



Government of the Republic of Ethiopia  
**EEPCO (Ethiopian Electric Power Corporation)**  
Addis Ababa, Ethiopia

# **GILGEL GIBE II POWER TRANSMISSION PROJECT**



## **Environmental and Social Impact Assessment**

*Milano, August 2004*



**ELC-Electroconsult**

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## **ANNEXES**

### **Annex I The Ethiopian Environmental Laws**

- 001 Proclamation N°9/1995 “Environmental Protection Authority Establishment Proclamation” 24<sup>th</sup> August, 1995
- 002 Proclamation N°295/2002 “Environmental Protection Organs Establishment Proclamation” 31<sup>st</sup> October, 2002
- 003 Proclamation N°299/2002 “Environmental Impact Assessment Proclamation” 3<sup>rd</sup> December, 2002
- 004 Proclamation N°300/2002 “Environmental Pollution Control Proclamation” 3<sup>rd</sup> December, 2002
- 005 Proclamation N°...../2003 “A Proclamation to provide for appropriation of land for government works & payment of compensation for property “ (DRAFT)

### **Annex II Plans**

- 001 HVTL General Plan (Scale 1: 500.000)
- 002 HVTL GGII HEP Switchyard – Welkite Substation (Scale 1: 250.000)
- 003 HVTL Welkite Substation – Sebeta Substation (Scale 1:500.000)
- 004 HVTL GGI HEP Switchyard – GGII HEP Switchyard (Scale 1:125.000)

### **Annex III List of the people that attended to the meetings**

- 001 Meeting in Woira
- 002 Meeting in Gomsha
- 003 Meeting in Gasore
- 004 Meeting in Guraghe Zone (SNNPR) office
- 005 Meeting in South-western Shoa Zone (Oromiya Region) office

### **Annex IV Pictures**

## ABBREVIATIONS

ADB	Asian Development Bank
ADLI	Agricultural Development Led Industrialization
AfDB	African Development Bank
ARCCH	Authority for Research and Conservation of Cultural Heritage
CEP	Country Environmental Profile
CSA	Central Statistics Authority
CSE	Conservation Strategy of Ethiopia
EA	Environmental Assessment
EBRD	European Bank for Reconstruction and Development
EPCO	Ethiopian Electric Power Corporation
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EMaP	Environmental Management Plan
EMF	Electromagnetic Field
EMoP	Environmental Monitoring Plan
EMU	Environmental Monitoring Unit
EPA	Environmental Protection Authority
EPE	Environmental Policy of Ethiopia
ESIA	Environmental and Social Impact Assessment
EU	European Union
FDRE	Federal Democratic Republic of Ethiopia
GOE	Government Of Ethiopia
GGIHEP	Gilgel Gibe I Hydro Electric Power Plant
GGIIHEP	Gilgel Gibe II Hydro Electric Power Plant
HVTL	High Voltage Transmission Line
IDB	Inter-American Development Bank
IEE	Initial Environmental Examination
INIRC	International Commission on Non-ionizing Radiation Protection
IRPA	International Radiation Protection Association
NRPB-UK	United Kingdom - National Radiation Protection Board
REA	Regional Environmental Agencies
ROW	Right Of Way
SNNPR	Southern Nations and Nationalities People's Region
STDs	Sexual Transmitted Diseases
TL	Transmission Line
WB	World Bank
WHO	World Health Organization

# 1. FOREWORDS

## 1.1 GENERAL

The review of the Environmental and Social Impact Assessment is a part of Agreement No. 33-20/99, between EEPCO and ELC ELECTROCONSULT S.p.A, for Engineering Services for Gilgel Gibe II Power Transmission Lines and Substations Project.

In general terms the purpose of the ESIA is to predict the negative and positive impacts that are likely to occur as a result of preparing, constructing and operating the HVTL. Moreover the ESIA should also identify measures to avoid, reduce or compensate the identified negative impacts.

In details the assessment, according to Terms of Reference, has the following targets:

- visit project sites between GGIIHEP switchyard and Addis Ababa, focusing on the densely settled area of Welkite, evaluating critical environmental issues, if any;
- review the IEE report prepared by EEPCO local offices;
- consider the Environmental Management and Monitoring aspects;
- prepare the Environmental and Social Impact Assessment report in accordance with financing agencies guidelines.

The following assessment was carried out by ELC Power Environmentalist, as part of the activities requested by EEPCO, from July to August 2004.

## 1.2 METHODOLOGY

ELC was charged with the responsibility of reviewing the ESIA prepared by EEPCO officers and of predicting the likely environmental consequences of implementing project activities.

For these reasons the following actions have been undertaken:

- Areas with distinct characteristics based on settlement pattern, production system, agro climates zones have been chosen for sampling;
- List of names for house hold heads has been prepared for random selection;
- Interviews with community house holds and community elders have been carried out;
- Meetings with local communities and focus group discussions have been organized;
- Meetings with Weredas agricultural and environmental officers of the affected regions or zones have been held;

- Relevant literature has been reviewed.
- Topographic maps (1:50.000 and 1:250.000) have been used during the assessment.

According to the above targets, the ELC consultant, together with EEPSCO officers, performed the following activities:

- on July 7 ELC Power Environmentalist organized the inspections to the HVTL route sites together with Mr. Yohannes (EEPCO Environmental Expert) and Mr. Belay (EEPCO Project Manager);
- on July 8 and 9 ELC Power Environmentalist analysed the available documentation in Addis Ababa project office, the route's maps and the Ethiopian legislation framework;
- on July 10 and 11 ELC Power Environmentalist carefully reviewed the Draft Initial Environmental Report prepared by Mr. Yohannes (EEPCO Environmental Expert);
- on July 12, 13, 14 and 15 ELC Power Environmentalist together with EEPSCO Environmental Expert performed the inspection visit to the HVTL route and to the substations sites. During the visit several meeting with local communities chiefs were held in order to understand the perception of the project by rural people and to evaluate the resettling problems and related solutions with local communities;
- on July 16 the Environmental problems and aspects highlighted during the site visits were deeply discussed with EEPSCO Environmental Expert and EEPSCO Project Manager;
- on July 17 ELC Power Environmentalist together with EEPSCO Environmental Expert performed the inspection visit to the HVTL route between Woliso and Addis Ababa and to the substations sites. During the visit they had a meeting with the Oromiya Zone Administrative Officers and with some local communities in order to discuss with the affected communities, the resettlement and compensation problems;
- On July 18 and 19 the site visit report, with a tentative evaluation of compensation costs was prepared by the consultant.
- From July 20 to August 5 the consultant prepared the following report in ELC Italian home office.

### 1.2.1 Assessment Team

A team consisting of ELC – Electroconsult experts and members of EEPCO was assembled and given the responsibility for conducting the ESIA and preparing the draft and final reports.

The team included of the following members:

- Mr. E. Romagnoli (ELC Power Environmentalist);
- Mr. G.F. Pedroni (ELC Project Director);
- Mr. G. Pellizzaro (ELC Project Manager);
- Mr. Y. Yohannes (EEPCO Environmental Expert);
- Mr. T. Belay (EEPCO Project Manager);
- Mr. Assafa (EEPCO Surveyor for the HVTL GGIIHEP - GGIIHEP Switchyards);
- Mr. H. M. Dagne (EEPCO Surveyor for the HVTL GGIIHEP Switchyard- Welkite);
- Mr. Ababayehu and Mr. Nega (EEPCO Surveyors for the HVTL Welkite -Addis A.).

## **2. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORKS**

### **2.1 INSTITUTIONAL AND ADMINISTRATIVE FRAMEWORK**

The Federal Democratic Republic of Ethiopia (FDRE) includes the Federal State and nine Regional State Members.

The Power and duties of the Federal, Regional and Local governments have been defined by proclamations n° 33/1992, 41/1993 and 4/1995.

Under these proclamations, duties and responsibilities of Regional States include planning, directing and developing social and economic development programmes, as well as the protection of natural resources of their respective regions.

#### **2.1.1 Regional Government**

The HVTL project between GGIHEP-GGIIHEP-Welkite Substation-Sebeta Substation crosses the following zones:

- Guraghe Zone of Southern Nations and Nationalities People's Region (SNNPR);
- South-western zone of the Oromiya Region;

The Oromiya and SNNPR Regional Governments are regional states established by the Federal Government.

The Regions have Zones and Woredas. Within each Woreda there are Kebeles or Peasant Associations. Each administrative unit has its own local government elected by the people.

The Regional Governments have established sector Bureaus, Commission and Authorities.

#### **2.1.2 Environmental Protection Authority (EPA)**

The Environmental Protection Authority (EPA) was first established in August 1995 under the proclamation N° 9/1995 (please refer to Annex I – 001) and re-established in October 2002 under the proclamation N° 295/2002 (please refer to Annex I – 002). It is an autonomous government body reporting directly to the prime minister.

EPA has broad mandates covering environmental matters at federal level. The proclamation sets out the main responsibilities and broad organizational structures of EPA such as:

- Preparing policies and laws on environmental protection;
- Preparing directives and implementation of systems for the evaluation of the impact of projects on the environment;
- Preparing environmental protection standards and implementation of directives on soil, water and air;

- Enforcing implementation of EIA process (i.e. review EIA reports).

### **2.1.3 Agricultural Institutions**

The Ministry of Agriculture and Rural Development has delegated almost its authority to the regional Bureau of Agriculture and Rural Development.

## **2.2 ENVIRONMENTAL NATIONAL POLICIES AND STRATEGIES**

The Constitution dictates important provisions relevant to the countries environmental policy: art. 44 states that all persons have the right to live in a clean and healthy environment, art. 92 oblige the government to make all efforts to provide every Ethiopian with clean and healthy environment.

Articles 91 and 92 also hold the government and the people of Ethiopia responsible for the preservation of natural resources and maintenance of ecological balance.

### **2.2.1 Conservation strategy of Ethiopia (CSE)**

Since the early 1990s, the GOE has undertaken several initiatives to develop regional, national and sector strategies for Environmental conservation.

Paramount amongst these was CSE, approved by the council of ministers, which provided a strategic framework for integrating environmental planning into new and existing policies, programmes and projects.

Although yet to be approved by the GOE, the CSE is an important strategical document which views environmental management from several perspectives.

