tolerant and once established can live for a 100 years. Its leaves provide soil nutrients and thus can be planted with other species to their benefit. Its pods provide feed for livestock, but its wood is not as suitable for charcoal production.

Technical assistance would be provided in achieving better charcoal production efficiencies to further reduce pressure on the Acacia cover in the Red Sea Hills.

(ii) Promotion of Fodder (Lucerne) Production

The typical transient camel herds can exceed 100,000 annually. This translates into a total fodder requirement of 630 MT DM/yr, an amount that could seriously jeopardize local fodder stocks. The project would support the increased cultivation of fodder crops, in particular lucerne through the provision of seed and technical training.

(iii)Eco-tourism

To encourage natural–orientated tourists the WABR requires investment in camp-sites, simple rest houses and centers where visitors can be oriented and directed to sites, facilities and services. Brochures, maps and other published material should be available (the visitor information system) as well as some educational material with explanations (e.g. a tourist quite, book for WABR).

Principals to be followed;

- Communities should be involved in ecotourism planning from the earliest stages;
- The local community should be both beneficiaries of, and stakeholders in ecotourism activities. The local people must understand that the benefits they receive are linked to protected area;
- Tourist activities should be sensitive to local cultural values; tour operators and WABR staff need to be informed of these by the community.

Proposed measures to maximise the local benefits of the tourism development:

- Using local products and skills;
- Employment;
- Restoration of biodiversity and ecosystem, e.g. planting indigenous to Wadi Allaqi economically important plants in ecologically favourable habitats as alternative to over exploitation in natural habitats.

5.4.4 Supporting Interventions

In addition to the support to tree planting and vegetable production activities the project would provide assistance to a number of supporting activities. These would include:

- Training for selected off-farm employment opportunities (both men and women);
- Support to improvement and increase of value chain addition (product storage, improved processing) and to market linkages;
- Support to establishment and legal recognition of Pastoralist Associations for improved access to inputs and markets.

6 Distribution of Benefits

There are a number of local, regional and global benefits that would accrue to the Project.

At the local level a sustainable supply of wood for charcoal production would be achieved. Increased cash incomes would be obtained particularly for the resource poor and women headed households. Household assets would be increased and there would be a widening of households' livelihood strategies. There would be reduced vulnerability to market price shocks for vegetables. At the Regional level there would be reduced pressure on the Acacia trees in the Red Sea Hills.

At the global level species and habitat biodiversity would be enhanced and carbon sequestered in woody biomass increased.

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EASTERN NILE TECHNICAL REGIONAL OFFICE

NBI – Institutional Strengthening Project
PROJECT DELINEATION AND PRIORITIZATION

ANNEX 4.9
WADIS ALLAQI/GABGABA (SUDAN)
UNESCO BIOSPHERE RESERVE
BASELINE STUDIES
(FINAL)

7th June, 2011

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CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AHD	Aswan High Dam
AHDA	Aswan High Dam Authority
ARPA	Aswan regional Planning Authority
BCM	Billion Cubic Meters
C	Carbon
CAP	Compliance Action Plan
CAPMAS	Central Agency for Public Mobilization and Statistics
CIDA	Canadian International Development Agency
DRC	Desert Research Centre
DRI	Drainage Research Institute (NWRC)
EEAA	Egypt's Environmental Affairs Agency
EEIS	Egypt Environmental Information System (a CIDA project at EEAA)
EHD	Environmental Health Department (MOHP)
EIA	Environmental Impact Assessment
EIMP	Environmental Information and Monitoring Program
EMUs	Environmental Management Units
EOHC	Environmental and Occupational Health Center (MOHP)
ERC	Environmental Research Council
FAO	Food and Agriculture Organization of the United Nations
GOE	Government of Egypt
GOFI	General Organization for Industrialization
HAD	High Aswan Dam
IDRC	International Development Research Centre (Canada)
LCD	Liters per Capita per Day
LE	Egyptian Pound
MAB	Man and the Biosphere
MALR	Ministry of Agriculture and Land Reclamation
masl	meters above sea level
Mm^3	Millions of cubic meters
MSEA	Ministry of State for Environmental Affairs
MOHP	Ministry of Health and Population
MHUNC	Ministry of Housing, Utilities and New Communications
MOI	Ministry of Industry
MWRI	Ministry of Water Resources and Irrigation (previously MPWWR)
NAWQAM	National Water Quality and Availability Management (CIDA project)
NEAP	National Environmental Action Plan
NOPWASD	National Organization for Potable Water and Sanitary Drainage (MHUNC)
NRI	Nile Research Institute, NWRC (previously known as: HADSERI)

NWRC	National Water Research Center, MWRI
NWRP	National Water Resources Plan
PRIDE	Project in Development and the Environment (USAID)
RIGW	Research Institute for Groundwater (NWRC)
SLR	Sea level rise
TDS	Total Dissolved Solids
TSP	Total Suspended Particles
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
USAID	United States Agency for International Development
VOC	Volatile Organic Compounds
WFP	World Food Programme
WHO	World Health Organization
WPAU	Water Policy Advisory Unit (MWRI)

DISCLAIMER

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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[17] 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 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

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

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 Transboundary 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 Transboundary 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 nine of the Investment Projects located within the Main Nile Sub-basin, the Tekeze-Atbara Sub-basin and the Baro-Akobo-Sobat

Sub-basin. Those Projects identified in the Abay-Blue Nile Sub-basin are being considered separately.

1.2 Primary Objectives of the Project

There has been a wealth of ecological, sociological and economic studies undertaken over two decades in the current Biosphere Reserve within Egypt. The objective of this Project is to provide support to the Sudan Wildlife Conservation General Administration (WCGA) in obtaining baseline information to enable the Governments of Egypt and Sudan establish a Trans-boundary Wadi Allaqi UNESCO Man and the Biosphere Reserve. This would require undertaking botanical, ecological and livelihoods surveys in the Sudan part of the Reserve.

The Project would provide human capacity building support to enable close collaboration between Egypt and the Sudan both at the local and the national levels. This would involve provision of logistical support to undertake the necessary surveys. The project provides support to enable knowledge exchange through workshops and meetings.

2. NATIONAL SETTING - SUDAN

2.1 Bio-physical and Socio-economic Setting

Sudan covers an area of approximately 2.5 million km2 and in 2002 an estimated population of 31.3 million with an annual growth rate (1998-2003) of 2.6 percent. The projected 2025 population is 49.6 million. The total, rural % and growth rates by region are shown in table 1.

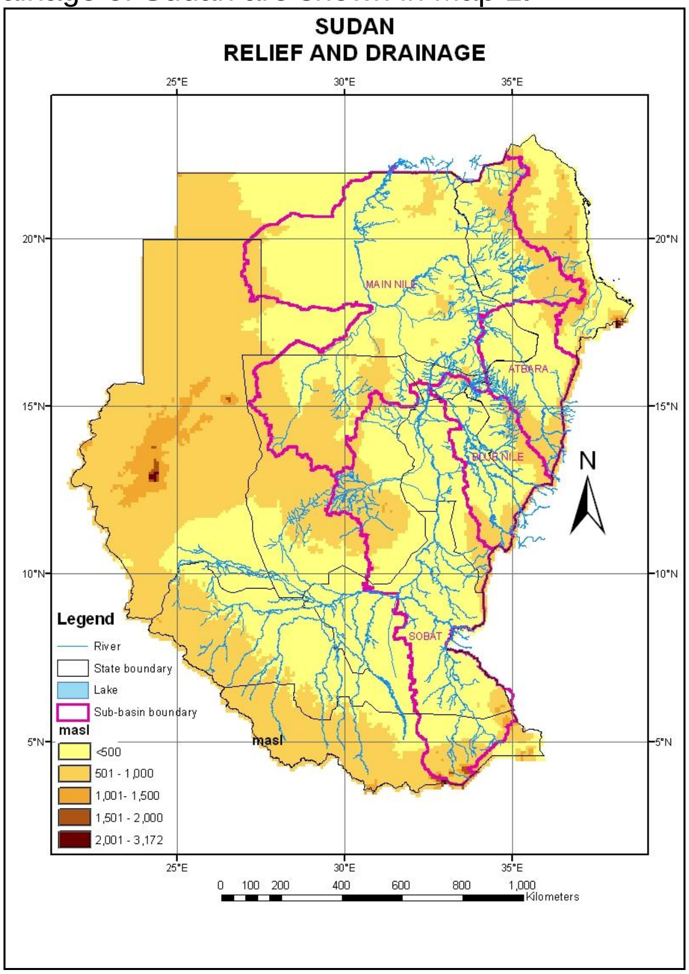
Table 1. Sudan: Total population, Rural % and growth rates by Region (2002)

REGION	TOTAL POP ('000) 2002	RURAL %	TOTAL GROWTH RATE
Eastern	3,360.5	57%	2.25%
Northern	1,392.5	75%	1.85%
Khartoum	5,301.3	14%	4.04%
Central	6,278.7	70%	2.80%
Kordofan	3,512.0	74%	1.50%
Darfur	6,212.6	82%	3.01%
N. Sudan	26,057.0	60%	2.58%
S.Sudan	5,283.3	79%	1.61%
SUDAN	31,340.0	65%	2.64%

Source: Y.A.Mohamed (2005)

Overall population density is 12.4 p.p.km2 but this masks considerable variations. Population tends to concentrate along the streams and rivers and other water sources.

The relief and drainage of Sudan are shown in Map 1.



Map 1. Sudan: Relief and Drainage

Land under 500 masl occupies the central White and Main Nile valleys as very gently sloping plains. Higher land is found along the eastern edge as outliers of the Ethiopian Highlands together with the Red Sea Hills. The southern and southwestern edges of the basin form the Congo-Nile watershed. The Jebel Marra forms the Nile-Lake Chad watershed along the western border. Locally hills and mountains rise above 1,500 masl (e.g. the Imatong Mountains being the country's highest point at 3,224 masl).

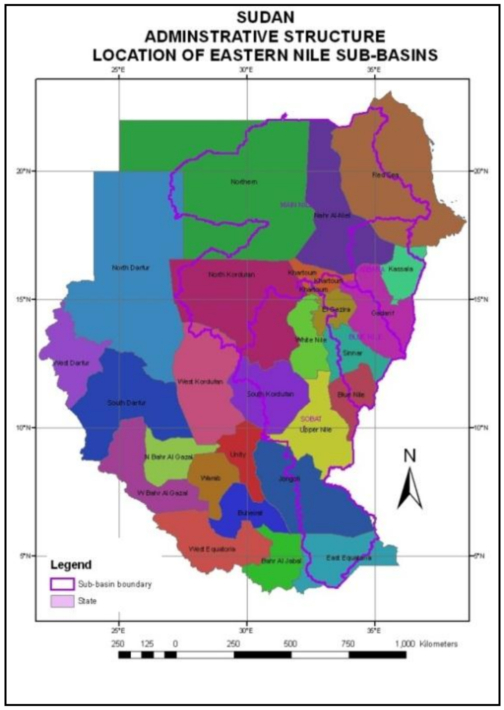
The Bahr el Jebel enters Sudan from Uganda with the Bahr el Ghazal forming on the northern slopes of the Congo-Nile Divide. They join at Lake No to be known as the White Nile. They both lose much water through evaporation in the Sudd. Just above Malakal the Sobat River, which rises in the southwestern Ethiopian Highlands, joins the White Nile. At Khartoum the White Nile is joined by the Blue Nile, which rises in the Central and Northern Ethiopian Highlands. Thence known as the Main Nile it is finally joined by its last tributary the Atbara, which also rises in the northern Ethiopian Highlands. There are many seasonal wadis and khors, which flow intermittently during the rainy season. Locally they are of considerable importance in small-scale irrigation, water harvesting and human and livestock water supplies.

The country encompasses three major ecological zones: desert, semi-desert and savanna. Annual rainfall varies from less than 25 mm in the north to 1,500 mm in the south. Rains are erratic and variable, increasingly so in the north. Rains fall in a single season and are closely related to movements of the inter-tropical convergence zone (ITCZ).

Soils in the Sudan are commonly classified into four groups: (i) thin desert soils consisting of loose sand over bare rock in the north, (ii) fixed or shifting aeolean sands in the north and central parts, (ii) clay soil derived from old and recent alluvium over large areas of the central and eastern parts, and (iv) lateritic soils on the ironstone plateau in the southwestern part of the country.

Natural vegetation closely follows the rainfall patterns with local edaphic variations related to soil moisture conditions. Successively from the north are desert, semi-desert, woodland savanna on clay, woodland savanna on sands, high rainfall woodland and swamps. Large areas of the central woodlands on clay have been cleared for semi-mechanized farming and other areas of woodland are under severe pressure from traditional farming, and fuel wood and charcoal production for both urban and rural household consumption.

2.2 Administrative Structure



Map 2. Sudan: Adminstrative Structure with Eastern Nile Sub-Basin Boundaries.
Source: ENTRO GIS data base:

In the past decade Sudan has embarked a policy of administrartive decentralization. According to the Local Government Act of 2003, the Sudan has been divided into 26 States, some 16 located in the north and 10 in the south (Map 3). Each State is divided into anumber of Localities (Mahaliyat). The aim of decentralization is to improve the delivery of basic social services and address the severe spatial disparitries in access to education, health, water, agricultural extension and other government services.

Decentralization and concommitant capacity building will be undertakenn over two pahses: Phase I (2005 – 2007) and Phase II (2008 – 2011). Priorities in the local government will be:

- Enhancing managment capacity by empowering suitable structures to lead reform;
- A broad consultation on organizational structures;
- Developing a comprehensive strategy for institutional arranbgement, polices and guidleines for public services and training;
- Improving systems and practices of local publicprivate partnerships in service delivery;
- Support to Locality development planning;
- Improving Locality information systems;

- Establishing Locality monitoring systems;
- Promoting civil society participation in planning and organization of governmenbt activities;
- Mobilizing local revenue generation for State and Local Government.

2.3 National and Regional Policy Framework

2.3.1 The National Comprehensive Strategy (NCS) (1992-2002)

Sudan's main objectives and priorities for sustainable development were spelt out in the National Comprehensive Strategy (NCS) which provided policy directions to all economic and social sectors. The NCS incorporates the country's environmental strategy, which states clearly that environmental issues must be embodied in all development projects. Within the NCS, the government manages the economy through a series of three years rolling plans and annual budget processes. The NCS has also served as a key reference document and basis for sectoral policies and measures.

A main weakness of the NCS is the lack of coherence as it was a result of work of different sectoral teams without emphasis on horizontal and vertical integration

2.3.2 Comprehensive Peace Agreement CPA

The Comprehensive Peace Agreement (CPA), signed between GoS and SPLMA on 9 January 2005, represents a remarkable event in the history of Sudan and is a major opportunity for restoring peace and the social contract between the state and society in the country.

The CPA provides for a socially informed land tenure policy and legislation as it accords specific reference to ownership of land and natural resource. It calls for competency in land administration, provides for incorporation of customary laws and practices and establishes an independent Land Commission for the purposes of arbitration, rights of claims in respect to land, land compensation and the possibility of recommending land reform policies.

The CPA is expected to have many implication (institutional and administrative) - e.g. the establishment of a Land Commission for the south parallel to existing central institutions responsible for land and natural resources management.

However, there is the question of the existing sectoral environmental legislation. Should that legislation remain federal as it is currently stands, or should it be amended and passed down to the states in accordance with the obligations given to them by the federal structure? (NBSAP,2002)

There is now a counterpart ministry of Environment and Wildlife in Southern Sudan and it is expected that the post CPA developments will witness greater decentralization on all levels. This will necessitate the initiation of a dialogue on developments in the sub-basins in Sudan as a basic requirement for sustainable development in the sub-region. Of special concern also are issues related to conflict resolution, internally displaced refugees, good governance, and the rights of the socially, economically and politically marginalized groups in post conflict Sudan

2.3.3 The Joint Assessment Mission (JAM) (2005)

The JAM Reports are the most recent documents which are guiding the economic development in post peace period in Sudan. The reports have developed the policy guide lines and interventions in eight clusters, including the economic policy cluster. The issue of environment has been classified as one of the cross-cutting issues. The report identified many environmental challenges Sudan is facing and need to be addressed during the short and medium term to enable the country make an equitable and sustainable development in the foreseen future.

The JAM report has stated that the foremost challenge is to minimize the negative environmental impacts that returning refugees and Internally Displaced Populations (IDPs) may pose on the natural resources base through increased deforestation and destructive agricultural practices

2.3.4 Poverty Reduction Strategy (2000)

Under the coordination and leadership of the Ministry of Finance and National Economy, Sudan is also in the process of formulating a national poverty reduction strategy. This strategy is expected part of the country’s long-term strategic plan and seeks to involve all groups of Sudanese society.

The preliminary draft of the PRSP was prepared in January 2004 with participation and contribution of a number of highly qualified national experts, The PRSP is considered to be the main available document of the government of the Sudan for poverty reduction. It covers the sixteen States of North Sudan for the period 2005-2007.

PRSP main objectives are:

- Maintain Economic Stability.
- Ensure Political Stability
- Social Stability.
- Environmental integrity
- Improve standards of living
- Assist in the flow of financial resources.

2.3.5 Environment Protection Act 2001

In 2001, the Higher Council for Environment and Natural Resources (HCENR) initiated the development of environmental regulations under the Environment Protection Act which was issued through a presidential decree. It established guidelines and requirements for environmental impact assessments and environmental conservation frameworks.

The Environmental Protection Policy (2001) requires that any new projects that are deemed to have an impact on the environment conduct an Environmental Impact Assessment (EIA). This must be done in order to obtain an Environmental Compliance Certificate (ECC) from the HCENR through the receipt of an Initial Environmental Impact Assessment (IEA) Report. This report should contain a Mitigation Plan or a description of the mitigation measures to be implemented to reduce the environmental impacts of the proposed project.

The EIA report is normally made available for viewing and comment by interested and affected parties prior to the HCENR giving the go ahead with the project. This legislation represents a major step in coordinating national developmental projects on an environmentally sustainable basis

2.3.6 National Water Policy (2001) - Draft

Through a process of consultations with stakeholders, a Draft National Water Policy was prepared. The policy builds on experiences of a wide range of experts and institutions involved in water sector. The draft policy document assesses the water situation in the country, existing policies and legislation and then provides the main policy principles and statements. These policy principles are considered under water resources, water utilization, water and environment, international issues, socio-economic issues, disaster management and institutions and capacity building. It also recommends development of strategic plan for the water sector.

The objectives of the NWP are to:

- Review and adapt water policy to meet changing circumstances within the country;
- Ensure that the water resources of Sudan are properly managed, protected and efficiently utilized for the benefit of all;
- Provide the basis for the on-going development of water related regulations and legislation, and
- Strengthen and clarify the functions and responsibilities of water related institutions in both the public and private sectors in Sudan

Part 3 of the Water Policy (2001) addresses issues related to water and environment. It examines at policy as it affects the environment and related matters such as pollution and catchments degradation.

2.3.7 National strategies in response to Multilateral Environmental Agreements (MEAs)

(i) Agenda 21 Project - Sudan

In response to Agenda 21 (Rio Earth Summit 1992) a project was implemented in Sudan to build the capacity needed to meet the challenges of the Twenty First Century. The project helped to build capacities of government institutions, the private sector and non-governmental organizations to implement sustainable development projects. The project played an important catalytic role in promoting community level environmental protection. The project succeeded in building the capacities of Two State Environmental Councils and in the preparation of Environmental Action Plans for 4 States. This provided the basis for a ground level identification of a National Agenda 21 and initiated the formulation of a National Sustainable Development Strategy.

