APPENDIX VIII

ENVIRONMENT ASSESSMENT AND WATERSHED MANAGEMENT

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CHAPTER 1 ENVIRONMENT AND NATURAL RESOURCES IN ETHIOPIA

1.1 Status and Trend of Environment and Natural Resources

1.1.1 Topography

Ethiopia has a total area of 120 million ha with a very rugged and diversified topography and climatic conditions being closely influenced by the topography. Oromia Region in particular has variable topography consisting of high and rugged central plateau that is divided into two by the Great East African Rift Valley, and the peripheral lowlands. The Rift Valley ranges between EL 1,600 m and EL 2,500 m, while the Region extends from less than EL 500 m to over EL 4,300 m, of which 88% is within the range from EL 500 to EL 2,500 m. The highland above EL 2,500 m is 11% and the area below EL 500 m covers only 1% of the total land area of the Region.

1.1.2 Climate

(1) Temperature

The major controlling factors in Ethiopia are altitude and latitude. The annual range of temperature is low, i.e. 4ºC on the highlands and 4ºC - 8ºC in the low lands. Temperature is inversely related to elevation, thus temperatures range from 14ºC - 20ºC on the highlands and 20ºC - 25ºC in the low lands.

(2) Rainfall

Rainfall in Ethiopia is also influenced by topography. As a result rains are seasonal and unevenly distributed in time and space. In the mountainous areas, rains can last around eight months and reach as much as 1,500 to 2,400 mm a year. In lower areas including the Rift Valley, total rainfall can be as little as 400 mm. The unsustainable farming practices have contributed to the looming threat of desertification, which is also attributed other destructive developmental activities of inadequate and erratic rainfall and frequent droughts. The most devastating droughts were those of 1972-74, 1975-76, 1978-79, 1983-84 and 1990-91, during which over 2.7 million people in Oromia Region alone were affected, hence there is urgent need for water resource development.

1.1.3 Renewable Resources

Ethiopia is a relatively unindustrialized country whose economy depends almost

entirely on its renewable natural resources, i.e. water, land, biodiversity – wildlife, forests, aquatic genetic resources, which are mostly used for subsistence living. Yet, these resources are being depleted at unprecedented rate for food, fuel, building materials etc.

(1) Water Resources

(a) Water Use

Ethiopia is endowed with vast water resources, but only 1% of this potential has been developed for irrigated agriculture and hydropower generation. The irrigation potential in Oromia Region is around 1.7 million ha, but only 5% of this is developed. Oromia Region is endowed with large quantities of surface and ground water capable of producing large amounts of electricity and able to irrigate vast areas of land. The system has nine (9) major water bodies that form an interconnected system: Rivers Katar, Meki, Bulbula and Horakelo, and Lakes Ziway and Abijata, all of which except Lake Abijata are stable sources of irrigation water. However, competition and conflicts are mounting for these water resources from irrigation, domestic and livestock use, industries, and protected areas (e.g. Lake Abijata-Shalla National Park).

(b) Water Quality

Water quality assessment for domestic and irrigation use is extremely limited and highly localised in Ethiopia. Regular monitoring of bacteriological, physical and chemical quality of ground and surface water including supplied water is lacking. Generally, the water bodies are characterised by localised and limited quantities of water with fair to poor chemical qualities. For example, in Oromia Region all streams are intermittent except for few perennials, which are often turbid with high sediment yield. And Fluoride content in ground water is the highest in the country (up to 10 mg/l compared to WHO permissible level of 1.5 mg/l), and salinity levels are high (more than 3,000 ppm). Water quality for irrigation is generally satisfactory from the Meki and Bulbula rivers and along Ziway Lake. Due to high salinity in Lakes Abijata and Shalla water use is unsuitable for irrigation. Recent water quality analytical results are presented in Table VIII.1.1.

(c) Domestic Water Supply

Generally, there is very inconsistent reporting on water supply coverage both at country and regional levels. Water supply services in Ethiopia are usually

carried out by the government and NGOs. Prior to the issuance of Proclamation 41/92 of 1992, the role of water supply was that of the central government, but currently it is the responsibility of the Bureau of Water Resources, Mines and Energy Development of the Regional States. Although Ethiopia is rich in water resources, less than 50% of the national population has access to clean water supply, while only 30% of the population in Oromia Region has access to clean water supply: 24% in rural areas and 78.6% in urban centres. The sources of rural water include boreholes, springs, rivers and ponds. Oromia has more than 5,200 functional rural water supply schemes. A summary of water supply coverage in Oromia is shown in the table below.

A Summary of Water Supply Coverage (1999) in Oromia

Service Level		Total	%
Population	**Total**	**21,694,000**	**100.00**
	Urban	2,520,000	11.62
	Rural	19,174,000	88.38
Water supply coverage (Access)	**Total**	**6,604,642**	**30.44**
	Urban	1,980,072	78.57
	Rural	4,624,570	24.11
Population without water supply		15,089,358	69.56

Source: Regional Conservation Strategy Vol. 1, 2000 (Oromia National Regional Govt.)

(2) Land

(a) Land Use

Estimates of land use in 1980 suggested that approximately 12% of the total land area in Ethiopia was arable land, while 41% was under meadows and pastures, 24% under forest and woodlands and 23% under miscellaneous use including barren or swamp lands. In Oromia land use is estimated as follows: cultivated land area 29%, forested area 7%, and woodland 25%. And land use pattern for Dogda Bora Wareda in Oromia Region is shown in Table VIII.1.2.

(b) Soil Erosion and Sedimentation

Exploitative land use practices (including over-grazing and deforestation), in combination with erratic rainfall, have resulted in severe soil erosion over more than 50% of Ethiopia. Both sheet and gully erosion is widespread in the country. Fertile soil losses due to erosion is estimated at 42 tons of top soil per hectare. This is 6 times the rate of soil formation and causes annual reduction

of 4 mm in soil depth in about 50% of cultivated land, which is on slopes with a gradient greater than 16%. These lands account for 60% of fertile soil loss in Ethiopia, with erosion rates reaching up to 300 tons per hectare per year. It is estimated that soil erosion in Ethiopia amounts to 1.5 billion tons per annum, and that 0.5% of the highlands of Ethiopia is being lost annually. Soil erosion continues to be responsible for over 40,000 hectares of productive land being lost every year. It is also a major cause of heavy siltation in lower river channels and water reservoirs. For example, sediment yield of Lake Koka over 23 years has been the highest in he country (2,300 tons/km^2/year). And, reservoirs such as Metallitia dam in the Mojo catchment was completely filled in two years as a result of gully erosion in the catchment, signifying the seriousness of erosion in Ethiopia.

In economic terms, soil erosion in 1990 was estimated to have cost (in 1985 prices) nearly Birr 40 million in lost agricultural production (i.e. crop and livestock), while cost of burning dung and crop residues as fuel was nearly Birr 650 million. Thus, in 1990 about 17% of the potential agricultural GDP was lost from soil degradation. The permanent loss in value of the country's soil resources caused by soil erosion in 1990 was nearly Birr 59 million. This is the amount by which the country's soil "capital" should be depreciated in the National Accounts or which should be deducted (as capital depreciation) from the country's Net National Income (NNI)

(c) Soil Conservation Measures

The Ministry of Agriculture (MOA) started soil conservation efforts in Ethiopia in the mid 1970s by creating a Soil and Water Conservation Division. After the devastating famine of 1973-74 the Division began using relief food aid to undertake work in drought-affected areas in the highlands including some parts of Oromia region. By the late 1970s, it was clear that ad hoc relief-oriented program was an inadequate response to the large-scale needs of containing soil degradation. In collaboration with the World Food Program (WFP), a disaster mitigation strategy was formed combining soil and water conservation efforts with afforestation and the consolidation of work on a catchment basis. Details of WFP work are presented in Attachment 2 in this report.

(3) Wildlife

Formal wildlife resource management in Ethiopia was initiated in the 1960s and they include (i) protected areas, (ii) sanctuaries, (iii) extractive protected areas, and (iv)

agro-biodiversity.

Protected areas in Ethiopia include (i) Strictly Protected Areas (scientific reserves, national parks, natural monuments and wildlife sanctuaries); and (ii) Extractive Protected Areas such as natural forests, hunting and fishing zones and protect rural landscapes. Examples of protected areas in Oromia Region are presented in the table below.

Wildlife in Oromia Region

Conservation Program	Area (km^2)	Important Species
(1) National Parks		
• Awash Park	756	466 bird species
• Abijata-Shalla Lakes Park	887	31 mammal and 229 bird species – proposed RAMSAR site for its waterfowls especially, Flamingos & Pelicans
• Bale Mountain Park	247	220 bird and 64 mammal species including Mountain Nyala & Antelope
• Dhera-Dilfeqar Park	25	100 bird and 20 mammal species
(2) Sanctuaries		
• Babile Elephant Sanctuary	6,982	Largest wildlife protection area coverage in Ethiopia for recovering the remaining endemic Ethiopia's elephant population.
• Kuni-Muktar Mountain Nyala Santuary	n/a	24 bird and 20 mammal species – a conservation pocket for antelope and Mountain Nyala
• Sinkele Swayne Hartebeest Sanctuary	54	For the recovery of endangered Swayne species that are endemic to Ethiopia
• Yavelo Sanctuary	2,496	200 bird species

Source: Regional Conservation Strategy, VOL. 1 (2000), Oromia National Regional Govt.

(4) Forest Resources

(a) Terrestrial Vegetation including Forests

Vegetation inventories are scanty in Ethiopia. Due to destructive crop production and uncontrolled communal grazing practices, rangeland and forested areas have been seriously degraded, and virtually no extensive areas of undisturbed forest and wildlife habitat remain. In many areas in Ethiopia, the present consumption of forest products is in excess of unaided natural sustainable production. The country's current biomass is estimated to vary between 10 and 50 m^3/ha for woodlots, but due to open harvest system, their harvest has exceeded their annual incremental yields of 1.2 m^3/ha due to expansion of agriculture, infrastructure and urban development. Estimates of

deforestation, which is mainly for expansion of rainfed agriculture, vary from 80,000 to 200, 000 ha per year. A century ago, closed forest covered 40% of the country, but barely 4% is left today, suggesting that deforestation rate has been and continues to be very high. The Ethiopian Forestry Action Program (EFAP) estimated the full value of forest depletion to have been about Birr 138 million or some 25% of the potential forestry GDP of Birr 544 million.

At a regional level, Oromia Region has about 3 million ha of forestry and it is estimated that about 50,000 – 100,000 ha of this is lost annually due to shifting and commercial agriculture, fuelwood collection, forest fires etc. The original forests in the Region include "Podocarpus mixed forests" dominated by *Junipers, procera* and *Podocarpus gracilior*. Other types include Olea, Scheffera, albizia, Polyscias and Teclea. At Wereda level such as in Dogda Bora in Oromia Region, the area covered by bushlands and shrubs is estimated to be about 11.3%. The wood and bushlands are important sources of fuel and construction materials for local communities. There are very few if any forest plantations in the Wareda, but there are over 130 ha of community forests maintained by PAs (e.g. Tuchi Sumeyo PA). Community forests usually consist of *Eucalyptus globulus* and *Eucalyptus camaldulensis*.

Assuming a demand of 0.9 m^3/person/year, planting at 2,500 trees/ha (at a spacing of 2m x 2m), and production at 15 m^3/ha/year, each 1,000 head of population will need 60 ha of woodlots at a cost of Birr 19,500 or Birr 20/person/year. Thus, Dogda Bora Wareda with a population of about 162,750 will need to plant at least 9,765 ha to meet the current total demand of 146,475 – 195,300 m^3/year. The current capacity of the tree nursery at Meki is estimated at 800,000 seedlings. Assuming 2,500 trees/ha are planted (e.g. Eucalyptus for area afforestation), the nursery can supply seedlings to plant only 320 ha. Common trees grown on homesteads include Eucalyptus, Olea, Croton, Cordia, Juniperous and Podocarpus. Trees planted on cultivated areas include *Acacia albida, A. saligna, Croton*, Cordia, *Milletia, erythrina, Veronia, Dodena viscosa, Albizia, ficus vasta, acacia abyssinica*.

(b) Aquatic Vegetation

Common aquatic flora such as grass weeds, marsh hydrophyte Bulrush, and riverine reeds including *Sorghum virigatum* and *Sporobolus* species are found along the rivers. However, aquatic weeds of nuisance such as Nile cabbage (*Pistia stratiothes)*, the water hyacinth (*Eichoriumia crassipes*) and water fern (*Salmenia molesta*) are not common in most parts of Ethiopia. The common

species of riparian and swamp vegetation along River Meki and Lake Ziway includes *Ficus sycomorus, F. vasta, Tamarindus indica, Syzyphus mucrnata, Maytenus senegalensis, Acacia species (A. tortilis, A. albida, A. asak).*

(5) Aquatic Genetic Resources

The aquatic genetic resources of Ethiopia currently are in a critical situation due to mainly development activities, and require urgent attention to device mechanisms to maintain balance in resource exploitation and to promote their conservation. Effective legislative and policy frameworks that consider integration of regional planning and management of aquatic biodiversity, and development of multiple use strategies for off-reserve management are among necessary actions lacking. A strategy is also needed to rehabilitate wetlands and rivers. Several rivers in the country such as the Blue Nile, Awash as well as lakes including Ziway and Abijata are reported to have fisheries of economic importance (e.g. Tilapia, Clarias, Common carp, Barbus and Crucian carp). Ziway and Abijata Lakes have a potential fish production of 3,000 ton and 2,000 ton per year, respectively. Fishing provides rural employment for about 2,000 people in Oromia Region. There is no mechanism or policy for conserving and rehabilitating aquatic habitats, as well as for the rehabilitation of depleted stocks of biodiversity importance.