The CSE itself provides a comprehensive and rational approach to environmental management in a broad sense, covering National and Regional Strategies, sector and cross sector strategy, action plan and programmes, as well as establishing the basis for development of appropriate institutional and legal frameworks for implementation (EPA/MEDAC 1996).

Based on CSE, the Oromiya and SNNP Regional Governments have already prepared conservation strategy document for their respective region. The document specifies environmental issues prevalent in the territory, and indicates the guidelines for facing environmental issues.

### **2.2.2 Ethiopian Environmental Policy**

The Environmental Policy of Ethiopia (EPE) was approved by the council of ministers in April 1997 (EPA/MEDAC 1997). It is based on the CSE which was elaborated through consultative processes over the period 1989-1995.

The policy has the intent of rectifying previous policy failures and deficiencies which in the past have led to serious environmental degradation. It is fully integrated and compatible with the main long terms economic development strategy of the country, known as Agricultural Development Led Industrialization (ADLI), and other key national policies like the national population policy and the national policy on women.

EPE's main policy goals can be summarized in terms of improvement and enhancement of the health and quality of life of all Ethiopians and of promotions of sustainable social and economic development through the adoption of sound environmental management principles.

Specific Policy objectives and key guiding principles are set out clearly in EPE, and expand on various aspects of the main goal.

EPE includes sector and cross sector policies as well as provisions for the appropriate implementation of the policy itself.

Among the sector policies, the wildlife policy is the one developed by the ministry of Agriculture aiming to preserve, develop and utilize the countries wildlife resources.

Water resources policy and biodiversity policy can also be cited as the ones that already were implemented in the country.

## **2.3 ENVIRONMENTAL FRAMEWORK LEGISLATION**

### **2.3.1 Proclamation on Institutional Arrangement for Environmental Protection**

The Proclamation for the Establishment of Environmental protection organs, n° 295/2002 was issued to establish a system which separates and in the meanwhile coordinates the coordinated but differentiated responsibilities among environmental protection agencies at Federal and Regional levels.

The Proclamation recognizes assigned responsibilities to different organizations for environmental development and management activities on one hand, and environmental protection, regulations and monitoring on the other. This behaviour is instrumental for the sustainable use of Environmental resources, avoiding possible conflicts of interest and efforts duplication.

### **2.3.2 Proclamation on Environmental Impact Assessment (EIA)**

The primary aim of the proclamation on EIA, N° 299/2002 (please refer to Annex I – 003) is to make EIA mandatory for specified categories of activities undertaken by the public or private sectors and to define the extension of EIA for policies, plans and programmes in addition to projects.

The provision of the proclamation includes:

- Projects shall be subjected to EIA and their implementation is subjected to an environmental clearance from the EPA or the Regional Government Environmental agency, as applies;
- EPA or the regional agency, depending on the magnitude of expected impacts, may waive the requirement of an EIA;

- All other licensing shall, prior of license issuing, ensure that either EPA or the regional environmental agency has authorized the implementation of the project;
- A licensing agency shall either suspend or cancel a license that has already been issued in case that EPA or the regional environmental agency suspends or cancels the environmental authorization.

There are also procedures that must be followed in EIA Process.

### **2.3.3 Proclamation on Environmental Pollution Control**

The proclamation on Environmental pollutions control N° 300/2002 (please refer to Annex I – 004) is mainly based on the right of each citizen to live in a healthy environment, as well as on the obligation to protect the environment of the country.

The primary objective of the proclamation is to provide the basis from which the relevant environmental standards applicable in Ethiopia can be developed, and to punish the violation of these standards.

The proclamation states that the “polluter pays” principle will be applied to all persons.

Thanks to this proclamation EPA and REA inspectors have the authority to ensure implementation and to enforce environmental standards and related requirements.

## **2.4 LEGAL FRAMEWORK FOR EXPROPRIATION AND COMPENSATION**

### **2.4.1 Land tenure**

Land in Ethiopia is state owned according to the proclamations N°31/1975 (concerning rural land) and N° 47/1975 (concerning urban land). Under article 3 (1) of the first proclamation, all rural land shall be a collective property of the Ethiopian people.

In December 1994 the new constitution was approved, retaining land under Ethiopian people and government control.

Article 40 states that ownership of both urban and rural land is a common property which is not subjected to sale or other means of exchange.

Peasants have the right to obtain land without payment and are protected against eviction from their land.

### **2.4.2 Expropriation**

In Ethiopia involuntary relocation due to expropriation is addressed in the civil code, N° 165/1980 (Arts 1460-1488) under this code the owner may be compelled to surrender the ownership of land for public purpose.

According to the constitution of FDRE, individuals who have built a property or have carried out improvements of their grant of land have the vested right of immovability.

The government may expropriate such property for public purposes, under advance payment of the property value or other means of compensation, as relocation with adequate state assistance.

### 2.4.3 Compensation

Article 7 (2) of proclamation 4/1975 states that the government shall pay fair compensation for property built on the grant of land, but the amount of compensation shall not include the value of the land since the land is state owned.

The constitution lays down the basis for the property compensation in case of expropriation as a result of state programmes or projects in both rural and urban areas. Article 44.2 states that *“All persons who have been affected or whose livelihoods have been adversely affected as a result of state programmes have the right to a commensurate monetary or alternative means of compensation, including relocation with adequate state assistance.”*

Therefore, persons who have lost their land as a result of HVTL projects are entitled to be compensated with a similar land and with the related costs arising from relocation: assets such as buildings, crops or fruit trees that are part of the property, etc...

Hence project planning must include an “attractive” and sustainable resettlement strategy, offering adequate compensation and incentives to the loss of livelihood.

A new proclamation to provide for appropriation of land for government works and payment of compensation for property is actually under approval by FDER (please refer to Annex I – 005).

## 2.5 INTERNATIONAL REQUIREMENTS

### 2.5.1 Multilateral agreements

The FDRE has ratified several international convention and protocols, which include:

- Vienna convention on Ozone layer protection (1996);
- Montreal protocol for substances depleting the Ozone layer (1996);
- The Rio de Janeiro convention on biodiversity (1994);
- Cartagena protocol on biosafety (2003);
- Frame work convention of U.N. on climate change (1994);
- Basel Convention for control and regulation of tranboundary movement of hazardous substances (1989);
- Bamako convention on the Ban of the Import into Africa and the Control of Tranboundary Movements and Management of Hazardous Wastes within Africa, (1991);
- African convention on the conservation of nature and natural resources;

- Ramsar convention on wet lands of international importance (1971);
- U.N. Convention to combat desertification (1997);
- Paris convention concerning the protection of world cultural and natural heritage (World Heritage Convention) (1972);
- Convention on international trade in endangered species (CITES) (1970);
- Stockholm convention on persistent organic pollutants (POPs) (2002)

### **2.5.2 Regional requirements**

The Regional Development Banks, such as EBRD, AfDB and ADB, have environmental policies and guidelines mostly similar to those of the WB.

The Regional Development Banks use environmental screening to grade projects as category A, B or C (ADB & EBRD), or as category I, II or III (AfDB). These categories are similar, in principle, to those of the WB with only minor differences between each bank.

IDB and EBRD procedures are developed from WB ones (Hydro Power development, Environmental effects, 1955).

The fact that responsibility for meeting the lands environmental requirements rests with the borrower, is common to all the Regional Development Banks and to World Bank.

The EIA Report shall be commissioned and/or carried out by the authorities of the country, seeking loan.

The banks normally oversee EA works of potentially controversial projects by establishing independent expert panels to control and to inform about the dealing of certain environmental aspects.

### **3. REVIEW OF EEPKO PREVIOUS ENVIRONMENTAL STUDIES**

Mr. Yohannes, EEPKO Environmental expert, together with EMU and assigned surveyors carried out an Initial Environmental Examination (IEE) on 2004.

The Report is based on Government Laws and Regulations concerning analysis of environmental impacts, land acquisition procedures and other pertinent aspects.

The IEE appears to be exhaustive and considers all the most important aspects related to HVTL Environmental Impact.

It is particularly focused on the legislative framework regarding environmental aspects and expropriation and compensation of land acquisition.

It contains a description of the existing environment and his human and natural components, assessing negative and positive impacts either temporary or permanent.

Socio-economical aspects, which are the most important in HVTL projects, have been examined.

Moreover some mitigation measures have been established and an Environmental Management Plan (EMaP) has been defined.

However as agreed, during the first days meetings with EEPKO officers, the social aspects of the project and namely the resettlement of the affected people must be examined closer.

The consultant's field activity was, therefore, focused on the perception of the feeling that local communities have about the project, involving them in the evaluation of the correct price of compensation of crops and affected houses.

## 4. PROJECT INFORMATION

### 4.1 PROJECT DESCRIPTION

The aim of the Project is to connect the new Gilgel Gibe II Hydroelectric plant to the Interconnected System, through High Voltage transmission line from Gilgel Geibe II to Sebeta (Addis Ababa) substations passing near Wolkitie area (please refer to Annex II-001).

The project will transfer a 400 MW electric power to the grid.

It is intended to construct a 400 kV single circuit transmission lines. This line, around 230 km length will be constructed from Gilgel Gibe II switchyard to a new 400/230 kV substation using the area in the existing Sebeta substation. For reliability purposes a single circuit 400 kV line with around 45 km length is also proposed to be constructed from Gilgel Gibe I HEP switchyard to Gilgel Gibe II HEP switchyard.

The 400 kV lines would be supported by steel lattice tower with hot deep galvanized members.

The conductor to be used shall be selected by the feasibility study and confirmed during subsequent detail design.

As for the substations, a 400/230 kV substations will be made in the existing substations of Sebeta and Gilgel Gibe I.

#### 4.1.1 System Option Analysis

During the feasibility study, two options were considered to alleviate the transmission system problems and minimize some of the environmental and socio-economic impacts:

Option 1. requires a 400 kV complete transmission line but energization of the line with 230 kV temporarily. This doesn't require establishing a new substation but to extend the existing 230 kV substations at Sebeta and Gilgel Gibe I;

Option 2. requires the construction of a 400 kV transmission line from GGII HEP to Sebeta and Gilgel Gibe I substations.