(ii) National Biodiversity Strategy and Action Plan (NBSAP)

In 1995, the Sudan government has become party to the Convention on Biological Diversity (CBD). The Government developed with GEF support and technical assistance from World Conservation Union (IUCN) its first National Biodiversity Strategy and Action Plan in May 2000 and its first Country Study on Biological Diversity in April 2001. The NBSAP outlines strategies, priorities and actions for biodiversity conservation and protection of natural ecosystems

(iii) National implementation Strategy for the UN Framework Convention on Climate Change

In 1992, the government of Sudan signed the United Nations Framework Convention on Climate Change (UNFCCC), and ratification took place in 1993. An enabling activity for climate change funded by GEF/UNDP was implemented by the HCENR. The project conducted many activities including training, a Greenhouse Gas inventory, a vulnerability and adaptation assessment and mitigation analysis and an intensive awareness program. As part of complying with its commitments to the Climate Change Convention, Sudan completed its National Communication under the UNFCCC in February 2003.

To fill the gaps and short comings of the vulnerability and adaptation assessment to climate change a three-year project is being implemented as part of the

"Global Assessment of Impacts of and Adaptation to Climate Change (AIACC)" through GEF/UNEP. This project aims at enhancing the scientific and technical information, assessing the impact of climate change and designing cost-effective response measures needed to formulate national policy options.

(iv) National Action Plan (NAP) to Combat Desertification

In November 1995 Sudan ratified the United Nations Convention to Combat Desertification (UNCCD). The National Drought and Desertification Control Unit (NDDCU) has been designated as the national focal point to the UNCCD. The NDDCU identified the States that are affected by the desertification process. As part of its commitments under this convention, a National Action Programme (NAP) has been prepared in April 2002.

The challenges which face the implementation of NAP in Sudan include lack of a coherent national land use plan, dependence of household energy on forests products, expansion of mechanized rain fed agriculture and the civil war.

(v) Other International Environmental Obligations

Sudan is also involved in key GEF funded regional initiatives under the international waters operational programmes and is an active player in all these initiatives. These include the Kijani Initiative, the project for the Protection of Key "Bottleneck" Sites for Soaring Migratory Birds in the Rift Valley and Red Sea Flyway, the Nile Trans-boundary Environmental Action Project, the Strategic Action Programme for the Red Sea and Gulf of Aden (PERSGA) and the project for the Removal of Barriers to the Introduction of Cleaner Artisanal Gold Mining and Extraction Technologies.

2.4 Institutional Framework

2.4.1 Higher Council for Environment and Natural Resources (HCENR)

In recognition of the importance of environmental protection for the sustainable development of Sudan, as well as for the fulfillment of the various United Nations global environmental commitments, the government in 1992 established the Higher Council for Environment and Natural Resources (HCENR) as the central government organ co-ordinating efforts for sustainable development, use of natural resources and environmental protection. The Council includes a number of relevant ministries and places special emphasis on addressing degradation, resource depletion, and chronic pollution. A parliamentary committee on environment and natural resources was also established in 1992.

In 1995, the Government also created the Ministry of Environment and Tourism, now Ministry of Environment and Physical Development (MOEPD) to oversee overall environmental management and integrate environmental protection into national development strategies.

The mandate of the HCENR as stated in the Environment Protection Act 2001 includes inter alia:

- Formulation of general policies for Natural Resources, inventories and development to ensure the appropriate management of the resources and their conservation and sustainable use,

- Develop in co-operation with other government authorities strategies to encourage environmentally sound and sustainable activities; and

- Initiate measures for the co-ordination and enforcement of environmental protection legislation.

The HCENR is chaired by the Minister of the Environment and Physical Development. The HCENR discharges its functions by a General Secretariat with the following mandate:

- Draft general policies for Natural Resources Inventories and Development to ensure the appropriate management of the resources and their conservation and sustainable use.

- Environment conservation in coordination with the appropriate authorities in the States.

- Coordinate the work of the Council Branches and all efforts in natural resources inventories and conservation and efforts for the sustainable development of the resources, monitor changes in the natural resources;

- Specify areas subjected to depletion, desertification and pollution and decide on priorities for surveys and studies on natural resources.

- Make long-term plans for rational and balanced use of the natural resources and environment conservation and follow-up the execution of the plan with appropriate authorities.

- Periodically review legislation related to the natural resources and the environment, make sure that Laws are effective and introduce any necessary amendments to improve the Laws.

- Establishment of branches in the different States to help the Council in performing its responsibilities.

- Encourage support and coordinate scientific research in all fields of the environment and natural resources.

- Formulate a federal plan for environmental awareness and rational use of the natural resources and try to incorporate environmental education in school curricula.

The HCENR is Sudan's outlet to the international environmental arena. It acts as the technical focal point for most of the environmental the conventions emerged from the Earth Summit in Rio de Janeiro (1992) namely: Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC). In addition it is a party to the Convention on Persistent Organic Pollutants (POPs).

The cross-cutting nature of the environmental issues, which spread over different disciplines, has guided the HCENR to form steering and technical committees so as to bring all the concerned stakeholders together, and playing its coordinative role.

2.4.2 Other Government Institutions

In addition to the HCENR, other government ministries have significant roles and responsibilities in the areas of natural resource management, land use planning, and socio-economic development, including :

- Ministry of Agriculture and Forests;
- Ministry of Irrigation and Water Resources;
- Ministry of Finance
- Ministry of Technology and Scientific Research;
- Ministry of Industry and Commerce;
- Ministry of Energy and Mining
- National Council for Strategic Planning
- Ministry of Health;
- National Meteorological Authority
- Ministry of Culture and Information; and
- The General Directorate of Public Corporation for Investment

The **Ministry of Agriculture and Forests** is responsible for agricultural development and natural resources planning and policies, and the National Drought and Desertification Control Unit (NDDCU) in this Ministry has been designated as the national focal point (NFP) to the UNCCD.

In 1989 the **Forest National Corporation** (FNC) replaced the old Forest Administration (that was established in 1902) to be responsible for the protection and management of forest resources in the country. The FNC is a semi-autonomous corporate body that is attached to the Ministry of Agriculture and Forests. It has a Board of Directors constituted by the Council of Ministers and 10 representatives from related institutions. As such, the FNC is entrusted with the role of protection and conservation of forest resources.

The **Ministry of National Industry** is responsible for formulating industrial policies, strategies and programmes that fall within overall national objectives. The Ministry can orient the activities of many industrial activities that are directly related to the Biodiversity, Climate Change and Desertification issues, as the industrial sector is an important user of natural resources.

The **Ministry of Irrigation and Water Resources** is responsible for setting national water resources policies, strategies and plans, development of water resources to meet the needs, monitoring of ground water basins, and forging cooperation between the Nile basin countries. It also, contributes to the environmentally sound socio-economic development such as in big irrigated agriculture schemes.

The Wildlife Conservation General Administration (WCGA) was established in 1902 by the colonial authorities. The WCGA was part of the Game and Fisheries Department of the Ministry of Animal Resources. Today, it is administratively accountable to the Ministry of Interior while technically it is accountable to the Ministry of Environment and Tourism. It is entrusted with the conservation of wildlife in the Sudan. Wildlife includes also ecosystems and habitats where species are living. WCGA is also entrusted with the task of establishment and management of protected areas in Sudan. Among its main responsibilities are:

- Sustainable management and utilization of wildlife resources in the country.
- Origination of hunting (issuing licenses and setting by limits).
- Cropping of wildlife, trade in wildlife parts and live animals.
- Establishment of zoological gardens for wildlife public education.
- Control of wildlife damaging problems.
- Management of marine national parks and protected areas.

WCGA is the focal point for CITES (Convention on International Trade in Threatened and Endangered Species (includes botanical or animal species.) as well as for RAMSAR Convention for the protection of wetland.

The **Wildlife Research Center (WRC)** is a part of the Animal Resources Research Corporation. There are no official links between the WCGA and WRC. Research recommendations are not implemented, and the WCGA major approach to wildlife conservation is policing and licensing with no efforts in the area of involving the people in participatory wildlife management or applying scientific wildlife management practices (NBSAP, 2001). The WCGA lacks official link with the Fisheries Administration, Fisheries Research which is also under the Ministry of Animal Resource.

The Institute **of Environmental Studies (IES), University of Khartoum** was formally established in 1979. Although in fact it was created in 1972 following United Nations Conference on Human Environment in 1972 and the subsequent call by the Arab League Educational Cultural and Scientific Organization, (ALECSO) that universities should respond to environmental problems and challenges. Since then, he IES (the first in Africa and the Middle East) has pursued a program that blends a) post-graduate education in environmental studies b) short-term training in natural resources c) research and consultancies in project design, environmental impact assessment and education.

IES executes projects funded by international organization e.g. i) Dry Land Husbandry project (OSSREA & EPOS) i) Environment Impact Assessment projects (UNEP, UNICEF, US-AID, CPECC, UNSO) and iii) Acted as coordinators between Research Institutions and NGOs (Ford Foundation).Project proposals are coordinated through the IES pertaining to the field of coastal zone , arid lands, wetlands meteorology and urban planning. IES qualifies teaching assistants and lecturers to obtain M.Sc. and PhD degrees in environmental sciences.

2.4.3 Non-Government and Civil Society Institutions

Several national NGOs in Sudan have formed a network called the Network Committee for Combating Desertification (NCCD), NDDCU and NCCD worked in close collaboration throughout the NAP process. Organized forms of NGOs have become well known after 1975 (Mohamed, 1999). Many registered NGOs are actively working on different fields of the environment and rural development. Also there are some networks for coordination between NGOs e.g. the NGOs National Coordination Committee on Desertification (NCCD). The following are some examples of Sudanese NGOs working on environment-related work.

The Sudanese **Environmental Conservation Society (SECS)** is considered to be the most active NGO in promotion of environmental awareness and lobbying for better environmental policies and actions. It does so by initiating and supporting small projects with grassroots involvement designed to improve living conditions and wellbeing. Examples of these projects include tree planting, waste management and awareness-raising. SECS have more than 80 branches distributed all over Sudan, with more than 6000 members. The main objectives of SECS include:

- Conservation of the environment and mitigation of any action that may lead to environmental degradation.
- Dissemination of environmental awareness.

- Cooperation with the government in law enforcement for environmental conservation.
- Strengthening the links with the local, national, regional and international institutions endeavoring to conserve the environment.
- Encouraging scientific research and studies aiming at the conservation of the environment, in addition to writing of the natural history of the Sudan. (El Nour *et al* ., 2001)

The Sudanese Social Forestry Society (SSFS) is a charitable NGO with dedicated memberships who believe in social and multiple benefits of the forest. SSFS seeks promotion of concepts and practices of people involvement and social forestry in Sudan. The main objectives of SSFS are:

- To promote the concept and practices of social forestry, through networking and linkages between social forestry and extension units in Sudan.
- Enhance the standards of awareness of the community participation in social forestry.
- Encourage the scientific applied research in social forestry and promote the output of the same among the interested persons.
- Assist in the fund raising and appropriate resource funding of the social forestry projects.
- Facilitate and forward the technical consultancies in the field of social forestry projects.
- Cooperate with the concerned bodies, for the development of social forestry.
- Collect, authenticate and publish information regarding the social forestry activities.
- Establish advanced relation with international and national network.
- Preserve the natural forests as a natural heritage.

The Environmentalist Society is one of the active national NGO's in the field of environment. It aims at promoting environmental awareness and capacity building in environment related fields. All graduates from the Institutes of Environmental Studies are by default members in this society and could volunteer to provide services and contribute to environmental assessments and training programs whenever, it is required.

2.4.4 Traditional Institutions

These include traditional structures (local Administration, community leaders and other community-based organizations (CBOs). Traditional leaders are generally elected from the same families and thus, the holding is semi-hereditary one. These systems play important roles at the local community level. Their responsibilities include:

- Land allocation and settlement of conflicts;
- protection of the common natural resources;
- organization of usage of natural resources;
- construction of fire lines;
- keeping order of security and organization of foreign tribes presence in their areas, assigning nomadic routes;
- organization of communal public activities e.g. pest and bush fire control and settlement of tribal disputes

They have well identified roles in relation to resource conservation and management. According to Elnour the system of traditional management was supported by equity of use right and social customs governing common property resources. This flexibility facilitated resource conservation particularly under the dry conditions. Additionally, they play an important role in conflict resolution based on the indigenous mediation (*Judiyya*) system. The "*Judiyya*" is established tradition in Sudan and can be initiated by a member of the local administration or a religious leader (Fagir) or a group consisting of representatives of all of them. They all represent mediating roles with the ultimate objective of reaching a consensus and peaceful settlement to their conflicts.

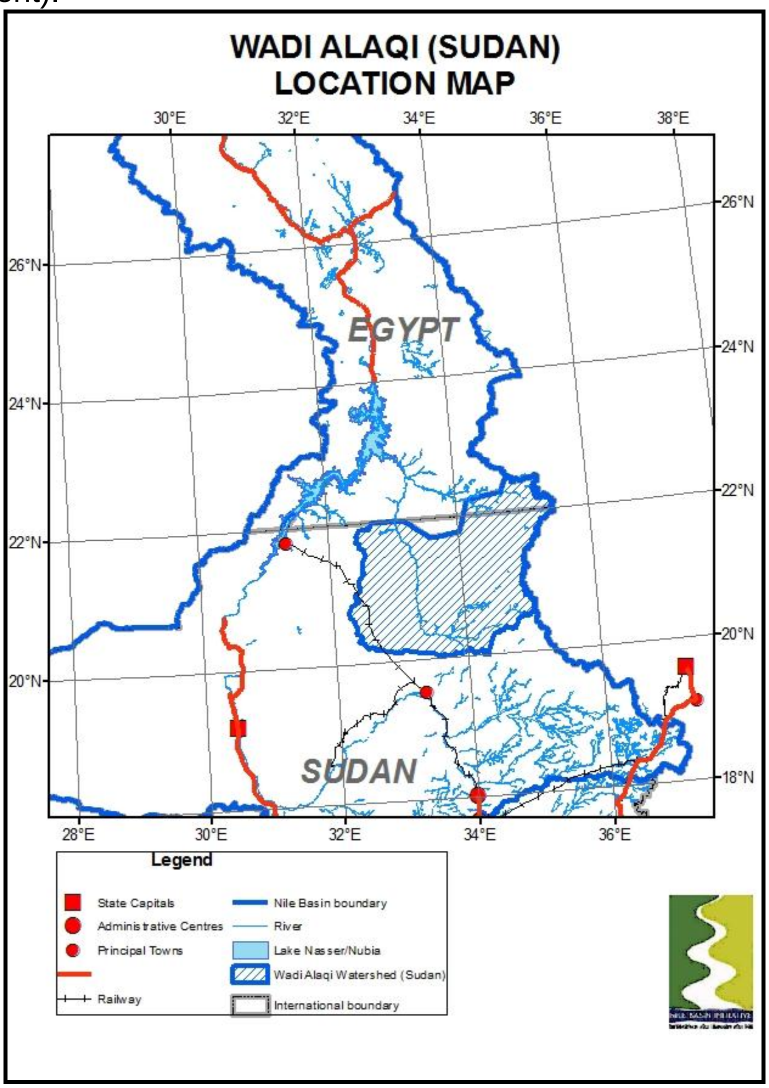
3. WADI ALLAQI (SUDAN) - BIOPHYSICAL AND SOCIO-ECONOMIC SITUATION

3.1 Biophysical Characteristics

3.1.1 Location and Extent

The Wadi Allaqi Watershed extends some 210 kms southwards into the northeastern part of Sudan (Map 3). There are two main wadis: the Wadi Allaqi that occupies the eastern sub-watershed and the Wadi and trhe Wadi Gabgaba that occupies that to the west. It is considered by some that in the geological past the Wadi Gabgaba was the main courve of the Nile River.

Within Sudan the total Watershed covers some 60,096 km2: that of theWadi Allaqi is14,727 km2 (25 percent) and that of the Wadi Gabgaba some 45,369 km2.(75 percent).

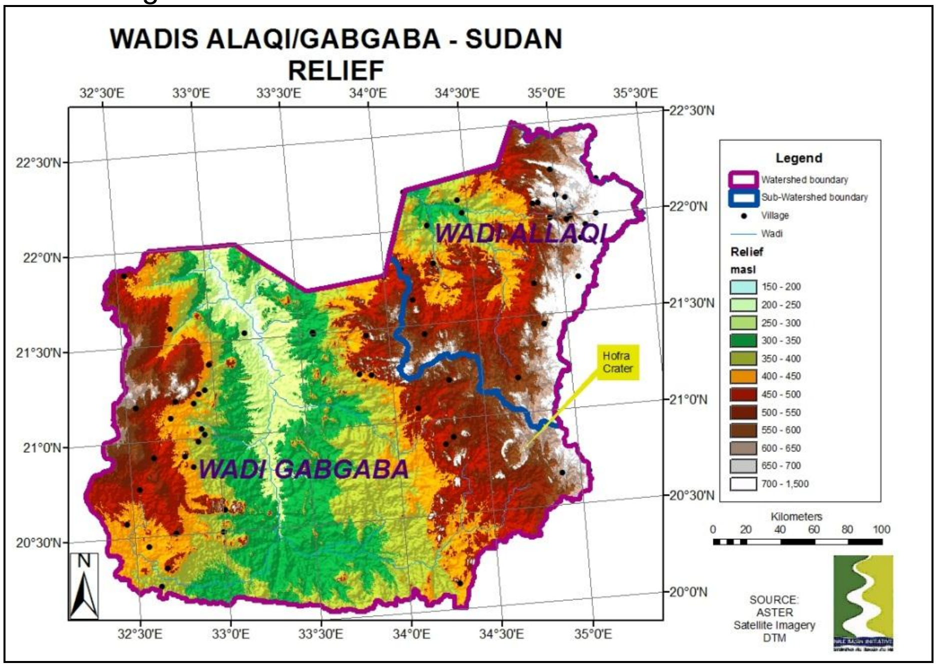


Map 3. Location of Wadi Allaqi Watershed within Sudan

3.1.2 Relief and Drainage

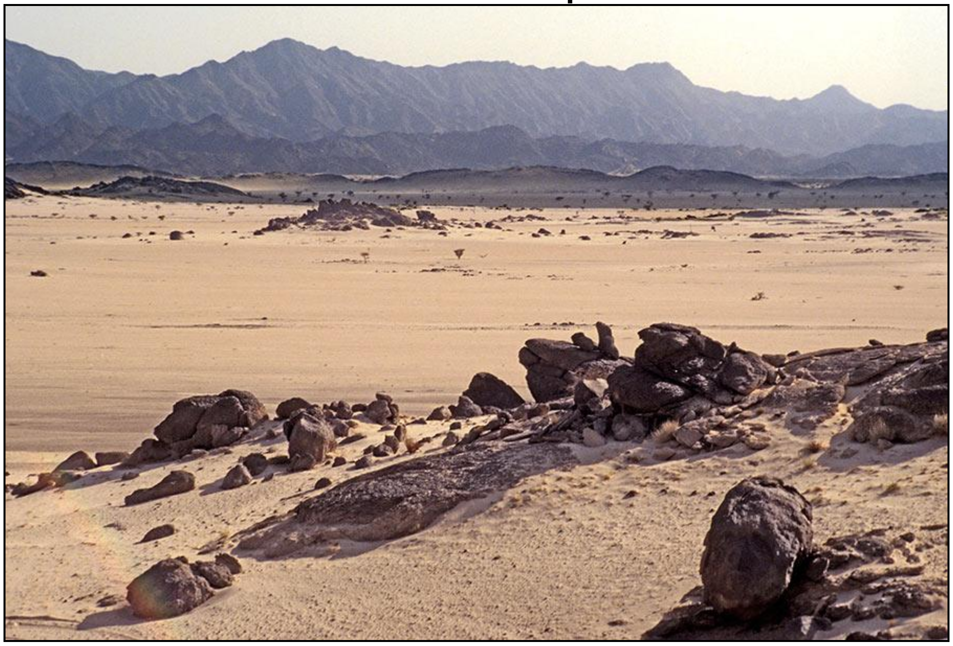
(iv) Relief

The wadi floors lie between 180 and 250 masl. The Wadi Gabgaba is contained within two north-south trending ridges rising to 800 masl. In the southeastern corner of the Gabgaba Sub-watershed is the Hofra Crater.



