ENVIRONMENT AND SOCIAL IMPACT ASSESSMENT

OF

GEOTHERMAL SECTOR DEVELOPMENT PROJECT

FOR

ALALOBAD TENDAHO GEOTHERMAL PROJECT SITE

BY
ETHIOPIAN ELECTRIC POWER CORPORATION

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Public Disclosure Authorized

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ACRONYMS

ADLI	Agricultural Development Led Industrialization
ADB	Asian Development Bank
AFD	Agence Francaise De Developpement
AfDB	African Development Bank
ARCCH	Authority for Research and Conservation of Cultural Heritage
Birr	Ethiopian Local Currency
CSE	Conservation Strategy of Ethiopia
EEPCo	Ethiopian Electric Power Corporation
EMP	Environmental Management Plan
EMT	Environment Monitoring Team
FEPA	Federal Environmental Protection Authority
EPE	Environmental Policy of Ethiopia
ESIA	Environmental and Social Impact Assessment
FDRE	Federal Democratic Republic of Ethiopia
FHH	Female Headed Household
GSE	Geological Survey of Ethiopia
GRC	Grievance Redress Committee
Ha	Hectare
HIV/AIDS	Human Immunodeficiency Virus /Acquired Immune Deficiency Syndrome
IC	Implementation Committee
Km	Kilometer
kV	Kilovolt
MW	Megawatt
MoEF	Ministry of Environment and Forest
MoWIE	Ministry of Water, Irrigation and Energy

1 EXECUTIVE SUMMARY

Introduction

The Alalobad-Tendaho geothermal field is one of the potential geothermal fields in the Ethiopian Rift valley that is intended to be explored with a set of four test drillings and several production drillings. The ultimate aim of the project is to generate 70 MW electric power to be supplied to Semera substation and connected to the national grid.

The following are Alalobad-Tendaho Geothermal Power Development Project components.

- Drilling of geothermal wells
- Heat Gathering System (from geothermal wells to the power house)
- 70 MW Power Plant Construction and Switchyard
- 132 Kv Transmission Line (from Alalobad-Tendaho power plant to Semera substation)

The Alalobad –Tendaho geothermal field is located in Doubti Woreda, Afar Regional State, Zone 1, in the North Eastern part of Ethiopia, some 600 km from the capital city, Addis Ababa.

A feasibility study on geothermal power development has been conducted in March 2010 by consulting firms Ernst & Young ShinNihon LLC, Japan External Trade Organization (JETRO) and West Japan Engineering Consultants. The objective of the feasibility study was to assess the capacity of the geothermal resources to generate electricity and to determine the technical and eco-financial feasibility of the project.

The objective of this ESIA is to identify potential impacts of the proposed project and to recommend appropriate mitigation measures to reduce adverse potential impacts. The ESIA study is conducted by EEPCo's Power System Planning office, Environmental and Social experts. The study team conducted and identified i) base line environmental and social conditions, ii) environmental and social impacts, iii) mitigation measures iv) public consultation and collected information on views of stakeholders and communities on the proposed project.

Project Location

The Alalobad –Tendaho geothermal field is located in Doubti Woreda, Afar Regional State, Zone 1, in the North Eastern part of Ethiopia, some 600 km from the capital city, Addis Ababa.

The proposed geothermal project site is located at geographic coordinates of latitude 11^0 38' North and longitude 41^0 00' East. Tendaho graben is traversed by an excellent national highway that serves as the main transport route for Ethiopia's foreign trade through the port of Djibouti.

Project Justification

Generation source of EEPCo is mainly dominated by hydropower. About 99.3 % of the energy sources are from the hydropower plants, followed by two wind power plants of 120 and the other one with 100 MW capacity, respectively. Thus, Ethiopia's energy generation capacity is likely to be affected by climatic change /drought and variability. To overcome this problem the energy mix /diversification scheme is very important.

Currently the Ethiopian Government has embarked upon various plans and programs to explore and develop different energy resources (i.e., from wind, geothermal, solar and hydropower) to achieve the major goals of accelerating economic growth and reducing poverty.

Geothermal resource is one source of the energy of the country. Along the Ethiopian Rift Valley, about 14 sites (i.e., *Dalol, Tendaho, Abbe, Teo, Danab, Meteka, Dofan, Fantale, Kone, Gedemsa, Tulu Moye, Aluto Langano, Corbetti and Abaya*) were investigated for their geothermal energy potential which extends some 400 km NNE from latitude of 6^0 North to latitude of 9^0 North.

Ethiopian electric energy potential from geothermal resource is estimated to be 5,000 MW (*Source, EEPCo's facts in brief, 2011/12*).

Legal and Institutional Framework

There is sufficient legal and administrative ground in Ethiopia for environmental and social management in the process of implementing development projects.

The ESIA study considers both the Ethiopian and the World Bank environmental and social policy documents and guidelines.

Concerning the institutional arrangement, Ministries and Organizations has established environmental and social branches to address their development activities. Ministry of Water, Irrigation and Energy (MoWIE) has an Environmental Impact and Social Development Office and EEPCo's Power System Planning comprises of Environmental and Social Experts to address Environmental and Social issues in its development activities.

Project Alternatives

Different project alternatives has been identified and discussed in the assessment. The do-nothing alternative will worsen environmental degradation such as deforestation problem. Moreover, this alternative will not help to promote educational, commercial and industrial development.

Thermal power option would depend on foreign fuel and it increases the emission into the atmosphere of CO_2 which is the most important greenhouse gas contributor.

In contrast with other energy generation sources, the geothermal energy source, being a renewable energy and environmentally friendly, it is therefore the most preferred.

Description of the Project Environment

Physical Environment

The Alalobad-Tendaho geothermal Power Development Project will be carried out near Logiya town some 23 km from Semera, Afar Regional State Capital. The total area of Doubti Woreda is 539,044.13 hectare and the total area of land required for this development project is about 40 km^2.

Topography

The area of potential interest is predominately a flat /plain terrain at an elevation of 1319 feet, covering a surface area of thousands of square kilometers, locally surrounded by volcanic hills, rising a few hundred meters above the flat plain. Alalobad-Tendaho geothermal field is located in a geologically active zone with a history of naturally occurring earthquakes and smoking springs.

Climate

From 2003 - 2009, the maximum mean annual temperature is around 36.27 ^{0} C, minimum mean annual temperature is around 23.20 ^{0} C and mean monthly temperature ranges from 18.14 to 42.02 ^{0}C, with a little difference from month to month.

The mean annual precipitation is around 15.94 mm. July to September and April are the wettest seasons, while October to March is dry season with low level of rainfall.

Soil

The quality of the soil is generally not good for agriculture and is low in natural fertility. Soil analysis carried out on surface soil samples, collected at a depth of 0 - 20 cm inside the project area appeared to have low contents of organic matter and nutrients. The soil is essentially alkaline with good cation exchange capacity owing to the high clay content. It consists of sand 50.7 %, silt 19.1 %, and clay 30.2 % (Aquater, 1996).

Geology

Alalobad-Tendaho geothermal field is located in the Afar Depression, a plate tectonic triple junction where the spreading ridges that are forming the Red Sea and the Gulf of Aden emerge on land and meet the East African Rift. As locally known, the Tendaho geothermal field in Afar Region consists of a NW-SE elongated broad plain of about 4,000 km^2 (Tendaho graben), mainly filled by alluvial and lacustrine deposits (Aquater, 1996).

Water Resource

In the proposed Alalobad-Tendaho Geothermal Power Development site, the major river draining the Tendaho graben is the Awash River. The Awash River is far away (about 10 km) from the project site.

Effluent Discharges

For precautionary measures, the effluent discharged during excavation shall be directed to flow into retention and sedimentation ponds.

Biological Environment

Flora

The project site contains vegetation such as, *Acacia sp*ecies, *Prosopis juliflora* and some other grasses, bushes and shrubs.

Fauna

Domestic animals present in the proposed geothermal project area are cattle (ox, cow), sheep, goat, donkey, and camel.

Among wild animals prevalent in the Woreda are, hyena, anubis baboon, jackal, bush duiker, monkey, porcupine, leopard, soemmerring gazelle, dik dik and mongoose.

Some of the bird species found in and around the project site are ostrich, guinea fowl, secretary bird and other smaller once.

Protected Areas in the Woreda

There are no Parks or protected areas in the project area. The *Awash* and *Yangudi Rasa* National Parks are located tens of kilometers away from the project site.

Socio Economic Environment

Demographic Characteristics

The total population of the Project area Woreda, Doubti Woreda, is 65,324 (male 34,870 and female 30,444) and the Woreda's land size is 539,044.13 hectare.

The average population density of the Woreda is 1 person per 8.26 hectare and the average population growth rate is 2.5 %. The average household size is 5 persons.

Currently the total population size of the Kebele (Gurmudale and Hayideru Kebele), where the proposed geothermal project is located, is about 12,500. The number of male exceeds the female population.

Ethnic Composition

The major ethnic group of the Woreda is Afar, mixed with Amhara, Tigrai and Oromo. Around the project area Kebele (Gurmudale and Hayideru Kebele), Afar ethnic group (*Arebta clan)* comprises 100%.

Settlement Pattern, Housing and Household Economy

The community around the proposed geothermal project is dominantly pastoralists herding their domestic animal and agro-pastoralists practicing agriculture activities. Permanent settlement areas are very rare and limited into villages and towns. Inside the proposed geothermal project area there are no settlements.

Land Use

The uncultivable land of the Woreda is about 76.07 %, which is the largest of all land cover. The wet land constitutes about 12.32 %, of the total land use system, the forest land cover is only 1.56 %, grazing land is about 5.68 % and agricultural land cover is about 4.38 %.

Social Services

Education

In Doubti Woreda, there are 1 kindergartens, 12 primary schools (1 - 4 grade), primary schools (1 - 6 grade) 3 primary schools (5-8 grade) and 1 high schools (9-10 grades) and 1 preparatory education, that is, from grade 11-12. At present, the educational coverage of the Woreda has reached 58 %.

Health

There is one governmental health post in the project area with one nurse and 3 health assistants. The health coverage in Doubti Woreda is 83 %.

Potential Environmental and Social Impacts

Socio Economic Impacts

There is no community living in the proposed project area. However, two potential impacts are identified related to the natural hot springs that is found within the proposed project area.

1. Pastoralist communities use the hot spring as medicine for their cattle. The project may affect the path to the hot springs.
2. The Afar Region Culture and Tourism Bureau consider Alalobad hot spring as potential tourist attraction.

Residential House

There are no residential houses in the project site, hence no impacts are expected from the project development at Logiya and Semera towns situated over 30 kilometers away from the project site.

Agricultural Land

Communities around the project area are pastoralists and agro-pastoralists. No agricultural practice is undertaken in the project area and there will be no impact on agricultural land and agricultural production.

Social Service

There are no social infrastructures or facilities such as churches, mosques, schools, health facilities and other major community service to be affected by the project.

Noise

There will be noise arising from geothermal fluid escaping from the drilling of deep wells, working noise; well testing and vibration are the potential noise sources of the project, but these can be contained below acceptable limits.

Cultural and Historical Heritage

There are no known historical and cultural sites to be affected by the project. However, during construction, if there are any accidental "*chance findings*" of some archaeological artifacts, the contractor shall inform EEPCo's Project Office and the Project Office shall report to the Power System Planning /PSP/ of EEPCo. The Office will then report to the Authority for Research and Conservation of Cultural Heritage (ARCCH) for further investigation.

Impacts on Women

There will be no significant impact on women because of the project development.

Dust /Air Quality

From the very nature of the project, there will be emissions to be released to the atmosphere. Information gathered during the field assessment revealed that the contents of the emission is likely to be 99 % steam and the other 1 % comprising of CO_2, H_2S, ammonia and other non-condensable gases.

Impact on Health and Safety

Occupational Health and Safety

The anticipated major occupational health and safety impacts are likely to come from geothermal gases (CO_2, H_2S, ammonia), confined spaces, heat and noise.

Community Health and Safety

The major community health and safety impacts are, exposures to hydrogen sulphide /H_2S/, ammonia, infrastructure safety, and sexually transmitted infections /STIs/.

HIV/AIDS

The influx of project workers from other areas may cause short term social concerns in the area that may need to be addressed. Such concerns include spread of HIV/AIDS and Sexually Transmitted Diseases.

Substance Abuse

Construction labor force comprising primarily of young men living away from their families, with stable wages and ideal time, with few recreational pursuits and no domestic responsibilities, can often lead to the overindulgence with alcohol which will lead to abuse, fighting and injury, particularly if women are involved.

Health Effect of Electro Magnetic Fields (EMF)

Electromagnetic fields (EMF) are invisible force that surrounds any electrical device. Power transmission lines, electrical wiring and electrical equipment all produce EMF. No significant effects are expected from EMFs during the development of the Geothermal Power Project.

Impacts on Biological Environment

Flora

The impact is likely to be insignificant since the proposed project area is arid and void of any significant vegetation, except Prosopis spp. and Acacia spp. These are common species (non-endemic, not threatened nor endangered) dominating the entire area.

Fauna

The presence and abundance of indigenous fauna has been affected for many decades by anthropogenous factors so that there is likely to be no negative impact on the fauna as a result of the proposed Geothermal Power Project.

Impacts on Birds

There is no recorded migratory bird route in the proposed site, except some indigenous species that inhabit the area. These species are non-endemic, not threatened and not endangered.

Impact on Protected and Reserve Areas

There are no protected and reserved areas within and in close proximity of the project site. Far away from the project site and towards the eastern part, there are the *Awash* and *Yangudi Rasa* National Parks and three game reserves (*Aldeghe*, *Gewane* and *Mille Serdo*). These are unlikely to be affected by the development of the Geothermal Power Project.

Impacts on Wetlands

There is no wetland within or in close proximity to the project site except the *Awash River* and the *Tendaho dam* that are distant away from the site.

Impact on Physical Environment

Soil

During excavations to erect foundation pads for the drilling rigs and construction of sludge retention and sedimentation ponds, soil may be exposed to particularly wind erosion since vegetation may be cleared. This could be a problem if construction doesn't happen soon after clearance of vegetation and the soil is left bare and exposed to the vagaries of the wind for a longer time. Erosion could be contained, but it is expected that should erosion occur, this may be localized, minimal and temporary.

Air Quality

The drilling of the geothermal wells may have short term adverse effect on air quality due to emission of gas particles (CO_2, H_2S, ammonia and other non-condensable gases) which may escape into the atmosphere from the drilling activity. These may be localized.

Water Quality

Since there are no rivers/streams nearby for human use in the proposed project area, it is not anticipated that there would be any hazards to be posed to people, animals, birds and aquatic life due to contamination of any water-bodies. .Drilling discharges and sludge material will be piped and contained in specially constructed evaporation ponds (lined) on site. There should be no project impact on the groundwater quality.

Positive Impacts

- The global environmental improvement effect of this project is the reduction of carbon dioxide (CO_2) emissions for electricity generation using renewable geothermal energy compared to other fossil firing power generation.
- Replacement of imported fuel by the indigenous resource, geothermal energy, will also save foreign currency.
- Since 99.3 % of the country's energy generation source is from hydro power, the development of the geothermal project has great importance in the energy mix.
- The access to electric power supply in villages and towns would contribute to social and economic development in general and ease the burden of women in particular.

Environmental Hazard Management

Aside the drilling discharges, the risks expected from the drilling of geothermal wells could emanate from accidental spills of chemicals (used oil and lubricants). Also, unsafe working conditions (fall from above, hit by objects) during drilling could result in safety concerns. In addition, incidents/accidents may arise due to increased traffic during transportation of materials and personnel on- or off-site.

Mitigation Measures

Socio-Economic Environment

Regarding the Alalobad hot springs that are considered as potential tourist attraction, there is possibility to harmonize the geothermal resource development plan with the Region's culture and tourism plan to ensure a win-win situation. With a well-developed plan, communities and institutions should be able to co-exist in harmony with the geothermal resource development project. Therefore, it is recommended that the EEPCo and the Afar Regional Tourism Office consider how to make both plans mutually-reinforcing and beneficial during the design phase of the Alalobad-Tendaho Geothermal Power Development Project.

The Alalobad Geothermal Power Development Project will demarcate and make accessible the animal routes to the hot springs for the pastoralist communities who occasionally take their animals to the hot springs. The pastoral communities make use of the hot spring as medicine for cattle as well as for people.

For individuals exposed to physical hazards associated with the wells and related pipeline networks, the mitigation measures include demarcation of the project site and placement of fences around the geothermal wells and placing of warning signs in English, the national language and the local language. Safety and health standard manuals shall be exposed at the work places and also provided to communities living around the project area.

Compensation for Loss of Crop

No crops (no agricultural land) will be affected by the project development and no need for arranging compensation payment.

Valuation Committee Formation

No need for valuation committee to be formed since there is likely no land acquisition and or any compensation payment to be made for damaged property.

Agricultural Land

- No crop at farmland and homestead vegetation belonging to the community will be affected and there is no need for mitigation measure.
- In order to avoid land use dispute, the geothermal project site shall be demarcated.
- Resettlement Policy Framework has been prepared to complement this report and will be used if private land is acquired or access to natural resources are restricted

Education

There is only one school located far away from the project site which will not be affected by the project activities; therefore, no mitigation measure is required.

Air Quality

Use an environmental clause for dirt and dust clouds arising from vehicles transporting equipment and materials during implementation period.

Sexually Transmitted Infections (STIs)

Awareness creation program shall be arranged for the labor force as well as to the surrounding community about sexually transmitted infections (STIs) and other communicable diseases in the project site.

HIV/AIDS

Health education especially on HIV/AIDS and STIs should be given regularly. It is also best to recruit work forces from the project area in order to avoid any new cases coming with migratory workforce.

Substance Abuse

Orientation shall be given to all workers and penalties imposed for drunkenness, substance abuse and disorderly behavior by workers.

Occupational Health and Safety

The mitigation measures recommended for "geothermal gases" are, installation of H_2S monitoring and warning system, provision of facility for emergency response for workers in locations with high risk of exposure, personal H_2S monitors, self-containing breathing apparatus, provision of adequate ventilation, etc.

Community Health and Safety

The mitigation measure for exposure to hydrogen sulphide gas includes installation of H_2S monitoring network with the number and location of monitoring stations determined through air dispersion modeling, emission sources and areas of community use and habitation, emergency planning involving community input to allow for effective response to monitoring system warnings.

Biological Environment

Flora

The mitigation measure for the clearance of vegetation and affected trees is to minimize vegetation clearance to only areas demarcated for the drilling activity and other infrastructures, keep other areas outside the project influence intact as possible, and re-vegetate cleared areas with indigenous tree species according to environmental clauses.

Physical Environment

Soil

There will be insignificant impact on soil which may occur due to excavation for erecting foundation pads for drilling rigs and constructing retention/sedimentation ponds for containment of discharges and sludge. To minimize wind erosion, it is recommended to water work place and roads under construction.

Air Quality

The drilling of the geothermal wells may have short term adverse effect on air quality due to emission of gas particles (CO_2, H_2S, ammonia and other non-condensable gases) which may escape into the atmosphere from the drilling activity. These may be localized. To mitigate these impacts, the Project should provide personal safety gadgets such as mouth and nose mufflers to workers, install monitoring systems on site, prepare an emergency evacuation plan, train workers on how to respond to emission warnings, etc.

Environmental Hazard

To mitigate these impacts, the Project should provide personal protective equipment such as mouth and nose mufflers to workers, install monitoring systems on site, prepare an emergency evacuation plan, train workers on how to respond to emission warnings, etc. The developer has to maintain safe working conditions at all times.

Monitoring Program

Environmental monitoring is an essential component of project implementation. It facilitates and ensures the follow-up of the implementation of the proposed mitigation measures. It helps to anticipate possible environmental hazards and/or detect unpredicted/unforeseen impacts over time.

Public Consultation and Disclosure

Public consultation has been conducted with vulnerable and underserved groups (The Afar tribe religious leaders, community elders, Alalobad Area Gurmudale and Hayideru Kebele, women representative from November 23-25, 2013. There has been prior consultation by EEPCo in June 2013.

The community understands and recognizes the importance of the geothermal project for the supply of electric power to the Afar Region and they expressed their full support to the project.

The community suggests respecting the culture and tradition of the local people by contractors and project workers.

Continuous public consultation will be conducted with communities, stakeholders and relevant local administration in order to solve problems arising through time during the project activities.

Cost Summary

The total budget cost for implementing the Environmental and Social Management/Mitigation Plan is estimated to be Birr 2,197,100.00 (USD 109,850.00**).** The total mitigation cost covers the cost for Environmental management, enhancement, environmental and social monitoring, procurement of IT equipment, monitoring equipment and vehicles for Environment Monitoring Team.

No	Items	Quantity	Method	Production Quintal/ha	Average unit price (Birr)	Estimated Total Cost (Birr)	Cost USD
1	**Tree plantation**		1ha	--	86,000.00	86,000.00	4,591.56
2	Water pipe and water distribution centre + cattle trough		For one kebele	--	2,000,000.00	2,000,000.00	100,000.00
	Sub total				2,086, 000.00	2,086, 000.00	104,591.56
	Monitoring and valuation						
1	Monitoring and evaluation		Lump sum	Lump sum		96,000.00	5,125.47
2	Valuation committee per diem		Lump sum	Lump sum		15,000.00	800.85
	Sub Total					111,000.00	5,926.32
	Total					2,197,100.00	109,850.00

Exchange Rate: 1 USD≈ 20.00 ETH. Birr

Conclusion

The major environmental benefit of this Project is the reduction of CO_2 emission for electricity generation using renewable geothermal energy as compared with other fossil-fired power generations.

The proposed geothermal project has great significance in increasing the power supply of the country including energy mix as an important factor, where energy supply is dominated by hydro power generation.

The proposed geothermal development project will have great contribution for the socio economic development for both the Afar Region and national levels.

Some negative impacts include issues related to health and safety can be mitigated with proper health safety measures for the workers as well as for the community.

Impacts related to Alalobad hot springs which are potential tourist attractions will be addressed in consultation with this the Regional Culture and Tourism Office. The geothermal resource development will co-exist with institutions and communities around the project area. The project office will consider the issue in the design phase and ensure to create a win-win situation.

The project will also construct access paths to the hot springs to allow pastoral communities take their animals to these hot springs.

Implementation of the Environment and Social Management Plan (ESMP) will be done during preconstruction, construction and operation period of the project.

Provided that the recommended mitigation measures and environmental management measures are effectively implemented during the construction phase of the project, it can be concluded that the anticipated negative impacts will be insignificant.

Recommendation

From the environmental and social point of view, the proposed Alalobad-Tendaho Geothermal Power Development Project poses no significant negative impact on the existing bio-physical and socio-economic environment.

Therefore, it is highly recommended to implement the proposed Geothermal Power Development Project, which is a renewable energy source and that is also very important in the energy mix for the country.

Moreover, the power generation is paramount importance for social and economic development for the Afar Region as well for the nation in general.

I. INTRODUCTION

I.1. Background

The Ethiopian Electric Power Corporation (EEPCo) is a national electricity utility established as a public enterprise by Council of Ministers regulation No. 18/1997. According to this regulation, EEPCo is mandated to engage in the business of power generation, transmission, distribution and selling of electric energy and to carry out any other activities that would enable it to achieve its stated mission.

Generation source of EEPCo is dominantly hydropower. About 99 % of the energy comes from the hydropower plants and the other power projects under construction which are predominantly hydro based with two wind power plants each 120 MW capacity. Thus, Ethiopia's energy generation capacity is likely to be affected by climatic change /drought and variability. To overcome this problem the energy diversification /mix is very important.

Currently, the Ethiopian Government has embarked upon various plans and programs to explore and develop different energy resources (i.e., from, wind, geothermal, solar and hydropower) to achieve the major goals of accelerating economic growth and reducing poverty.

Geothermal is one of the energy resources of the country. Along the Ethiopian Rift Valley, about 14 sites (i.e., *Dalol, Tendaho, Abbe, Teo, Danab, Meteka, Dofan, Fantale, Kone, Gedemsa, Tulu Moye, Aluto Langano, Corbetti and Abaya*) were investigated for their geothermal energy potential which extends some 400 km NNE from latitude of 6^0 N to latitude of 9^0 N. From amongst these sites, EEPCo and GSE intend to develop Tendaho area geothermal resource.

Ethiopia is endowed with the largest geothermal resource base in Africa. The estimated potential total capacity of geothermal resource is estimated to be 5,000 MW.

Since the late 1970s, geophysical surveys, mostly comprising electrical resistivity, were carried out, from south to north, at *Abaya, Corbetti, Langano, Tulu Moye* and *Tendaho* prospects. In addition, a reconnaissance survey of ten sites in the Central and southern Afar Region has been carried out, some of these being followed by more detailed surface investigation.

The Alalobad-Tendaho geothermal field is one of the potential geothermal fields in the Ethiopian Rift valley that is intended to be explored with a set of four test drillings and several production drillings. The ultimate aim of the project is to generate 70 MW electric power to be supplied to Semera substation and connected to the national grid.