From environmental point of view both options doesn't need new substation area. Considering that Option 2 is the best option from the economical point of view based on the future generation expansion, this HVTL route was selected by the feasibility study.

#### 4.1.2 Synthesis of project characteristics

The main components of the project can be summarized as follows:

- construction of an interconnection line between the switchyard of the designed GGII hydropower plant passing by the Welkite area (70 km) to the existing Sebeta substation in Addis Ababa (140 km from Wolkite) (please refer to Annex II – 002 and Annex II – 003);
- the construction, for reliability purpose, of an interconnection line between the switchyard of the existing GGI hydropower plant and the designed GGII hydropower plant (between 33 and 26 km) (please refer to Annex II – 004).

#### 4.1.3 Project Benefits

The construction of the power line would improve services, promote the conservation of forest resources by reducing fuel wood consumption and biomass resources, increase reliability and provide additional flexibility for future development and expansion when necessary.

The availability of electric power in an area plays a significant role in:

- Economic development: the availability of electric power allows the development of industries. Referring to CEP prepared by the GOE, industrialization in the country shall take place through the development of agriculture which is expected to play a leading role. Industrialization is seen as the most important means of reducing the impact of population on the natural resources base. Priority areas of action in this sector consist in encouraging agro-based industrial undertakings which will use local raw materials as much as possible. The government also intends to give priority to industries which will use labour intensive technologies in order to create job opportunities easing the pressure on natural resources in rural areas.
- Reducing pressure on biomass resources: domestic energy requirements are mainly met by of fuel wood, charcoal, cow dung and crop residue. The main environmental problems arising from the use of biomass energy include loss of biodiversity, loss of shelter and shade, reduction of crops fertility, soil erosion, which result in the pollution of rivers and lakes. Gases such as CO<sub>2</sub> and CH<sub>4</sub> from burning biomass and fossil fuels pollute the environment.

In order to reduce the pressure on biomass, as a short terms measure, GOE is giving high priority to increased tree planting.

However GOE, on long term perspective intends to switch to alternative sources of energy such as hydropower, geothermal power, biogas, wind, solar, etc. both developing the existing potential (mainly hydroelectric) and increasing the transmission and distribution system through new HVTL's and through an intensive rural electrification program.

## 5. ANALYSIS OF THE EXISTING ENVIRONMENT

### 5.1 SOCIO-ECONOMIC ENVIRONMENT

The affected areas belong to the following administrative Regions:

- Guraghe Zone of Southern Nations and Nationalities People's Region (SNNPR) (most of the line between GGII switchyard and Welkite);
- South-western Zone of the Oromiya Region (most of the line between Welkite and Sebeta Substation);
- Guraghe Zone of Southern Nations and Nationalities People's Region (SNNPR) and Oromiya Region (the line between GGI and GGII switchyards)

#### 5.1.1 Population

According to the census of Central Statistics Authority (CSA), the total Woreda population along the transmission line route is estimated to be 1.525.650.

The density of population in each Woreda is not the same.

The average population density along the 70 km stretch of GGIIHEP up to Welkite substation (in the Guraghe Zone) is 211,1 persons per km<sup>2</sup>, while average population density in the stretch from Welkite substation to Sebeta substation (Oromiya Zone) is 167,8 persons per km<sup>2</sup>.

Though there is no available data of population growth for the specific localities, the country's average annual population growth is estimated to be 2.73 % (National Office of Population).

#### 5.1.2 Settlement pattern, housing and household economy

The settlement pattern of the population is totally permanent type of settlement.

In the Guraghe Zone most of the population along the line routes are sedentary cultivators, supporting their livelihood from the traditional agro-silvi-pastoral production.

They cultivate their land mainly with perennial or permanent crops, see Table 5.1 (please refer to Annex IV, pictures 1-9):

**Table 5.1. Permanent crops**

▪ ENSET	( <i>Enset ventricosum</i> )	also known as false banana is the most common staple food in these areas
▪ COFFEE	( <i>Coffea Arabica</i> )	are the major cash crops for farming communities
▪ CHAT	( <i>Chat Edulis</i> )	
▪ EUCALYPTUS	( <i>Eucalyptus sp.</i> )	

The annual crops like vegetables, corn and root crops are usually intercropped with the permanent crops.

The crop production is mainly dependent on rainfalls.

The traditional livestock production though constrained by feed shortage it is also one of the communities' economic sources to integrate the crop cultivation practice.

The land holding size per household in Guraghe land varies from 0.1 to 0.2 Ha.

In the Oromiya Zone the population settlement is scattered.

They cultivate their land mainly with annual crops (please refer to Table 5.2).

**Table 5.2. Annual crops**

▪ TEFF	<i>(Eragrostis teff)</i>
▪ WHEAT	<i>(Triticum aestivum)</i>
▪ MAIZE	<i>(Zea mays)</i>
▪ LENTILS	<i>(Lens culinaris)</i>
▪ PULSE SEEDS	

The used farming techniques are still traditional ones, with land worked with animal traction scratch plow (please refer to Annex IV, picture 10).

The farmers usually support their livelihood from the sale of the mentioned crop production.

These areas have different settlement and cultivation characteristics:

- the area between the switchyard of the designed GGII hydropower plant and the existing Welkite substation, is densely populated (around 1 Tukul<sup>1</sup> every 0.5 km of line alignment) and cultivated (75%). In this area the main crops are: Enset (False Banana), Coffee, Chat and Eucalyptus;
- the area between the existing Welkite substation and the existing Sebeta substation in Addis Ababa is more scattered populated (around 1 Tukul every 2 km of line alignment) and cultivated: permanent crops represent here less than 10% of the total length (140 km), in the remaining portion of the line annual crops (such as teff, wheat, maize, etc...) are found;
- in the area between the switchyard of the existing GGIHEP and the designed GGIIHEP the population has a medium density (around 1.5 Tukul per km of line alignment) and permanent crops represent here around 50% of the total length (26 or 33 km), in the remaining portion of the line there are wild scattered vegetation and grazing areas.

### 5.1.3 Social services

The development of social services, particularly health and education, in all Woredas are low.

<sup>1</sup> The **Tukul** is the typical house where farmers live. There are different kinds of tukuls, but mainly they are made with wooden walls covered by mud and with grass roofs (please refer to Annex IV picture 11).

The health coverage in the Guraghe Zone and Oromiya Region are respectively 48% and 46.91% (the national health coverage is around 51.24%).

The main diseases in these areas are:

- In Guraghe Zone:
- unspecified Malaria;
  - gastro-intestinal parasites;
  - broncho and atypical pneumonia;
  - upper respiratory tract infection;
  - trachoma & other eye diseases;
  - skin and subcutaneous infections;
  - amoebiasis.
- In Oromiya Region:
- acute upper respiratory infections;
  - lower respiratory tract infections;
  - all forms of Malaria;
  - intestinal parasites;
  - gastritis and duodenitis;
  - skin and subcutaneous infections;
  - all other diseases of genitor-urinary system;
  - all forms of Tuberculosis.

Regarding the education services there are 250 schools at primary & junior level and 12 schools at senior secondary level giving service in different Woredas of the Guraghe Zone.

The total number of students currently enrolled at all levels is 258.842 (95% at primary and junior level and 5% at senior and secondary level).

## **5.2 PHYSICAL AND BIOLOGICAL ENVIRONMENT**

### **5.2.1 Physical characteristics**

The line route passes through undulating hills and flat, locally swampy areas, which elevation varies between 1.980 and 2.400 m a.s.l.

Locally (in the stretch between GGI switchyard and GGII switchyard), mountainous areas (up to 3.000 m a.s.l.) are crossed.

The interconnection line crosses the Gibe River between GGI and GGII switchyards.

The line crosses several perennial rivers such as Dogossa, Zikir, Winke, Rebu and Wabe and also several intermittent streams in the study area.

Both perennial and intermittent rivers are used by the communities for human and livestock consumptions.

Locally the water of some rivers is used also for irrigation purposes.

The land use in the studied area comprises:

- Cultivated land;
- Grazing land;
- Shrub & Bush land;
- Rural settlement.

Overgrazing, deforestation and intensive cultivation techniques have produced large soil erosion problems in several areas, mainly where Eucalyptus trees are planted (please refer to Annex IV, picture 12).

### 5.2.2 Flora & Fauna

The natural vegetation coverage of the area is generally low.

The population density is, together with the conversion into crops and grazing land, the main deforestation factor.

The autochthonous tree species sparsely present in the area are:

- *Albizia schimperiana*,
- *Podocarpus gracilior*,
- *Croton machrostachys*,
- *Cordia Africana*,
- *Sapium ellipticum*,
- *Juniperus procera*,
- *Phoenix reclinata*,
- *Syzygium guineense*,
- *Acacia sp.*
- *Ficus sp.*

The main bush and shrub species found in the area are:

- *Dodonea viscosa*,
- *Pterolobium stelatum*,
- *Carrissa schimperiana*.

The exotic Eucalyptus tree species are widely grown on individual land holdings as the major cash crops for the communities.

Due to the decline of the natural habitat, the diversity of wild animals in the studied area is expected very small, however the following animals are found: Hyenas, Porcupines, Foxes, Monkeys, Hares, Duikers, Guinea Fowls and other different Bird species (please refer to Annex IV, picture 13)

## 6. REPORT OF FIELD VISIT

### 6.1 SITE VISITS

From the 12<sup>th</sup> to the 17<sup>th</sup> of July 2004, the Consultant together with Mr. Y.Yohannes (EEPSCO Environmental Expert) assisted by the surveyors carried out an inspection along the proposed HVTL alignment and had several meetings with local communities.

From a socio-environmental point of view, the impression is that the main aspect that has to be taken in consideration is the impact that the construction of the line is likely to have on local communities' homes and crops.

In the next paragraphs the activities carried over during the week, data collected, assemblies with local communities and meetings with zone authorities are described.

#### 6.1.1 From GGII switchyard to Welkite

The area between the switchyard of the designed GGII hydropower plant and the existing Welkite substation, is densely populated (around 1 Tukul every 0.5 km of line alignment) and cultivated (75%). In this area the main crops are: Enset (False Banana), Coffee, Chat and Eucalyptus.