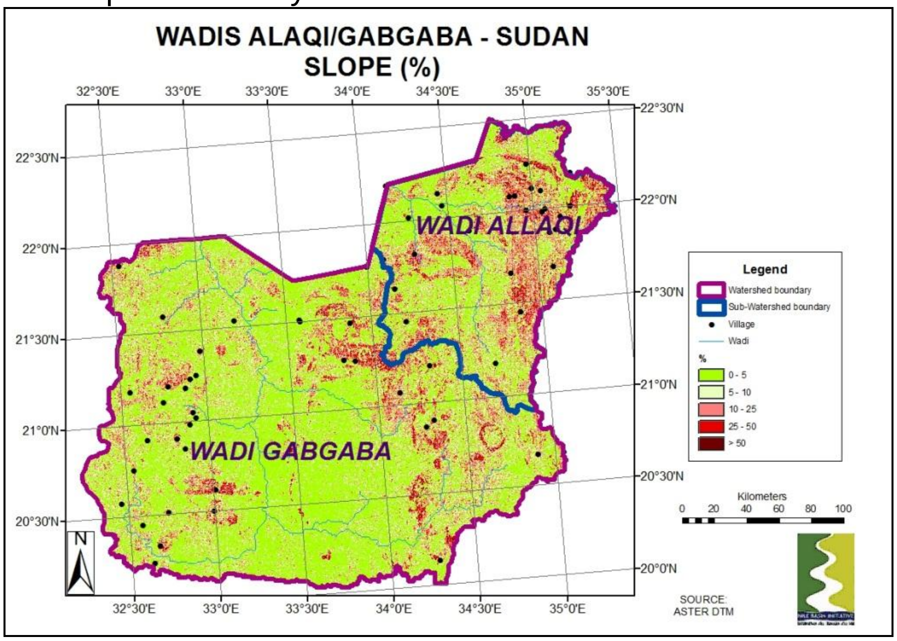
Map 4. Relief and Drainage

Figure 1. The Hofra Crater: Note the steep walls of the crater



(v) Slope

Slopes of less than 5 percent are found along the wide floor of the Wadi Gabgaba, with steeper slopes along the sides of the east and west ridges. Also noticeable are the steep slopes of the Hofra Crater. Slopes are generally steeper in the Wadi Allaqi as the valley floor is much narrower.



Map 5. Wadis Gabgaba and Allaqi: Slope (%)

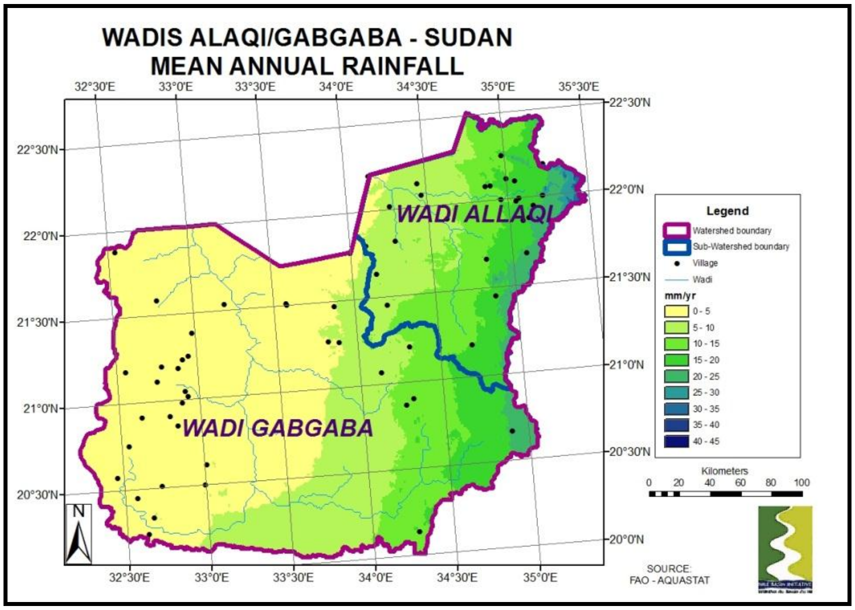
(vi) Ground water

The long axes of the Wadis Gabgaba and Allaqi follows fault zone between the basement complex rocks to the northeast and the Nubian Sandstones to the southwest. These are overlain by unconsolidated wadi sediments of Holocene and Recent age when the local climate was wetter. The Wadi floors have a very gentle gradient of 0.5 degrees. Groundwater is from deep percolating water from the Red Sea Hills over which there is varying amounts of rainfall annually. This is normally 30 meters below the surface and of poor quality.

3.1.3 Climate

(VI) Rainfall

Rainfall increases from zero on the western side of the Wadi Gabgaba to 45 mm/yr on the tops of the Red Sea Hills on the eastern side of Wadi Allaqi. However, as indicated above some years may pass with no rainfall.

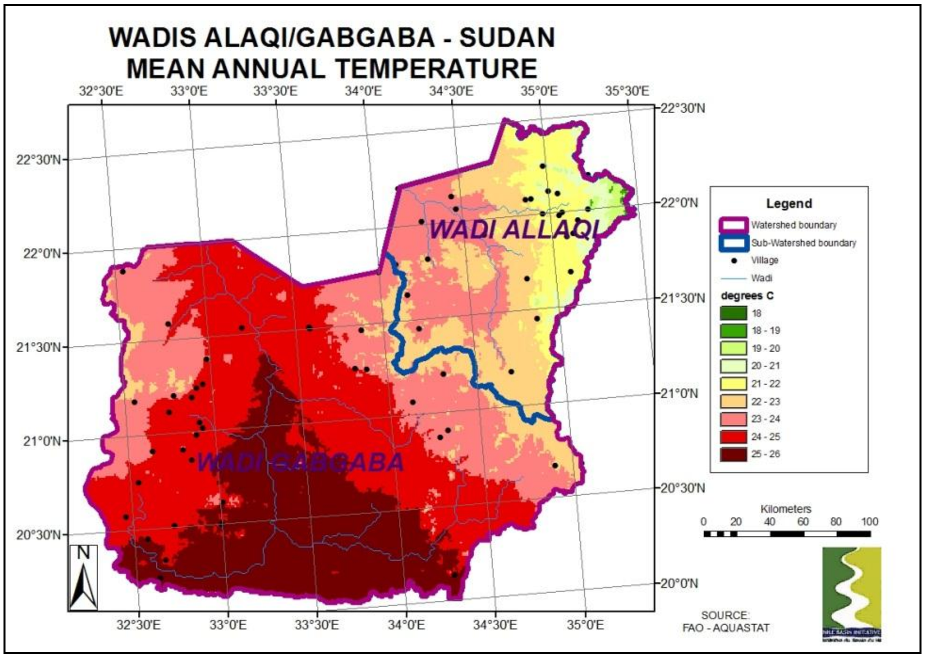


Map 6. Mean annual rainfall

During the past decade, 5 rain events were observed in the Wadi Allaqi basin, mainly during autumn (September - November), of which three in 1982, 1986, and 1994 were sufficiently large to affect biotic parts of the system. In 1994 the torrent (runoff) reached the downstream part of the Wadi, at the point of influx with Lake Nasser, and discharged a considerable quantity of water into the Lake Nasser. Water flow continued for 10 days from November 2 to November 12, 1994. This torrent was the result of series of rain events in the upstream part of the Wadi during September - October 1994. Another torrent occurred in Allaqi during May 1995. It originated on the Red Sea hills and reached the downstream part of the Wadi throughout its eastern tributaries. In the downstream part of Wadi Guileb (the eastern tributary of Wadi Allaqi) the water ran for 15 hours (Springuel and Belal, 2001).

(ii) Mean annual temperature

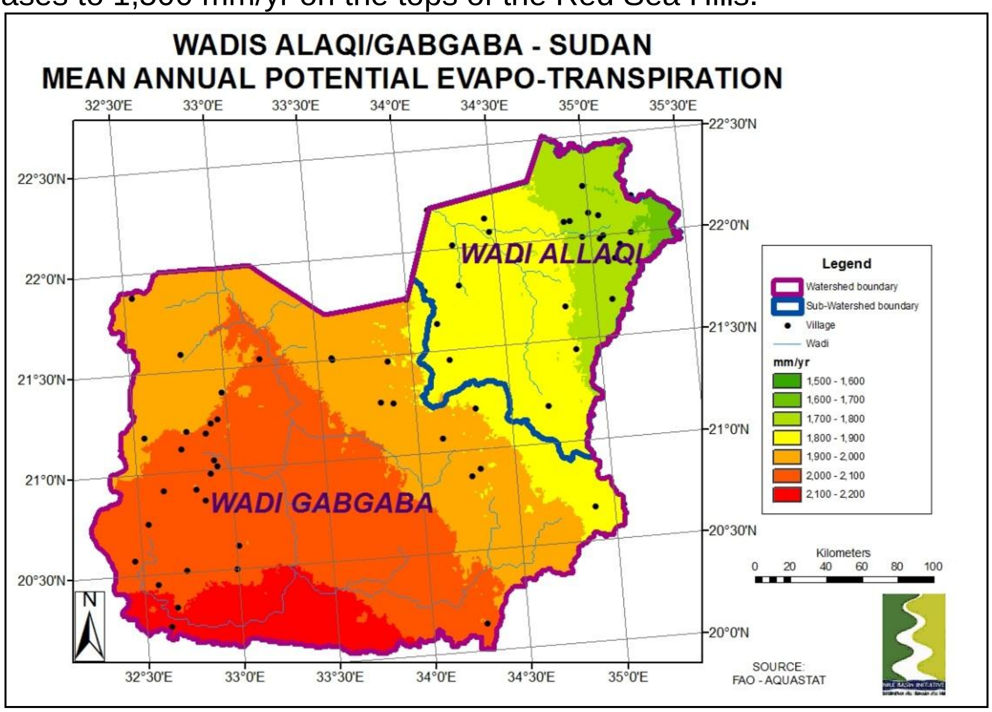
Mean annual temperature varies with altitude, ranging from 26°C in the Wadi Gabgaba bottom to 18°C along the tops of the Red Sea Hills (Map 7). A mean minimum temperature of + 8.1° C has been recorded for the month of January. However, it can be as low as -2° C (Wadi Allaqi records, January 1992). A mean maximum temperature of +41.8° C has been recorded for the month of July. However it can often reach above 45ºC especially in August (Allaqi Meteorological Station, August 1997). The Wadis Gabgaba and Allaqi is characterized as a “hyperarid environment” with an aridity index of less than 0.05.



Map 7. Mean annual temperature (degrees C)

(iii) Mean Annual Evapotranspiration

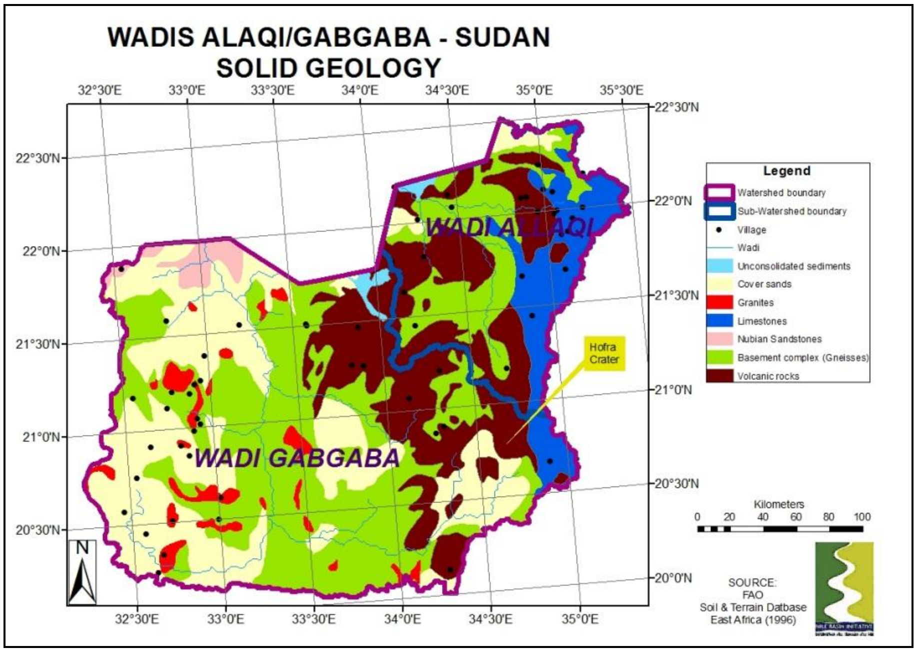
The pattern of mean annual evapotranspiration is highest in the upper Wadi Gabgaba and decreases to 1,800 mm/yr at the border with Egypt. In the Wadi Allaqi Sub-watershed PET in the lowest part of the valley is 1,900 mm/yr and decreases to 1,500 mm/yr on the tops of the Red Sea Hills.



Map 8. Mean annual evapo-transpiration.

3.1.4 Geology

The main part of the Wadi Gabgaba is underlain with Basement Complex rocks (Gneisses). In the east are Volcanic rocks (Map 9). The wadi itself is covered with unconsolidated sediments and cover sands. To the south and in the Wadi Gabgaba are Nubian sandstones.



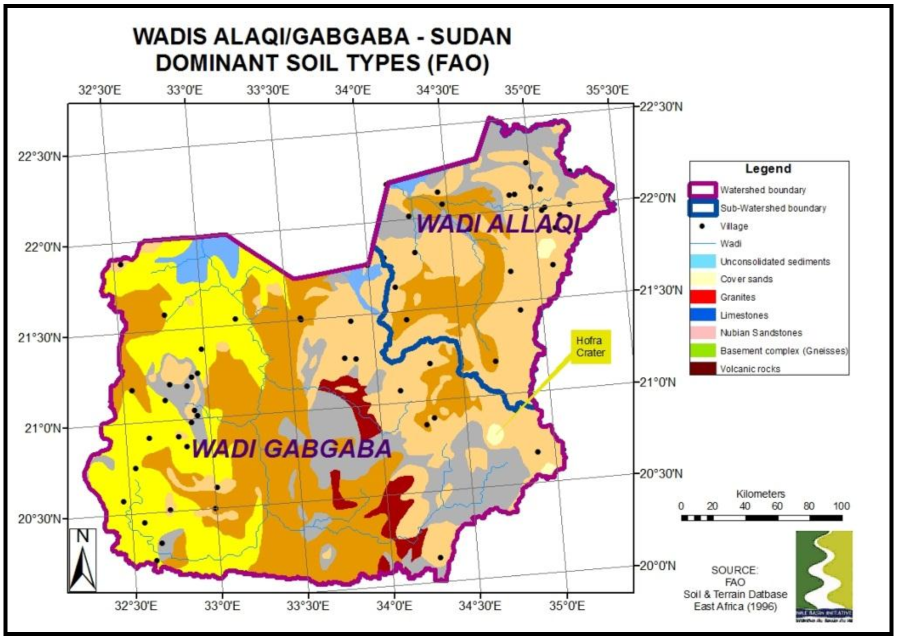
Map 9. Geology

3.1.5 Soils

In the Wadi Gabgaba sandy Arenosols are found on the more gentle slopes derived from the thin layer of cover sands. Where slopes are moderately steep shallow and stony Leptosols occur. On the steepest slope even shallower Regosols occur.

In the Wadi Allaqi where there is a greater preponderance of steeper slopes, the main soil types are lithic Leptosols (very shallow gravelly) and eutric Leprtosls which are slightly deeper.

In the wadi bottoms deep Fluvisols occur derived from alluvium, and which are being utilised for irrigation in the lower end of the Wadi. Their parent material is from one or more of three sources: sediment in the lake, wind-blown sand and flowing water. Laboratory analysis of the soils in the Wadi Allaqi indicated that wind-blown sand was the least significant although there is some reworking of fine sediment by wind. Running water (although extremely infrequent) represented the most important source of soil parent material.



Map 10. **Dominant Soils (FAO Classification)**

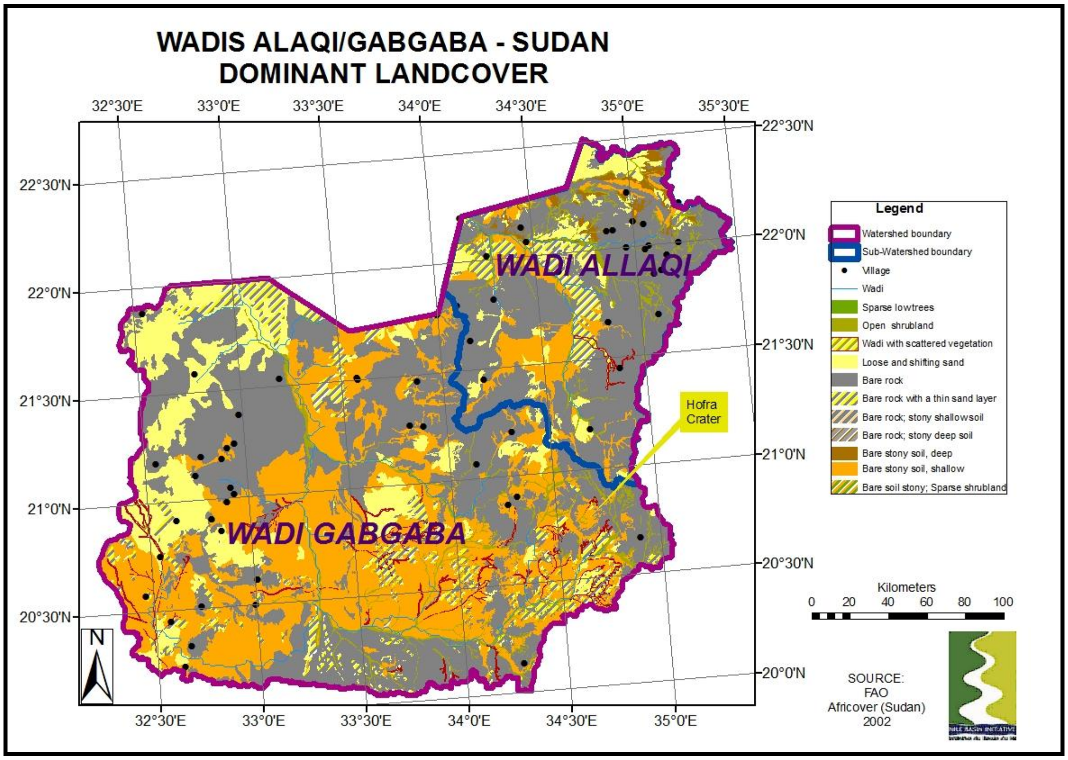
3.1.5 Land Cover / Vegetation

(iv) Landcover

The two most extensive land cover types are bare rock and bare shallow soil (45 and 30 percent respectively). Loose shifting sand covers some 13 percent followed by bare rock with a thin sand layer (7 percent). Sparse shrubland, sparse low trees and scattered vegetation in wadis are the only vegetation and cover just 5 percent of the area and located in the wadi bottoms.

