INSTITUTE OF BIODIVERSITY CONSERVATION (IBC)

Site Action Plan

For the Conservation and Sustainable Use of the Lake *Ziway* Biodiversity

(Rift Valley Lakes Project)

Institute of Biodiversity
Tel. 251-1-612244
P.O.Box: 30726
E-mail: biod@ethionet.et
Addis Ababa

Amare Lemma
Tel. +251-1-633750/51
P.O.Box: 33124
E-mail: cedep.con@telecom.net.et

June 2005

ABBREVIATION AND ACRONYMS

AAU	Addis Ababa University
ARDO	Agricultural and Rural Development Office
BOA	Bureau of Agriculture
BS	Beach Seine
CADU	*Chilalo* Agricultural Development Unit
CBD	Convention on Biological Diversity
CBO	Community-Based Organizations
COD	Cut Off Drains
CRS	Christian Relief Service
CSA	Central Statistics Authority
CV	Coefficient of Variation
DEC	Department of Ecosystem Conservation
DOC	Dissolved Organic Carbon
DoH	Department of Health
EARO	Ethiopian Agricultural Research Organization
EBSAP	Ethiopia Biodiversity Strategic Action Plan
EC	Ethiopian Calendar
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority
EPO	Environmental Protection Office
EWNHS	Ethiopian Wildlife and Natural History Society
EWRP	Ethiopian Wetlands Research Project
GEF	Global Environmental Facilities
GN	Gill Net
GOs	Government Organizations
GTZ	German Technical Cooperation
HC	Hand Craft
HHs	Households
IAs	Implementing Agencies
IBA	Important Bird Areas
IBC	Institute of Biodiversity Conservation
IBSc	Important Bird Sites
IGS	Income Generating Scheme
IPSC	Inter-Regional Project Steering Committee
IRSC	Inter-Regional Steering Committee
IUCN	World Conservation Union
Km	Killometer
LAs	Local Associations
LFDP	Lake Fishery Development Project
LMB	Livestock and Meat Board
MCM	Million Cubic meter
MoA	Ministry of Agriculture
MoARD	Ministry of Agriculture and Rural Development
MoWR	Ministry of Water Resources
MSY	Maximum Sustainable Yield
NBF	National Biodiversity Framework

NBSAP	National Biodiversity Strategy and Action Plan
NGOs	Non-Governmental Organizations
OFRC	*Oromiya* Fish Research Center
PAs	Peasant Associations
PCU	Project Coordination Unit
RANRDB	Regional Agricultural and Natural Resources Development Bureau
RARO	Regional Agricultural Research Organization
RCWDA	Rift Valley Children and Women Development Association
REPO	Regional Environmental Protection Office
RV	Rift Valley
RVLB	Rift Valley Lake Basin
RVLS	Rift Valley Lakes System
SAP	Site Action Plan
SAREC	Southern Africa Region Economic Cooperation
SEDA	*Selam* Environmental Development Association
SIDA	Swedish International Development Agency
SWC	Soil and Water Conservation
TITB	Trade, Industry and Tourism Bureau
UK	United Kingdom
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nation Development Program
UNFCCC	UN Framework Convention on Climate Change
USA	United State of America
USAID	US Aid for International Development
WRDB	Water Resources Development Bureau
WWF	World Wide Fund
Z/WTTTD	Zonal/We*reda* Trade, Transport and Tourism Department
ZANRDD	Zonal Agricultural and Natural Resources Development Department
ZWRDD	Zonal Water Resources Development Department

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXES

EXECUTIVE SUMMARY

Background

1. The recently endorsed study document (BSAP) has enumerated a number of factors affecting the biodiversity resources and eco-systems of the Rift Valley Lakes System including Lake *Ziway*. *Catchment* degradation, over utilization of the lake's water as well as uncontrolled fishing practices are among the major causes for resource degradation and ecosystem disturbances of the lake and its surroundings.

2. Preparation of the Site Action Plan (SAP) was, therefore, justified to timely reverse the degradation process so that the animals, plants and other aquatic resources harbored in these areas can be saved from extinctions.

3. Convinced of the fact that no time is afforded passing without actions against the degradation, the UNDP commissioned CEDEP Consultants to prepare SAP for the development, conservation and sustainable use of the biodiversity resources of the lake and its surroundings[1].

4. Multidisciplinary and participatory approaches were used while data and information relevant for the study gathered through review of documents, physical observation and interviewing resource persons and community members considered stakeholders.

Review of the Resource Bases

5. Altitudinally, the Lake and its surroundings are located in the range of 1,650 to 1,850 m.a.s.l. Topographically, the dominant landform of *Ziway* plain, which includes Lake *Ziway,* is flat *lacustrine* terrace, gently undulating with *mollic* and *Eutric Fluvisols*. Lake *Ziway*, located in *Oromiya* region some 160 km south of Addis Ababa, occupies an area of about 434 km^2 with maximum extensions of 20 km by 25 km. *Katar* (from *Arsi* highlands) and *Meki* (from *Gurage* highlands) are the two important rivers flowing into the Lake.

6. The lake and its surrounding host diversity of plants, animals and microbial resources that require specific nitch to perpetuate. Like other Rift Valley, the watersheds of *Ziway* contain a number of habitat types and associated biotic and abiotic factors.

---

[1] Members of the CEDEP Consultants team were:
Amare Lemma (MA) – Lead Consultant, Economist
Meseret Wondimu (PhD) – EIA Specialist
Asfaw H/mariam (PhD) – Aquatic Microbiologist
Tesfaye Wudneh (PhD) – Fish Biologist
Birhanu Mengesha (MSc) – Forester
Shewaye Deribe (MSc) – Plant Ecologist
Mohammed Abdi (MSc) – Wildlife Expert
Teshome Estifanos (BA, Dipl.) – Land Use Expert

7. Although the upper part of the watersheds of River *Meki* are covered with bushes and remnants of *Juniperus* regenerations and that of River *Katar* with remains of trees of *Tid* (*Juniperous)*, *Warka (Ficus sp.), Kosso* (*Hagenia)* and with *Wadadi* (*Erica arborea)* shrubs at the extreme lowland surrounding the lake, the lake's ecosystem is characterized by *Acacia-commiphora* woodland ecosystem, the swamp vegetation and *Serdo (Cynodon plectostachyus) grass land* with scattered Acacia.

8. Although lake *Ziway* is well known for its aquatic bird life and other aquatic animals such as the 11 fish species (of which one is exotic), various species of phytoplankton, zooplankton and other micro flora, there are also terrestrial plants and animals found around the lake constituting its fauna and flora.

9. There are reportedly MoA (2003) about 1,700 fishers with 960 BS and 750 GN deployed in commercial fishing operating in about thirty landing sites. As obvious response to many water scarce agricultural areas, irrigation is practiced around the lake.

Threats and Gaps

10. Deforestation, loss of Acacia woodlands, land degradation at major watersheds, lake shore farming and siltation/sedimentation, uncontrolled fishing, water abstraction and habitat loss are the principal threats to the ecosystem of lake and its surroundings.

11. Lack of coordination in controlling resource degradation, inadequate regulatory/enforcement mechanism on over-fishing, over pumping of water, inadequate urban planning, unregulated human settlement with high demographic pressure, improper land use management and lack of demarcated buffer zone have been identified as the main gaps.

Opportunities

12. On the other hand, some of the existing policy provisions on natural resources conservation; global support available for the biodiversity conservation initiatives as well as institutions established at federal, regional and w*ereda* levels supporting such initiative are among the opportunities that can be exploited for the successful implementation of SAP.

Conclusions

13. According to the Biomass-Land Evaluation Study (2003), the *wereda* where the lake is mainly located, is categorized as one, which has lost its "critical capacity to support more human and livestock population". The ecological imbalances are immense and protecting and conserving the ecological niches elucidates huge pressure in terms of time and resources. Therefore, very limited, if any, medium or long-term rural development programs are feasible before rehabilitation measures are taken for the area.

Recommendations

14. Exploring and using alternatives water sources, promoting economical use of water, demarcating buffering zone, promoting integrating watershed/development activities, making capital investment environment friendly, providing more training and licensing of fishermen and raising public awareness on natural resources conservation are among the tasks to harmonize development with the Lake's environment.

Components of Site Action Plan

15. Taking into account the gaps identified, opportunities available, conclusions reached and recommendations made, five projects with a total outlay of Birr 13,849,000 to be implemented in 3-10 years have been identified as components of SAP. These are (i) Rehabilitation of depleted *O. niloticus* stock at Lake *Ziway*, (ii) Evaluation and Impact Assessment of Introduced Alien Fish Species in Lake *Ziway*, (iii) Integrated Watershed Management, (iv) Eco-Tourism Promotion on Lake *Ziway* and (v) Baseline Survey.

Implementation Arrangements

16. For the implementation of SAP (a) establishment of a small Project Coordination Unit (PCU), (b) appointing most appropriate regional/zonal/*wereda* sector offices as implementing Agencies (IAs), (c) forming an Inter-regional Project Steering Committee (IPSC) and (d) involving Communities, CBOs and NGOs are proposed.

Logical Framework Matrix
Site Action Plan (SAP) for the Conservation and Development Sustainable Use of Biodiversity Resources at Lakes *Ziway* and *Awasa* and their Surroundings (Summary)

Project Hierarchy	Performance Indicator	Means of Verification	Assumptions Risks
1. Goal: Biodiversity resources and their habitat at Lake *Ziway* and *Awasa* rehabilitated	Aquatic and terrestrial ecology stabilized	Ecological and Baseline Survey Report	All SAP projects Implemented
2. Purpose • Initial resources situations known • Lake/wetland ecosystem/ biodiversity stabilized • High/lowland ecology/biodiversity maintained • Community income improved • Fish food made available • Ecology of most demanded fish sp. maintained • Aquatic animal/people enjoyed the lake	- Natural Resources and Socio-Economic Baseline Study Conducted - Buffer zone established - Re-/Vegetation undertaken - Most comm. engaged in IGS - Nutritional requirement met - Aquatic ecology rehabilitated - Catchments Treated well and Lake is pollution free - Tourists/local people visit the area	- Baseline Report published - Progress Report - " " - HHs Income study - HHs Nutrition study - Study Report - " " - " "	Finance available, project components implemented as planned
3. Output • Condition/extent of the resource base for the watershed recorded • Buffer zone demarcation, Fishery management plan preparation completed • *Catchment* revegetation, SWC activities done • Non-Agri IGS, Agro-forestry promotions done • Tilapia and other fish sp rehabilitation completed • Extension on improved land management practiced	- Natural, social and economic resources baseline available - xx ha demarcated as buffer - xx ha treated, xx trees planted - x # of HHs engaged in IGS, etc, - x ton/year Tilapia catch achieved - x # of framers trained and improved land mgm't practiced	- Progress/survey report - Progress Report - HHs Study Report - Monitoring Study - Farm HHs Survey Report	- Participation of people, government and non-government organizations, etc, and support to projects forthcoming - PCU established on time
4. Activity • Carrying out Baseline Survey • Survey of the Lakeside, Mgm't plan preparation • Seedling production, SWC, enrichment planting, • Provide support for agro-forestry promotion • Promote non-agriculture IGSs • Rehabilitation study, activity, measures • Deploy Extension workers to teach land mgm't	- xx Br to conduct the Baseline Survey - xx Br for awareness raising, manpower, etc, - xx Br for material, labor, etc - xx Br for material, training, etc - xx Br for seedling raising, etc, - xx Br for manpower, material, - xx Br for manpower, etc	- Contract Agreements commissioning the survey - Project Prog/Fin. Rep. - " " " - " " " - " " " - " " " - " " "	- Required organizational support, offices for project implementing agencies, manpower, finance, etc available on time - Project documents for all SAP component are prepared

I. BACKGROUND

1.1. Introduction

Lake *Ziway* is located in the Rift Valley 160 km from Addis Ababa. It is found in the National Regional State of *Oromiya*. The lake is highly influenced by rural, urban and other economic activities as it is situated next to the *Ziway* town and its hinterlands. Farming activities, municipal waste discharge and fishing are taking place without adequate consideration for the environment. The lakes' resources have been misused causing resource degradation and eco-system disturbances. The recently endorsed EBSAP (Ethiopia Biodiversity Strategic Action Plan) has elaborated the different threats faced by the biodiversity resources in all the rift valley lakes system that includes lake *Ziway*.

There are strong evidences to believe that both terrestrial and aquatic biodiversity are threatened. Lake siltation and degradation of its watershed are all threats posed to its very existence. These realities call for concerted effort and timely intervention to reverse the damages taking place on the lake and associated resources.

This study, therefore, is to identify the probable root causes of terrestrial and aquatic loses and suggest appropriate intervention areas that will promote the conservation and sustainable utilization of the lake's and its surrounding resources.

1.2. Need for the Site Action Plan

Ethiopia contains a significant number of the world's rare animals, plants and aquatic resources. Some of the endemic and rare species such as *O. niloticus* (Tilapia) are disappearing or threatened due to overuse and/or loss of natural habitat. This is visible in this Lake, which is known for its aquatic biodiversity and avifauna.

Moreover, deforestation, shore damage, water pollution, eutriphication and uneconomic water use are concerns while introduction of alien species, lack and/or inadequate policy framework and enforcement mechanisms for efficient water utilization aggravate the problems the Lake is facing.

These unhealthy situations are caused by a number of factors including inadequate soil and water conservation measures on watersheds of the river flowing into the lake. Lack of conservation based crop production/management practices, too little attention to the conservation and sustainable use of the lake's resources, hesitation to establish buffer zones were done on limited areas. Insufficient awareness among policy makers, planners and the general public about the economic, biological and scientific significance of the lake's living resources and their habitats are limited.

Delays in reversing the deterioration processes may result, not in a distant future, in the depletion or extinction of the lake's biodiversity followed by the Lake facing the fate of lake *Alemaya* in *Haragae* and lake *Aba' Samuael* near *Akaki Bseka* which all are nearly dried up.

Bringing to a halt the continuous resource degradation necessitates identification of the threats specific to the Lake and its surroundings. For each identified threat, suitable measures need to be mapped out, logically sequenced and integrated for effective implementation. The tasks to be performed are crucial and may prove difficult unless development and conservation measures are taken urgently with commitment by all concerned.

The need for the Site Action Plan, therefore, rests not only on the identification of the actual gaps and intervention areas and then their prioritization, but most importantly on the timely implementation of the measures chosen to bridge the gaps.

1.3. Previous Development Initiatives

In the past many agricultural development activities have been initiated in the vicinities of lake *Ziway* and/or to the watersheds of the rivers flowing into it. These development initiatives and studies include (i) *Chilalo* Agricultural Development Unit (CADU) which implemented integrated rural development programs, (ii) *Abernossa* Ranch by the Livestock and Meat Board (LMB) which introduced modern ranch management, (iii) the establishment of Fisheries Corporation under the Ministry of Agriculture which introduced modern fish processing and transport facilities, (iv) the *Ethio-Korean Meki-Ziway* irrigation project, although implementation interrupted, provided a study document on how conservation of the Lake sites have been disrupted, (v) The Rift Valley Lake Basin (RVLB) Master Plan Study which identified development project types, areas and sequence of their implementation and (vi) Fishery Research Center to provide information on fish and other aquatic resources.

These development initiatives and/or studies, however, couldn't produce significant impacts on the conservation of the Lake's and its surrounding's biodiversities. Shortage of finance, lack of integrated and environment friendly planning approach, insufficient commitment and inadequate follow up were among the factor to blame for.

On the other hand, the effort made in the late 1980's (1987-1988) to control over exploitation and restore the depleted fish stock in the Lake through *'marshal-closing'* was a success. In this measure, farmers were advised to plant sisal at the upper edges of the lake to slow down water erosion.

1.4. Scope of Activities in the SAP Preparation

In the preparation of the SAP, reviewing existing natural/agricultural resources base, assessment of the extent of biodiversity loss and ecological disturbances, understanding the socio-economics governing the communities utilizing the Lake, determining the constraints and potentials worth considering, identifying and costing intervention measures were carried out while appropriate institutional arrangement for effective and efficient implementation of SAP components is proposed.

Moreover, quick verification field visit, allowed the study team, to directly observe the physical conditions of the Lake and its surroundings as well as testing of water samples to have a feel of its chemical status.

1.5. Approach and Methodology

1.5.1. Approach

Multidisciplinary, interactive and target-oriented approaches were used in the preparation of the SAP. The weekly consultation and preview sessions have been useful to exchange views and opinions among study team members. The multidisciplinary team comprised of fish biologist, aquatic microbiologist, plant ecologist, forester, environmental impact assessment expert, land use specialist, wildlife expert and an economist.

1.5.2 Methodology

(i) Sources and Methods of Data Collection

Study documents, research reports and other relevant literature forwarded by the client and those obtained by the Team's own efforts have been used to gather secondary data/information mainly on the resource base, threats and development opportunities to Lake and its surroundings.

Rapid field assessment was carried out by visiting the Lake and watersheds of the rivers flowing into it. Water sample was taken and analyzed to determine the current aquatic micro flora and chemical status. Professional observation and interview and discussion with officials, experts and resources persons were done when visiting relevant institutions.

(ii) Data Compilation and Processing

Data obtained from all sources through the above methods were compiled for interpretation into components of viable site action plan. The data, collected by each team member, was circulated or discussed among all others for a common understanding of phenomenal issues on the study areas.

(iii) Analysis and Synthesis

Team members analyzed collated data individually to identify appropriate components for the SAP. Synthesis of the individual component was made to prioritize the components in their logical sequence of implementation and ensure objective linkages of components to the Lake's actual situations.

1.6. Limitations and Strengths of the Study

1.6.1. Limitations

The study was planned as "desk top" activity using data from secondary sources. The sources, however, apart from being old, deal with the Rift Valley Lakes in general and not specifically about the Lake under study.

The exact geographical boundaries of the study areas were not delineated. This created practical problem in the identification of area specific projects especially for watershed treatment measures which are vital in saving the lake.

The obvious limitations of using 'secondary data' (inaccurateness, obsolescent, lack of originality, etc) as well as problems that can be faced in 'rapid assessment' (errors, bypassing facts, etc…) could not be avoided.

1.6.2. Strengths

To compensate for limitations associated with the secondary data/information sources, the Team made a rapid verification field assessment to the lake and its watershed areas. This has enabled the team to physically observe current situations of the study areas, meet resource persons and stakeholders and discuss with on issues of observed concerns. (Annex 6)

As there are no studies on aquatic micro flora and because the data on the chemical status was 15 years old (ie, of 1989), water samples from the Lake were taken and analyzed to find out the current micro flora conditions and the chemical status.

Watersheds of the lake, which have strong influence on the Lake's physical and biological attributes, have been delineated and proposed as SAP implementation areas.

II. REVIEW AND ANALYSIS OF EXISTING SITUATION

The Ethiopian Rift valley Lakes System (RVLS) including the basins of lake *Ziway* is home for large number of human population engaged in activities which are, directly or indirectly, related to the well-being of the ecosystem. The basins also host a vast diversity of plant, animal and microbial resources that require their specific niche to perpetuate. Any activity that disrupts the normal functioning of the environment will influence these niches thereby affecting biological diversity.

In the last three to four decades, a rapid population growth has been recorded in the basin. This may be attributed to easy access to the area, and the attractive features such as permanent lake water, mineral hot springs, fertile soil and a wealth of biological resources that flourish in warm climate.

Together with the population growth, changes have occurred in land use due mainly to expansion of subsistence agriculture, large-scale commercial farms and related developmental ventures. These changes, however, were pursued with out any impacts appraisal on the *biotic* and *abiotic* environments. As a result, aquatic and terrestrial habitat disturbances, land degradation, and desertification are being observed.

Some of the factors that worsened the situations are deforestation (for cultivation and charcoal making), emergence of urban centers, unsustainable resource utilization and lack of proper environmental management practices. The negative impacts of the "development" initiatives have manifested themselves in soil erosion, siltation, water pollution and overall ecosystem degradation.