Due to ineffective conservation measures, scattered fishing activities carried along these water bodies are devastating the balance of species populations in these ecosystems. Also, the declining water levels due to on-going development activities and natural phenomenon including drought, and the introduction of alien species of fish for example, in Ziway Lake, are threatening native fish species with extinction.

1.1.4 Environmental Health

(1) Sanitation

Sanitation refers to the creation of environmental conditions favorable to health. It includes numerous measures in addition to the provision of safe excreta and refuse disposal. Sanitation in Ethiopia is generally low. Dry pit latrine is the most widely used way of excreta disposal in the country. In regions such as Oromia, 95% of homes do not have pit latrines. The low coverage is attributed to resentment of pit latrines due to smell. Most people prefer defecating in the bush. The high rate of tapeworm (*Taenia saginata*) and related fecal borne diseases can be attributed partly to mode of fecal disposal as the eggs of tapeworm are readily eaten by cows while grazing. When beef is not cooked adequately or eaten raw, as is a common practice in Ethiopia, this increases infection rate of tapeworm. Tape worm among other

internal parasites rank third among the top 10 diseases. A new system of pit latrine called the Ventilated Improved Pit (VIP) was introduced in the country. The VIP is designed to remove smell and prevent fly breeding. For example, over 10,000 VIPs were established in Oromia region, but the system was not well accepted, mostly due to lack of awareness.

(2) Vector Borne Diseases

As for vector borne parasitic diseases, malaria is the most prevailing disease in many parts of the country. Increase in the prevalence of vector borne diseases (especially, malaria and schistosomiasis) has been observed in irrigation areas in Awash Basin of Oromia Region (Wonji and Methehara irrigation projects). Other communicable diseases like diarrhoea, dysentry and helmintniasis have also widely spread in these schemes. According to a study carried out in 1999, *Biomphlaria periphery* (snail host of schistosomiasis) is endemic in all irrigation schemes in the upper Awash valley.

Both types of schistosomiasis have been reported in these schemes: *Schistosomiasis mansoni* (with prevalence rate of 5-15%, and *Schistosomiasis hematobium*. The top10 diseases in Dogda Bora Wareda, in Oromia Region are presented in Table VIII.1.3.

1.2 Constraints of Environmental Management in Ethiopia

1.2.1 General Policy Issues

(1) Introduction

Environmental legislation in Ethiopia is found in various sectoral statutes under the different line ministries dealing with agriculture, health, water, forestry, fisheries, and livestock, which have competing and exclusive interests in the use of natural resources and taking responsibility over their management. These statutes face fundamental constraints in enforcement mainly due to adoption of a sectoral approach rather than an integrated one, and in coordination at Federal and Regional levels. The policies also tend to contradict or overlap each other, rendering their implementation difficult. Although the Ethiopian constitution has a clear provision for some aspects of integrated development such as on land ownership, sub-sector specific policies are lacking for forestry, wildlife resources, land use, settlement and socio-economics at both national and regional levels. Where new policies exist, explicit development policy guidelines for implementation, monitoring, evaluation and regulation are lacking. For example, the Water Policy is comprehensive enough, but lacks guidelines on minimum maintenance flow in rivers and on minimum water

levels for lakes for monitoring and regulation of development actions. These deficiencies have resulted to forest degradation, conversion of natural ecosystems to other uses, and promotion of excessive uniformity of crops and crop varieties that encourage the use of agro-chemicals.

(2) Economic Causes of Water and Land Degradation in Ethiopia

Overexploitation of natural resources is mainly because the net revenues currently being earned by the local population for conserving natural resources are quite inadequate to cover the opportunity costs of the land (i.e. the forgone benefits of alternative land uses). This creates economic incentives to destroy water catchment areas including soil, water and vegetation at the expense of conservation. This is because the current economic and environmental policies in Ethiopia do not generate the scale of revenues needed to prevent the wide spread water and land degradation. Unless the compensation to landowners for not developing say, land in catchment areas is raised adequately, significant water and degradation will continue as the opportunity cost of conservation increases. And the productivity of land will decline as water and productive soil cover diminishes. Incentives in form of land ownership, access to inputs and credit facilities are also needed to rehabilitate badly degraded and abandoned areas (e.g. grazing land and gullies).

There are several but inter-related causes of water and land degradation in Ethiopia. The *proximate* cause of water and land degradation is due to habitat conversion, while the fundamental causes are considered to be 'economic policy failures'. Policy failures include *absence of policies* and *market failure* (absence of prices to reflect the true costs or benefits of conservation). And *implementation failure* is failure to manage the environment due to weak institutions, inadequate technical capacity, and funding, while *information failure* is failure to demonstrate and communicate the values of conservation to decision-makers and stakeholders. What these economic and institutional failures do is to make conservation appear less investment-worthy than alternative land uses.

If these economic distortions are identified and removed and good policies are provided, the resulting incentives can be used more effectively to divert land, capital and labour towards conservation of say, watershed areas. This policy change, which involves a three-stage procedure, is being promoted in other African countries:

(1) to demonstrate the economic values of say, soil and water conservation often not reflected in market place;
(2) to capture economic value by showing how institutions could be modified so that real flows of benefits come from the unmarketed functions of natural resources

(e.g. through proceeds of afforestation of gullies); and

(3) to direct at least part of the subsequent benefits of natural resources (e.g. in watershed conservation and gate fees in wildlife conservation) to local communities as incentives.

(3) Institutional Issues

To address the growing environmental issues in Ethiopia, the Government has over the years, set up institutions on environmental matters, notably the Environmental Protection Authority (EPA), which was established in 1995, and other environment-related agencies. These institutions were set up at Federal and Regional levels to help the Federal Government to integrate development plans within overall national set goals. The EPA is the Co-ordinating Agency for the Federal Policy on Natural Resources and Environment. Other agencies are: Ministries of Agriculture; Water Resources; Mines and Energy; Public Works and Urban Development; Education; Information and Culture; Health; Labour and Social Affairs; Trade and Industry; and Economic Development. However, these institutions have several deficiencies: (i) lack of capacity to deliver environmental management services; (ii) extension system is strongly crop-bias with less attention to the environment; (iii) inadequate research on natural resources conservation and water hydrology; (iv) inadequate budget for extension services; and (v) inadequate participatory process in conservation.

1.2.2 Specific Policy Issues

Natural resources conservation in Ethiopia is constrained by several specific issues relating to (i) land, (ii) soils, (iii) forest, (iv) biodiversity, (v) energy, (vi) water, (vii) rangeland ecosystem, (viii) crop production, and (ix) health and sanitation.

(1) Land

(a) Lack of Land Tenure Security

Lack of land tenure has been a problem in Ethiopia for a long time, and has been more acute in the southern part of the country, including Oromia, than the northern part. Land tenure insecurity relates to periodic reallocation of land among farmers, eviction of farmers for the purposes of using the land for state farms, rearrangement due to villagization process, etc. Tenure insecurity has resulted to fear of investment in conservation (e.g. to plant perennial crops and trees), resulting in the worsening land degradation and deforestation.

(b) Land Fragmentation

Land fragmentation is due to periodic land reallocation to provide land to those who are new claimants such as is planned for the proposed Meki Irrigation and Rural Development Project. It also results from subdividing one's holding among eligible heirs. Fragmentation of land leads to wastage of productive time in travelling between fields, wastage of land as farm boundaries, inconvenient farm operation, and often leading to unsustainable land husbandry, hence land degradation.

(i) Diminution of Size of Land Holding

Individual size of landholding is decreasing progressively in the subsequent reallocations. This is due to shortage of land, and increase in population – thus the same land is being reallocated each time to progressively increasing claimants. In some parts of the country, the holding has gone below economic level of holding. Unless there is additional source of income, the individual holdings cease to sustain food and other requirements. The only remedy under this situation is to intensify production and change the cropping system to high yielding types such as vegetables.

(ii) Landlessness

Given the present population growth rate of 3.1%, considerable proportion of the rural households have been rendered landless, and landlessness has reached more than 50% in some areas. Population growth in Ethiopia has led to shortage of cultivable and grazing land and also to encroachment of forested and marginal lands with the consequent massive soil erosion and excessive land degradation, shortage of forest products for fuel and construction.

(2) Soils

(a) Lack of Systematic Soil Inventory

There are no systematic soil inventory that completely cover the different regions of the country at a reasonable scale. Also, comprehensive, multipurpose soil surveys are scarce, and available studies are incomplete and are of different scales. The root cause of this problem is lack of appropriate structure at the Federal and Regional levels for undertaking soil survey and laboratory analysis to ensure proper land planning.

(b) Inappropriate Soil Research Priority

Current soil research emphasizes on crop improvement concept and does not comprehensively assess basic soil problems such as control of surface soil water. Effective control of surface soil water, for example, enables rational use of the land for crop production and grazing. Research also tends to ignore traditional soil management systems in preference to imposing solutions found outside Ethiopia, making adoption of research results difficult.

(3) Forests

(a) Lack of Clear Forest Policy

A comprehensive policy framework of inter-related issues such as land and forestry is lacking. The only proclamation in force is that of 1994 that simply recognizes three types of forests: (i) the State Forest, (ii) Regional Forest, and (iii) Private Forest. In absence of a sound policy, the on-going unprecedented deforestation and the need to meet population demand for forest products and conservation can not be realized.

(b) Inadequate Research

Forest research has some deficiencies: (i) silvicultural research work so far has emphasized on exotic forest species, neglecting indigenous species; (ii) research neglected ecological aspect of forestry; and (iii) no attention is paid to social forestry. These problems stem from lack of forest policy and lack of defined rural land policy. Efforts should be turned to thoroughly assessing existing natural forests and their protection and management.

(c) Development

Currently, the location, extent, annual growth rate, natural mortality rate and depletion rate of the available forest resources in Ethiopia are not clearly known. The lack of these data has rendered it difficult to draw management plan for the development and utilization of forest resources. Therefore, development efforts should concentrate on forest demarcation, mapping, inventory collection, stock measurements and estimation of forest products (e.g. logs, poles, incense, myrrh, gum) that can be harvested. Attention should also be paid to tree species, which are fast growing and of high calorific value as well as of multipurpose utilization to be able to balance the existing high rate of deforestation.

(d) Community Plantations

Although community forestry started in 1980s to provide fuelwood and revegetate degraded areas (hill sides), the planning did not involve the communities or even lacked the minimum level of consultation. Thus, it is vital to encourage community participation to be able to sustain hillside plantations. Furthermore, the plantations often get no weeding, cultivation, thinning or pruning, such that the survival rates are very low. This is mainly because clear policy is lacking on the ownership and the modality of using these plantations to create a strong sense of ownership and care.

(e) Farm Forestry

There are several types of farm forestry in Ethiopia, but information is lacking on the location, extent, kind of practice, purpose and the effectiveness of the program. Also, because trees have long gestation period, farmers tend to be discouraged to invest in them. Uncontrolled grazing also discourages adoption of farm forestry, and the capacity of the extension system to promote it is inadequate. Thus, the development of farm forestry in Ethiopia is generally very weak.

(4) Biodiversity

Although there are some Federal and Regional conservation efforts underway in Ethiopia, there are still several constraints in preventing degradation of the key natural ecosystems and species therein. Areas that need attention include legislative framework, capacity building, organizational setup and program designing.

(a) Legislative Framework

There are serious gaps in legislation with regard to biological resource conservation and utilization at both Regional and National levels. For example, there is no legislation for conservation of medicinal plants, land resources use and ecosystem conservation. In the forestry and wildlife sub-sectors, there are few proclamations, which provide for conservation and development of forests and wildlife resources. Therefore, there is a need to have definitive legislation to: (i) address the rights and obligations of communities and citizens; (ii) resolve issues related to ownership and use rights; (iii) define legal guidelines for crop genetic resources with regard to germplasm; and (iv) to conserve medicinal plants.

(b) Management and Organization

Biodiversity conservation is also constrained by (i) lack of systematic documentation of the composition, distribution, and population of species; (ii) lack of system to communicate the values of biodiversity; and (iii) lack of activities for the reintroduction of lost species.

(c) Vegetation and Flora

The natural vegetation cover in almost all ecological zones is sharply declining due to lack of management attention and overexploitation of the resources at a rate higher than the generation capacity. Threats to biodiversity include those to: (i) scrub land vegetation in the lowlands from overgrazing by both wild and domestic animals; (ii) Awash valley flora from overexploitation; (iii) *Acacia comiphora* woodland by agricultural activities, overgrazing, and tree harvesting; (iv) irreversible genetic erosion of wild coffee and the floristically rich evergreen forest vegetation by the expansion of coffee plantation; and (v) depletion by agricultural practices of the dry evergreen montane forest and grassland. Therefore a survey and identification of threatened and endangered species, and environmental impact assessment are urgently needed to enhance formulation of practical measures for ecological restoration.

(d) Protected Areas and Wildlife

Major constraints of wildlife management relate to:

- unsystematic classification and management of protected areas;
- management bias towards ecotourism activities;
- most protected areas being not gazetted and receiving little resources;
- communities living around protected areas being isolated from the management system and access to wildlife resources; and
- lack of buffer zone systems in most protected areas.