In order to minimize the impact on local communities, focus group discussions with the representatives of some selected villages were held (please refer to Annex IV, pictures 14 - 20).

The persons that attended to the meetings were affected households, community elders and chairmen of local peasant associations (please refer to Annex III – 001, 002, 003).

During the discussion with local communities (Woirra, Gomsha and Gasore) members the following aspects were highlighted:

- their awareness that the project plays a vital role in the National Economic Development of the country;
- their general good attitude or impression on the project, expecting employment opportunities and some income generated by the presence of workers studying and constructing the line alignment;
- their expectation to be able to get electric power supply to their localities, in order to improve their livelihood status;
- the fact that all the affected family heads must be properly compensated for all their losses (houses and permanent crops);
- regarding people relocation, each community underlined that affected people resettling within the community area is possible, due to the availability of space.

After that each focus group was asked to give a value to houses and permanent crops that will be affected by the project (the data given are reported in table 6.1).

In order to make local population aware of the project and to establish a collaborative relationship, local zone authorities were contacted.

During the discussion, the representatives of zone administration and agricultural offices (please refer to Annex III - 004) underlined that:

- all affected family heads must be properly compensated for their losses;
- the compensation values of the resources must be well defined before expropriation procedure starts and, in any case, before acquiring the area for construction.

Moreover, they strongly recommended to establish an evaluation committee (that shall include also affected members' representatives), whose goals will be the definition of the proper value of the different items (houses and crops) affected by line construction.

### **6.1.2 From Welkite to Sebeta**

The area between the existing Welkite substation and the existing Sebeta substation in Addis Ababa is sparsely populated (around 1 Tukul every 2 km of line alignment) and cultivated: permanent crops represent here less than 10% of the total length (140 km), in the remaining portion of the line annual crops (such as teff, wheat, corn, etc...) are found.

In order to minimize the impact on local communities, some interviews with the representatives of some selected affected areas were held (please refer to Annex IV, pictures 21, 22).

During the discussion with local communities (Fodu Gora and Obi Koji Peasant Associations) members, the following aspects were highlighted:

- their awareness that the project plays a vital role in the National Economic Development of the country;
- their general good attitude or impression on the project, expecting employment opportunities and some income generated by the presence of workers studying and constructing the line alignment;
- the fact that all the affected family heads must be properly compensated for all their losses (houses and permanent crops);
- regarding people relocation, each community underlined that affected people resettling within the community area is possible, due to the availability of space.

After the discussion, the representatives gave us a value of houses and permanent crops that will be affected by the project (please refer to table 6.1).

In order to make local population aware of the project and to establish a collaborative relationship, local zone authorities were contacted (please refer to Annex III - 005).

During the discussion, the representatives of zone administration and agricultural offices underlined that:

- all affected family heads must be properly compensated for their losses;

- the compensation values of the resources must be well defined before expropriation procedure starts and, in any case, before acquiring the area for construction;

Moreover they strongly recommended to establish an evaluation committee (that shall include also affected members representatives), whose goals will be definition of the proper value of the different items (houses and crops) affected by line construction.

### 6.1.3 From GGI HPP Switchyard to GGII HPP Switchyard

In the area between the two switchyards the population has a medium density (around 1.5 Tukul per km of line alignment) and permanent crops represent here around 50% of the total length (26 or 33 km), in the remaining portion of the line there are wild scattered vegetation and grazing areas.

Considering that this portion of the HVTL is still at the pre-feasibility stage the local communities were not consulted.

However the senior surveyor of Gilgel Gibe I Hydropower project, Mr. Assafa, gave an idea of the value of crops and houses in the area to the Consultant.

Considering his long experience on the area the information given by him were also reported in table 6.1.

## 6.2 SYNTHESIS OF RESOURCES VALUES

Local communities, local affected people, administrative zones and agricultural officers and experienced surveyors were asked to give a value to the resource that HVTL construction may affect.

In order to standardize the values the following categories were established:

**HOUSES** (Tukul, wood walls with grass roof) (please refer to Annex IV, picture 11);

- |            |                 |
|------------|-----------------|
| 1) Small : | < 7 m diameter  |
| 2) Medium: | 7-10 m diameter |
| 3) Large:  | > 10 m diameter |

**PERMANENT CROPS** (please refer to Annex IV, pictures 1-9);

#### ENSET

- |                        |                  |
|------------------------|------------------|
| 1) Small :             | 1 – 3 years old; |
| 2) Medium:             | 3 – 5 years old; |
| 3) Large (productive): | 6 – 7 years old; |

#### CHAT

- |                        |                         |
|------------------------|-------------------------|
| 1) Small :             | 1 – 7 years old;        |
| 2) Medium:             | 8 – 15 years old;       |
| 3) Large (productive): | more than 15 years old; |

**COFFEE**

- 1) Small : 1 – 4 years old;
- 2) Medium: 4 – 8 years old;
- 3) Large (productive): more than 8 years old;

**EUCALYPTUS TREES**

- 1) Small : 1 – 8 years old;
- 2) Medium: 8 – 20 years old;
- 3) Large: more than 20 years old;

The values given, divided into the mentioned categories, are summarized in the following table 6.1.

**Table 6.1 Values of the different resources at survey date (in Ethiopian Birr)**

EVALUATION BY	TUKUL			ENSET			CHAT			COFFEE			EUCALYPTUS		
	s	m	l	s	m	l	s	m	l	s	m	l	S	m	l
Woirra	10.000	15.000	20.000	3	5	8	5	20	50	15	50	100	5	38	75
Gomsha	10.000	15.000	20.000	5	8	15	10	30	60	50	70	100	20	38	75
Gasore	10.000	18.000	25.000	10	15	20	50	100	150	100	150	200	50	100	200
Guraghe zone	7.000	15.000	30.000	7	15	20	10	20	30	7	9	15	20	75	300
<b>Guraghe aver.</b>	9.250	15.750	23.750	6,3	10,8	15,8	18,8	42,5	72,5	43,0	69,8	103,8	23,8	62,8	162,5
Fodu Gora	1.500	3.000	6.000	10	15	25	15	30	50	5	10	20	10	50	100
Obi Koji	3.000	4.000	6.000	10	15	20	2	5	10	5	-	-	5	25	150
Oromiya zone	-	-	-	-	15	-	-	-	-	-	-	-	-	20	-
<b>Oromiya aver.</b>	2.250	3.500	6.000	10	15	22,5	8,5	17,5	30	5	10	20	7,5	31,7	125
Mr. Assafa	3.000	6.000	10.000	-	-	-	-	-	-	-	-	-	-	-	-
<b>TOTAL AV.</b>	<b>6.357</b>	<b>10.857</b>	<b>16.714</b>	<b>7,5</b>	<b>12,6</b>	<b>18,0</b>	<b>15,3</b>	<b>34,2</b>	<b>58,3</b>	<b>30,3</b>	<b>59,8</b>	<b>87,0</b>	<b>18,3</b>	<b>49,4</b>	<b>150,0</b>

## 7. ENVIRONMENTAL AND SOCIO - ECONOMIC IMPACTS

The following considerations are based upon the results of field visits and on the contents of the IEE carried over by EEPSCO Environmental Expert.

The impacts that can be expected from implementing the project are described and an indication of mitigation actions that may be considered is given.

In addition to addressing the impacts, some sections highlight potential mitigation measures which will be described in more details in the Environmental Management Plan.

The EMaP provides a format for the mitigation measures. The repetition should be helpful in allowing readers to become aware of the mitigation as the issues or impacts are defined. More details of the measures will be given in the section on EMaP along with some cost estimates and schedules for implementation.

In general terms we can affirm that no major environmental impacts are predictable, prior, during or post project construction.

Therefore, environmental critical issues are limited to land acquisition.

However the negative and positive impacts along the R.O.W. of the HVTL have been described, taking into account the various phases of the project, namely the ground survey, the construction works, the operation and maintenance aspects.

### 7.1 SOCIO-ECONOMIC IMPACTS

#### 7.1.1 Impacts on residential areas and community services

Experience with forced resettlement in other development projects has not been good. Relocation can occur over a period of several years and unless resettlement is planned and implemented carefully it can create psychological and socio-cultural stress and tension amongst those displaced and those in the receiving areas, especially if the two areas are different culturally, ethnically and linguistically.

The HVTL routes across the towns and villages of Kose, Woira, Gubre, Welkite, Girura, Dilela, Woliso, Goro, Tulubolo, Teji, Asgori, Tefki, Sebeta and Alem Gena.

During the ground survey several dwelling houses have been identified (please refer to Table 7.1).

**Table 7.1 n° of dwelling houses per stretch of the HVTL**

STRETCH	N° OF AFFECTED TUKULS PER SIZE		
	s	m	l
GGIHEP – GGIIHEP	--	25	25
GGIIHEP – Welkite	36	60	24
Welkite – Sebeta	32	24	24
TOTAL	68	109	73

Totally 250 houses are expected to be affected during the construction phase. Of the total affected houses, around 50% (almost one every 580 m) are located in the stretch of only 70 km between GGIIHEPP switchyard and Welkite (this area is characterized by a dense type of settlement).

In the stretch between Welkite and Sebeta (140 km) only 80 houses are expected to be affected by the project (one every 1.750 m), and between GGIHEPP and GGIIHEPP 50 houses are probably along the alignment (one every 660 m).

During the final route alignment, all considerable measures shall be taken by the line surveying team to minimize the number of residential houses to be affected.

However, even if the number of displaced houses and people is high, during the discussion with local communities and with local peasant's associations, there is the possibility to relocate people within the communities to which they belong, avoiding the mentioned problems.

If the resettlement plans will be successfully implemented, there should be no loss of livelihood for the relocated population.

The GOE, through local peasant's associations, shall provide a resettlement site equal in size and quality to the expropriated land.

All the people will be able to continue with their means of livelihood, but in addition many will gain employment and new job skills as project labourers.

New means of earning of living will become available through supplying goods and services to the construction of labour force. A new temporary market at the construction camp will be opened for the sale of their agricultural and stock production.

As to the community services facilities, the utmost efforts should be taken to avoid any visual impact on schools, health institutions, churches and mosques during the route alignment. Thus all the stated community services should be made off the entire route corridor and none should be affected during the construction and operation phases.