Table 3. Wadi Allaqui (Sudan): Dominant Landcover (km2)

LANDCOVER	AREA (KM2)	%
Bare rock	26,049	45%
Bare soil , shallow	17,205	30%
Loose and shifting sand	7,295	13%
Bare rock with a thin sand layer	4,338	7%
Sparse Shrubland	2,148	4%
Wadi with scattered vegetation	708	1%
Bare soil, deep	469	1%
Sparse low trees (broadleaved deciduous)	2	0.0%
TOTAL	**58,214**	



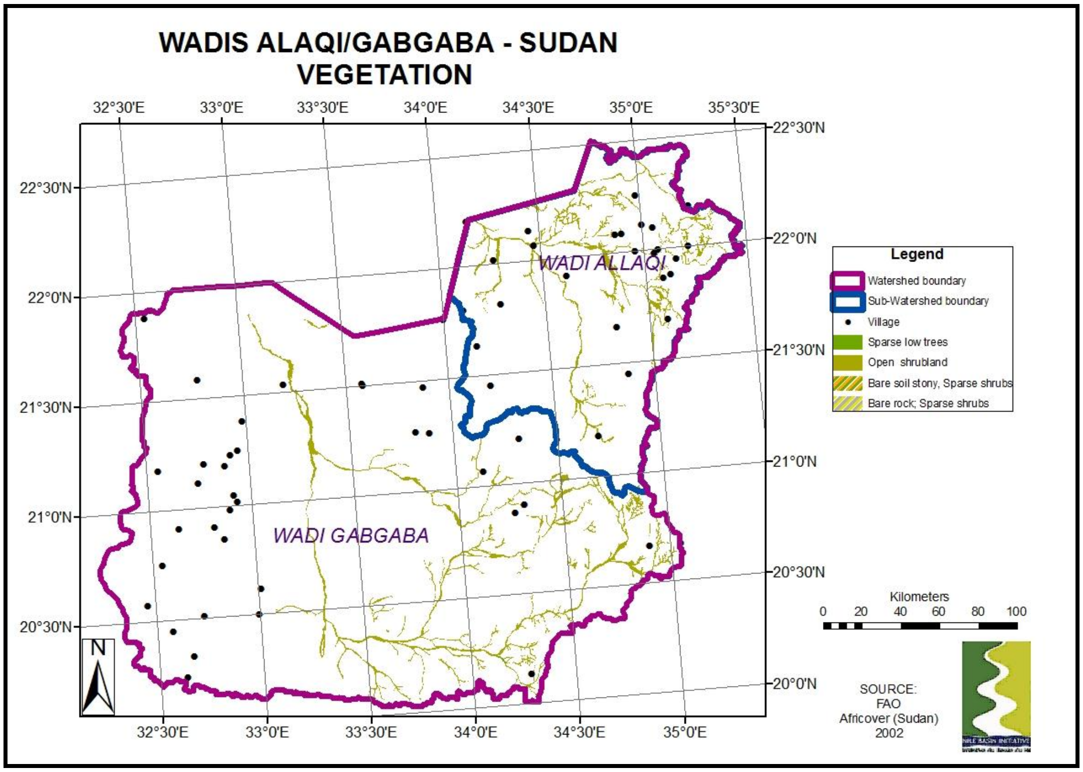
Map 11. Dominant Landcover

(v) Vegetation

According to availability the desert pasture plants can be split into three groups. The first group comprises the perennial plants (trees and shrubs) that form the permanent but limited source of fodder for livestock. These are scattered and can be difficult to reach, for example the trees forage and fruits. For animals, suitable shade will reduce water loss and lower respiratory energy consumption.

The second group is perennials that life- span is in accordance with water availability stored in the wadi- fill deposits after the rain events.

The third group is composed of annual and ephemeral plants that provide temporal (a few months) but abundant (high biomass and high nutrition) pasture for livestock. These emerge after rain events which do not necessarily occur every year.



Map 12. Vegetation Patterns

Group 1: Trees and shrubs

The indigenous desert trees, Acacia spp (*A. tortilis, A. raddina, A. ehrenbergiana* and *Balanites aegyptiaca*), are the most common and important fodder plants in Wadis Allaq/Gabgaba. The scarcity of water in the hot desert enhances the young tree to grow a deep root system that is able to make the best use of the available moisture in the soil. The growth of branches above the ground is slow whilst this is happening, and the tree can remain in dwarf form for many years before growing on to reach maturity.

Because of slow growth grazing adversely influences the seedlings more than the mature trees. Very often plants stay in dwarf form waiting the fortune of the rain. As soon as favourable conditions come, they grow quickly. Usually this happens when rain falls in two successive years. This gives considerable grazing for livestock on ephemeral pasture, hence the grazing pressure on Acacia will decrease, and, using the available moisture, trees will quickly establish themselves (Springuel et al., 1995).

Observations in Wadi Allaqi show that under sufficient water supply and protection from grazing the trees can reach a mature stage and height of seven

meters in less than 10 years, while in natural conditions it can take approximately 50 years (Springuel & Mekki, 1994).
Acacia trees are of considerable importance as fodder plants. They are the drought reserve fodder, which are only fed to stock at times when other food is very scarce. Permanent trees are vital as a drought reserve and as the stable source of food upon which people can always rely (Hobbs 1989, Hjort and Dahl 1991).The ripe pods of this species, called *ollaaf*, are important fodder for domestic animals, particularly during the dry summer months. Acacia trees are nutritious and contain high values of protein, ranging between 5 percent and 14 percent in young shoots and 21 percent in fruits. The protein content shows high variability according to the seasons. It is higher in the wet season and low in the dry season.

Balanites aegyptiaca is the most widely distributed tree in Sudan. Relatively large undisturbed populations of Balanites occupy the upstream parts of the Wadi Gabgaba and Allaqi. Experiments on cultivation of the Balanites aegyptiaca in desert farm in Wadi Allaqi began in 1991. The preliminary results of these studies show that Balanites grows slowly. The growth rate is high in the first two years, low in the next years.

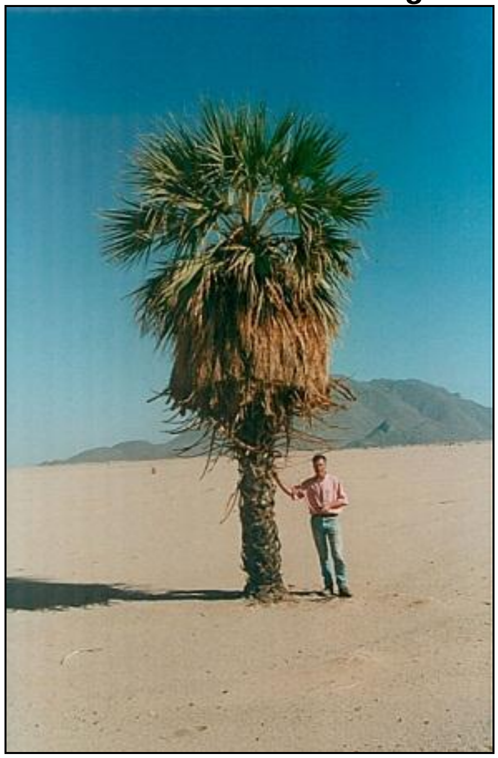
Balanites is a useful tree for livestock farmers, as a source of shelter, protection and fodder for their animals. It is especially good for providing shade for livestock because the trees have a dense cover of dark green leaves and often keep their leaves during the dry season when most other trees are bare.

In places where there is an abundant mixture of different pasture plants, or in the rainy season when pasture is easily available, livestock will often feed on other plants in preference to Balanites. However, when other fodder sources are scarce, especially towards the end of the dry season, animals do not hesitate to feed on the tree. The foliage of Balanites is nutritious. The fresh green young shoots are also palatable but have less nutrition value than the leaves, particularly they are poor in carbohydrates and fat. The leaves and young shoots of Balanites have a high mineral content (calcium, magnesium, sodium, potassium, phosphorus and chloride); some of these may be beneficial to animals while others may be harmful.

The seeds of Balanites, enclosed within the hard woody stones of the fruit, are also edible and nutritious. The seeds are particularly rich in oil and protein. The fruits contain 8.8 percent protein and high amount of carbohydrates (26.6 percent). The mineral contents of fruits are less than what are present in young shoots except for phosphorus.

The rare palm *Medemia argun* is found in profusion in the Wadi Gabgaba (Figure 2) but is extremely elsewhere (Gibbons and Spanner,2006)

Figure 2. The Medemia Palm in the Wadi Gabgaba



Group 2: Perennial plants

Senna alexandrina, Aerva javanica, and *Pulicaria crispa* and are woody perennials that grow as under-shrubs. *Citrullus colocyntus* grows prostrate on the ground. These plants are available in dry periods, usually the second year after the rain, but they dry after extended rainless periods.

Aerva javanica and *Pulicaria crispa* have a low score for grazing value, while *Citrullus colocyntus* and *Senna alexandrina* were reported to have no grazing value. However, both plants (Citrullus and Senna) have high medicinal value. Chemical analyses show that during the dry period Citrullus has a low protein content but a high amount of minerals. *Senna alexandrina, Pulicaria crispa* and, *Aerva javanica* and show a high protein content in the wet season which decreases sharply in the dry season.

Psoralea plicata is perennial, drought resistant herb that is usually available as animal food up to two years after a strong rain event. It can produce new off-springs even following a light shower. It has a high grazing score because it is abundant and has high nutrition values even in a dry season.

Group 3: Annual plants

Astragalus vogelii and *Euphorbia granulata* are ephemerals with a short life cycle (3-5 months) that grow in the desert after a rain event. Both plants provide temporal pasture for livestock.

Astragalus vogelii has a high protein contents while Euphorbia granulata has low protein and is highly valued as fodder by the Bedouin who claim it encourages fertility and milk production in their animals.

3.2 Biodiversity and Natural Flora and Fauna, and Cultural heritage

Natural genetic resources include within species genetic differences in certain characteristics (i.e. sub-species) and the germplasm of selected species of considerable economic importance. For example medicine and aromatic plants are of major importance.

3.2.1 Plant Communities

Kassa and Giogis (1970) have described in detail the vegetation of southeastern Egypt and northeastern Sudan. They identified 18 Plant Communities named after the dominant plant species. Seven of these are represented in the two wadis and a summary description follows.

Type I. *Indigofera argentea* community type is one of the less common community types, and is represented by stands of thin plant cover within distantly spaced localities of the Wadi Allaqi/Gabgaba drainage system. The dominant plant is a much-grazed leguminous species, including *Aerva persica* (P = 100%), *Fagonia indica* (P = 100%), *Cassia senna* (P = 60%) and *Salsola baryosma* (P = 60%). The shrub-layer (2-5 m) is very thin or absent: *Acacia ehrenbergiana* (P = 20%), *A. raddiana* (P = 20%). The suffrutescent layer (30-200 cm) includes the dominant and most of the perennial associates, and is thus the layer that contributes the main bulk of the perennial framework of the Communities. The ground layer includes the very common associate *Fagonia indica*.

Type II. The *Aerva persica* Community. *Cassia senna,* Indigofera argentea and Fagonia indica are well represented. Acacia ehrenbergiana (P = 71%) forms the main part of the shrub layer. The suffrutescent layer is the most obvious part of the Community. The dominant is *Aerva persica,* which contributes most of the plant cover. The ground layer comprises growth of *Fagonia indica*. Ephemerals may enrich this layer in rainy seasons.

Type X. The community is dominated by the succulent undershrub *Salsola baryosma*. Perennials include *Aerva persica* (P = 66%), *Colocynthis vulgaris* (P = 50%) and *Pulicaria crispa* (P = 43% and 50%). The shrub layer, though thin, contains *Acacia raddiana* and *A. ehrenbergiana*. (P = 50% for these two Acacia species).. The ground layer includes the common *Colocynthis vulgaris* (P = 50%) and the less common *Fagonia indica* (P = 33%).

3.2.2 Fauna

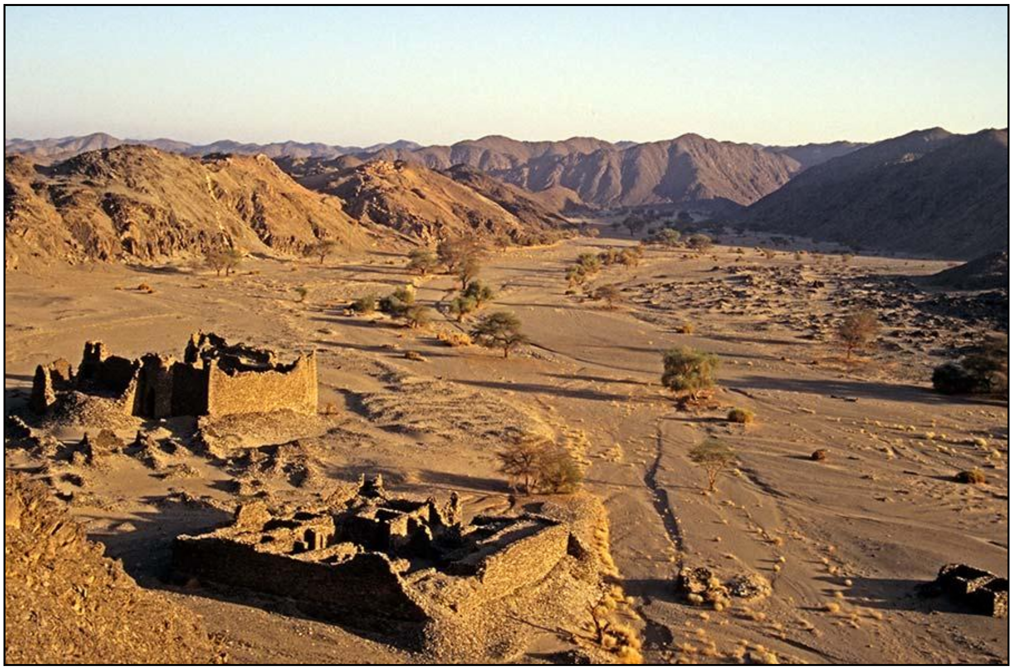
About 15 species of Globally Endangered or Threatened animals and birds live within the two Wadis, which easily cross the border between Egypt and Sudan. These include the Sand Cat (Felis margarita), the Nubian Ibex (Capra ibex nubiana), the Greater Spotted Eagle (Aquila clango), and the Eagle Owl (Bubo bubo). The great value of this biodiversity is that this community is an example of one of extra-ordinary adaptiveness and survival, not only to drought, but to uncertainty and randomness of availability of life-support resources that has developed in such an extremely harsh environment.

3.2.3 Cultural heritage

There is a particularly rich archaeological record in the Wadi Allaqi area, that includes petroglyphic and other evidence of a Prehistoric occupation culturally distinct from that of the Nile Valley. Inscriptions of the Fifth Dynasty confirm that this region was not only used as a caravan route, but also that stone for sarcophagi was quarried here. In the Old Kingdom, Wadi Allaqi was a place of contact between Egyptians and the tribes of the Nubian Desert, playing a very important role in the economic, social, and cultural life of this part of the desert. It is most probably here that the ass and the cat were domesticated by the Ancient Egyptians. As is well known, the domestication of these two animals is the only case of its kind in Africa. In almost every tributary of Wadi Allaqi there are remains of human settlements of different periods, including for mining gold. One of the most important of these mines, the Umm Gerayat mine, had a continuous history which extended to the early decades of the 20th century.

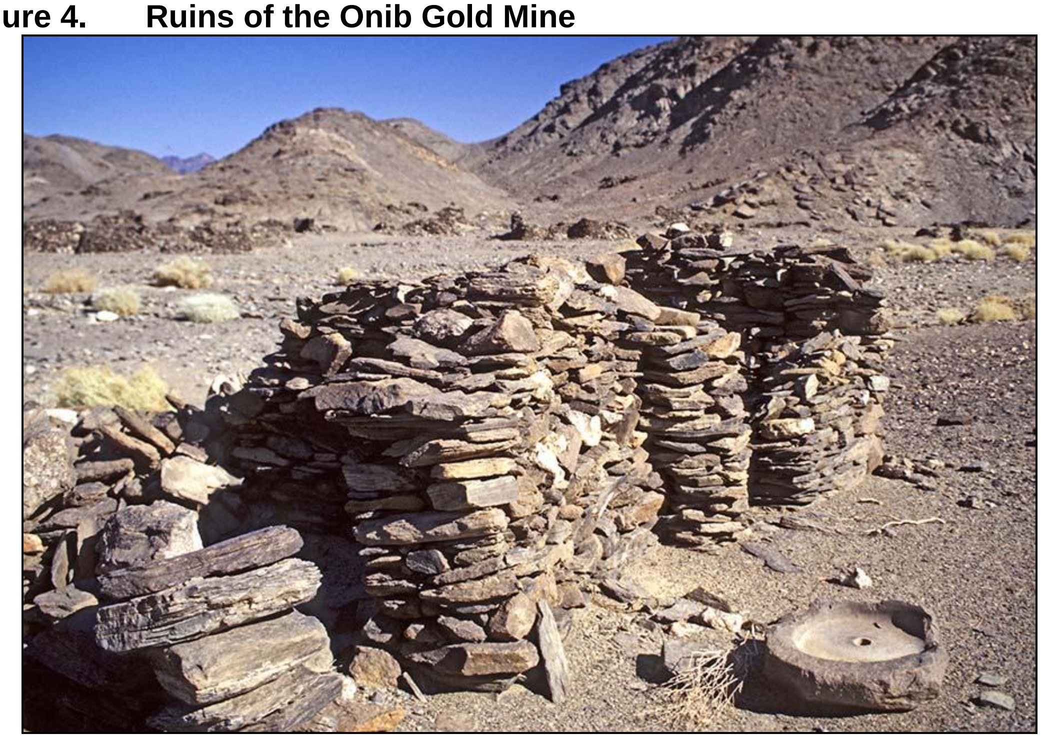
The Wadi Gabgaba is rich with remains of what seems to be an extensive Neolithic occupation: tombs, settlements, rock inscriptions, etc. Berenike Panchrysos is a large settlement that includes many building covering an area of about one and a half km on both banks of the wadi. The latest buildings are made with flat stones, while the older ones are of granite blocks, roughly squared. Near the wide bend of the wadi, which runs east to turn north, there are two majestic forts. The city could have had a population of about 10.000 people and its name has been often changed by its inhabitants. Now the nomads call it *Deraheib*, which means “buildings”. Berenike Panchrysos, the golden city of the Ptolemaic Dynasty, was the subject of many legends for centuries, up to the point that it became nearly a mythological town.

Figure 3. Ruins of the Ancient City of Berenike Panchrysos



In the same areas are the remains of ancient gold mine settlements and also Wadi Hofra (Figure 1), an crater of white sand surrounded by black mountains where there is only one narrow passage to enter.