(5) Energy

(a) Over-dependence on Biomass

The single most serious constraint in the energy sector is the excessive dependence of the country on biomass for its energy requirements. For example, biomass accounts for more than 93% of all energy consumed in Oromia. Of this, woody biomass accounts for more than 80% of the total biomass energy source and the balance is covered by agri-residues, animal dung and in town by charcoal. Alternative energy sources (solar, wind,

geothermal steam, etc.), are generally not developed in the country. Given the per capita wood demand of 1 m^3 for rural and 0.94 m^3 for urban areas, the energy demand grows by 3.27%, generating the total requirement for example, for Oromia Region as 19,722,425 m^3 (17,640,418 m^3 for rural and 2,082,007 m^3 for urban areas) of wood. This is equivalent to about 100,000 ha of forest land with an assumed yield of about 200 m^3/ha. Yet, available records show that the annual plantation establishments are not more than 2,000 to 3,000 ha. Due to lack of security of tree and land tenure, tree planting is limited to around homesteads. Thus, even if half of the rural households plant trees, the maximum area planted would not exceed 40,000 ha, indicating that depletion rate of forests is alarmingly high just to meet the energy needs of the population.

(b) Crop Residue

In Oromia Region, an equivalent of 3,034,808 to 3,856,966 G cal/year of crop residue is used for fuel, corresponding to about 4.9% of the fuel energy consumed in the region. Together with these residues, a lot of nutrients which are extracted from the soil and absorbed from the air are irreversibly lost, and therefore greatly impoverishing the soil of nutrients. This practice, which is country-wide leads to decline in productivity and eventual land degradation, and is of serious concern and need to be abated to restore healthier crop production.

(c) Animal Dung

Animal dung is used as fuel in many parts of Ethiopia, leading to another disruption of the organic cycle. An equivalent of about 5,388,333 to 6,848,082 G cal/year of animal dung is used for fuel in Oromia Region, representing about 8.7% of the total energy used as fuel. Use of dung for fuel means denying the soil of its effective conditioner and fertilizer. An alternative energy should be found to this practice.

(d) Wasteful Energy Consumption

The second most important constraint is the wastefulness of the energy consumption practice, especially, the open fire system for baking and cooking. Earlier studies show that about 50 to 75% of the energy consumed for baking and cooking is wasted. A remedy for this includes improved stoves, but this technology is yet to be adopted in Ethiopia.

(e) Increasing Price of Electricity

The price of one KWh of electricity increased from 2.67% in 1994 to more than 50% over the previous years. In 1997, it again increased by 36.95% to 68.98% over that of 1994. This kind of very sharp price rise would mean that many users of electricity may revert back to the use of biomass, threatening further depletion of forests.

(f) Energy Policy

The above constraints can be addressed by putting in place a sound energy policy to develop and promote alternative energy sources. The issues to be addressed include over dependence on biomass, development and implementation of energy utilization and conservation strategies, excessive energy wastage, access to affordable modern technology, environmental pollution and degradation etc.

(6) Water

(a) The Water Resources Management Policy (2000)

The FDRE has a water policy, but it lacks guidelines on the modalities of water use for proper land and water management, ecological balance, the rights of downstream water users, water charges, conservation of catchments and water courses. It also does not specify minimum maintenance flow in rivers or minimum water levels in lakes. Thus, these guidelines are urgently needed to ensure efficient apportionment of water for various development activities.

(b) Inadequate Coordination

Currently, there is a general lack of effective coordination regarding water resources management among the various institutions at the National and Regional levels. Therefore, the roles of these institutions should be spelled out to ensure smooth coordination in this sector.

(c) Inadequate Study

There is inadequate inventory and assessment of the basic parameters such as meteorological data, hydrological data, soil and ground water information, etc. for many catchments and sub-catchments. Water quality assessment is also extremely limited and highly localized. Similarly, amount of land available for irrigation is not well established, and there are no data on water requirements for domestic and industrial use, which depends on availability of water, cost of water, population etc. A major constraint of water use is lack of inventory of

and study on the traditional irrigation systems in the country. For example, there is lack of monitoring and control of water use in irrigation schemes, rendering prioritization of irrigation areas difficult. Thus, studies are urgently needed to generate such information.

(d) Major Issues of Domestic Water Supply

- Lack of adequate trained manpower and insufficiency of operational facilities;
- In urban areas, water tariff is so low that the cost of service can not be recovered – existing tariff ranges from 1 to 3.50 Birr/m^3 of water consumed.
- Lack of coordination of activities and lack of information exchange among institutions involved in water development activities;
- Inadequate monitoring of bacteriological, physical and chemical quality;
- Lack of timely maintenance of water supply systems (e.g. about 20% of the schemes are not functioning in Oromia region);
- Where there are no alternative sources of water other than ground water, high fluoride content of water is the main problem – the problem being most serious in the Rift Valley.

(7) Rangeland Ecosystem Conservation and Management

(a) Livestock Carrying Capacity

Due to human and livestock population pressure, the rangeland ecosystem currently suffers a heavy load, which is beyond carrying capacity. For example, in a semi-arid agro-ecological zone the recommended livestock stocking rate is 8 ha per TLU (tropical livestock unit: 270 kg of live-weight). However, with a total of 35.7 million TLU or about 0.62 TLU per person the stocking density is 3.4 ha/TLU (ranging from 30 ha/TLU in the pastoral lands to 0.2 ha/TLU in the heavily populated areas of the highlands. Thus, the recommended stocking rate is exceeded by as much as 4 times, making overgrazing a major cause of land degradation.

(b) Importance of Livestock in Ethiopia

Ethiopia ranks first in Africa in the number of cattle and equines and second or third in sheep and goats. The following table shows the estimated population of Ethiopian livestock. It is estimated that the highland areas above 1,500 m contain 75% to 80 % each of the national cattle herd and sheep flock and about 30% of the national goat flock. The Rangeland areas contain 20-25% of the national cattle herd and sheep flock plus 70% of the goats, which support some

12% of the total human population.

Livestock populations in Ethiopia

Livestock species	Africa Total number	Ethiopia Number	% of Africa	Rank in Africa
Cattle	202 596 000	29 900 000	14.8	1
Sheep	212 674 000	21 853 000	10.3	3
Goat	180 304 000	16 850 000	9.3	2
Horse	4 795 000	2 750 000	57.4	1
Donkey	13 588 000	5 200 000	38.3	1
Mule	1 376 000	630 000	45.8	1
Camel	14 443 000	1 030 000	4.6	3
Pig	22 168 000	23 000	0.1	35
Poultry	1 115 000 000	55 000 000	4.9	4

Source: ILCA, 1991

(8) Environmental Health

(a) Sanitation

Due to lack of sanitary facilities and poor public concerns related to hygiene and nutritional availability, health conditions of the local people in Ethiopia are under serious threat, making environmental hygiene generally poor. Sanitation services are also currently poorly planned. One aim of sanitation is to safely dispose of human and industrial refuse from the living environment to avoid filth and fecal borne diseases. However, industrial enterprises in the country were established without due concern for sanitation requirements. Industrial solid waste and effluents are dumped untreated into rivers and streams, making solid wastes an eye sore in urban centers like Addis Ababa and Adama.

(b) Vector Borne Diseases

Vector borne diseases such as malaria are currently among the top diseases, but because the majority of Ethiopians remain inaccessible to health facilities and services, the incidence and prevalence are not adequately contained.

CHAPTER 2 INSTITUTIONAL ANALYSIS FOR ENVIRONMENT AND NATURAL RESOURCE MANAGEMENT

2.1 National Policy and Institutional Conditions on Environment

2.1.1 National Environmental Policy

One of the most significant changes in public awareness in recent years in Ethiopia is the growing concern about maintaining the integrity of the environment, on which the country is fully dependent on the natural resource base for most economic activities. The commitment of the FDRE to conservation of environment and sustainable use of resources has been stated in all national development plans over the past decade. A national environmental policy, which is stated in the Environmental Action Plan, 1997 provides guidance for actions in all sectors. Key objectives of the policy are to:

1. facilitate optimal use of the national land base and water;
2. promote sustainable use of natural resources to meet the needs of present generations while preserving their ability to meet the needs of future generations;
3. treat environmental conservation and economic development as integral aspects of the same process of sustainable development; and
4. generate income and meet national goals and international obligations by conserving biodiversity, reversing desertification, mitigating effects of disasters including drought.

2.1.2 Institutional, Policy and Legal Framework

(1) Institutional Framework

Socio-economic reforms in Ethiopia during the seventies and eighties disregarded the conservation of natural resources, which have seen unprecedented depletion. A century ago, closed forest covered 40% of the country, but barely 4% is left today, suggesting that deforestation rate has been and continues to be very high. Desertification, which is due to destructive developmental activities, inadequate and erratic rainfall, and frequent droughts, is also threatening the country. Both sheet and gully erosion is also widespread in the country. Fertile soil losses due to erosion is estimated at 42 tons of top soil per hectare, and soil erosion amounts to 1.5 billion tons per year. And water resources are shrinking and being degraded with problems of high salinity and fluoride.

To address these issues, the Government has over the years, set up institutions on environmental matters, notably the Environmental Protection Authority (EPA),

which was established in 1995, and other environment-related agencies. These institutions were set up at Federal and Regional levels to help the Federal Government to integrate development plans within overall national set goals. The EPA is the Co-ordinating Agency for the Federal Policy on Natural Resources and Environment. Other agencies are: Ministries of Agriculture; Water Resources; Mines and Energy; Public Works and Urban Development; Education; Information and Culture; Health; Labour and Social Affairs; Trade and Industry; and Economic Development. However, these institutions have several deficiencies: (i) lack of capacity to deliver environmental management services; (ii) extension system is strongly crop-bias with less attention to the environment; (iii) inadequate research on natural resources conservation and water hydrology; (iv) inadequate budget for extension services; and (v) inadequate participatory process in conservation.

(2) Policy and Legal Framework

Environmental legislation is found in various sectoral statutes under the different line ministries dealing with agriculture, health, water, forestry, fisheries, and livestock, which have competing and exclusive interests in the use and management of natural resources. These statutes face fundamental constraints in enforcement mainly due to adoption of a sectoral approach rather than an integrated one. The policies also tend to contradict or overlap each other, rendering their implementation difficult. Although the Ethiopian constitution has a clear provision for some aspects of integrated development such as on land ownership, sub-sector specific policies are lacking for forestry, wildlife resources, land use, settlement and socio-economics at both national and regional levels. Where new policies exist, explicit guidelines for implementation, monitoring, evaluation and regulation are lacking. For example, the Water Resources Management Policy is comprehensive enough, but lacks guidelines on minimum maintenance flow in rivers and on minimum water levels for lakes to facilitate monitoring and regulation of development actions that would ensure ecological balance.

(3) Economic Causes of Water and Land Degradation in Ethiopia

Overexploitation of natural resources in Ethiopia is mainly because the net revenues currently being earned by the local population for conserving natural resources are quite inadequate to cover the opportunity costs of the land (i.e. the forgone benefits of alternative land uses). The relatively high opportunity costs create economic incentives to destroy, for example, water catchment areas including soil, water and vegetation at the expense of conservation. This is because the current economic and

environmental policies in Ethiopia do not generate the scale of revenues needed to prevent the wide spread water and land degradation. Unless the compensation to landowners for not developing say, land in catchment areas is raised adequately, significant water and degradation will continue as the opportunity cost of conservation increases. And the productivity of land will decline as water and productive soil cover diminishes.

This Study identified several but inter-related causes of water and land degradation Ethiopia. The *proximate* cause of degradation is due to habitat conversion, while the fundamental causes are considered to be 'economic policy failures'. Policy failures include *absence of policies* and *market failure* (absence of prices to reflect the true costs or benefits of conservation). And *implementation failure* is failure to manage the environment due to weak institutions, inadequate technical capacity and funding, while *information failure* is failure to demonstrate and communicate the values of conservation to decision-makers and stakeholders. What these economic and institutional failures do is to make conservation appear less investment-worthy than alternative land uses. If these economic distortions are identified and removed and good policies are provided, the resulting incentives can be used more effectively to divert land, capital and labour towards conservation of the environment and watershed areas in the country.

CHAPTER 3 INITIAL ENVIRONMENTAL SCREENING OF THE PROPOSED PROGRAMS/PROJECTS

3.1 Irrigation Development Program

(1) WUA Support Program

Environment Screening: Neutral to Positive. No IEE or EIA is required if planning considers the environmental and social aspects.

The objective of the program is to support small-scale farmers' irrigation activities through technical and institutional capacity building for WUAs as well as local staff of OIDA. The program will also assist in the establishment of new WUAs in the project area. The community mobilization and technical guidance will lead to improved and efficient management of water. The program will also help in improvement of farm income and living conditions of WUA members. This should result in neutral or positive environmental effects due to better management of the projects and program.

(2) Meki Irrigation and Rural Water Supply Project

Environment Screening: Variable. The aim of the project is to increase food security and income in the Meki Project area. The water from the Meki river will be used for the irrigation and rural water supply by constructing water supply system. It will use water from the Meki river. In such case an IEE or IEA may be required after screening of the project is undertaken.