### **7.1.2 Impacts on cultural and historical sites**

The project is expected to have no impact on the cultural and historical resources of the area: no known historical and cultural site is crossed by line alignment. Where there are accidental "chances of findings" of some archaeological artefacts on the line routes, construction workers and surveyors shall report to the environmental monitoring unit (EMU) of EEPKO, that will then report to the Authority for Research and Conservation for Cultural Heritage (ARCCH) for further investigations.

### **7.1.3 Impacts on health and safety**

#### Dust and Noise

General construction activity and traffic, will lead to an increase in dust and noise. This will have an effect on people's health: dust can cause respiratory problems and noise, when loud and frequent, can cause hearing problems amongst both workers and local residents, and it can cause stress.

These impacts can be mitigated through the provision and use of proper hearing equipment for workers and warnings provided well in advance in order that local people will be prepared. The impact of dust on local people can be limited through watering the roads and controlling speed of road traffic.

The contractors will be required to address these issues in their environmental management plan when they submit their contract proposals. In addition EEPKO EMU will monitor contractor's compliance with environmental protection standards in the contracts.

#### Public Safety

Public safety will not be a significant problem since residents within the R.O.W. area will be relocated.

Heavy vehicles movements between Addis Ababa and the project area may cause road accidents, particularly with local residents who are not accustomed to heavy traffic and heavy vehicles.

Project related vehicle will be required to abide by good driving conduct, obey speed limits and generally follow the rules of safe driving. All vehicles will be equipped with properly maintained lights and audio warning systems. Night driving will be minimal and strictly controlled.

During construction, some work accidents (e.g. fall from above, hit by object, car accidents, etc.) may occur mainly due to the lack of safety precautions.

During the operation phase impacts are related mainly with electrocutions and possible induce effects from electromagnetic fields.

#### Sexually Transmitted Disease (STDs)

The major impacts on health and safety are related to the work force engaged in the construction and operation of the HVTL: mainly communicable diseases like sexually transmitted diseases (HIV/AIDS, Hepatitis, etc...) and Malaria can spread around in the construction areas.

The mitigation plan will take an aggressive approach to control the spread of STDs: health education programs, control of informal sector activities near the project site and distribution of condoms.

Even with the most vigorous campaign and safeguards, an increase in STDs resulting from the project is inevitable. Systematic blood testing at the camp clinic is absolutely necessary, if the increase in AIDS is to be kept at a minimum.

The blood testing must be used for information purposes and not be used to dismiss infected employees. Contractors should address employee health issues in their contract proposals.

#### Other Infectious Diseases

Intestinal diseases, hepatitis, respiratory diseases (including tuberculosis) and plague are diseases that can occur in situations where a large work force is not provided with the proper sanitary and work place facilities.

Contractor work camps shall be maintained in a clean and healthy condition as prescribed by international worker health standards. Human waste will be treated properly and disposed of by the existing camp sewerage system which will be maintained in good working order. A clean and protected water supply should be provided. Kitchen wastes must be burned, buried or taken off site, to prevent a large rodent population and the breeding of disease carrying flies and other insects.

Health education will include the proper handling and storage of food stuffs, and all living quarters and work places will be adequately ventilated to prevent respiratory diseases. Workers should be screened for tuberculosis.

### Substance Abuse

A large construction labour force comprised primarily of young men living away from families, relatively stable wages and ideal time with few recreational pursuits and no domestic responsibilities can often lead to the overindulgence with alcohol. This can lead to abuse, fighting and injury, particularly if women are involved. Men who live in the area but who work on the construction of the TL, return home in an inebriated state and abuse and injure family members, and generally can cause a good deal of domestic upheaval.

The problems of alcohol abuse must be explained to workers as a part of the health education program. Recreational areas are available at the camp and additional activities should be a normal part of camp living. Severe penalties for drunkenness and disorderly behaviour must be given out along with the provision of counselling services for substance abuse.

### The Electromagnetic Field

Being a good conductor, a human body interacts with the electromagnetic fields (EMF's) surrounding transmission lines. When a man is introduced into an electric field, an electric current interests his body: inside the body voltage drops are produced, inducing internal EMF's.

In the last thirty years a great deal of research has been undertaken worldwide in order to understand the biological effects of EMF's. Most of the studies have concentrated on a possible relationship between cancer and field exposure, although questions have been raised about increased risks of birth defects and neurological effects like chronic depression. A few of the cancer-related studies seem to show a possible link between exposure to EMF's and cancer, but other doesn't seem to support the relationship at all. Generally, all the researches tend to exclude any effects with field lower than 10 kV/m.

The field generated by a 400 kV transmission could be high, so it is suggested not to neglect the problem until the scientific community do not achieve certain results. On long term EMF's question could produce many complains by people who live near or below the conductors: in the United States as well as in other countries, inhabitants supported by environmental organisations are going to law against electric companies in order to obtain millionaire compensations.

Figure 7.1 shows the mathematical calculation of electric field intensity carried out for two type of towers than can be adopted for the project, namely the delta and the trocopyramidal tower. Both calculation refer to the same type of conductor (twin Moose ACSR) load conditions and sag.

The calculation show the maximum electric field at the ground level would be about 3 (2.98) kV/m for the delta tower and 2 kV/m (2.01) for the trocopyramidal tower (two circuit on the left and one in the right side of the tower).

Accordingly to the above, measurements of effective electric and magnetic field should be taken by EEPKO specialists, after line energization, inside the line corridor, especially near the settlements, at the lowest point of conductors and maximum current rating.

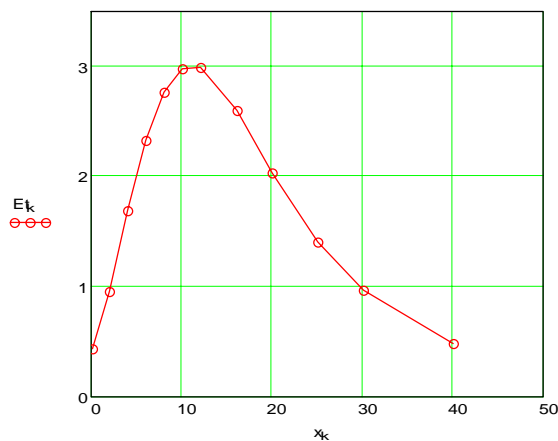


Fig. 7.1.a

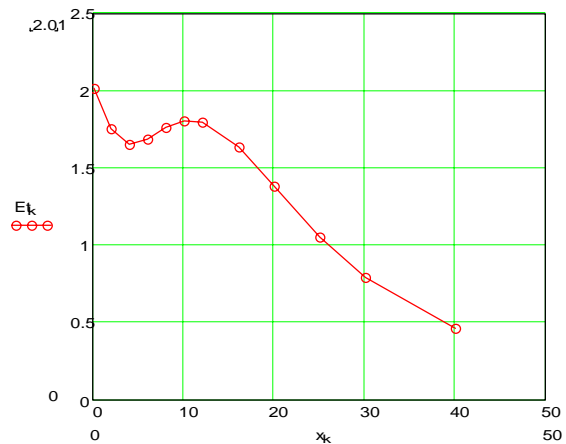


Fig. 7.1.b

**Figure 7.1.: EMF at ground level generated by 400 kV T.L.**

- a. Delta Tower with conductor in horizontal arrangement
- b. Troncypyramidal tower with conductor in vertical arrangement

The result of measurements must be compared with the existing international regulations and indications. The Table 7.2 shows the exposure limit prescribed by different institutions and organisations in the world: the range of the limits is very large, giving evidence of great uncertainty existing among the researchers.

**Table 7.2.: Exposure limits adopted by different organization in the world**

ORGANIZATION	Exposure Limits	
	Electric Field (kV/m)	Magnetic Field (mT)
IRPA/INIRC	5	0.1
NRPB – UK	10	0.1
WHO	10	-
EU	10	0.3
World Bank <sup>(*)</sup>	2-8	-
ex-USSR	5-0.5 <sup>(**)</sup>	-
Japan	3 <sup>(***)</sup>	-
New York State (USA)	1.6 <sup>(****)</sup>	-
Florida (USA)	2 <sup>(****)</sup>	-
New Jersey (USA)	3 <sup>(****)</sup>	-
Montana State (USA)	1 <sup>(****)</sup>	-
Italian Regulation	5	0.1

(\*): Limits adopted in different projects  
 (\*\*): Inside houses  
 (\*\*\*): Limits adopted to avoid electrostatic effects  
 (\*\*\*\*): Outside right-of-way  
 IRPA/INIRC: International Commission on Non-Ionizing Radiation Protection  
 NRPB – UK: UK National Radiation Protection Board  
 WHO: World Health Organisation  
 EU: European Union

## 7.2 IMPACTS ON PHYSICAL ENVIRONMENT

Clearing of vegetation from sites and R.O.W., construction of access roads, tower pads and substations are the primary sources of construction related impacts.

### 7.2.1 Impacts on Land Use

The transmission lines will have significant impacts on land use.

The existing land use of the project area will be affected by the construction of access roads, the transmission line and the tower pads.

Impacts on substation sites are expected to be marginal because it is intended to use the existing substation, at list enlarging within the substations the area (actually available) occupied by transformers or switches.

The HVTL is expected to be a 236 to 243 km 400 kV line.

The width of the free corridor lines (R.O.W.) will be 40 m and the towers pad (on average) will have an extension of 100 m<sup>2</sup>.

The towers are assumed to be erected with average span of 350 m each.

Globally the land area that is expected to be affected by HVTL construction is summarized in Table 7.3 (the temporarily affected area has been overestimated for a percentage of 5% in order to consider also the access roads).

**Table 7.3 land area affected by HVTL construction**

STRETCH	Length (km)	N° of Towers	Permanently (Ha)	Temporarily (Ha)
GGIHEP - GGIIHEP	26 (option I)	74	0.74	109.20
	33 (option II)	94	0.94	138.60
GGIIHEP - Welkite	70	200	2.00	294.00
Welkite - Sebeta	140	400	4.00	588.00
TOTAL	236 (option I)	674	6.74	991.20
	243 (option II)	694	6.94	1020.60

Referring to the above table altogether around 1000 Ha of land will be temporarily affected and 7 Ha of land will be permanently lost due to tower erection and construction of access roads.