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Socioeconomic and Cultural Profile of Some Underserved Communities

Most communities in Ethiopia, especially those in the drier parts of the country, rely upon exploitation of ground water resources for year-round drinking water. As population pressure grows and demands for water resource increases due to domestic, small scale farming and large scale agriculture use, it is becoming apparent that sustainable fresh water supplies will become increasingly difficult to secure. Many hand dug wells and springs, and even shallow drilled wells, already stopped working during the dry season, particularly in some parts of Somali, Afar, and Tigrai regions where water resources are barely sufficient to meet projected needs[1]. The government is now seeking long-term economic solutions for the underserved communities, including implementing the Water and Sanitation program, to realize the full economic potential of these areas. The following are background assessment conducted on the bases of economic and sociocultural profile of underserved groups, within the Afar region, and the findings indicate their unique sociocultural characteristics and level of vulnerability and have significant implications to wider population of underserved living around targeted project site, given that some of these communities have similar characteristics required in OP4.10 and face the same risks and impacts as those not assessed. The economic and sociocultural characteristics of these groups, including how their social organizations and cultural characteristics would enable the project specifically focus on developing mitigation actions for providing culturally appropriate economic and social benefits and for avoiding, minimizing, mitigating or compensating any potential adverse impacts on those meeting the defining characteristics in OP4.10.

Afar Region

Afar is one of nine regional states situated in the north-eastern part of Ethiopia, it borders Oromia region in the south, Tigray region and Eritrea in the north, Djibouti and Somali region in the east, and Amhara region in the west. The altitude of the region ranges from 1500 m.a.s.l. in the western highlands to -120 metres below sea level in the Danakil/Dallol depression. Afar is characterized by an arid and semi-arid climate with low and erratic rainfall. Temperature varies from 20’C in higher elevations to 48’C in lower elevations. Rainfall is bimodal throughout the region with a mean annual rainfall below 500 mm in the semi-arid western escarpments decreasing to 150 mm in the arid zones to the east.

The major sources of water for pastoral and agro-pastoral communities and their livestock are rivers, ponds, and stagnant water during rainy season, springs, *birkads*, hand-dug wells, motorized deep wells and *elas*. The quantity and distribution of existing surface and ground water supply schemes developed in the region are insufficient to meet the demand. According to UNICEF, more than 30% of the schemes are not functioning due to technical and management reasons. Efforts have been made by both government and NGOs working in the region to mitigate the problems but due to lack of coordination among concerned parties and planning constraints have been hindering the identification of sustainable solutions. As per the National WaSH Inventory (NWI) done in 2011 the potable water supply coverage of the Afar region is 37.4% (82% urban and 34.8% rural) . Some woredas likeAsayita and Elidar of zone 1, Awash Fentale, Amibara, and Gewane of zone 3, and Gulina of zone 4 have higher coverage, while woredas like Erebti, Magale, Dallol, Berhale, Afdera, Argoba, Teru and Yalo still have relatively few potable water supplies.

[1] UNICEF (2012)- Investing in Boys and Girls in Ethiopia: Past, Present, and Future

Overall, community management of the water supply schemes is at their infant stage in some places, and non-existent in many places. Hygiene and sanitation activities seem to be limited, with about 55% per cent of the households in the region having access to sanitation facilities. The proportion of households using open defecation in 1996, 2000, and 2004was reported to be 84.4%t, 83.3%, 81.5% respectively. Access to potable water within 1.5 km (15 litres/capita/day) is reported to be 37.7%. The sources of water include: rivers; lakes; unprotected wells; springs; public taps and privately owned taps (UNICEF, 2012). Due to the shortage of water, poor sanitation and limited hygiene, the region has been repeatedly attacked by **AWD**, from 2006- 2009. According to government report on the epidemic made by the regional state health bureau in 2009, there were 6,583 suspected cases and 183 deaths (FMoH, 2011)FMoH-National Hygiene & Sanitation Strategic Action Plan for Rural, Per-Urban &informal Settlements in Ethiopia. The report also indicated that the capacity of government departments to implement projects or coordinate those involved in the sector is limited. NGOs involved in the development of this sector (i.e., water supply, sanitation, and irrigation) in Afar region are also insufficient in number.

Demographics of Afar Region

According to the 2007 Population and Housing Census, the Afar Region houses 1,390,273 people, comprising 775,117 men and 615,156 women. The Central Statistics Agency (CSA) data in July 2011 indicates that the region population has reached 1,559,001people with 867,999 men and 691,002 women. In Afar regional state, about 95% (1,324,854) of the people are followers of Islam. Other ethnic groups found in the region are; Afar (90.03%), Amhara (5.22%), Argoba (1.55%), Tigre people (1.15%), Oromo (0.61%), Wolayta (0.59%), and Hadiya (0.18%).

Livestock management is central to the Afar economy. In fact, about ninety percent of Afar inhabitants derive their livelihoods from livestock production. Pastoralists are predominantly nomadic with approximately 80 % practicing transhumant pastoralism. Pastoral livelihoods have evolved over many centuries as a rational response to low and erratic rainfall and the human and animal mobility ensure maximum sustainable use of the available grazing resource. The agro-pastorals in Afar region are located mainly in the woredas adjacent to the neighboring highland regions, specifically in Argoba, Dulecha, Fursee, Semurobi, Abala and Afambo woredas and their livelihood is based mainly on crop production (Sorghum, maize, Teff and cotton), honey production and livestock production.

Afar People

The Project will be implemented in Afar region, the home for the Afar ethnic group of Ethiopia. The group constitutes 90% of the people that reside in the region. The Afar ethnic communities are differentiated from the neighbouring communities because of their cultural features and customary life style and the nature of the ecology. They are predominantly pastoral in their way of life. The Afar communities have an original, distinctive information exchange system called *Dagu* and possess an oral, interpersonal communication/ritual which they perform when one meets another. In Afar region, *Dagu* is a common form of information sharing among various segments of the population. Religion and clan/family membership are the key social ties keeping the social cohesion of the pastoral peoples. They are a polygamous society and favour living in extended family group. The communities are organized in clans (*Mela*), local community (*Kaido*), lineage group (*Afa*), extended family (*Dahla*) and the household (*Burra*). As one of the key clan based institution, marriage,

divorce and resource sharing are governed by Islamic principles. The *Kadis* and *Shekas* implement Islamic religious rules, regulations and teach the faith.

The Afar practices exogamous marriage and polygamy in accordance with Islamic laws. Marriage, divorce and inheritance are determined by their religious beliefs. It was noted that women do not have equal rights over resources, during marriage, at divorce, and inheritance at the death of their spouse. It is uncommon for women to speak and share concerns and life experiences in Afar without the permission of male clan members. They shy away to speak, as they consider their male counterparts as their spokesperson. This is also reflected in the leadership positions in formal and informal institutions, in the area of participation and memberships of clan institutions.

The Afar people engage in pastoral and agro pastoral (along the riverbanks) economic activities as their main source of livelihoods. They draw their main livelihood from rearing animals such as camel, cattle, sheep, goats and donkey. In some woredas where there is access for water, they practice both crop farming and livestock rearing to support their livelihood. Agro pastoral households produce sorghum along the riverbank using traditional irrigation methods. The communities are chronically food insecure. Further, the region exhibit vulnerable characteristics in terms of the various forms of shocks, seasonality and trends affecting the lives and livelihoods of people. Water shortages, frequent drought, shortage of grass/fodder, outbreak of human disease, malaria and livestock disease, among others, are the source of vulnerability that affect the lives of Afar people.

Traditional Institution for Managing Resources in Afar

The Afar people administer themselves through their traditional administrative system of *Madaa* and *Adaa*, which handles all economic, social and political issues at the local level. *Madaa* is the traditional legal system for the Afar, which is considered as a base for other administrative system and a constitution for Afars. It has a hierarchical structure starting from a head of a household (*BuraHaba*) to clan leaders at top level (*KedoHaboti*). The *Madaa* is the highest decision making body of all the clans and encompasses every aspect of legal issues and the system is not subject to alterations. For example, wildlife is protected by the Act of the *Madaa*. If someone kills a wild beast for the first time, there is a fine of ETB 150. If the same person does it for the second time, the fine will rise to ETB 300. If that goes for the third time, there will be a serious imprisonment. There are also protected areas under the Act of the *Madaa* system. The fines vary according to the type and extent of damage caused by respective individuals and/or groups.

Payments of fines are also effected by two ways known as *Foor* and *Katii*. The *Foor* enforces payments to take place in live animals as much as possible, and *Katii* which is flexible considers payments in combining both live animals and equivalent cash money, and even approves payments in equivalent monetary values when payments are difficult and/or impossible in live animals. The *Katii* also re-assesses the monetary value of livestock in light of developments in the market.

When there is conflict between the *Madaa* system and the local governmental administration, for example, if the police arrest any person for some wrong doings, this is taken as an offence by the community (*Madaa* system). The police and the respective clan will be considered as accountable to the *Madaa* system for the arrest and it is only if this is impossible, the local government will intervene. The latter one is very unlikely to happen

because in the *Madaa* there is a system known as *Fataha* (last and final decision given by the highest body of the *Madaa*), which is respected and accepted by everybody, including the government.

Adaa is a cultural mechanism where they manage the system by applying various rules and regulations within the system such as resource management, marriage arrangements, conflict management, external relations, etc. The *Adaa* respects the rules and regulations of the *Madaa*, and the *Adaa* does not have any structure, it is just a system functioning within the pastoral and agro-pastoral production systems and has been in use since time immemorial. The rules also govern every day's life situations; for example, if some families do not have enough to eat they have the right to get food from the others who do have enough. Committees such as *Woger Habaa* and others are assigned and make decisions at any time whenever appropriate with regards to natural resource management, conflict resolution, etc.

During drought incidences, energetic young men are selected within the community by *WogerHabaa*to assess the condition of grazing and water locally known as *Edo* before deciding where to move the animals. In the case of movement in particular, the pre-assessment of different areas on the availability of water and pasture are evaluated and the committee decides to which area to move. The communities assisted by *Madaa* members also plan on how to economically utilize the resources. The number of livestock and length of time to stay on the particular spot will also be decided by the *Madaa* and *Adaa*. They pass resolution to protect and even have more *Kalo* (grazing reserves) and temporarily protected dry season grazing land (this is used where most of the grazing lands that are far away from the water sources are depleted). They rationally plan and make economical use of the *Kalo*. Weakened livestock will be allowed to feed on the nearby *Kalo* and drink from the nearby water source.

To manage water, water resources will be categorized for the purpose of rational planning. These categories are ponds, *Ela* (wells), rivers and springs during mild and average drought. Strong camels and donkeys will be selected to fetch water from distant places during average drought situations for domestic use. As women are responsible for fetching water, they are most affected. They travel long distances to fetch water for domestic use during mild and average droughts. Women might walk for about 6 hours to find water for domestic use.

During average drought crisis, the *Ela* serves the livestock only in the morning and the people late in the afternoon. In the case of springs and rivers, people will have direct access whereas livestock queue on first come first served basis. Rationing of water is practiced during the average drought conditions. This is executed through the *Madaa* and *Adaa* system. The livestock will be allowed to drink water for survival but not as they wish at two or three day interval. Searching and finding perennial water resources during the average drought period and keeping few animals around watering points at the acute drought period are customary within the *Madaa* and *Adaa system* (Fasil*et al*, 2001)[2]. It has been shown that the Afar community has a dynamic culture and norms to manage resources in general and water specifically. These traditional approaches are socially inclusive to all community members in sharing resources and resolving conflicts.

[2]FassilKebebew, DiressTsegaye and GrySynnevåg (November 2001)-Traditional Coping Strategies of the Afar and Borana Pastoralists in response to drought, DCG Report No. 17.

Although the project site is a desert with no vegetation for agricultural activities and no project affected persons, the site visit and assessment indicate that the population living around the site are mainly pastoral households who depend on livestock as dominant livelihood and agro-pastoral households with small herds and flocks and who, to some extent, depend upon cropping. The pastoral areas have rich customary laws used for many centuries for political and social administration of the rangelands and their people. Building on such laws, pastoral communities have developed traditional institutions and networks that have been serving their people in solving their various economic, social and political matters. The dominant social capital or customary institutions involve social support mechanisms, natural resources management systems, social security systems, and conflict resolution systems and are characterized by poor infrastructure developments, very limited social services (and therefore low education and literacy levels), susceptibility to natural hazards, poor resource endowments, increasing competition for scarce resources and limited livelihood opportunities.

The pastoralist and agro-pastoral communities are known to have complex social relations, are prone to conflicts and are located in the arid and semi-arid regions of the country where the environment is fragile. The main factors that induce conflict include competition over resources. Recurring conflicts between ethnic groups over the use of rangelands has been common phenomenon in most pastoral areas of the country. There has also been a loss of productive assets and increasing household food insecurity due to drought. Whereas, high population growth, and climate change are negatively affecting their resilience capacity and stretching the capacity of local institutions and customary practices cope with shocks and deal with resource management/sharing.

As a community, pastoralists have been economically, socially and politically underserved due to inadequate attention from policy makers in the past. Although significant improvements have been achieved over the last ten years, pastoralists remain under-served in terms of basic social services. Development issues faced by pastoralists include: (i) weak government institutions and limited public participation in local decision-making processes, (ii) poor access to social services; (iii) dependence on extensive livestock production with poorly developed support services, and uneven access to markets; (iv) long-term environmental degradation; (v) vulnerability to recurring droughts exacerbated by climate change; and (vi) increasing competition for natural resource use.

A more detailed socioeconomic data from the project site is discussed in paragraph IX.2-XIII. Overall, GSDP is designed with the sensitivity of the mobile nature of the pastoral communities. The project will contribute in improving livelihoods of pastoralists and agro-pastoralists in terms of provision of basic services as requested by them during the consultation process as well as will empower in culturally appropriate manner.

a. Project Location

The Alalobad-Tendaho geothermal field is located in Doubti *Woreda* (district), Afar Regional State, north-eastern part of Ethiopia, some 600 kilometers from the capital city, Addis Ababa. Alalobad-Tendaho Geothermal field is located at geographic coordinates of latitude 11^0 38’ North and longitude 41^0 00’ East. It is one of the most promising areas for geothermal development in Ethiopia.
The proposed project is situated in the northwestern part of Tendaho graben, a 4,000 km^2 structural feature with high-standing fault scarps bounding a flat plain dotted by young

volcanic edifices and local structural highs. The graben hosts the world's famous "Afar Triple Junction" where the Red Sea, Gulf of Aden and Main Ethiopian Rifts come together giving rise to a prime region of geothermal potential. Altitudes on the graben floor vary from 400 m in the northwest to 240 m at Lake Abe in the southeast. The proposed drilling area in Doubti Woreda is at 402 m altitude. Awash River enters the graben through a gap in the Magenta range, the southwestern graben bounding up-lifted block, at Logiya and flows southeast into Lake Abe, on the border with Djibouti Republic.

Location Map of Alalobad-Tendaho Geothermal Power Development Project Location

b. Purpose of the ESIA

The main purpose of ESIA can be stated as:

- To identify and forecast the possible positive and negative impacts on the environment resulting from the proposed project.
- To identify the impact of the project on the surrounding community and to suggest mitigation measures.
- To provide mitigation measures which up on implementation will reduce or offset the negative impacts of a project resulting in a minimal level of environmental degradation.
- To measure the level of plan implementation and the degree of effectiveness of the environmental protection provisions.
- To develop an environmental and social management plan with recommended mitigation measures and strategies.

c. Methodology

The methodology used to conduct the study is chosen in accordance with the nature of the information needed.

The study methodology comprised the following activities:

i. Field Work

Intensive field work has been conducted in the proposed Alalobad-Tendaho geothermal field in June 2013 and November 2013. Primary data were obtained through public meetings and bio-physical and socio- economic assessment field survey.

ii. Public Consultation

Public consultation has been conducted with vulnerable and underserved groups (The Afar tribe Religious leaders, community elders, Alalobad Area Gurmudale and Hayideru Kebele, women representative from November 23-25, 2013. Prior to that consultation has been conducted in June 2013.

The community understands and recognizes the importance of the geothermal project for the supply of electric power to the Afar Region and they expressed their full support to the project.

The community suggests respecting the culture and tradition of the local people by contractors and project workers.

Continuous public consultation will be conducted with communities, stakeholders and relevant local administration in order to solve problems arising through time during the project activities.

Public consultation was conducted with Afar Regional State and Woreda Administration Sectoral offices and the affected kebele chairperson and elders.

During the consultation meeting, Woreda Administration, Pastoralist and Agriculture and Rural Development, Education, Health, Water Resource, HIV/AIDS Office heads, and kebele chairperson, have participated.

During the discussion, various positive and negative environmental, social and economic issues most likely occur due to the proposed project have been raised and mitigation plan have been discussed.

iii. Contact Offices

The Regional, Woreda and Kebele Government Administration Offices, such as Pastoralist and Agriculture Development Bureau, Health Bureau, Education Bureau, Finance and Economic Development Bureau, Land Administration and Environmental Protection Office, Geological Survey of Ethiopia (GSE), Aluto /Tendaho Geothermal Power Plant Expansion Project Office were contacted. Positive and negative impacts of the project and mitigation

measures were thoroughly discussed with officials and basic data collected from the sector offices.

iv. Material Used

- Tendaho Geothermal Resources Development, Project Concept, March 2011,
- Preliminary Environmental Impact Assessment for the Development of Tendaho Geothermal area Ethiopia, Solomon Kebede, Geological Survey of Ethiopia,
- Afar National Regional State, Regional Atlas 2, BoFED, June, 2009,and other brochures,
- Aluto Langano Drilling of Four Deep Geothermal Wells ESIA, November 2010.
- Digital camera.
- Formatted questionnaires were prepared and used.
- Different literatures, including WB guidelines were referred.

v. Field Assessment Team

A team consisting members of the Power System Planning /PSP/ of EEPCo and Geological Survey of Ethiopia (GSE) took the responsibility to conduct the ESIA study of the project site.

Accordingly, the following team member has participated in the assessment:

1. Mr. Girma Demissie	Sociologist (EEPCo)
2. Mr. Kidane Gizaw	Environmentalist (EEPCo)
3. Mr Abebe Abate	Sociologist (EEPCo)
4. Miss Tirusew Kasahun	Environmentalist (EEPCo)
5. Miss Bethlehem Ermyas	Sociologist (EEPCo)
6. Miss Sintayehu Moges	Sociologist (EEPCo)

I.2. Policy, Legal, Institutional and Administrative Frameworks

d. National Policies and Strategies

i. The Constitution of FDRE

As the supreme law of Ethiopia, all national policies, laws and regulations as well as the institutional frameworks of the country must comply with the constitutional provisions. The constitution of the Federal Democratic Republic of Ethiopia, Proclamation No. 1/1995, contains a number of articles, which are relevant to environmental matters in connection with development projects, as well as to the environment in general.

Article 43 gives the right to people to improved living standards and to sustainable development.

Article 44 provides that all persons have the right to live in a clean and healthy environment. And states in its sub article 1 that: *"All persons have the right to live in a clean and healthy environment".*

Furthermore, concerning compensation to project affected people (PAPs), sub article 2 provides that: "*All persons who have been adversely affected or whose rights have been adversely affected as a result of state programs have the right to commensurate monetary or alternative means of compensation, including relocation with adequate state assistance".*

Article 40.3 of the constitution provides for the public ownership of both rural and urban land as well as all natural resources. It further states that land is the common property of Ethiopian people and cannot be subject to sale or to other means of exchange.

Article 40.7 of the constitution states that "*every Ethiopian shall have full right to the immovable property he builds and to the permanent improvements he brings about on the land by his labor or capital"*. It further states, among other things, that the owner of such rights is entitled to compensation and that the particulars shall be determined by law.

Article 40.8 in turn strengthens this by providing for expropriation of private property by the Government for public purposes subject to the payment in advance of compensation commensurate to the value of the expropriated property.

The right of the public and the community to full consultations and participation as well as to the expression of their views in the planning and implementation of Environmental Policies and development projects that affect them is enshrined in the constitution (Article 92.3 and 43.2).

Women have the right to full consultations in the formulation of national development policies designing and execution of projects, particularly in the case of projects affecting the interests of women.

In general, the Constitution is the primary regulation on which the other proclamations and regulations have been based.

ii. Conservation Strategy of Ethiopia (CSE)

Since the early 1990s, the Federal Government has undertaken a number of initiatives to develop regional, national and sectoral strategies for environmental conservation and protection. 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, programs and projects. The CSE provides a comprehensive and rational approach to environmental management in a very broad sense, covering national and regional strategies, sectoral and cross sectoral strategy, action plans and programs, as well as providing the basis for development of appropriate institutional and legal frame works for implementation.

Based on CSE, the Afar Regional State have already developed Conservation Strategy document for its respective Zones and Woredas. The document gives details about environmental issues prevalent in the territory and outlining how the environmental issues to be addressed.

iii. Environmental Policy of Ethiopia (EPE)

The Environmental Policy (EPE) of the Federal Democratic Republic of Ethiopia was approved by the Council of Ministers in April 1997 (EPA/MEDAC 1997). It is based on the CSE, which was developed through a consultation process over the period 1989-1995.

The policy has the broad aim 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 overall long term 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 overall policy goals may be summarized in terms of the improvement and enhancement of the health and quality of life of all Ethiopian's and the promotion 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 the EPE, and expand on various aspects of the overall goal. The policy contains sectoral and cross-sectoral policies and also has provisions required for the appropriate implementation of the policy itself.

iv. Ethiopian Water Resources Management Policy

The Ministry of Water and Energy (MoWE) has formulated the Federal Water Resource Management Policy (WRMP) for a comprehensive and integrated water resource management. The overall goal of the policy is to enhance and promote all national efforts towards the efficient, equitable and optimum utilization of the available water resources of the country for significant socio economic development on sustainable basis.

The specific objectives of the policy include:

- Promote the development of the water resources of the country for economic and social benefits of the people, on equitable and sustainable basis;
- Allocate and apportion the water, based on comprehensive and integrated plans and optimum allocation principles that incorporate efficiency of use, equity of access and sustainability of resources;
- Manage and combat drought as well as other drought associated impacts and disasters through efficient allocation, redistribution, transfer, storage and efficient use of water resources; and
- Conserve, protect and enhance water resources and the overall aquatic environment on sustainable basis.

The policy requires water resources schemes and projects to have "Environmental Impact Assessment and Evaluation".

v. Wildlife Policy

The wildlife policy covers a wide range of policies and strategies relating, amongst others, to wildlife conservation and protected areas. It is developed by Ministry of Agriculture /MoA/ whose prime objective is the preservation, development and sustainable utilization of Ethiopia's wildlife resources for social and economic development and for the integrity of the biosphere.

vi. Forest Policy and Strategies

There is no forest policy statement in place at the federal level. However, draft forest development and conservation policy is currently under discussion in the MoA and also at regional levels. They are expected to express the determination and commitment of the government to conserve and develop and rehabilitate the forest resources of the country and regions.

vii. National Population Policy

This policy was issued in April 1993 and aims at closing the gap between high population growth and low economic productivity, through a planned reduction in population growth, combined with an increase in economic returns. With specific references to natural resources, the population policy had the following specific objectives:

- Marking population and economic growth compatible and the over exploitation of natural resources unnecessary.
- Ensuring spatially balanced population distribution patterns, with a view to maintaining environmental security and extending the scope of development activities.
- Improving productivity of agriculture and introducing off-farm non-agricultural activities for the purpose of employment diversification.
- Maintaining and improving the carrying capacity of the environment by taking appropriate environmental protection and conservation measures.

viii. National Policy on Women

This policy was issued in March 1993 and stresses that all economic and social programs and activities should ensure equal access of men and women to the country's resources and in the decision making process so that they can benefit equally from all activities carried out by the central and regional institutions.

ix. Research and Conservation of Ethiopian Cultural Heritage

Article 51/3 of the constitution of the FDRE declares that Federal government "*shall establish and implement national standards and basic policy criteria for public health, education, science and technology as well as for the protection and preservation of cultural and historical heritage"*. Based on this, the Council of Ministers of FDRE endorsed the cultural policy of Ethiopia in October 1997 and issued the Research and conservation of Cultural Heritage (ARCCH) proclamation no. 209/2000.

Protection and conservation of cultural heritage from manmade and natural hazards is one of the goals of the ARCCH. There is also an article which states that the removal of any cultural ruins is to be carried out under strict supervision of the responsible authority, ARCCH.

x. National Energy Development Policy, May 1994

The National Energy Development Policy of 1994 has the objective of facilitating the development of energy resources for economical supply of energy to consumers in an appropriate manner and in the required quantity and quality. The strategies consist of the accelerated development of indigenous energy resources and the promotion of private investment in the production and supply of energy.

1. Objectives of Energy Policy

- Enabling access of the largest portion of the population to modern energy at an affordable price,
- Protecting and preserving existing fuel wood resources, realization of the national energy resources potential,
- Establishment of efficient strategies for the energy sector and its different sub-sectors

The national energy policy of the country emphasizes the need to develop environmentally friendly energy source to meet the countries energy needs and to encourage the private sector to invest in hydropower. The following are the main priorities of current energy policy in Ethiopia:

- The need for equitable development of the energy sector in parallel with other social and economic developments.
- Attainment of self-sufficiency through the development of indigenous resources with minimum environmental impact and equitably distribution of electric in all regions

In order to achieve the aforementioned objectives in an environmentally and socially sustainable manner, the following strategies have been defined by EEPCo:

- Fast development of the countries hydro power resources,
- Increasing the current low level electricity access within short period of time,
- Expanding EEPCo ‘s market to neighboring countries and beyond , through active participation in regional and bilateral power trade initiatives,
- Intensifying electric usage within already electrified towns, and
- Improving EEPCo’s service delivery capabilities through implementing reforms.