The objective of the project is to introduce a gravity irrigation system, which is more sustainable in comparison to pump irrigation system. Headworks and irrigation system will be constructed on the Meki river to irrigate 2,300 ha of agricultural land. The project is expected to contribute to promotion of stable food production and poverty alleviation in the area. The proposed irrigation system will divert water from the Meki river, which is a source of water for the rift valley lakes (Ziway and Abijata). Therefore, assessment of environment impacts on the lake system is necessary and IEE/EIA should be undertaken when necessary.

3.2 Rain-fed Agriculture Improvement Program

(1) Semi-Arid Farming Improvement Project

Environment Screening: Positive. The program will establish semi-arid farming system suitable for the project area. The developed practices will aims on soil conservation, improvement of soil fertility and controlling soil erosion and salinity. These are positive to the environment, therefore No IEE or EIA is required.

The program aims to establish the optimum farming system suited to local conditions of the Meki area under semi-arid climate through the actual three years research in situ. The techniques to be optimized will be transferred to local farmers through existing extension channel. This program, if successful, should result in increase production, and controlling soil erosion and salinity with positive environmental results.

(2) Community Seed Bank Project

Environment Screening: Neutral. The project aims at the preservation of second generation seeds harvested from quality seed planted crops, which are otherwise consumed. Moreover, project will promote community-based approach for the timely distribution of quality seeds. It will contribute to food security with neutral environmental impact. Therefore, no IEE or EIA is required.

The project aims at preservation of second-generation seeds to be harvested from plots sown with quality seeds instead of consumption. Limited use of certified seeds is one of the constraints against reasonable crop yields in the Meki area. Although quality seeds are introduced to the Meki area through the extension program, its coverage is still limited. The project will be promoted by community-based approach with minimum government supports. Quality seeds will be procured by communities and released to peasants timely. The production will increase with improvement of seed quality and its timely distribution to the farmers.

(3) Post Harvesting Techniques Improvement Project

Environment Screening: Neutral. The project will promotes improved post harvest techniques for the minimization of post harvest loss at

threshing, milling and storing. Therefore, no IEE or EIA is required.

Post-harvest loss is significant in Ethiopia. According to the FAO staff in Addis Ababa, the total loss in the nation is estimated as much as 25% of the total production at on-farm level. The project aims at minimization of post-harvest loss at several processes, namely threshing, transport, milling and storing. It is expected to reduce the post harvest loss and promotion of micro-enterprises for post harvest sector.

(4) Community Pond Project

Environment Screening: Neutral. The community ponds will be constructed in the remote areas for water supply. The storage capacity of pond will be less than 500 m^3 with micro-catchment area less than 5 km^2, therefore will not have any significant negative environmental impacts. Moreover, these ponds will help in reducing workload of fetching water for domestic water supply. No IEE or EIA is required if planning considers the environmental and social aspects.

The project aims at development of community ponds in remote areas far from stable water resources such as the Meki river and the Ziway lake. Rather than natural development potentials, social factors may be more important for successful community pond development. The pond water will be used for drinking, animal and supplementary irrigation purposes and it help in reducing the workload for fetching water for domestic supply.

3.3 Animal Husbandry Modernization Program

(1) Demonstration Unit

Environment Screening: Neutral to Positive. The demonstration unit for livestock modernization will be established under this project, which will promote the crossbred cattle and modern animal husbandry techniques. The project will also educate farmers about modernized animal husbandry under zero grazing with crossbred and improved forage. It is expected to get neutral to positive environment results from the project in the environmental conservation. Therefore, no IEE or EIA is required.

The objective of this program is to create community based initiative for livestock modernization. The basic concept of the livestock modernization program is to increase livestock productivity by introduction of crossbred integrated, forage production and improvement of husbandry techniques. The environmental conservation, the regional livestock sector needs to be optimized under the zero-grazing system. The program is expected to convince farmers about high profitability of modernized animal husbandry under the zero-grazing system with crossbreeds and improved forages.

(2) Forage Production Project

Environment Screening: Neutral to positive. This project will promote the introduction of forage crops and efficient use of crop residues and by-products of agro-industries such as molasses and cotton seed cake. The planting of grasses and legumes should contribute to environmental conservation. Therefore, no IEE or EIA is required.

The project aims at introduction of forage crops in the Meki area and promotion of efficient use of crop residues and by-products of agro-industries. The program will help in meeting the rapidly increasing forage demand in the livestock sector, thereby increasing their productivity. The efficient use of by-products of agro industries such as molasses will help in improving environmental conditions.

(3) Improved Breed Promotion Project

Environment Screening: Neutral to Positive. This project will promote the crossbred cows and veterinary service in the project area. This should lead to healthier animals with neutral to positive environmental results. Therefore, no IEE or EIA is required.

The project envisages multiplying the Boran and Holstein crossbred and introduce them. For successful introduction of the crossbred, the animal health services will be reinforced. The project promotes introduction of more veterinary services and installation of crushes for preventing and controlling the prevailing diseases. The zero grazing of crossbred cow will lead to enhancement of environmental conservation.

3.4 Environmental Conservation Program

(1) Environmental Monitoring Program

Environment Screening: Positive. The project aims at environmental monitoring of the water resources of whole river basin. The monitoring will promote awareness creation and optimum water resources development. This will lead in better management of water resources, thereby positive environmental results. Therefore, no IEE or EIA is required.

The project aims at execution of the environmental monitoring which will cover all these water resources under the same program. The results will fully be utilized for optimum use of the water resources in the Meki area with minimum influence to the natural environment. Within the framework of Environmental Monitoring Program, progress of the WFP watershed management program and other environmental factors including drinking water quality, disasters such as drought, floods and flash water, frequency and area of epidemic diseases. The project will focus not only on establishment of environmental monitoring system and capacity building for the government staff and communities.

(2) Seedling Center Program

Environment Screening: Positive. The project is expected to contribute expansion of agro forestry and alley cropping system. This will help in preventing soil erosion and enhancing soil conservation with positive environmental effects. Therefore, no IEE or EIA is required.

The project aims at reinforcing capability of the existing tree nursery in order to encourage environmental conservation activities. In addition to tree species for afforestation purposes, it is envisaged to produce seedlings for tree crops such as papaya and coffee in the nursery. This will contribute to expansion of agro forestry and alley cropping system and to improve farm family income through cash crop production.

(3) Watershed Management Program

Environment Screening: Positive. The project envisages establishing a model scheme in which agronomic and engineering measures of soil conservation are effectively integrated in order to

supplement each other and enhance their benefits. The model will demonstrate the positive environment effects of expanding soil protection area and agro forestry with above measures for watershed conservation. Therefore, no IEE or EIA is required.

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The objective of the project is to introduce agronomic as well as engineering measures of soil conservation. The soil conservation measures are expected to expand the agro forestry and protect the watershed from soil erosion with positive environmental effects. The model program will create awareness and need of watershed conservation and introduce watershed conservation methods. It is anticipated to expand the area of agro forestry and soil protection, which will lead to watershed conservation with positive environment effects.

3.5 Capacity Building Program for OIDA and Wareda Staff

(1) OIDA Engineers Training Program

Environment Screening: Neutral to Positive. No IEE or EIA is required.

The OIDA Engineers Training Program aims at providing training to the OIDA engineers on water and irrigation policy, hydrological analysis methods, civil design, preparation of tender documents, environment and watershed conservation, water management, preparation of reports and participatory development approach. The training program includes environment and watershed conservation and water management, which can provide neutral to positive environmental effects.

(2) OIDA Community Development Expert Training Program

Environment Screening: Neutral to Positive. No IEE or EIA is required if planning considers the environmental and social aspects.

The program envisages to train 20 community development experts including, at least, 5 female staff. The particular attention will be paid to NGOs' activities in the program. The program will establish a database of NGOs accessible for the people of Oromia Region. The gender issue will be highlighted in the program. Therefore, program is expected to give neutral to positive environmental effects.

(3) Wareda Staff Training Program

Environment Screening: Neutral. No IEE or EIA is required.

The training will be provided to the Wareda staff on participatory development, improved techniques of rain-fed agriculture, irrigation technology, and animal husbandry. The program will help in improving working capacity of the Wareda staff of OIDA and BOA.

(4) Community Resource Mapping Project

Environment Screening: Neutral to Positive. No IEE or EIA is required.

The objective of program is to prepare a resource map of each community to verify their geographical position, population of community members, natural resources, social conditions and other essential information. The map will assist in smooth operation of administrative services including extension. The map can also be used for planning of community based rural development. Therefore, the project will have neutral to positive environmental effects.

3.6 Community Development and Cooperative Promotion Program

(1) Community Leader Training Program

Environment Screening: Neutral. This program will promote the participatory development and democratic operation of community activities. No IEE or EIA is required.

The program aims at systematic capacity building of community leaders in order to promote democratic operation of community activities and participatory development. This program will enhance community leaders' knowledge for better community management. This program will not have any environmental impacts.

(2) Visioning Workshop Program

Environment Screening: Neutral to positive. The program is expected to promote participatory development and empowerment of rural community with neutral to positive environment impacts. Therefore, No IEE or EIA is required.

Visioning Workshop Program will create awareness for advocacy for quality of life among community and empowerment especially of poverty groups of community. This program will have neutral to positive environmental impacts.

(3) Drinking Water and Nutritional Improvement Program

Environment Screening: Positive. The project aims at creating awareness of improving drinking water quality and nutritional status among rural farmers especial women. It will assist in controlling water borne diseases and reducing the infant mortality rate. Therefore, no IEE or EIA is required.

The objectives of the program is to transfer the knowledge of the prevention of water borne diseases, drinking water quality controlling methods, importance and improvement of nutrition especially for infants and pregnant women and promotion of nutritionally rich horticultural crops. The awareness creation among small farmers especially women will lead to healthier life with positive environmental results.

(4) Community Center Project

Environment Screening: Neutral. No IEE or EIA is required if planning considers the environmental and social aspects.

The Community Center Project aims at provision of conventional shed-type building to rural communities so as to encourage the community activities. The facilities will be utilized for the meetings, training program, administrative service, cooperative activities, recreation, temporary space for seedlings and seeds and other purposes of community. It will promote participatory development and empowerment of local farmers without any environmental effects.

(5) Grain Bank Promotion Program

Environment Screening: Neutral to Positive. No IEE or EIA is required.

This program aims at securing food grains during the lean season through lending and borrowing products among the surplus and deficit farmer producers at PA level. The products in the peak harvesting season will be stored by the farmers at a grain bank warehouse. During the lean season, the deficit farmers who need to purchase food grains shall borrow the food grains from the grain bank and return the grains in the next harvesting season with a certain additional quantity as an interest. The program will

establish food grain security system at village level and promote grain marketing. It will contribute in increasing farmers' income and village welfare with neutral to positive environmental effects.

3.7 Conclusion

The initial screening process indicated 20 projects will give positive or neutral environmental benefits. However, only project "Meki Irrigation and Rural Water Supply Project" shows variable environmental impacts and requires IEE for further assessment of environmental impacts. The following chapter describes about the IEE of this project.

CHAPTER 4 INITIAL ENVIRONMENTAL EXAMINATION OF THE MEKI IRRIGATION AND RURAL WATER SUPPLY PROJECT

4.1 The Scope and Objectives of the Study

The IEE, which is a requirement of the Environmental Policy of the FDRE, has two components: screening and scoping. Screening is a preliminary environmental review to assess whether EIA is necessary or not for a proposed development project. And if needed, to decide the nature and magnitude of the proposed project's potential environmental and social impacts and assigns the project to one of the three categories (Schedules) according to the EIA Guidelines of the FDRE. Once a project is categorised, a scoping process defines the project's likely environmental impacts and the area of influence more precisely and develops terms of reference (TOR) for the EIA. As part of this process, information about the project is disseminated to local communities and NGOs, followed by consultations to help to focus the EIA on issues of concern at the local level. The IEE was conducted using existing data and experience in similar projects. To attain these objectives, the Study: reviewed all relevant data and documents related to potential environmental impacts of the Project, especially, the Environmental Assessment Guidelines Document of: the FDRE (2000). The Study area is located in Dogda Bora Wereda district in the East Shewa Zone of the Oromia Regional State (Figure VIII.4.1).

4.2 Environmental Attributes and Ecological Regions

Major components of the proposed irrigation development are the construction of a diversion weir, an intake, canals, and drains and water supply system. Its principal purposes are the development of water resources for irrigation to promote agricultural development over 2,300 ha and provide rural water supply in the downstream plains. The 21 environmental attributes (items), which were used for IEE are principally the common items related to dam and irrigation development projects based on the Environmental Assessment Guidelines Document for the FDRE, and have taken into account the general features of the Project. On this basis, the Study area can be broadly divided into the following seven (7) ecological regions as shown in Figure VIII.4.1. These ecological regions are useful to clarify the locations of impacts caused by the Project.

Region I : Catchment area of the diversion weir

Region II : Head works area

Region III : Meki river channel (from the diversion weir to Lake Ziway)

Region IV : Proposed irrigation area (2,300 ha of agricultural land owned by some 1,000 to 2,000 Households)

Region V : Lake Ziway system

Region VI : Bulbula river channel (from the Ziway lake to the Abijata lake)

Region VII : Abijata- Shalla lake system

4.3 People's Participation and Scoping of Public Opinion

4.3.1 Background

The key stakeholders of the MIRDP include the Dogda Bora Wareda, the FDRE, the Oromia Regional State and OIDA, which will realize economic, benefits from the project. Other stakeholders include agencies of the FDRE which are interested in future development opportunities that the project will bring (e.g. trade), and those that have a mandate for environmental and natural resource management (e.g. EPA), as well as NGOs and international organizations. The IEE obtained various information from such stakeholders as local community, the Dogda Bora Wareda, the EPA, the Federal and Regional Bureau for Agriculture, Water, and Health and agencies working on related projects such as the World Food Program (WFP). Meetings and interviews with communities and individuals were also carried out. Thus, scoping of the project focussed on the interests of these key interested and affected parties and the affected local communities living around the proposed MIRDP. And, the overall IEE components are discussed in terms of people's perceptions and their views on remedial measures.