As a result of unsustainable resource utilization, the natural features of lake *Ziway* and its surroundings, as reviewed in this chapter, are now changed to a threatened unit calling for immediate corrective measures.

Different local, regional, national and global institutions have common interest to safeguard the Lake basin and its biodiversity resources. Through creating partnership among different stakeholders, integrating efforts and effecting proper plan of implementation, conservation and sustainable use the Lake's resources are attainable.

2.1. Resource Base

The catchments of lake *Ziway* contain a number of habitat types (riverine woodland, grassland) along Rivers *Katar* and *Meki* and agricultural land and associated biotic and abiotic factors. It is appropriate to have a clearer picture of the resource base of the lake and its vicinities in drawing up a realistic Action Plan. The unique geological, edaphic, climatic and biotic features of the area and the socio-economic conditions of the population are reviewed. For ease of presentation, the resources are assessed under categories of "terrestrial resource base", "aquatic resource base and uses", "institutional base" and "social-economics and demography" classifications.

2.1.1. Terrestrial Resources Base

Terrestrial resources are include: (1) the physical resource base comprising of topography, geology, soils and climate and (2) biological resource base showing the vegetation (woodland, forests, grasslands) and wildlife (mammals and birds).

(i) Physical Resources

(a) Topography

The dominant landform of *Ziway* plain, which includes Lake *Ziway,* is flat *lacustrine* terrace with *Andi-Eutric Fluvisols Sodic* phase, gently undulating terrace with *mollic* and *Eutric Fluvisols* and nearly level *lacustrine* plain with *Andi-Mollic Fluvisols*. The altitude of the area varies from 1,650 to 1,850 m.a.s.l.

The Rift floor slopes from north to south into central trough, which contains the lakes *Ziway*, *Shalla* and *Abijata*. Lake *Shalla* is deepest which resulted from a combination of volcanic and tectonic activity.

(b) Geology and Soils

Geology

The Ethiopian Rift Valley (ERV) is part of the great East African RV, which was formed as a result of Tertiary-Quaternary tectonic movements. The regression of the Mesozoic sea to the southeast and the occurrence of a major up lift, which is known as the *Arabo-Ethiopian* swell, preceded the formation of the rift (*Tesfaye Cherinet*, 1982). The Tertiary uplift and formation of the rift was followed by the extrusion of large masses of basaltic magma through fissures. As a result, in the rift valley lakes basins including that of Lake *Ziway*, basalts, *ignimbrites*, *pyroclasts* and *lacustrine* sediments overlie the ancient basement rock. Other volcanic products such as *ash flow*, *tuffs*, *trachytic* lava flows, alkaline and per alkaline *silicics*, *rhyolites* and *pumicous* materials are found distributed in different parts.

The landscape in the southern part of the Lake (Mount *Aluto* area) is a major center of Quaternary *silicic* volcanism. In the western part of the lake, *lacustine* terraces were formed from interbeded ash, pumice and siltstone during late Quaternary times.

The deposits on the terraces include coarse textured pumice, sand, gravel and medium-textured volcanic ash derived form Mount *Aluto*. West of the *Bulbula* River, there is a consolidated ash siltstone out crop. Near *Adami Tullu*, *lacustrine* deposits surround older volcanic plugs, which form prominent small hills. Except the southeastern and southern margins of the Lake, other parts are bordered by swamp. The swampy areas and the lakebed are composed of *pumic* material. Recent basalts bound the southeastern margin of the Lake while *lacustrine* sediments particularly silt and clay predominate in other areas.

Soils

The soils in the rift valley have been derived form the parent materials ie, from *ignimbnites*, unwelded *pumicious pyroclastics* some coarse beds of *lacustnne* sediments and alluvial deposits (*Makin* et al 1974 and *Tesfaye*, 1982).

Soils in the eastern and western swampy margins of the Lake are coarse textured with organic loam topsoil over *pumic* sand. *Silty* clays have developed on fine textured alluvium along the deltas of rivers *Meki* and *Katar*. Alkaline sub soils occur in all areas except the mid-*Meki* valley. The mid-*Meki* valley is dominated by heavy-textured soils, which are neutral in reaction (*Makin* et. al, 1974).

The terraces of the Lake to the east of *Bulbula* River and seasonally flooded grasslands bordering the Lake comprise coarse-textured soils on pumice. Soils affected by both high salinity and alkalinity occur fairly extensively along the north eastern, northwestern and southeastern shores of the Lake and to the north-west of *Adami Tullu*.

(c) Hydrology

Hydrologically, the surface waters of the Rift Valley Lakes Basins are not connected (as some think so), though there is a considerable flow of ground water. Precipitation in the basin, as in the tropics, is very high although there is a time-to-time variation in distribution. (See Annex 2)

There is also high groundwater recharge directly from precipitation. This recharge is therefore an important element in the hydrological cycle. However, due to the layering controls and limited groundwater storage capacity of the volcanic ash, retention of groundwater is only for short period perhaps for a few years. In addition to precipitation, there is indirect groundwater recharge from rivers flowing across the valley floor. These rivers, which receive flow from the groundwater systems, normally terminate in lakes and rivers.

(d) Climate

Ziway has steppe climate of semi-arid type. There was a climatic change over the last three decades due to erratic rain and temperature variation in the rift valley ecosystem. The East-South monsoon has an influence on the Rift Valley Lakes. *Ziway-Abijata-Langano* climatic complex covers an area of over 10,700 km^2.

Table 1. Altitude, depth, area, dimension of the lake and weather summary

Altitude masl	Mean Depth m	Area km^2	Width km	Length km	Rainfall (mm/yr)	Temperature (^{0}C) Max	Mean	Min
1650	2.5 Urban 4 South	434	20	25	600-800	28	20	12

Source: Own Compilation from Meteorological Data Collected by *Ziway* Agricultural Research Center

Lake *Ziway* obtains most of the water from rivers *Katar* (originates from *Arsi* zone) and *Meki* (originates from *Gurage* highlands) both of which get bi-modal rainfalls.

Substantial amount of inflow is also contributed from the surrounding areas to the lake, particularly in good rain of years. Mean annual rainfall of varies from 600 to 800 mm. The 1961-1997 data shows high rainfall fluctuation within CV of >30%. Mean annual potential evaporation is higher than mean annual precipitation and April to July are the peak months.

Mean annual maximum and minimum temperatures are 27 and 13^{o}C, respectively. The temperature is higher from November to April and lower from June to October. February and March are hottest months of the year. Lake *Ziway* reaches its peak from September to November and low from May to June and evaporation mean PET is 1,600 mm.

The amount of rainfall has declined over the last five years and rainy days shortened by twenty. The silt deposition raises the water level reducing the water holding capacity of the lake's surface. Discharges of River *Meki* show variations between years due to the degradation of watershed (Annex 2). Huge amount of water is lost by evaporation from the lake surface due to high solar radiant, caused also by clearance of high canopy Acacia wood and the speedy nature of the wind in the valley.

(ii) Biological Resource Base and Land Use System

The rift-valley lakes, among which lake *Ziway* is one, are chain of permanent lakes lying in the Cealval and southern part of the Ethiopian rift valley. The area is well known for its rich flora and fauna.

(a) The Terrestrial Ecosystem

Lake *Ziway* has sources of water from Rivers *Katar, Meki* and rainfall (precipitation). The River *Meki* originates from the *Gurage* highlands at altitude of 3,600 m.a.s.l and flow about 100 km. The total watershed area of the river covers 2,433 km^2. The upper part of the watershed are covered with bushes and remnants of *Juniperus* regenerations and few old trees, Bisana *Croton machrostachys,* Bazra-Grar *Acacia abyssinica,* Birbira *Podocarpus falcatus* and other associated species. The lower part is covered with open acacia woodlands in the farmlands.

The River *Katar* originates from the *Arsi* highland, *Chilalo* and *Galama* escarpments and has watershed area of about 3,400 km^2. The upper parts of the *catchment* remained with few trees of Tid *Juniperous,* Zigba *Podocarpus,* Kosso *Hagenia* and at extreme high altitude covered with Wadadi *Erica arborea* shrubs. The lowland, surrounding the lake, is characterized by *Acacia-commiphora* woodland ecosystem.

Wooded grasslands, banks of Rivers *Meki* and *Katar*, the escarpments from where the Rivers originate flood plains and swamps around the lake and agricultural lands are major components of the watersheds of Lake *Ziway*. Some remnant patches of vegetation in the islands' churchyards and in *Abernossa* and *Adami Tullu* ranches indicate the original picture of the ecosystem.

In these areas rainfed crop cultivation and irrigated commercial farms are replacing the wooded grassland. The natural grace and ecological significance of acacia trees have

diminished by this rapid agricultural expansion, uncontrolled charcoaling and overgrazing. Uncultivable slopes, in both sides of the lake are also cultivated extensively without sufficient water and soil conservation measures. Sediments from these areas are filling the lake and the surrounding swamps.

- **Vegetation/Habitats**

Woodland and Forest

There is no closed woodland found in the plain area. Dense woodland and trees around the lake were used to support variety of wildlife. Now, however, they are degraded due to their conversion into different land uses. The areas around the Lake have now been left with only patches of remnants wood and bush lands. According to Zerihn Woldu and Mesfin Tadesse (1990) the dominant tree species are Tedecha *A. tortilis,* Wachu *A. seyal,* Kontir *A.snegal,* Dare *A. etbaica,* Garbi *A.albida,* Bedeno *Balanites aegyptica* and Adesa *Dichrostachy cinerea.* In addition, other woody species like Weira *Olea europea* sub sp. *cuspidata and Acokanthera shimperi* grow in the escarpments of the hills bordering the lake, whereas species like *Anqwa Commiphora shimperi,* Debobosso *Rhus natalensis and Cordia monoica* characterize recovering and protected sites in lower altitudes. Forests and natural woody vegetation of acacia, which are found around the Lake, are owned communally.

Swamp Vegetation

Eventhough the level of water in the lake determines the zone of swamp vegetation along the lakeside, human interference is affecting its profile. According to *Makin* et al, (1974), there was well-marked vegetation zonation around the shore. They described the sequence of vegetation in the lakeside from the margin to the adjacent dry land as: Reed *Phragmites* and Water Lilly *Nymphaea* in standing water, blocks of Typha in the Bulrush and Dengel *Cyperus papyrus* in the lake shore, Qetema *Jancus* and *Panicum repens* in the swamp, Murii *Sporobolus* and Serdo *Cynodon plectostachyus* grass land in the drier parts and at last this sequence was marked by a line of tall trees of Warka *Ficus sp*., Talalaa *Trema,* Garbi *Acacia albida* and Bedeno *Balanites aegyptica*. Currently this setup is highly disturbed and ecosystem degradation has exacerbated.

Important of all are the Phytoplanktons and the Zooplankton that make the bulk of aquatic life. They contribute much to the presence of numerous water birds in the area. According to the EWNHS (1996) the most dominating phytoplankton are *Microcystis flos-aquae*, and species of *Aphanotheca, Chroococcus, Gleotrichia, Mesrimopedia* and *Spirulina*. The dominating zooplanktons include the rotifers with species of *Brochionus,* molluses are also abundant among the vegetations. Snails present in the lake include *Anisus natalensis, Biophlaria sudanica, Balinus forsical, B. truncates, Lymnea natalensis* and *Melanoids tuberculata*.

Rangelands

Acacia woodlands, seasonally flooded plains and grazing grounds in the uncultivated steep of the escarpments around the Lake constitute the rangelands of the catchments.

Different species of grass and other herbaceous plants cover the open ground level under the canopy of woody species like Dare *A. etbaica* and Garbi *A. albida*, a multipurpose legume which is vital in providing its pods and leaves as a complement to dry season forage. Some of the species in the ground layer are *Cynodon dactylon,* Sembeliet *Hyparrhenia sp., Cenchrus ciliaris, Heteropagon contortus, Achyranthus aspera* and *Hypoestes sp.*

Most of the rangelands out side the *Abernossa* and *Adami Tullu* ranches are deteriorating in productivity due mainly to mismanagement. They are also shrinking by the expanding farming. As a result, the remaining grasslands are stocked beyond their carrying capacity. Moreover, climatic changes such as drought, lack of accountability for rangelands, cultural factors like cattle hoarding as a symbol of wealth and prestige are key factors contributing to the degradation of the range.

Biophysical indicators of degradation like soil loss, changes in vegetation productivity and cover, bush encroachment and reduction in animal productivity are conspicuous. The continuation of resource abuse will inevitably result in sever land degradation and socio-economic crisis.

Wildlife

Although Lake *Ziway* is well known for its aquatic bird life and other aquatic animals and plants, there are also significant larger terrestrial animals, which if the habitat is protected and developed, can contribute to eco-tourism activity. *Hippopotamus amphibius* and warthog *Phacochoerus aethiopicus* are the commonly occurring mammals around the lake. Other species of fauna are several species of snakes, monitor lizard and some antelope species which are occurring in the escarpments along some parts of the lakeside. It has been observed that in the outskirt of *Adami Tullu*, antelopes such as Greater Kudu Duiker are hunted legally and illegally. Owing to the Lake's proximity to urban centers and the lust for irrigated agriculture, no more importance seem to be given for the Lake's benefits as wildlife habitat.

The importance of the lake as a wetland bird habitat is immense. As indicated in EWNHS (1996), the Lake is identified as one of the important bird areas of the country supporting seasonally over 20,000 water birds comprising of often over hundred species. This fact makes the lake globally important wetland and can be considered as a *Ramsar* site. The *Ramsar* convention defines wetlands as areas of marsh, fen and peat land, and the depth of which at low tide does not exceed 6 meters.

According to a Bird Survey by *Syvertsen* (1995), there are, various species of waterfowls in and out side the Lake. The most common being Great-White Pelican, Marabou Stork, Fulvous Whistling Duck, and White-faced whistling Duck, Black-headed Duck, Grey-headed Gull, Whiskered Tern, and White-winged Black Tern. A roost of several thousands of White-breasted Cormorants, Reed Cormorants and many other species of Ducks, Geese, Herons and Egrets occur in smaller numbers. The marshy ground around the lake supports several *palaearctic* wader species and Afro-tropical water bird species. The most recent waterfowl survey (EWNHS, 2005) done in the area is annexed to this

document as Annex 5. Fifty-five wetland aquatic birds have been identified by this survey around Lake *Ziway*.

Of the birds identified around the lake and annexed to this document, 16 are *palaearctic* migrants, 17 residents with breeding proof and 11 residents with no breeding proof. These facts make the lake one of the most important habitat for some birds in the country and globally. Therefore any threat this habitat faces will have an adverse effect on the birds mentioned above.

There has been a dramatic decrease in bird populations around Lake *Ziway*. This indicates that there is a considerable habitat change apart from what one can observe as birds can serve as indicators of an overall habitat change in quality and quantity.

Changes in birds population have certainly been influenced by changes of the water quantity and quality of the lake, by human presence disturbances, and birds response probably to widespread contamination of the lake by some kinds of pesticides.

(b) Land Use/Cover Systems

Land cover refers to the land surface cover, characterized by main vegetation type. These include, cropped land, forests, woodlands, bush lands and water bodies without reference to how this cover is used. On the other hand, land use refers to the use made of the various land cover types taking into account the type of management linked to economic consideration. In many cases, land cover and land use are described as interrelated.

The major land use/cover in the SAP implementation areas are categorized by Cultivated Land (including intensively and moderately cultivated), grazing land (ie, open grassland and shrub land), woodland (including open and dense woodland), forests (including montane mixed forest and forest land), wetland, uncultivated land and bare/west land.

Traditional peasant farming dominates the present land use of the seven weredas, where the watershed of the two inflowing rivers of the lake is delineated. The following table shows the land use/cover of *Sodo*, *Meskan* and *Mareko***,** *Dugda Bora*, *Adami Tullu Jido Combolcha* and *Ziway Dugda* and *Digeluna Tijo woredas*.

Table 2. Major Land Use/Cover Types, Per-capita Cultivated Land and Population Density of the Watersheds of Rivers *Katar* and *Meki*, by *woreda (ha)*

Land Use/Cover	*Wereda*							**Total**	**%**
	Dugda Bora	***Adami Tullu Jido Kombolcha***	***Degeluna Tijo***	***Tiyo***	***Ziway Dugda***	***Sodo***	***Meskan and Mareko***		
Intensively Cultivated		468						**468**	**0.06**
Moderately Cultivated	86004	52817	66897	29473	27614	73181	76833	**412819**	**53.7**
Moderately Cultivated and Grassland				7366	8221			**15587**	**2.0**
Moderately Cultivated and Open Grassland		6098	7133	4490				**17721**	**2.3**
Moderately Cultivated And Woodland	1804		6214	3147		6244	1507	**18916**	**2.5**
Grassland	22300							**22300**	**2.9**
Open Grassland	1681	3931			7274			**12886**	**1.7**
Open Shrubland	27579	33953		6633	65868	4291	11550	**149874**	**19.5**
Open Woodland		4174						**4174**	**0.5**
Dense Woodland		22784						**22784**	**3.0**
Afro-alpine Vegetation Heath			19723	7204				**26927**	**3.5**
Montane Coniferous Forest			863					**863**	**0.1**
Plantation Forest			569					**569**	**0.07**
Wetland	20658	24532		4	18145			**63339**	**8.2**
Total Area	**160,026**	**148,757**	**101,399**	**58,317**	**127,122**	**83,716**	**89,890**	**769,227**	**100.0**
Per capital cultivated	0.49	0.4	0.59	0.27	0.32	0.56	0.26	0.4	
Density (persons/km^2)	112	101	133	281	87	167	300	153	

Source: Woody Biomass Inventory and Strategic Planning Project, Ministry of Agriculture, 2003, land Use/Land Cover Study of *Oromiya* Region.

: Woody Biomass Inventory and Strategic Planning Project, Ministry of Agriculture, 2003, land Use/Land Cover Study Southern Nations and Nationalities Peoples State.

The total watershed area of Lake *Ziway* in the seven *weredas* is 769,227 ha (ie, 173,606 ha on *Meki* side and 595,621 ha on Katar side). Nearly 60 % of the land is under cultivation showing the domination of agriculture over all land uses. Traditional peasant farming occupies 95% of the total cultivated land indicating the low level of production and productivity[2] (Siraj, 1998).

Occupying some 24.1% of the total area, grazing land is the next larger land use category[3]. Wetlands, mainly found in *Dugda Bora*, *Adami Tullu* and *Ziway Dugda woredas*, have also a considerable coverage, 63,339 ha (ie, 8.2% of the total).

The land use/cover categories of the *weredas* in *Gurage* zone are only two (ie, cultivated and open shrubland) while in those *weredas* of the *Arsi* and East *Shewa* zones are more than five (ie, cultivated, grazing, shrubland, wood/forest land and wetland). Montane

[2] Cultivated land here is the sum of all categories of cultivated land (ie, moderately and intensively cultivated land, moderately cultivated grass land, open grassland and woodlands).

[3] Grazing land = open shrubland (19.5%), grassland (2.9%) and open grassland (1.7%)

coniferous forest and plantation are found only in *Digeluna Tijo wereda* covering small area while Afro-alpine vegetation heath are found in considerable proportion here (19,723 ha) and in *Tiyo wereda* (7,204 ha).

Per capita cultivated land in all the *weredas,* but *Digeluna Tijo* (0.59 ha), is less than half hectare. The lowest in this category are found in *Meskan* and *Mareko* (0.26 ha) followed by those in *Tiyo wereda* (0.27 ha). The cultivated land size may be considered as the per capita land holding. Proper land management are not practiced in the watershed. As a result much of the land in each *wereda* is highly degraded. The very small land holding calls for intensive agricultural practices and increased off farm activities.