Figure 4. Ruins of the Onib Gold Mine



3.2 Administration

The Wadis Gabgaba and Allaqi are located in three States and four Localities as follows:

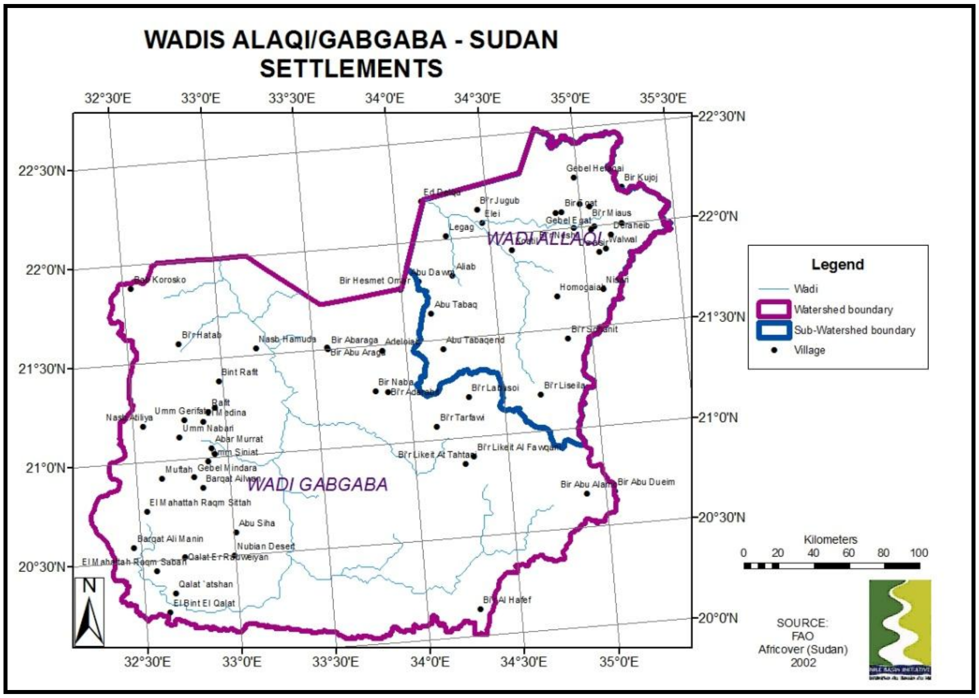
STATE	LOCALITY	KM2	% AREA
RED SEA	Port Sudan	1,356	22%
RED SEA	Halayeb	2,391	38%
NILE	Abultamad	2,233	36%
NORTHERN	Halfa	241	4%

3.3 Population and Settlement

The watershed's inhabitants are Bishari, or Bisharin (of Hamitic origin) and are a branch of the large Beja cultural group extending on the Red Sea coast as far as the Horn of Africa. They speak an ancient Hamitic language, the Bishari language. Many remain fully nomadic. There is no information on population numbers for the two wadis. It is known that in common with pastoralists across northern Sudan, the Bishari suffered huge losses of livestock during the 1983-84 drought. Some families moved down the Wadi Gabgaba to the Wadi Allaqi by Lake Nasser.

A very important aspect of Wadi Gabgaba and in its lower reaches the Allaqi, is that it has been for centuries a route for camel caravans from the eastern Sudan to be sold in Egyptian markets in Cairo. These caravans, called *dabouka,* have from 1,000 to 1,500 camels each, and scores of them traverse the Wadi Gabgaba each year. Hundreds of camels die on the way from thirst and exhaustion, and these become food for the Egyptian vultures, Neophron.

The settlement pattern is shown in map 13. The locations were established by GPS. It not certain how permanent these settlements are.



Map 13. Settlement Patterns

3.4 Livelihood Systems

Camels have been the backbone of pastoralists' economy and culture. Camel milk is their basic subsistence food as the camel provides milk for many months after calving. Camels also provide meat, skins and fat. Bishari are excellent camel breeders, selling camels to Egypt and Arabia. They are very skilled in camel riding. Camels are also used to carry grain, tents and household equipment when on the move. These camels compete with those of Oman as the best breeds of the Arab world. The three main breeds are: Shallagea, the sturdiest and best milk producers. Aririit, having great endurance and able to cover long distances at a steady pace without water, and Matiaat, the fastest camels used for raiding and racing.

Sheep and goats are kept for their milk and meat. In times of drought they die off faster than the camels but recover faster too. Some flocks are kept near the camp for everyday use but most are taken far away for grazing, drinking only every second day. Surplus sheep and goats are sold in the town markets and sometimes exported (or smuggled) into Saudi Arabia.

Milk and its products are the staple diet supplemented by cereals, especially durra (harob) or millet from which they cook a thick porridge called O'tam. Eating it with milk or clarified butter is a characteristic of Beja culture. Sorghum is also used as a supplementary fodder for Beja animals. In good years it is stored in holes dug in the earth in special areas where it can keep for several years.

The life of the Beja groups has been regulated by a customary law called *silif*, a complex but flexible body of rules based on Beja traditional values. *Silif* regulates access to and redistribution of resources, reciprocal use of environmental resources (grazing land, water points, arable land or firewood), conflict resolution and reciprocity around major social events (birth, marriage and death). Clear land rights codes embodied in the *silif* (*asl* and *amara*)[2] have helped minimise conflict over land, supported by the mediation of the tribal authorities who were entrusted with the management of land rights. However, the resilience of this system has significantly weakened through drought and conflict.

3.5 Tourism

The area is well to the north of the main tourist areas. It is not mentioned in one of the standard Tourist Guides to Sudan (Clammer, 2009). However the Italian Tourist Company, based in Khartoum operates a 16 day trip to the Gabgaba and Allaqi wadis. The trip is described as follows:

A long and tough expedition through the Nubian Desert to meet nomads and explore the legendary Berenike. Mainly a desert crossing with interesting encounters with the local population. Visits to some archaeological sites. It is a tough journey with more than 800km off road. Over-nights in wild camp.

There is an increasing market for this type of eco-tourism and given the remoteness and wild beauty of the scenery the area has considerable potential.

4. IDENTIFICATION OF PROJECT COMPONENTS

4.1 Review of Current Projects

The Watershed is not the subject of any official protected area status within Sudan.

4.2 Observations and lessons learnt from the establishment of the Wadi Allaqi UNESCO Biosphere Reserve in Egypt

The Wadi Allaqi Biosphere Reserve was declared a conservation area in 1989 and has had protected status since then within the Egyptian Environmental Affairs Agency (EEAA), and is administered by the Aswan Governorate branch of that Agency. It was designated a biosphere reserve in 1993 within the UNESCO Man and Biosphere Programme (MAB). The total area of the Wadi Allaqi Biosphere reserve is 23,000 square km and it lies within the administrative boundaries of the Aswan and Red Sea governorates.

The research programme in the Wadi Allaqi with the Universities of the South Valley in Aswan and of Glasgow, U.K. for over a decade, which has developed an understanding of the complex desert ecosystem and the livelihood strategies in the area (Briggs et al., 1993, Briggs et al., 2003). The research has produced an impressive body of environmental, social and economic knowledge, which is being utilized in the sustainable development and management of the Reserve.

4.3 Project Stakeholder

The Primary Project Stakeholders include:

- The Bishari households who live within the Project Area;
- Staff of the Sudan Wildlife Conservation General Administration who will receive technical and logistical support;
- Sudanese Researchers who will undertake medium term research into the Bishari Livelihood systems and into the desert ecosystems.

Secondary Project Stakeholders will include the Eco Tourists who visit the Project Area to enjoy and appreciate the livelihood systems and culture of the Bishari people, the unique desert ecosystem in a pristine condition and the archeological and cultural heritage.

4.4 Proposed Activities

4.4.1 Selection of Project area

The Project Area is defined by the Watersheds of the Wadi Allaqi and the Wadi Gabgaba within Sudan.

4.4.3 Proposed Components

(i) Baseline Survey

In order to acquire the information necessary to seek UNESCO recognition of the Project Area as a UNESCO Man and the Biosphere Reserve a Baseline Survey will be undertaken. This will cover all aspects of the physical environment; an inventory of the flora and fauna and their habitats; the socio-cultural and livelihood aspects of the resident population; archeological and historical aspects; and information on other aspects that would enable an effective application to be made to UNESCO for the area to be included as a UNESCO MAB Reserve.

(ii) Medium term (5 years) Research Programme

This component would support a 5 year research programme to be undertaken by selected Sudanese Universities into specific aspects of human-environmental interactions that have been identified in the baseline Study as requiring deeper research. This research programme could be conducted under the auspices the existing UNESCO Desertification Chair located in Khartoum University.

(iii) Eco-tourism Study

This study would examine the opportunities and requirements for the promotion of eco-tourism within the new MAB Reserve.

A number of principals should be followed;

- Communities should be involved in ecotourism planning from the earliest stages;
- The local community should be both beneficiaries of, and stakeholders in ecotourism activities. The local people must understand that the benefits they receive are linked to protected area;
- Tourist activities should be sensitive to local cultural values; tour operators need to be informed of these by the community.

Potential measures to maximise the local benefits of the tourism development could include:

- Using local products and skills;
- Employment;
- Restoration of biodiversity and ecosystem, e.g. planting indigenous to Wadi Allaqi economically important plants in ecologically favourable habitats as alternative to over exploitation in natural habitats.

(iv) Support to Trans-boundary Collaboration for a Trans-boundary Biosphere Reserve

The project would support joint meetings and workshops to enable the sharing of experience and knowledge.

- The establishment of the Trans-boundary Reserve would follow a number of sequential stages:

- Formal expression of commitment by Egyptian and Sudanese Governments to establish a Transboundary Biosphere Reserve,
- Establish a Joint Steering Committee;
- Develop a single Reserve Management Plan;
- Implement human capacity building
- Establish formal joint monitoring system

5 Anticipated Benefits

The project would provide the Government of Sudan sufficient information to make a successful application to UNESCO to have the upper Wadi Allaqi and Wadi Gabgaba declared a biosphere reserve under the Man and the Biosphere Programme.

The project would also enable the Government of Sudan and Egypt to work together towards declaring both Biosphere Reserves as Trans-boundary Biosphere Reserves.
Such status would support the livelihoods of the Bishari pastoralist and at the same time conserve a unique ecosystem with its rare biodiversity.

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ANNEX 2. UNESCO Chair in Desertification established in 2001 at the University of Khartoum (Sudan).

Fields/Disciplines

Desertification and desert cultivation.

Objectives

Short-term objectives:

Reinforcement of the University's teaching and research capabilities so that it may efficiently undertake its postgraduate and in-service training programmes in desertification and desert cultivation (DDC).

Development of qualified staff in DDC to contribute effectively to national, sub regional and regional efforts to combat desertification.
Implementation of coordinated national research projects in DDC, ensuring that they are integrated within the National Action Programme of Sudan in relation to the UN Convention to Combat Desertification (CCD).

Long-term objectives:

Development of specific, effective and coordinated activities and cooperation at all levels for achieving the objectives of the Chair.

Strengthening training and research capabilities of the University, and of departments, centres, and institutions in universities contributing to the Chair's research programme.

Establishment of an international centre of excellence for postgraduate training research and documentation in the domain of desertification and desert cultivation.

Development of pilot scheme(s) for testing, validating and demonstrating the use of modern and traditional technology in combating desertification.

Host Institution

<u>University of Khartoum</u>

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Country – Sudan

EASTERN NILE TECHNICAL REGIONAL OFFICE

NBI – Institutional Strengthening Project
PROJECT DELINEATION AND PRIORITIZATION

ANNEX 4.10
ALATISH-DINDER TRANSBOUNDARY PARK PROJECT
(FINAL)

7th June, 2011

CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ARP	Agricultural Revival Programme
bcm	Billion cubic meter
BSG	Bene-Shangul Gumuz
CBD	Convention on Biological Diversity
CEM	Country Economic Memorandum
CRA	Cooperative Regional Assessment
ENSAP	Eastern Nile Subsidiary Action Programme
FAO	Food and Agricultural Organization
GEF	Global Environmental Fund
HCENR	Higher Council for Environment and Natural Resources
IDEN	Integrated Development of the Eastern Nile
IFPRI	International Food Policy Research Institute
IGADD	Inter Governmental Agency for Drought and Desertification
IUCN	International Union for the Conservation of Nature
JMP	Joint Multipurpose Programme
Km	Kilometre
Km2	Square kilometre
MoA	Ministry of Agriculture
MIWR	Ministry of Irrigation and Water Resources
MCM	Million Cubic Meters
NP	National Park
MW	Mega Watt
NBI	Nile basin initiative
NCS	National Comprehensive Strategy
NWP	National Water Policy
PRSP	Poverty Reduction Strategy Project
SLM	Sustainable Land Management
SWC	Soil and Water Conservation
t	ton
UNDP	United Nations development Programme
UNFCCC	United National Framework Convention on Climatic Change
USAID	United States Agency for International Development
WB	World Bank
WCGA	Wildlife Conservation General Administration
WSM	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[18] 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 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

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

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 nine of the Investment Projects located within the Main Nile Sub-basin, the Tekeze-Atbara Sub-basin and the Baro-Akobo-Sobat

Sub-basin. Those Projects identified in the Abay-Blue Nile Sub-basin are being considered separately.

1.2 Primary Objectives of the Project

The Dinder National Park, which was proclaimed in 1935 is located within three States: Sennar, Blue Nile and Gedarif. It's boundaries follow to the north of the Rahad in the north, to the south of the Dinder in the south and the Ethiopian border to the east, and covers an area of 8,960 km^2. It is also a designated Biosphere Reserve and has been designated under the Ramsar Convention as an international Wetland. Immediately across the border within Ethiopia the Amhara regional State have designated an area as the Alatish National Park

The Park lies on a transition ecotone between two floristic regions: the Ethiopian High Plateau and the arid Saharan-Sudanian biomes. It also lies along the boundary of two major faunal Realms of the world: the Palaearctic and the Ethiopian. It is also located along a major north-south flyway of migratory birds.

It has a high level of biodiversity with over 160 species of birds, 27 species of large mammals and unknown number of small mammals. It comprises the last extensive tract of woodland in eastern Sudan. Its importance to conservation can be summarized as follows (ArabMAB, 2006):

- The proximity of the Park to the desert and semi-desert makes it an important buffer zone for the vegetation cover of central Africa in addition to its significance in providing genetic material for the rehabilitation in the semi-arid and arid areas.

- The park is an important watershed area protecting the most important feeders of the Blue Nile, the Dinder and Rahad rivers.

- The Park, together with the south-western corner of the Ethiopian Plateau make a complete Ecosystem for wild animals, for which the Park is the dry season habitat for migratory species.

- The park supports a high diversity of fauna and flora, including such animals of international conservation importance as the African elephant, African buffalo and the lion.

There are three groups of people who have an interest in the park. The first is the original inhabitants of the areas - a small group of Maganu people who continue to live in the south-eastern part. This community has a unique culture that needs to be preserved. They depend on subsistence farming in the rainy season and supplement their diet by collecting fruits and wild honey. In the dry season they move to the Dinder for fishing.

The second group are pastoralists and agro-pastoralists who enter the Park in the Dry Season looking for forage and water because much their rangeland has been converted into semi-mechanized farms. Included in this group are the Um Barrarow or Falata who use the Park in the dry season along the Dinder River and move into Ethiopia during the wet season. They burn the tall grasses in the dry season to make green grass available, but in doing so eliminate susceptible herbs and shrubs.

Around the Park are a considerable number of Internally Displaced Peoples taking refuge from the war in Dafur in the 1970's and are settled along the Dinder and Rahad rivers and enter the Park for fishing, fuelwood and honey collection but also for illegal hunting and present the most serious threat to the wildlife. It is estimated that 100,000 people live around the park in 36 villages.

The Dinder and the Rahad Rivers and their tributaries drain the Park. They rise in the Ethiopian Highlands and are highly seasonal almost drying out in the dry season. Due to the abrupt change in gradient the rivers meandering a large number of cut-off meanders have been formed locally called *Maya'as*. They are generally flat and cover an area some 0.16 to 4.5 km2. Rain and flood water fill them during the rainy season. The maya'as provide a valuable source of water and forage for domestic livestock and wildlife, as well as unique habits rich in biodiversity.

Under natural conditions there is a constant evolutionary sequence of the formation of young maya'as that are deeper with clear water. Gradually they pass through stages of becoming gradually silted up. Over long periods of time with the meandering new maya'as are being formed. The spectrum runs from young productive maya'as to old non-productive dry ones.

With the accelerated erosion in the Ethiopian Highlands this gradual and long term evolutionary process has been disturbed because increased flood peaks and high sediment loads. The area is now subject to annual flooding and many of the Maya'as are becoming silted up with a consequent loss of habitat biodiversity and forage productivity.

In Ethiopia the recently gazetted Alatish National Park is located in Quara wereda of North Gonder Zone, almost opposite the Dinder national Park in the Sudan. The area represents the Sudan-Guinea Biome. The park has been gazetted as a National Park and demarcated.

The Park covers an area of 2,666 km2 to the north of the Dinder River, which forms its southern boundary, and to the south of the Gelegu River that forms its northern boundary. The Alatish and other ephemeral streams drain the central area. Its altitude ranges from 500 to 900 masl. The main vegetation is woodland, shrubland and lowland bamboo thicket. Studies so far have revealed that the

Park contains 48 mammal species and 180 bird species. It contains such endangered species as *Loxodonta africana, Panthera pardus* and *Panthera leo*.

The area is intact with no permanent settlement, although Fellata pastoralists enter the Park in the dry season with over 10,000 head of livestock. The northern and eastern sides have a 2 kms buffer zone, but the southern boundary has no buffer zone as it border Beneshangul-Gumuz regional State.

The Gumuz people have settled to the south of the Park and practice poaching and fishing along the Dinder River. Settlement is increasing and agriculture expanding along the northern boundary and numbers are being swelled by migrants from other parts of Amhara region. People enter the Park area to collect honey, gums and resins.

There is an urgent need to collaborate with the Beneshangul-Gumuz Regional government and with the Government of Sudan to secure the area. The Ethiopian Wildlife Conservation Organization has strongly recommended that the Alatish Park been proclaimed a National park and that in the future it should form part of a Trans-boundary Park with the Dinder National Park. There is also an urgent need to develop a park management plan in participation with local communities.

There is considerable scope to develop an international trans-boundary park by combining the Dinder and the proposed Alatish National Parks. Both Parks are located alongside each other, either side of the border between Ethiopia and Sudan. The Dinder Park is well established, gazetted and internationally recognized. In contrast, the Alatish Park currently has only Regional government recognition although the Federal Ethiopian Wildlife Development and Conservation Department (EWDCD) has recommended that it be nationally gazetted and also made the recommendation for the establishment of a Trans-boundary Park.

There is now considerable experience in Sudan of a community-based approach to Park management in the Dinder National Park. Both Parks experience seasonal grazing from Felata pastoralists and are subject to pressures from people living around the Park.

The proposed Project would provide support to both Ethiopia and Sudan to develop Park Management Plans that although separate are compatible with each other. The project would also provide physical and human capacity building support to enable physical infrastructure (roads, offices) within the Park and training to Park staff. In the initial stages of establishment there will be need for close collaboration between Ethiopia and Sudan both at the local and the national levels. The project provides support to enable this process through workshops and meetings. There is considerable experience in Southern Africa in establishing Trans-boundary Parks and the project would provide funds for a

Study Tour to enable concerned Ethiopian and Sudanese officials to learn from experiences in that Region.

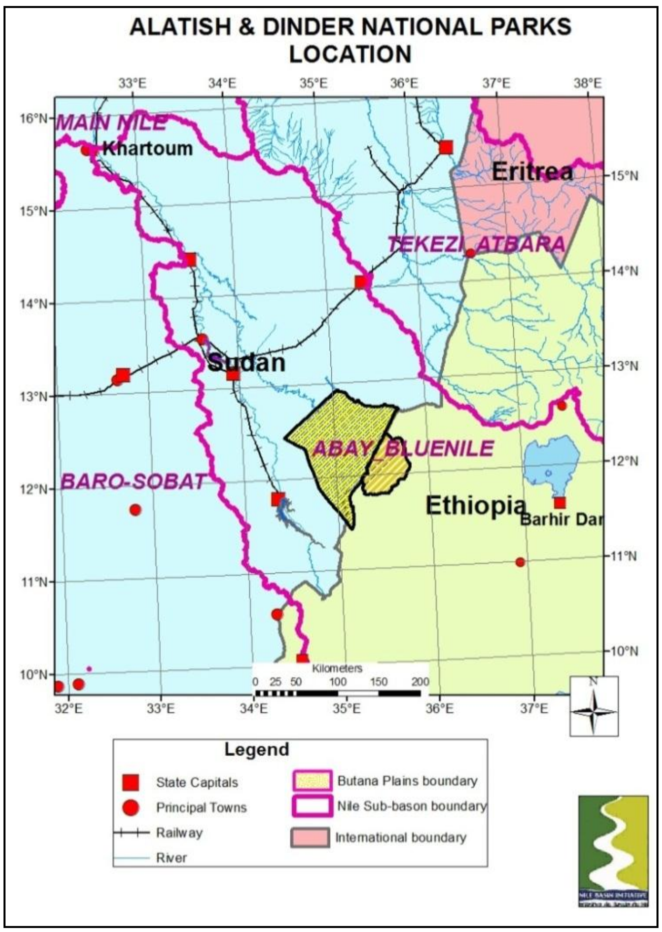
The project would also provide support to Participatory Community Development for those Communities living in and around the two parks that are dependent to a greater or lesser degree on natural resource products and services located in the parks for their livelihoods.