4.3.2 Perceived Major Environmental and Natural Resource Issues

(1) Soil and water degradation is alarming in Dogda Bora, threatening agricultural productivity, hence food security and livelihood of the people in the Wareda.

(2) No experience exists in watershed management, especially, soil and water conservation in most of the PAs except in the 4 PAs, where WFP has initiated similar activities;

(3) Soil and water conservation is a long-term commitment that requires substantial resources.

(4) Rotational grazing or closure of grazing land is not feasible in most PAs due to shortage of land; zero grazing or cut-and-carry practice does not also exist in most PAs, but believed that with technical and financial support they would practice it.

(5) In other regions in Ethiopia, where WFP has had projects on soil and water conservation, the loss of grazing land due to area closure was noted as the most

resented effect of the project.

(6) Water Use Associations (WUAs) exist for construction and fencing of pond and irrigation but most of them are ineffective as a result many ponds have dried up.

(7) Water use charge was introduced recently when the Water Policy (2000) of the FDRE introduced the "User Pays" principle for water use, but is not operational, and regulation of water use for development activities is non-existent.

(8) Although the Water Policy (2000) requires that water allocation and priority setting criteria be established, no guidelines exist for say, minimum flow or water level requirements in water bodies of the country.

(9) Women are most affected by soil and water degradation (in terms of pasture, fuelwood and water availability), but disproportionately few women are involved in soil and water conservation as compared to men.

4.3.3 Gender Issues

Given the existing linkage of gender-environment-food security in Ethiopia like elsewhere, this study considered the community and field staff perception of both men and women on land use. The study through scoping of public opinion attempted to elicit the constraints faced by women; different roles of men and women in soil and water conservation and food security; and their access to resources (land, livestock, credit, and extension services). The Study revealed that there are 62,051 female and 64,523 male in Dogda Bora, almost a 50:50 situation. The main activities of men include cultivation, building, pond and well construction, participation in PA meetings, and family security. The women's role includes cooking, nursing, child bearing, fuelwood and water collection, and livestock herding. Women are overburdened by domestic chores and outdoor activities: assisting their husbands in sowing, land preparation, weeding and harvesting - women work longer hours (>13 hours/day) than their male counterparts.

Women have very limited access to resources (e.g. land and livestock belong to men), and generally women do not participate in development planning. However, women are being encouraged through the newly introduced soil and water conservation at 4 sites in (Joro Reka, Menjegso Weji, and Daloti Mati PAs) under WFP program. In these areas, each watershed management team comprises at least 5 women and 5 men, and women are encouraged to participate in soil and water conservation. For example, in Joro Reka PA, 20 women and about 200 men participate in gully stabilization project. Although there is a National Policy for Women in Ethiopia (1993), there are no effective women or gender-sensitive organizations in the project area to promote gender awareness.

4.4 Broad Program Options with Environmental Implications

4.4.1 Dam Versus Diversion Weir

The Project consists of six (6) programs, namely (i) irrigation development, (ii) rain-fed agriculture improvement, (iii) animal husbandry modernization, (iv) environmental conservation, and (vi) capacity building for OIDA and Wareda Staff and (vi) community development and co-operative promotion. Of the six programs, only irrigation development is considered for the purpose of IEE because the rest of the components are expected to have no significant environmental impacts, rather, their implementation will help improve environment and natural resources. In this context the IEE is carried out for a large-scale development based on the Meki Irrigation and Rural Water Supply Project. Thus, three options are considered for the IEE: (i) no action, (ii) irrigation by headworks, and (iii) irrigation by dam. The no action option seems feasible due to the enormous pressure from the Government and local population to increase food production to ensure food security.

Of the other two options, a water balance study shows that irrigation by dam (at 30m, 35m, and 40m heights) is environmentally undesirable because it will drastically reduce water inflow into Lake Ziway, and outflow into River Bulbula as shown in the following tables. This in turn will reduce the water storage and surface area of Lake Abijata, significantly affecting ecological balance. Specifically, change in river flow would decrease water levels below critical limits of water temperature and increase salinity in Lake Abijata with the corresponding decrease in fish population on which Flamingos and Pelicans feed. This could reduce the population of these birds in Lake Abijata-Shalla National Park, which was recently proposed as a RAMSAR site. The RAMSAR Convention (the Convention on Wetlands of International Importance Especially as Waterfowl Habitat) has been ratified by the FDRE.

The dam option also has undesirable socio-economic impacts. The reduction in water flow will reduce irrigation activities in the downstream areas, causing conflicts among various water users, threatening current efforts to improve food security in the country. Probably the most crucial social impact of the dam is that, it would result in inundation of up to 17 km^2 for the reservoir, approximately 30% of which is crop and grazing land. As a result, more than 40 households (about 200 people), all of whom are in the Southern Region would have to be relocated. This could present a thorny issue in terms of compensation for the Oromia and Southern Regional States. Drastic reduction in water flow will also render water in Lake Abijata too saline for the large number of cattle (about 60,000), which still use water in this lake

for drinking. In contrast, the diversion weir would not result in any significant loss of land or relocation. Consequently, due to the relatively adverse environmental and socio-economic impacts of the dam option, irrigation by head works is selected for irrigation of up to 2,300 ha of land mainly during the rain season.

4.4.2 Alternative Sites for Diversion Weir

Two alternative sites for the diversion option were considered during the IEE: upstream and downstream plans. On the basis of the merits and demerits of these options, which are presented in the table below, the downstream option is proposed from environmental and economic viewpoints.

Weir Site	Merits	Demerits
Upstream Option	• Reliable foundation; and • Stable river course.	• High-elevated weir; • Head reach canal to irrigation area will be relatively long; • Much rock excavation along head reach; and • Relatively more costly.
Downstream Option	• Relatively low-elevated weir; • Less excavation volume along Main canal; and • Relatively less costly.	• Relatively unstable foundation and; • Unstable river course.

4.5 Results of Initial Environmental Examination

4.5.1 Environmental Impacts Due to Project Location

The results of the IEE are presented in Table VIII.4.3 and discussed as follows.

(1) Impacts on Minority Ethnic Group

The people living in the Study area (Regions II – VII) are mostly of the Oromo tribe (73%), which is the most dominant ethnic group in Ethiopia, followed by Guragie (14%) and Amhara (8%). Region I (the catchment area), 90% of which lies in the Southern Region, is occupied by the Guragie people. Although other communities of ethnic minority groups can benefit from the increased economic development of the proposed Project, they may be disadvantaged as they could be excluded from the scheme, especially, because of uncertain usufructuary land rights in force, and some may be pastoralists rather than farmers. Much as existing information shows that there will be no adverse impacts on these minority groups, further studies should assess any potential negative impacts and appropriate rehabilitation or compensation measures should be provided for in this regard during the project design.

(2) Social Impacts related to Resettlement

Approximately 2,300 ha in Region IV will be irrigated under the Project. The command area of the Project is not yet selected, but some 1,000 to 2,000 households (HHs) have usufructuary rights of upto 10 ha per HH of farmland in this area. Although these communities will not be resettled to other areas, parts of their farmland will be reallocated to other communities under the project. The OIDA plans to allocate to each HH between 0.25 ha – 0.5 ha. Thus, the 2,300 ha will be sub-divided or fragmented among at least 4,600 HHs; many of these will come from outside the command area. This may cause negative social impact to these communities, in that, they will loose their land and will have to cope with influx of new people and the associated social discomfort.

(3) Impacts on Land Use

Accurate data is lacking on land use in the project area, but a broad land use pattern for Dogda Bora is presented in Table VIII.1.2. The proposed irrigation will inundate through the construction of the weir and head works an area of only about 10 ha (5 km x 20m) for backwater flow in Region II, most of this area represents badly degraded river banks, and therefore is unproductive. Thus, the diversion weir and the irrigation development would not affect any undisturbed land with environmental values or lead to substantial loss of agricultural land. However, as mentioned in (2) above, part of the 2,300 ha proposed for irrigation under the Project, will be allocated to farmers currently not living in this area. Thus, this land will be sub-divided or fragmented into 0.25 – 0.5 ha plots among at least 4,600 people, a situation that may lead to diminution of size of land holding, wastage of land as farm boundaries, inconvenient operation etc. Also, the creation of agricultural monoculture may reduce biodiversity by promoting horticultural production and reducing existing local flora and fauna.

Although these changes may be of relatively minor significance, they often interact to produce a cumulative effect over a prolonged period of time, which can result to significant long-term changes to the local ecology. Thus, these changes should be carefully assessed and corrective measures be provided. Overall, the Project will have a positive impact on land use in that it will provide additional 2,300 ha for crop production farmers in and around the Project area.

(4) Impairment of Transportation System and Existing Infrastructure

Water bodies in the Project area, especially, Meki and Bulbula Rivers and Lakes Ziway and Lake Abijata are not used for inland navigation. The rivers in particular

have relatively small discharge and steep riverbed slopes (Tables VIII.4.4 & VIII.4.5). Also, the weir and headworks will not directly affect any local trunk road being used by the local people or affect existing infrastructure. The existing road conditions in Regions I and IV are poor and often impassable, so donkeys and horses are a common mode of transport. There are currently no built-up area or installations in the proposed project area. Therefore, the project will not lead to substantial disturbance on the existing transportation systems or infrastructure, rather, it will have a positive impact in that, the Project plans appropriate farm and access road system.

(5) Inundation of Mineral Resources

Mineral resource development in Ethiopia is at its infancy, so there are few reports and documents from the FDRE or Oromia Regional State to confirm the existence of valuable mineral resources in the project area for evaluating the potential impacts of the Project on them. The available information from the United Nations Assisted Survey and other studies, identified five major categories of minerals in Oromia Region: Gold, Platinum, Tantalum, Nickel, Iron and base metals. None of these is found in the areas to be inundated in Regions II and IV. The only mineral reserve nearest to the Project site is 400 million tonnes of Soda Ash near Lake Ziway, which will not be inundated by the project. Therefore the Project will have no negative impact on mineral resources.

(6) Inundation of Historical Assets

According to the Regional Conservation Strategy (2000), Oromia has over 134 archaeological sites. But based on scoping of public opinion during this Study through the Agricultural Bureau (including wildlife and tourism agencies) and information from the zonal and Wereda offices, there are no historical and cultural assets that will need to be protected in the Study area. Besides, given the small scale of inundation by the proposed project in Regions II and IV, the Project will have minor impact if any, on historical and cultural assets.

(7) Encroachment of Precious Ecosystem: (Terrestrial Fauna and Flora)

Oromia has about 3 million ha of forestry and it is estimated that about 50,000 – 100,000 ha of natural forests are lost annually due to shifting and commercial agriculture, fuelwood collection, forest fires etc. Virtually no extensive areas of undisturbed forest and wildlife habitat remain in Regions I and IV. The remnants of the original forests include “Podocarpus mixed forests” dominated by *Junipers,*

procera and *Podocarpus gracilior*. And the area covered by bushlands and shrubs is estimated to be only about 11.3% including various species of Acacia, Boswllia, Commiphora, Balanites, Euphorbia, combbretum, Croton, Oxythantera, and Protea.

This represents currently a biomass of between 10 and 50 m^3/ha for woodlands and 5 and 30 m^3/ha for bushlands. Due to the open access system, their harvest has exceeded their annual growth. The annual incremental yields are only 1.2 m^3/ha for woodlands and 0.2 m^3/ha for bushlands. Dogda Bora Wereda with a population of about 162,750 will need to plant at least 9,765 ha to meet the current total demand of 146,475 – 195,300 m^3/year. Thus, the Project will not encroach on any precious ecosystem.

(8) Encroachment of Precious Ecosystem: (Aquatic Fauna and Flora)

Only common aquatic flora such as grass weeds, marsh hydrophyte bulrush, and riverine reeds including *Sorghum virigatum* and *Sporobolus* species are prevalent along the rivers in the Study area. Other common species of riparian and swamp vegetation along River Meki and Lake Ziway includes *Ficus sycomorus, F. vasta, Tamarindus indica, Syzyphus mucrnata, Maytenus senegalensis, Acacia species (A. tortilis, A. albida, A. asak*). Thus, there are no precious aquatic flora in the Project area, and therefore the location of the Project is expected to have no impact on any precious aquatic vegetation, in Regions II and III.

As for aquatic fauna, while there is no information on the ecological and economic importance of fishery in Meki River, Bulbula River and Lake Ziway are reported to have fisheries of economic importance (e.g. Tilapia, Clarias, Common carp, Barbus and Crucian carp). Ziway Lake has a potential fish production of 3000 tonnes per year, and fishing provides rural employment for about 2000 people in Oromia Region. Due to ineffective conservation measures, fishing activities along Lake Ziway and River Bulbula are reducing the population and diversity of fish species in these ecosystems. Also, the reduction in water level due to on-going irrigation activities and the frequent droughts are already contributing to the decline in fish population and diversity. The introduction of alien fish species in Lake Ziway is likewise threatening native fish species with extinction. Further reduction in water level by diverting Meki River for irrigation, and the degradation of water quality in Lake Ziway, which will receive a return flow laden with agrochemical from the irrigation area (Region IV) may cause incremental reduction in fish population and diversity.