Population density of the watershed *woredas* on the River *Meki* sides is much higher than that of the River *Katar* side. The average density for all the *weredas* in the two watersheds is 153 while for *Sodo* and *Meskan* and *Mareko weredas* (*Gurage* zone) the population density is 251 persons/km^2, for *Ziway Dugda*, *Tiyo* and *Digeluna Tijo weredas* (*Arsi* zone) and for *Dugda Bora* and *Adami Tullu* woredas (East *Shewa* zone) are 107 persons/km^2 and 143 persons/km^2, respectively. The population density is highest (300 persons/km^2) in *Meskan* and *Mareko woreda* (*Gurage* zone) and lowest (101 person/km2) in *Adami Tullu Jido Kombolcha* woreda (East *Shewa* zone).

2.1.2. Aquatic Resources Base and Uses

(i) Aquatic Resources Base

(a) Physical Features of Lake Ziway

Lake *Ziway*, one of the important Rift Valley Lakes, is located in the *Oromiya* Regional State about 160 km south of Addis Ababa at an altitude of 1,850 m.a.s.l. It has a surface area of 434 km^2 with maximum extensions of 20 km by 25 km. The Lake has a mean depth of 2.5m with some areas (especially near the islands) showing deeper gorges of up to 8m (*Schroder*, 1982). Of the five islands on the lake, people who depend mainly on fishing for their livelihood are found in *Tulugudo, Tsedecha and Funduro* islands. The remaining two islands, *Debre Sina* and *Gellila* are not inhabited and are more important as nesting area and sanctuary for a diversity of bird species.

It has a wide watershed area of 7,025 km^2 (including the areas outside the watersheds of the two rivers) and two inflowing rivers at the northern side, River *Katar* and River *Meki*, and River *Bulbula* connects Lake *Ziway* to Lake *Abijata*. The Lake is surrounded by a farming community, which competes the water for farming. Medium and small-scale irrigation farms are found close to the Lake using its water or from the rivers flowing into it causing far reaching effects on the lake ecology.

Ziway is in close proximity and with a good road link to the large markets in Addis Ababa that initiated the development of commercial fishing, irrigated farming for vegetables and fast growing crops.

(b) Lake Water Chemical Composition

The water of lake *Ziway* is one of the salt free in lakes in the RV and fit for irrigation and human consumption. As available data on the status of aquatic micro flora and chemical composition was old, water sample was taken and analyzed to know the current status. The following table shows data obtained from the water sample taken from the lake.

Table 3. Comparison of Results of Water Chemical Analysis in 1989 and 2004, Lake *Ziway*

Parameters	Lake *Ziway*	
	***Tudorancea* et.al 1989**	**Present (2004)**
pH	8.9	9.2
E.c.ds/m	-	0.54
Na (Meq/lt)	2.3	7.0
K (Meq/lt)	0.31	0.53
Ca (Meq/lt)	0.72	0.37
Mg (Meq/lt)	0.64	0.51
HCO_3	3.67	4.8
SO_4	0.01	0.68
Cl^-	0.34	0.60

Source: Sample Taken on 7 July, 2004, CEDEP Consultants

According to results of the analysis, chemical quality of the water sample, which was taken in early July, for irrigation has not changed much (Table 3). The change in this span of time is very minimal, except a slight worry of Na whose value increased from 2.3 to 7.0 Meq/lt. This is not very bad for an open *Humic* water which have usually acidic pH. However, *Ziway* has an alkaline pH ranging from 8.9 to 9.2, showing that the deposition of nutrients has not influenced the physicochemical status of the aquatic system as a whole. However, the change in watercolor is very significant that colored Dissolved Organic Carbon (DOC) is very high. The light attenuation from DOC concentration will affect the *photoautotrophic* life in the Lake. The measurement of absorptive coefficient can be one of the parameters to monitor the pollution status of the lake.

(c) Flora and Fauna

The Lake is *polymictic* shallow fresh tropical Rift Valley Basin Lake. Lakes, in general, are not extreme habitats in regard to *abiotic* factors. For example, there is never a shortage of water, which often is a limiting factor in terrestrial habitats. The temperature is never below 0^oC and never exceeds 30^oC. On a hot summer day, the ground temperatures in a dry upland habitat may easily differ by $10\text{-}20^oC$ between day and night. But, theoretically, in the *epilimnon* of the lake rarely exceed 2^oC. Thus, aquatic organisms have evolved many adaptations in response to biological factors rather than physical conditions. This makes aquatic systems especially useful for the study of interactions of biodiversity

(d) Fish Resources

Lake *Ziway* contains indigenous fish species including *Oreochromis niloticus* and *Barbus* sp. and recently introduced species such as *Tilapia zilli*, *Clarias gariepinus*, crussian carp *Carassius carassius*, golden carp *Carassius ouratus*. The *C. gariepinus*, (the African catfish), was accidentally introduced into the lake possibly by escaping from the fish processing plant located at the lake shore where all fishes from several lakes are collected, processed and stored until transported to big markets.

Tilapia zilli and the *Cyprinid carps* were introduced by the Fishery Department of the MoA to enhance the Lake's productivity by utilizing the open niche, apparently without sufficient consideration on the long-term impacts. Attributed to such factors as destruction of littoral zones, excessive pumping of the lake water along with fish fries and selective fishing of *O. niloticus* is exhibiting a declining trend. This has been observed from the commercial catch data record and the species proportion changing in favor of the alien fish species (*Ziway* Research Center).

O. niloticus has been the dominant species in the lake consisting over 80% of the fish stocks (*Schroder*, 1984). Proportions of fish species recorded in the annual catch were 89%, 9% and 2% of *O. niloticus, catfish* and *crucian carp, respectively* (LFDP, 1997). It is estimated that the Lake can give a maximum sustainable yield (MSY) of about 3,000 ton/year (LFDP, MoA reports).

Phytoplakton

Although studies are very few in number and focus mainly on lake *Awasa*, some have made detail taxonomic studies on algal communities and seasonal distribution. In these studies a total of 206 algal species were identified from ten Ethiopian Rift Valley lakes (including lake *Ziway*). The three major groups that presently dominate the preliminary observation are *Chlorophyceae, Cyanophyceae* and *Diatomophyceae.*

The littoral zones of the lake is fringed by an emergent and submergent vegetation belt which usually extends offshore down to 2.5m at Lake *Ziway* or even 4m depth (lake *Awasa*). The species composition may vary between the two lakes but the most common emergent plants according to *Tudorancea* et al. 1989 were *Scrpus spp., Typha angustifolia, Paspallidium geminatum (*abundant in lake *Awasa*) and Reed *(Phragmites sp.)* The floating and submerged vegetation were represented by *Nympaea coerulea* and *Potamogeton* spp.

Zooplankton

Species found in this lake are a mixture of *taxa* found throughout tropical Africa. *Paleartic* species may be found because of its relative high altitude and moderate Climate. One of the few studies (*Tudorance* et al. 1989) has shown that there is a large diversity in *zoobenthic* communities. Distribution in sediments of different particle size groups – medium sand (0.25-0.50 mm) contains the greatest *taxa* richness than the very fine or the coarse sand particles.

The zooplankton fauna in lake *Ziway* is believed to be dominated as a biomass by *Copepods* and *Cladocera*. Unlike crater lakes, in which the fauna is limited to *Nematoda*, *Chironomidae*, *Epydridae* and *Hempitera*, the fresh water of the lake has abundance in wide ranges of *Zoobenthic* and Weed bed faunas.

Micro flora

The Lake, being fresh water tropical rift valley lake, enjoy a possession of larger mixture of *micro flora*. Taking into account of *bacterioplankton* alone, it is believed that there is a huge mass in the lake. In a preliminary study, Dr. Elizabeth *Kebede* indicated that there is link between bacterial abundance and chlorophyll. Ten to thirty percent of bacterial production was supported by gross primary production in Lake *Awasa*. This contrasts with the mere 1% of primary production of the zooplankton community. The dominance of *cyanobacteria*, particularly *Microcystis* and its toxins uses are mentioned. These and personal preliminary studies in this tropical lake emphasize the importance of the microbial loop once again. Other *micro flora* found in the lake include some *organotrophs* such as *Spirochetaleceae* and *Speudomonaledeceae*.

(ii) Aquatic Resource Uses

(a) Fishing

Lake *Ziway* is an important commercial center as a major supplier of fish to the markets in Addis Ababa. The main fishing methods are beach seine (BS) and gill net (GN). Hook and Line fishing were introduced recently with the appearance of catfish in the lake. The BS catch contains over 65% of the total annual landing

Highest annual fish landing from the lake was 3,180 ton recorded in 1997. This is beyond the recommended MSY estimate. In spite of increased effort to maintain the annual catch levels, total catch has been constantly decreasing since then. Over-fishing and deterioration of the littoral zones have been the major reasons for the depletion of tilapia stock from the lake.

Change in fish species composition has also been observed. Being substituted by the alien *C. gariepinus* and *Crucian carp fish* Sp., the indigenous *O. niloticus* is constantly declining. The tilapia stock is also negatively affected by the beach seine fishing, which disturbs its spawning/nesting ground and indiscriminately collects the juveniles and adult brooding fish. Over-fishing of the tilapia stock is reported in several studies including by Elias (1998, 2000); *Seyoum* and *Zenebe* (2000).

(b) Irrigation

Irrigation is most obvious response to water scarce agricultural areas. This explains for the lots of efforts being made around the lake which has great irrigation potential. However, there is no a responsible body to ensure the sustainable use of water by protecting it from any pollution, over utilization and disturbance of the ecosystem as a whole. Currently, due to lack of institution enforcing the economic use of water, water from the lake is used as ‘open access resource’.

The common irrigation method practised is “furrow irrigation” with two to three production seasons in a year. As of January 2003, total irrigated land was about 1,848 ha. Users of the lake’s water for irrigation are State Farm (867 ha), private investors (491 ha), individual farmers (320 ha), ILRI (4.5 ha) and others (166 ha). According to a study, the potential irrigable land using the water from the lake is 46,497 ha.

Crops cultivated include cereals (only maize), pulses (haricot bean), vegetables (tomato, onion, green/red paper, cabbage, carrot, beet root...) and fruit (papaya and grapes). The once flourished floriculture in *Ziway* area has ceased to exist since five years now. High freight costs to Europe have made the ventures uncompetitive at that market.

Except the State farm which uses hydroelectric power, there are 87 diesel generators for pumping the water out from the lake. According to a study made in the neighboring *wereda*, *Dugda Boru*, it was found that a total of 462 water pumps are used in the area. The horsepower range between 7.5 and 20 and operate on 1,561 ha of the total 2,455 ha cultivated by farmers. Apparently these farmers use the water either from River *Meki* or lake *Ziway*. In most cases, as generators are erected close to the lake, leakage of diesel is common. The diversion of the River *Katar* at the upper stream took large amount of water in the critical months of the year.

Despite the financial benefits that can be obtained, considerable siltation and unplanned extraction of the lake’s water are frequently reported as problems associated with the irrigation. However, no comprehensive assessment has been initiated yet on impacts of the activities on the Lake and its environment.

(c) Town Water Supply

The other use of the lake is as a source of the town’s water supply. The city administration provides both ‘house connection’ and ‘communal type’ services. The water purification plant is installed at the southern tip of the lake where it outflows into *Bulbula* River.

The water is used for household consumption, gardening and sanitation purposes. Restaurants and hotels use considerable volume daily. The daily discharge of water ranges between 1,000 and 1,500 cubic meter and this uptake is critical during the dry period.

iii) Eco -Tourism

Eco-tourism is nature-based tourism where the main motivations are the observation and appreciation of nature as well as traditional cultures prevailing in the natural setting. Lake *Ziway* and its surroundings have great potential for eco-tourism which has educational and recreational features and supports protection of natural areas by (a) generating economic benefits for organizations responsible for conserving natural areas, (b) creating income and jobs opportunities for local communities and (c) increasing awareness among locals about the need to conserve natural and cultural assets.

Ziway is endowed with a considerable number of bird species and landscapes that are highly attractive. Moreover, caves, monasteries, traditional terracing around the hills, traditional buildings and hot springs in the islands of the lake such as in *Tullu Guddo*, *Debrezion* and *Yewef Deset* (Birds Island) are important sites of attractions for tourists. The lakesides are also highly conducive for bird watchers, boating and swimming. About half of the waterfowls in the country can be encountered in this wetland including in the islands.

The *Oromo* people and their cultures are important attractions for tourists. The *Zay* people, who inhabit the islands for long with their unique language and ways of living very much related to the Semitic people of Ethiopia, have cultural and historical significance for anthropologists and historians.

In addition, conservationists currently encourage a land-use system a system called "eco-agriculture" which is management of land for "agricultural production" and "wild biodiversity conservation". The system promotes fulfillment of food requirement from a farm without any negative impact on the biodiversity. This is through using improved ecological and agricultural methods as well as on farm research. Eco-agricultural techniques should help to preserve wild species, increase land productivity and empower farmers to be good stewards of the land.

This system allows the search for new crop breeds, organic fertilizers, and biological pest control as well as farm and landscape management techniques that raise agricultural yields without affecting wild species to survive on farms and around the lake. In line with this, agro-eco-tourism, which is promoted through mass educational tours of organic farms is on the rise. This can generate monetary income to people around biodiversity rich areas such as Lake *Ziway*.

2.1.3. Institutional Base and Policy Support

(i) Institutional Base

Government, non-government and community-based organizations (CBO) are important partners in the planning and implementation of the SAP. Government organizations and local authorities are vital for their regulatory and other strategic services while NGOs engaged in environmental conservation and related activities will have a critical role in experience sharing and/or funding. On the other hand, CBO are vital in project, prioritization, planning as well as implementation phases.

(a) Government Organizations

Some of the government organizations most useful in the planning and implementation of SAP are reviewed here highlighting their major institutional objectives and organizational structures. These are the (i) Ministry of Agriculture and Rural Development (MoARD), (ii) Environmental Protection Authority (EPA) and (iii) Institute of Biodiversity Conservation (IBC). Other government institutions to be included may be Ministry of Water Resources, Ethiopian Tourism Commission, Addis Ababa and *Debub* University and other Regional Offices in the SNNP and *Oromiya* Regional States.

Ministry of Agriculture and Rural Development (MoARD)

The Ministry is organized under three major sectors, each headed by Minister of the State. They are charged with promoting arms of (a) Natural Resource Protection and Development, (b) Agricultural Production and Productivity and (c) Marketing of Agricultural Inputs and Outputs. Each supported by 3-12 departments, the Ministry has parallel Bureau at regional level, which in turn is represented by Departments and Office at zonal and *wereda* levels, respectively.

According to the recently issued (November 2001) agricultural and rural development policy document, the Ministry, among others, (i) provides support to the conservation and development of degraded and drought prone areas; (ii) encourages and supports farmers' skills in water conservation and utilization; (iii) works for the improvement of agricultural land productivity and works toward the issuance of policies, regulations and guidelines that facilitate policy objectives achievements.

The emphasis on conservation of natural resources is given to the degraded land and drought prone areas of the country while required packages for the collection, conservation and utilization of water resources are promised.

The Ministry supports and encourages efficient utilization of water for agricultural purposes through supporting the promulgation of legislations, guidelines, etc, required for effective agricultural utilization of 'water resources' as well as building the technical know how of farmers.

Ministry of Water Resource Development (MoWRD

The MoWRD in proclamation No. 92/1994 identified the articles used in water resources development, conservation and utilization. Watershed and aquatic resource conservation and management is supported and carried out by the MoWRD.

Environmental Protection Authority (EPA)

The Federal Environmental Protection Authority (EPA), with its five technical departments, is a responsible for the protection of the environment. Some of its duties are (a) Preparing environmental protection policy and laws, and upon approval, follow up their implementation; (b) Issuing directives and systems necessary for evaluating impacts of social and economic development projects on the environment; (c) Determining standards that help in the protection of soil, water and air as well as the biological systems they support and (d) Coordinating environmental researches.

In its drive to build regional capacity, EPA is encouraging the establishment of Environmental Protection Offices (EPO) and provided technical and financial support to the *Oromiya* and SNNPR that may play a leading role in the conservation of the lakes of *Ziway* and *Awasa* and their catchments.

Institute of Biodiversity Conservation (IBC)

The Institute of Biodiversity Conservation is established to implement Biodiversity Policy. The policy (Biodiversity Conservation Policy, 1998) has the major objectives of promoting exploration, collection, conservation, characterization, evaluation and utilization of biological entities in the country.

The Institute, organized only at federal level, is charged with the identification, conservation and promoting the sustainable use of biodiversity resources in the country. It is structured in different specialized departments each responsible for *in-situ* and *ex-situ* conservation. The existing structure is composed of 9 technical departments and 3 services. The Technical departments are Department of Ethno-biology; Department of Forestry and Aquatic Plants Genetic Resources; Department of Animal Genetic Resources; Department of Microbial Genetic Resources; Department of Medicinal Plants; Department of Biotechnology and Bio-safety; Department of Forage and Pasture Genetic Resources; Department of Horticulture Genetic Resources and Department of Ecology (DEC).

The IBC, among others, identifies target areas for conservation programs, bridges the gaps between the conflicting interests between the use and conservation of genetic resources. It is involved in raising awareness of the public and policy makers about *in-situ* and *ex-situ* conservation activities; supporting and strengthening of local capacity in the planning and implementation of sustainable use and conservation of genetic resources. Conservation programs with full participation of the farming community and others concerned and creation of national capacity in conservation research are also carried out.

(b) Non-Government Organizations (NGOs)

NGOs currently operating and which are relevant for the SAP are SEDA (*Selam* Environmental Development Association) and RCWDA (Rift-valley Children and Women Development Association).

Other NGOs that are not currently operating but can possibly be potential partners in the implementation of the action plan include the German Technical Cooperation (GTZ), US Aid for International Development (USAID), Christian Relief Service (CRS/USA) Oxfam/UK and Save the Children UK. These can assist the conservation program in capacity building, logistic support and initiating and facilitating experience sharing.

(c) Community Based Organizations (CBO)

Formal and informal traditional institutions are very useful in determining the success of plan implementation. Community based formal institutions such as Cooperative Societies (Fishery, Irrigation, Multipurpose, etc,), rural and urban *Kebele*, Youth and Women's Associations and informal Social and economic traditional institutions such as *Idir*, *Senbete* and *Ekub* are instrumental in the identification, implementation and evaluation of SAP components.

(ii) Policy Support on Natural Resources Conservation

The Ethiopian constitution Article 44 (Proclamation No. 92/1995) provides for a basis to the country's environmental policy. The articles emphasize the importance of natural and cultural heritage in every body's life and underscores the need for strong conservation and thoughtful utilization by every citizen.

Federal policies include on (i) Natural Resources, (ii) Forestry Development (Proc. No. 94/1994), (iii) Wildlife Protection, (iv) Water Resources Utilization, (v) Land Use and Administration support the initiatives contained in the SAP and (vi) Fisheries Development and Utilization (Proclamation No. 315/2003).

Policies and acts promulgated on areas of environmental protection and sustainable utilization include Environmental Protection Policy (EPA 1997); Environmental Impact Assessment (Proc. No. 299/2002); Water Utilization Policy (Proclamation No. 92/1994) and Pollution Act (Proc. No 300/2002); Biodiversity Strategy and Action Plan (BSAP), *Oromiya* and SNNP Regional Forest Proclamations; *Oromiya* National Conservation Strategy, National and Regional Forestry Action Program, Water Resource Development Fund Establishment (Proc. No. 268/2002), Ethiopian Water Resources Management Regulations (Council of Ministers Regulation No. 115/2005) and Water Sector Development Program (2002-2016), 2002.

2.1.4. Population and Demographic Trends, Farming/Tenure Systems and Economic Resource Base

(i) Population and Demographic Trends

Population of the watershed areas of the two rivers is estimated at 1.17 million as of July 2005.[4] Rural and urban populations of the seven *weredas*[5] computed for the same period are 935,349 (79.5%) and 240,310 (20.5%), respectively. Because of the huge impact of this population on the natural resources, the actual rural and urban population depending, directly or indirectly, on agriculture for their livelihoods need to be known in the preparation of the project document.