Hydro power development should reconcile with the three fundamental framing principles:

- the promotion of human right;
- The protection of the environment; and
- The right to economic development.

2. National Environmental Impact Assessment /EIA/ Procedural Guidelines

The Federal Environmental Protection Authority /F EPA/, 2003, EIA Guidelines are based on the Constitution, the Environmental Policy of Ethiopia, the Proclamations on EIA, Pollution Control and Establishment of EPA and other Environmental Organs in the country. The document gives detailed required procedures for conducting an EIA in the country and the requirements for environmental management.
The FEPA EA Procedural Guideline mainly aims particularly at:

- Ensuring the implementation of the EPE and compliance of EA related legal and technical requirements,
- Providing a consistent and good practice approach to EA administration in Ethiopia,
- Assisting proponents and consultants in carrying out their environmental assessment related tasks,
- Assisting Interested and Affected Parties, especially communities in realizing their environmental rights and roles,
- Assisting Environmental Protection Organs, Competent and Licensing agencies in discharging their roles and responsibilities, and
- Establishing partnership and networking among and between key stakeholders in EA administration.

3. Sectoral Environmental Policies

Among the sectoral policies, the wildlife policy is the one developed by the Ministry of Agriculture aiming to preserve, develop and sustainably utilize the countries wildlife resources. Water resource policy is to enhance and promote all national efforts towards the efficient and optimum utilization of the available water resources for socio-economic development on sustainable bases. The policy is to establish and institutionalize environmental conservation and protection requirements as internal parts of water resources planning and project development.

e. Environmental Framework Legislation

i. Proclamation on Institutional Arrangement for Environmental Protection

The proclamation for the establishment of Environmental Protection Organs, No. 295/2002, was issued to establish a system that fosters coordinated but differentiated responsibilities among Environmental Protection Agencies at Federal and Regional levels. The proclamation recognizes assigning responsibilities to separate organizations for environmental development and management activities on the one hand and environmental protection, regulations and monitoring on the other, is instrumental for the sustainable use of environmental resources, thereby avoiding possible conflicts of interests and duplication of efforts.

ii. Proclamation on Environmental Impact Assessment

The primary aim of the proclamation on Environmental Impact Assessment (No. 299 /2002) is to make ESIA mandatory for specified categories of activities undertaken either by the public or private sectors and possibly, the extension of ESIA to policies, plans and programs.

iii. Proclamation on Environmental Pollution Control

The proclamation on Environmental Pollution Control No. 300 /2002 is mainly based on the right of each citizen to live in a healthy environment, as well as the obligation to protect the environment of the country. The primary objective of the proclamation is to provide the basis from which the relevant ambient environmental standards applicable to Ethiopia can be developed and to make the valuation of these standards a punishable act. The proclamation states that the "*polluter pays*" principle will be applied to all persons. Under this proclamation, EPA is given the authority to ensure implementation and enforcement of environmental standards and related requirement to inspectors assigned by FEPA or Regional Environmental Agencies.

f. Legal Framework for Expropriation and Compensation

i. Land Tenure.

Land in Ethiopia is state owned by Proclamation No. 31 /1975, issued to deal with government ownership of rural land and Proclamation No. 47 /1975, issued to cover Government ownership of urban land. Under article 3 (1) of the first proclamation, all rural land shall be the collective property of the Ethiopian People.

The new constitution of December 1994 retained land under the control of the people and government of Ethiopia. Article 40 states that "*ownership of both urban and rural land is vested in the state and the people and is common property, which is not subject to sale or other means of exchange"*. Peasants have the right to obtain land without payment and are protected against eviction from land in their possession.

ii. Forest Resources Conservation Proclamation (1994)

The proclamation has incorporated provisions that aim at ensuring the conservation of forests and determines how forest shall be developed and utilized. It also recognize that the sustainable utilization of the country's forest resources should be achieved through the participation of the people and benefit sharing by the concerned communities, as well as by formulating policies and programs in conformity with other economic sectors particularly agricultural development.

iii. Expropriation

The power to expropriate landholdings belongs to a *woreda* (rural local government) or urban administration for a development project (*Proclamation No. 455/2005 Article 3*). The implementing agency is required to provide written notification, with details of timing and compensation, which cannot be less than 90 days from notification (Proclamation No. 455/2004 Article 4). Any entitled landholder who has been served with an expropriation order shall hand over the land to the local *woreda* or urban administration within 90 days from the date of payment of compensation should the leaseholder accept payment. Furthermore, where there is no crop or other properties on the expropriated land, the title holder shall hand over the land within 30 days of receipt of expropriation order. The implementing agency is responsible for gathering data on the land needed and works, and sending this to the appropriate officials for permission. It is also required to compensate

affected landholders (*Proclamation No. 455/2005 Article 5*). Proclamation No.455/2005 "Expropriation of land for public purposes and payment of compensation proclamation". This law provides for the compensation of displaced persons for their lost assets and to restore their livelihood. *Article 14 (1) and Article 14(2)* provides for replacement of land for the construction of houses.

Regarding the removal of utility lines, the relevant government body must give a written request to the affected landholder, and this body must determine a fair compensation within 30 days (*Proclamation No. 455/2005 Article 6*). Compensation must be paid within 30 days of the receipt of the valuation, and the landholder must vacate the land within 60 days of receipt of compensation.

The Constitution also guarantees people whose livelihood is land based and pastoralists the right to have access to land as well as the protection against eviction from their possession (Article 40.4 and 40.5). In article 40.8, it also states that, private property may be expropriated for public use subject to payment in advance of compensation commensurate to the value of the property".

In July 2005, the Government of Ethiopia has issued a new proclamation entitled, *"Proclamation to provide for the expropriation of land holdings for public purposes and payment of compensation"* Proclamation No. 455/2005. This new proclamation has several articles on determination of compensation, on displacement compensation, valuation procedures, and property valuation committees and on complaints and appeals in relation to compensation.

In part two, article 3, No.1 of the proclamation it states that; " *A Woreda or an urban administration shall, up on payment in advance of compensation in accordance with this proclamation, has the power to expropriate rural or urban land holdings for public purpose where it believes that it should be used for a better development project to be carried out by public entities, private investors, cooperative societies or other organs, or where such expropriation has been decided by the appropriate higher regional or federal government organ for the same purpose".*

Proclamation No. 455/2005 provides a better displacement compensation for rural land holdings compared to previous laws.

In part 3 of article 8 it states that: "*A rural land holder whose land holding has been permanently expropriated shall, in addition to the compensation payable under Article 7 of this proclamation, be paid displacement compensation which shall be equivalent to ten times the average annual income he secured during the five years preceding the expropriation of the land".*

The proclamation also states that in urban areas PAPs will be provided with a plot of land (land for land compensation) for their expropriated land to be used for the construction of house and also be paid with compensation for displacement.

Recently, Council of Ministers Regulation No. 135/2007 was issued on the payment of compensation for property situated on land holdings expropriated for public purposes, for the proper implementation of the Proclamation No. 455/2005. This regulation was issued

for the purpose of not only paying compensation but also to assist displaced persons to restore their livelihood.
This regulation set forth details to determine the amount of compensation for different assets found on land holdings expropriated for public purpose and stipulated the formula to calculate the amount of compensation payable for different assets.

iv. Compensation

v. Acquisition, valuation and Compensation of land and Other Assets

1. *Directive No.135/2007* "Payment of compensation for property situated on landholding expropriated for public purposes Council of Ministers Regulation".
   This Regulation deals in detail with compensation for loss of property. Although Proclamation No.455/2005 stipulates assisting displaced persons to restore their livelihood, this regulation does not deal with this issue. The Regulation determines the payment of compensation for assets based on current cost, cost of demolishing, lifting, and reinstalling where applicable, and the provision of replacement of land. The compensation categories include the following:

   - Compensation for building: All components of building structures will be considered and current cost per square meter will be used to calculate amount of compensation.
   - Compensation for crops: This category is logically sub-divided into crops and perennial crops. In both cases the amount of compensation is calculated based on yield per square meter of land multiplied by current price per kilo gram
   - Trees: Trees could be cut and used by owner plus payment of compensation for loss of continued income.
   - Permanent improvement of land: The cost of machinery, labour for improvement, and any infrastructure built as part of the improvement have to be compensated based current cost.
   - Property relocation: Amount of compensation for any property that could be relocated and used again without being damaged is calculated based on cost to relocate he property.
   - Protected grass: Amount of compensation for loss of land that is used for grazing or production of grass is based on area of land and the current price per square meter.

Land valuations are often done at the *woreda* and urban administration levels. These local government units establish valuation committees to value private properties (*Proclamation No. 455/2005*). In the case of publicly owned infrastructure with a designated right-of-way (ROW), the owners of the structures within the ROW would assess the value of properties to be removed. However, the law does not take into account depreciation values. The landholder is entitled to compensation for the property on the basis of replacement. Permanent improvements to the land, equal to the value of capital and labor expended (*Proclamation No. 455/2005 Article 7*), are specified as valid basis for determining replacement value. Where property is on urban land, the law specifies that compensation "may not be less than constructing a single room in low cost house as per the region in which it is located." It is also required that the cost of removal, transportation, and erection be paid as compensation for a relocated property, continuing its service as before. Compensation will also be based on current cost, cost of demolishing, lifting, and

reinstalling. Valuation formulae are to be provided by regulations (*Proclamation No. 455/2005 Article 7*).

Assets will be broken down into components to assess value (*ANRS 28/2007 and Directive No. 135/2007*). Components for building costs include cost per square meter. Crops are subdivided into crops and perennial crops, and calculated based on yield per square meter of land multiplied by price per kilogram. Trees could be cut and used by owner plus payment of compensation for loss of continued income. The cost of machinery, labor for improvement, and any infrastructure as part of the improvement will be compensated based on current costs. Property relocation is based on the cost to relocate property given that it is not damaged while being moved. The amount of compensation for loss of land that is used for grazing or production of grass is based on the area of land and the current price per square meter. (Note: more detailed instructions for compensation are included within *Directive No. 135/2007*.)

Further, assets will be classified as movable and immovable. For movable assets, compensation will be paid for inconvenience and other transition costs (*Proclamation No. 455/2005 Article 7(2) and ANRS Regulation No. 51/2007*). Urban immovable assets include residential houses, business installations, institutional structures, stores, fences and public service providing installation. In rural areas, they include seasonal crops, perennial fruit trees, timber trees and other cash crops.

For losses that cannot be easily valued or compensated in monetary terms (e.g. access to public services, grazing areas, water points, fishing ponds, etc.), an attempt will be made to establish access to equivalent and culturally acceptable resources and earning opportunities (*Proclamation No. 455/2005 Article 7(2)*).

In addition to compensation according to *Proclamation No. 455/2005 Article 7*, a displacement compensation shall be paid equivalent to ten times the average annual income he/she secured during the five years preceding the expropriation of the land (*Proclamation No. 455/2005 Article 8(3) and ANRS Regulation No. 51/2007*). Compensation will be in an amount sufficient to reinstate displaced people to their economic position prior to displacement, the regionally relevant administration is required to give another piece of land to any person who lost his land in favor of a public project (*Proclamation No. 455/2005 and ANRS Directive No. 28/2007*). The assessment of compensation does not include the value of the land itself because land is a public property and not subject to sale in Ethiopia.

Those with informal, or undocumented rights, and those without titles or use right (e.g. squatters, encroachers) are eligible for specific assistance. Such assistance recognizes some "typical claim to use rights or even ownership" after occupation of unused or unprotected lands has been established. Informal use-rights are likely to have structures or land improvements that are eligible for compensation, as stated in *Proclamation No. 455/2005*.

In general, valuation of property is to be carried out by a certified private or public institution or private consultants as per the valuation formulae (*Proclamation No. 455/2005 Article 9*). The committee must be made up of experts with relevant qualifications (*Proclamation No. 455/2005 Article 10*). This must be not more than 5 experts in rural areas and be designated by the *woreda* or urban administration. A specialized committee of experts may also be set up separately if required.

The local and federal governments have different roles in compensation. The *woreda* and urban administrations are responsible for payment of compensation and rehabilitation support to the extent possible, and maintain data regarding properties removed from expropriated landholdings (*Proclamation No. 455/2005 Article 13*). The Ministry of Federal Resources has the power and duty to ensure there is compliance with *Proclamation No. 455/2005* at the regional level, to provide technical and capacity building support in implementation at the regional level, and prepare the valuation formulae (*Proclamation No. 455/2005 Article 12 and ANRS Proclamation No. 133.2006*).

Proclamation No.456/2005 "FDRE Rural land administration and land use proclamation"
This proclamation regulates the use and administration of rural land and provides for registration of land, the obligation to pay compensation to land holders if the holder is displaced or to provide replacement with compensation for lost assets. The proclamation decrees that rural land holders expropriated for federal projects have to be compensated based on federal compensation laws or if displaced for regional projects they have to be compensated according to regional regulations.

Regarding the determination of compensation in part three, article 7 of this proclamation (Proclamation No. 455/2005), the basis and amount of compensation is clearly explained. In this article, sub article 1, "*A land holder whose holding has been expropriated shall be entitled to payment of compensation for his/her property situated on the land and for permanent improvements he/she made such land"*.

Article 7(2) states that the amount of compensation for property situated on the expropriated land shall be determined on the basis of replacement cost of the property.

Under Article 8(1) of proclamation 455/2005, a survival landholder whose land holding has been permanently expropriated shall in addition to the compensation payable under Article 7 of this proclamation be paid displacement compensation, which shall be equivalent to ten times the average annual income he secured to bring the five years preceding the expropriation of the land.

All PAPs and organizations (whether public or private) that losses houses, crops or sources of income will be compensated or rehabilitated according to the types and amount of their losses. The cut-off-date for compensation eligibility will be set once all detailed measurements have been completed. Compensation will not also be paid for any structure erected or crops and trees planted purely for the purpose of gaining additional compensation. Cultivating land, constructing settlement in project affected areas after the cut-off-date will not be eligible for compensation or subsidies.

Administrative arrangements to implement policies: Compensation for loss of assets and relocation of displaced persons are handled on the basis of regulations governing the issue. The federal law on compensation (Proc. No.455/2005) requires that inventory and valuation of assets should be done by an agency consisting of 3-5 persons established for the purpose. The agency implementing and assessing compensation and relocation depends on who carries out the project that is cause for relocation. In most cases, displacement in urban areas is dealt with by urban administrations while displacements in rural areas are handled by the project owner (private investor, federal or regional government agency).

Grievance and Redress Mechanism (GRM): A number of regional states (most notably Amhara and Tigray) have begun the process of creating grievance procedures approximating international standards which provide grievant in those states with a forum to complain about governmental maladministration and seek redress for any harm done to the grievant. Amhara has grounded its grievance redress mechanism in legislation approved by the regional cabinet council. Tigray used Amhara's GRM procedures as a "benchmark" for its draft regulation and procedures manual. These two early adopters have provided other regional states, such as SNNPRS, Benishanghul Gumuz and Oromia, with a template for strengthening existing GRMs based on the BPR or enacting regulations which provides new GRMs strong legal underpinnings. These regional initiatives are manifestations of the impact of Ethiopia's decentralization policies and the ability of federalism, as it currently operates in Ethiopia and elsewhere, to provide a variety of "laboratories" where experiments in good governance can flourish.

Nations, Nationalities and Peoples, Pastoralists, and National Minorities

The Ethiopian Constitution recognizes the presence and rights of many ethnic groups, including historically disadvantaged and vulnerable groups. These include Nations, Nationalities and Peoples, pastoralists, and national minorities.

Article 39 of the Ethiopian Constitution recognizes the rights of groups identified as "Nations, Nationalities and Peoples". They are defined as "a group of people who have or share a large measure of common culture or similar customs, mutual intelligibility of language, belief in a common or related identities, a common psychological make-up, and who inhabit an identifiable, predominantly contiguous territory." This represents some 75 out of the 80 groups who are members of the House of Federation, which is the second chamber of the Ethiopian legislature. The Constitution recognizes the rights of these Nations, Nationalities and Peoples to: self-determination, including the right to secession; speak, write and develop their own languages; express, develop and promote their cultures; preserve their history; and, self-government, which includes the right to establish institutions of government in the territory that it inhabits and equitable representation in state and Federal governments. The vast majority of the project participants and beneficiaries belong to this group.

The Ethiopian Constitution also recognizes the rights of pastoralist groups (Articles 40 and 41). This includes the right to "free land for grazing and cultivation as well as the right not to be displaced from their own lands" and the right to "receive fair prices for their products, that would lead to improvement in their conditions of life and to enable them to obtain an equitable share of the national wealth commensurate with their contribution. This objective shall guide the State in the formulation of economic, social and development policies." Pastoralist regions/areas recognized by the government are: Afar; Somali; Borena Zone and FenteleWereda (Oromia); South Omo Zone, Bench-Maji Zone, and parts of DechaWereda in Keffa Zone (SNNPR); and, Nuer Zone (Gambella).
The pastoralists comprise approximately 12-15 million people that belong to 29 groups of Nations, Nationalities and Peoples[3]. Whilst government policies have strengthened and resource allocations increased over the last decade[4], pastoralist areas are still amongst the

[3]Pastoralist Forum Ethiopia, http://www.pfe-ethiopia.org/about.html
[4]PASDEP (2005 -2010), the previous five year poverty reduction plan to GTP promoted more targeted assistance to underserved areas – the emerging regions and pastoralist/agro-pastoralist areas (MOFED

least served with basic services. Education indicators for pastoralist areas are among the lowest in the country: lowest literacy rates, highest dropout rates and furthest distance from schools. (Jennings et al., 2011).Formal education is seen in some pastoralist households as a threat to the future contribution of children to the household and to the pastoralist way of life. Pastoralist girls access to education is also constrained by perceptions of parents that schooling compromises girls' reputation, makes them less compliant which, in turn, reduces their worth as marriage partners (Brocklesby et al. 2011).
The Constitution also recognizes another group called "national minorities". Article 54 (1) states that: "Members of the House [of Peoples Representatives], on the basis of population and special representation of minority Nationalities and Peoples, shall not exceed 550; of these, minority Nationalities and Peoples shall have at least 20 seats." These groups have less than 100,000 members and most live in the 'Developing Regional States'. Owing to their limited access to socioeconomic development and underserved status over the decades, the Ethiopian government has designated four of the country's regions, namely: Afar, Somali, Benishangul-Gumz, and Gambella as Developing Regional States (DRS). In this respect, Article 89 (2) of the Ethiopian Constitution stipulates: 'The Government has the obligation to ensure that all Ethiopians get equal opportunity to improve their economic situations and to promote equitable distribution of wealth among them'. Article 89 (4) in particular states: 'Nations, Nationalities and Peoples least advantaged in economic and social development shall receive special assistance'.

In connection with institutional framework designed to ensure equity between regions, the government has set up the Ministry of Federal Affairs (MoFA). The responsibilities of this Ministry include promoting equitable development, with emphasis on delivering special support to the developing regions. The main purpose of the especial support is to address the inequalities that have existed between the regions over the decades, thereby hastening equitable growth and development. Federal Special Support Board, which consists of relevant sector ministries including the MoA, was reorganized in March 2011. The MoFA acts as Vice Chair and secretariat of the board. A Technical Committee (TC) composed of sector ministries constituting the Board, was also set up under the MoFA to monitor and report the implementation of special support plans. As its main aim, the Board coordinates the affirmative support provided to the developing regions by the different organs of the federal government, and ensures the effectiveness of the implementation process.

In addition, Equitable Development Directorate General has been set up within the MoFA, with directorates put in place to operate under it for the respective developing regions. Among many other activities, the Directorate General coordinates and directs case teams to collect, organize and analyze data in relation to the gaps in capacity building, social and economic development, good governance, gender and environmental development in the regions in need of special support.

This project site covers Afar region of Ethiopia and given that the Ethiopian Constitution recognizes the presence of the above different socio-cultural groups, as historically disadvantaged and underserved communities, as well as their rights to socio-economic equity and justice which also meets the OP4.10 criteria. The policy is triggered and this ESIA is complemented by extensive consultation process with project beneficiaries and project affected peoples, including identified vulnerable and historically underserved

2010).

groups, meeting the OP 4.10 criteria, to seek broad support for the project from these groups.

vi. EEPCo's Strategy for Expropriation and Compensation

It is the objective of EEPCo to avoid or reduce the environmental and social impacts of its power projects to a minimum level. If adverse social impacts that will occur are unavoidable, EEPCo then will open consultation with PAPs and perform legal compensation for loss of all their properties. To achieve the social mitigation goal, EEPCo will allocate adequate budget for compensation before the project implementation. EEPCo in consultation with the administration of Regional State, Zones, Woredas and Kebele Associations shall establish property valuation committee as per the proclamation No. 455/2005. It is the project's prime task to initiate the establishment of property valuation committee to properly implement compensation payment for PAPs on time before the implementation of the project.

g. Multi - lateral Agreements

The Federal Democratic Republic of Ethiopia has ratified several international conventions and protocols as listed below:-

- Vienna Convention for the Protection of Ozone Layer (1996)
- Montreal Protocol for Substances Depleting the Ozone Layer (1990)
- United Convention on Law of the Sea.
- Convention on Biodiversity (Rio convention) 1994
- Framework Convention of United Nations on Climate Change (1994)
- Basel Convention on the Control of Trans-boundary movement of Hazardous Substance (2002)
- African Convention on the Conservation of Nature and Natural Resources
- Convention on Wetlands of International Importance especially as waterfowl habitat (Ramsar)
- Convention to Combat Desertification (CCD), ratified in 1997
- Convention Concerning the Protection of World Cultural and Natural Heritage, ratified 1972
- Convention on International Trade in Endangered Species (CITES) (1970)
- Stockholm convention on persistent organic pollutants (PAPs, 22nd May 2001)
- International Plant Protection Convention

h. International Banks' Requirements

The Regional Development Banks, such as the European Bank for Reconstruction and Development (EBRD), the African Development Bank (AfDB) and the Asian Development Bank (ADB), all have environmental policies and guidelines which in most part resemble and respect those of the World Bank Policies.

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

each Bank. ADB and EBRD procedures are developed from the World Bank procedures (*Hydro power development, Environmental effects, 1995*).

Common to all Regional Development Banks, including the World Bank, the responsibility for meeting the environmental requirements rests on the hand of the borrower. The FEPA report shall be commissioned and /or carried out by the authorities of the country seeking a loan. On controversial projects the Bank normally establishes an independent panel of experts to control and give advice on how to deal with environmental aspects.

i. The World Bank's Requirements

According to the World Bank project screening criteria, the Alalobad-Tendaho Geothermal Power Development Project is categorized as "Category A".

The World Bank provides guidance on requirements in the Environmental Assessment Sourcebook, which includes the most recent versions of the World Bank Operational Policies as well as the updates. The World Bank has ten "Safeguard Policies" whose primary objective is to ensure that Bank operations do not cause adverse impacts. The ten safeguard policies are grouped into Environment and Social Policies.

Of these ten safeguard policies, three are not applicable as they relate to international law on waters and disputed areas, and the safety of dams. The following safeguard policies have been considered in this study.

1. The Bank's Safeguard Policies

The following are the World Bank Safeguard Policies that are pertinent to the Program under consideration.

a. OP 4.01 Environmental Assessment

The core requirement of this Policy is that screening should be done as early as possible for potential impacts and select appropriate instrument to assess, minimize and mitigate potentially adverse impacts. Environmental Assessment (EA) ensures that appropriate levels of environmental and social assessment are carried out as part of project design. It also deals with the public consultation process and ensures that the views of PAPs and local NGOs are incorporated as early as possible for Category A and B projects.

It is worth noting that OP 4.01 applies to all components of a project with financing from the World Bank, including co-financed components by the Borrower or by other funding agencies.

b. Underserved Groups

The Bank's policy on underserved groups to ensure that development project respects fully the dignity, human rights, economies and cultures of these people. The policy stipulates the requirement of the borrower to engage in a process of free, prior and informed consultation.

Measures to be taken include:

a) Avoid potentially adverse effects on these communities

b) When avoidance is not feasible, minimize, mitigate or compensate for such effects.

Bank financed projects are also designed to ensure that these groups receive social and economic benefits that are culturally appropriate and gender and intergenerational inclusive. Accordingly, as part of its due diligence, the World Bank has conducted social screening of the Alalobad site to assess safeguards risks and potential impact of the proposed project on humans and environment, particularly, to determine whether the physical and sociocultural characteristics of Alalobad meets the OP4.10 requirement of distinct, vulnerable, social and cultural group, possessing the following characteristics, in varying degrees: (a) self-identification as members of a distinct indigenous cultural group and recognition of this identity by others; (b) collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories; (c) customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and (d) an indigenous language, often different from the official language of the country or region. The finding indicates that the vast majority of target population met the criteria detailed in OP/BP 4.10. Further, the Ethiopian Constitution recognizes the presence of many ethnic groups, including historically disadvantaged and vulnerable groups, as well as the rights to their identity, culture, language, customary livelihoods, socioeconomic equity and justice. These groups include various nations, nationalities and peoples, pastoralists, and national minorities, of which the Afar people belong. Accordingly, the project has triggered the policy and has conducted an enhanced social assessment and extensive consultations (within this ESIA) with potential project beneficiaries and project affected peoples, including those identified as vulnerable and historically underserved groups to seek broad support from these groups.

c. OP 4.11 Physical Cultural Resources

The Policy requires the project to avoid or mitigate adverse impacts of development on physical cultural resources.