(9) Watershed Erosion and Sedimentation

Earlier geological studies show that the common soils in Dogda Bora are cambisols, which are extensive in the eroded, hilly and sloping areas. Vertisols and fluvisols on the other hand, are found around valleys of rivers and lakes. According to the preliminary investigations in this study, a tendency of soil erosion at present along the Meki River is not so serious at the proposed weir and intake sites because of the relatively gentle topography. However, in the uppermost catchment area, over 90% of which lies in the Southern region, erosion is observed to be serious as characterised by deep and wide gullies. The effect of erosion and the resultant sedimentation can reduce the efficiency of irrigation structures in Regions II and IV, increasing maintenance and operating efficiency and costs. Since erosion rates in the catchment area are unavailable, it is difficult to quantitatively assess sedimentation in the backwater flow at the proposed intake. However, the impact of soil erosion and sedimentation is expected to be minor because the Project has a community-based plan for micro watershed management that will reduce soil erosion and sedimentation.

(10) Conflicts with Water Use

Extensive use of water resources often leads to competitions and conflicts among various users. Conflicts in proposed project area arise from water for domestic use and livestock, crop production, fishery, irrigation and for the maintenance of sensitive ecosystem such as in Lake Abijata-Shalla National Park. All these activities are in direct competition of the scarce water resources in the project area (Figure VIII.4.2). Also, the Soda ash factory currently abstracts about 2.25 MCM of brine water per year from Lake Abijata by evaporating it to extract soda ash. It has been reported that the production will be expanded from 15,000 tons currently to 25,000 tons of ash to meet the country's current internal requirements. While the impact of these activities are not clearly understood, the first phase of production (15,000 tons/year) is reported to have increased evaporation rate by 1%. Reduction in water disrupts the food chain of the Flamingos and the white Pelicans famous for being a tourist destination. Further reduction in water in Lake Abijata will shatter the current plan by the FDRE to register Lake Abijata-Shalla wetlands as a RAMSAR site.

Currently, a total of 15 WUAs have been established in PAs around Meki River and Lakes Ziway and Elen (Table VIII.4.6). With the enforcement of the Water Resources Management Policy, more WUAs will be established and empowered on

water use and conflicts. Thus, the WUAs are likely to be among the first beneficiaries to raise issues relating to the expected decrease in water for downstream users due to the Project. The conflicts if not addressed may disrupt the smooth implementation of the Project. Therefore, it is recommended that further studies as proposed in (4.5.3) below to establish water demand for various downstream users and come up with appropriate planning and guidelines for water use, monitoring and regulation. This will ensure equitable apportionment of water for various uses at local, regional and countrywide basis.

Another source of conflict would be in Region I, given that most of the catchment of Meki River is in the Southern Region. However, serious conflicts from Region I are not expected because much as River Meki originates in the Southern Region, the main course of the river course is in Oromia Region. However, the proposed irrigation plan should be discussed adequately among OIDA, the Agricultural Bureau of the two states and relevant Ministries such as Environment and Water Resources to avert unnecessary disputes that may affect the implementation of the project.

4.5.2 Environmental Impacts Associated with Construction Stage

(1) Air Pollution, Noise and Vibration

The Project might cause some negative impacts on the local people related to air pollution from CO, SO_2, NO_2, dust and noise and vibration hazard around the weir site, quarry sites, irrigation area and roads during the construction stage mainly due to operation of vehicles and machines for construction works. Case studies in Kenya and elsewhere show that pollution load, for example, from such activities increases by less than 5% of the background level of these gases, and the gases are usually dispersed such that their concentrations assume background levels within 50-100 m of the pollution source. The present background concentrations of these gases are expected to be low because air pollution prone activities are non-existent in the Project area.

Given the small construction scale, the few human settlements near these sites, and absence of schools, hospitals and other institutions in Regions II and IV, no serious impacts are expected on air quality, as well as noise and vibration during the construction stage.

(2) Soil Erosion and Silt Runoff

Soil erosion and silt runoff are expected to result from the construction of diversion weir, intake, access roads, and quarry sites in Regions II and IV. In the rainy season, its impacts on river water quality relate to relatively high turbidity of the river water, and it may cause some impacts due to the discharge of high turbid wastewater in the dry season. Given the relatively small-scale of construction, the overall impact will be minor. The project plans measures including preparation of sedimentation ponds, re-greening of quarry sites and tarfing slopes of irrigation canals to reduce the magnitude of impacts.

(3) Sanitation of Workers' Camp and Hazardous Wastes

About 200- 300 labourers will be employed daily during the construction stage. At peak period, the construction is expected to last at least for 5 months. This means that about 4 -6 kg/day of Biochemical Oxygen Demand (BOD) load (20mg/person/day x 200 – 300 persons) could be discharged to the Meki River. This untreated wastewater from workers' camp and other facilities might pollute water quality of the river, which are rather good conditions at present. Assuming discharge rate of pollution load of about 30%, the water quality of the Meki river could deteriorate by about 4 mg/l in BOD. The FDRE has no environmental water quality standards for BOD. However, according to Environmental Water Quality Standards in Japan, permissible limit for BOD in rivers for fishery is 5mg/l or less, for agricultural use is 8mg/l or less, and conservation purposes is 10mg/l or less. According to these standards, the project will not cause significant pollution at the workers camp (Region II), and water bodies in Regions III – V as the Project has planned appropriate measures such as waste water treatment, solid waste management, including use of pit latrines and purification of drinking water. And impacts caused by hazardous wastes are not expected because no materials or substances with hazardous wastes will be used in the construction of the Project.

(4) Aesthetics and Landscape

At present, there are no tourism spots and recreation areas with precious aesthetics and landscapes in and around Regions II and IV. Thus, the project will have no negative impact on these attributes.

4.5.3 Environmental Impacts Due to Project Operation

(1) Change of River Flow Regime

Since the main purpose of the Project is agricultural development through supply of irrigation water from a diversion weir, the Project will cause some significant changes of the existing river flow regime. This in turn may cause downstream water quality deterioration, and depreciation on precious ecology including decrease in fishery. The major features of rivers and lakes that will be affected by the proposed project are presented in Tables VIII.4.4 and VIII.4.5. A substantial amount of water will be taken at the intake to supply irrigation water to the proposed irrigation area (Region IV).

The water flow of Meki River will be reduced by the diversion works, and will also reduce the inflow into Lake Ziway by 5.4% and the outflow from Lake Ziway into Bulbula River will be reduced by 8%. Reduced flow in Bulbula River will ultimately reduce Lake Abijata storage volume by 5.1% (about 50 MCM), representing loss of about 27% of total inflow into the lake. The results of a recent water balance study on the effect of Meki water intake on the water resource system in the project area are presented in Tables VIII.4.1 and VIII.4.2. The relationship between these changes and variation in the depth of Lake Abijata is not known. Information on the depth of the lake is important as it is directly related to water temperature regime, which influences the biochemistry and rate of water evaporation. Reduction in inflow and increase in evaporation in turn increases the alkalinity and salinity, which alters the composition of phytoplankton food chain or optimum biochemistry balance for aquatic life in the lake. Massive fish kills and decrease in the waterfowl population has been observed in the area.

(2) Downstream Water Quality Deterioration

Information on current water quality in the project area is lacking. Although the Project does not have substantial pollution load the potential water quality deterioration is expected through changes of existing river flow regime (Tables VIII.4.1 and VIII.4.2) and additional pollution loads from the irrigation area, through a return flow from Region IV into Lake Ziway. The return flow would contain agro-chemicals with deleterious effect on human and animal health. These impacts might cause some negative impacts on river water quality and aquatic ecosystem of the Meki and Bulbula rivers, and Lakes Ziway and Abijata in the downstream area [see also (3) below]. Thus, detailed assessment is required to clarify the magnitude of

these impacts.

(3) Depreciation of Fishery

The decrease in lake level due to irrigation activities is already affecting the fishery resources in Lakes Ziway and Abijata. Any further decrease in the current net inflows to these lakes will lower the average lake depth and this will reduce the length of shoreline (Tables VIII.4.1 & VIII.4.2). Decrease in water depth has direct ecological adverse effects on fish breeding areas, and is expected to alter the critical temperature for aquatic ecosystem, resulting into high salinity, incremental death of phytoplankton on which fish feed, and consequently reduction in fish population. Since there are no inventories of river fisheries for the Study area, the magnitude of the project's impact on these resources can not be determined during this study. However, negative impacts of the project on river fishery are expected, especially in Lake Ziway and Lake Abijata, which produce annually 3,000 tonnes and 2,000 tonnes respectively. Reduction in fishery will reduce the badly needed income for alleviation of poverty.

(4) Impacts on Precious Ecology

As mentioned in the previous section 4.5.3 (1, 3 & 4), changes in river flow will have some negative effects on precious ecosystem and endangered species, especially, Flamingo and Pelican birds including other waterfowl species, which would be directly affected by the Project. The population of the birds that feed on fish will decline. The waterfowls attract an annual income of Birr 200,000 from tourism. However, because the diversion weir will not have any flood control capacity to the downstream area, it would not substantially deprive spawning habitats for the indigenous species including fish during the flood season.

(5) Eutrophication

A change of water body from lotic to lentic condition in the backwater flow of the diversion weir would cause water quality change especially by eutrophication. Although eutrophication in stagnant water bodies is a natural limnological process, excessive eutrophication may cause offensive odour and increase in manganese (Mn) concentrations. Eutrophication sometimes causes proliferation of phytoplankton, aquatic weeds, fresh water bloom, and occurrence of Hydrogen Sulphide (H_2S) under anaerobic conditions. Aquatic weeds and algae may interfere with the efficient operation of the diversion weir through blockage. Potential eutrophication depends on the inflow of nutrients from the catchment (Region I) and the

characteristics of the backwater flow (e.g. average depth, surface area, storage capacity, annual inflow into the weir etc.). Given that the catchment area uses low quantities of agrochemical concentrations, the Total Phosphorous (T-P) and the low storage capacity and retention time, the proposed backflow water has minor eutrophication potential and no serious impacts.

(6) Vector Borne Parasitic Diseases

Due to lack of sanitary facilities and poor public concerns related to hygiene and nutritional availability, health conditions of the local people are under serious threat causing relatively high morbidity rates of diarrhoea infections. As for vector borne parasitic diseases, malaria is the most prevailing disease in and around the Project area (Table VIII.1.3). Schistosomiasis (bilharzia) is also known to be present in the Study area. Increase in the prevalence of both diseases has been observed in irrigation areas in Awash Basin of Oromia Region (Wonji and Methehara irrigation projects). According to a study carried out in 1999, *Biomphlaria periphery* (snail host of schistosomiasis) has been endemic in all irrigation schemes in the upper Awash valley. Both types of Schistosomiasis have been reported in these schemes: *Schistosomiasis mansoni* (with prevalence rate of 5-15% and *Schistosomiasis hematobium*. The incidence of schistosomiasis in Dogda Bora is less than 10% compared to 60-70% in endemic areas such as around large irrigation schemes in Kenya. The creation of a new habitat through increased surface area of irrigation water in Region IV may increase the breeding of mosquitoes and snail hosts of schistosomiasis. However, given small size of the project, the incidence of these diseases is expected also to be low. But, epidemiological studies are required to establish the actual impact of the Project on these diseases and prepare monitoring and implementation plan for preventive and curative measures through the Meki Health Centre and the recently established Mukuye health post.

(7) Change of Micro-climates

In general, a change of microclimate occurs in case of dams having huge surface area of reservoir particularly in the arid or semi-arid regions such as the Aswan High dam in the Nile River in Egypt. Since there will be no reservoir area, the project will have no impact on climate change around the project area.

4.5.4 Summary of IEE

In the IEE phase, a preliminary evaluation of the magnitude/significance of impacts is conducted on the selected 20 environmental attributes, and its result is shown in

Table VIII.4.3. Among the selected items, the following five (5) items (marked "A" and "B" in the Table) are expected to cause significant impacts, largely due change of river flow regime (Tables VIII.4.1 & VIII.4.2), and will be the focal points for further studies as summarised below.

Environmental Attributes	Re*-I	Re-II	Re-III	Re-1V	Re-V	Re-VI	Re-VII
A. PROBLEMS DUE TO PROJECT LOCATION							
1. Conflicts with water use rights	0	0	B	0	B	B	A
2. Social Impact	0	0	0	B	0	0	0
B. PROBLEMS DUE TO PROJECT OPERATIONS							
1 Change of river flow Regime	0	0	A	0	A	A	A
2 Deterioration of down stream water quality	0	0	B	0	0	0	A
3 Depreciation of fisheries	0	0	B	0	B	0	B
4 Impacts on precious Ecology	0	0	0	0	0	0	A

* Re: Ecological Region

(1) Conflicts with Water Supply Rights

The diversion of water from Meki River for irrigation in Region IV will reduce water for downstream users especially, in regions III and VII. This can lead to competition and conflicts among various water users (WUAs, the Soda-ash enterprise near Lake Abijata, fishery, and local communities including pastoralists) within the influence of the project.