[4] The seven weredas are identified by super imposing the watershed map on the administrative map both prepared in the "Woody Biomass Inventory and strategy Planning Project (2003), MoA.

[5] This estimate is computed from the 1994 census results. The official growth rates used by the Central Statistical Authority (CSA) are 2.23% and 4.11% for rural and urban population, respectively.

Table 4. Rural and Urban Population of Lake *Ziwai* Watershed Areas by *Wereda*, July 2005

Zone/*Wereda*	July 2005		Total
	Rural	Urban	
***Gurage* Zone**			
• *Sodo Wereda*	130,167	9,504	139,671
• *Meskan* and *Mareko Wereda*	252,222	44,746	296,968
East *Shoa* Zone			
• *Duga Bora Wereda*	136,657	42,604	179,261
• *Adami Tullu Jido Combolcha Wereda*	102,031	48,440	150,471
***Arsi* Zone**			
• *Ziway Dugda Wereda*	107,403	3,684	111,087
• *Tiyo Wereda*	83,879	80,033	163,912
• *Digeluna Tijo Wereda*	122,990	11,899	134,889
Total watershed population	935,349	240,910	1,176,259

Ziway town which influences the lake considerably is found in *Adami Tullu Jido Kombolcha wereda*. With its population of 31,236 (July 2005) *Ziway* town is the major urban center for the *wereda*. The town constitutes almost 20% and over 63% of the *wereda* population and the *wereda's* urban population, respectively. Proportions of male and female are almost equal, 50.07% and 49.03%. The ratio of working age group (15-64 years) to that of dependent (0-14 years and 65 years and above) is 3 to 2, ie three adults support two dependents who are either under 14 or over 64 years of age[6]. Although there is no unemployment figure for the town, in the absence of visible economic activities, the rate of unemployment in the town is high. The demographic attributes discussed above for *Adami Tullu Wereda* do not show sharp variation from the other *weredas* in the watershed.

(ii) Indigenous Knowledge

The indigenous farmers in the study area have rich heritage which enabled them make the best use of agricultural resource as they have been practicing soil and crop management and livestock rearing (with good background from earlier pastoral experience) for many years. Before the introduction of modern administration and population increase, the communities used to practice their own way of conserving natural resources. This includes terracing, mulching, selection of good seeds and livestock rearing.

They were living harmoniously with the forest and cutting of live trees was not much practised. Only died wood were collected for home use and get fruit from the forest. Farmers have had good conservation systems which include mixed farming practice, the traditional agro-forestry system which used to leave different Acacia trees on farmland and having graves amidst forest which makes the place a "scared groove" and a high levels of reverence for trees such as Warka *(Ficus spp.), Olea* and big Acacia trees.

[6] In this report, children who are 14 years or below and people over 65 years of age are considered as economically inactive or dependent. This is also the working definition adopted by the CSA.

(iii) Land Tenure and Farming Systems

(a) Land Tenure System

The 1995 constitution states that the right of ownership of rural land as well as all natural resources is exclusively vested in the state and/or the public. There is no private tenure in Ethiopia. The fact that the land is owned by the state has Jeopardized tenure security of the farming community and made them reluctant to make long-term investments in the form of terracing, tree planting or other activities that increase agricultural productivity by controlling land degradation. Many believe that insecurity of tenure has made farmers misuse or under utilize the land.

According to the land use and administration policy under implementation in the Region, issuance of "title deeds" is expected to be carried out soon. The move is believed to make farmers feel more secured of their holdings and encourages long-term investments (tree planting and other land development activities) without fear of 'land redistribution'.

(b) Farming System

Farming system in the watershed of the two rivers is represented by subsistence mixed farming where crop production and livestock rearing are practiced under same management. In this system, production technology is backward where land is prepared mainly with oxen plough and seeds broadcasted randomly.

In the mixed farming system, cereals (maize, sorghum and *teff*), pulses (haricot bean, peas) oil crops (linseed, rape), vegetables (cabbage, carrot, onion, tomato, pepper) and fruits (papaya, grapes, watermelon, etc) are commonly grown in the catchments and/or around the lake. In the highlands bordering the RV in the west (ie, *Guragae* highlands) crops such as *enset*, barley and wheat are cultivated while maize, sorghum and haricot bean predominate in the lower altitudes.

The smallholder farming system makes about 95% of cultivated land and agricultural production in the area (*Siraje*, 1998). However, productivity is very low due to shortage of agricultural inputs, inefficient farming practices and inadequate incentives to enhance productivity.

Commercial agriculture, which is insignificant area wise, is mainly found in areas bordering the lake uses improved farming technologies like selected seeds, fertilizers, pesticides, herbicides and tractors. Growing irrigated private commercial farming as well as a state farm established nearly 30 years ago are conspicuous along the main road and adjacent to the lake.

(iv) Economic Resource Base

The economic bases of the community in the watershed *weredas* as a whole are farming, fishing, small scale trading and limited agricultural processing. Looking into the economic activities in *Ziway* town, farming in the outskirt of the town followed by the service sector dominate the others. Considering the number of people engaged in farming

(cattle raising and farming), trading (whole sale and retail), wage labouring (civil servants or employees in private entities), fishing and small-scale industry (mainly flour mill) are the major economic activities in their order of importance.

(a) Farming Activities

Smallholder's mixed farming is the main activity for those engaged in agriculture. Few are engaged in irrigated agriculture using water from the lake while others rent out their holdings for private operators who use own diesel generators to pump out the water from the lake. In the peasant farming system, where production technology is traditional, productivity is low while performance of the commercial mechanized farms is relatively high.

Major crops grown in the watershed areas are maize, *teff*, haricot bean, onions, potatoes, tomatoes, watermelon and papaya. There is enough market for agricultural outputs especially from around *Ziway* as it is situated in close proximity to the major markets (Addis Ababa, and Nazareth) connected with excellent asphalted road. With planned use of the water and cultivating in environment friendly manner, *Ziway* has considerable potential for intensive fruits and horticultural crops production aiming at the international markets.

(b) Fishing

Fishing is an important economic activity in *Ziway*. There are reportedly 1,700 fishers with 960 BS and 750 GN deployed in commercial fishing (MoA 2003) operating in about thirty landing sites around the lake.

Thus, income from fishing is declining due to small daily catches. The over-fishing is far beyond the capacity of the fish stock to maintain sustainable production.

(c) Trade and Industry

Although Soda Ash Processing Plant, Pesticide Factory, Smoked Fish Processing Unit, *Ziway* State Farm and Green Bean Packing Plant are some of the agro-industrial businesses, the major economic activities in the *Adami Tullu Jido Kombolcha wereda* are retail trade, wholesale, service and industry, the former being the most dominant. According to a recent survey, the *Wereda's* Office of Trade and Industry issued/renewed licenses for a total of 905 (retail), 216 (wholesale) and 186 (services).

The Office has also issued/renewed licenses for "industry" which mostly refers to small-scale industry mainly flour mills. In 1993 EC, a total of 114 trade licenses were renewed or issued for the category.

Among the retail trade services, hotels, restaurants, garages and kiosk are found in bigger proportion. Civil servants, employees in the private transport services and daily laborers engaged in other different private ventures are also found in small proportion.

(d) Tourism Activities

In spite of seriously dwindling resources, there are still considerable tourist attraction sites landscapes, sceneries and birds. Most important is the water bird life that attracts bird watchers from within and outside the country. In the Lake, there are also islands that have historical significance and great cultural value. Boat rental services, provided by 13 boat owners organized in a cooperative, provide access to the islands easy.

Other interests for tourists in the area are licensed hunting on birds (Guinea fowls, Ducks, Geese Teals and Francolins) and sport hunting on game animals (Greater Kudu, Duikers and Gazelles). Communities in the areas also benefit by selling traditional crafts and home made articles and by providing services as tour guide and interpreter, highly needed by tourists and professional hunters.

2.2. Threat and Gaps

2.2.1. Threats

Threats of biodiversity are causes and background factors that indicate and tell the decline story of conservation and loss of biodiversity through various destructive and extinction mechanisms. The natural resources and environmental deteriorations in the biophysical and human activities and poor attempts towards sustainable use of potential resources are among the threat factors. The principal threats in Lake *Ziway* and its surroundings emanate mainly from fast growing human population and joblessness. The specific threats include deforestation, land degradation at the watersheds, lakeshore farming, siltation/sedimentation, uncontrolled water abstraction and fishing. The problems outlined below are considered serious causes threat for Lake *Ziway*.

(i) Climate Change

The global, sub-Saharan and the Eastern Africa Rift Valley climatic change has influence in decreasing water bodies at the rift valley Lakes. Increase in heat over the years has accelerated evaporation due to increased heat, the low rainfall on the watershed area and high sedimentation that have shrunk the water body and decreased the depth.

(ii) Deforestation

Lack of proper management of the natural resources of the Rift Valley and conversion of the forest and woodlands to crop production and urban expansion, has threatened the biodiversity and ecosystem. Cutting of *Ficus* (boat making tree), lakeside native trees and acacia woodland for charcoal making have increased wind incidences, aggravated evaporation, accelerated soil erosion and increased loss of water from the lake surface**.**

The metropolitan Addis Ababa and bigger town such as *Ziway* itself, *Shashemane*, *Arsi Negelle* and *Nazareth* are the major pull sites of charcoal and fuelwood supplies. Lack of reliable rainfall and frequent crop failure have forced local communities to rely more on the natural woodland for their survival.

(iii) Lakeside Farming and Erratic Rains

Short of appropriate measures, shoreside farming causes siltation and pollution with agro-chemical that induces *eutrophication* of the lake water. Another problem noted is the destruction of the submerged reeds in the shallow area of the lake (the reed-belt) that used to serve as a refuge and breeding site for the fishes. These tall grass and aquatic trees are intensively cut and sold in town without any control.

The erratic rain at the site has induced little *in-situ* precipitation and reduced run off coming into the lake. In the absence of adequate pasture near by, more livestock are brought around the lake for grazing and watering.

(iv) Erosion/Land Degradation

The soil class around Lake *Ziway* is *Anodosol*. It has a light texture, wich is vernerable to both wind and water erosion. The area had a good natural prairies acacia trees cover and grass undeneath serving as grazing area to southrn and eastern pastoralists during the dry spell.

Due to the high population and destructive harvest of trees, the accecia woodland is now changed nearly to barren land. Overgrazing has exposed the soil to wind erosion which leaves back sand particles thus reducing the waterholding capacity of the soil. The flat topography also exacerbates sheet erosion causing high silt deposition into the lake.

(v) Siltation, Sedimentation and Reduced Water Depth

The Lake is situated in the midst of high agricultural activities where no or little soil conservation efforts are made. Silt debris from mechanized farming in *Arsi* and intensive plough cultivation in the *Gurage h*ighlands and upper *Meki* town areas have deposited heavy load of sediments in to the Lake. With the reduced water holding capacity of the lake, the deposition will not only threaten survival of the fauna and flora, but also the very existence of the lake.

The shrinking water body and reduced average depth have caused aquatic imbalance and disturbances of the lakeside ecology. The water level has decreased and the lakeshore shrunk so much that one could walk 50 to 80 m over the exposed land. The slow death noticed of lakes "*Abasamuel*" near *Akaki*; "*Adele"* near *Adele* town; "*Lange"* near *Lange* town and recently "*Alemaya"* near the *Alemaya* Agricultural University are sad stories which should alert all the concerned about Lake *Ziway*.

(vi) Uncontrolled and Unplanned Water Abstraction

Medium and small-scale irrigation schemes following Rivers *Meki* and *Katar* large number of pumps (87) using water directly from the lake and over 460 pumps in the neighboring *wereda*. The "open resource access policy" has aggravated uncontrolled use of the water Lake's and the rivers flowing into it. The *Arata* (100 ha) and the *Katar* (420 ha) irrigation projects are other examples of inadequately planned river diversion.

(vii) High Population Growth and Unemployment

The high population growth is triggered by a multiple of factors, viz high natural growth rate (4.11% per annum), urban-rural migration and urban-urban movement. In a situation of inadequate economic activity unemployment is rampant among the working age group.

This unemployed labour force makes its way to "uncontrolled" or "free access resources" such as fishing and woodland clearing for self-sustenance. These activities do not have any regard to the sustainable use of these resources, ie, fishes, trees.

(viii) Over-fishing and Displacement of the Native Tilapia

Excessive fishing efforts, inappropriate fishing method and gear (BS) have caused over-fishing of *O. niloticus*. It is also believed that the depletion has further been exacerbated by the competition and displacement by the introduced alien species of catfish and carps.

Although the MoA, 2003 report indicates that up to 5,000 fishers engaged all around the lake, the study team during the site visit was informed that some have already moved to *Langano*, with their beach seine (BS) due to low catch at lake *Ziway*. Their migration with the destructive gear is shocking as it will result in the depletion of the fish stock in *Langano* too. The gill net fishing was practiced by islanders of Lake *Ziway*, *Tulugudo* and *Tsedecha*, with larger mean size of tilapia catch than that of the BS's is becoming a past history.

(ix) Introduction of Alien Aquatic Flora Species

The Lake harbors large number of unfamiliar species of flora such as "*Water lettuce*" which, affects the fish population by taking over the breeding sites and competing with phytoplankton. The change in composition of phytoplankton may induce changes in zooplankton which in turn leads to changes in biotic community that influence the fish stock in types, composition and size.

(x) Ecological Imbalance

(a) Terrestrial

Biodiversity gets the phenomena of ecological imbalance when one of the three main elements (viz, the Genome, Species and the ecosystem) is affected because of "habitat degradation", "spread of invasive species" and/or "over use". This is noticed where food chain is disturbed and naturally intact habitats and their communities are in disharmony. The mutual balances of the major eco-system, lake's watershed and wetland are disturbed by human interferences such as lakeside farming and habitat destruction.

(b) Aquatic Ecological Imbalance

In the Lake, it is evident that the present aquatic ecosystem is not as it had been in the past. The water level has shrunk very much, the volume has drastically been reduced and lots of debris deposition is observed favoring some lives while inhibiting others.

(xii) Decline in Waterfowl and Big Wild Animals

Destruction of the lake's habitat and ecological imbalances have resulted in the decline of bird population. The 1,559 waterfowls sited in 1992 have drastically fallen down to 443 birds in 1994 Syvertsen (1995).

The increased number of people coming for recreation (bathing, surfing, boating, bird watching, walking and jogging) with out adequate preparation and care for the surrounding physical environment has exerted pressure on the birds' survival especially the young ones. Migrant birds such as geese, ducks, and waders, which come in large numbers to the lake for feeding or roosting, have also been affected.

Weak law enforcement and "open access resource" practice by poachers have affected the survival of the big wild animals around the Lake. Greater Kudu and Duikers for their meat and *Colobus* monkey and Hipopotamus are hunted illegally for their social values.

2.2.2. Gaps

Gaps are arising from weak facilitation, erosion of traditional resource conservation mechanism, institutional malfunctioning and other insufficient biophysical conditions. Some of the pitfalls not addressed, when they should be, due to lack of enabling environment are considered here as gaps. Inadequately designed policy and institutions to implement and practice the conservation code of conducts are contributory to gaps.

Main gaps at the Lake and its surroundings include (i) Poverty and Resource Degradation, (ii) Inadequate Guideline or Enforcement Mechanisms, (iii) Lack of Watershed and Environment Oriented Planning, (iv) Lack of Buffer Zone Demarcation, (v) Population Pressure and Unregulated Settlement, (vi) Lack of EIA Prior Interventions, (vii) Lack of Peoples Awareness, (viii) Frequent Institutional Changes and Weak Capacity and (ix) Lack of Basic Information.

(i) Poverty and Resource Degradation

Poverty and inadequate conservational practices and land degradation are closely correlated. Limited economic activity and high population growth without productive engagements are causes for over utilization of natural resources.

The low level of labour productivity and other factors of production have remained the major cause for inadequately meeting basic human needs and thus, reduced care for the environment. The people, when in abject poverty, take any action for subsistence including destruction of the natural resources.

(ii) Inadequate Guideline or Enforcement Mechanisms

Although regulations (Fishery regulation) and policy (water utilization policy) are in place, lack of institutional capacity or inadequate guidelines for their enforcement have been the difficulties observed for their implementation. There are proclamations for the protection and conservation of wildlife including birds but are not enforced properly.

(iii) Lack of Watershed and Environment Oriented Planning

There are no concerns on degrading *Arsi* and *Gurage* highlands, the resultant of which is deterioration of the lake. This is due to erroneous environmental planning and development considerations. Lack of watershed based planning and management has aggravated natural resources degradation and made development efforts ineffective.

(IV) LACK OF BUFFER ZONE DEMARCATION

Farm expansion with poor land management practices to the lakeshore and encroachment of same by residential housing are caused by problem of implementing the master plan and/or lack of buffer zone demarcation.

(v) Population Pressure and Unregulated Settlement

Low level of economic activity coupled with unhealthy demographic proportion of the dependent population (40%) caused widespread unemployment. Authorities may not have the institutional capacity or the means to enforce regulations or implement development plan such as protection of lakeside from farming or settlement encroaching the fragile eco-system.

(vi) Lack of EIA Prior Interventions

Although there is policy provision for environmental impact assessment (EIA) prior to any development undertakings, the exercise is hardly done both in the rural and urban areas. Institutional capacity, inadequate enforcement mechanism and more importantly, lack of commitment at all levels, are major hurdles.

(vii) Lack of Peoples Awareness

Other development problems considered as gaps requiring attention are (i) lack of people's awareness on natural resource management, (ii) wrong belief that most resources including fishes are inexhaustible (iii) inadequate trained manpower, (iv) financial shortages, (v) lack of good governance and (vi) inadequate cooperation and coordination among stakeholders in biodiversity conservation (ie, LAs, GOs, NGOs, CBO,).

(viii) Frequent Institutional Changes and Weak Capacity

Frequent change of organizational structures without notable differences in their institutional objectives is among the causes for the weak performance of the economy in general and the agriculture and related sectors in particular. High turnover of officials and experts assigned in government hierarchy made the offices weak in the implementation and monitoring of activities eg on conservation.

(ix) Lack of Basic Information

Information gap exists on aquatic biodiversity and other natural resources due to shortage of adequate research. This has caused the shortage of reliable data on fish biology and other microbials that could be used to formulate appropriate conservation and development plans.

2.3. Opportunities

Situations that create enabling environment in the implementation of SAP components include (i) policy provision on natural resources conservation and related activities, (ii) research and academic institutions, (iii) global support for conservation initiatives; (iv) permanent water flow into the lake, (v) uniqueness of habitats with scientific significance, (vi) proximity and accessibility for tourists and (vii) lessons from past activities.

2.3.1. Policy Provisions

There are policy provisions that support SAP implementation. These include (i) policies on natural resource development, (ii) environmental and related acts, (iii) policy on biodiversity conservation and (iv) policy on land use and administration.

The policies and acts issued at federal and/or regional levels provide institutional support for the conservation of natural resources in general and ecological biodiversity in particular. Federal development policies adopted at regional level suit the latter's specific circumstances and provide legal framework for their implementation.

2.3.2. Global Support to Conservation Initiatives

Multilateral organizations, bilateral donors, specialized agencies and non-government organizations support initiatives in the rehabilitation, conservation, development of biodiversity resources. Effort must be made to benefit from these aid facilities. The type of support each provides are summarized in the following table.