The land use systems of the affected areas are mainly cultivated land, shrub and bush land (please refer to Table 7.4).

**Table 7.4 land use system of the affected areas**

STRETCH	Length (km)	Perennial Crops (Ha)		Annual Crops (Ha)		Bush and Shrub (Ha)	
		Temp.	Perm.	Temp.	Perm.	Temp.	Perm.
GGIHEP – GGIIHEP	26 (option I)	54.60	0.37	-----	-----	54.60	0.37
	33 (option II)	69.30	0.47	-----	-----	69.30	0.47
GGIIHEP – Welkite	70	220.50	1.50	14.70	0.10	58.80	0.40
Welkite – Sebeta	140	58.80	0.40	470.40	3.20	58.80	0.40
TOTAL	236 (option I)	333.90	2.27	485.10	3.30	172.20	1.17
TOTAL	243 (option II)	348.60	2.37	485.10	3.30	186.90	1.27

Considering that grazing and annual crops uses are usually not precluded in R.O.W.s and under the towers, the lands that will be permanently lost are:

- 350 Ha of perennial crops;
- 3.30 Ha of annual crops (please refer to Annex IV, picture 23);
- 1.30 Ha of Bush and Shrub.

The TL and access roads may open up more remote lands in human activities such as settlement, agriculture, hunting etc...

### 7.2.2 Impacts on Soils

In Ethiopia, up to 400 tons of fertile soil per hectare are lost annually from land with insufficient vegetation cover as well as from land where no effective soil conservation has been carried out.

It is estimated that the amount of soil that the country loses annually due to water and wind erosion reaches 1.5 to 1.9 billion tonnes.

Soil erosion has caused several direct and indirect negative impacts. It has led to the degradation of agricultural land and consequent reduction in agricultural production thus exposing the population to food insecurity.

The accumulation of silt in various water bodies has led to water resources degradation as well as the shortening of the life span of dams.

During the construction of the tower pads and access roads the clearing of vegetation and the excavation works may lead the top soil underneath to be threatened by wind and water erosion. The erosion factor will increase in steep areas.

In the mean time the emergence of soil erosion may cause increasing of sedimentation load and deterioration of the quality of rivers or streams near by.

Considering that soil erosion linked to deforestation and overgrazing practice creates some environmental concerns in Ethiopia, this aspect should be managed properly and mitigation actions should be undertaken during the construction phase.

### 7.2.3 Impacts on Air Quality

The implementation of the project would also have short term adverse effect on air quality due to dust and air emissions released by the machineries involved in the clearing of R.O.W. from shrub, bush and perennial crops.

Road construction will also cause temporary dust pollution in the area.

## 7.3 IMPACTS ON BIOLOGICAL ENVIRONMENT

### 7.3.1 Flora

Ethiopia is one of the biodiversity richest parts of the world.

Owing to the long history of agriculture coupled with the diversity of the environment, Ethiopia is one of the 12 Vavilov centres of crop genetic diversity.

The Ethiopian flora is estimated to contain nearly 7,000 species of higher plants, of which about 12% are endemic. The vegetation types with the highest portion of endemics are the woodlands, followed by the Afroalpine and Subafroalpine.

Ethiopia is the centre of origin for various crop species including Arabica coffee, teff, enset (*Ensete Ventricosum*) and sorghum in part (State of the Environment Report for Ethiopia – August 2003).

The clearing of trees, shrubs & bushes during the construction period may negatively affect the flora genetic resources in the project area.

The loss of natural vegetation cover may also cause habitat disturbance and favours the expansion of alien invasive species in the study area. Alien invasive species usually lead to ecosystem disruptions by destroying or displacing indigenous species through rapid reproduction and expansion (please refer to Table 7.5).

**Table 7.5 Exotic invasive species, localities invaded and damage occurring**

<b>SPECIES</b>	<b>Distribution area</b>	<b>Damage occurring</b>
<i>Parthenium hysterophorus</i>	Northern, eastern and western Ethiopia	Invading most of the country
<i>Eichornia crassipes</i>	Oromiya, SNNPR, Gambella	Invading relatively moist lowlands

During the construction period forest encroachment may increase in the project area due to the opening of new access roads and to natural vegetation cut for clearance of the R.O.W..

### 7.3.2 Fauna

Wildlife can be considered as one of the most important Ethiopian natural resources.

Out of 277 mammals 31, out of 862 birds 16, out of 201 reptiles 10, and out of 63 amphibians 34 are endemic to Ethiopia.

Out of the birds species, 31 are globally threatened. There are 5 mammals and 3 birds found endangered in Ethiopia (State of the Environment Report for Ethiopia – August 2003).

In the study area some wild animals may be affected during the construction period. Their shelters would be disturbed and exposed to poaching by the construction workers or go away from their original locations.

During the assessment, non endangered or endemic wildlife species were observed in the project area.

Particular attention must be given to the impact that HVTLs may have on migrant birds: various migratory birds considered endangered at international level also visit fifty sites in Ethiopia every year.

Birds usually are affected by obstacles and mass killing through TL. Electrocutation mainly kills larger predatory birds and other birds are more often killed through flying into the wires at high speeds (mainly night active species).

Bird collision with TL nowadays is becoming a significant issue not only on environmental point of view, but also for power companies for power outages.

In the study area there are not known migratory bird routes, which may be affected by the proposed transmission lines.

Some migratory birds may be present in the swampy areas between Welkite and Addis Ababa (please refer to Annex IV, picture 24), but for this reason (and also for geotechnical reasons) the line route has been moved far away.

### **7.3.3 Impacts on National Parks and Reserve Areas**

The richest wildlife areas are today mostly assigned as National Parks or Natural Reserves and are consequently rarely in conflict with HVTLs projects.

The route of the TLs has been selected in order to avoid National Parks and Natural Reserves.

## **7.4 SYNTHESIS OF ENVIRONMENTAL IMPACTS**

The possible negative and positive impacts have been considered and classified by five categories (from *most important* to *less important*): this classification has been introduced in an environmental impacts matrix (please refer to Table 7.5).

All possible negative and positive impacts have been identified in the different phase of the project:

- Pre-construction Stage Activity;
- Construction Stage Activity;
- Post-construction Stage Activity.

No	Environment Component	Pre-construction Stage Activity Component		Construction Stage Activity Component			Post-Construction stage Activity Component Operation			
		Line Route Survey	Land Acquisition	Equipment and Material Mobilisation	Tree Cutting and Corridor Free	Foundation Tower Erection and Stringing	Induction Influence	Electromagnetic Wave Influence	Radio Interference	Maintenance
<b>I. Social- Economic</b>										
	- Residential areas	O	c	O	c	d	O	O	O	E
	- Income	O	C	E	D	E	O	O	O	O
	- Cultural and historical sites	O	O	O	O	O	O	O	O	O
	- Health	O	O	e	d	e	O	e	O	O
	- Quiet Daily Life	O	O	d	d	d	e	e	e	O
	- Society Unrest	O	e	O	O	O	O	O	O	e
<b>II. Physics</b>										
	- Soils	O	O	e	d	c	O	O	O	O
	- Air quality	O	O	e	e	O	O	O	O	O
	- Land Use	O	O	c	e	d	O	O	O	O
<b>III. Biology</b>										
	- Flora	e	O	e	d	e	O	O	O	e
	- Fauna	e	O	e	d	e	O	O	O	e
	- Parks and Reserves	O	O	O	O	O	O	O	O	O

**Positive Impact**

A = Very Important  
 B = More Important  
 C = Important  
 D = Fair Important  
 E = Less Important

**Negative Impact**

a = Very important  
 b = More important  
 c = Important  
 d = Fair important  
 e = Less important

O = No Impact

**Table 7.6 - Synthesis of Environment Impact Matrix**

## **8. ENVIRONMENTAL MANAGEMENT PLAN**

The purpose of the Environmental Management Plan (EMaP) is to describe in details, the possible actions that must be taken to ensure that the identified impacts will be mitigated as much as possible.

Where impacts cannot be mitigated, compensation programs will be designed, as well as any environmental enhancement activity that will be required to offset, where possible, those impacts that cannot be mitigated.

This plan will also provide an estimation of compensation costs where feasible and a schedule for the implementation activities.

Implementing responsibility will be of EEPCO or EEPCO's contracted representatives unless noted otherwise.

To a considerable degree, construction contractors will be responsible for implementing mitigation measures but, in any case, the ultimate responsibility for ensuring that environmental and social protection elements are being carried out properly is of EEPCO.

Most of the impacts which occur during the construction phase can be reduced or avoided through the application of sound construction management guidelines.

Construction contracts will require all qualified bidders to include environmental management plans as a part of their submitted bids. The additional costs of these plans cannot be predicted at this time, but they are considered an integral part of total project costs.

The EMaP, outlined below, takes into account the impacts identified and described in the previous chapters.

### **8.1 SOCIO-ECONOMIC IMPACTS**

#### **8.1.1 Resettlement**

Impacts on residential places and community services can be avoided or minimized by a careful selection of ROW.

The sensitive spots such as mosques, churches, graveyards, schools, clinics or hospitals must be avoided during the final route selection.

However 250 houses are expected to be affected during the construction phase.

Over the years, world experience gained in involuntary relocation programs, has produced a number of basic criteria that should be followed in order to reduce problems to relocated people:

- quality of life of resettled people and host communities should not be compromised;

- the resettlement program has to be adequately financed by GOE through Regional Governments, to ensure that local commitment and newly occupied resettlement land will have the same production characteristics of the expropriated ones;
- support should be given to provide that resettled persons will not produce a negative impact on the life standards of host communities;
- both resettled persons and host communities should actively participate in the resettlement planning procedure;
- transition period should be as short as possible, and the clearance of line corridor should not proceed until the affected persons have not move to the relocation places;
- the resettlement areas should be as close a possible to the abandoned ones;
- resettlement planning must assure that families, communities and social/cultural groups will be kept together;
- resettled people should be provided with a proper compensation value of their houses, in order to allow them achieve the same or a higher standard of abandoned ones.

A proper EEPKO resettlement implementation unit should be established for working together with local communities authorities (supervised by regional officers) that should be charged of the following matters:

- disbursement and utilization of funds;
- preparation of new sites;
- preparation of programmes and timetable for expropriation of immovable properties;
- compensation payments;
- preparation of progress report.