(2) Social Impacts

Approximately 2,300 ha in Region IV will be irrigated under the Project. Although the command area of the Project is not yet selected, some 1,000 to 2,000 Households live within this farmland. Although no communities in Region IV will be resettled to other areas, parts of their farmland will be reallocated to other communities under the project. This may cause some significant social impacts to these communities, in that, they will loose part of their land and will have to cope with influx of new people and the associated social discomfort.

(3) Change of River Flow Regime

The Project will cause a change of current flow regime in Meki and Bulbula rivers due to diversion of Meki River for irrigation in Region IV. The magnitude and

significance of expected impacts should be established based on ecological studies, hydrological data and plan of operation of the Project. Currently, there is no policy on minimum flow requirements in rivers, and minimum water levels in lakes, and this guideline is urgently needed to ensure equitable apportionment of water resources.

(4) Water Quality Change

Water quality deterioration is expected through changes of existing river flow regime and additional pollution loads from the irrigation area, especially, through a return flow from Region IV into Lake Ziway. This would contain chemical fertilizers, insecticides and herbicides with deleterious effect on human and animal health. The possibility and magnitude of these impacts should be clarified based on the data related to river flow discharge and water quality analysis.

(5) Depreciation of Fisheries

Diversion of Meki River will cause reduced flow downstream, affecting the ecology of fish especially in the lower reaches of Meki River, Lake Ziway and Lake Abijata. The two lakes are economically important sources of fish. Moreover, reduction of fish in Lake Abijata due reduced water inflow into the lake may reduce the current earnings from tourism and diminish the international status of Lake Abijata as a would-be RAMSAR site. More detailed hydrological and ecological studies are needed to establish requirements for minimum water flow in Bulbula River and minimum water levels in Lake Abijata that will not disrupt ecological balance in these water bodies.

(6) Impacts on Precious Ecology

Like in (4) above, precious ecology that is host to phytoplanktons, zooplanktons, fish and water fowls in the water bodies in the ecological Regions III and V-VII will be disturbed significantly due to change in water flow regime. The same remedial measures as in (1-4) above are needed.

(7) Positive Impacts

Despite the above potential negative impacts of the proposed Project, the overall effect of the Project on the people of Dogda Bora is expected to be positive. The environmental conservation component of the Project will ensure environmentally sustainable development. The planned afforestation and water conservation will ensure sustainability of the irrigation development and animal husbandry

modernisation components in the currently badly degraded Project area by reducing soil erosion and sedimentation in the planned irrigation system as well as by improving riverflow regime and water supply. Also, the environmental monitoring and management plan to be developed in the EIA is expected to effectively mitigate the negative environmental and social impacts of the proposed irrigation development. Overall, the Project is expected to improve the livelihood of the target group through increased food production and availability of water for crop production, human and livestock use, thus achieving the objective of the Project of ensuring food security and poverty reduction. The Project will further contribute to food security and poverty reduction through the other three components of the Project: (i) rain-fed agriculture improvement, (ii) capacity building for OIDA and Wereda Staff, and (iii) community development and co-operative promotion. And on a short-term basis, the Project will create employment for over 200 people during the construction phase.

4.6 Conclusion

Overall, the Project is expected to improve the livelihood of the target group through improved food security and reduced poverty through environmentally sustainable practices. According to the IEE results, the proposed project falls under Category (Schedule) I, which requires a full EIA, as its adverse impacts may be sensitive, irreversible, and diverse. The most crucial negative impact of the proposed project relates to diversion of water Meki River through an intake for irrigation. The diversion of water will result into competition and conflicts from water users downstream due to change of river flow regime. The conflicts relate mainly to reduced flow for on-going irrigation activities, pastoral and domestic water uses depreciation of fish and fisheries, and reduction of waterfowl population (especially, Pelicans and Flamingo) in Lake Abijata-Shalla National Park, which is a proposed RAMSAR site. The adverse social impact of the Project relates to loss of land by the communities in the proposed irrigation area due to the planned influx of new farmers and the associated social discomfort. Although these impacts range from moderate to highly significant effects, they were identified during the limited period of the IEE, which is characterized by inadequate supporting data. Therefore, the IEE results are not considered decisive to approve or discredit the project viability at this stage. In view of this, a full EIA as per the attached terms of reference (TOR) in Attachment 1 is recommended to address the following most crucial issues of change in water flow and the social impacts of the irrigation development.

(1) The significance of the expected change in river flow on down stream

development activities and Lake Abijata ecosystem.

(2) Quantitative information on the relationship between water level and salinity in Lake Abijata and how these changes relate to the aquatic life including fishery and waterfowls.

(3) A detailed environmental cost-benefit analysis to establish the opportunity costs and trade-offs in conserving Lake Abijata-Shalla ecosystem as compared to the expected economic returns from the proposed project.

(4) As the FDRE does not have guidelines on minimum river maintenance flow and minimum water level for optimum ecological balance, the EIA should help the Government establish these critical parameters based on hydrological, ecological and water demand data for on-going development activities.

(5) A socio-economic profile of the Study area, especially, Region IV be undertaken to establish the actual beneficiaries, social issues and indicators for monitoring benefits.

(6) Finalise the environmental sector report.

(7) The EIA is expected to provide a conclusive opinion on the viability of the project and come up with effective countermeasures, environmental monitoring and management plan that could render the project acceptable from environmental viewpoints.

It is therefore recommended that no implementation of the proposed irrigation project is undertaken until a full EIA is conducted to address among others, the issues outlined above.

APPENDIX VIII
ENVIRONMENT ASSESSMENT AND
WATERSHED MANAGEMENT

Tables

Table VIII.1.1 Test Results of Water Quality Analysis

Date of Test: 22 November 2000

	Parameters	Unit	Meki River (Mukeye)			Ziway Lake (Near Meki)			Groundwater Sample		
			1	2	3	1	2	3	Mukeye	Berta-Sami	Woyo Gebriel
1	pH		8.21	8.23	8.22	7.8	7.82	7.86	8.24	7.91	8.44
2	Biochemical Oxygen Demand (BOD)	mg/l	<1	<1	<1	8.5	8.5	8.52	<1.0	<1.0	<1.0
3	Chemical Oxygen Demand (COD)	mg/l	6.246	6.25	6.25	11.28	11.3	11.3	<1.0	<1.0	<1.0
4	Suspended Solids (SS)	mg/l	111.988	119	118.99	15.98	16	16	<1.0	1.7	<1.0
5	Dissolved Oxygen (DO)	mg/l	6.58	6.6	6.605	5.001	5	5	6.3	6.7	5.9
6	Total Nitrogen as N	mg/l	0.249	0.251	0.253	0.441	0.442	0.442	0.22	0.15	0.245
7	Electrical Conductivity (EC)	µs/cm	294.9	295	295	614.8	615	615.5	868	1126	1932
8	Total Dissolved Solids (TDS)	mg/l	140.9	141	141.01	295	295	294.9	418	547	954
9	Flouride as F	mg/l	0.608	0.61	0.61	1.71	1.71	1.708	3.3	9.4	10.6
10	Phosphate as PO_4	mg/l	0.238	0.24	0.241	0.17	0.17	0.171	0.28	0.28	0.22
11	Calcium as Ca	mg/l	19.202	19.2	19.199	25.59	25.6	25.601	10.4	12	10.4
12	Magnesium as Mg	mg/l	9.27	9.27	9.271	6.338	6.34	6.34	3.66	2.93	1.46
13	Chloride as Cl	mg/l	6.495	6.5	6.5	12.97	13	13	5	16.5	2.5
14	Sulphate as SO_4	mg/l	17.902	17.9	17.9	0.1	0.1	0.101	55.9	0.4	0.7
15	Sodium content	mg/l	34.17	34.17	34.17	76.001	76	75.998	138.5	178.1	338.8
16	Arsenic content	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	0.003

Table VIII.1.2 Land Use Pattern in Dogda Bora Wereda

No.	Land Use	Extent (ha)	(%)
1.	Farmland	67,828	46
2.	Forest, shrub, bush	19,971	14
3.	Grazing land	36,326	25
4.	Others (residence, roads, swamps)	9,758	15
Total		146,882	100

Source: Dogda Bora Bureau of Agriculture, 1998

Table VIII.1.3 The Top 10 Diseases in Dogda Bora Wereda

Rank	Morbidity	No.	%
1	URTI	4973	16.6
2	Malaria	3035	10.1
3	Internal parasite	2842	9.5
4	Skin disease	2362	7.9
5	Eye disease	1851	6.2
6.	Diarrhoea	1245	4.2
7	Anemia	1025	3.4
8	Gastritis	894	3
9	Injury	821	2.8
10	Tonsillitis	750	2.5
	TOTAL	19798	66.2

Source: Meki Health Centre, 2000

Table VIII.4.1 Different Options for Irrigation

Case	Condition	Cropping Intensity (%)	Potential Area (ha)	Total Irrigation Area (ha)	Reduction in Meki Flow to Ziway Lake (%)
1	Diversion Weir	105	2,300	2,415	5.4
2	Dam H=30m	195	4,700	9,165	29.7
3	Dam H=35m	195	8,000	15,660	48.4
4	Dam H=40m	195	9,400	18,330	57.1

Table VIII.4.2 Effect of Irrigation Options on rivers and Lakes in Project Area

Case	Condition	Reduction in Ziway Lake Storage (%)	Reduction in Outflow to Bulbula River (%)	Reduction in Abijata Lake Storage (%)	Reduction in Abijata Lake Area (%)
1	Diversion Weir	1.6	8.0	5.1	2.0
2	Dam H=30m (CI=195%)	10.3	42.5	25.9	10.6
3	Dam H=35m (CI=195%)	19.6	66.4	37.5	17.1
4	Dam H=40m (CI=195%)	24.2	76.3	41.3	20.1

Table VIII.4.3 Result of IEE of Meki Irrigation and Rural Water Supply Project

Environmental Items	Catchment Area Region-I	Headworks Area Region-II	Meki River Channel Region-III	Irrigation Area Region -IV	L. Ziway system Region-V	R. Bulbula Channel Region-VI	Abijata-Shalla System Region-VII
A. PROBLEMS DUE TO PROJECT LOCATION							
1. Impacts on minority ethnic group	x	x	x	x	x	x	x
2. Resettlement	x	x	x	x	x	x	x
3. Impacts on land use	++/B	x	--/C	++/A	--/C	--/C	--/C
4. Impairment of transport system & existing infrastructure	x	++/C	x	++/C	x	x	x
5. Inundation of minerals	*	x	*	x	*	*	*
6. Inundation of historical assets	*	x	*	x	*	*	*
7. Encroachment on precious ecosystem	x	--/C	++/C	++/C	++/C	x	x
8. Watershed erosion & sedimentation	x	x	*	x	*	*	*
9. Conflicts with water supply rights	--/C	x	--/C	x	--/C	--/B	--/B
B. PROBLEMS RELATED TO CONSTRUCTION							
10. Air pollution, noise & vibration	*	--/C	x	--/C	*	*	*
11. Soil erosion & silt run off	x	--/C	--/C	--/C	--/C	x	*
12. Sanitation in workers' camp & wastes	x	--/C	x	x	x	x	*
13. Aesthetics &Landscape	*	x	x	x	*	*	*
C. PROBLEMS DUE TO PROJECT OPERATIONS							
14. Change of river flow Regime	*	--/B	--/A	*	--/B	--/A	--/A
15. Deterioration of down stream water quality	*	*	--/B	*	--/B	x	--/B
16. Depreciation of Fisheries	*	x	--/C	*	--/B	x	--/B
17. Impacts on precious Ecology	x	x	x	x	x	x	--/B
18. Eutrophication of back water flow	*	--/C	*	*	*	*	*
19. Vector borne parasitic diseases	x	--/C	x	--/C	*	*	*
20. Change of micro Climate	X	x	x	x	x	x	x

Notes:

++/A	:	Upper parts stands for the direction of impacts and the lower part shows the magnitude of impacts
A	:	Relatively high magnitude of impact expected
B	:	Relatively moderate magnitude of impact expected
C	:	Relatively low (minor) magnitude of impact expected
X	:	No effect is expected
*	:	No relationship
++	:	Positive effect is expected
--	:	Negative effect is expected

Table VIII.4.4 Major Features of Rivers in Project Area

No.	River	Station	Catchment Area (Km^2)	Annual Rainfall (mm)	Annual Discharge (MCM)	Runoff Coefficient	Drain Into Lake
1	Meki	Meki Village	2433	1006	292.1	0.12	Ziway
2	Katar	Abura	3350	874	405.6	0.14	Ziway
3	Kekersitu	Adamitulu	7488		180.2		Abijata
4	Horakelo	Near Bulbula	2050		46.7		Abijata

Table VIII.4.5 Major features of Lakes in Project Area

No.	Lake	Lake Area (Km^2)	StorageVolume (MCM)	Mean Depth (m)	Altitude (m)	Catchment Area (Km^2)	Annual Inflow (MCM)
1	Ziway	440	1466	2.5	1636	7380	704
2	Langano	230	3800	17	1590	2006	
3	Abijata	180	954	7.6	1580	10740	227
4	Shalla	370	37000	86	1567	2300	