2. ALATISH AND DINDER NATIONAL PARKS - BIOPHYSICAL AND SOCIO-ECONOMIC SITUATION

3.1 Biophysical Characteristics

3.1.1 Location and Extent

The Dinder National Park is located within three States: Sennar, Blue Nile and Gedarif along the border with Ethiopia , and covers an area of 8,960 km^2. The Alatish National Park is located in Quara wereda of North Gonder Zone, almost opposite the Dinder National Park. The Park covers an area of 2,666 km2.

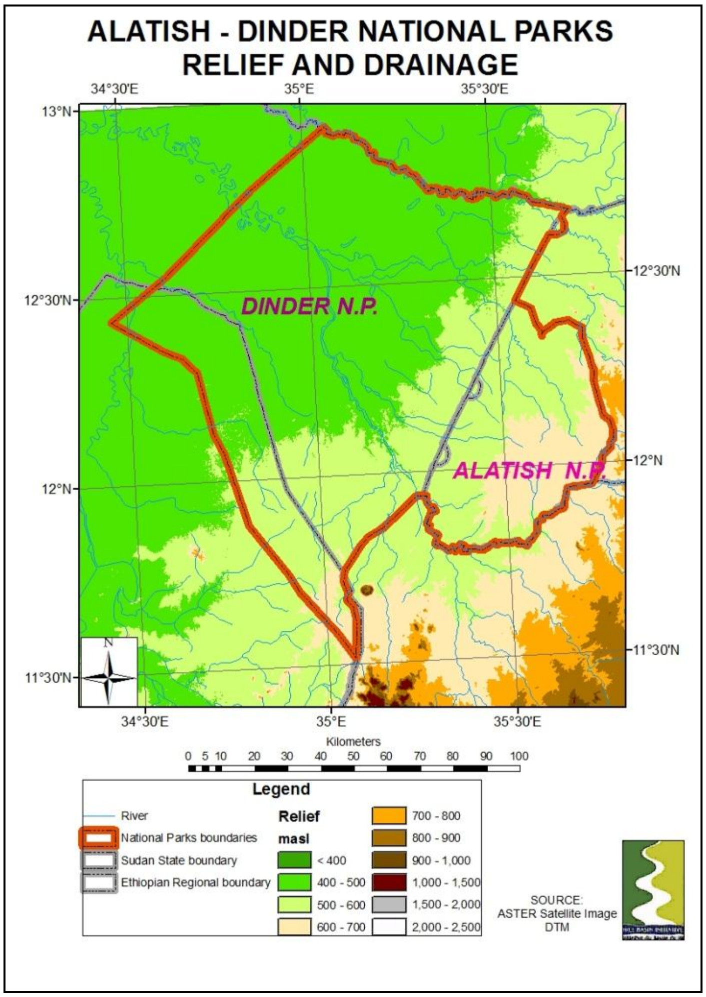


Map 1. Location of Alatish-Dinder NP's

3.1.2 Relief and Drainage

(i) Relief

The Dinder NP is located on the clay plains with little relief between 400 and 600 masl. The Alatish NP is located in more broken country with frequent rocky outcrops between 600 to 700 masl.



Map 2. Relief and Drainage

(ii) Hydrology

The Dinder and Rahad rivers are the two seasonal rivers that water the park during the rainy season. Both rivers descend from the Ethiopian highlands and flow northwesterly across a level plain and into the Blue Nile. The run-off from the Ethiopian highlands often leads to seasonal accumulations of water in streams that join Dinder or Rahad rivers. Along the river course, levels (*Gerf*), and gully erosion and badlands (*kerib* land) have developed.

Table 1. Area and average gross runoff depth of the Rahad and Dinder drainage basins

Unit Name	Area (Km^2)	Gross runoff depth (mm)
Rahad	8,401	339
Dinder	15,128	276

Source: MWRI, Addis Ababa, 2006.

As it stands today, the Dinder River is going through a trend of decreasing volume of annual discharge. The trend seems to have persisted throughout the past 20 years. In the 1970s the annual volume of discharge of water was around 3 billion cubic meters. It has declined to around 2 bcm. In 1985 it was down to 0.6 bcm (Abdel Hameed *et al* 1996).

Figure 1. Dinder River in the dry season

The major tributaries of Dinder River are khor Galegu and khor Masaweek. Other smaller streams are Kennana, Suneit, Heneifa, Abu Khamira, El Qisar and many others.

(iii)Ground water

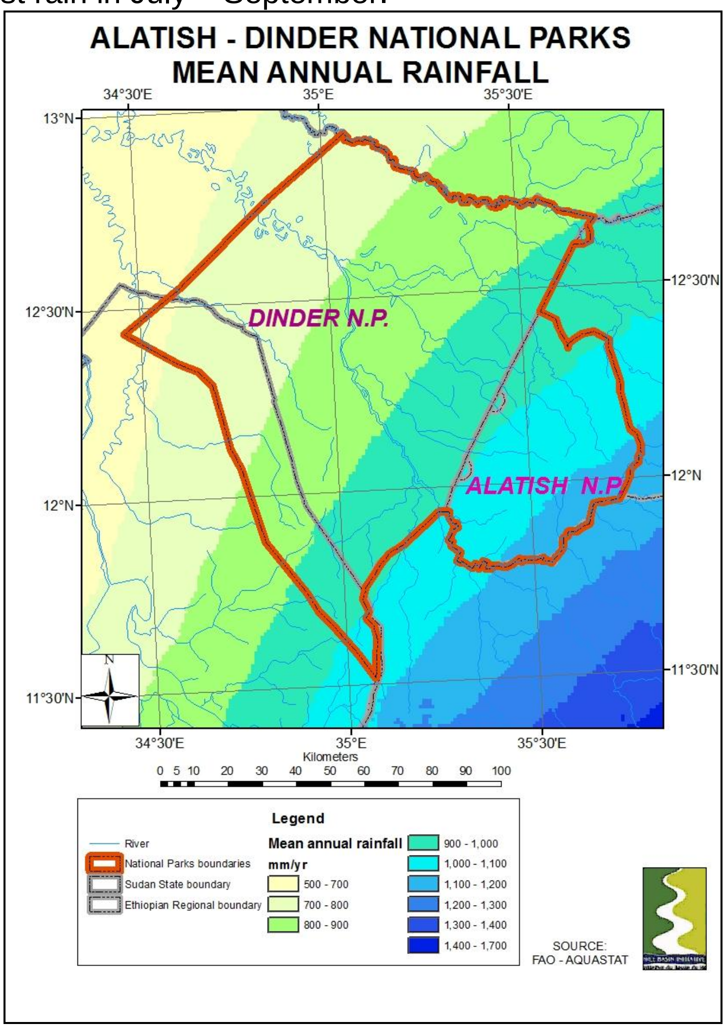
The area of the Dinder Park is dominated by the Al Atshan formation tapering off towards el Tabia and is underlain by shallower Basements outcrops (Salwa Mansour Abdel Hameed and Abdelhafes Osman Eljack,, 2003). The water bearing formations, in the river Rahad area, lie in the superficial deposits along the banks of the river. Along river Dinder copious quantities of high quality water could be tapped from the superficial deposits of the river terraces.

There are three boreholes at Galegou, Ras Amir and Gerirrisa wetlands and one hand pump at el Seneit. The borehole at Galegou is 8m deep while that at Gerirrisa is 16m, Ras Amir being 60m deep. Deep boreholes could go down to 70m while slim boreholes (hand pump operated) can draw water at less than 50m. However, there seems to be differences of opinion as to the volume and accessibility of ground water in the area. Some scientists advocate that ground water supplies are abundant and readily accessible all over the area of the park (Ali, 2001).

3.1.2 Climate

(i) Rainfall

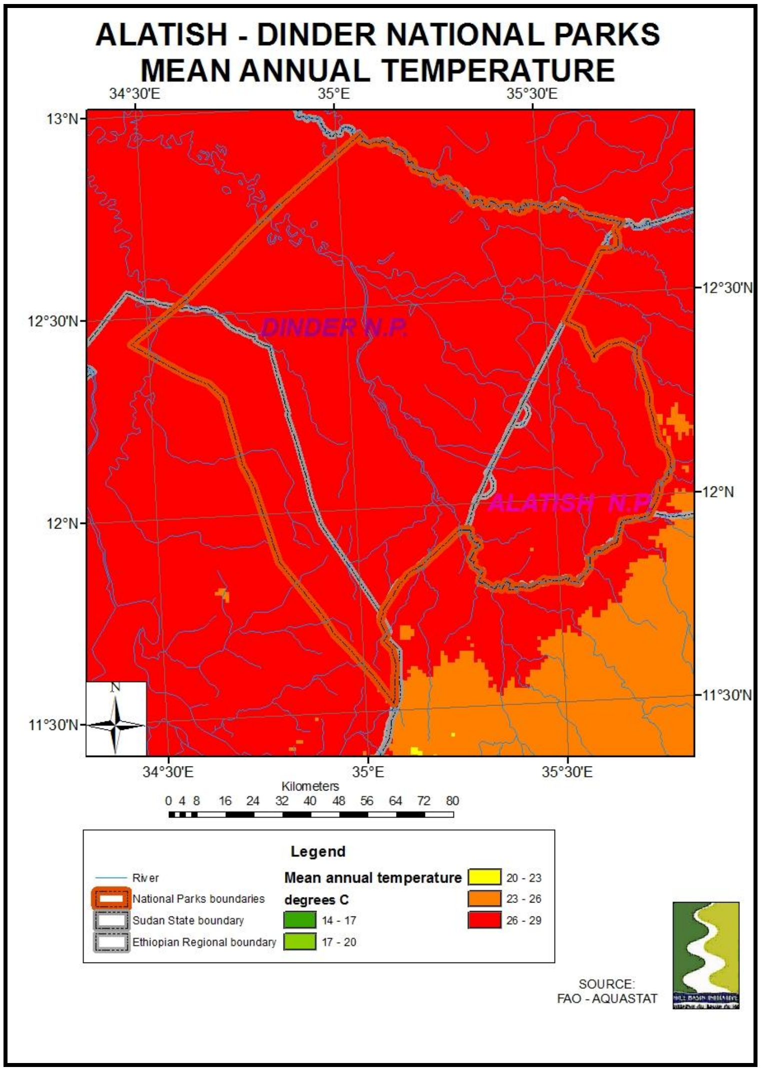
Mean annual rainfall decreases from the southeast to the northwest: from 1,100mm/yr in the Alatish NP to 700 mm/yr on the western boundary of the Dinder NP. Rainfall pattern is uni-modal, falling mainly between June to October, with the heaviest rain in July – September.



Map 3. Mean annual rainfall

(ii) Mean annual temperature

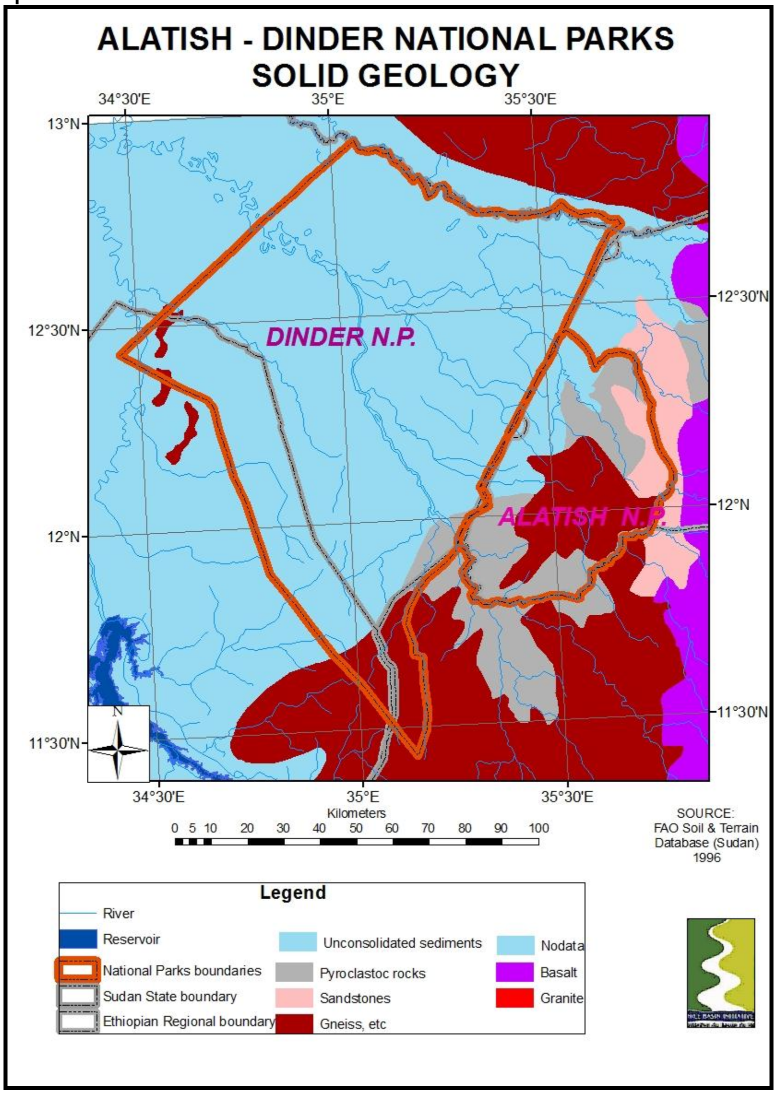
Mean annual temperature is 27 °C to 28°C from the eastern border of the Alatish NP tothe western border of the Dionder NP. across the project area. During the rainy season, the maximum temperature is approximately 30oC and the minimum is approximately 20oC. As the rains gradually subside, the temperature also gradually rises until it reaches a maximum of 36o C. On the other hand, the relatively cool months of December, January and February are followed by a general rise in temperatures that average 38oC in March, with an average humidity of 60-65%. The maximum temperature sometimes exceeds 40oC in April and May and then drops suddenly by the first rains of the new season.



Map 4. Mean Annual temperature (°C)

3.1.3 Geology

The Dinder NP is almost totally underlain by Unconsolidated Sediments. The Alatish NP has a more varied geology, with Unconsolidated Sediment found near the western border, gneisses of the Basement Complex and Pyroclastic rocks in the southeast part and Gneisses and Sandstones in the northeastern part.

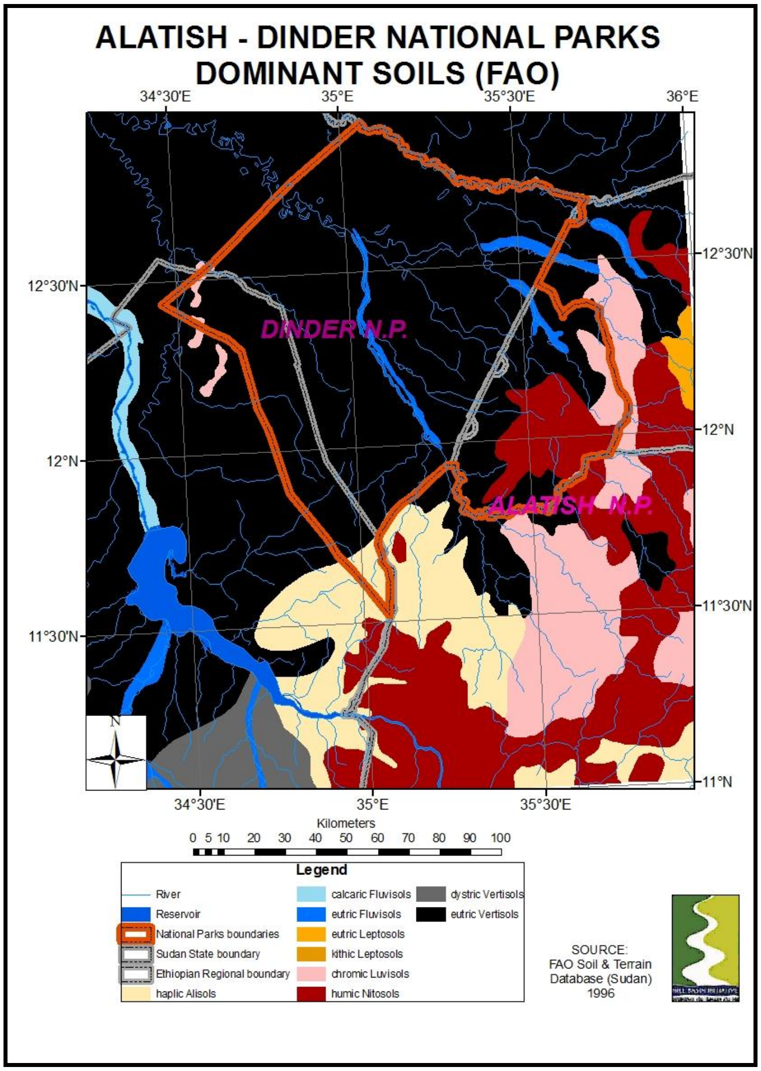


Map 5. Solid Geology

3.1.4 Soils

The soils pattern largely mirrors that of the underlying geology. The Dinder NP is almost completely covered with black cracking Vertisols. In the Alatish NP Vertisols extend into the Park from the border with Sudan until the foothills are reached. Where there is a slight increase in slope chromic Luvisols occur. These are deep soils having a clay rich subsoil. On areas with steeper slopes haplic

Nitosols are found. These are deep red clay loam soils with a base saturation of less than 50%.



Map 6. **Dominant Soil Types**

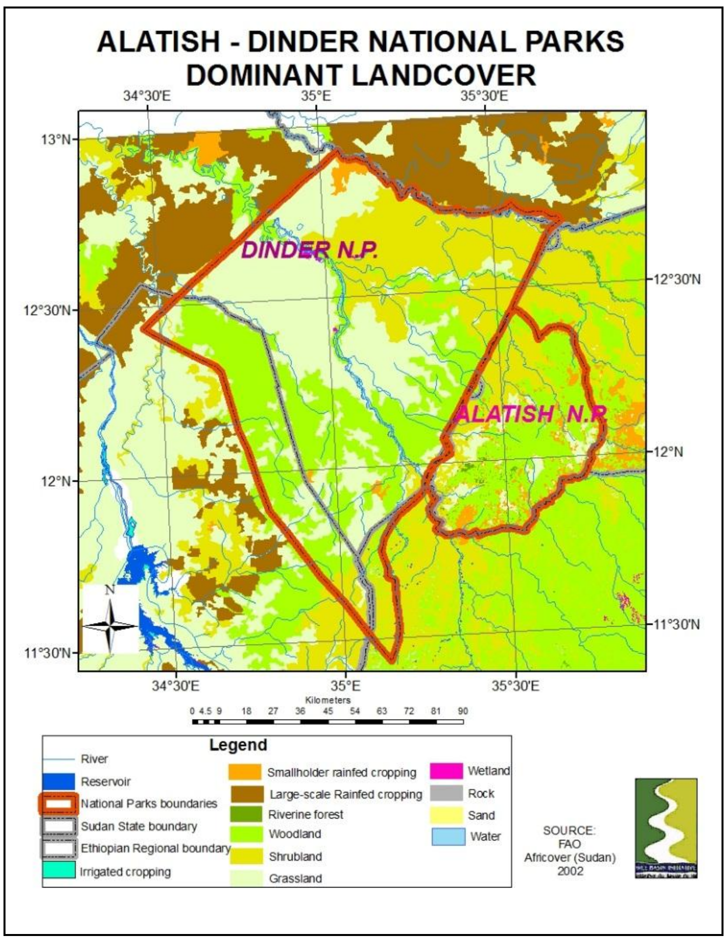
3.1.5 Land Cover / Vegetation

(i) Landcover

Open woodland covers the largest area (36 percent) in the two Parks, with grassland with 1 – 10 percent trees cover coming second (27 percent) and open shrubland third (21 percent). These cover types thus account for 84 percent of the landcover. Cultivation, large and small scale cover just over 3 percent of the area of the two Parks. Riverine forest and wetland are locally important along the main rivers.