The resettlement implementation office will ensure that the relocated population is properly re-established and has reached the previous production level and living standard.

### **8.1.2 Health and safety**

In general terms, in order to avoid the diffusion of communicable diseases, coming from migrant workers, it is suggested to recruit work forces from project areas communities.

#### Dust and Noise

These impacts can be mitigated through the provision and use of proper hearing equipment for workers and warnings provided well in advance in order that local people will be prepared. The impact of dust on local people can be limited through watering the roads and controlling speed of road traffic.

The contractors will be required to address these issues in their environmental management plan when they submit their contract proposals. In addition EEPKO EMU will monitor contractor's compliance with environmental protection standards in the contracts.

### Public Safety

All construction sites must be well marked, warning both workers and general public of danger to their safety.

Project related vehicle will be required to abide by good driving conduct, obey speed limits and generally follow the rules of safe driving. All vehicles will be equipped with properly maintained lights and audio warning systems. Night driving must be minimal and strictly controlled.

### Sexually Transmitted Disease (STDs)

STDs cannot be totally prevented. To minimize their incidence, informal sector development in proximity to the construction site must be regulated.

Workers should be provided with health education lectures and free condom should be made available.

### Other Infectious Diseases

Malaria prevention and control measures should be taken in the camp sites.

Sanitary conditions of the camps should be developed and maintained to international standards for construction camps. Human wastes must be managed using proper disposal and treatment facilities that should be located in order to ensure that seepage does not occur. Kitchen wastes must be disposed of in a proper manner (incineration, burial or taken off site and disposed of in sanitary landfill sites) to prevent the proliferation of rodents, flies and other diseases carrying insects.

Proper facilities for washing and bathing should be provided for the work force. All work and living areas must be properly ventilated to prevent respiratory diseases including tuberculosis. All workers should be tested for tuberculosis.

### Substance Abuse

The problems of alcohol abuse must be explained to workers as a part of the health education program. Recreational areas should be available at the camp and additional activities should be a normal part of camp living. Severe penalties for drunkenness and disorderly behaviour must be given out along with the provision of counselling services for substance abuse.

### Occupational health

Comprehensive occupational health standards established by GOE should be followed and the contractors will be considered responsible for full implementation.

## 8.2 PHYSICAL ENVIRONMENT IMPACTS

In order to minimize the impacts on physical environment the following measures should be taken into consideration:

- the shortest possible line route should be selected;
- the construction of access and maintenance roads should be reduced to the minimum necessary level. These roads should be temporary as much as possible;
- placement of new structures in agricultural areas should be done minimizing crops disruption, damages to irrigation systems and established field management practices. If some flexibility of TL alignment is still possible, field boundaries, roads or canals should be followed;
- the extent and duration of land clearing and levelling should be reduced to minimum. Where clearing of land is required, re-vegetate the area with native flora and/or crops. Manually clear the vegetation and sell firewood where clearing of trees is required. Cut trunks with flush surface and retain roots in place to minimize soil erosion and consequent increment of surface water turbidity;
- forest transiting and, in general terms, tree cutting for access roads should be reduced to the minimum. Tree cutting should be limited, if and where necessary, for line construction and /or maintenance activities;
- the area of shrub and bush lands loss due to TL and access roads construction should be compensated by a proper reforestation program, in order to restore the lost woody biomass;
- the use of herbicides and/or defoliation substances should be avoided as much as possible for vegetation clearing, prior construction activities;
- after construction, the vegetation cover within line corridor should be restored. During operation, vegetations should be maintained by manual or mechanical means to the extent necessary to guarantee vertical clearance;
- after construction access roads should be maintained only if strictly necessary for line's maintenance activities and/or when necessary or useful to local dwellers, otherwise land previous conditions should be restored;
- during construction of towers and access roads, some erosion problems may occur, particularly on hilly or slope terrains. Therefore particular care should be taken to avoid significant erosion problems in these areas.

### 8.3 BIOLOGICAL ENVIRONMENT IMPACTS

The clearing of trees, shrubs & bushes during the construction period may negatively affect the flora genetic resources in the project area.

In order to reduce the damages on natural vegetation, tree cutting should be carefully evaluated one by one, taking into consideration the fact that shrub and bush are generally not so high to affect HVTL during operation.

In order to minimize the adverse effect on flora and maintain the ecosystem, re-vegetation activities should be practised on disturbed and open areas.

The reforestation activities should be realized using autochthonous species of plants, such as: *Cordia Africana*, *Albizia schimperiana*, *Acacia* sp., etc...

The cost of revegetation programme should be included in the total project cost and revegetation activity should be handled by local Woreda environmental protection offices.

In order to reduce to the minimum level the pressure on existing wild animals, the following measures should be undertaken during construction and maintenance period:

- construction workers should be oriented not to practise any illegal hunting or poaching in the project area. They must be aware that hunting is strictly forbidden by Ethiopian laws, unless for persons holding a permission from national authorities;
- the habitat losses should be minimized by reducing the vegetation clearing and avoiding unnecessary ones;
- re-vegetation activities for restoring wild animal's habitats, should be carried on as soon as possible, in order to reduce the spoiling of shelter, hunting etc... areas to the minimum.

## **9. ENVIRONMENTAL MONITORING PLAN**

### **9.1 INTRODUCTION**

Monitoring is required prior to, during and after construction is completed.

The purpose of this phase is to make periodic checks on the environmental impacts during the different phases of the project, comparing them with those foreseen during the first phases of ESIA process.

Monitoring provides a very useful feedback, which permits to correct at the right moment any environmental problem due to the project and meanwhile to acquire experience in planning future projects.

It must be mentioned that usually institutions that manage projects hardly worry about monitoring, because they want to avoid correspondent costs, but the experience shows that, on a medium-long term, preventing problems is far more convenient than fixing them (when it's too late).

In this chapter of the ESIA report we will establish the control and monitoring methods.

### **9.2 ENVIRONMENTAL MONITORING RESPONSABILITIES**

The Environmental Monitoring Responsibilities shall be divided into three categories:

1. the executing responsibilities;
2. the supervising responsibilities;
3. the monitoring responsibilities.

Referring to that, three organizations will participate in the environmental monitoring and management program as described below.

#### **9.2.1 The executing agency**

The executing agency will have the responsibility for the design and the assessment of the physical works in accordance with Ethiopian environment regulations. Moreover it's under the executing agency responsibility the physical implementation of the activities of the project, as well as the efforts to mitigate potential negative impact.

The management contractor should create the executing agency. Two or three persons whose specific tasks are to control and monitor the environmental aspects of the project as described in the following chapters should constitute this agency.

#### **9.2.2 The supervising agency**

The supervising agency will have to verify if the implementation of works, in order to fit environmental recommendations, has been carried out. It will also control periodically if the monitoring plan is proceeding.

The supervising agency shall perform periodical checks and produce a report on the results of these checks, as described in the following paragraphs.

### **9.2.3 The monitoring agency**

The monitoring agency will have the responsibility for monitoring the environmental aspects of the project during normal working operations. This responsibility must be of a public agency: its specialists and inspectors will be responsible for the timely monitoring of the agreed indicators as described in the following paragraphs.

## **9.3 ENVIRONMENTAL MONITORING PLAN**

Referring to the above considerations on environmental impacts and management plan an Environmental Monitoring Plan (EMoP) has been established in order to reach the following objectives:

1. to help decision making in environmental management monitoring;
2. to create a co-ordination mechanism between EEPKO and the other partners involved in the environment monitoring activities;
3. to emphasize the positive effects caused by the electric energy supply;
4. to give general guidelines to prevent or decrease negative effects of HVTL construction;
5. to give general guidelines for environmental management in HVTL operations;

The possible negative and positive impacts have been considered and classified by five categories (from *most important* to *less important*): this classification has been introduced in an environmental impact matrix, dividing the different impacts phases: pre-construction, construction and operation.

The results of the study are summarised in an Environment Observation Matrix (please refer to Table 9.1.).

In this matrix when, what, how, how frequently monitoring is necessary is defined.

Activity Phase	Resource	Environmental components	Environmental Indicators	Weight effect	Standardisation	Location of the observations	Observations frequency
<b>I.: pre-construction</b>	<b>Site survey</b>	Plants belonging to residents	Plant damages	e	The width of the plant damaged area	Areas around towers and lines	Once
	Land acquisition	The society where are the tower basis	Society complaint	b	The land acquisition has been suitable with the rules	Areas around towers and lines	Twice (before and after land acquisition)
<b>II.: Construction</b>	<b>Labour, equipment and material mobilisation</b>	Workers recruitment	Society complaint	D	Level of labour recruitment	Around the tower close to residence	Once at six months
		Air quality	Dust pollution	e	Air quality standard	Part of the tower close to residence	Once at six months
		Noise	Noise	e	Noise quality standard	Part of the tower close to residence	Once at six months
	Route clearance	Society's land	Plant damages	e	New land functions	Part of the tower close to residence	Once
	Tower erection and stringing	Space and area	Land use	e	Changes in area function, erosion and landslide problems	Part of the tower close to residence	Once at six months
		Traffic	Traffic nuisance	e	Level of traffic nuisance	Part of the tower close to residence	Once at six months
<b>III.: Operation</b>	<b>Electric power transmission</b>	Free area	EM field	e	Free area according to the rules	Under the towers and in the R.O.W.	At the beginning of operations and every six months
	Maintenance	Society plants	Plant damages	e	How many plants are damaged	Part of the tower close to residence	Once at six months
		Excavation activity	Landslide / erosion	e	How much erosion appears	The tower sole	Once at six months

**Positive Impact**

A = Very Important  
 B = More Important  
 C = Important  
 D = Fair Important  
 E = Less Important

**Negative Impact**

a = Very important  
 b = More important  
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 d = Fair important  
 e = Less important

O = No Impact

**Table 9.1 - Synthesis of Environmental Monitoring Matrix**

## 10. EVALUATION OF COMPENSATION COSTS

Referring to the average cost (please refer to Table 6.1) of all the different items considered to be affected by the construction of the HVTL a tentative evaluation of the compensation has been carried over.