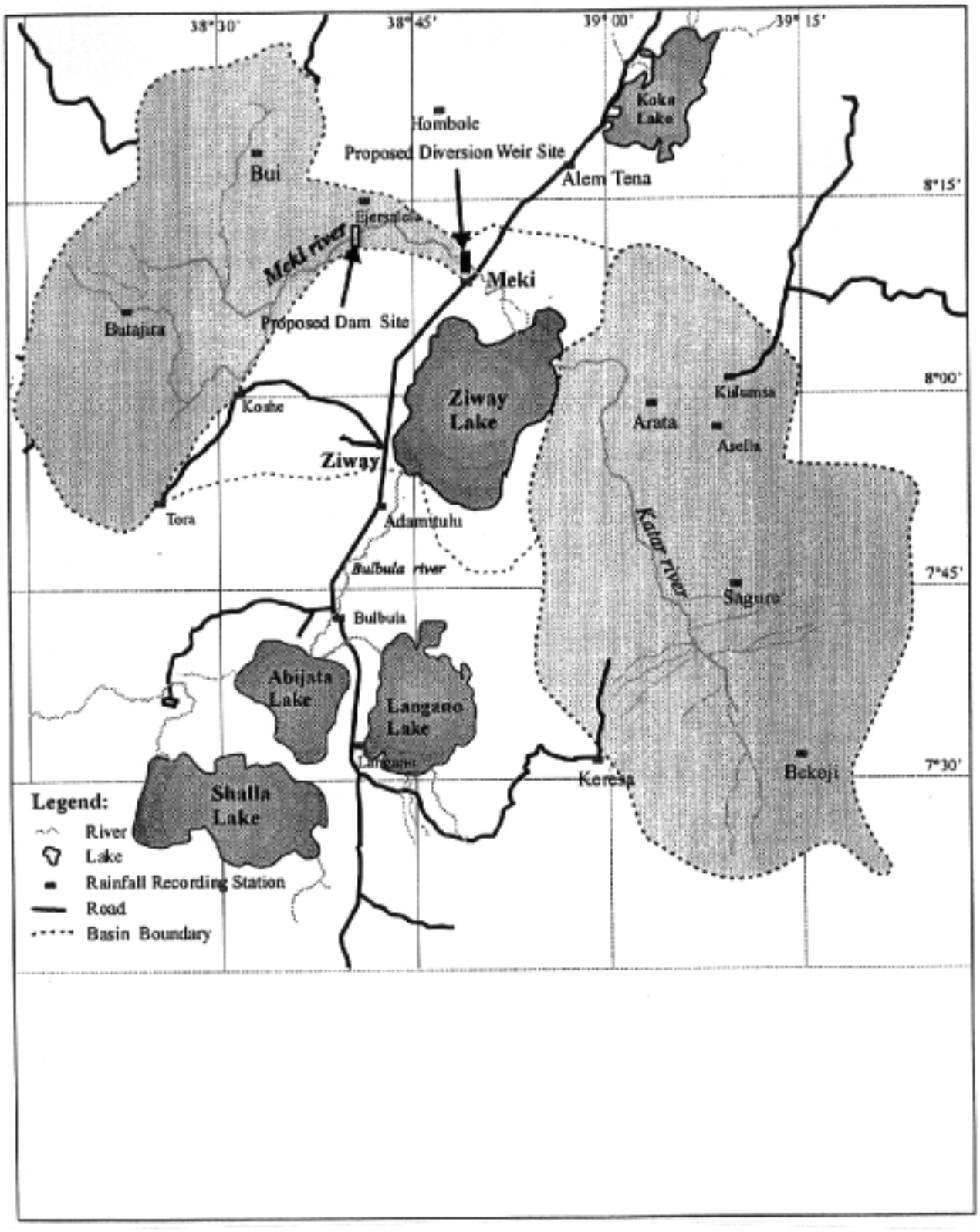
Table VIII.4.6 Water Users Association: Co-operation Union, Meki

			Members					
No.	Name of WUA	Name of PA	Male	Female	Total	Irrigated Area (ha)	Source of water	Year Established
1	Lega Meki-1	Gemu Shubi	10	0	10	32.5	Meki River	1997
2	Lega Meki-2	Bekele Girrisa	19	5	24	6.0	Meki River	1998
3	Bekele Girrisa	Bekele Girrisa	130	5	135	218.0	Lake Ziway	1997
4	Melka Cherecha	Welda Mekidela	34	0	34	14.1	Lake Ziway	1998
5	Melka Korma	Welda Kelina	28	9	37	16.6	Lake Ziway	1998
6	Melka Aba Godan	Welda Kelina	18	1	19	7.8	Lake Ziway	1998
7	Oda Bokota	Oda Bokoda	0	23	23	5.0	Meki River	1999
8	Teppo-140	Teppo Choreke	40	0	40	13.0	Lake Ziway	1997
9	Cheleleka Denbel	Doddata Dembel	34	1	35	10.9	Lake Ziway	1998
10	Doddata Denbel	Doddata Dembel	15	0	15	18.1	Lake Ziway	1997
11	Woyyo Gabriel	Wayyo Gabriel	19	5	24	13.8	Lake Ziway	1995
12	Walda Kelina	Welda Kelina	30	1	31	8.6	Lake Ziway	1998
13	Wayyo Serrit	Wayyo Gabriel	28	4	32	17.0	Lake Ziway	1999
14	Tuchi Denbel	Tuchi Denbel	16	0	16	15.3	Lake Ziway	1995
15	Jara Wayu	Elen	20	5	25	8.0	Lake Elen	1998
	TOTAL		441	59	500	404.6		

Source: OIDA Office, Meki (2000)

APPENDIX VIII
ENVIRONMENT ASSESSMENT AND
WATERSHED MANAGEMENT

Figures

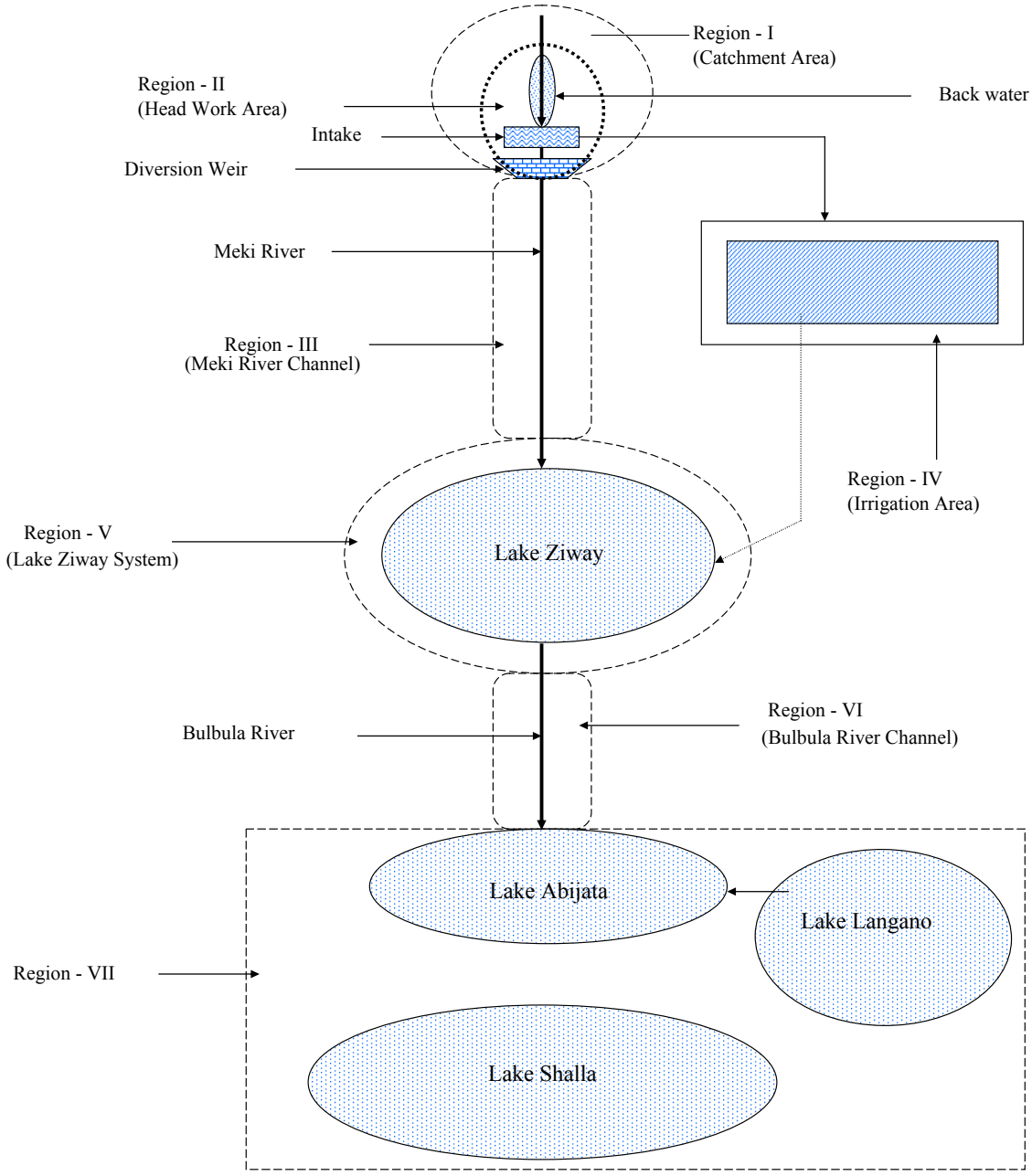


The Study for
Meki Irrigation and Rural Development Project
in Oromia Region, Ethiopia

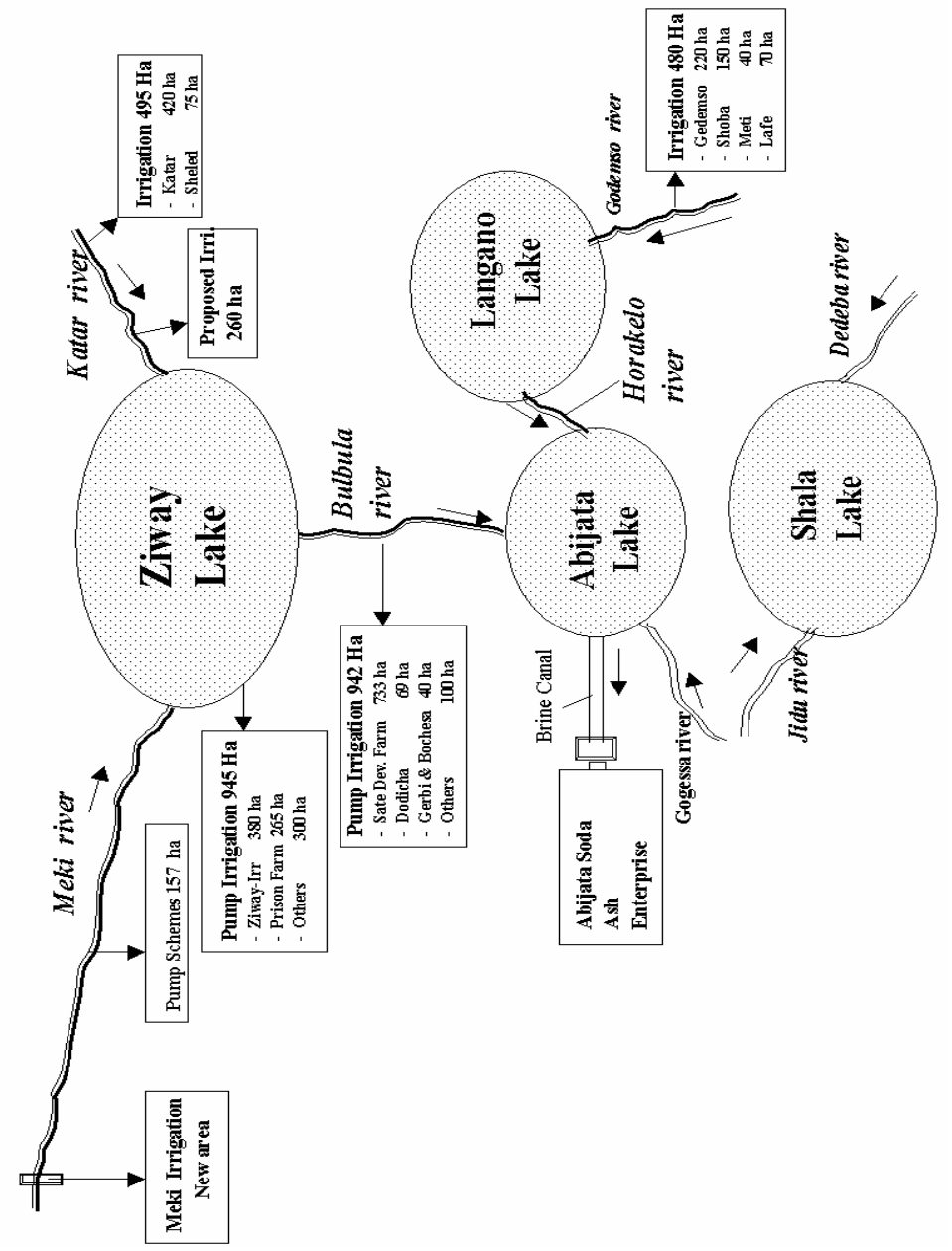
Japan International Cooperation Agency

Figure VIII.1.1

Study Area



The Study for Meki Irrigation and Rural Development Project in Oromia Region, Ethiopia	Figure VIII.4.1 Ecological Regions of the Project Area
Japan International Cooperation Agency	



The Study for Meki Irrigation and Rural Development Project in Oromia Region, Ethiopia	Figure VIII.4.2 Water Utilization in the Meki-Ziway-Abiata Water Resources System
Japan International Cooperation Agency	