The Policy bases itself on investigating and inventorying any *chance findings* and cultural resources potentially affected. It includes mitigation measures when there are adverse impacts on physical cultural resources.

The Borrower assesses the project's potential impacts on physical cultural resources as an integral component of the Environmental Assessment (EA). The process and steps to be taken for physical cultural resources component of the EA are the same for Category A and B projects.

The physical cultural resources component of the EA provides for (a) an assessment of physical cultural resources likely to be affected by the project, (b) documentation of the characteristics and significance of the these resources, and (c) an assessment of the nature and extent of potential direct and indirect impacts on these resources.

Where the EA predicts adverse impacts on physical cultural resources, the cultural resources component of the EA includes a management plan which includes: (a) actions to mitigate adverse impacts, (b) provisions for the treatment of physical cultural resources discovered during project implementation and operation (hereafter referred to as "*chance finds"*), (c)

any necessary measures for strengthening institutional capacity to implement the management plan, and (d) a monitoring system to track progress of these activities.

The management of cultural property should be undertaken in conjunction and consultation with appropriate agencies including NGOs and academic institutions. The Bank avoids projects that will significantly damage non-replicable cultural property, and will assist only those projects that are sited or designed so as to prevent such damage.

d. OP 4.12 Involuntary Resettlement

Avoid or minimize involuntary resettlement where feasible by exploring all viable alternative project designs.

Assist displaced persons in improving their former living standards, income earning capacity and production levels, or at least in restoring them.

Encourage community participation in planning and implementing resettlement.

Provide assistance to affected people regardless of the legality of land tenure.

The policy covers not only physical relocation, but any loss of land or other assets resulting in: (i) relocation or loss of shelter; (ii) loss of assets or access to assets; and (iii) loss of income sources or means of livelihood, whether or not the affected people must move to another location.

The impetus of this Policy is that development projects should not cause the impoverishment of the people who are within the area of influence of the projects. In cases where resettlement of people is inevitable, proper resettlement action plan should be undertaken to at least restore or improve, as stated above, their standard of life prior to the projects.

Concerning public consultation, resettlers as well as the host communities should be consulted for the successful implementation of the resettlement process. The views of the consulted resettlers and the host communities should be incorporated into the resettlement action plan (RAP) including the list of their choices.

e. OP 4.36 Forests

The Policy envisages the protection of forests through consideration of forest-related impact of all investment operations, ensuring restrictions for operations affecting critical forest conservation areas, and improving commercial forest practice through use of modern certification systems.

In the process of forest conservation interventions, especially the local people, the private sector and other pertinent stakeholders should be consulted.

In general, the Policy aims at reducing deforestation and enhancing the environmental and social contribution of forested areas. Experience with the Bank reveals that the Bank does not support commercial logging in primary tropical moist forest.

f. Bank's Policy on Disclosure

It is the requirement of the Bank that people residing in the project area have the right to be informed of the proposed development project(s) in their respective areas. Therefore, prior to project appraisal, the summary of the study of projects along with other relevant information should be disclosed at the Bank's as well as project area (local) level.

The Disclosure Policy requires that Category A and B Environmental Assessment reports should be self-standing document and thus disclosure is a pre-requisite for appraisal of the project. These effects can lead to the improvement of the infrastructure related to agriculture, commerce and the activation of the regional economy.

g. Institutional and Administrative Frameworks

The Federal Democratic Republic of Ethiopia (FDRE) was formally established on August 21, 1995. The FDRE comprises of the Federal state with nine Regional State members.
The following paragraph discusses the institutional and administrative frameworks at the federal and regional level and organizations responsible for the preparation of environmental policy and technical guidelines.

Federal Democratic Republic of Ethiopia (FDRE)

The Federal Democratic Republic of Ethiopia (FDRE) comprises of the Federal State and nine Regional States. The power and duties of the Federal, Regional and Local governments have been defined by Proclamation Numbers 33 of 1992, 41 of 1993 and 4 of 1995. Under these proclamations, duties and responsibilities of Regional States include planning, directing and developing social and economic development programs, as well as the protection of natural resources of their respective regions.

Regional Governments

The Afar Regional State is one of the nine regional states established by the Federal Government of Ethiopia. The proposed geothermal resource site at Alalobad-Tendaho is fully located in this Regional State. The Region has Zones and Woredas. And under each Woreda there are many Kebele administrations. Each administrative unit has its own local government elected by the people. The Regional Government has established sectoral Bureaus, Commissions and Authorities.

The Geological Survey of Ethiopia (GSE)

The Geological survey of Ethiopia (GSE), under the Ministry of Mines, has the organizational mandate and legislative instruments that empower it to execute geothermal projects to the end of the exploration stage. These includes: (i) surface exploration, (ii) exploratory drilling and (iii) well testing and feasibility studies. To execute geothermal projects, GSE is equipped with deep drillings and shallow drilling rigs, scientific equipment and trained manpower in geothermal exploration and development.

Ministry of Water, Irrigation and Energy (MoWIE)

The Ministry of Water and Energy (MoWE) is a regulatory body for the energy sector, *inter alia*. Based on the delegation from FEPA, the whole draft ESIA document will be submitted to the Ministry for comment and reviewing purpose, and then they will give their comments and recommendations and finally provide approval /certify the implementation of the project and monitor the performance of the development project during and after the implementation of the project.

Ministry of Environment and Forest (MOEF)

The rights and obligations of the former Federal Environmental Protection Authority (FEPA) established under the Proclamation No. 295/2002 are transferred to the Ministry of Environment and Forest. It was an autonomous government body reporting directly to the prime minister until it was folded into the newly established Ministry of Environment and Forest (MoEF).

Ministry of Environment and Forest has the following powers and duties

- Coordinate measures to ensure that the environment objectives provided under the constitution and the basic principles set out in the environmental policy of Ethiopia are realized
- Establish a system for environmental impact assessment of public and private projects, as well as social and economic development policies, strategies, laws and programmes;
- Prepare a mechanism that promotes social, economic and environmental justice and channel the major part of any benefit derived thereof to the affected communities to reduce emissions of greenhouse gases that would otherwise have resulted from deforestation and forest degradation;
- Establish a system for the evaluation of the environmental impact assessment of investment projects submitted by their respective proponents by the concerned sectoral licensing organ or the concerned regional organ prior to granting a permission for their implementation in accordance with the Environmental impact Assessment Proclamation
- Establish an environmental information system that promotes efficiency in environmental data collection, management and use;

Promote and provide non formal environmental education program and cooperate with competent organs with a view to integrating environmental concerns in the regular educational curricula.

Ethiopian Electric Power Corporation (EEPCo)

The Ethiopian Electric Power Corporation (EEPCo) is a national electricity utility established as a public enterprise by Council of Ministers Regulation No. 18/1997. According to the regulation, EEPCo is mandated to engage in the business of power generation, transmission, distribution and sale of electric energy nationwide and carry out any other activities that would enable it to achieve its stated mission.

On the basis of the Constitution as well as the Environmental Policy, and based on the peculiar functional and operational characteristics of EEPCo, it has produced an Environmental Guidelines that is currently serving the Environmental and Social Experts of EEPCo for their day-to-day environmental activities.

Pastoralist and Agricultural and Rural Development Office of Afar Regional State

The Ministry of Agriculture (MoA) and the Federal Environmental Protection Authority (FEPA) have delegated their authority to the regional bureau of Pastoralist and Agriculture and Rural Development.

Environment Monitoring Team/EMT/ of EEPCo

Environment Monitoring Team/EMT/ of EEPCo comprises environmentalist and sociologist to address environmental and social issues that may arise due to its operation.
The following are the major duties and responsibilities of the Environmental and Social experts of Environment Monitoring Team/EMT/ within the functional or operational framework of the EEPCo:

- Responsible to carry out Initial Environmental Examination (IEE) or Environmental Screening in the preliminary design phase. The experts are expected to conduct full EIA study for category B projects.
- Prepares TOR to conduct full EIA study. Corporate Planning is taking full responsibilities to short list Environmental Consultants, prepare RFP or tender documents and evaluate the technical and financial proposals of the short listed firms.
- The Environmental and Social Experts of EEPCo are responsible to monitor the environmental and socio-economic activities in different power project areas, to make sure that contractors are complying according to the technical specification stated in the contract agreement.
- The Environmental and Social Experts of EEPCo may also conduct the monitoring of resettlement activities either independently or together with the government and non-government stakeholders on regular basis.
- Monitoring of forest clearing operation will preferably be conducted jointly with the government stakeholders.
- Review of documents related to environmental and social management undertakings by consultants.
- Power System Planning represents EEPCo in all matters that are related to the Environmental issues of a project.

Economic benefit can be obtained by the reduction of the need to import fossil fuels. Furthermore, electricity supply to the central part of Ethiopia can also be expected by connecting adverse environmental and social impacts caused by the EEPCo's project operations will be jointly monitored by the EEPCo's, Environment Monitoring Team/EMT/ and the project office. The Environment Monitoring Team/EMT/ and the project office are responsible for the monitoring of adverse environmental and social impacts and coordinate the preparation and implementation of the EIAs, EMPs, and the RAPs where it is deemed necessary.

Aluto Geothermal Power Plant Expansion Project Office

EEPCo has established a project office named Aluto Geothermal Power Plant Expansion Project Office to manage Aluto, Tendaho and Alalobad Geothermal Resource Developments. The project office is located in Addis Ababa and reports to the Generation Construction Executive Officer of EEPCo.

Relevant Guidelines

The Federal Environmental Protection Authority /FEPA/ has issued guidelines for environmental and social impact assessment of projects in different sectors.

These include:

- Environmental Study Procedural Guidelines require all projects to be subject to an IEE to decide whether the project is to be submitted to full EIA, EPA, 2000.
- Environmental Impact Assessment Procedural Guidelines Series 1, EPA, 2003.
- Sectoral Guidelines for specific types of projects, e.g. water supply, dams and reservoirs, irrigation, hydropower, rangeland management, soil conservation.
- Guidelines to prepare environmental and social management plans, EPA, 2004
- Guidelines on Hydropower Production, Transportation and Distribution.
- Guideline on ambient water quality for domestic, agricultural and industrial wastes
- EEPCo's environmental guideline.

II. PROJECT DESCRIPTION

The following are Alalobad-Tendaho Geothermal Power Development Project components.

- Drilling of geothermal wells
- Heat Gathering System (from geothermal wells to the power house)
- 70 MW Power Plant Construction and Switchyard
- 132 Kv Transmission Line (from Alalobad-Tendaho power plant to Semera substation)

According to the planned activity, it is intended to produce 70 MW of electric energy.

The Alalobad-Tendaho Geothermal Power Development Project will be carried out in the north eastern part of Ethiopia in Afar Region Doubti Woreda. Alalobad-Tendaho geothermal field is located at geographic coordinates of latitude 11° 38' North and longitude 41° 00'East.

Tendaho graben is traversed by an excellent tarmac highway that serves as the main transport route for Ethiopia's foreign trade through Djibouti.

In this case, energy diversification is also very important step, since most of the country's power generation (about 99 %) depends on hydropower. (*EEPCo's facts in brief 2010/11)*

i. Project Objectives

Overall Objectives are:

- To increase the level of knowledge of Alalobad-Tendaho geothermal field to a level that would encourage developers to assume dependability for its development.
- To develop the potential geothermal natural resource for energy production

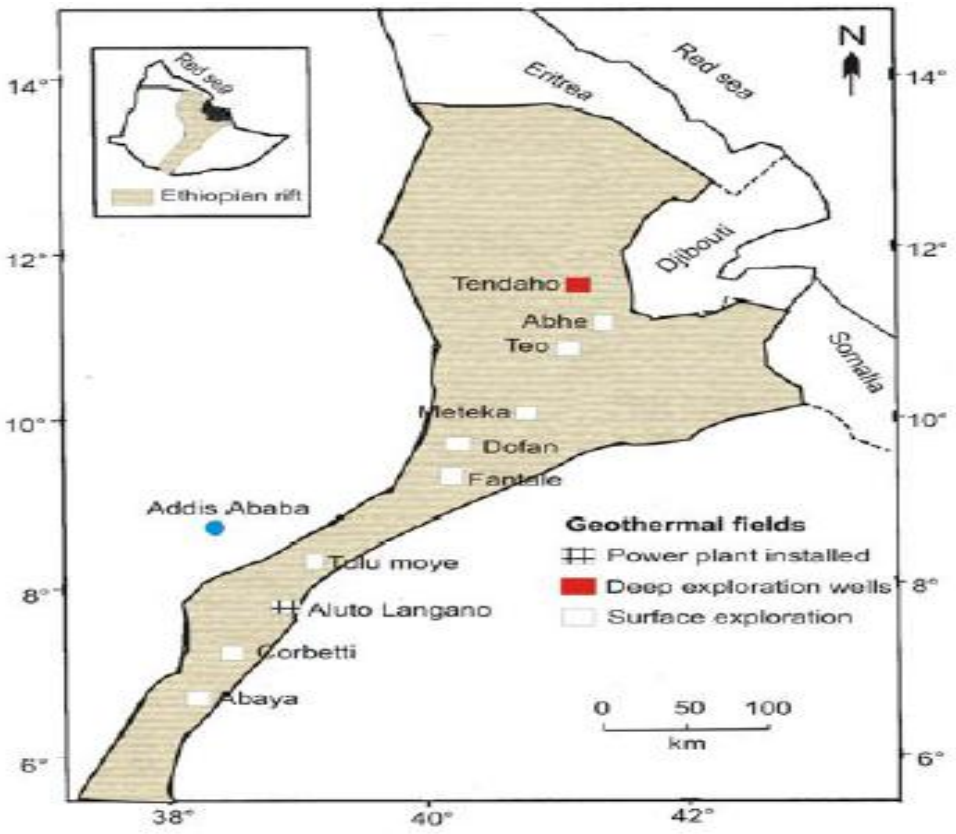
Immediate Objectives:

- To prove the deep, high temperature geothermal reservoir by drilling;
- To provide geo-scientific and geothermal engineering information regarding its physical and chemical state as well as its preliminary optimal production conditions;
- To propose a program of appraisal drilling to delineate the resource and to determine its full development potential and develop the deep resource evaluated in phase II with first phase power plant installation. Design the power plant, for execution under Phase III: Production drilling and construction of second phase power plant.

j. Planned Activities

The geothermal wells will be excavated in the project component with the following main activities:

- Drill well site preparation, that is excavation of top soil and compaction of the ground at the drill pads in order to create stable ground capable of carrying the "*rig and its structure*". Usually the pads have dimensions of: 170 m (L) X 75 m (W), 100 m(L) X 50 m (W) and 100 m (L) X 80 m (W).
- Excavation of the soil to form ponds for the disposal of drilling effluents. The ponds have dimensions of: 50 m (L) X 25 m (W) X 2 m (D) (D=depth), 50 m (L) X 40 m (W) X 2 m (D) and 40 m (L) X 40 m (W) X 2 m (D).
- Transportation of the rig and its accessories to the project site.
- Drilling of 500 m deep geothermal wells using circulating water and testing.
- Disposal of the drilling effluents to evaporation ponds.
- Well testing of the wells to be drilled,



Map of Rift Valley Geothermal Resource Potential
Location of Alalobad geothermal resource area (40 km^2)

III. PROJECT ALTERNATIVES

Currently electricity access in Ethiopia reaches an estimated 48.5% (*EEPCo, facts in brief, 2010/11*) of the population. Further electricity generation is therefore necessary in order to reach a greater percentage of the population to promote economic growth. The situation is aggravated by the fact that 99.3 % of the electric power produced is based on hydropower which has often been unreliable especially during the dry seasons. Persistent shedding is affecting the productivity of the industrial and agricultural sectors, leading to reduction in economic growth.

The Ethiopian Government has embarked upon various plans and programs to explore and develop different energy resources (i.e., hydropower, geothermal, wind and solar) to achieve the major goals of accelerating economic growth and reducing poverty.

To overcome the growing demand, planning for energy diversification is very important. Therefore, the proposed Alalobad-Tendaho Geothermal Power Development is one of the most important steps to generate electricity which will enable to back up the other energy sources.

k. Alternative 1: Do-Nothing Alternative

From a purely physical environmental viewpoint, the "*do-nothing*" alternative is preferable than project implementation, since it would avoid creation of any of the adverse impacts

associated with any development projects. However, the potential social and socio economic benefits to the nation would be foregone and quality of life would remain at a low level /worsen for many of those who live in the country. If this option is accepted, long term development plans for the country would be compromised and slowed down, since reliable power supply and improved services associated with it are fundamental to achieving the full benefits.

The majority of the nation's energy needs are covered by biomass, mostly in the form of fuel wood and charcoal for cooking. The extraction of wood has led to large scale deforestation. Deforestation leads to increased soil erosion, changes in natural habitat and as a consequence, loss of bio-diversity.

The "*do-nothing*" alternative will worsen the deforestation problem, because it will not reduce the need for fuel wood, halt the clearing of forests, conserve the nation's soils, stop environmental degradation, etc. This alternative will not also help to promote educational, commercial and industrial development.

l. Alternative 2: Exploration and Expansion of Geothermal Energy

Geothermal energy is a renewable energy source and environmentally friendly as compared to other energy sources especially fossil fuel, which is a naturally endowed resource. Development of geothermal energy thus has a minimal negative impact on the environment compared with development associated with conventional energy sources. In addition to this, geothermal power plants require relatively little land, taking up only a fraction of that needed by other energy sources. Geothermal facilities have neither huge piles of ash, nor slag/ bags of radiation-tainted sulfur to contend with. Greenhouse gas emissions are almost zero, ozone depleting chemicals from both direct and indirect sources are also almost zero, sulfur oxide emissions are virtually zero because, by design, geothermal modern closed-cycle systems re-inject almost everything but the extracted heat and geothermal facilities present light demands on land use, looking much like any light industry facility. Its initial cost is much less as compared to other sources of energy. The impact it causes on the environment and community is also localized and insignificant. This option has to be also explored in order to supply diversified energy sources which make energy supply sustainable.

m. Alternative 3: Conservation and Demand Management

Conservation and demand management is becoming one supply option. They free up existing energy to be used elsewhere, thus postpone the need for new capacity. Although environmentally this option is preferable, the demand forecast still call for a significant increase in generation capabilities to maintain economic growth and development (*Please, refer to Ethiopian Power System Expansion Plan – April 2004).*

To keep pace with the growing population and fast economic growth of the country, the electricity generating requirement must also grow annually, so that over the next five years strategic plan , the total electricity generating requirement of the ICS could be, at the very least, some 8,000 MW– 10,000 MW. To reach this target is a genuine challenge, but the benefits to the environment alone will be immense with huge knock-on benefits for social and economic development. Therefore, EEPCo has developed an expansion plan in the area

of generating capacity. The conservation and demand management alternative is not a realistic option to meet the growing demand of the nation.

n. Alternative 4: Thermal Power

The high costs of importing fossil fuel preclude thermal power option that would depend on foreign fuel. Fossil fuel resources in the country have not been developed or proven to the extent that a thermal station would be feasible. Also from an environmental viewpoint, the thermal alternative is not preferable; it increases the emission into the atmosphere of CO_2, which is the most important Green House Gas contributor.

o. Alternative 5: Renewable Energy (Wind and Solar)

The prospects for solar and wind power generation in Ethiopia is significantly attractive. According to the 2003 Master Plan Study, the specific generation cost of wind power was estimated at over US cents 40 per kWh, more than five times the price of thermal energy. The cost of solar power was computed as over US cents 90, which is more than ten times that of a thermal plant. There are efforts being undertaken by the EEPCo to establish wind farm at two locations and solar energy may well of interest for remote small load centers. Therefore, due to its significant generation cost, the development of these two energy sources is not at this point in time considered feasible.

p. Alternative 6: Other Hydropower Schemes

Studies have shown that the potential for hydropower construction, given that there are many rivers, is another alternative to be undertaken. However, a considerable amount of money will be invested in the construction period of hydropower plants. Also, from the past experience of the country, the hydro power energy generation capacity will be altered by seasonal fluctuation of rain due to drought.

q. Analysis/ Evaluation of Alternatives

In contrast with other energy generation sources, the geothermal energy source, being a renewable one and environmentally friendly, it is the one most preferred.

The Alalobad-Tendaho Geothermal Power Development is feasible, and is exceptionally attractive, from the technical, economical and environmental viewpoints. Such a worthwhile scheme, which will bring net benefits to the nation in general and to the local communities in particular, should be implemented at the earliest possible date.

IV. BASELINE ENVIRONMENTAL CONDITIONS

a. Bio-physical Environment

i. Location

The Alalobad-Tendaho Geothermal Power Development Project will be carried out in the North Eastern part of Ethiopia Afar Region. Alalobad-Tendaho Geothermal field is located at geographic coordinates of latitude 11^0 $38^{'}$ North and longitude 41^0 $00^{'}$ East, within the

North East part of the main Ethiopian Rift valley about 600 km North of Addis Ababa in Afar Regional State of Doubti Woreda.

The national highway that connects Ethiopia with the Port of Djibouti runs from Addis Ababa north-northeast direction near the Alalobad-Tendaho Geothermal Resource Development Project site (i.e., Semera Town, capital city of Afar Region).

ii. Topography

The area of potential interest is predominately a flat terrain at an elevation of 402 m.a.s.l. covering a surface area of thousands of square kilometers which is locally interrupted by scattered isolated volcanic hills, rising a few hundred meters above the flat plain. Alalobad-Tendaho geothermal field is located in a geologically active zone with a history of naturally occurring earthquakes and many fumaroles.

iii. Geology

Alalobad-Tendaho geothermal field is located in the Afar Depression, a plate tectonic triple junction where the spreading ridges that are forming the Red Sea and the Gulf of Aden emerge on land and meet the East African Rift. The Afar Depression is one of the two places on earth where a spreading oceanic ridge can be studied on land, the other being Iceland (Abbate et al., 1995). The geothermal field in Afar Region consists of a NW-SE elongated broad plain of about 4,000 km^2 (Tendaho graben), mainly filled by alluvial and lacustrine deposits (Aquater, 1996). The oldest volcanic products in the area are lava pile outcroppings on the graben edges (Afar stratoid series), whereas the most recent activity, both linear and central, is concentrated within the graben.

Seismic studies that were conducted in the early 1990's in the central northern part of the Ethiopian Rift Valley indicate that shocks were mainly located in the central part and their focal depths were confined at 3-8 km (Gresta, et al 1997). The depth of their occurrence was deeper than the potential geothermal reservoir of the area.

Sub-surface stratigraphy in the drilled wells showed that the Tendaho graben is filled with: upper thick sedimentary sequence consisting of fine to medium grained sandstone, siltstone and clay, intercalated by basaltic lava sheets; and lower basaltic lava flows of the Afar stratoid series. The upper layer has permeable zones at intervals, while poor permeability is indicated in the drilled Afar stratoid series.

iv. Soil

The quality of the soil is generally not good for agriculture. Soil analysis carried out on surface soil samples, collected at a depth of 0-20 cm inside the project area (Doubti Plantation) appeared to have low contents of organic matter and nutrients (Table 1). The soil is essentially alkaline with good cation exchange capacity owing to the high clay content. It consists of sand 50.7%, silt 19.1%, and clay 30.2% (Aquater, 1996).

In general, the soil is of low natural fertility. The boron, chloride and arsenic values of the soil are high.

Table 1:- Analytical Results of Doubti Soils (Aquater, 1996)

pH	Organic matter (%)	Total Nitrogen (%)	Phosphorus (mg/kg)	Cation exchange capacity (meq/100g)	Chloride (mg/kg)	Boron (mg/kg)	Arsenic (mg/kg)
9	**0.24**	**0.04**	**1.8**	**38.6**	**270**	**1.6**	**3**

v. Air Quality

The state of the atmosphere at Alalobad-Tendaho and its surroundings is good. The area has not been exposed to any major anthropogenic interference that has a significant impact on the environment. However, micro pollutions may have originated from exhaust smoke from heavy duty trucks crossing the area.

The geothermal power site assessed in this report operates by collecting steam from the geothermal wells. The steam is used to drive turbines which generate electrical energy. The used steam is discharged as liquid water and vapor /steam into the re-injection well. The water vapor or steam which is 99 % harmless will be released into the atmosphere, but it is associated with non-condensable gases of about 1 %, including CO_2, H_2S, Ammonia and others.

Some amount of H_2S will be released during well testing. It is potentially noxious and toxic gas with the odor of rotten eggs. Small quantities of air pollutants will be released from mobile construction equipment and other vehicles. Furthermore, air pollutants in particular oxides of nitrogen will be released from the drilling rig engines during well drilling.

Small quantities of air pollutants will be released from mobile construction equipment and other vehicles. Furthermore, air pollutants in particular oxides of nitrogen will be released from the drilling rig engines during well drilling.

Table 2:- Hydrogen Sulfide Guideline Values

Substance	Guideline value	Averaging time
Hydrogen sulfide (H_2S)	150 µg/m^3	24 hours

Source: Guideline ambient environment standards for Ethiopia (EPA, August 2003)

vi. Water Quality

The major river draining the Tendaho graben is the Awash River. The river starts in the highlands of central Ethiopia, at an altitude of about 3,000 m.a.s.l. and after flowing to south-east for about 250 km, enters the Rift Valley and then follows the valley for the rest of its course up to Lake Abe on the border with Djibouti Republic. This river passes about 10 km south of the proposed geothermal resource site and is characterized by extensive variations of flow throughout the year, the maximum being in September to October.