Table 5. Global Organizations by Type of Support

Facility/Support Organization	Type of Support Available
1. Global Environment Facility (GEF)	Funds conservation initiatives in countries that have ratified the convention on Biological Diversity.
2. World Wide Fund for nature (WWF)	Under National Development Program, establishes a trust fund to generate income to finance capacity strengthening programs for the development of wildlife.
3. United Nations, Development Program (UNDP)	Under National Development Program, establishes a trust fund to generate income to finance programs related to the development and conservation of natural resources.
4. World Bank (WB)	Allows loan to the conservation and sustainable use of national biodiversity resources.
5. Bilateral donors (such as the Netherlands Germany, Austria, Sweden and Britain)	Support biodiversity conservation initiatives in protected area and assist institutional capacity building .
6. IUCN (The world conservation union)	Support biological conservation initiatives.
7. *Ramsar* Convention	Provides support to activities such as "water bird census", "monitoring" and studies on "sustainable use".
8. SIDA (SAREC)	Supports financially and technically regional programs on sustainable utilization of dry land Biodiversity.
9. Important Bird Areas (IBA)	Provides technical support to IBA's of Ethiopia.

2.3.3. Research and Higher Learning Institutions

The Addis Ababa and *Debub* Universities (AAU and DU), the Ethiopian Agricultural Research Organization (EARO) and other higher learning and research institutions operating nationally or regionally provide also useful services/support during the implementation phases. Surveys and studies on the lakes' biodiversity and related subjects that had been conducted by these institutions are sources of vital information/data. By using the knowledge and database from their earlier studies, resources can be saved and/or efforts concentrate only on uncovered subjects.

2.3.4. Regular Water Flow

The two perennial rivers viz, *Katar* and *Meki*, *in-situ* precipitation and run off are the sources of water to the lake. The two highland streams supply the Lake with enough fresh water that could serve it as good *dilutants* to nutrient accumulations. On the other hand, major causes of water loss are (i) evaporation, (ii) outflow through River *Bulbula* and (iii) abstraction. According to *Tenalem* (1998), however, the water balance of the Lake showed a deficit (ie, the outflow is higher than the amount of water entering the lake) by 74 mcm.[7]

[7] Direct precipitation at the Lake area is about 323 mcm, the mean flow from R. *Katar* (392 mcm) and *Meki* (265 mcm) and run off about 56 mcm/year (ie, 7.5% of the 750 mcm/year. Run off is expected to enter the Lake)

Annual evaporation ($\underset{\sim}{}$ 898 mcm) + outflow via *Bulbula* (184 mcm) + Annual abstraction for irrigation/water supply to *Ziway* town ($\underset{\sim}{}$ 28 mcm. Hence water balance is the difference between inflow and outflow figures ie, [(323 + 392 + 256 + 56) mcm – (898 + 184 + 28) mcm] $\underset{\sim}{}$ - 74 mcm.

2.3.5. Habitat Wealth

The Rift Valley areas including lake *Ziway* are habitat for many endemic and migratory birds and other mammals, which have scientific significance to the country's biodiversity and the world at large. Wetlands of the lakes region play very important role for both aquatic and terrestrial ecosystems.

The lake is known for its phytoplankton (algae), zooplankton and fishes. There are vegetation with beds of reeds and water-lily inhabited by large fish eating birds[8]. The Sasebania bushes around the Lake provide nesting sites for smaller egrets and herons.

2.3.6. Proximity and Easy Access to Services

The Lake is very close to Addis Ababa which is the main business center of the country and the largest market for fishes and vegetables. *Ziway* is well served by all weather roads. An enlarged asphalt road traverses the eastern part of *Ziway*, linking Addis-Ababa with *Awasa* and other towns in the southern nations. All weather roads connect *Ziway* with *Butajra* and through *Meki* to *Asella* town in *Arsi* zone.

Ziway is served by a number of institutions such as office of the Agriculture Rural Development, Education, Health, water supply, cooperative development and micro-finance enterprise. The office of agriculture and rural development is responsible for the promotion of modern agriculture, improved land management and natural resource conservation by raising farmers' awareness through extension education. Other rural development oriented institutions including NGO are operating in the town.

2.3.7. Experience from Past/Current Development Initiatives

Chilalo Agricultural Development Unit (CADU) by SIDA, the Southern Rural and Agricultural Development Project (SORADP) by the French Development Agency, the *Adami Tullu* Animal Breeding Research and the *Abernossa* ranch by the Ethiopian Livestock and Meat Board, the *Mitto* Private Farms, establishment of the Fish Corporation by the MoA, the State Prison Farm, the *Ziway* state farms, *Ethio-Korean Meki-Ziway* Irrigation Project, the Ethiopian Children *Amba* and 'Marshal closing' of 1987-89 were interventions that have brought about agricultural and other rural development to the population and *catchments* of Lake *Ziway*. Nevertheless, poor land use planning and management, the tradition of not carrying out EIA for mainly lack of concern and/or awareness about environmental conservation, rapid population growth and inadequate care for the natural resources have contributed to the present ecological imbalance of the area.

The lessons that can be learnt from these interventions are, therefore, promoting the will of development agencies and the communities to carry out development activities with full awareness about environment during the planning and implementation stages of projects both in urban and rural areas.

[8] The birds include darter, long tailed cormorant, various herons, fish-eagle, king fishers spur winged goose, African pygmy goose, white faced tree dusk, bleak crake, jacana, *palearctic* migrant waders and terms, and water fowl.

III. CONCLUSIONS AND RECOMMENDATIONS ON THE THREATS AND GAPS

3.1. Conclusion

The growing human population, unemployment, poverty, lack of awareness on conservation practices, poor policy and lack of capacity to conserve and utilize available resources are the major causes of biodiversity degradation and ecological disturbances. According to the Biomass-Land Evaluation Study (2003), the *Adami Tullu Jido Kombolcha wereda* is categorized as one, which has lost "critical capacity to support more human and livestock population".

These imbalances elucidate formidable hurdles, viz, difficulty in protecting and conserving the remaining ecological niches, problem of restoring lost biological diversity, huge resource requirement and concerted efforts by all stakeholders.

From the conserved of biodiversity, however, the community can enjoy environmental, social and economic benefits such as improving food security, forage and firewood availability, climatic balance, conserving natural resources for next generation and promotion of eco-tourism related cottage industries.

Thus, based on the results of above mentioned study, any rural and agricultural development programs are difficult to anticipate in the medium and long-term period before implementing rehabilitation and lake vicinities conservation activities.

3.2. Recommendations

The above conclusions alert the extent of resource requirement in terms of manpower, expertise, technology and efforts in bridging the gaps and avoiding the threats. The following recommendations are measures to conserve, develop and sustainably utilize the biodiversity resources in the short and medium-term.

1. Implement efficiently and effectively components of SAP to rehabilitate the biodiversity resources of the lake and the watershed areas.
2. Explore and use alternatives water sources including underground water from distant escarpments such as *Munessa* and *Mareko* areas.
3. Introduce and promote use of energy sources such as wind and solar energies, biogas, and geothermal of the area to reduce cutting of wood for fuel.
4. Study and enforce water tariff, ensure the use of appropriate water pumps/generators, introduce use of "drip application for irrigation" and "non-water pumping season" during months of low water level (ie, April-July).
5. Promote economic use of water and introduce a design that encourages roof rainwater harvesting for washing and gardening purposes.
6. Enforce strict regulation in avoidance of garage and other detergent base wastes along the lakeside and ensure acceptable municipal waste collection and disposal procedures.
7. Device safe and closed system dyke diverting run off to the lake through sediment trapping grass strips, small shrubs and open canopy trees.

8. Demarcate strict buffer zones at Rivers *Meki* and *Katar* entry sites using live fence such as water loving trees, bushes and other agro-forestry crops.
9. Carry out area closure, afforestation and, thorough socio-economic study, halting settlers' encroachment on the water heads of the two rivers.
10. Establish collaborative interregional (SNNP and *Oromiya*) and inter-zonal (*Gurage/Siliti*, East *Shewa* and *Arsi*) committees for supporting the implementation of SAP in a coordinated manner.
11. To address poverty and agricultural resource abuse in the towns and promote employment creation opportunities in all the towns and rural areas of the *weredas* in the watershed.
12. Provide family planning and reproductive health education integrated with HIV/AIDS prevention and control programs.
13. Promote livestock development using minimum grazing system thus, avoiding overgrazing.
14. Co-ordinate and integrate efforts in Biodiversity Conservation to avoid duplication of efforts through.
15. Provide additional training and licencing of fishermen based on fish availability with regular follow up.
16. Introduce Environmental – Audit management and/or EIA through “Pollutant pay” principle.
17. Encourage financial institutions to attach “environmental auditing” requirement before financing industrial investments and insurance commitment for the environment.
18. Implement water related policies and enforce all regulations on river diversion, etc useful for the conservation and sustainable use of water resources.

IV. SITE ACTION PLAN

4.1. Categories of SAP Projects

The SAP for *Ziway* is composed of five projects. These are (i) Rehabilitation of depleted *O. niloticus* stock, (ii) Evaluation and Impact Assessment of Introduced Alien Fish Species, (iii) Integrated Watershed Management, (iv) Eco-Tourism Promotion and (v) Baseline Survey Study.

The first two projects are on the aquatic resource, viz, fish. They aim at (a) rehabilitating the *O. niloticus* species and (b) determining impacts of alien fish species introduced in to the lake.

The third project is "Integrated Watershed Management" which has two sub activities ie, "reducing the sediment load" to the lake by treating the degraded watersheds of the rivers" and "establishing buffer zone" to rehabilitate the lakeside, which is threatened by farming and human settlement.

The fourth project is "eco-tourism promotion" which aims at income-generation, promotion of sustainable use of biodiversity resources and ensuring the principle of benefit sharing. Follow up projects are expected to be prepared and implemented based on the results that may be obtained from this rehabilitation phase activities.

The fifth project is a "natural resources and socio-economic baseline study" with the aim of availing data and information on the existing natural resource base and socio-economic conditions at the start of SAP implementation. Results of this project are believed to establish the benchmarks against which achievements SAP implementation are compared.

The individual project is prepared based on the threat and gaps identified in the assessment and analysis phases of the Lake and its surroundings. Each component is summarized in terms of the rationale for its identification, the goal, objectives, outcomes and outputs, major activities to be performed, implementation strategy, benefits of the project, organization and management, financial costs, anticipated problems and monitoring and evaluation. Log-frame matrices showing the project hierarchies (viz, goals, outputs, outcomes and activities) also prepared for the respective components. A single Log-Frame summarizing all components of the SAP for lakes *Ziway* and *Awasa*, is also attached.

All projects will have actual implementation period of "three to ten years" in addition to a six-month preparatory phase when the Project Coordination Unit (PCU) is set up and implementing agencies selected. Summary of estimated total cost for the respective project, as well as for the PCU is shown on Annex 1. These estimates are rough and must be used cautiously as they are meant to give only clues for soliciting funds. During preparation of the project document, a more realistic costs should be computed. During negotiations with the respective implementing agencies, there may be changes in major cost category and/or value of the respective component.

The institutional arrangements, in SAP implementation, are discussed next chapter in more detail. The implementation in *Ziway* and *Awasa* requires a lot of coordination and networking. For this there has to be regular periodic exchange of information on project achievements and/or problems faced in the course of implementation.

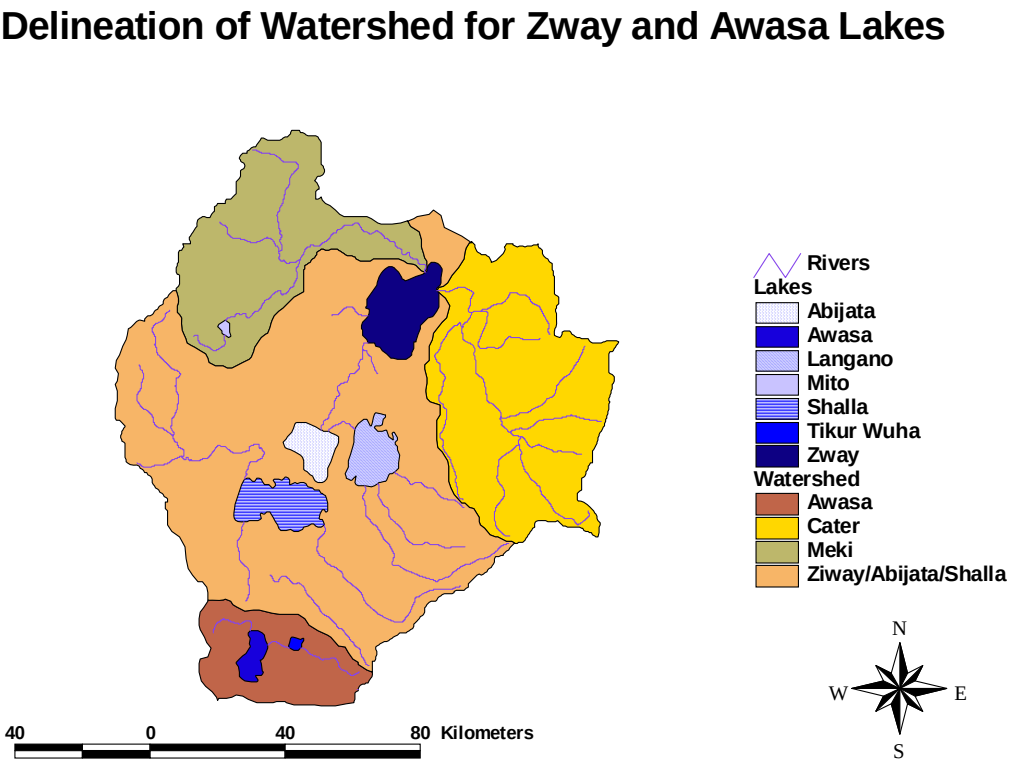
The success of SAP depends, among others, on the efficient performance of the PCU which is to be established anew and located at *Awasa*. Problem may be faced in finding experienced and highly educated (preferably tertiary level) staff in the market to man the PCU. The *Debub* University, which has demonstrated interests in the Rift Valley Lakes and conducted various studies, may be considered as fall back position when recruiting staff for the PCU proved difficult.

4.2. Delineation of SAP Project Area

The study team proposes the vicinities of Lake *Ziway* and watersheds of the two inflowing rivers as the geographic boundaries for SAP implementation. These delineated watersheds have an estimated total area of 5,833 km^2 ie, 2,433 km^2 (*Meki*) and 3,400 km^2 (*Katar*).

The watershed (Project area) are found in seven *weredas* of the *Oromiya* and Southern Regions. These are *Sodo and Meskan* and *Mareko Weredas* (*Gurage* zone), *Dugda Bora* and *Adami Tullu Jido Combolcha Weredas* (East *Shoa* zone) and *Ziway Dugda, Tiyo* and *Digehina Tijo Weredas* (*Arsi* Zone). The following map shows the geographic watershed areas of the Lake *Ziway*.

Fig 1. Watersheds of Lakes *Ziway* and *Awasa*: Proposed areas delineated for SAP Implementation



The watersheds of lake *Ziway*, shaded in dark yellow (*Katar* watershed) and light green (*Meki* watershed) at the upper parts of the map have strong influence on the Lake's biological and physical attributes. In the preparation of the project document, proper and detail study need to be carried out to specifically identify socio-economic and physical features affecting the natural resources in the micro watershed and determine relevant intervention measures. Silt coming from the threatened watershed areas of the two rivers is a grave concern in the rehabilitation of the lake's biodiversity..

Project Summary

Project Title:- Rehabilitation of Depleted *O. niloticus* Stock

Rationale:- *Oreochromis niloticus* is one of the important fish species found in lake *Ziway*. Unfortunately it is also highly depleted fish species due, among others, to its high demand in the market. Despite selective fishing, its survival from extinction has been due to its resilience acquired from the high reproductive ability and short life span. However, we cannot rely on this inherent character to ensure biodiversity of this threatened species. Apart from the fishing practice, pollution, siltation and destruction the spawning grounds are factors threatening its continued survival. Hence identifying the type of measures to rehabilitate the species are appropriate and timely.

Goal:- The overall goal is to revive the fish biodiversity through the rehabilitation and conservation of the depleted *O. niloticus*;

Objectives

- To revive the fish biodiversity and the depleted *O. niloticus*;
- Devise and implement appropriate fisheries resources management regulation;
- Enhance awareness of users and promote participatory resource management.

Activities

- Control fishing effort, fishing area and season;
- Introduce and implement licensing for commercial fishers;
- Develope lake management plan and enhance regulation;
- Organize awareness raising and skill upgrading training programs to resource users;
- Strengthen professional capacity of fishery officers and extension workers;
- Undertake constant biological survey, data collection and analysis;
- Initiate, promote and support research projects.

Major Cost Components and Total Cost:- The major cost items in the 3-5 implementation years of the project are manpower; vehicle operating cost, material and equipment; training, skill upgrading and awareness creation programs and miscellaneous expenses. The total cost is estimated at Birr 1,345,500 (15% contingency included). The following table shows allocations for the respective cost category.

1	Manpower	300,000
2.	Material and Equipment	300,000
3	Training, Skill Upgrading and Awareness Creation	200,000
4	Operating Cost	300,000
5	Miscellaneous Expense	70,000
	Sub Total	**1,170,000**
6	Contingency (15%)	175,500
	Total	**1,345,500**

Output

- *O. niloticus* rehabilitated ensuring the sustainable biodiversity of its fauna;
- Only licensed and registered fishers work on the lake;
- Fishery regulations enforced and management system for the lake implemented;
- Users are trained and acquired better awareness on values of biodiversity;
- Fishery Data and biological information documented.

Benefits and Beneficiaries

- Conservation of fish biodiversity resources;
- Sustainable use of the resource;
- Contribute to food security and poverty reduction;
- Management Capacity of implementing agency upgraded;
- Fishing communities ensured sustainable income;
- Government agencies participating in the implementation;
- Fish (Tilapia) consumers at large.

Significance:- Significance of the project, implemented properly, include:

- Protection of Tilapia Habitat and increase in population;
- Management plan controlling fishing activity in breeding areas and/or at low seasons will be implemented; and
- The promotion of public awareness on resource conservation and sustainable use.

Implementation Strategy:- The strategy emphasizes on genuine participation of the fisherman and other stakeholders in the Fish industry. Consultations will be a priority with the fishermen and other community members on the importance of enforcing the Fishery Regulation and introducing and implementing the Fishery Management Plan on the Lake.

Organization and Management:- The project will be implemented under the *Oromiya* Fish Research Center. The Implementing Agency (IA) will make all required preparations to carry out the assessment and the rehabilitation activities. The participation of the Fishermen and others involved in the fish sector is crucial.

Anticipated Problems and Solutions:- Shortage of fund at project level, inadequate community awareness and cooperation from fishermen and community might not be forthcoming. The solutions lie in soliciting funds by approaching potential donors, Fishery Corporation and private operators who have interest for such ventures. Awareness creation through workshop and training and enforcement of Fish Regulations are important measures to ensure community cooperation.

Monitoring and Evaluation:- The monitoring activities will be done through established data collection system and periodical reporting based on developed objective indicators. The exercise serves the IA as a management tool to follow up effective resource (finance, time, manpower…) use and implementation of project activities as planned.

An external body will conduct evaluation with predetermined indicators, objective and timing. Communities/stakeholders will be encouraged to participate in the reporting, monitoring and evaluation activities.