The evaluation of total n° of plants affected by project construction has been done considering a distance between each plant of 2 m (that means a density of 10.000 plants per km of line alignment).

In order to make the evaluation more clear the same division into three different stretches of areas affected by the construction of the HVTL has been maintained.

### 10.1 FROM GGII SWITCHYARD TO WELKITE

The area between the switchyard of the designed GGII hydropower plant and the existing Welkite substation, is densely populated (around 1 Tukul every 0.5 km of line alignment) and cultivated (75%). In this area the main crops are: Enset (False Banana), Coffee, Chat and Eucalyptus.

The total length of this stretch of the line is around 70 km.

The number of Tukuls along the line alignment is likely to be 120, of which 24 are large size ones (20% of all), 60 are medium size ones (50%), and 36 small size ones (30%).

Of the 70 km of total length, permanent crops as detailed in following table 10.1 cover around 50 km.

**Table 10.1 percentage and total length of different crops along the line alignment**

CROPS	ENSET (30% = 15 km)			CHAT (20% = 10 km)			COFFEE (10% = 5 km)			EUCALYPTUS (40% = 20 km)		
	s	m	l	s	m	l	s	m	l	s	m	l
dimension	s	m	l	s	m	l	s	m	l	s	m	l
percentage (%)	25	50	25	15	45	40	50	25	25	45	45	10
length (km)	3,75	7,5	3,75	1,5	4,5	4	2,5	1,25	1,25	9	9	2

Considering a density of 10.000 plants per 1 km the expected, and coffee crops (taking to consideration that even large plants are not high) will be affected only by tower erection compensation costs have been reported in the following table 10.2.

**Table 10.2 expected compensation cost per item** (in thousands of Ethiopian Birr)

TUKUL			ENSET			CHAT			COFFEE			EUCALYPTUS		
s	m	l	s	m	l	s	m	l	s	m	l	s	M	l
229	651	401	281	945	675	229	1539	2332	15	15	22	1647	4446	3000

Referring to this data the total estimated compensation cost for the stretch is 16.427.000 birr.

Considering an exchanging rate of 8.7 birr per 1 US\$, the tentative estimated compensation cost in US\$ for the stretch 1.888.000.

## 10.2 FROM WELKITE TO SEBETA

The area between the existing Welkite substation and the existing Sebeta substation in Addis Ababa is sparsely populated (around 1 Tukul every 2 km of line alignment) and cultivated: permanent crops represent here less than 10% of the total length (140 km), in the remaining portion of the line annual crops (such as teff, wheat, corn, etc...) are found.

The number of Tukuls along the line alignment is likely to be 80, of which 24 are large size ones (30% of all), 24 are medium size ones (30%), and 32 small size ones (40%). Of the 140 km of total length, permanent crops as detailed in following table 10.3 cover only 10 km.

**Table 10.3 percentage and total length of different crops along the line alignment**

CROPS	ENSET (30% = 3 km)			CHAT (25% = 2,5 km)			COFFEE (2,5% = 0,25 km)			EUCALYPTUS (42,5% = 4,25 km)		
	s	m	l	s	m	l	s	m	l	s	m	l
percentage (%)	50	25	25	100	----	----	50	50	--	70	30	----
length (km)	1,5	0,75	0,75	2,5	----	----	0,125	0,125	--	3	1,25	----

Considering a density of 10.000 plants per 1 km the expected, and coffee crops (taking to consideration that even large plants are not high) will be affected only by tower erection compensation costs have been reported in the following table 10.4.

**Table 10.4 expected compensation cost per item** (in thousands of Ethiopian Birr)

TUKUL			ENSET			CHAT			COFFEE			EUCALYPTUS		
s	m	l	s	m	l	s	m	l	s	m	l	s	m	l
203	261	401	112	95	135	383	-----	-----	7	15	-----	549	618	-----

Even if tower erection and line stringing operations will be mainly realized after the harvest, probably there will be some damages. Therefore some compensation value should probably be considered also for annual crops disturbances.

Around 85% of the 140 km stretch (119 km) is cultivated with annual crops: mainly teff and wheat. Considering that in 119 km, the construction of 340 towers is expected and each tower occupies an area of 100 m<sup>2</sup> the affected areas and related compensation costs will be as reported in table 10.5.

**Table 10.5 annual crops affected areas by tower erection**

CROPS	TEFF (76% = 95 km)		WHEAT (24% = 2,5 km)	
	Affected areas (Ha)	26	8.3	
Productivity (q/Ha)	14	25		
Average price (birr *q)	250	180		
Value of crops lost (birr)	91000	37350		

Referring to this data the total estimated compensation cost for the stretch is 2.907.000 birr.

Considering an exchanging rate of 8.7 birr per 1 US\$, the tentative estimated compensation cost in US\$ for the stretch 334.000.

### 10.3 FROM GGI HPP SWITCHYARD TO GGII HPP SWITCHYARD

In the area between the two switchyards the population has a medium density (around 1.5 Tukul per km of line alignment) and permanent crops represent here around 50% of the total length (26 or 33 km), in the remaining portion of the line there are wild scattered vegetation and grazing areas.

Taking in consideration that up to now still two different options are under evaluation the tentative estimation has been carried out for both: OPTION I (33 km length) and OPTION II (26 km length).

For OPTION I the number of Tukuls along the line alignment is likely to be 50, of which 25 are large size ones (50% of all) and 25 are medium size ones (50%).

For OPTION II the number of Tukuls along the line alignment is likely to be 40, of which 20 are large size ones (50% of all) and 20 are medium size ones (50%).

In OPTION I alignment 4.5 km and in OPTION II 3.6 km are covered by permanent crops as detailed in following table 10.6.

In both alignments data on the age of the permanent crops is not available, therefore it has been considered an average cost between the categories previously mentioned (small, medium, productive).

**Table 10.6 percentage and total length of different crops along the line alignment**

OPTIONS	CROPS	ENSET	COFFEE	EUCALYPTUS
I	Percentage (%)	67	16,5	16,5
	Length (km)	3	0,75	0,75
II	Percentage (%)	67	16,5	16,5
	Length (km)	2,4	0,6	0,6

Considering a density of 10.000 plants per 1 km the expected compensation costs have been reported in the following table 10.7.

**Table 10.7 expected compensation cost per item** (in thousands of Ethiopian Birr)

OPTIONS	TUKUL		ENSET	COFFEE	EUCALYPTUS
	m	l			
I	271	418	381	46	545
II	217	334	305	36	436

Referring to this data the total estimated compensation cost for the stretch is 1.661.000 birr for OPTION I and 1.328.000 birr for OPTION II.

Considering an exchanging rate of 8.7 birr per 1 US\$, the tentative estimated compensation cost in US\$ is 191.000 (for OPTION I) and 153.000 (for OPTION II).

### 10.4 OVERALL COMPENSATION VALUE

Referring to the previous considerations, the overall compensation value can be estimated as follows:

**OPTION I:**                     $1.888.000 + 334.000 + 153.000 = \mathbf{2.375.000 \text{ US\$}}$

**OPTION II:**                     $1.888.000 + 334.000 + 191.000 = \mathbf{2.431.000 \text{ US\$}}$

## REFERENCE DOCUMENTS

ASIAN DEVELOPMENT BANK - Environmental Assessment Guidelines / Vol III: Sector Guidelines. 1992.

ASIAN DEVELOPMENT BANK - Environmental Guidelines for Selected Industrial and Power Development Projects. 1990

BRUZZI L. "Valutazione d'impatto ambientale: guida agli aspetti procedurali, normativi, tecnici" – *S. Marino October 1999*

BRESSO M., RUSSO R., ZEPPESELLA A. "Analisi dei progetti e valutazione d'impatto ambientale" – *Milano June 1988*

EBRD – EUROPEAN BANK FOR RECONSTRUCTION AND DEVELOPMENT – Environmental Procedures

EC WORKING GROUP - Proposal for basic restrictions for protection against occupational exposure to electromagnetic non ionizing radiation. Recommendations of an international working group set up under the auspices of the commission of the European Communities. *Physica Medica, vol. VII, n. 2, 1991.*

EPA – ENVIRONMENTAL PROTECTION AUTHORITY – State of Environment Report for Ethiopia – *Addis Ababa - 2003*

FDRE – THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA– June, 1997 – Country Environmental Profile.

FDRE – August 24, 1995 - Proclamation N° 9: "Environmental Protection Authority Establishment Proclamation"

FDRE - THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA – October 31, 2002 - Proclamation N° 295: "Environmental Organs Establishment Proclamation"

FDRE - THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA – December 3, 2002 - Proclamation N° 299: "Environmental Impacts Assessment Proclamation"

FDRE - THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA – December 3, 2002 - Proclamation N° 300: "Environmental Pollution Control Proclamation"

FDRE - THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA – ETHIOPIAN ROADS AUTHORITY - 2003 - Proclamation N° ..... : "A Proclamation to provide for appropriation of land for government works & payment of compensation for property" (DRAFT)

IEA – INITIAL ENVIRONMENTAL ASSESSMENT OF GILGEL GIBE II TRANSMISSION PROJECT (Internal Report), *EEPCO EMU (Environmental Monitoring Unit) – Addis Ababa - 2004*

G.A. LOVISOLO et al. - Elettrodotti e Campi Elettromagnetici a Bassa Frequenza: Ricerca Scientifica e Politica Normativa. *Dipartimento Ambiente, C.R.E. Casaccia, ENEA, Dipartimento di Ingegneria Elettrica, Universita' dell'Aquila; 1996*

ITALIAN GOVERNMENT- Italian Regulation concerning Installation of overhead lines (Norma Italiana CEI, 11-4) - 1989.

ITALIAN GOVERNMENT – MINISTERO DELL'AMBIENTE – Decreto 10 settembre 1998, n.381. “Regolamento recante norme per la determinazione dei tetti di radiofrequenza compatibili con la salute umana” - 1998.

SCHMIDT DI FRIEDBERG P. & MALCEVSCHI S. “Guida pratica agli studi di impatto ambientale” – *Milano December 1998*

WORLD BANK - Environmental Assessment Sourcebook / Vol. III: Guidelines for environmental assessment of Energy and Industry Project. *Washington DC, 1991.*