The Awash water has a sodium-carbonate type of composition with a total dissolved solid (TDS) content of about 600 p.p.m and is suitable for irrigation. The groundwater potential of the area is generally high, however in many part, the water is of poor quality (high

salinity, high iron and high temperature) (MoWR and UNICEF, 2003). The natural thermal systems are also affecting the quality of the groundwater.

The Alalobad-Tendaho area is located in a broad, very flat basin that has a thick stratigraphic section of unconsolidated to poorly consolidated, often fine sediments. The water table is relatively near the surface, so water fills the interstices of the sediments. Under these conditions, it is of paramount importance that fluids produced from the shallow reservoir be re-injected into the subsurface in order to prevent subsidence. It also needs good reservoir engineering practice to maintain reservoir pressure in order to maintain well productivity and the life of the geothermal reservoir. An injection well should be an integral part of the well field commissioning. Subsidence monitoring network and installation of stations are required. This will be accomplished either by gravity methods or by conventional surveying techniques or both.

Groundwater aquifers of the region include coarse sedimentary and fractured volcanic units. The water at depth in the Alalobad-Tendaho geothermal area is of sodium chloride type. The deep recharge to the system originates in the western escarpment and plateau at elevations above 2,000 m.a.s.l. The main hot springs at Alalobad have similar isotopic compositions to those of waters from the Doubti wells, suggesting a hydrological connection (Aquater, 1991).

The shallow water reservoir is characterized by a TDS value of about 2,500 and 2,000 ppm at wellhead and reservoir conditions respectively (Aquater, 1996). The gas content of the separated steam is low amounting to 0.1% in weight. The fluids of the deep reservoir exhibit a chemical composition similar to that of the shallow reservoir, except for a relatively higher content of non-condensable gases, amounting to about 1% in weight of the separated steam (Aquater, 1996).

Table 3:- Alalobad Water Quality

Parameters	Unit	Limit value	Remark
Temperature	25^0C	± 3	
pH: Al-1 Al-2	- 8.92 9.15	8.3	
Calcium (Ca) Al-1 Al-2	mg/L 21 19	22	
Potassium(k) Al-1 Al-2	mg/L 40 39	38	
Magnesium (Mg) Al-1 Al-2	mg/L 0.1 0.1	0.2	
Nitrate (NO_3) Al-1 Al-2	mg/L 0.89 0.89	1.33	
Sodium (Na) Al-1 Al-2	mg/L 545 530	575	
Silicic acid (SiO_2) Al-1 Al-2	mg/L 289 289	273	
Fluoride (F) Al-1 Al-2	mg/L 0.85 0.68	0.81	
Chloride (Cl) Al-1 Al-2	mg/L 730 737	794	
Hydro-Chloride (HCO_3) Al-1 Al-2	mg/L 20 --	57	
Cond. Al-1 Al-2	mg/L 2778 2570	3050	

Source: Chemical analysis of samples taken from Alalobad Springs, 2004.

vii. Effluent Discharges

A large thermal anomaly was indicated by the presence of high concentrations of leakage detectors such as NH_4, CO_2 and boron (B).

The waters at depth are sodium chloride types having a chloride concentration not exceeding 800 mg/l and exist in the reservoir in the liquid phase; the system is water dominated.

The absence of tritium and the significant ^{18}O isotopic shift in the waters indicated very long circulation times and a high level of water-rock interaction; and
the isotopic evidence showed that the main gas component in the thermal manifestations, CO_2, has a magmatic origin.

As a precautionary measure, the effluent discharged during excavation shall be directed to flow into retention and sedimentation ponds.

Table 4:- Standard for Effluents Discharged on Land

Parameters	Unit	Limit value	Remark
Temperature	-	40	-
pH	^0C	5.5 - 9.0	-
Total dissolved solids (TSS)	mg/L	2100	
Biochemical oxygen demand (BOD_5)	mg/L	500	20 ^0C
Fats, oils and grease	mg/L	30	
Mercury (Hg)	mg/L	0.001	
Boron (B)	mg/L	5	
Arsenic (AS)	mg/L	0.25	
Fluoride (F)	mg/L	20	
Chloride (Cl)	mg/L	1000	
Sulphate ($S0_4$)	mg/L	1000	

Source: Guideline for industrial Pollution Control in Ethiopia (EPA, September 2003)

viii. Noise

Noise will be emitted from geothermal fluid escaping during the wells drilling, working noise and vibration and well testing are the only temporary noise sources. Thus, it is deemed to have an impact on the environment and surrounding community.

The environmental standards for noise are established by the zone type for residential, commercial and industrial and by time division into daytime and nighttime.

Table 5: - Noise Standards

S. No.	Category of area	Limits in decibel (dB)	
		Day time (6 am to 9pm)	Night time (9pm to 6 am)
1	Industrial area	75	70
2	Commercial area	65	55
3	Residential area	55	45

Source: 1) Guideline for industrial Pollution Control in Ethiopia (EPA, September 2003)
2) Guideline ambient environment standards for Ethiopia (EPA, August 2003)

Table 6: - The World Bank Requirement on Noise level (World Bank 1998)

World Bank's Maximum Allowable Ambient Noise Level		
Receptor	**Maximum Allowable Limit (Hourly) in dB**	
	Day time (0700 – 2200 hr)	**Night time (2200 – 0700 hr)**
Residential, Institutional and educational	55	45
Industrial and commercial	70	70

ix. Climate

Diverse rainfall and temperature patterns are largely the result of Ethiopia's location in Africa's Tropical Zone and the country's varied topography. Altitude-induced climatic conditions form the basis for three environmental zones: cool (*Dega*), temperate (*Weina Deg*), and hot (*Kolla*), (U.S. Library of Congress, 2005).

The hot zone consists of areas where the elevation is lower than 1,500 m. The Alalobad-Tendaho geothermal potential field is designated as a hot zone. Daytime conditions are torrid, and daily temperatures vary more wide. Although the hot zone's average annual daytime temperature is about 27°C, mid-year readings in the Alalobad-Tendaho area often soar to more than 40°C. The moisture content of the air through most of the year is very low.

Rainfall in Doubti Woreda is always meager. The total mean rainfall from March 2003 to July 2009 was 204.74 mm (NMSA, 2011). The evapo-transpiration is much higher than the precipitation rates. The project area biome is characterized as desert scrubland (Wikipedia, 2001).

From 2003 - 2009, the maximum mean annual temperature is around 36.270 C, minimum mean annual temperature is around 23.200 C and mean monthly temperature ranges from 18.14 to 42.020C, with a little difference from month to month.

The mean annual precipitation is around 15.94 mm. July to September and April are the wettest seasons, while October to March is the dry season with low level of rainfall.

Table 7: - Mean monthly temperatures and mean monthly rainfall for Doubti (2003 - 2009)

Month / Item	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Mean annual**
Mean monthly temp. (^{0}C)	**26.3**	**27.5**	**29.4**	**31.3**	**33.9**	**34.3**	**34.2**	**32.6**	**33.2**	**29.9**	**27.3**	**25.6**	**38.46**
Mean monthly rain fall (mm)	**2.0**	**0.64**	**5.7**	**38.4**	**1.3**	**2.1**	**48.5**	**67.3**	**17.3**	**0.30**	**9.54**	**11.7**	**17.07**

Source: National Meteorological Services Agency

From 2005 - 2009, the mean annual temperature is around 20.75^0 C and mean maximum and minimum annual temperature ranges from 27.26^0 C to 13.93^0 C.

x. Altitude

The project site's elevation is about 402 m.a.s.l.

xi. Flora

Vegetation is mostly confined to drought resistant stunt plants such as Acacia and Prosopis juliflora. Most of the existing vegetation has been destroyed by the local people to produce charcoal and for firewood. Broader leafed vegetation is restricted along the Awash River course and areas irrigated by the river. The narrow belt along the course of Awash River covers about 10 % of the prospect area.

During the recent ESIA study, the community and Woreda Pastoralists and Agricultural and Rural Development Office has informed the study team that there is vegetation such as, Acacia species and Prosopis juliflora in the project area. Shrubs/bushes are also seen scattered all over in the proposed project site.

Table 8: - Common Flora in the Project Site

S. No.	Common name	Scientific name	Remark
1	Prosopis	Prosopis juliflora	
2	Acacia */Girar/*	Acacia sp.	

Source: Field visit survey and questionnaire from Pastoralists and Agricultural and Rural Development Office.

N.B:- Words written in asterisk are local Amharic names.

Also, the dominant annual agricultural products in the Woreda are Maize /*Bekolo*/, Tomato /*timatim*/, Onion /*Shinkurt*/, Green pepper /*karia/*, *wheat,* and *barley* are primarily cultivated and grown on the farmlands and homesteads.

Table 9: - Common Agricultural Product in the Woreda

S. No.	Common name	Scientific name	Remark
1	Maize /*Bekolo*/	Zea mays	
2	Tomato/ *Timatim*/	Lycopersicum esculentum	
3	Onion /*Shinkurt* /	Allium cepa	
4	Green pepper /*Karia*/	Capsicum frutescens, C. annuum	
5	Wheat	Triticum sativum	
6	Barley	Hordeum vugare	

N.B:- Words written in italic are local Amharic names

Source: Field visit survey and questionnaire submitted from Pastoralists & Agricultural and Rural Development Office

xii. Fauna

Domestic animals present in the proposed geothermal resource development area are cattle (ox, cow), sheep, goat, donkey, mule, and camel.

Table 10: - Common Domestic Animals in the Project Site

S. No.	Common name	Number	Remark
1	Donkey	1,591	
2	Oxen /cows	40,599	
3	Sheep	46,819	
4	Goats	52,727	
5	Camel	5,966	

Source: Field visit survey and questionnaire submitted from Pastoralists, Agricultural and Rural Development Office

Among wild animals prevalent in the Woreda are, Hyena, Lion, Anubis baboon, Black backed jackal, Bush duiker, Vervet monkey, porcupine, leopard, wild ass, Klipspringer, hippopotamus, Soemmering's gazelle and warthog. The existing environment presents a lower degree of preserved nature resulted from human intervention.

Table 11: - Common Wildlife in the Project Site

S. No.	Common Name	Scientific Name	Remark
1	Hyena	Crocuta crocuta	
2	Anubis Baboon	Papio anubis	
3	Jackal	Canis aureus, C. mesomelas	
4	Bush duiker	Sylvicapra sp.	
5	Vervet monkey	Cercopithecus aethiops	
6	Porcupine	Hystrix cristata	
7	Leopard	Panthera pardus	
8	Guenther's dikdik	Rhynchotragus guentheri	
9	Genet	Genetta sp	
10	Soemmering's gazelle	Gazella soemmeringii	
11	Warthog	Phacochoerus aethiopicus	

Source: Field visit survey and questionnaire submitted from Pastoralists, Agricultural and Rural Development Office

Furthermore, according to information from local residents, rats, snakes and several kinds of reptiles are seen in the area.

Table 12:- Common Type of Birds in the Project Area

S. No.	Common Name	Scientific Name	Remark
1	Ostrich	Struthio camelus	
2	Goose	Cyanochen sp.	
3	Francolin	Francolinus sp.	
4	Guinea fowl	Acryllium sp.	
5	Pigeon	Treron sp.	
6	Dove	Streptopelia sp.	

Source: Field survey and Woreda Agricultural Office
: No migratory bird record is available

b. Socio- Economic Environment Data from the Project Site

i. Location

The proposed project is found in the Afar Regional State, Zone 1, Doubti Woreda in the NE part of Ethiopia, some 600 km from the capital city, Addis Ababa. The project site is situated in the northwestern part of Tendaho graben, a 4,000 km^2 structural feature with high-standing fault scarps bounding a flat plain dotted by young volcanic edifices and local structural highs.

The economic livelihood of the region's population is mostly based on pastoralism, camel and goat herding. Because of the existence of fertile alluvial soils and Awash River, the most important sedentary economic activity in the past 4-5 decades has been growing cotton at plantations at Doubti, Det Bahri, Tangaye Koma and Asayita. Recently sugar cane plantation replaced the cotton plantation. Irrigated farming for food crops has been also growing in importance.

Tendaho graben is traversed by an excellent tarmac highway that serves as the main transport route for Ethiopia's foreign trade through Djibouti. Thus, another economic basis for the towns in the area is service provision to the truck traffic on that highway. The town of Logiya is a product of the road traffic. Doubti Woreda started as satellite town for the farms that bear its name. Semera town was established recently as administrative city of the Afar Regional Government, the campsite for the geothermal exploration project is also situated in this city.

ii. Demographic Characteristics

The total population of the Project surrounding Woreda, Doubti according to information gathered from the Woreda Administration office is 65,314 and the Woreda's land size is 539,044.13 hectare.

In the project area Woreda 49.6% of the population live in rural areas and 50.4% live in towns. The number of male population in the Woreda slightly exceeds the female population.

The total population size of the project Kebele is 12,500 and the average household size is 5.

The average population density of the Woreda is 1 person per 8.26 ha. and the average population growth rate is 2.5%. The average household size is 5 - 8 persons.

Table 13: - Total population of Doubti Woreda

Urban Population		Rural Population		Total Population	
Male	**Female**	**Male**	**Female**	**Male**	**Female**
17,127	15,787	17,743	14,657	34,870	30,444

Source: Woreda Administration Office

iii. Ethnic Composition

The major ethnic group of the Woreda is Afar, mixed with few other ethnic groups like Amhara, Tigre, Oromo and others. Around the proposed project Kebele Afar ethnic group comprises of 100 %.

iv. Settlement Pattern, Housing and Household Economy

The economic livelihood of the region's population is mostly based on pastoralism, mainly camel and goat herding. Due to the existence of fertile alluvial soil around Awash River basin, the important sedentary economic activity of the past 4-5 decades has been growing cotton at plantation sites at Doubti. Recently, vast sugar cane plantation is underway by the Tendaho Sugar Cane Plantation Project. Irrigated farming for food crops has been also growing in importance. The Sugar cane plantation farms will attract considerable number of migrant workers, mostly from overpopulated areas in the southern part of the country.

The Afar people has portable house called "Ari" a movable tukul that the community carrying with them wherever they move with their cattle. Recently the communities started to be agro- pastoralists practicing agriculture and animal rearing.

The main transit artery of landlocked Ethiopia for import and export purposes is through the Afar Region to Djibouti port. The road transport became a typical "truck-stop economy" to towns along the highway providing service mainly for truck drivers.

Semera town is a recently established town, currently the capital city of Afar Regional State with the potential to develop into a major commercial centre. A paved all weather road connecting to the main highway passes near the geothermal resource development area.

The main sources of water for Doubti Woreda, for domestic and livestock consumption include groundwater, Awash River, traditional wells, ponds and water tanks.

In regard to education, there is one Preparatory School (11-12 grade), 1 high school (9-10 grade), 18 Primary schools (1-8 grade) and 1 kindergarten in the Dubti Woreda.

Regarding health services, there are one hospital and 8 health centers (MoWR and UNICEF, 2003).

The energy consumption of the region is mainly based on biomass fuel using wood from acacia trees, crop residue and camel and goat droppings. The local community sells firewood and charcoal to generate income, by deforesting the already scarce vegetation.

Recently, six towns including the project area Woreda town, Doubti, got electricity from the national grid. Semera Substation supplies electric power to Semera, Logiya, Doubti, Mille, Asayita and Dicho-oto towns. The electric power is connected by 230 kV Transmission line from Kombolcha Substation.

The common annual crops grown in the project areas are maize, tomato, onion, green pepper, etc.

A well-constructed highway leads to the project area (Afar Region, Semera town). Names of towns along this road are: Awash Arba, Melka Sedi, Gedamayitu, Gewane, Endufo, Adaytu, Mille, Logiya, and Semera. These towns are several kilometers away from the centre of the initial development area (Asayita about 40 km, Logiya about 10 km, and Doubti about 10 km). Among these towns, Semera plays an important role as a central town in the region and offers a relatively developed infrastructure such as internet service.

The major economic activities around the project area are rearing animal and mixed farming, that is, make their living out of agricultural and animal products and rearing of domestic animal.

v. Land use

The total land area of Doubti Woreda is 539,044.13 ha and the total number of the kebeles under this local administration is 16, including 4 urban centers, Gurmudale and Hayideru kebele being one of them. The land holding in the Woreda is communal and personal land holding is not known.

The potential prospect, where exploration work may be conducted, covers an area of about 40 km^2. The proposed development area was not used for farming, partly due to its high salinity, induced by widespread surface thermal activity and aridity. The main land use activity around and far away from the project area is grazing animal.

The uncultivable land cover of the Woreda is about 76.07% which is the largest of all land cover. The wet land constitutes about 12.32%, of the total land use system, the forest land cover is only 1.56 %, grazing land is about 5.68 % and agricultural land cover is about 4.38% (*out of the total land use of Doubti Woreda*).

vi. Social Services

Health and education are one of the fundamental social development indicators of a country. Getting health and educational services are part of human right and without which the economic development of a country becomes unimaginable.

The development of social services particularly, health and education, in the project area Woreda is improving.

1. Education

Education plays a crucial role in the social and material progress of a country including the development and appropriate use of environmental resources.

In the last decade, encouraging efforts have been made in the Woreda to expand educational opportunity to reach unaddressed section of the population.

In Doubti Woreda, there are 4 kindergartens, 13 primary schools (1-4 grade) 10 primary schools (5-8 grade) and 2 high schools (9-10 grades) and 1 preparatory education, that is, from grade 11-12.

At present, the educational coverage of the Woreda has reached 58 %.

Table 14:- Education in Project Area Kebele

Name of Kebele	**Type of school**	**Number of Students**				**Total No. of Students**
		Grade 1- 4		**Grade 5- 8**		
Gurmudale and Hayideru	Primary	male	Female	male	Female	
		9	3	-	-	12
Total		**9**	**3**	**-**	**-**	**12**

Source: Woreda Education Bureau

There are 12 students in project area Kebele. The number of male students exceeds the number of females in this primary school of the project area Kebele.

2. Health

Health is an important social indicator that has enormous development implication. The health coverage in Doubti Woreda is 83%.

There is one governmental health post in the project area with one nurse and 3 health assistants.

Table 15:-Top common Diseases in the Woreda

S. No.	Common diseases	No. of cases	Percent	Remark
1	Malaria	410	18.51	
2	Respiratory Tract infection	391	18.50	
3	Diarrhea	315	14.23	
4	Helminthiasis	300	13.55	
5	Wound	263	11.88	
6	Urinary Tract Infection	170	7.68	
7	Gastritis	120	5.42	
8	Arthritis	110	4.97	
9	Conjunctivitis	91	4.11	
10	Accidental injury	45	2.04	
Total		**2215**	**100**	

Source: Woreda Health Office

According to the information gathered from the Woreda health office malaria is the most common disease in the Woreda.

vii. HIV/AIDS

HIV/AIDS has become a national health problem and the disease is availing itself everywhere in the country. Tuberculosis is known to be one of the opportunistic infection for HIV carriers and for AIDS patients.

HIV/AIDS infection occurs among adults between the ages of 15 and 49 and mostly women. This age group encompasses the most economically productive group of the population. This infection negatively impacts on labor productivity and work time is lost through frequent absenteeism and decreased capacity in performing the normal work.

According to the information gathered from Doubti Woreda HIV/AIDS office, the prevalence rate among examined patients is approximately 1.78 %.

The institutions engaged in the prevention of the disease are Doubti health centre, and OSSA and 3 local HIV/AIDS associations.

To decrease or minimize the spread of HIV/AIDS, the Woreda HIV/AIDS Office is working on community communication and awareness creation.

viii. Cultural and Historical Heritage

According to ESIA study, the project area has no known site of culturally, historically, archeologically, geological or topographical important features. However, there are some hot springs and boiling mud around the proposed project site which are visited by different wild animals (such as, Soemmerring gazelle and Dik dik). The hot spring is unique and attractive.

Moreover, during drilling, if there are any accidental "*chance findings*" of archaeological importance, the contractor shall immediately inform EEPCo's Project Office and the Project Office shall report to the Power System Planning /PSP/ of EEPCo. The Office will then report to the Authority for Research and Conservation of Cultural Heritage (ARCCH) for further investigation.

ix. Electric Power

There is a substation owned by EEPCo at Semera town. This substation connects six towns in the Afar Region, through a 230 kV transmission line. In the project area some of the towns that get electric power from Semera substation are Doubti and Logiya towns.

V. ENVIRONMENTAL AND SOCIO ECONOMIC IMPACT

An environmental and social impact is any change to the existing condition of the environment caused by human activity or any external influence.

The potential impacts may be:

- Positive (beneficial) or negative (adverse),
- Direct or indirect, long term or short term in duration and wide spread or localized in the extent of their effect.

Drilling of geothermal wells and related activities for geothermal resource development can have numerous impacts which if not mitigated can make the project not environmentally viable.

Summary of the potential environmental impacts anticipated from the proposed project include the following:

- Impacts on flora and fauna,
- Noise of geothermal fluid escaping from the drilling wells, rigs, well testing and vibration,
- Degradation of air quality by emitted NH_4, H_2S CO_2,
- Discharge of excavation sludge, construction waste and debris that will be generated during drilling operation and geothermal operations,
- Vehicles transporting equipment and material will exacerbate the dirt and dust clouds,
- Civil engineering work will generate waste soil
- Land acquisition

a. Socio Economic Impacts

There is no community living in the proposed project area. However, two potential impacts are identified related to the natural hot springs that is found within the proposed project area.

1. The Afar Region Culture and Tourism Bureau consider Alalobad hot spring as potential tourist attraction.

2. Pastoralist community uses the hot spring as medicine for their cattle. . The project may affect the path to the hot springs.

Alalobad hot spring is found 15 km away from the Region's capital. The availability of hot springs, the boiling mud makes the place unique and most attractive for the tourists, especially for medicine tourism. At the present there are no tourist facilities around the hot springs.

During consultation the Afar Region Culture and Tourism Bureau expressed a tourist facility plan around the Alalobad hot spring and suggested to harmonize the Alalobad hot spring development plan with the geothermal resource development plan.

The pastoralists around the project area and from places far away bring their cattle to the hot spring for medicinal purposes.

The other main impact is associated with community health and safety issues. Due to scarcity of water in the area and lack of awareness, individuals may utilize the water to be disposed of into evaporation ponds for human consumption. But, the waste water is neither chemically nor thermally safe for human use.

Besides the normal accidental injury type, individuals may be exposed to physical hazards associated with the wells and related pipeline networks. Hazards may result from contact with hot components, equipment failure or the presence of active and abandoned well infrastructure which may generate confined space or falling hazards, transporting of machineries, installation of the drilling machine may cause or may become source of accidents.

The environmental standards of FEPA and the World Bank have established noise emission by the zone type, which is, for residential, commercial and industrial and by time division into daytime and night time. For residential area, the day time limit in decibel (dB) is 55 and for night times, it is 45. Noise level during drilling and testing will be above permissible levels for people living around the project area. However, there are no community's residential houses near the proposed project site, hence there will not be any impact concerning noise pollution.

Hot spring at the proposed project site

i. Residential Houses

There are no residential houses in the project site therefore there will be no impact.

ii. Agricultural Land

Communities around the project area are pastoralists and agro-pastoralists regularly moving with their cattle searching for grazing land and water. No agricultural practice is observed in the project area during the site visit and there will be no impact on agricultural land and agricultural production.

iii. Community Service

There are no infrastructures or facilities such as churches, mosques, schools, health institutions and other major community services to be affected by the project.

iv. Historical, Cultural, Archaeological and Religious Sites

It is known that the Afar Region is rich in archaeological heritage, but according to the ESIA study of the geothermal site of April 2011, the project area has no known site of culturally, historically, archaeologically or topographical important feature.

There are no known historical and cultural sites to be affected by the project. However, there are some hot springs and boiling mud in the project site.

v. Impacts on Women

The proportion of female population is lesser (47.97%) than that of male in the towns and 45.24% in rural areas of the Woreda.

Most of the constraints in the project area are related with cultural, social, economic, legal environmental factors and affect both genders. However, the magnitude of the problems is found to be critical when it comes to women. It is known that rural women have total responsibility for cooking food, caring for children, fetching water and collecting fuel wood. The availability or non-availability of these resources within a reasonable walking distance is of particular interest to women. Therefore, the depletion or total degradation of natural resource has adverse effects on women's status. Ecological disturbance, deprivation of water supplies and other related environmental damage expose the rural women to excessive hard work and destitution.

Special assistance needs to be rendered to vulnerable groups, which may include the following:

- Provision of potable water supply within a reasonable distance.
- Priority access to all other mitigation and development assistance.

The easy and sustainable access to electric power supply in villages and towns would ease the burden on women.

vi. Impact on Health and Safety

1. Occupational Health and Safety

The anticipated major occupational health and safety impacts are:

- Geothermal gases: Exposure mainly to H_2S gas may occur during non-routine release of geothermal fluids (for example, in case of pipeline failure).
- Confined spaces: Entry into confined space by workers and the potential for accidents, which may vary among geothermal facilities.
- Heat: Exposure to heat occurs during construction activities non-routine cases which include potential blowout accidents during drilling.
- Noise: Its main sources are related to well drilling, steam flushing and venting. Other sources include, equipment related to pumping facilities, turbines and temporary pipe flushing activities. Temporarily noise level may exceed 100 dB during certain drilling and steam venting activities.