Logical Framework Matrix
Rehabilitation of Depleted *O. niloticus* Stock

Project Hierarchy	Performance Indicator	Means of Verification	Assumptions
1. Goal: Endangered fish biodiversity revived	High and sustainable yield Obtained	Catch data report	Lake management plan implemented
2. Purpose • Tilapia rehabilitated and higher yield achieved • Fishery and lake Management • Regulation enforced • Lake management plan introduced • Aquatic/lakeside ecosystem stabilized • Fishermen made environment conscious • Open access fishing controlled • Fishery biological/other data acquired	- Tilapia catch/availability increased - Fishing proved profitable - Lakeside attractive to visitors - Better concern for the environment - Revenue generated from Fishing increased - Lake management plan preparation achieved - Fishery data book prepared	- Survey/progress Report - Study Report - " " - " " - " " - Gov't Finance Report - Study Report	All project components implemented as planned
3. Output • Tilapia rehabilitation activity performed • Fishery regulations properly enforced • Lake management plan prepared and implemented • Registration and licensing of fishermen carried out • Environment awareness raising done to Fishers • Data/information collection planned and done	- xx tons/year catch achieved - Mgm't plan ready by end of year x - x # of fishery men trained, licensed - x awareness raising sessions done - Data compiled made ready by 200x	- Survey/progress Report - Progress Report - " " - " " - Study Report	Participation of people, organizations, etc, during implementation and support to project forthcoming
4. Activity • Restriction of fishing in area and season • Preparation and implementation of Lake management plan • Enforcing fishery regulations • Developing criteria and carrying out registration • Organizing and conducting awareness raising program • Design method and collect fishery/biological data	- xx Br for labor, material, etc - xx Br for Manpower, facility, etc, - xx Br for manpower/material, etc, -xx Br training, workshop, etc, - xx Br for material, training etc,	- Project Prog/Fin. Report - " " " - " " " - " " " - " " "	Required manpower, finance, etc available on time

Project Summary

Project Title:- Evaluation and Impact Assessment of Introduced Alien Fish Species

Rationale:- *Oreochromis niloticus* was the main indigenous fish species in Lake *Ziway* constituting over 90% of the commercial catch. Recently, however, other species like the carps and catfish were introduced in the lake. Subsequently there has been observation of change in species composition with the tilapia catch continuously declining and the carp and catfish becoming more and more important. Apparently the introduction of these alien fish species did not consider the long-term impact on the fish productivity and the biodiversity of the lake. It is now found necessary to study this impact to understand the aquatic biological processes, to formulate management program and consider such impact study for similar future interventions in other aquatic systems.

Goal:- understanding the influence of the introduced fish species for better management of the aquatic fish biodiversity and the lake ecosystem.

Objective

- To assess the impact of introduced alien fish species on *O. niloticus*
- To understand the biological processes of the aquatic productivity

Activities

- Assign high level researchers – Fishery biologists, limnologists and technical assistants;
- Plan detail research program;
- Prepare required laboratory facilities;
- Design appropriate sampling method and equipments;
- Undertake the research to identify and describe the processes;
- Provide recommendations on better management of the fish in the Lake.

Major Cost Components and Total Cost:- The major cost items in the three implementation years of the project are manpower; vehicle operating cost, material and equipment; training, skill upgrading and awareness creation and miscellaneous expenses. The total cost is estimated at Birr 1,805,000 (15% contingency included). The following table shows allocation for the respective cost category

1	Manpower	300,000
2	Material and Equipment	400,000
3	Training and Skill Upgrading	700,000
4	Operating cost	100,000
5	Miscellaneous Expenses	70,000
	Sub Total	**1,570,000**
6	Contingency (15%)	235,000
	Total	**1,805,000**

Output

- Impacts of alien species identified, explained and documented;
- Appropriate recommendation on fishery development obtained;
- Research capacity of the center and its staff strengthened;
- Useful lessons learned for future interventions.

Benefits and Beneficiaries

Benefits

- Research institutions benefits from higher level researchers capacity;
- Proper lake management plan and implementation;
- Maintenance of *O. niloticus* and higher yield of ecosystems.

Beneficiaries

- Users of the lake resources;
- Development planners and management body;
- Researchers

Critical Assumption:-

- Two PhD programs, which will be linked to the objectives of the research, will be implemented

Implementation Strategy:- The strategy emphasizes on genuine participation of the fisherman and other stakeholders in the Fish industry. Consultations will be a priority with the fishermen and other community members on the importance of enforcing the Fishery Regulation and introducing and implementing the Fishery Management Plan on the Lake.

Organization and Management:- The project will be implemented under the Oromiya Fish Research Center. The Implementing Agency (IA) will make all required preparations to carry out the assessment. The other institutions like the IBCR and EPA will collaborate in the project implementation and financial support.

Anticipated Problems and Solutions:- Shortage of fund and finding senor researchers (PhD) can be a problem. The solutions lie on soliciting fund from donors, the government, private operators and Fishery Corporation who may finance the initiatives. The senior researchers one in fishery biology and the second on limnology would be looked for at higher learning institutions or research organization.

Monitoring and Evaluation:- The monitoring activities will be done through established data collection system and periodical reporting based on developed objective indicators. The exercise serves the IA as a management tool to follow up effective resource (finance, time, manpower…) use and implementation of project activities as planned.

An external body will conduct evaluation with predetermined indicators, objective and timing. Communities/stakeholders will be encouraged to participate in the reporting, monitoring and evaluation activities.

Logical Framework Matrix
Evaluation and Impact Assessment of Introduced Alien Fish Species in Lake *Ziway*

Project Hierarchy	Performance Indicator	Means of Verification	Assumptions
1. Goal: Ecology of most demanded fish species maintained	Demanded fish sp. availability increased	Study Report	Project components implemented
2. Purpose • Impact of alien fish species known. • Tilapia protection strategy identified • Researchers capacity enhanced • Knowledge for future intervention acquired • Influence of alien sp. on Tilapia reduced • Tilapia management plan prepared and implemented	- Alien sp. Impact adequately known - Size, number per catch increased - High quality research conducted on time - Research findings documented - Tilapia stock level raised and sustained - Management plan prepared timely	- Monitoring Study Report - " " " - Comment on research doc - Research Reports - Study Report - Progress report	All project components implemented as planned
3. Output • Evaluation of catfish/carp impact on Tilapia done • Tilapia enhancement strategy developed • The evaluation study made participatory • Tilapia management plan preparation done • Alien species controled	- x # of Surveys/year conducted - Strategy made ready by 200xx - xx researcher, xx fields participated - Management plan ready by 200xx - xx/year control activity performed	- Finalized Study Report - Progress report - " " - " " - " "	Participation of people, organizations, etc, during implementation and support to project forthcoming
4. Activity • Assign researchers • Purchase study facility/requirement • Design methodology and undertake the study • Develop criteria/strategy for Tilapia enhancement • Devise mechanism to protect Tilapia from alien fish sp. • Facilitate provide training on fishing techniques	- xx Br for Manpower, facility, - xx Br for Manpower, material, etc, - xx Br for study, material etc - xx Br for study, material etc, - xx Br training, workshop, etc,	- Project Prog/Fin. Report - " " " - " " " - " " " - " " "	Required manpower, finance, etc available on time

Project Summary

Project Title: Integrated Watershed Management

Rationale: Management of a lake, which acts as an environmental indicator, is very difficult as it requires resolution of important technological, financial and institutional issues and support from both the government and local communities. Innovative lake management requires partnership and integrated watershed management approach, holistic perspective and sustainable use of its resources. These resources, which possess immense socio-economic, scientific and cultural values, are threatened due to sedimentation, and encroachment which resulted in "disturbed lake" in dire need of management. Therefore, "integrated watershed management project" is vital to deal with issues of restoration of lake water quality and quantity reduction of sediment load, eco-zoning/buffer zone development and rehabilitation and conservation of aquatic biodiversity.

Goal:-The overall goal is to rehabilitate and conserve the Lake *Ziway* watershed area, its biodiversity and aquatic ecosystem.

Objectives:- The Objectives of the Project are include;

- To minimize pressure on the biodiversity of the Lake and its surrounding through creation of alternative livelihood for the local communities;
- To improve the conservation and development of biodiversity of the Lake's ecosystem through development of "management plan" for the Acacia woodland and forests found on the watershed areas;
- To help local communities produce different tree, fruit and grass species to meet their needs for food, wood, fodder and other services;
- To undertake different soil and water conservation measures to minimize soil erosion and siltation of the lake;
- To create awareness and build capacity on biodiversity conservation and environmental protection of the local communities and the government staff;
- To demarcate and rehabilitate the buffer zone of the lake.

Project Components:- There are two major activities or components in the implementation of the Project.

1. SWC afforestation and Reduction of sediment load
2. Buffer Zone demarcation and development

Planned Activities to be performed in the **reduction of sediment load** include:

- Rehabilitation of degraded land through reforestation and area closure;
- Promotion of agro-forestry to minimize pressure on remaining vegetation;
- Income diversification for the local communities to minimize their dependency on agriculture;
- Awareness creation and capacity building;
- Introduction of improved agricultural technologies for sustainable agricultural production and biodiversity conservation; and

- Build capacity both materially (finance,..) and skill wise (know how).

Planned Activities to be performed in **buffer zone development** include:

- Conduct detail participatory study on biophysical and socio-economic of the buffer zones;
- Create awareness on biodiversity conservation and development, and objective of buffer zone development objectives;
- Demarcation of buffer zone between 150m and 350m in the urban and rural sides, respectively[9];
- Selection of appropriate interventions to benefit both the local communities and the biodiversity of the lake aquatic eco-system.

Outcomes:- Major outcomes of the planned activities of the two components are:

- Lake protected from sedimentation and aquatic ecosystem stabilized sustainabily ensured.
- Stock of the woodland improved through area closure and natural regeneration;
- Proper watershed and lakeshore management plans implemented;
- Improved pasture production and utilization ensured;
- Income generation through conservation related activities promoted;
- Alternate livelihood of the local communities introduced and living conditions improved;
- Non-agriculture activities, including eco-tourism, encouraged,
- Lakeside demarcation effected, buffer zone established and properly managed;
- Enrichment planting of the buffer zone with appropriate trees species undertaken;
- Breeding, roosting and feeding habitats for fishes/birds rehabilitated and protected;
- Flood caused gullies reclaimed and gully formation processes halted;
- Displaced farmers from within the demarcated buffer zone conveniently relocated.
- Toward end of the project life, some of the pioneers and climax vegetations established;

[9] According to A. Ebregt and P.D. Greve (200), the preferred size of a buffer zone is variable, depending on the objectives, availability of land, traditional land use systems, threats and opportunities. From the ecological point of view, the larger the buffer zone the more it can be seen as an extension of protected area, the better for the conservation area and its biodiversity, including natural processes. For example migrating species normally demand large areas, Cronies, a very old system of wild duck harvesting in Europe, has a core zone (a pond surrounding by dense vegetation) and around this core a buffer zone of 500 meters or more wide in which agriculture (mainly grazing is allowed, but no people.

Based on IUCN Conservation guidelines of 1995b, P. Shrestha (---), also proposed that 10-30 m strip of land along the lake shorelines and next 90m is recommended for buffer zone and controlled development zone with horticultural/agro-forestry activities respectively. IUCN (2004) also recommended a coastal no-build zone of 100-200m for Sri Lanka after the Tsunami to protect the environment of the seashores.

Therefore, based on the observation of the expertise and discussion made with few farmers, the buffer zone size of 150-300m was recommended for Lakes *Awasa/Ziway*, based on land use type, slope and socio-economic situation of the areas. The boundaries of the buffer zone will be determined with local communities and other stakeholders, after thorough study, to ensure sustainability of the buffer zone.

Output:- Major outputs of the project outcome are:

- As a result of vegetation cover, improved land management and prohibition of farming the lakeside, siltation into the Lake reduced;
- At least 50% of the degraded woodlands and steep slopes in the watershed are enclosed for rehabilitation;
- Most woodland is rehabilitated through enrichment planting;
- Women from households engaged in income generation scheme to reduce dependency on forest resources;
- Agro-forestry promoted and households incomes improved;
- Farmers and government staff trained in natural resources conservation and development;
- Based on the land use system, topography and sensitivity of the ecosystem, 150 to 350 meter wide buffer zone is demarcated for vegetation and grass to protect the Lake from sediments;
- Climax vegetation enrichment planting effected at different sites with appropriate tree seedlings;
- Establishment of pioneer vegetation in all the lakeside areas ensured;
- Threatened habitats rehabilitated and protected for breeding, feeding and roosting;
- Gullies reclaimed through physical and biological conservation measures;
- Required relocation arrangements of displaced farmers from the Lakeside done.

Project Benefits:- The benefit expected of the project are:

- Restoration of fish and bird habitats for roosting, feeding and breeding;
- Reduction of siltation in to the Lake and maintaining volume of water body:
- Creation of employment opportunities to participating farmers, etc,;
- Stabilization of the Lake's ecological imbalance and its surroundings;
- Rehabilitation/restoration of tourist attractants and promotion of eco-tourism;
- Sustainable utilization of high quality fodder.

Major Cost Components and Total Cost:- The major cost items in the ten implementation years of the project are manpower; vehicle operating cost, material and equipment; training, skill upgrading and awareness creation, seedling production, relocation and miscellaneous expenses. The total cost is estimated at Birr 8,636,500 (15% contingency included). The following table elaborates the cost categories.

1.	Manpower	600,000
2.	Vehicle operating cost	450,000
3.	Technical equipments and office materials	200,000
4.	Nursery tools, establishment and maintenance cost	60,000
5.	Seedlings production cost	2,000,000
6.	Training, awareness creation & resources assessment	700,000
7.	Social development support and promotion	500,000
8.	Relocation costs	2,500,000
9.	Vegetation management plan preparation and Implementation follow-up cost	500,000
	Sub Total	**7,510,000**
10.	Contingency (15%)	1,126,500
	Total	**8,636,500**

Significance:- Significance of the project, implemented properly, include:

- Reduction of silt and sedimentation into the lake;
- Reduction in over exploitation of forest resources;
- Increase the biomass supply and habitat protection for wildlife and birds;
- Conservation of forest/green vegetation and control of their degradation;
- Control of land degradation and promotion the woodland;
- Restoration of the breeding, feeding and roosting sites of fishes/birds;
- Increased attractiveness of the area to tourists;

Implementing Strategy:- The strategy emphasizes on genuine participation of the farmers in the watershed, fisherman and other stakeholders in the lakeside. Consultations with community members is necessary on the importance of watershed development, demarcation of buffer zone and protecting the ecosystem from degradation. The Zonal/*Wereda* Natural Resources Development Department takes the lead role in awareness creation, etc. Farmers will be trained in appropriate watershed and lakeside management and related skills.

Institutional Arrangement:- The Zonal/*Wereda* Natural Resources Development Department working with Farmers and Associations and the relevant government authorities will implement the project. The Department (ie, IA), on technical matters is accountable directly to the PCU. The project document should elaborate the IA's authorities on matters of financial and other resources of the project.

Organization and Management:- The project will be implemented under the Zonal/*Wereda* Natural Resources Development Department (Z/WNRDD) which is known here as Implementing Agency (IA). The department will carry out all implementation activities under the technical guidance of the PCU at *Awasa*. Cooperation of individual farmers cultivating in the watershed, the Municipality and other relevant government and non-government organizations is vital during the planning and implementation phases.

Anticipated Problems, Environmental Impacts and Mitigations:- The anticipated problems are shortage of finance and farmers' intrusion into the lake's shores. Soliciting donors, NGOs and the Government can solve the financial shortage. Raising community awareness through workshop and training, demarcating the buffer zone based on the land use system, topography and sensitivity of the ecosystem, can solve problems regarding farmers and environmental impacts.

Monitoring and Evaluation:- The monitoring activities will be done through established data collection system and periodical reporting based on developed objective indicators. The exercise serves the IA as a management tool to follow up effective resource (finance, time, manpower…) use and implementation of project activities as planned.

An external body will conduct evaluation with predetermined indicators, objective and timing. Communities/stakeholders will be encouraged to participate in the reporting, monitoring and evaluation activities.

Logical Framework Matrix
Integrated Watershed Management (SWC afforestation Reduction of Sediment Load)

Project Hierarchy	Performance Indicator	Means of Verification	Assumptions
1. Goal: S & W C activities performed and ecology/biodiversity maintained	Natural resources rehabilitation and development achieved	Study Report	Project components implemented
2. Purpose • Watershed areas rehabilitated • Woodland stock improved • Management plan implemented • Non-agri activities promoted • Eco-tourism promoted • Siltation reduced • Aquatic ecosystem sustained • Pasture/crop production improved	- Adequate Plantation SWC carried out - Planting of undertaken appropriate tree sp. - Mgm't plan preparation Study done - Credit provided for Non-Agri. IGS - Improved Land management practised - Technology packages provided	- Progress report - " " - " " - " " - Study Report - " "	All project components implemented as planned
3. Output • Planting/SWC activities on watershed done • Rehabilitation of woodlands/steep slops done and SWC covered area • Enrichment planting on high/low land carried out • Facilitation of IGS to HHs completed • Agro-forestry promotional activities performed. • Preparation of management plan completed	- xx tree planted, xx Km SWC structures built - x # of tree species planted on slops, etc, - xx trees in low land, xx trees high land planted - x # of HHs got credits to start IGS - xx HHs given training on Agro-forestry, etc… - Management plan finalized by 200x	- Progress report - " " - " " - " " - " " - " "	Participation people, organizations, etc, in and support to project implementation forthcoming
4. Activity • Enclose degraded catchments and cut-and-carry • Support/raise seedlings for enrichment planting • Select appropriate tree species • Provide support for agro-forestry promotion and SWC • Promotion non-agriculture IGS activities • Train of farmers and government staff	- xx Br for Manpower, facility, - xx Br labor, material, etc, expenditures - xx Br for Labor, material, etc, - xx Br for IGS, Agro-forestry, material etc, - xx Br for equipment, material, etc - xx Br for training, workshop, material, etc,	- Project Prog/Fin. Rep. - " " " - " " " - " " " - " " " - " " "	Required manpower, finance, etc, available on time

Logical Framework Matrix
Integrated Watershed Management (Buffer Zone Development)

Project Hierarchy	Performance Indicator	Means of Verification	Assumptions
1. Goal: Buffer zone rehabilitated and biodiversity conserved	-Ecological stabilization Achieved	Fishes/birds abundance	Project implemented
2. Purpose • Buffer zone established, Lakeside rehabilitated • Pioneers and climax vegetations established • Lake shore farming controlled, gullies reclaimed • Fishes/birds habitat rehabilitated • Farmers from lakesides relocated	- Buffer zone demarcated - Vegetation coverage increased - Farming stopped within the buffer zone - Fishes/birds encountered easily - HHs relocated live better	- Survey Report - Survey/progress Report - Progress Report - Survey/progress Report - Survey/progress Report	All project components implemented as planned
3. Output • Buffer zone demarcation as per recommendation done • Pioneer/climax vegetation establishment undertaken • Lakeside farming prohibition effected • Lost feeding,. habitats restoration activities done • Gullies reclamation activities carried out • Relocating the displaced carried out	- 150-350 m marked as buffer zone - x # seedlings of tree sp. raised - xx trees Planted - Buffer zone protected by community arranged guarding system - #, type of birds, increased by x% - xx Km Check dams, COD, etc, constructed - x # of Displaced people relocated	- Survey/progress Report - " " " - " " " - " " " - " " " - " " "	Participation of people, organizations, etc, during implementation and support to project forthcoming
4. Activity • Raise community awareness on lake shore buffering • Demarcate buffer zone at appropriate distance • Identify needs of those to be relocated • Undertake relocation activities • Support private seedling production schemes for sale • Construct physical/biological SWC structures	- xx Br for training and awareness raising, etc, - xx Br for manpower, etc - xx Br for need assessment - xx Br for Relocation, etc - xx Br for seedling raising, etc, - xx Br for labor, material, etc	- Project Prog/Fin. Report - " " " - " " " - " " " - " " "	Required manpower, finance, etc available on time

Project Summary

Project Title:- Eco-Tourism Promotion

Rationale:- The mode of life and culture of the *Oromo* people around the lake, the monasteries located at different islands, the uniqueness of the language of the *zay* community and the design of their houses, the presence of especially large number of aquatic birds, some mammals and reptiles are good attractions to tourists. The conservation of these cultural heritages and natural attractions warrants eco-tourism activities for income generation to the community the sustainable use of the resources.

Goal:- The overall goal is to improve community incomes through eco-tourism

Objectives:- The objectives of the project are to:-

- Conserve the cultural and traditional heritages of the *Oromo* people around the lake and especially those of the *Zay* people at the islands;
- Decrease the loss of breeding sites for wildlife and birds;
- Protect wildlife and bird feeding habitat;
- Increase the diversity and species of wildlife and birds;
- Identify and develop tourist facilities to create employment opportunities and generate income.