Table 2. Alatish-Dinder National Parks: Dominant Landcover (km2)

LANDCOVER	AREA (KM2)	%
Woodland: open	4,764.6	36.5%
Grasland: 1 - 10% trees	3,556.3	27.2%
Shrubland: open	2,703.4	20.7%
Shrubland: dense	510.3	3.9%
Grassland: 11-20% trees	372.5	2.9%
Cultivation: Rainfed: Shifting	313.8	2.4%
Grassland: No trees	282.9	2.2%
Woodland: dense	208.5	1.6%
Cultivation: Rainfed:Small-scale	107.5	0.8%
Water	77.9	0.6%
Cultivation: Rainfed: Large-scale	64.9	0.5%
Plantation	40.3	0.3%
Riverine Forest: open	37.4	0.3%
Wetland: Seasonally flooded	14.3	0.1%
Forest: dense	0.7	0.0%
Riverine Forest: dense	0.2	0.0%
Bare sand	0.1	0.0%
TOTAL	**13,056**	



Map 7. Dominant Landcover

(ii) Vegetation

Acacia seyal-Balanites Woodland

A. seyal in association with *Balanites aegyptiaca are the dominant trees in the dense and open woodland.* . *A. senegal* is retained for gum arabic harvesting whilst *A. seyal* is used for charcoal production. *B. aegyptiaca* is becoming increasing prevalent because it is fire resistant, does not produce good charcoal and is hard to cut.

Riverine Forests:

Riverine forests are characterized by *Hyphaene thebaica, Acacia sieberiana, Tamarindus indica* and *Dalbergia melanoxylon;*

Grasslands:

Succulent perennials have been replaced by tall unpalatable annuals(e.g. *Sorghum sudanense*),and A. nilotica seedlings (Abdel Hameed 1983).

Wetlands:

The swampy areas and shallow lakes (*mayas*) dominated by *Ipomoea aquatica, Sorghum sudanensis, Cynadon dactylon* and *Echinochloa spp. The* mayas ecosystem provides the wild animals with forage and water especially during the dry season (Feb.-June). The *mayas* pass through different successional stages from young, wet to old, dry ones (Salwa Abdelhameed et al., 1997).

3.1.6 Fauna of the Alatish and Dinder Parks

The distribution of the wild animals in the two parks is basically determined by availability of green fodder and water. The most important herbivores are buffalo (*Syncerus caffer*), waterbuck (*Kobus defassa*), reedbuck (*Redunca redunca*), red-fronted gazelle (*Gazella rufifrous*), roan antelope (*Hippotragus equinus*) and grivet monkey (*Cercopithecus aethiops*). Lion (*Panthera Leo*) is the dominant predator together with the spotted hyaena (*Crocula crocuta*) and the stripped hyaena (*Hyaena hyaena*).

Rock hyraxes (*Heterochyraxes brucei*) is commonly seen near the inselbergs and the crested porcupine (*Hystrix cristrata*) is abundant every-where. The common reptile is the python (*Python sebae*). Giraffe have not been seen in the park since 1984, when the last 5 of them were seen (Abdelhameed et al 1994). They seemed to be extinct from the park. The game scouts reported that elephants (*Loxodonto africana*) only enter the Dinder Park crossing Sudanese-

Ethiopian border during the rainy season and their footmarks were found near the border after the rainy season.

There are abundant colorful starlings (*Spreo spp*), bee-eaters (*Merops spp*), herons (*Advea spp*.), rollers (*Coacias spp*.) and egrets (*Casmerodius spp*). Ostrich (*Struthio camelus)*, Arabian bustard (A*rdeolis Arabs*), greater bustard (*Ardeotis kori*), tufted Guinea fowl (*Numida meleagris*), marabou stork (*Leptoptilos crumeneferus*), crowned crane (*Baleanica pavonina*), and pink-backed pelican (*Pelecanus rufiscens*) are the larger birds known to inhabit the park.

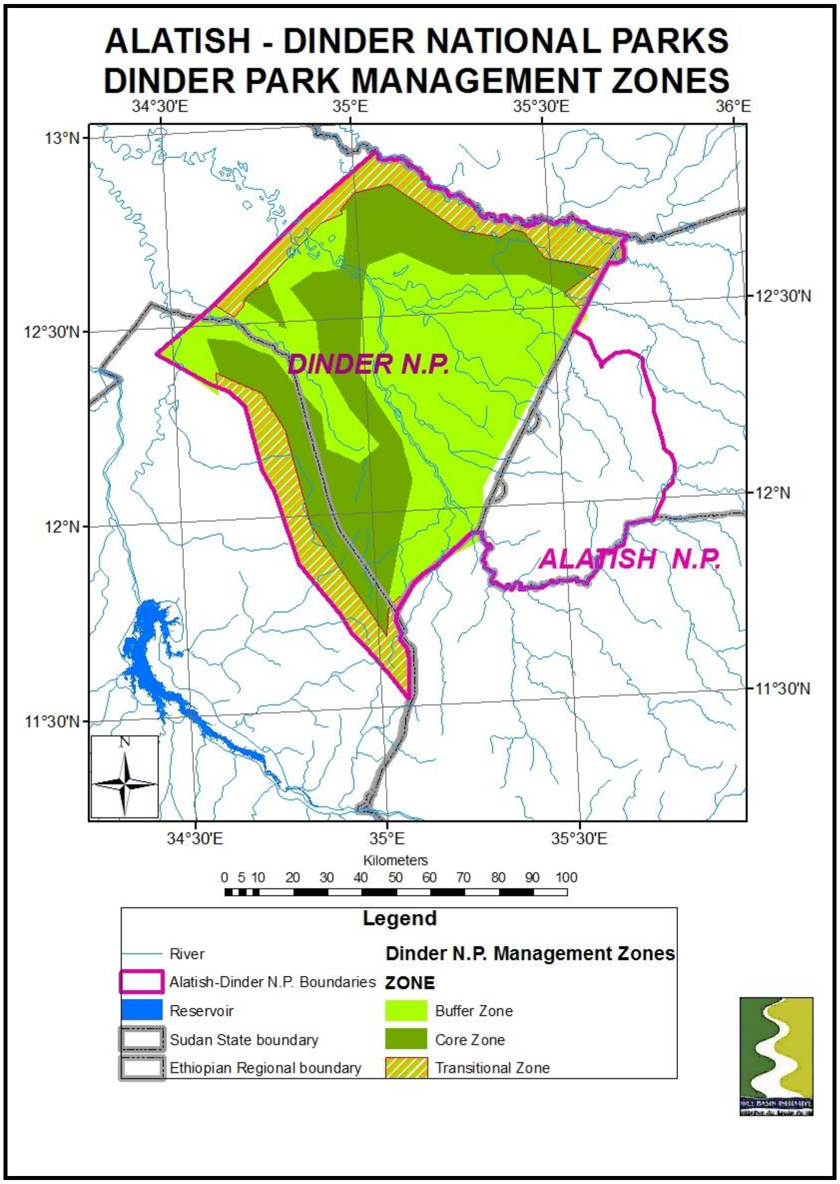
Several species, which were reported to occur in the Dinder Park, have disappeared, such as black rhino *(Diceros bicornis*), wild dog (*Lycaon pictus*) and leopard (*Panthera pardus chui*). Their disappearance has been attributed to habitat destruction and over-hunting (Nimir 1983). The hippopotamus (*Hippopotamus amphibious*) was last reported at the beginning of the century. Crocodiles (*Crocodiles niloticus*) were abundant until the 1940,s when an organized campaign drastically reduced their numbers. There are few crocodiles remaining in the Dinder Park. The Soemmering gazelle (*Soemmeringi gazella*), which was abundant until the 1960,s, had disappeared from the park by 1970 due to the vast expansion of agriculture in its wet season habitats (Nimir 1983). The last Nubian giraffe (*Giraffa camelopardalis*) was to be seen in 1985 (Abdel Hameed et al 1995).

In the Alatish Park a survey of Insectivores and rodents (Tadesse Habtamu and Aferwork Bekele, 2008) revealed a total of 370 individuals comprising 23 rodent and six insectivore species. The endemic rodent species of the Ethiopian highland forest, *S. albipes* and *D. harringtoni*, and the three shrew species (*C. flavescens, C. turba* and *C. fumosa*) were captured from areas outside their formerly recorded altitudinal limit and geographic ranges in the country. The study revealed the importance of remote areas in harbouring unique fauna although the harsh climate and limited accessibility are barriers for further exploration. The high diversity of small mammals and limited number of people within the Park make Alatish an important conservation centre.

3.2 Administration

The Dinder NP is located within three states: Sennar (one Locality), Gedaref (three Localities) and Blue Nile (one Locality). The Alatish NP is located with the Amhara Regional State.

The Dinder NP is administered by the Sudan Wildlife Conservation General Administration WCGA), whilst the Alatish NP is administered by the Ethiopian Wildlife Conservation Authority (WCCA). The Dinder Park has already been demarcated into “Core”, “Buffer” and “Transition” Zones (Map 8).



Map 8. Dinder NP: Management Zones

3.3 Population and Settlement

(ii) Indigenous Populations in and immediately around the Parks

In the Dinder NP is the Magano Community. The dominant group is the *Hadarba*. They, by virtue of their descent from the founder are the elites of the Magano Community. They affiliate themselves to the *Hamada* tribe, which is one of the dominant Arab nomadic tribes in the Blue Nile area. The *Hadarba* claim that their historical homeland is el Zomati, well inside the declared boundary of the Dinder National Park.

Size-wise the Gumuz are the second distinctive ethnic group inhabiting the Magano Mountains. Ethnically, the population of the Magano Mountain Community belongs to four major tribal groups: *Hamaj, Funj*, *Gumuz* and *Abu Ramala*. The percentages of these tribal groups make 82.9% of the population.

The rest belong to the *Halloween, Agallen, Nuba* and *Dinka*. The *Hamaj* is the third significant group. They are the descendants of the Funj in the kingdom of Sennar and who, historically, inhabited this area and then found their way to the Magano village.

There are 10 villages inside the Park and 38 outside it. Villages inside the Park are: Ain El Gamal, Um Kakar; Nour el Madeina; Hanou el-Shateib; El-Hanon el-Azrag, Um kura west; El- Gammam west, Hilat Hashim, El-Khairat; and Um Salala.

Most of the Rahad villages outside the Park are within a distance of less than one kilometre from the boundaries of the Park.

In the Alatish NP there are no people permanently living in the Park.

(iii)Migrant and other Populations moving in and out of the Parks

In both the Dinder and Alatish NP's incursions by livestock pose a major challenge (Adil Mohamed Ali and Mutasim Bashir Nimir, 2006). Within the three states surrounding the Park the problems related to the livestock presence, range lands and their productivity and limitations were identified. In the state of Gedaref, there is gradual encroachment of the rain-fed mechanized farming on range lands.

The situation of the range lands is aggravated by the overgrazing of palatable species such as Blepharis spp, increase in the number and areas covered by invaders, fires and successive droughts. Range land productivity declined to 0.13 tons/acre in the northern areas and to 0.75 tons/acre in the southern areas of the state of Gedaref. The total number of livestock in the state of Gedaref is estimated as follows 538,000 cattle, 1,300,000 sheep, 410,000 camels and 780,000 sheep (Sulaiman, 2002).

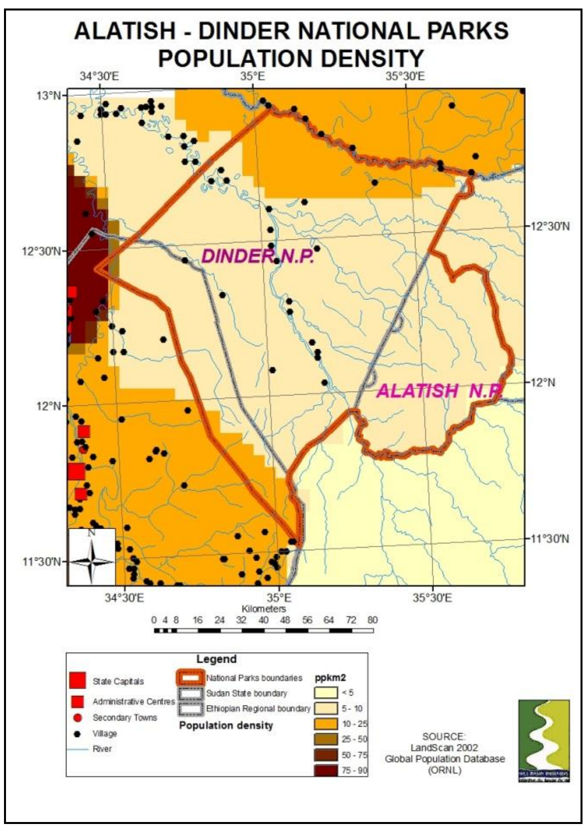
In the state of Sennar cattle routes of 400 km were identified width of these routes are less than 150 meters most of these traditional routes were encroached upon by cultivation which is causing serious conflict with the farmers. Estimated livestock numbers are as follows: 1,338,000 cattle, 1,983,000 sheep, 1,120,000 goats and 250,000 camels.
In the Blue Nile State estimates livestock numbers are as follows: 1,000,000 cattle, 2,000,000 sheep and 1,000,000 goats. Encroachment of agriculture

activities are identified as the main problem affecting pastoralist and blocking their traditional routes and their access to watering areas.

Cattle entering the park are accompanied by herders and originate both from settled villages along the borders of the park and also from more distant areas when accompanied by nomadic and semi nomadic pastoralists such as Fulani and Mbororo (SWECO, 2006). The impact of these cattle on the park is likely to be enormous, they will compete with the wild ungulates for food, are likely to transmit diseases to wild animals and cause large scale changes to the grass sward. In particular grasses of poor nutritive value will replace highly palatable species and cause a progressive reduction in the quality of the habitat for grazing ungulates. In addition these poor nutrient content grasses are usually dense and tall and act to hide the few remaining palatable species from the more selective grazers such as Oribi and Red Fronted Gazelle.

(iv) Population surrounding the Parks

The population densities surrounding the Dinder NP are far greater than those around the Alatish NP.



Map 9. Population density

3.4 Livelihood Systems

3.4.1 Cropping

Cropping systems by local people inside and just outside both the Dinder and Alatish NP's are similar. Village land, under all different uses including cultivation, is under communal tenure (HCNER-WCGA, 2004). Cropping is of two types: traditional rain-fed and *gerif* cultivation.

(a) Rainfed Cropping

Crops are produced under shifting cultivation practices, whereby a land holding is cultivated for a number of years, after which it is left to rest. Meanwhile a new plot of land adjacent to the old one is put under cultivation which is usually done by felling of trees and clearance of land.

The main crops cultivated in this area are sorghum (Dura), sesame, beans, pumpkins, okra and cucumber. Other crops include maize, cabiscum and groundnuts. Farmers care more for securing their stable food crop, so that sorghum ranks as their staple crop. Dura is the main stable crop and sesame is the main cash crop. The productivity of the two crops is quite low.

(b) *Gerif* Cropping

Gerif land is the land that stretches along the riverbanks and from which floodwater recedes i.e. flood plain. It is thus quite productive since soil fertility is annually renewed by floodwater and has a high rate of water retention. Crops produced are mostly high value vegetables and fruits (Mango, guava and paw paw) as well as beans.

After harvest the gerif land is usually rented out to nomads .The crop residues are a valuable resource, in the dry season. This is an added reason for animal herds to enter the Park.

3.4.2 Livestock Production

Livestock amongst the Gumuz peoples around the Alatish NP are not important n contrast to those around and in the Dinder NP. Goats are raised by 55 percent, percent poultry by 65 percent, donkeys by 14 percent and sheep by 7 percent of the population. It is only the rich households that own cattle. Settled villagers generally keep their animals in their vicinity. Animals graze first on the natural pasture around the villages, and then they move into the traditional and mechanized rain-fed farms to feed on crop residues and sometimes they move into the Park.

Goats and sheep are kept for their meat, cash returns, milk as well as the social significance in bride wealth, while donkeys are used for transport. Poultry are mainly used for festivals and cash return.

3.4.3 Use of Trees

Many trees and shrubs (28) are considered to be of multiple- uses in the Park (Salwa Mansour Abdelhameed, 2003). All inhabitants depend on trees within the Dinder Park for a number of purposes:

- 27 tree species for timber and for traditional medicine,
- 20 species for fire wood and charcoal,
- 23 species for forage,
- 17species for food,
- 18 species for raw material,
- 12 species for protection and shelter belt and
- 9 species for handcraft.

About 95% of the people prefer *A. seyal* for fuelwood and for making charcoal; *A. nilolica, B. aegyptiaca* and *Tamarindis indica* for protection, shade and for food fruits).

Timber is obtained from *A. seyal , Hyphene thebaica, B, aegyptiaca*. The tall annual grasses such as *Sorghum sudaneses, Panicum targidum, Cympopogon nervatus, Aristida plumora*, and *Setaria incrassata*, are used for house building and thatch. Gum is collected from *A.seyal, A. senegal*, and *A polycantha* and resin oil from *B. aegyptiaca* fruits.

3.4 Basic Social Services and Human Development Indicators

3.4.1 Health Indicators

Infant and child mortality rates are significantly higher in Gedaref State than other states in northern Sudan (Table 3).

Table 3. Mortality and Nutrition Rates in Gedaref State

Indicator	Gedaref	Average (North Sudan)
Neonatal mortality rate (per 1000 live births)	43	37.3
Post-neonatal mortality rate (per 1000 live births)	43	34.7
Infant mortality rate (per 1000 live births)	86	71.2

Child mortality rate (per 1000 live births)	55	37.3
Under-5 mortality rate (per 1000 live births)	137	105.8
Underweight prevalence (% below -2 SD and -3 SD)	33.8 and 8.7	31.9 and 9.4
Stunting prevalence (% below -2 SD and -3 SD)	38.4 and 16.8	32.9 and 15.1
Wasting prevalence (% below -2 SD and -3 SD)	9.8 and 1.7	13.9 and 3.2
Children who received all vaccinations (DPT1-3, OPV-1-3, BCG and measles)	50.8%	50.3%
Houses with at least one mosquito net	43%	38.5%
Use of improved source of drinking water	37.3%	55.1%
Population using sanitary mean of excreta disposal	14.6%	38.0%
Using improved sources of water and sanitary means of excreta disposal	9.6%	27.7%

Source: Sudan Household Health Survey (2006)

The above picture is depicted by the last survey conducted at the national level, i.e. the Sudan Household Health Survey (2006). According to survey findings, although birth registration in the state (45.8%) was higher than the average for northern Sudan states (34.6%) and antenatal care by trained personnel (for deliveries during the two years preceding the survey) was (71.8%) not far from the average for northern Sudanese states (72.5%), doctor-assisted deliveries was only (3.5%) in Gedaref as compared to (15.2%) in other North Sudan states. Likewise, the percentages of still births and miscarriages in Gedaref stood below North Sudan average while maternal mortality ratio in Gedaref (609 in every 100 000 live births) was higher than in other North Sudan states (503 in every 100 000 live births).

Although no (national) survey data on the health situation after 2006 is available, available data from the State Ministry of Health (SMoH) indicates that some improvement on the situation was achieved during the last few years, a fact which should by no means be taken to mean that no challenges are currently being faced. Of course some challenges are still there probably with a difference in degree.