2. Community Health and Safety

The anticipated major community health and safety impacts are:

- Exposure to hydrogen sulphide /H_2S/: The potential exposure to members of the community should be carefully considered during the planning process and necessary precautions implemented (however, no one lives in the vicinity).
- Infrastructure safety: Communities may be exposed to physical hazards associated with the wells and related pipeline networks. Hazards may result from contact with hot components, equipment failure or the presence of

active and abandoned well infrastructure which may generate confined space or falling hazards, transporting of machineries, installation of the drilling machine will cause accidents /incidents.

- Impacts on water resources: The extraction, re-injection and discharge of geothermal fluids may affect the quality and quantity of surface and ground water resources.

3. Noise

There will be noise arising from geothermal fluid escaping from the drilling of deep wells, working noise; well testing and vibration are the potential noise sources of the project. These anticipated noise sources have no impact on the environment and surrounding community since there are no residential houses near the project site.

4. Hazards/ Risks

This impact might affect human health and the natural environment and the reasonable project scenarios (cause and effect) might result in damage to health, the environment or the financial viability of the project.

The risks expected from the drilling of geothermal wells are spill of chemicals (used oil and lubricants), unsafe working condition during drilling (fall from above, hit by objects, etc).

Incidents /accidents might arise due to increased traffic movement during transporting of materials and personnel.

5. Sexually Transmitted Infections /STIs/

The major impacts on health and safety are related to the work force engaged in the drilling of the geothermal deep wells.

Communicable diseases like sexually transmitted infections, hepatitis, malaria, etc can easily spread around the construction area.

The influx of migrant labor to the drilling sites and the interaction with the local people can cause tensions and opportunities for the spread of communicable diseases in the area.

The mitigation measure for this impact will take an aggressive approach to control the spread of STIs through health education programs, control informal sector activities near the project site, etc.

6. HIV/AIDS

The Ethiopian Government issued a policy, which calls for an integrated effort involving a multi-sectoral response, to control the epidemic. The Ethiopian Government's HIV/AIDS policy urges communities at large, including government ministries, woreda /local level government institutions and the civil society to

assume responsibility for carrying out HIV/AIDS awareness and prevention campaigns.

In line with this policy, EEPCo has taken the initiative to establish an office which will implement an HIV/AIDS awareness and prevention strategy. The strategy will comprise of three phases:

(a) Awareness creation campaign for EEPCo's management personnel.

(b) Awareness creation, health educational program and campaign to be organized for EEPCo district and project staffs (2,000 persons);

(c) Continuation and consolidation of awareness creation and education program and campaign for domestic and international contractors and their work forces.

The overall objective of EEPCo's HIV/AIDS awareness creation strategy is to contribute in the reduction of HIV/AIDS infection and incidents. This will not only contribute to strengthening national efforts to halt the epidemic but also support international initiatives to stop the spread of the disease.

7. Substance Abuse

A large construction labor force comprising primarily of young men living away from their families, with 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, who work in the drilling of the geothermal wells return home in an inebriated state and can abuse and injure family members and generally cause a good deal of domestic upheaval.

The problem of alcohol abuse must be explained to workers as part of health education campaign. Recreational facilities shall be made available at the camp and additional activities should be arranged as normal part of camp living.

Severe penalties for drunkenness and disorderly behavior must be given along with the provisions of counseling services for substance abuse.

8. Polychlorinated Biphenyl (PCBs)

The problem of PCBs chemical is significant. It poses major health threat to human being and environment. In Stockholm Convention of 2001 (to which Ethiopia is a signatory), PCBs are one of the twelve Persistent Organic Pollutants (POPs) to be eliminated from production for use in transformers and capacitors.

vii. Gender Issues

Most of the constraints in the project area are related to cultural, social, economic, legal and environmental factors and affect both genders. However, the magnitude of the problems is found to be critical when it comes to women. It is known that rural women have total responsibility for fetching water and collecting fuel wood.

The availability or non-availability of these resources within a reasonable walking distance is of particular interest to women. Therefore, the depletion or total degradation of natural resource has adverse effects on women's status. Ecological disturbance, deprivation of water supplies and other related environmental damage expose the rural women to excessive hard work and destitution. Presently, employment opportunity should be given to women on equal basis as male.

viii. Vulnerable Groups

Vulnerable groups include women headed households, households victimized by HIV/AIDS that are headed by children, households made up of the aged or handicapped and whose members are socially stigmatized (as a result of traditional or cultural bias) and economically underserved.

However, during the recent ESIA study in the project area, there are no vulnerable groups which need special assistance.

ix. Health Effect of Electro Magnetic Fields (EMF)

Electro-magnetic fields (EMF) are invisible lines of force that surround any electrical device. Power transmission lines, electrical wiring and electrical equipment, all produce EMF. Electromagnetic fields are produced by voltage increase in strength as the voltage increases.

Most electrical equipment has to be turned on i.e., current must be flowing for any magnetic field to be produced. Electric fields are often present even when the equipment is switched off too, as long as it remains connected to the source of electric power.

Electric fields are shielded or weakened by materials that conduct electricity - even materials that conduct poorly, including trees, buildings and human skin. Magnetic field, however, passes through most materials and is therefore more difficult to shield. However, both electric fields and magnetic fields decrease rapidly as the distance from the source increases.

The World Health Organization (WHO) has concluded that "despite extensive research to date, there is no evidence to conclude that exposure to low level electromagnetic field is harmful to human health" (*Ethiopia – Sudan Power System Interconnection ESIA, 2005, P.62*).
The table below briefly summarizes the potential implementation risks and challenges, and mitigation actions to address them.

b. Impacts on Biological Environment

i. Flora

Ethiopia has a rich biodiversity with a high proportion of endemic species (those that are only naturally present in Ethiopia). Owing to the long history of agriculture coupled with the degradation of the environment, Ethiopia is still one of the 12

Vavilov centers of crop genetic diversity. The Ethiopian flora is estimated to contain nearly 7,000 species of higher plants, of which 125 are endemic. Ethiopia is the center and origin for various crop species including *Coffee arabica, Teff, Enset* and *Sorghum* (*State of the Environment Report, Ethiopia, August 2003*)

The drilling of the proposed geothermal project is unlikely to impact negatively on biological environment. Although vegetation will be cleared for foundation pads and evaporation ponds, these will not result in habitat and biodiversity loss.

As observed during field survey, the project could involve the removal of few patches of bush /shrubs (stunted Acacia sp. and Prosopis juliflora). The affected vegetation area will be very minimal. But, it is still very important to carry out compensatory reforestation activities in collaboration with concerned sector offices to plant in the project camp site, in highly disturbed, sensitive and open areas, in order to maintain the ecosystem as a mitigation measure to the lost woody biomass.

The presence of indigenous flora has been destroyed for many decades and due to arid climate, so there will be no additional negative effect on the flora by the Geothermal Power Development Project.

According to the field survey conducted recently, there are no threatened or endangered species, or endemic tree species in the proposed geothermal well drilling sites.

ii. Fauna

The presence of indigenous fauna has been affected for many decades, so there will be no additional negative effect on the fauna by the Geothermal Power Development Project. Evidence of some feral animal life (Soemmerring gazelle, mongoose and dik dik) was observed at the proposed project site.

As a result, the wild life resource in the project area is less due to habitat loss and arid climate. Some of their shelters /habitat would be exposed to noise and they will be forced to evacuate the site or be exposed to illegal hunting.

iii. Impact on Birds

Various migratory birds are considered endangered as they visit fifty sites in Ethiopia every year (*according to, Ethiopian Wildlife and Natural History society, there are 69 sites so far registered as important bird areas in Ethiopia*).

However, in the study area, there is one known migratory bird route i.e., through the Great Ethiopian Rift Valley, where the proposed geothermal project is to be constructed.

There is no recorded migratory bird route in the proposed site. Furthermore, the wetlands around the lakes which are usually visited by birds (such as, Lake Gamari, Afambo, and Abe) are very far away from the project site, which will not cause any hindrance to migratory or endemic bird species.

iv. Impact on National Parks and Forest Reserve /Protected Areas

The rich wildlife areas today are mostly assigned as national parks or natural reserve areas.

Far away to eastern part of the project area, there is the *Awash* and *Yangudi Rasa* National Parks, which are designed as a national park for Oryx, Greater kudu, Lesser kudu, Wild ass and Sommerring gazelle. Also, there are three game reserves in the Region, *Aldeghe*, *Gewane* and *Mille Serdo*, designated for Grevy's zebra, Oryx, Sommerring gazelle, Wild ass and Dorcas gazelle, which of course will not be affected by the proposed geothermal power project.

This project will not affect any protected /forest reserve areas.

v. Impacts on Wetlands

Wetlands occur in many different forms and serve vital functions, including storing runoffs, regenerating ground water, filtering sediments and pollutants and providing habitat for aquatic species and wildlife. In general terms, any construction activity can damage wetlands in: (a) heavy machinery can crush wetland vegetation and wetland soils, (b) wetland soils, especially very peaty soils can be easily compacted, increasing runoff, blocking flows and greatly reducing the wetlands water holding capacity, (c) the construction of access roads can change the quality or direction of water flow, causing permanent damage to wetland soils and vegetation, (d) construction and maintenance equipment that cross wetlands can stir up sediments, endangering aquatic life, (e) clearing forested wetlands can expose the wetland to invasive and shrubby plants, thus removing habitat for species and (f) vehicles and construction equipment can introduce exotic plant species with few natural controls, these species may out-compete high quality native vegetation, destroying valuable wild life habitat.

At the end of the Awash River, there are series of lakes, to mention some, Afdera, Gamari, Afambo, and Abbe are the largest who are located about 45 km south of Gewane where Lake Erta Ale and Meteka wetland complex exists. Where the water is fresh the lakes (L. Loma) and marshy have reed grasses or *shembeqo* (Phragmites spp.), bulrushes or *fila* (Typha species) and sedges or *qetema* grows. However, the wetlands are located very far away from the proposed project site; hence there will be no wetland that will be impacted by the proposed development.

c. Impacts on Physical Environment

i. Land Use

The proposed drilling of geothermal wells will have an impact on the existing land use both temporarily (for access roads, etc) and permanently (for camp site, substation and wells).

The impact on farm land is totally non-existent and the grazing land is found to be quiet minimum and not significant as cattle can graze on the abundant grazing land around.

ii. Soil

Soil analysis carried out on surface soil samples; collected at a depth of 0 -20 cm inside the project area appeared to have low contents of organic matter and nutrients. The soil is essentially alkaline with good cation exchange capacity owing to the high clay content. It consists of sand 50.7 %, silt 19.1 %, and clay 30.2 % (Aquater, 1996). In general, the soils are of low natural fertility, except on the Awash River basin. The boron, chloride and arsenic values of the soil are high.
During foundation pads and ponds excavation, bare soil could be exposed to erosion temporarily.

iii. Air Quality

Besides creating noise, from the very nature of the project, there are other emissions that will be released into the atmosphere. The contents of the emission according to the information gathered during the field assessment, 99 % steam and the left 1 % constitute of CO_2, H_2s, ammonia and other non-condensable gases.

The dust arising during the proposed construction activity, vibration and air pollutants released from mobile construction equipment could also have potential impact which affects the air quality in the immediate project area. Any dust associated with construction activities would be short term, lasting only through the drilling phase of the project.

iv. Water Quality

The presence of freshwater aquifers that may be present in the area of the present and future Alalobad-Tendaho geothermal resource development and injection wells is highly important. The freshwater aquifers provide water for domestic use (drinking, bathing, etc.), as well as for farming, ranching, and other commercial use. The quality of this water will be protected. It is common practice and normally a regulatory requirement worldwide in geothermal power development to case off the shallow aquifers to a point considerably below the freshwater zones and this will be done at Alalobad-Tendaho. It should be further noted that casing off of the cooler, freshwater aquifers prevents its mixing with the hotter geothermal liquids. It is, therefore, better for any geothermal power project to prevent the mixing of the geothermal fluids with cooler fluids.

Disposal of the drilling effluents into evaporation ponds has the potential to contaminate shallow groundwater from the drilling fluid chemicals, caustic soda and bentonite mud. However, since the ponds will be lined, there will be no risk of contaminating ground water. Also, there are no rivers /streams for use in the proposed project area, hazards to be posed to people due to contamination or discharge /sludge are not foreseen. Therefore, there is no project impact on the water quality.
However, during drilling, the water used by machinery which will come out as sludge/ effluent to the surface shall be confined and collected in enclosed evaporation ponds with its wall covered with plastic linings.

d. Positive Impacts

Ethiopia is a developing country with very low income per capita, the proposed project will stimulate economic growth of the country, by providing power supply to areas where electrical energy were not supplied before through connecting more households and institutions to the national grid and reduce power outages.

- By ensuring more sustainable and regular supply of electricity, it will contribute to an improvement of the living standard of the population and reduce poverty through energy mix (geothermal, hydropower, wind, etc).

- The most immediate benefit the local people get from the project will be in the form of temporary employment opportunity by recruiting local labor. The proposed geothermal energy development would encourage investors to invest in the region, ultimately creating more job opportunities. As a result, it will effectively enhance the income of the society, reduce production costs and increase the purchasing power of the consumer and by extension contributes to poverty reduction efforts of the government both at local and national level.

- Improves economy and availability of sufficient social services due to the development which will rapidly change the way of life of the community.

- Moreover, there will also be a temporary surge in the economy during the construction phase as new markets and services will develop in the area to provide goods and services for the workforce.

- There will also be improvement in rendering social services, like health institutions, education, etc.

- Besides, supplying electricity to rural towns and villages, it will replace /reduce the consumption of woody biomass and petroleum products that is used currently for cooking, lighting, etc.

- The environment improving effect of this project is the reduction of carbon dioxide emissions from electricity generation using renewable geothermal energy compared with other fossil firing power generation.

- As the economic activity grows, there will be high demand for electricity, for example, in the agricultural sector for (irrigation pumps, poultry farming, animal husbandry, preservation of food products), in the commercial sector for (shops, bars, restaurant, etc), in small and medium industries for (flour mills, oil mills, rural water supply installations, tanneries, coffee processing plants, etc), in the residential sector for (lighting, heating, cooking, etc) and in the health sector for (pharmacies, clinics, health centers, hospital activities, sterilization of medical equipment, cold storage of vaccines, etc).

- The easy and sustainable access to electric power supply in villages and towns would ease the burden on women.

- It is assumed also that for irreversible negative impacts, appropriate compensation payment will be undertaken by EEPCo, when the problem is encountered.

- For temporary impacts, such as loss of agricultural products, access roads, etc during drilling, EEPCo will pay compensation for one year's loss.

- Replacement of imported fuel by the indigenous resource, geothermal energy, will save foreign currency.

- In addition to the above mentioned issues, it is likely to have the potential for carbon trade among other positive benefits.

VI. MITIGATION MEASURES

a. Socio-Economic Mitigation

As indicated in the social impact section above, the negative impacts are associated mostly with health and safety issues as well as to the Alalobad hot springs which is considered potential tourist attraction by the Region Culture and Tourism Bureau. The pastoralist community also make use of the hot spring for medicinal purpose for their cattle that is identified as negative impact that needs mitigation measures.

For individuals exposed to physical hazards associated with the wells and related pipeline networks, the mitigation measures include: -

- Demarcation of the project site and placement of fences around the geothermal wells and placing of warning sign in both national and local languages.
- As precautionary measure, safety and health standard manual shall be used in work place.

Regarding the Alalobad hot springs that are considered as potential tourist attraction, there is possibility to harmonize the geothermal resource development plan with the Region's Culture and tourism plan. With well-developed plan communities and institutions can co-exist with the geothermal resource development project in harmony. Therefore, it is recommended to consider the issue during the design phase of the Alalobad-Tendaho Geothermal Power Development Project.
Hence:

1. The Alalobad geothermal project will develop animal routes to the hot springs for the pastoralist communities. The communities make use of the hot springs as medicine for cattle as well as for people.
2. The Region's tourism plan for the hot spring will be harmonized with the geothermal resource development project plan. The Alalobad-Tendaho Geothermal Power Development Project will consider harmonizing the plan at its design phase.

i. Residential Houses

There are no residential houses to be affected by the project development and there is no need for suggesting mitigation measure.

ii. Compensation for Loss of Crop

There is no agricultural activity in the proposed project site; hence no crop will be affected by the project development and no need for arranging compensation payment.

iii. Valuation Committee Formation

No need for forming valuation committee since there will be no land acquisition and or any compensation payment for affected asset to be made.
However, in case any grazing used by pastoralists is to be expropriated for the project activities, valuation committee will be established at the Woreda Administration level according to the Proclamation No. 455/2005.

iv. Agricultural Land

- As mentioned above, no agricultural land will be occupied nor crops affected and there is no need for mitigation measure.
- In order to avoid future land use problem, the geothermal project site shall be demarcated and geothermal wells shall be fenced.
- The Project has also prepared Resettlement Policy Framework to be used if land is acquired

v. Education

There is one school located far away from the project site and it will not be affected by the project activities.

vi. Health and Safety

1. Occupational Health and Safety

The mitigation measures recommended for "***geothermal gases***" are:

- Installation of H_2S monitoring and warning system.
- Development of contingency plan for H_2S release events.
- Provision of facility for emergency response team and workers in locations with high risk of exposure, with personal H_2S monitors, self-containing breathing apparatus.
- Provision of adequate ventilation.
- Development and implementation of a confined space entry program for areas designated as confined spaces.
- Provision of workers with a fact sheet or other readily available information about the chemical composition of liquid and gases.

Mitigation measures for "***confined spaces***" is to set alarm threshold for facility or personal H_2S monitors which should be set well below the recommended safety standard based on the advice of Occupational Safety Specialist.

The mitigation measures to "***heat exposure***" are:

- Reducing the time required for work in elevated temperature areas and ensuring access to drinking water.
- Shielding surfaces where workers come in close contact with hot equipment including generating equipment, pipes, etc.
- Use of personal protective equipment /PPE/.
- Implementing appropriate safety procedures during the drilling process.

The mitigation measures to "***noise exposure***" are:

- Use of ear mufflers.
- Sound insulation.
- Barriers during drilling.

2. Community Health and Safety

The mitigation measure for exposure to ***hydrogen sulphide gas*** (H_2S) includes:

- Siting of potential significant emission sources with consideration to nearby communities, if any, (considering key environmental factors such as proximity, morphology and prevailing wind directions).
- Installation of H_2S monitoring network with number and location of monitoring stations determined through air dispersion modeling - emission sources and areas used by the community and habitation.
- Continuous operation of H_2S gas monitoring systems to facilitate early detection and warning.
- Emergency planning involving community input to allow for effective response to monitoring system warnings.

For communities exposed to physical hazards associated with the wells and related pipeline networks, the mitigating measures include:-

- Placement of access deterrents, such as fences and warning signs.
- Minimizing length of unnecessary pipeline systems.
- Consideration of the feasibility of subsurface pipelines or heat shields to prevent public contact with hot geothermal pipelines.
- Managing closure of infrastructure such as pipelines and access roads, including cleaning disassembly and removal of equipment, analysis of soil quality with cleanup where warranted, re-vegetation of site and blockade and reclamation of access roads, where necessary.
- Managing closure of well heads, including sealing well with cement, removing the well heads and backfilling depression around the well heads, as necessary.

- As a precautionary measure, safety and health standard manual shall be used in work place and for the community living around the project area.

vii. Noise

- There will be no impact due to noise to the community since their settlements are far from the project area.
- Use of personal protective equipment /PPE/ recommended to workers.

viii. Hazardous Material

During transportation and construction activities, the contractor shall comply to safe handling and store hazardous materials, seek direction from the supervising engineer for disposal of hazardous material, clean up spills of hazardous materials immediately, suppress fires on or adjacent to construction or ancillary sites and in case of any spill, relevant departments will be informed at once and deal with it in accordance with the spill contingency plan.

ix. PCBs chemicals

Strict procedures would be followed to order supplying companies and to import PCBs free transformers, capacitors and other electrical equipment.

x. Health

The health post is located far away from the proposed project site and will not be impacted by the project.

xi. Dust /Air Quality

VII. The health post is located far away from the proposed project site and will not be impacted by the project.

i. Noise and Vibration

During the construction period workers should wear ear mufflers and other safety equipment /PPE/. Noise level shall be kept low and monitored according to the limited standards.

Machines and vehicles shall be maintained regularly to keep noise at a minimum.

ii. Sexually Transmitted Infections (STIs) and HIV/AIDS

There should be an aggressive approach to fight against STIs and HIV/AIDS. Aggressive health education will be provided and awareness be created to workers and surrounding communities during construction. The local administration should play vital role in controlling informal sector activities near the project camp and the contractor is expected to provide free condom to construction workers.

iii. Electro Magnetic Fields (EMF)

Most electrical equipment when turned on, current will flow from any magnetic field. The World Bank has concluded that "despite extensive research to date, there is no evidence to conclude that exposure to low level of electromagnetic field is harmful to human health" (*Ethiopia – Sudan Power System Interconnection ESIA, 2005, page 62*). Keeping some distance between the residents and the project can help the impact of EMF, which is the case on hand. Hence, there is no health threat because of EMF due to the project.

iv. Substance Abuse

The problem of substance and alcohol abuse must be explained to workers as part of health education program and given due emphasis to be strictly followed by each employee.

Recreational facilities shall be made available at the camp and additional activities should be a normal part of camp living. Severe penalties for drunkenness and disorderly behavior must be given along with the provisions of counseling services for substance abuse.

v. Gender Issue

It is known that rural women have total responsibility for fetching water and collecting fuel wood. As a mitigation measure it is proposed to prepare water well near to community location. The exact location of the new water well to be prepared by the Project Office and shall be determined after discussing it with the community.

The cost for the preparation of the water pond is estimated to be about 20,000.00 Birr.

Ethiopia recognizes that, failure to capture women's contribution may lead to inadequate consideration of their needs for income, training, credit and technology during project development.

Equal employment right has to be given to women as that of male during the implementation of the project.

vi. Vulnerable Groups

During the recent ESIA study in and around the project area, there are no such vulnerable groups which need special assistance.

vii. Protection of Cultural Heritage

During the recent ESIA study there are no cultural, historical, religious and archaeological sites that will be affected. However, when there is any "*chance findings*" the contractor will immediately inform EEPCo on such findings and the

Authority for Research and Conservation of Cultural Heritage (ARCCH) will be informed for further investigation.

The following are procedure when "*chance findings*" occurs:

a) Upon discovery of ancient heritage, relics or anything that might or believed to be of archaeological or historical importance during the execution of works, immediately suspend the work and report the findings to the supervising engineer (SE) so that the appropriate authorities may be expeditiously contacted for fulfillment of the measures aimed at protecting such historical or archaeological resources.

b) The contractor shall take the necessary measure for preventing from damage to articles or things shall be barricaded, fenced and signaled, if necessary and protect against atmospheric agents, as directed by the engineer. Also guard service may be required by the engineer.

c) The supervising engineer (SE) shall take the following measures:

- Notify the Project Office of EEPCo,
- EEPCo will notify the relevant Regional Department of antiquities and Authority for Research and Conservation of Cultural Heritage (ARCCH),
- Request for representative to make site inspection,
- Secession of work in the vicinity of the finding until the visit by ARCCH representative, and
- Decision by the department of antiquities on possible salvage or excavation within 48 -72 hours of notification,

viii. Hazards /Risks

Accidents /incidents risk will increase with any construction activities. Apart from the regular training on health and safety issues, working staff should be sensitized on how to work within varying ecological and social areas.

Occupational health and safety standards and guidelines /method statements/ for the project should be prepared at the earliest stage by the contractor. These standards and guidelines shall be made part of contract document to be signed with the contractor.

First aid kits, warning tapes and safety belts, etc, should be provided. In case of any accident, there should be an earlier arranged referral health centre where patients should be treated.

In general, all work operations should be considered in a systematic manner to reduce the short term and long term risks to health (disease, injury and death) of the work force.

b. Mitigation on Biological Impact

i. Flora

The proposed project site has grassland, bush /shrub land and barren land. The implementation of the drilling activity will be undertaken in a naturally degraded site. Some disturbance will be expected to some vegetation (stunted Acacia and Prosopis species) in the process of foundation pads and ponds preparation. It is therefore, necessary to plant indigenous species of plants around the camp and other disturbed area and the removal or cutting of unnecessary vegetation shall be avoided.

ii. Fauna

During recent ESIA study, it is confirmed that most of the plain area are already heavily degraded and deforested due to utilization of vegetation and its arid climate. However, there are still few wildlife habitats in the proposed project site. The drilling of geothermal wells being located in a small plot of land, its impact on wildlife is minimal.

iii. Birds

There are some bird species as indicated in the base line data. The proposed project does not cause any kind of threat to either the indigenous types nor to the migratory birds. The migratory birds are assumed to pass over the Ethiopian Rift valley, though no recorded data was available whether or not they pass over the project site.