Outcome:- Major outcomes of the planned project activities are:

- Adequate efforts made to rehabilitate tourist attraction sites;
- Training provided to tour guides and awareness of community members raised;
- Required support given to individuals engaged in handcraft production and selling;
- Support given to build and open shops for handicraft and tourist articles;
- Support given to local boatmen to acquire motorized boat to ensure safe transport of Tourists to the islands;
- All engaged in eco-tourism promote the protection and conservation of the lake and its buffer zone biodiversity;
- Data and information collected and compiled on lake's and islands eco-tourism resources.

Outputs:- Major outputs of the project outcomes are:

- Lakeside birds habitat, the monasteries and wildlife sites identified and rehabilitated;
- Training provided to selected members of the community to work as professional tour guide;
- Awareness of community raised to care for natural resources and cultural heritages to ensure sustained services to tourists;
- Handcrafting skills upgraded on pottery, tannery, etc,;
- Seed money committed to initiate handicraft making and proceeds revolved;
- 1-2 in each island and 3-5 handicraft shops in *Ziway* town established and supported;
- Three motorized boats each with a capacity of 10-15 passengers procured;

- Biodiversity of the lake/islands protected for eco-tourism purposes;
- Informative booklet with facts and figures for tourists published.

Planned Activities:- The major activities to be performed are:

- Listing tourist attractions by appropriate category (site, cultural objects, etc) and undertaking rehabilitation and conservation measures;
- Conducting training, skill upgrading and awareness raising programs to tourist guides and handicrafts people and communities in the islands and *Ziway* town and other communities around the Lake;
- Availing, on credit terms, money for raw material purchase and other required equipment for making handicrafts;
- Supporting the design and construction of low cost handicraft shops in the three islands (3-6) and *Ziway* town (3-5);
- Preparing the specification and procurement guideline and advertise for competitive bidding to procure the 3 motorized boats;
- Recruiting professionals to prepare and publish the Tourist Information Booklets.

Benefits:- The benefits to be obtained include:

- Benefit sharing and increased employment opportunity;
- Generate alternative source of income other than farming;
- Promotion of local crafts of tourist interests;
- Conservation and protection of cultural artifacts and natural attractions;
- Promotion of biodiversity resources conservation and their sustainable use;
- Conservation/protection of birds/wildlife habitat and tourist attraction sites;
- Preservation of cultural, historical and natural attractions at the islands;
- Creation of employment opportunities and income generation for community;
- Promotion of tourism activities such as tour operation, souvenir shops, campsites and cultural events;
- Acquiring knowledge and experience on eco-tourism.

Major Cost Components and Total Cost:- The major cost items in the implementation of the project are manpower; material and equipment; training, skill upgrading and awareness creation and surveys and studies. The total cost is estimate including 15% contingency stands at Birr 1,552,500.

1.	Manpower	250,000
2.	Material and Equipment	600,000
3.	Training, Skill Upgrading and Awareness Creation	250,000
4.	Surveys and Studies	150,000
5.	Miscellaneous Expense	100,000
	Sub Total	**1,350,000**
6.	Contingency (15%)	202,500
	Total	**1,552,500**

Implementation Strategy:- The strategy emphasizes on genuine participation of the community in all phases of the program. Community empowerment to enhance their roles in the protection, conservation and development of tourist attractions sites in the area; and orienting all activities toward income-generation. The project conducts training to raise awareness and skill and provides material which the community lacks.

Institutional Arrangement: The project-implementing agency (IA) is the Zonal/*Wereda* Trade, Transport and Tourism Department (Z/WTTTD). On matters of lakeside development and conservation, the Zonal Natural Resources Development Department is expected to provide technical support. The IA is responsible directly to the Project Coordination Unit on technical matters. The project document should elaborate the IA's authority on financial and other resources management and administration.

Organization and Management:- The project will be implemented under the Zonal/*Wereda* Trade, Transport and Tourism Department (Z/WTTTD) and the community organized in different societies such as "boat renters", "souvenir sellers" and "guides". The Implementing Agency (IA) will provide all material and guidance required during implementation.

Anticipated Problems, Environmental Impacts and Mitigations:- Shortage of fund at project level, lakeshore encroachment and inadequate communities awareness about eco-tourism are anticipated problems. Donors interested in such activities may be eager to finance such initiatives. Moreover, funds for community members may be sought from micro-finance institutions and other credit services providers. Buffer zone demarcation and enforcement, conservation and preservation of natural attractions are made easy by awareness creation through workshop and training.

Monitoring and Evaluation:- The monitoring activities will be done through established data collection system and periodical reporting based on developed and objective indicators. The exercise serves the IA as a management tool to follow up effective resource (finance, time, manpower…) use and implementation of project activities as planned.

An external body will conduct evaluation with predetermined indicators, objective and timing. Communities/stakeholders will be encouraged to participate in the reporting, monitoring and evaluation activities.

Logical Framework Matrix
Eco-tourism Promotion

Project Hierarchy	Performance Indicator	Means of Verification	Assumptions
1. Goal: Community annual income improved	Community life improved	- HH Income Study	Proj. Components valid
2. Purpose • Tourist attraction sites identified/rehabilitated • Tour guides trained, community awareness raised • Handcrafts producers supported • Handicraft/tourist articles shops opened • Motorized boat acquired and started services • Lake biodiversity protected/conserved • Data/information on eco-tourism compiled and published	- Number/category known - Training provided - Support to HCs people given - Article shops built - Motorized boat on service - Lake shore revegetated - xx leaflets printed	- Project progress report - " " " - " " " - " " " - Assessment study Rpt. - Leaflets in store/distrb	All project components implemented as planned
3. Output • Identification of tourist attraction sites done • Training to Tour guides conducted • Community awareness raising on tourism conducted • Support to handicraft producers identified and extended • Handicraft shops designed and built • Motorized boats procured • Lakeside biodiversity rehabilitated • Informative booklet published	- x # of sites identified - x # of tour Guide trained - x # of many People awareness raised - Type/amount of sup.Rpt - xx many shops opened - xx boats on service - Report submitted - xx Leaflets printed	- Sites visited - Trained Guide on serv. - People active in protec. - More/better HC prod. - Visits to the shops - Boats inspected if as per specification - Project progress report - Leaflets distributed	Participation of people, organizations, etc, during implementation and support to project forthcoming
4. Activity • Conduct study to identify tourist attraction sites • Carry out rehabilitation measures on tourist attractions • Organize/conduct training and awareness raising programs • Design and construct low cost handicraft shops • Provide seed money to handcraft producers • Specify and procure motorized boats • Recruit professionals to prepare and publish information booklets	- xx Br for traveling, etc - xx Br for rehabilitation,. - xx Br for training, etc.. - xx Br fro construction - xx Br for support - xx Br For boat Purchase - xx Br for professional	- Project prog/Fin.report - " " " - " " " - " " " - " " " - " " " - " " "	Required manpower, finance, etc available on time

Project Summary

Project Title:- Natural Resources and Socio-Economic Baseline Study

Rationale:- Current state of degradation of the natural resources and the socio-economic conditions of the people inhabiting SAP implementation areas are not known. Meaningful assessment of SAP achievements cannot be made without comparisons between conditions before and after the project. Thus, the baseline survey study will provide realistic baseline data on the extent to which the natural resources are degraded and the conditions of socio-economic factors influencing them.

Goal:- The overall goal is benchmarking of the natural and socio-economic conditions of the SAP implementation areas.

Objectives:- Major objectives of the baseline survey are to:-

- Identify all natural resources in appropriate category;
- Identify social, cultural and economic factors influencing the lake's biodiversity;
- Tabulate quantified data/information as a benchmark; and
- Indicate the extent of natural resources degradation in the vicinities of the Lake and watersheds areas of the two incoming rivers.

Outcome:- Major outcomes of the survey are:

- Detailed information/data on natural resources;
- Quantified data on extent of resource degradation;
- Quantified data on type of threats to biodiversity;
- Data on existing social, cultural and economic conditions of the population;
- Appropriate indicators are developed for variables.

Outputs:- Outputs of the project outcomes are:

- Baseline data on natural resources under appropriate category compiled;
- Data on socio-economic activities and variables showing people's situations established;
- The extent of biodiversity loss on agreed upon categories recorded; and
- Objective assessment of project achievements facilitated.

Activities:- Major activities to be performed are:

- Prepare terms of reference detailing activities to be performed and modalities of performing them; and
- Agree on the subject/are coverage by the survey.
- Design/agree upon the methodology of undertaking the survey;
- Identify recruit required Firm for the survey;

Total Cost:- The cost of the consultancy to undertake the survey is estimated at birr 1,200,000. This includes professional fee, support staff salary, logistics, materials and equipment, publication and government taxes.

Implementation Strategy:- For lack of adequate time and/or expertise to undertake the survey within the IA or PCU, it is proposed that the task is contracted out to a competent consulting firm. The IA's, however, should benefit from the exercise by assigning its staff to work with the consultants.

Organization and Management:- This will be limited to managing the contract agreement with the consulting firm. Adequate monitoring of the survey activities need to be made to ensure the data collection and compilation are done professionally.

V. INSTITUTIONAL ARRANGEMENTS

Neither identification of root causes of ecosystem disturbances and preparation of appropriate intervention plan nor availability of financial resources alone will reverse the loss of habitat and biodiversity. Timely and effective implementation of SAP components are important. Critical in this process are addressing problems of finding and assigning resources (manpower, material, etc…) to their efficient use and ensuring proper follow up toward achieving SAP's goals. These processes, above all, require a well thought organizational structure and adequate institutional arrangement.

5.1. Proposed Organizational Structure and Responsibilities

The proposed institutional arrangements for the implementation of SAP components are (i) establishment of a small Project Coordination Unit (PCU), (ii) assigning as Implementing Agencies (IAs) relevant zonal/*wereda* level government sector offices, (iii) forming an Inter-regional Project Steering Committee (IPSC), and (iv) ensuring the participation of Community Based Organizations (CBOs) and the community. This proposal is based on four considerations, viz, cost effectiveness, organizational slimness, capacity building and promoting community involvement.

Cost Effective

Involving competent government sector offices as implementing agency, not only reduces organizational costs but also minimizes the time required to set up new institution. Cooperation of the IA among government, non-government and community based organizations as well as the community at large is indispensable in the implementation of the planned activities

Project Coordination Unit

A small with all required resources, authority and independence will be established to provide technical guidance and coordination in project implementation, monitoring and evaluation. The Unit will be staffed by 3 highly experienced professional core staff (MSc and above) consisting of (i) Environmentalist, (ii) Forester/SWC Expert and (iii) Agricultural Economist. Coordinated by the Environmentalist, the Team will be supported by an executive secretary and other small number of support staff.

The Unit is proposed to be established at *Awasa* where, in addition to its proximity to the two lakes, economic and technological facilities and services required are better available than in *Ziway*. Moreover, the social amenities and economic facilities are incentives to attract the highly qualified staff for the Unit.

In case of difficulty in finding PCU professionals at that level of education and experience in the open market, *Debub* University may be considered a potential fall back option. The fact that many staff of the university have worked and are still working on researches related to the conservation and development aspects of the Rift Valley Lakes, make it easier to assign the University for coordination and technical guidance in the SAP

implementation. But this requires detail planning and understanding of required activities to ensure benefit and avoid unnecessary burden to the University.

Capacity Building

As components of SAP will be implemented by the appropriate government sector offices individually (or jointly as may be required), capacity of these offices will be strengthened through transfer of technology (management, etc…) and/or equipping them with material resources. Financial support, technical back up and provision of skill upgrading training will improve the implementation capacity of the staff of the selected IAs.

Inter-regional Project Steering Committee (IPSC)

To facilitate smooth implementation of project activities in the two lakes, which are found in the *Oromiya* National Regional State and the SNNPR, the setting up of Inter-Regional Steering Committee (IRSC) is proposed. The committee will work with PCU especially in policy harmonization, initiation or resolving implementation hurdles that may require joint action. CBOs and Community members that may be affected or contribute to the SAP need to be identified and modalities of their participation (from document preparation through implementation and follow up) worked out.

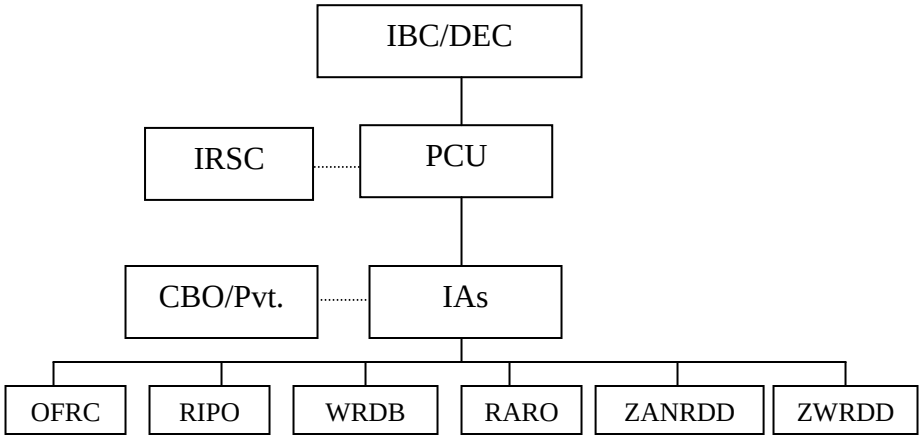
Detailed responsibilities of the PCU, IPSC and the respective IA as well as the terms of reference for each staff needs to be prepared with the SAP project document.

Proposed Organizational Structure

According to the proposed organization structure, the PCU is suggested to be accountable to the Department of Ecosystem Conservation (DEC) of the IBC for all technical matters. The IBC, which is accountable to the National Biodiversity Framework (NBF) whose national focal point is the MoARD has the overall responsibility for the implementation of SAP.

The IAs will be directly responsible to the PCU on matters related to the project activities while the PCU works collaboratively with IPSC on issues that require interpretation of policy related issues as does the IA with CBO and communities. The organizational structure proposed for SAP implementation is shown below.

Fig 2. Proposed Organizational Structure for Implementation of SAP Components, *Ziway*



Some of the institutions identified as potential partners in implementation with anticipated areas of participation and support are shown below. They are categorized under (a) government local authorities at *wereda*, regional, Federal levels, (b) NGOs operating in the area, (c) particularly Research and University (d) community members and community based organizations and (e) private operators.

5.1.1. Federal/Regional Government Agencies

Some of the government institutions at federal level in providing technical assistance during the planning and implementation stages include (i) Institute for Biodiversity Conservation (IBC), (ii) Environmental Protection Authority (EPA), (iii) Wildlife Conservation Department of MoARD, (iv) Ministry of Water Resource Development (MoWD) and (iv) Addis Ababa and *Debub* Universities.

5.1.2. NGOs, Projects and Other Societies

NGOs and projects operating in *Ziway* and societies that have interest in components of the SAP may have roles in experience sharing, networking and funding. Some of the known NGOs, projects and Societies include (i) *Selam* Environmental Development Association (SEDA), (ii) Rift Valley Children and Women Development Association (RCWDA), (iii) GTZ, CRS/USA, Oxfam/UK and Save the Children UK, (iv) Ethiopian Wetlands Research Project (EWRP) and (v) Ethiopian Wildlife and Natural History Society (EWNHS).

5.1.3. Community and CBOs Participation

Local communities are dependent on the Lake and its watersheds for fishing, food production, grazing, fuelwood and construction materials and other income generation purposes. They all are affected, directly or indirectly, by the implementation of components of the SAP. Therefore, their involvement as community or members of CBO such as Cooperative Societies (Fishery, irrigation, multipurpose, etc,) and *Kebele*

Associations (Peasant, Youth and Women's) in all the activities of SAP is crucial for the conservation and development of the lake's ecosystem. Mechanisms of benefit and responsibility sharing with the community have to be designed during preparation of the project document.

5.1.4. Private Operators

Conservation of the natural resources cannot be left to certain groups or the government alone. Private investors who are undertaking such activities as irrigated farming, fishing and other related operations on the Lake and its surroundings are stakeholders in the development and sustainable use of the resources. It is, therefore, considered necessary to involve these groups in the SAP planning and implementation phases.

5.1.5. Assistance/Cooperation Expected from Other Organizations

Assistances/cooperation expected of organizations that are not mentioned in the above category are many. Important institutions that can be considered during the implementation and the follow up phases are listed down below with their respective areas of possible cooperation.

1. ***Municipality/City Administration:-*** Controlling pollution, implementing lakeshore buffering from the urban side and enforcing pollutant pay principle.
2. ***The East Shewa Zonal and Ziway-Dugeda Wereda Councils:-*** Supporting moves toward proper and economic use of lake water, determine and enforce rate of "water charges" and reutilize the proceed for the lake's safety".
3. ***Department of Education:-*** Assists in awareness raising (through school curricula) and mobilization of students' labour in ditch making, and tree planting in the lake's watershed.
4. ***Department of Health:-*** Assists in Sanitary drainage arrangements and waste collection facilities, identifies disposal sites and advises on their treatment.
5. ***Tourism Office:-*** Maps out tourist and recreation areas and related activities to promote tourism.
6. ***Pesticide Factory:-*** Assists/supports periodical impact of the pesticide assessment study on the lake and its vicinities.
7. ***Caustic Soda Plant:-*** Assists in cleaning ash disposal from open yard and supervision of water quality.
8. ***Ziway State and Prison Farm and Private Investors:-*** Quantifies water in use, changes water use into drip application and participates in afforestation and soil and water conservation activities.
9. ***Abijata-Protected Areas:-*** Shares Experience and Coordinate biodiversity Protection activities with SAP management.
10. **Ziway Water Resource Office** – Water supply in Fish Research

5.2. Implementation and Coordination

The management and project implementation will be undertake by the relevant regional, zonal or *wereda* government agency believed appropriate and have relative competence. IAs and proposed partners are indicated for each component/project under the headings "Implementation Strategy", "Organization and Management" or "Institutional Arrangements". Modalities of cooperation with the different stakeholders such as the local government authorities, the community, NGOs, the private sector and other in the implementation are also detailed with each project above.

Project coordination in the two regions entirely rests on the PCU. It provides the required guidance and technical backstopping to ensure efficient implementation of project components. The PCU works closely with all concerned in the project areas and outside to mobilize the necessary support to the IAs especially from regional/zonal authorities.

5.3. Timing and Project Duration

The total duration for implementing SAP components in *Ziway* is 3-10 years. The PCU will be established 6 months earlier than the project is launched while the baseline survey conducted in the first year of the project. The implementing agencies for each project will be identified and necessary formalities finalized with their parent organizations with in those 6 months of PCU establishment.

5.4. Financial Costs and Financing

The financial costs of the five projects planned for Lake *Ziway*, its surroundings and watersheds are estimated at Birr 14,539,500 for the duration of 3-10 years. Major costs categories include 'manpower', 'material and equipment', 'training, skill upgrading and awareness creation', 'relocation costs', 'surveys and studies' and 'vehicles and operating costs'. The estimated financial costs of the proposed components are shown below.

Project Title	**Estimated Cost (Br)**
1. Rehabilitation of *O. niloticus* Stock	1,345,500
2. Evaluation and Impact Assessment of Introduced Alien Fish Species	1,805,000
3. Integrated Watershed Management	8,636,500
4. Eco-Tourism Promotion	1,552,500
5. Natural Resources and Socio-Economic Baseline Survey	1,200,000
Total	**14,539,500**

Initial financing of the project is anticipated from GEF with matching funds to be mobilized by the Government of Ethiopia. Participation of the community (up to 10%), NGOs, the private sector and other bilateral and multilateral donors in financing the project needs to be explored.

5.5. Project Sustainability

Depending on the type of components constituting the SAP, considerations ensuring the continuity of project activities after phasing out need to be made through smooth winding up procedures. Implementation modalities and strategies promoting effective resource management within the environmental and resource limits are necessary. Moreover, emphasis should be put on cost/benefit sharing among participating project partners.