3.4.2 Literacy and Education

The literacy and primary school enrollment rates for Gedaref State are shown in table 4.

Table 4. Literacy and Primary School Enrollment Rates of Gedaref State

State	Literacy >15yrs % Average	Literacy >15yrs % Male	Literacy > 15yrs % Female	Total Primary school enrol.	% enroll.
Gaderef	55.6	72.9	38.4	311,547	45.7

NORTH SUDAN	**54.5**	**66.6**	**42.4**	**3,308,387**	**51.0**

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

There are significant differences in literacy and primary School enrollment rates between Gedaref State and north Sudan. In terms of literacy Gedaref State is higher than the average except for females. However, primary school enrollment is lower than average.

3.4.3 Water and Sanitation

The percent population with access to drinking water and sanitation facilities are shown in table 5.

Table 5. Gedaref State (a) Percent Population Access to Drinking Water, (b) Sanitation Facilities

(a) Drinking Water by Source

State	Piped into		Deep Well/pump	Dug Well/ bucket	River/canal	Rainwater	Others
	dwelling	Public tap					
Gedaref	12.6	18.8	27.7	13.9	13.8	9.4	3.6
NORTH SUDAN	**50.8**	**4.3**	**15.8**	**9.8**	**12.8**	**--**	**6.4**

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

(b) Sanitation facility by type

State	Flush to Sewage System	Flush to septic tank	Traditional pit latrine	Soak away pit	Others	No facilities
Gedaref	--	5.0	31.7	3.1	0	60.1
NORTH SUDAN	**--**	**7.7**	**69.2**	**1.6**	**1.6**	**19.9**

Source: UN Population Fund & Sudan Central Bureau of Statistics. (2002).

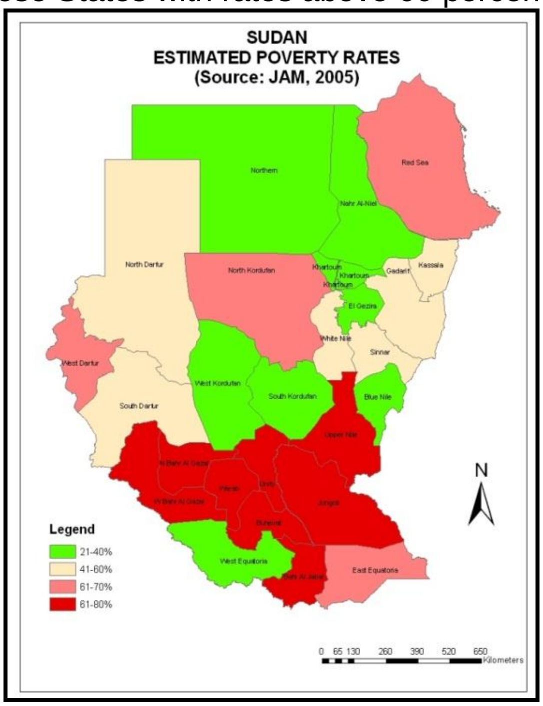
With respect to water and sanitation facilities Gedaref State is well below the national average with respect to all types of sanitation facilities with 60 percent of households with no facilities..

4. KEY ISSUES, CHALLENGES AND POTENTIALS

4.1 Poverty

4.1.1 Extent

The extent and dynamics of poverty in the Sudan since the 1990's has been examined by the Joint Assessment Mission - JAM (2005). It is estimated that in Gedaref and Sennar States 41 to 60 percent of the population are below the poverty line. Map 17 shows the distribution of poverty by State. In this respect Gedaref and Sennar State stands below the northern States with rates below 40 percent, but above those States with rates above 60 percent.



Map 10. Sudan: Distribution of Poverty by State (JAM, 2005)

4.1.2 Insecure Livelihoods Asset Base and High Vulnerability

The low rates of poverty from El Gezira to Northern State are a reflection of the assured access to generally low risk irrigated cropland along the Blue and Main Nile. In these areas land is generally held in freehold and perceptions of tenure insecurity are low. Where leaseholds prevail the general secure natural asset base, the availability of physical (pumps, irrigation water) and financial (seasonal credit) assets creates an environment for secure and sustainable livelihoods and low vulnerability.

This is in direct contrast to situation in Gedaref, Sennar and Blue Nile States where the pastoralist do not have secure tenure over their grazing lands (Faki et al, 2008). The Land Resettlement and Registration Ordinance that dates back to 1925 is still largely in force (De Wit, 2001). All unregistered land belongs to the

Government, but community rights are recognized over its use under customary rules. Individual land registration is limited; while long land lease applies in public irrigation schemes and large semi-mechanized rainfed private holdings. Despite incentives to increase herds irrationally under communal land use, fairly balanced management and protection of natural resources and harnessing local conflicts had been practiced within the traditional leadership systems. But two legal developments in the 1970s had far-reaching implications on land use. First, the Unregistered Land Act of 1970 transferred all unregistered land to the Government from rural dwellers, especially pastoralists, compromising communal and tribal ownership (De Wit, 2001).

Second, the Local Government Act of 1971 dismantled traditional authorities and largely transferred their functions to local governments that have limited experience and resources to handle issues such as local conflicts. Thus, control over natural resources has undergone profound relaxation resulting in misuse through deforestation and overgrazing. Official regulations governing access to pasture and water in rainfed areas remain rudimentary, but 1984 legislation allowed for pasture land allocation to communities. Water use legislation has been confined to water-pumping from the Nile and its tributaries for irrigation purposes. The existing legal setting for land, pastureland, water, and forests has been diverse and contradictory, giving little or no attention to traditional land use systems, especially grazing (De Wit, 2001).

4.1.3 A High Risk Environment and the Alienation of Natural Resource Assets

An assured and low-risk production environment clearly reduces the incidence of poverty. It enables households to build up assets that reduce their vulnerability to sudden changes in circumstances.

Where livestock are the main livelihood capital assets these too depend on the same high risk environment as well as dwindling rangeland resources in the face of expansion of large semi-mechanized farms. The coping mechanisms that communities and groups have developed over millennia to deal with and recover from natural calamities have been insufficient in the face of insecurity and alienation of basic natural resources. Livestock assets provide a buffer in times of need. Where access to water and forage has becoming limiting for the reason set out above vulnerability to shocks and hazards such rainfall variability and drought becomes more acute.

Decisions to adopt sustainable land management technologies depend on households' asset endowments (human capital). This is especially true for pastoral families because of their need for herding different animal types (camels, cattle, sheep and goats) in different places and times. In efforts to maintain livelihoods some household members have had to leave the farm in order to seek wage employment. This has led to a reduction in households' human capital and the lack of labour for cultivation and herding.

4.2 Population Pressure

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 (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.

There are a number of constraints to sustainably increasing agricultural production. These include poor management practices, inefficient markets, low technology transfer and inadequate agricultural services, low ratio of extension agents/farmer, lack of adapted varieties and insufficient certified seed are responsible for low yields attained. Thus, it is apparent that in many areas there are a number of constraints to farmers breaking out of neo-Malthusian trap and that there will be a continuing negative impact of population pressure.

4.3 Environmental Policy and Institutional Issues

Despite the active role played by Secretariat of the HCENR, which is the focal point for all environmentally related conventions, the HCENR has not been able to perform all its mandated tasks. This is mainly due to the following constraints:

- Most of the state's councils have not been established and this has resulted in weak representation of the HCENR at the state level.

- The council members (ministers of relevant institutions) have never met since the establishment of the HCENR. This reflects the low priority and commitments of the governments towards environmental issues in Sudan. This situation could be explained by the fact that that the country has been weighed down by long years of war and many urgent pressures and that politicians could not allocate the necessary time or resources to cater for environment.

However, this situation is expected to change now after the CPA and the need to follow and adopt a sustainable course of development.

At the field level it was reported that there a lack of horizontal and vertical coordination between and among responsible agencies, organizations and ministries.

4.4 Land tenure and Resource Conflict

Issues of land tenure here include insecurity of tenure, ability to use land as collateral and 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 Sudan. The World Bank Country Economic Memorandum (World Bank, 2003) outlined a number of problems relating to current land tenure and land policy in Sudan:

- it limits access to credit to the majority of farmers who cannot use land as a collateral,
- it does not provide incentives for sustainable land development and management, leading to continual cultivation and destruction of soils in the semi-mechanized farms,
- because land has not been demarcated, there are conflicting land use rights between pastoralists and sedentary crop farmers, which has led to civil strife,
- reform is inseparable from need for rural reconstruction and establishing agricultural credit institutions.

These problems have been re-iterated in the World Bank’s latest Country Economic Memorandum (CEM) (World Bank, 2009). The issue has been addressed in the Agricultural Revival Programme (ARP) (2008-2010) as one of eight key success indicators. The World Bank’s CEM concludes:

> *Until there is a land policy that transfers the wealth inherent in land from the state (the government) to the people on the basis of long-term tradable leases, be it through statutory or customary law, incentives to invest in agricultural and pastoral land will remain negligible. The consequences of low investment in arable land and rangelands are low productivity and hence high costs for domestic consumers and low competitiveness for agricultural exports and inevitably slow growth of the economy.*

Whilst Land Commissions have been established under the ARP no decisions have yet been made on a future land policy. A key problem has been the lack of a National or Regional Land Use Plans that could strategically guide land development activities. Thus the expansion of the mechanized farm sector was largely uncontrolled. No assessments were made on the environmental, social or economic impacts of these very large developments. It is understood that States are mandated to develop Regional land Use Plans but as yet no guidelines appear to have been issued. There is some debate as to whether there should be a national Land Use Plan that would provide at least a strategic framework for State Plans. A pre-requisite of any National or State Land Use Plans is a thorough reform of the Land Tenure Policy.

4.5 Agricultural Extension and Availability of Credit

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 higher the discount rate the shorter the time horizon. 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. A number of studies have found that adoption of natural resource conservation technologies is negatively related to high discount rates. However, where a technology is risk reducing (e.g. water harvesting, soil moisture conservation structures, small-scale irrigation) adoption is much more likely.

Currently credit and extension for the traditional agricultural sector are very weak. The extension worker-to-farmer ratios are very low indeed. Credit and input supply services have hitherto focused on the large-scale irrigation sector. The main problems are non-viable collateral, small loan levels, geographical distance and logistics of recovery. Attempts have been made to form cooperatives but without success. The main constraint to a successful resolution of a s*ustainable* credit system is a land policy that provides farmers and pastoralists with the equivalent of long-term tradable leases which can be used as collateral to stimulate commercialization of the traditional rainfed farming system (World Bank, 2009)

However, this situation may soon improve with the signing of a Micro-finance project between the GoS and the World Bank for a sum of US$ 269 million over 6 years. This will be aimed in part at the traditional agricultural sector (FAO/WFP, 2006).

4.7 Threats to the Dinder and Alatish NP's

The Dinder National Park Management Plan (HCNER-WCGA, 2004) provides a detailed description of the threats facing the Dinder Park. Because these threats also impinge of their integrity of the Alatish NP they are very relevant for any consideration of a Trans-boundary Park.

4.7.1 Mechanized and Traditional Rain-fed Farming

Both the mechanized and traditional rain-fed farming cause a great deal of harm mainly to the migratory wildlife species. The wet season habitat of these wildlife species have been largely occupied by mechanized rain-fed farming. The vegetation of these wet season habitats has been cleared to give way for the production of various crops. When animals come to their wet season habitats, they are considered as vermin and therefore are shot at sight. This is one reason why the populations of tiang and roan antelope have drastically been reduced. The meat of game species killed is used "illegally "for feeding the labourers who work on the farms.

4.7.2 Hunting and Poaching

Illegal hunting and poaching inside the Park are common activities both in the wet and dry seasons. It has been, and still is, the practice to close the Park and pull out all staff at the start of the rainy season. The few game scouts who remain at Galegu then patrol the wet season ranges of the Park's animals. This leaves the Park wide open to poaching.

Figure 2. Snare found in Alatish NP

7.3 Fishing

There is some illegal fishing in the productive mayas. The species of fish available in these mayas are: "garmut" *(*Clarius lazera), "noak" (H. niloticus), "bulti" (*T. niloticus*) and "gargur" *(Synadontus. spp*). These are locally sold, as dried fish, at the local market centres of the communities, the rich merchants and farmers buy most of this dried fish for feeding the labourers during the rainy season.

4.7.4 Honey Collection

Honey collection starts in the dry season in the months of January to March. Honey-gatherers usually cause many uncontrolled fires.

Figure 3. Bee hive in the Alatish NP

4.7.5 Tree-felling and Wood Collection

Trees are also cut-down for the production of charcoal, which is used as a source of fuel and income. Many trees in the area around the Park have been reduced to shrubs. The species of trees targeted are all species of *Acacia* and *Balanites*.

Repeated fires usually consume most of the dead wood and consequently most of firewood is acquired by cutting down live trees.

4.7.6 Non – Wood Products

The main non-wood product that is utilized by the communities around and within the Park is "*Saaf"* which are young leaves of the dom palm. These are used for making mats, baskets, honey pots and handicrafts. Some of the manufactured items are for household use and others are for sale.

The other non-wood products include the wild fruits and other special parts of both plants and animals that are used for food and medication. The wild fruits that are eaten include the dom palm, "Nabag" (*Ziziphus* spp.), "Lalob" *Balanites*), and "Tebeldi" (*Adansonia digitata*). Some are sold in the local market centres.

4.7.7 Livestock Trespassing

The sedentary villagers keep limited numbers of domestic animals, usually small animals because they are less demanding. After the harvest the mechanized and gerif farmlands are leased to the nomads to graze their livestock on the crop residues.

When the crop residues have been exhausted, the park, consequently, becomes an attractive area for large herds, during the dry season. Thus the herders will take serious risks and transgress on the park. Special mention is to be made here of the aggressiveness and high violence potential of the Umbararu tribesmen. They constitute a heavy burden on the limited grazing land. Signs of over-grazing have been evident in a number of mayas.

4.7.8 Fires

Fire assumes a significant role in the clay plain area of the Sudan along the 16-inch isohyet. All of the Dinder National Park lies above the 16-inch isohyet and is subject to frequent and often intense burning. Fire starts as early as mid-September (Dasmann, 1972). Many of the fires originate outside the Park started by nomad herdsmen, agriculturalists and others, seeking to reduce the grass cover in order to improve access and visibility and to provide green perennial grasses for livestock. Other fires are set inside the Park by poachers, trespassing nomad herdsmen and honey gatherers.

The fact that the use of fire has a long history does not mean that the role of wildfire is necessarily good. The Park, at present, exhibits a variety and distribution of vegetation caused by repeated wildfires. Ideally, fire can be used as a management tool at the time and in the place needed to achieve Park's objectives. Some areas in the Park need to be burned annually to allow animal viewing by visitors or to maintain areas of open or wooded grassland in their present condition.

5. IDENTIFICATION OF PROJECT COMPONENTS

5.1 Review of Current Projects

5.1.1 Ethiopia

Simien-Gondar Sustainable Development Programme, Alatish and Simien National Parks US$26,000 (ETB 330,000)

5.1.2 Sudan

Watershed Management Fast Track Project – Dinder National Park.

The project area for the Dinder National Park includes the park itself and surrounding localities outside the park. The focus is on those areas/localities outside the park that have a major influence on and/or stakeholder interest in the park. In reality this means the villages that surround the park up to a distance of approximately 10km from the park boundary as well as the transhumant pastoralists that seasonally make use of grazing resources both in and around the park.

The national park falls under the direct control of the central government and the Ministry of the interior. The executing agency is the General Administration for National Parks and Wildlife Conservation.

It is expected that most of the physical project interventions will take place outside the park in order to alleviate the pressure on the park caused by lack of resources outside the park.

5.2 Proposed Activities

The NTEAP supported “Alatish-Dinder Trans-boundary Park Management Plan” provides the foundation for this proposed project.

5.2.1 Coordination and Networking

In the initial stages of establishment there will be need for close collaboration between Ethiopia and Sudan both at the local and the national levels. The project provides support to enable this process through workshops and meetings.

All wildlife Conservation NGOs and wildlife law enforcement bodies in the area Dinder – Alatish Trans-boundary Park will come together and identify the role of each institution and organization can play in wildlife law enforcement in areas of their operation. There is need to assess different conservation NGOs, business communities and the support they can give to wildlife law enforcement institutions in curbing down illegal poaching of wildlife.

This cooperation and collaboration would be achieved through a number of meetings to establish and build trust and confidence between Ethiopia and Sudan at all levels local, regional and international. One result of these meetings would be to raise awareness on the impacts of overexploitation of wildlife in both parks and the threats it poses to the health of the ecosystem. More specifically on wildlife population trends, wildlife laws enforcement and sensitization on available alternatives.

These meetings would also promote collaboration, cooperation and engagement among different stakeholders and professional groups working in wildlife conservation and natural resources management in both Ethiopia and Sudan. This would increase their capacity for information sharing and to contribute in anti-poaching activities collaboration

5.2.2 Coordinated Park Management Plans

Both Parks have existing Management Plans. The Project would provide support to enable both Ethiopia and Sudan to develop a workable Trans-boundary Park Management Plan to enable both Management Plans to be compatible with each other.

As part of the first component the project would support two workshops to be held in both countries one in Dinder and another in Alatish Park to ensure cooperation and joint action. The workshops would be jointly organized with Alatish and Dinder NP's, with participant drawn from both countries to form a joining forces group for technical support.

A key outcome of the two workshops will be to form a permanent committee which will participate in the development of the management action plan for the trans-boundary park management of the two countries. The workshop will enhance their capacity to collaborate and cooperate in management action plan development and to establish communication means and materials.

An important area of agreement is the need for awareness and exchange of visitors between the two parks.

5.2.3 Capacity Building

The project would also provide physical and human capacity building support to enable physical infrastructure (roads, offices) within the Park and training to Park staff.

Long term training will be needed for both Ethiopia and Sudan Park's officers to improve their knowledge in wildlife management. Also a programme of short courses will be held to develop the capacity of the officers from both parks. The target group for the certificate, diploma and postgraduate in wildlife management will be six (6) from each park for the purpose of one year studies at the College of African Wildlife Management (MWEKA) in Tanzania.

There is considerable experience in Kenya, Tanzania and Southern Africa in establishing Trans-boundary Parks and the project would provide funds for a Study Tour to enable concerned Ethiopian and Sudanese officials to learn from experiences in that Region.

5.2.4 Physical Infrastructure

A construction of the roads is needed in the trans-boundary areas to improve movements and easy access of the remotes areas by the anti-poaching operation activities.

The main access road in the Alatish NP to the Park Headquarters at Delego is only 16 kms but takes about 4 hours driving (Heckel et al., 2007)

Figure 4. Aletish NP: Main access road

In the Dinder NP the roads between Tabeia and the bounder will be constructed. Opening the roads for foot patrolling between the two boundaries parks will also be constructed.

Both the Dinder and Alatish require additional office space. This can be built using local materials. In addition, the Project would support capacity in visual aids for both Parks.

5.2.5 Joint Research Programme

One output from the Coordination and Networking will to develop a prioritized joint programme of research and information gathering. Two areas currently identified are:

- Identify of the mobile nomads who use the trans-boundary and map their routes and numbers of livestock and identify possible alternative routes to minimize damage to the environment.

- Study of migrant animals between the two parks. For example there is a small herd of elephant of 4 to 10 individual who visit Dinder NP periodically. The study would determine the routes of their movement between the two countries.

6 Distribution of Benefits

A cooperative or joint management of a Trans-boundary Park would have a number of advantages:

- shared experiences in community-based Park management
- cost-effective joint management of the Park as one eco-system, and
- the strong possibility of international recognition and ability to secure both Government and external funding.
- Local Communities actively involved and part of Conservation process

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