Another reason for not causing any threat is that, the project site is far from the Lakes (*Gamari, Afambo* and *Abe*), so there will be no impact on the birds.

iv. National Parks /Protected Areas

The national parks located near the project site are *Awash* (found between the towns of Metahara and Awash Station) and *Yangudi Rasa* (located between the towns of Gewane and Mille) which are located far away to the south of the project site. The game reserves in the Region are *Aldeghe*, *Gewane* and *Mille Serdo* sites. These areas will not also affect by the proposed geothermal resource development.

v. Wetland

Lake *Erta Ale* (45 km south of *Gewane*) and *Meteka* wetland complex located at the northern end of Awash River near Djibouti border, where series of lakes are present, of which *Gamari, Afambo* and *Abe* are the largest. Where the water is fresh, the lakes and marshes have reed grasses (Phragmites species), bulrushes (Typha species) and sedges. The wetland sites are not affected by the proposed geothermal resource development.

c. Mitigation on Physical Impact

i. Land use

During the assessment, about 40 km^2 of land in Alalobad hot spring area was chosen as the potential site for geothermal power production. The site is totally barren without any settlement and farming. The only activity undertaken by the pastoralists is to use the area for seasonal grazing purpose. The land size in the area is very vast and the acquisition of the site poses very minimum impact on grazing land. Hence, the project will not have any significant threat on land use of the area. The project will also develop a plan that will enable pastoral communities to have access to the hot spring site with no problem.

ii. Soil

The used oil should be collected in barrels and be disposed off according to the supervising engineer's approval.

The excavation sludge and construction liquid waste should be collected in an evaporation pond and should not spill over the bund of the pond. It should be regularly collected and dumped in the appropriate site chosen by the Supervising Engineer (SE).

The solid waste from the work site and camp should be collected in covered barrels / dust bins and dumped in selected dumping site.

After the completion of the drilling process, the contractor has to reinstate /landscape the site to its previous state not to have any aesthetical and soil erosion impact.

iii. Air quality

Monitoring of the amount of the pollutants to be released shall be conducted in order not to exceed the thresh hold value at any time. Concentration of the sulfide in the surrounding air above the standard value is not expected, since the project area is an open space with adequate winds to disperse the emissions.

Vehicles delivering soil material shall be covered to reduce spills and vehicle speeds shall be limited to minimize the generation of dust.

iv. Water quality

There is no flowing river /stream in the proposed project area except the Awash River which is very far from the site. Hence, there is no envisaged threat to any natural water body. The only threat is when the sludge and excavation wastes spill over the bund of the evaporation pond and contaminate the run-off water. This needs the thorough supervision by the SE not to occur frequently and if it happens, the contractor has to take the necessary remedial action by his expense.

Table 16:- Potential Impacts and Mitigation Measures

Potential Environmental and Social Impacts	Proposed mitigation measures	Implementation /Monitoring Responsibility
Vehicles transporting equipment and materials will raise dirt and dust clouds	Use of Environmental and Social clauses by Contractor	Contractor / EEPCo
There will be noise emitted from geothermal fluid escaping from the drilled wells; working noise and vibration (though temporary), deemed to have an impact on the environment and surrounding community.	Workers should wear ear mufflers and other safety equipments /PPE/.	Contractor / EEPCo
Excavation sludge, construction waste and debris will be generated	Prepare appropriate disposal plan prepare dumping site	Contractor / EEPCo
Civil engineering work will generate waste soil.	Reduction of the volume and appropriate disposal	Contractor / EEPCo
Excavation of deep wells will use surface water /ground water which may affect the surface or underground water level.	Strictly use of water by circulation during excavation from the existing ponds only. Evaporation ponds should be prepared in order to keep the sludge not seeping into groundwater	Contractor
Drilling of geothermal wells could cause some unsightly condition on the topography.	Use appropriate dumping site. Restore /landscape the site after the completion of construction activity.	Contractor / EEPCo
Bare ground will be exposed due to pad and pond preparation during well drilling.	Use of Environmental and Social clauses by Contractor	Contractor / EEPCo
Fauna may be temporarily affected by noise during the construction period.	Use of Environmental and Social clauses by Contractor	Contractor / EEPCo
Flora will be affected during excavation	Re-vegetation of camp, sensitive sites	Contractor
Impacts on cultural heritage	Inform concerned authorities when there are any "*chance findings".*	Contractor / EEPCo
Degradation of air quality	Should not exceed threshold value	Contractor
Community health and Safety	Apply Community health and Safety mitigation measures	Contractor / EEPCo
Occupational health and Safety	Apply Community health and Safety mitigation measures	Contractor / EEPCo

VIII. PUBLIC CONSULTATION AND DISCLOSURE

During the field assessment, various "Information Dissemination and Public Consultations Meetings" were conducted with the Gurmudale and Hayideru kebele chairperson and elders, consultation with sector government offices at Regional and Woreda Administration, such as, Pastoralist, Agriculture and Rural Development, Culture and Tourism Bureau, Finance and Economy bureau, Environmental Protection and Land Administration, etc.

Consultation was made with Gurmudale and Hayideru Kebele elders, woman and chairperson.

Why Public Consultation: Objectives

Consultations with kebele chairperson, elders and local sector offices were held with the following key objectives, among others:

- To inform them about the project and discuss on the nature and scale of adverse impacts on the environment in a more transparent and direct manner and seek their participation in the project cycle.

- To give community offices a chance to have a say and express their views in the planning and implementation of the project activity.

- To inform local authorities of all the potential impacts, solicit their views on the project and discuss their share of the responsibility for the smooth functioning of the overall project operations.

a. Consultation Methodology

Consultation was carefully planned and conducted in such a way that it ensures efficiency and effectiveness in covering key issues both from the elders on one hand and the project on the other.

b. Major Findings from Public Consultations

Major Findings: Vulnerable and Underserved Groups, November 23-25, 2013

1. Awareness about the project: community members are aware of the project prior to the present Public Consultation and Disclosure Plan .

2. Attitude towards the propose project: community members have positive attitude towards the project

3. Major Perception: community members believe that the project will provide Positive impact on Job opportunity and income generation and Electric Light supply to the local community; on the Negative impact, many believe that it will lead to Loss of individual and communal properties. Hence, necessary compensation of payments for the affected asset should be under taken based on payment of compensation proclamation and regulation. They also believe that it will lead to the iintroduction of HIV and AIDS, as well as, other reproductive health infections. To mitigate the problem intensive public awareness by project proponent in collaboration with the stakeholder official in the project site is a Paramount Important

4. Conclusion and recommendation

-All participants understood the importance of the project and agreed to give support and other necessary cooperation for success of the project.
- All interviewed community members agreed that community norms and values must be respectedby project workers. Hence, they recommended that the project workers should be trained to respect community norms and culture.

Detail of results of Community Interview and Discussion are presented under Annex 1

Discussion with the Regional Offices and Local Administration, June, 2013
The team has also conducted various meetings on project issues with different regional and Woreda sector offices such as Pastoralist and Agricultural and Rural Development Office, Culture and Tourism Office, Health Bureau, Education Bureau, Environmental Protection, Rural Land Use and Administration Bureau.

Discussion was also conducted with EEPCo's Project office, Geological Survey of Ethiopia (GSE), Tendaho Dam and Irrigation Development Project.

In all the meetings, the discussions were focused on the following major issues:

- Dissemination of information about the project and potential positive and negative impacts,
- Description of the potential project impacts on the existing bio-physical environment and socio-economic conditions,
- The predicted negative and positive impacts during construction, operation and maintenance phases,
- The possible mitigation measures to be undertaken especially during the drilling of the geothermal wells,
- Attitude of community elders, local government officials and technical personnel towards the project.

During public consultations with Kebele chairperson and elders, a number of important points were raised and discussed. Key agenda that were forwarded for discussion include both positive and negative impacts of the project on local community.

Impact related to the Alalobad natural hot springs has been one of the most important consultation where negative impact and mitigation measures were highlighted and discussed with the Afar Region Culture and Tourism Bureau.

Only summary of key issues and major findings are sub-divided into relevant categories and presented in the section below:

These broader categories into which key findings of the consultations are regrouped include anxiety, fears, uncertainties, preferences, needs, demands, reservations, expectations, hopes, aspirations, general comments, commitments, appreciation and questions for clarification.

Public consultation and participation is not an event and is a continuous process which will enable in identification and discussion on key issues and impacts of the proposed project. Views from institutions and development partners who in one way or another would be affected or have interest were sought through interviews and public meetings.

Public participation includes both the information exchange (dissemination and consultation) and collaborative forms of decision making and participation. Dissemination refers to transfer of information from project authorities to the affected population. While consultation generally refers to joint discussion between project authorities and the affected population serving as a linkage for transfer of information and sharing of ideas.

Public participation is an ongoing process throughout the implementation of the project not an event. The level of information which is disseminated or the issues on which consultation takes place vary with the progress in the project process.

Environmental and social assessment was conducted in three ways, namely, (i) key informant interviews and discussions, (ii) field surveys and observations and (iii) stakeholder meetings.

Discussion with the Vulnerable and Underserved Groups, November 23-25, 2013

The study team has consulted with Vulnerable and underserved Groups (The Afar Tribe and Religious leaders, Community Elders, the Alalobad village concerned Grumudale and Hayideru Kebele chairperson and Women affairs representative) to grasp their views on the proposed project. The participants noticed that the construction of the project is one of the key development issues of the country in general (Ethiopia), within the country the project concerned region, Zone and the respective Woreda. They believed that the realization of the proposed project work will solve the existing insufficient supply of electricity, as well as, additional power supply. Finally, they promised to support the implementation of the project by all means as much as they can.
In addition, the participants of Focus Group Discussion (FGD) provide the following conclusions and recommendation;

- They considered and recognized the importance of the propose project for economic development. To this end, they recommended undertakings of intensive public awareness to the local by the proposed project proponent in collaboration with the stake holders in the project targeted site.

- They concluded that the culture and tradition of the local people should be respected by construction contractor and the project workers.

- They said that in the direct project affected area, pparticularly in Alalobad village, in Gure Mudale and Gayiru rural kebeles, there is no market for buying and selling of food and water supply services. To this end, they recommended that the project should facilitate the food production, water supply and marketing services.

- They concluded that sometimes there are insecurity problem in the project area and recommended that the project should ensure that adequate security is provided by concerned government security bodies to keep the project and its workers from aforementioned problems.
  (Details of FGD result with Minutes of Meetings are attached under Annex 1; public consultation minutes of meeting.)

Consultations with Local Communities

The involvement of local community members and other stakeholders in the project development will ensure the sustainability of the project. Accordingly, the project has conducted consultation with a wide range of integrated community groups based on interview and discussion. These community members unanimously agreed on the implementation of the proposed project. All of them believed that the realization of the proposed project construction will improve the socio-economic development of the areas and improve the existing problems and attract developmental investors and tourists to the area.
(Details of FGD result with Minutes of Meetings are attached under Annex 1; public consultation minutes of meeting).

Photo: Consultation with Alalobad community members, November 23-25, 2013

c. Discussion with the project area Kebele chairperson June 9, 2013

i. Outline of the Agenda

- Introducing the assessment team,
- Purpose of the meeting,
- Briefing on the Alalobad-Tendaho Geothermal Resource Development Project ,

- Positive and negative impacts of the Project,
- Discussion on mitigation measures,

ii. Briefing on the Alalobad-Tendaho Geothermal Power Development Project

After introducing the assessment team and explanation on the purpose of the discussion, the assessment team has discussed the positive and negative impacts of the project.

On the positive side, the contribution of the project to the socio- economic development of the country and region was discussed. On the other hand, the potential negative impact project is associated with community health and safety issues and the corresponding mitigation measures were discussed during the meeting.

iii. Views of the Kebele chairperson on the Project

- People around Gurmudale and Hayideru Kebele were employed during the geothermal project study and they were able to get income from the project. They know about the project and they are expecting employment opportunity. The people around the area do not have negative attitude towards the project.

- There are no communities living in the project area and there will be no problem of land acquisition as land is owned by the Afar Region not by clan elders and there will not be any dispute in this regard.

- The people bring their cattle to the hot spring once in a week because the hot spring is medicinal to the cattle as well as the people.

- The people will not have problem in movement from one place to the other because the project area is wide and will not be restricted.

Scene at the project area

d. Meeting Held on June 6, 2013 (4:30 AM) at Doubti Woreda Administration

Attendance: 5 participants from the Doubti Woreda Administration.

i. Agenda

- Introducing the assessment team,
- Purpose of the meeting,
- Briefing on the Alalobad-Tendaho Geothermal Resource Development Project ,
- Positive and negative impacts of the Project,
- Discussion on mitigation measures,

ii. Briefing on the Alalobad-Tendaho Geothermal Power Development Project

After an introduction by the assessment team and explanation on the purpose of the meeting, the assessment team discussed the positive and negative impacts of the project.

On the positive side, the contribution of the project to the socio- economic development of the country was discussed. The potential negative impact, particularly impacts associated with community health and safety issues and the corresponding mitigation measures were also discussed.

iii. Discussion with Doubti Woreda Sector Offices

Discussion was made with sector offices namely, Pastoralist and Agricultural and Rural Development office, Education and Health Offices and Woreda Administration of Doubti Woreda.

Information is given about the proposed geothermal project at Doubti Woreda Gurmudale and Hayideru Kebele, the positive and negative impacts of the project on the environment and on the surrounding community was discussed.

(Please refer to Annex II for contacted persons and organizations)

e. Positive Impacts

The following are summaries of the views of the officials interviewed:

- The geothermal project is essential for increasing the power generation which is very crucial for socio-economic development of the country. Being a renewable energy with very minimum environmental impact, the geothermal drilling and the subsequent power plant construction project is very important and the Woreda Administration will support the implementation of the project in every necessary way.

- The project will create job opportunities for the young people of the Woreda.

- Furthermore, wild animals will return to the area and this will be helpful for environmental protection and possibly for tourist attraction.

f. Negative Impacts

- The steam released from the geothermal wells at the time of maintenance will have negative impacts on trees and human health. No mitigation measure is proposed due to the fact that there is no settlement in the site.
- Hazard during the drilling of the geothermal wells could be a risk to individuals traveling through the geothermal fields, if not fenced.

- The geothermal field naturally emits smoke and gas known as fumaroles, a vent in a volcanic area, from which smoke and gases arise above the ground which may harm the health of people. People shall be kept away from these areas in order to avoid any possible harm.

- Malaria is one of the top ten diseases in the area and ponds created for project activity can exasperate the spread of the disease.

g. Suggestions

- The geothermal field should be fenced and individuals passing around the project area shall be informed about the risk and people shall be kept away from the geothermal project site.

- Where ponds will be constructed to hold sludge and waste water for drilling purposes, it will create a favourable ground for the spread of malaria. Prevention of the spread of malaria will be additional burden for the

administration and therefore the project office through woreda health bureau shall support in providing material help.

- Indigenous tree plantations by the project office around the sensitive area and camp site will help to replace trees that will be damaged due to the project activity.

i. Discussion with Culture and Tourism Bureau

Discussion was made with Culture and Tourism Bureau. Information is given about the proposed geothermal project on the positive and negative impacts of the project on the environment and on the surrounding community.

(Please refer to Annex II for contacted persons and organizations)

Positive Impacts

The following are summaries of the views of the officials interviewed:

- The geothermal project is necessary for increasing the power generation which is very crucial for socio-economic development of the country as well as to the Region.
- The project will create job opportunities for the young people of the Region.
- Road construction by the geothermal project to the Alalobad area will be beneficiary to tourism development

Negative Impacts

- The Alalobad area has natural hot spring that could be impacted by the geothermal resource development in the area. The culture and tourism Bureau has planned to develop the area for tourism purpose. The tourist Bureau has a plan to constructtourist facility such as establishment of lodge in the Alalobad area.

- The pastoralist community use the natural hot springs for medicinal purpose, especially for their cattle

Suggestion

- It is suggested that the geothermal project design as well as the geothermal resource development plan should not affect the tourist attraction of the area.

- To create a win win situation, the government must develop the geothermal project to co-exist with tourism development potential of the area.

- A study should be conducted to harmonize the geothermal project plan with the Alalobad hot spring development plan to incorporate unrestricted access to the pastoral communities.

h. PUBLIC CONSULTATION AND DISCLOSURE

The ESIA and RPF will be disclosed in Ethiopia by making copies available at EEPCo's Corporate Communication Office at the head office of EEPCo and posted in EEPCo's website. The disclosure will also be announced locally on the Ethiopian newspaper.

The project funding agency, The World Bank will also disclose the ESIA and RPF electronically through its website prior to the processing of the project.

Potential Risks and Challenges related to social development

Components	Potential risks and Challenges	Mitigation Actions
	Due to the fact that no community is living in the proposed project site, community consultation will be limited and will not recognize the mobile nature of pastoralist community and might exclude women and poorest households	GSDP consultation process will start with a PRA for a social mapping to identify resource use patterns around the project site and the types of vulnerable groups. The consultation will directly engage such groups as the sub-Kebele level and special attention will be given to female headed households and women. GSDP will provide technical assistance and culturally appropriate capacity building for the women groups and support community groups so that they can participate in consultative meetings and include specific measures to encourage and facilitate community awareness of the project and participation in project benefits.
	GSDP will be implemented by Federally hired staff, who might not be culturally sensitive to community economic institutions and cultural organization.	GSDP will provide culturally appropriate capacity building for its project staff and will involve during implementation, relevant regional, woreda and kebeles governments institutions as well as community organizations.
	Pastoralist Community uses the hot spring at the project site as medicine for their cattle and the project might restrict access to to them and their animals. The project might impact the tourism potential of the boiling mud in the project site.	The project will harmonize the geothermal resource development plan with the Region's Culture and tourism plan. The project will develop a plan that will enable communities and institutions co-exist with the geothermal resource development project in harmony, including constructing access paths to the hot spring to allow paastoralists gain access. This plan will be developed during the design phase of the Alalobad -Tendaho geothermal Power Development Project with the consultation of all stakeholders, including impacted communities
	The proposed drilling of geothermal wells will have an impact on the existing land use both temporarily (for access roads, etc) and permanently (for camp site, substation and Geothermal	In order to avoid future land use problem, the geothermal project site shall be demarcated and geothermal wells shall be fenced and Continuous consultation with local people as well as regional offices on land uses. Tree planting will be done in the camp site to replace any damaged local tree during project implementation. No agricultural land will be occupied nor crops affected and in order to avoid land use dispute, Resettlement Policy Framework (RPF) will be used for any land acquisition, and consultation with communities and local administration will

		be mandatory.
	The major community health and safety impacts include: exposure to hydrogen sulphide /H_2S/, and infrastructure safety.	The mitigation measures actions for "***geothermal gases***" are: Installation of H_2S monitoring and warning system; Development of contingency plan for H_2S release events; Provision of facility for emergency response team and workers in locations with high risk of exposure, with personal H_2S monitors, self-containing breathing apparatus; Provision of adequate ventilation; Development and implementation of a confined space entry program for areas designated as confined spaces; and Provision of workers with a fact sheet or other readily available information about the chemical composition of liquid and gases. These measures will be discussed with the stakeholders, including relevant communities. There will be continuous community awareness activities on health and safety impact of the project.
	There will be noise arising from geothermal fluid escaping from the drilling of deep wells, drilling machines impacts on working noise; well testing and vibration are the potential noise sources of the project.	During the construction period workers will wear ear mufflers and other safety equipments /PPE/. Noise level will be kept low and monitored according to the government approved standards. Machines and vehicles will be maintained regularly to keep noise at a minimum. The project will also undertake road safety campaign to educate community members in their local language
	Communities may be exposed to physical hazards associated with the geothermal wells and related pipeline networks. Hazards may result from contact with hot components, equipment failure or the presence of active and abandoned well infrastructure which may generate confined space or falling hazards, transporting of machineries, installation of the drilling machine will cause accidents /incidents	During transportation and construction activities, the contractor will comply to safe handling and store hazardous materials, seek direction from the supervising engineer for disposal of hazardous material, clean up spills of hazardous materials immediately, suppress fires on or adjacent to construction or ancillary sites and in case of any spill, relevant departments will be informed at once and deal with it in accordance with the spill contingency plan. Penalty for negligence will be stipulated in the contract agreement.
	The Afar Region is rich in archaeological heritage.	According to the ESIA study of the geothermal site of June 2013, the project area has no known site of culturally, historically, archaeologically or topographical important feature to be affected by the project. There are no infrastructures or facilities such as

		churches, mosques, schools, health institutions and other major community services to be affected by the project. The project will followed the well established protocol when there is any "*chance findings*" and the contractor will immediately inform EEPCo on such findings and the Authority for Research and Conservation of Cultural Heritage (ARCCH) will be informed for further investigation.
	The influx of project workers from other areas may cause short term social concerns in the area that may need to be addressed. Such concerns include spread of HIV/AIDS, Sexually Transmitted Diseases and substance abuse-- Workers in the drilling of the geothermal wells return home in an inebriated state and can abuse and injure family members and generally cause a good deal of domestic upheaval.	The project will embark on aggressive approach to fighting STIs and HIV/AIDS. Aggressive health education will be provided and awareness be created to workers and surrounding communities during construction. The local administration will play vital role in controlling informal sector activities near the project camp and the contractor is expected to provide free condom to construction workers. Health education especially on HIV/AIDS and STIs should be given regularly. The project will give preference to work forces from the project area in order to avoid any new cases coming with migratory workforce. The problem of substance and alcohol abuse will be explained to workers as part of health education program and given due emphasis to be strictly followed by each employee. Recreational facilities will be made available at the camp and additional activities will be a normal part of camp living. Severe penalties for drunkenness and disorderly behavior must be given along with the provisions of counseling services for substance abuse.
	Changing patterns in resource use and access by the project will reduce access to resources and land acquisition and might result in conflict.	The project will provide affordable and accessible procedure for grievance redress, including third party settlement of dispute arising from relocation such as grievance mechanisms which should take into account the availability of judicial resources and community traditional dispute resolution mechanisms.
	In Ethiopia, there is no law on benefit sharing mechanism for geothermal activities and the communities might not benefit directly from the development objectives of the project.	While there is no law on benefit sharing arrangement, the constitution of Ethiopia recognizes the participation of the communities in development agenda and the project as part of its corporate social responsibility has met and discussed with the communities and other stakeholders during public consultation. The

		communities have requested for Water pipe and water distribution center plus cattle trough. The project will continue to consult with the communities and will provide these utilities. The project will also partner will other projects in the area to provide basic services to these communities

Social safeguards Screening Information:

	Social safeguards screening information	Yes	No
1	Will the project reduce other people's access to their economic resources, like land, pasture, water, public services or other resources that they depend on?		
2	Will the project result in resettlement of individuals or families or require the acquisition of land (public or private, temporarily or permanently) for its development?		
3	Will the project result in the temporary or permanent loss of crops, fruit trees and Household infra-structure (such as granaries, outside toilets and kitchens, etc)?		
4	Will the project require excavation near any historical, archaeological or cultural heritage site?		
5	Might the project adversely affect vulnerable people (e.g., elderly poor pensioners, physically challenged, women, particularly head of Households or widows etc) living in the area?		
For all issues indicated by "Yes", the applicant is expected to explain how he/she intends to mitigate them. Implementation of the mitigation measures will require using the **Resettlement Policy Framework**			

IX. SYNTHESIS OF ENVIRONMENTAL IMPACT

The possible negative and positive impacts predicted were classified as very important, more important, important, fair important, and less important.

The impacts identified are also discussed in the environmental matrix table below.

Table 17: - Synthesis of Environmental Impact Matrix

No.	Environment components	Pre-drilling phase		Drilling stage activity components			Operation phase		
		Site survey	Land acquisition	Equipment and material mobilization	Foundation pad preparation	Excavation of foundation ponds	Induction influence	EMF Wave effluence	Radio interference
I	Social - economic Environment:								
	▪ Residential houses	0	a	0	0	0	0	0	E
	▪ Income	0	c	E	E	E	0	0	0
	▪ Cultural and historical sites	0	0	0	c	c	0	0	0
	▪ Health and safety	0	0	c	c	c	0	0	0
	▪ Quit daily life	0	0	d	d	d	0	0	0
	▪ Society unrest	0	c	0	0	0	0	0	0
II	Physical Environment:								
	▪ Soil	0	0	e	c	c	0	0	0
	▪ Air quality	0	0	c	c	c	0	0	0
	▪ Land use	0	c	0	c	c	0	0	0
	▪ Water	0	0	0	0	0	0	0	0
III	Biological Environment:								
	▪ Flora	e	d	e	c	c	0	0	0
	▪ Fauna	e	d	0	e	e	0	0	0
	▪ Parks and reserves	0	0	0	0	0	0	0	0

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=**Not important**

X. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

In any project context, Environmental Management Plan (EMP) is necessary to avoid, minimize or offset adverse impacts, enhance positive impacts and beneficial impacts during implementation.

Environmental Management Plan /EMP/ must be fully integrated with the overall project management effort at all levels, which should be aimed at providing a high level of quality control, leading to a project which has been properly designed, constructed and functions efficiently throughout its life.

a. Institutional Arrangement

The implementation responsibility of the EMP rests on EEPCo or EEPCo‘s contracted representative unless noted otherwise.

To a considerable degree, construction contractor will be responsible for implementing mitigation measures but the ultimate responsibility to ensure proper mitigation measures lies with EEPCo.

The Ministry of Water and Energy (MoWE) and Federal Ministry of Environmental Protection and Forest (MoEPF) will oversee all the environmental activities related to the project.

The Agricultural, Health and Education Offices and other stakeholders will be involved with their specific responsibilities in the environmental and socio economic activities.

Their responsibilities are exercised in different stages, i.e., pre-construction, construction, and operation and maintenance phases.

The principal actors involved in the management and monitoring of environment and social concerns related to the implementation of the Project are the following:

- The Aluto Geothermal Power Plant Expansion Project Office,
- The Environment Monitoring Team /EMT/,
- The Contractor, and
- The Supervision Engineer (SE).