Involving all stakeholders, particularly the local communities, in prioritizing project subcomponents and target setting should be emphased during documents preparation. Such participation clears, at the outset, the nature and extent of community contributions towards a smooth phasing out and sustainability of activities after SAP.

5.6. Monitoring and Evaluation

Monitoring is considered as a basic management tool toward efficiency and effectiveness in SAP implementation. The activity will be done through “standard data collection formats” and established “reporting systems”. It is coordinated and technically backed up by the PCU.

Monitoring is meant to follow up the effective resource (manpower, material, finance, etc,) use and implementation of project activities within the planned time. Reporting type and frequency (monthly, quarterly, bi-annual and annual) from the IA’s to the PCU and other stakeholders, such as the donors need to be specified.

Project documents will have developed ‘indicators’ that serve as a basis for project monitoring and evaluation. Stakeholders’ involvement in follow up activities is advantageous for realistic reporting. Monitoring surveys and studies will be conducted as required by the PCU and IAs management.

Evaluation will be conducted as part of project follow up with predetermined indicators, objectives and timing. The exercise, depending on the timing (Mid–term or Terminal), assesses the use of project resources in yielding social, economic and/or environmental impacts expected of its implementation.

REFERENCES

1. *Adami Tullu Wereda* Office of Agriculture and Natural Resource Development. 1993. '*Land Use Land Cover of Adami Tullu Wereda (Ziway)*'.
2. Anonymous. 2003. '*Adami Tullu-Jiddo Kombolcha Aanaa (District) Based Development Programme*'. *Oromiya* Economic Study Document. *Finfinne*.
3. Biodiversity Strategy and Action Plan (BSAP). 2004.
4. Biomass Land Evaluation Study. 2003.
5. Cairns M.A. and R. T. Lackey. 1992. '*Biodiversity and Management of Natural Resources: The Issues - Fisheries*'. A Bulletin of American Fisheries Society, Vol., 17, No. 3
6. Dereje Wako. 2004. '*Existing and Potential impacts of Human and Climate Changes on the Lake Ziway-Abijata Basin and its water systems*'.
7. Development Prospects in the Southern Rift Valley Ethiopia. Volume 2, Land
8. Donn, W.L. 1974. '*The Earth*'. New York
9. Dr. Elizabeth Kebede.
10. Ebregt, A, and Greve P.D. 2000. '*Buffer Zones and their Management Policy and Best Practices for Terresterial Ecosystems in Development Countries*'. International Agriculture Centre (IAC), Wageningen, the Netherlands.
11. Elias Dadebo. 2000. '*Fisheries Resources Potential and Challenges in the Rift Valley Lakes of Ethiopia*'.
12. Elias. 1998.
13. EWNHS. 1996. '*Important Bird Areas of Ethiopia*'. A First Inventory. Addis Ababa.
14. Fernando et. al. 1990.
15. Huffnngel, H.P. 1961. '*Agriculture in Ethiopia*'. Rome.
16. IBC. 2004. '*Biodiversity Strategy and Action Plan*'. Addis Ababa.
17. IBCR. 1999. '*Second National Workshop: Conservation and Sustainable use of Biodiversity in the Eastern Rift Valley Lakes, problem analysis and Synthesis*'. September 30th and October 1st, 1999. Addis Ababa, Ethiopia.
18. IBCR. 2000. '*National Report on conservation and sustainable use of biodiversity in RVL of Ethiopia: Problem analysis and syntheses*'. Addis Ababa, Ethiopia.
19. IUCN. 2004. '*Series in Best Practice Guideline (Sr; Lanke)*': After Tsunami where to reconstruct environmental issues.
20. LFDP Reports. 1994; 1997 & 1998. '*Working papers and quarterly technical reports*'.
21. Makin J., Kingham T., Waddams A., Birchal C. and Eavis B. 1976. '*Land Resources Study 26*'. Prospects for irrigation development around Lake *Ziway* Ethiopia
22. Mamo K., Tefera M., Demamu M., Zeleke E.,eds. 2004. '*Economic and Institutional Aspects of Forestry in Ethiopia*'. In Proceedings of a Workshop held at Wondo Genet College of Forestry, Ethiopia. 2003.
23. Mateos Mekiso. 2001. '*Report on Brief assessment of Ecosystem Performance in Meskel flower farm (near Lake Ziway)*'. EPA, Addis Ababa.
24. Meseret Wondimu. 1998. '*Rift Valley Lakes Basin Ecosystem: Identity, Gaps and Management Options*'. Addis Ababa.
25. Ministry of Agriculture. Sept. 2003. '*Fishery resources development and marketing plan (Amharic)*'.
26. MoWR. 1999. '*Water Resources Development and Constraints in the Rift Valley Lakes Basin*'.
27. Njuguna S. 2000. '*Conservation and Sustainable use of Biodiversity in the Eastern Rift Valley Lakes (Ethiopia, Kenya, Tanzania). Analysis and Synthesis Report*'. SPARVS Agency Ltd. Limuru, Kenya.
28. Oromiya Regional Proclamation No. 56/2002.
29. Proclamation No 300/2002. *Federal Negarrit Gazeta*.
30. Proclamation No 37/1996. *Federal Negarrit Gazeta*.
31. Proclamation No 416/1972. *Negarrit Gazeta*.
32. Proclamation No. 192/1980. *Federal Negarrit Gazeta*.
33. Proclamation No. 299/2002. *Federal Negarrit Gazeta*.
34. Proclamation No. 315/2003. *Federal Negarrit Gazeta*.
35. Proclamation No. 92/1994. *Federal Negarrit Gazeta*.
36. Proclamation No. 92/1995. *Federal Negarrit Gazeta*.
37. Proclamation No. 94/1994. *Federal Negarrit Gazeta*.

38. Roy H., Behnke Jr., Ian Scoones and Carol Kerven (eds.). 1993. '*Range Ecology at Disequilbrium. New Models of Natural Variability and Pastoral Adaptation in African Savannas*'. Overseas Development Institute.
39. Schroder, R. 1984. '*An attempt to estimate the fish stock of and sustainable yield of Lake Zewai and Lake Abaya, Ethiopian Rift Valley*'. Archiv fuer Hydrobiologie Supplement Band 69.
40. Seyoum M & Zenebe T. 2000. '*Stocktaking of Aquatic Animals Diversity in Ethiopia*'.
41. Shrestha, P. (__). '*Conservation and Management of Phewl Lake Ecosystem, Nepal*'. Botany department, Patan Campain, Tribhuvan University.
42. Siraj Bekelie. 1998. '*Land use and Socio - economic aspects and their Impacts on the Biological Diversity of Rift Valley Lakes of Oromiya (Ziway, Langano, Abijata and Shalla)*'. Paper presented to First National Workshop "*Conservation Strategy and Sustainable use of Rift valley Lakes Biodiversity in Ethiopia*" Addis Ababa, Ethiopia.
43. SNNPRS Water, Mines and Energy Resources Development Bureau. 2001. "*The Study of Lake Awasa Level Rise, Interim Report*". Volume II – Main Report. Lake *Awasa* Study and Design Project, WWDSE.
44. SOS SAHEL. 2001. Project document.
45. Syversen, P.O. 1995. '*Wintering water Birds on Ethiopian Rift Valley Lakes, Walia*'.
46. Tenalem Ayenew Tegaye. 1998. "*The Hydrological System of the Lake District Basin, Central Main Ethiopian Rift*". ITC Publications No. 64.
47. Tesfaye Awas, Minassie G, Getachew T. and Asfaw T. 2003. '*Ecosystems of Ethiopia*'. NBSAP - IBCR, Addis Ababa.
48. Tesfaye Chernet. 1982. '*Hydrology of the Lakes Region, Ethiopia (Lakes Ziway, Langano, Abijata, Shalla and Awasa)*'. Ministry of Mines and Energy Ethiopian Institute of Geological Surveys. Addis Ababa, Ethiopia.
49. Teshome Estifanos. 1983. '*Land Suitability Evaluation for Subsistence Cultivation of Sorghum and Maize in the Southern Rift Valley of Ethiopia*'. MSc Thesis England.
50. Teshome Estifanos. 1989. '*Land Evaluation of Haycoch and Butajra Awaraga'*. Addis Ababa.
51. Tewolde Berhan Gebre Egziabher (__). '*The Ethiopian Setting for Range Management*'. In IRA Proceedings of the first Natural Resources Conservation Conference.
52. Vinc, A.P.H. 1964. '*Land Use in Advancing Agriculture*'. New York.
53. Vinc. 1975. '*Land Use in Advancing Agriculture*' New York.
54. Yonas Teklemichael. 2004. '*Sustainable use of water resources from Zewai-Shala Lakes Sub Basin*'. A paper presented on the "*Forum on Environmental Issues related to Ziway …….*" *Oromiya* Management Institute, *Ziway*. June 2004.
55. Zerihun Woldu and Mesfin Tadesse. 1990. '*The Status of the Vegetation in the Lakes Region of the Rift Valley of Ethiopia and the Possibilities of its recovery*'. In SINET - An Ethiopian Journal of Science. Vol. 13, No. 2. Addis Ababa University.
56. Zinabu GebreMariam. 2002. '*The Ethiopian Rift Valley Lakes: Major Threats and Strategies for Conservation*'. In Tudorancea C. and Taylor W. (eds.), Biology of Inland Waters Series. The Netherlands.
57. Zinbabu GebreMariam. 1998. '*The Ethiopian Rift Valley Lakes: Human Interactions and Water Quality Changes as a possible threat to the Biodiversity*'. Paper presented to the first Workshop on '*Conservation and Sustainable use of Rift Valley Lakes' Biodiversity in Ethiopia*'.

ANNEXES

LAKE ZIWAY AND AWASA

Annex 1. Summary Project Costs for Lakes *Ziway* and *Awasa* Site Action Plan (SAP) and the PCU

Project Title	Estimated Cost
1. *Ziway*	
1.1. Rehabilitation of Depleted *O. niloticus* Stock	1,345,500
1.2. Evaluation and Impact Assessment of Introduced Alien Fish Species in Lake *Ziway*	1,805,000
1.3. Integrated Watershed Management	8,636,500
1.4. Eco-Tourism Promotion on Lake *Ziway*	1,552,500
1.5. Natural Resources and Socio-Economic Baseline Study	1,200,000
***Ziway* Total**	**14,539,500**
2. *Awasa*	
2.1. Rehabilitation of Depleted *O. niloticus* Stock	1,000,500
2.2. Impact Assessment, Evaluation and Control of Chemical Pollution from the Industrial and Domestic Effluents	1,575,500
2.3. Integrated Watershed Management	6,049,000
2.4. *Chelelleka* Wetland Rehabilitation, Conservation and Development	2,277,000
2.5. Eco-Tourism Promotion on Lakes *Awasa*	1,552,500
2.6. Natural Resources and Socio-Economic Baseline Study	800,000
***Awasa* Total**	**13,254,500**
3. Project Coordination Office (PCU)	**2,312,000**
4. Project Total for three years (ie, 1 + 2 + 3)	**30,106,000**

Annex 2. Meteorological Data for Ziway and Rainfall Data for near Meki Town, 1991-2000

	Year									
Meteorological Data	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Annual Rain (mm)	829	817	1023	658	553	729	722	720	751	837
No. Rain days/year	94	88	84	75	71	84	67	78	69	68
Min Temp (^{o}C)	13.0	13.6	12.9	13.1	13.7	13.1	14.0	14.5	11.6	12.5
Max Temp (^{o}C)	27.4	27.2	26.5	27.3	28.2	27.3	27.8	27.9	27.8	27.8
Relative Humidity (%)	57	58	59	57	57	58	60	62	56	56
Evaporation (mm)	6.47	6.32	6.48	6.99	6.9	6.51	6.50	6.43	7.44	7.15
Lake Water Rise (m)	1.11	1.13	1.36	1.18	1.11	1.37	1.30	1.31	1.29	1.30
River *Meki* Discharge at *Meki* (m)	8.52	11.41	13.02	13.32	8.12	21.12	5.91	11.65	8.8	8.9
Rain Fall on River *Meki* at Near *Meki* town (mm)	702	935	750	664	645	997	879	761	699	750

Annex 3. Scientific and Common and Local Names of Some Fish Species in Lake Ziway

Scientific Name	Common Name	Local Name
Barbus sp	-	Bilcha
Carassius carassius	Crussian carp	Duba
Carassius ouratus	Golden carp	Duba
Clarias gariepinus	The African catfish	Ambaza
Cyprinus carpis	Common carp	Duba
Oreochromis niloticus	Tilapia	Qoroso

Annex 4. Scientific and Common/Local Names of Some Plant Species around Lake *Ziway*

Scientific Name	Local/Common Name	Family Name	Remarks
A. abyssinica	Lafto, Bazira Girar, Umbrella Horn	Mimosoideae	Local names vary from place to place
A. albida	Garbi, Grar	Fabaceae	>> >> >> >> >> >>
A. etbaica	Dare, Dodoti	Fabaceae	>> >> >> >> >> >>
A. senegal	Sabas, Kontir, Gum Arabic	Fabaceae	>> >> >> >> >> >>
A. seyal	Wachu, White Galled Acacia	Fabaceae	>> >> >> >> >> >>
A. tortilis	Tedecha, Deweni Grar	Fabaceae	>> >> >> >> >> >>
Achyranthus aspera	-	Amaranthaceae	
Acokanthera shimperi	-	Apoceanaceae	
Balanites aegyptica	Bedeno, Desert Date	Balanitaceae	Local names vary from place to place
Cenchrus ciliaris	-	Poaceae	
Commiphora shimperi	Anqwa, Hamessa	Burseraceae	Local names vary from place to place
Cordia monoica	-	Boraginaceae	
Croton machrostachys	Makanissa, Bisana	Euphorbiaceae	Local names vary from place to place
Cynodon dactylon	-	Poaceae	
Cynodon plectostachyus	Serdo	Poaceae	
Cyperus papyrus	Dengel	Cyperaceae	
Cyperus sp.	Qetema	Cyperaceae	
Dichrostachy cinerea	Adesa, Ader	Fabaceae	Local names vary from place to place
Erica arborea	Wadadi, Asta, Giant Heath	Ericaceae	>> >> >> >> >> >>
Ficus sp.	Warka	Moraceae	
Hagenia abyssinica	Heto, Kosso	Rosaceae	Local names vary from place to place
Heteropogon contortus	-	Poaceae	
Hyparrhenia sp.	Sembeliet	Poaceae	
Hyperthelia sp.	Harran	Poaceae	
Hypoestes sp.	-	-	
Jancus sp.	Qetema	Jancaceae	
Juniperus procera	Tid, African Pencil Cedar	Cupressaceae	Local names vary from place to place
Nymphaea caerulea	Water-lily, Belbeta	Nymphaceae	>> >> >> >> >> >>
Olea europea	Ejersa, Weira, African Wild Olive	Oleaceae	>> >> >> >> >> >>
Panicum repens	-	Poaceae	
Phragmites sp.	Reed	Poaceae	
Podocarpus falcatus	Birbirsa, Zigba	Podocarpaceae	Local names vary from place to place
Rhus natalensis	Debobosso, Chakema,	Anacardiaceae	>> >> >> >> >> >>
Sporobolus sp.	Murii	Poaceae	
Trema orientalis	Talalaa	Ulmaceae	
Typha sp	Bulrush, Filla	Typhaceae	Local names vary from place to place

N.B: The problems in the family names for Acacia are not our mistake but the taxonomists change the names from time to time. (Very recently taxonomists have replaced Mimosoideae by Fabaceae for Acacia family)

Annex 5. Results of Recent Bird Survey at *Ziway*

Common Name	Scientific Name	Common Name	Scientific Name
White Pelican	*Pelecanus onocrotalus*	Marsh Harrier	*Circus aeruginosus*
Pink-Backed Pelican	*P. rufescens*	Crowned crane	*Balearica pavonina*
African Darter	*Anhinga rufa*	Black crake	*Aaurornis flavirostris*
Squacco Heron	*Ardeola ralloides*	Red-knobbed Coot	*F. cristata*
Cattle Egret	*Bubulcus ibis*	Jacana	*Actophilornis africanus*
Black Heron	*Egretta ardesiaca*	Lesser Jacana	*Microparra capensis*
Little Egret	*E. garzetta*	Common Pratincole	*Glareola pratincola*
Yellow-billed Egret	*E. interaedia*	Black-winged Stilt	*Hiantopus hiantopus*
Great White Egret	*E. alba*	Ringed Plover	*Charadrius hiaticula*
Grey Heron	*Ardea cinerea*	Kittlitz's Sandplover	*C. pecuarius*
Black-Headed Heron	*A. aelanocephala*	Three-Banked Plover	*C. tricollaris*
Goliath Heron	*A. goliath*	Spur-winged Plover	*Vanallus spinosus*
Hamerkop	*Scopus uabretta*	Little Stint	*Calidris minuta*
Yellow-Billed Stork	*Mycteria ibis*	Temminck's Stint	*C. temmincki*
Saddle-Billed Stork	*Ephissiorhynchus senegalensis*	Ruff	*Philoachus pugnax*
Marabou	*Leptoptilos crunemferus*	Common Snipe	*Gallinago gallinago*
Glossy Ibis	*Plegadis falcinellus*	Unidentified snipes	*Gallinago spp.*
Sacred Ibis	*Threskiornis aethiopica*	Black-tailed Godwit	*Liaosa liaosa*
Fulvous Whistling Duck	*Dendrocygna bicolor*	Spotted Redshank	*Tringa erythropus*
White-Faced Whistling Duck	*D. yiduata*	Marsh Sandpiper	*T. stagnatilis*
White-backed Duck	*Thalassornis leuconotos*	Green Sandpiper	*T. ochropus*
Egyptian Goose	*Alopochen aegyptiacus*	Common Sandpiper	*Actitis hypoleucos*
Spur-Winged Goose	*Plectopterus gaebensis*	Grey-headed Gull	*L. cirrocephalus*
Knob-Billed Duck	*Sarkidiornis aelanotos*	Black-headed Gull	*Larus ridibundus*
African Pygmy Goose	*Nettapus auritus*	Lesser Black-backed Gull	*L. fuscus*
Hottentot (Duck) Teal	*Anas hottentota*	Whiskered Tern	*Chlidonias hybridus*
Garganey	*A. querquedula*	White-winged Black Tern	*C. leucopterus*
African Fish-Eagle	*Haliaeetus vociter*	Gull-Billed Tern	*Gelochelidon nilotica*
		Caspian Tern	*Sterna caspia*

#

Annex 6. List of Institutions and Persons Contacted in *Ziway, Nazareth* and *Addis Ababa* for the study

No.	Person Contacted	Responsibility	Institution
1.	-	Center Director Team Leader	*Admai Tullu* Research center Metrological station
2.	Ato Abebe Seyom	Head of the Office	*Wereda* Rural Land and Natural Resources Administration Office, *Ziway*
3.	Ato Ahmed		Environment Protection Office, *Nazareth*
4.	Ato Alemayehu Gelta	Head	*Oromiya* Environmental Protection Office
5.	Ato Asfaw Dingamo	Water Resource Bureau Head	
6.	Ato Ayana	Engineers	Urban Planner and land Administration Office
7.	Ato Belachew Bunarie	D/Manager	*Adami Tullu* Pesticide Formulation S.Co; *Ziway*
8.	Ato Meseret Taye	Aquatic Biologist, Researcher	*Ziway* Fishery Resource Research Center
9.	Ato Seifu Gorefu	Planner	*Ziway* State Farm, *Ziway*
10.	Ato Terefe Disasa		*Oromiya* Bureau of Agriculture, Addis Ababa
11.	Ato Tibebu Kogi	Coordinator	SEDA, *Ziway*
12.	Farm Representative	Development Section	State Prison Farm
13.	Two elderly men	Private	From among the Zai People