However, it is recognized and obvious that:

- The Ministry of water and Energy (MoWE),
- Authority for Research and Conservation of Cultural Heritage (ARCCH),
- Other relevant sector ministries,
- Local NGOs (as required) are also components of stakeholders who may play an affirmative role in the process of the project implementation.

The major roles and responsibilities of each of the actors are presented in the following sections.

The Aluto Geothermal Power Plant Expansion Project Office

- The Aluto Geothermal Power Plant Expansion Project Office is the owner of the project that undertakes the overall contractual follow-up to ensure the successful implementation of the Project.

- The core responsibility of the Project Office is that it makes sure that compensations are effected (if any) as per the provision in Proclamation No. 455 /2005. The Project establishes an exclusive team to implement compensation.

The Environmental Monitoring Team (EMT)

- The Environmental Monitoring Team comprises of Environmentalists and Sociologists.

- The role and responsibility of the Environmental and Social Experts of EMT mainly focuses on regular monitoring of the project operations, that is, to ensure that the proposed mitigation measures have been properly implemented.

The Contractor

- The Contractor of the Project is responsible to undertake the construction works as per the design and the EMP. In simple projects, environmental and social clauses will be part of the bidding document and part of the contract to the contractor. In complex projects, the contractor needs to prepare their own Environmental and Social Management Plan (ESMP). The contractor is responsible for the implementation of its ESMP and need to appoint qualified environmental and /or social specialists.

- After preparing the ESMPs it needs to be approved by the Supervision Engineer and submitted to Bank for clearance and public disclosure before starting physical activities.

The Supervision Engineer (SE)

- The SE is responsible for the day to day monitoring of the implementation of the project. By contractual arrangement, the SE will be responsible also for adequate implementation of the environmental and social clauses in the ESMP.

- The SE approves or rejects, as the case may be, the proposals and undertakings of the contractor in relation to the requirements of the contract documents.

Authority for Research and Conservation of Cultural Heritage (ARCCH)

ARCCH will be informed whenever there are significant cultural heritage sites in the project area for further investigation.

Ministry of Water and Energy (MoWE)

The Ministry of Water and Energy (MoWE) is the regulatory body delegated to review the ESIA documents, give approval and monitor the performance of development projects.

Local NGOs

In the Project area, where there exists NGO involved in energy related intervention, EEPCo may approach that NGO for their possible contributions, especially for the sustainability of the Project. NGOs are important specifically during the operation phase of the Project.

b. Reporting Procedure

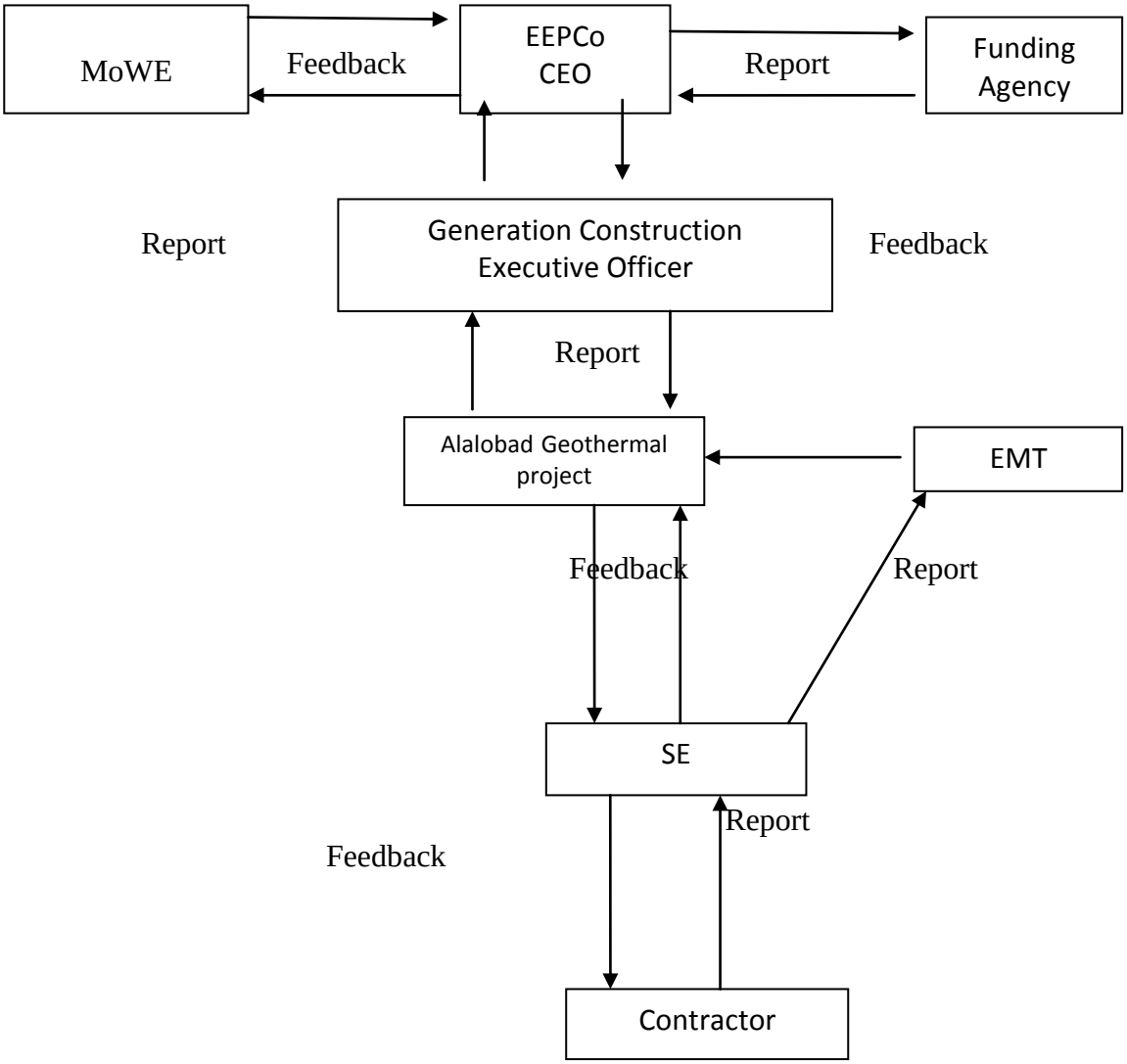
During the implementation of the Project, reports mainly originate from the SE's who is deals with the day to day progress of the works.

The SE's submits progress reports to the Aluto Geothermal Power Plant Expansion Project Office (AGPPEP) and the PSP for their follow up, review and comment on the reports.

EEPCo will submit copies of reports to the Ministry of Water and Energy (MoWE) for the prompt action of the latter and to the donor agency (WB).

The feedback of reports from Aluto Geothermal Power Plant Expansion Project Office and PSP should be provided to the SE's within the time period stipulated in the contract document.

The reporting procedure /flow within EEPCo as well as between EEPCo and other pertinent stakeholders are shown here below:



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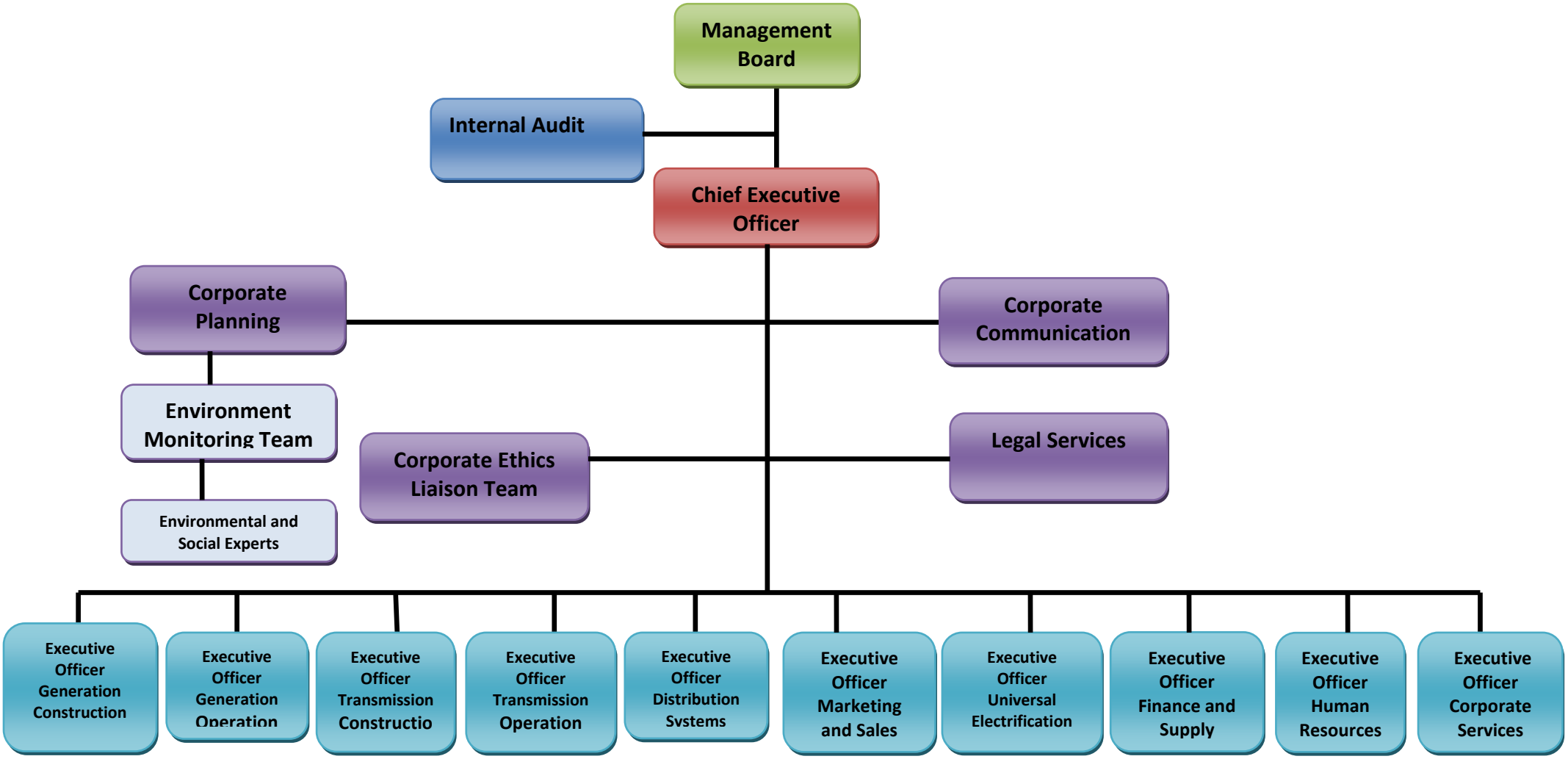
MoWE = Ministry of Water and Energy
AGPPEP = Aluto Geothermal Power Plant Expansion Project Office
SE = Supervision Engineer
EMT = Environment Monitoring Team

ETHIOPIAN ELECTRIC POWER CORPORATION PROCESS CENTERED ORGANIZATIONAL CHART



c. Pre - Construction Phase

Prior to contractor's mobilization and commencement of drilling of deep wells, environmental management will be considered with the following principal activities:

- Ensure that all government and funding agency's requirements and procedures relating to ESIA are complied with.
- Ensure that environmental and social considerations have been given due consideration /attention and the major clauses are incorporated in the contract document.
- Implementation of compensation payments for land or property acquisitions.

As a proponent, EEPCo will be responsible for submitting the ESIA report to the authorized body for their evaluation and comment (i.e., MoWE).

d. Construction Phase

All the impacts are expected to occur at this stage and the impacts to be occurred in this phase can be reduced or avoided through the application of sound construction guidelines.

All the environmental management activities will be carried out during the drilling phase.

Management is much concerned with controlling impacts that may result from the action of the contractor, through enforcing construction contract clauses related to protection of the environment as a whole and of the components within it.

It is important to recognize that successful mitigations can only be achieved if the environmental protection measures, as set out in the construction contract are properly enforced.

e. Operation Phase

Environmental management and monitoring at this stage will be the responsibility of Environmental and Social staff of EEPCo, with the implementation being carried out either by the members themselves or by contractor. Environmental and Social staff of EEPCo is expected to take a general overall advisory role during the operational phase.

f. Socio- Economic Environment

i. Compensation

According to the laws and regulations, EEPCo is fully committed to pay full compensation for lost items as per the Federal Proclamation No. 455/2005. The compensation shall be completed before the commencement of the project activities.

For the successful implementation of compensation, there will be a property valuation committee to be established by the Woreda administration (i.e., the local administration) of the project area. The committee would consist of different experts with relevant qualifications to value the properties thereon.

However, there is no individual or community asset to be compensated in the proposed Alalobad-Tendaho Geothermal Power Development site.

The scheme would be fully backed by appropriate technical and administrative supports.

ii. Residential Houses

There is no residential house to be affected by the proposed project.

iii. Health and Safety

1. Safety

The contractor is responsible to organize on site environmental management and safety trainings for the construction work force at least a month prior to the commencement of the construction. Environmental and Social Staff of EEPCo will supervise and monitor the activities.

The contractor, during the whole drilling period should regularly provide adequate personal safety equipments /PPE/ and give orientation to his employees.

The contractor and /or sub-contractors throughout the construction period will be required to use appropriate vehicles and comply with legal gross vehicle and axle load limits. They are also required to repair damages at their own expenses.

The contractor should minimize road safety hazards and inconveniences to other road users by taking all appropriate measures during the construction period.

2. Hazardous Materials

During all his activities, the contractor shall comply with the following:

- Safely handles and stores hazardous materials.
- Seek directions from the supervising engineer for disposal of hazardous material.
- Clean up spills of hazardous materials immediately.
- Suppress fires on or adjacent to construction or ancillary sites.
- In case of spill of any hazardous materials, relevant departments will be informed immediately and deal with it in accordance with the spill contingency plan and the law.

3. PCBs Chemicals

- Strict procedures would be followed to order companies to import PCBs free transformers, capacitors and other electrical equipment.

- As per the Stockholm Convention, most companies or manufacturers have already stopped manufacturing PCBs containing transformers and capacitors.

iv. Health

1. Dust Nuisance

- Heavy trucks and other vehicles delivering materials shall be covered to reduce spills and dust blowing off the load throughout the construction period.
- Watering of roads and traffic speed control limit will be followed by the contractor to minimize dust arising from access roads during the construction period.

2. Noise

- During the construction period workers in the vicinity of strong noise will wear ear mufflers and masks.
- Machines and vehicles will be regularly maintained in order to keep their noise at a minimum.

3. Sexually Transmitted Infections (STIs)

- There should be an aggressive approach to fight against STIs, including HIV/AIDS.
- Health education would be provided to the construction work force and local communities nearby during construction period.
- The local administration should play vital role in controlling informal sector activities near the project camp and construction sites.
- The contractor is expected to provide free condoms to construction employees during construction period.

4. Other Infectious Diseases

The contractor, during construction period should comply with the following:

- The contractor should construct pit latrines above water table at major drilling sites.
- Provide and maintain proper /potable drinking water.
- Establish workers health check-up schedule and sewage disposal facilities at camp.
- Camps shall be located away from water source (at least 100 meters).
- Sufficient measures should be taken by the contractor in the construction camp, like provision of garbage tanks /containers and sanitation facilities, including septic tank and soak away pits.

- Waste from septic tanks will be cleaned and safely disposed off periodically.
- Garbage /solid waste will be collected in covered bins /barrels and disposed off daily.
- To ensure that there is a good drainage system to avoid creation of stagnant water bodies including water in old tires as it will be a favourable breeding place for insects /mosquitoes.
- Provide adequate health care facilities for workers.
- Comprehensive occupational health standards established by the government would be followed by the contractor.

g. Bio-physical Environment

i. Vegetation Clearance

During the construction period:

- Vegetation clearance shall be undertaken once consent to clear individual trees along the alignment by SE.
- Instruct all construction workers to restrict clearing to the marked areas only and not to harvest any forest products for personal consumption.
- Ensure that all clearing is undertaken with minimal disturbance to the surrounding environment only to the extent of approved sites only.

ii. Protection of Vegetation

Prior to commencing construction activities, the contractor should:

- Identify vegetation type and number that is to be removed / protected.
- Remove identified trees in such a way as to minimize damage to surrounding vegetation and damage to sensitive soil.
- Ensure the construction crew is aware of the remaining vegetation that they must not cut or damaged.

iii. Erosion Control Measures

- Prior to the commencement of vegetation clearing, the contractor should clearly mark the areas to be cleared. No clearing of vegetation shall be done outside these areas.

- Ensure re-vegetation at all sensitive and camp sites at the earliest time and select tree and grass species suitable for soil conservation, immediately following the construction of works.

- Following the completion of works, the contractor shall prepare areas for rehabilitation. It is preferred to engage local communities for rehabilitation.

iv. Water Pollution

During construction period the contractor shall train work crews in safe handling of petro-chemicals and other discharges. Also, any discharges should be diverted away from waterbodies and in a manner to avoid contamination of soils and groundwater.

v. Waste Management

During the construction period and site cleanup, the contractor should:

- Remove disabled /damaged equipment including machineries from the area.

- Segregate, crush, burn and bury all inorganic solid wastes in an approved disposal area.

- Segregate, contain all solid wastes at designated location within construction sites only.

vi. Reinstatement of Services

- The contractor would take all inventories of services to be reinstated prior to interruption of any services.

- Progressively reinstate /landscape or repair all interrupted services and sites to their previous position.

- The engineer would inspect and certify for adequate reinstatement of services.

- The contractor shall fill excavated sites and holes with appropriate fill and finally cover with reserved top soil.

vii. Loss of Trees

- During the clearing operation, the contractor should avoid tree clearing outside what is required for construction activities.

- The contractor after completion of construction work shall re-vegetate areas that have been cleared for temporary works according to a re-vegetation action plan.

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viii. Re-vegetation

- Progressively sow all disturbed construction and ancillary site surfaces with a cover crop mix.
- Progressively implement re-vegetation works commencing in the correct planting season, especially in camp and sensitive sites.
- Environmental and Social Expert of EEPCo will monitor the effectiveness of re-vegetation measures, possibly in every six months for two years.

Table18:- Environmental and Social Management Plan

Environmental Impact Issues	Mitigation Measures	Location	Timing	Responsible Organization	
				Implementation	Supervision Monitoring
Pre-Construction Stage					
Land acquisition	Complete all necessary land acquisition prerequisite for the project activity in accordance with land administration of the Woreda (Local Administration)	Project Site	Before the commencement of construction	EEPCo	EEPCo
	Provide copies of land acquisition details and demarcated plan to the engineers and contractor.	Project site	Before the commencement of construction	EEPCo	Engineer
Safety and health issues	Notify the community moving around the project area about the commencement of the project activity, increase of traffic movement, safety precautions, etc.	All around the Project area	Before the commencement of construction	Contractar/EEPCo	EEPCo/ Engineer
	Notify the community moving around the project area about noise emissions.	At the project site and around the project areas	Before the commencement of construction	Contractar/EEPCo	EEPCo/ Engineer
HIV/AIDS	Create awareness program to workers, nearby towns and to the community living around the project area. During the implementation the project, they have to work closely with the Woreda Health Bureau, HIV/AIDS Coordination office.	Around the Project area	During the construction period	Contractar/EEPCo	EEPCo/ Engineer

Health and Safety issues	Organize an environmental management and safety training. All contractors and supervising consultant's field supervisors shall attend the training.	Project site	Before the commencement of construction	Contractor	Engineer
	Provide safety orientation to workers	Project site	At list one month prior to commencement of construction	Supervision consultant contractor	Engineer
	Provide PPE and other safety gadgets to workers	On site	During the construction period	Contractor	Engineer
	Place warning signs at well drilling and steam gathering systems	On site	During the construction period	"	"
	Collection and disposal of wastes /solid and liquid/	On site	"	"	"
	Management of pollution incident	On site	"	"	"
	Ensure that debris is disposed of in a sensible manner at specified and approved dumping area.	On site	During construction	"	"
	Compliance with standard health and safety regulations	On site	"	"	"
	Provision of standard 'first aid kit' at the construction sites.	On site	Before the commencement of construction	"	"
	Make 'firefighting equipment' available	On site	During construction	"	"
Public safety issues	Keep non- authorized personnel away from construction areas	Around the project area	Before the commencement of construction	"	"
	Begin educational programs in schools and communities. Educate people about hazards and safe practice when working and playing.	Around the project area	"	"	"
	Schools and other noise sensitive areas shall be notified at least 5 days before construction is due to commence.				

Construction Stage					
Impacts on Flora	Vegetation monitoring will be seriously undertaken, mainly near the drilling wells and along the steam pipes, monitoring of potential long term effect on natural vegetation will be carried out.	Drilling Site and excavation sites of ponds	Before clearing of the vegetation along a section of the drilling site	Engineer	EEPCo
	Brine and condensed discharges will be re-injected in order to avoid potential toxic effects on flora or soil.	Drilling Site and excavation sites of ponds	During well drilling.	Contractor	Engineer
Vegetation clearance	Inspect and approve all correctly located and pegged clearing sites. Vegetation clearance shall only be undertaken once consent to clear strip of plantation is decided. Individual trees along the alignment have been obtained from each owner (if any).	Drilling Site and excavation sites of ponds	Before clearing the vegetation.	Contractor	Engineer
	Instruct all construction workers to restrict clearing to the marked areas and not harvest any forest products for personal consumption.	"	"	"	"
	Ensure that all clearing is undertaken with minimal disturbance to the surrounding environment, within the extent of approved sites only.	"	"	"	"

Erosion	Clearly mark the vegetation areas to be cleared before clearing commences. No clearing of vegetation shall occur outside these areas.	Within the drilling site	Prior to commencement of vegetation clearing	Contractor	Engineer
	Whenever possible, avoid unnecessary clearing, access roads and construction camp on steep slope.	Drilling area	Prior to commencement of construction	Contractor	Engineer
	Following completion of works, prepare areas for rehabilitation by re-vegetation or engage local community to plant vegetation, where appropriate.	project site	Immediately following completion of works	Contractor	Engineer
	Ensure topsoil is left in a non-compacted condition following completion of works.	Drilling and dumping sites	Immediately following completion of works	Contractor	Engineer
	Ensure re-vegetation at the earliest time possible (where deemed necessary)	At all work sites	Immediately following completion of works	Contractor	Engineer

Water Pollution	Ensure that potential sources of petro-chemical pollution are handled in such a way as to reduce chemical spills and leaks.	At all work sites and stores	Prior to commencement of construction	Contractor	Engineer
	Train work crews in safe handling of petro- chemicals.	"	"	"	"
	Minimize soil sedimentation as outlined under sediment control	"	"	"	"
	Put in place, measures that will ensure wastage of water resources. Re-injection of water and recycling has been considered in the proposed design to use brine for drilling to minimize obstruction.	"	"	"	"
	Accidental leakages and bursts to water supply pipe lines should be reported and repaired immediately. Recycling water as much as possible should be encouraged.	"	"	"	"
	Control of water flows and water consumption records must be kept and availed to the supervising engineer at end of working days.	"	"	"	"
	All employees should be trained on proper water usage practices.	"	"	"	"

Waste management	Adequate waste management facilities should be provided and compliance to standard is necessary	At all work sites	Throughout drilling	Contractor	Engineer
	Contain all solid wastes at designated location within construction sites.	"	Throughout drilling	Contractor	Engineer /supervisor
	Crush, burn and bury all inorganic solid waste in an approved disposal area.	"	Throughout drilling	Contractor	Engineer /supervisor
	Remove disabled/damaged equipment, including machinery from the area.	"	Throughout drilling	Contractor	Engineer /supervisor
	Use above water table pit latrines at major construction sites.	"	Throughout drilling	Contractor	Engineer /supervisor
	Compost all green or biodegradable waste.	"	Throughout drilling	"	"
	Cleared areas should be rehabilitated with indigenous vegetation spp. as soon as possible to restore habitat loss.	"	Throughout drilling	"	"

Noise issues	Workers in the vicinity of high level noise should wear protective device, ear muffler.	Throughout drilling	Throughout construction period	Contractor	Engineer
	Use well maintained equipment (with mufflers where appropriate).	"	"	"	"
	Use noise screens or mounds near residences, schools and health centers.	"	"	"	"
	Carry out noisy construction activities during day time where ever possible.	"	"	"	"
	Advise local people when there will be unusually high levels of noise.	"	"	"	"

Protection of sensitive environmental areas	Identify natural areas on site plans, especially environmentally sensitive or ecologically fragile areas.	Throughout drilling	Prior to commence-ment of works	Contractor	Engineer
	Locate construction sites/activities away from sensitive areas.	"	"	"	"
	Provide training to construction workers to ensure that an understanding of the requirements regarding environmental protection of sites.	"	Throughout construction	"	"

Protection of vegetation	Identify vegetation that will need to be removed /protected.	Throughout drilling	During site preparation	Contractor	Engineer
	Remove identified trees in such a way as to minimize damage to surrounding vegetation	"	Prior to construction	"	"
	Ensure the construction crew is aware that the remaining vegetation must not be cut or damaged.	"	Prior to commence-ment of construction	"	"

Workers' Camp	Contractor to prepare for approval detailed site environmental plans for camps and other work sites, which make adequate provision for safe disposal of all wastes and prevention of spillages and leakages of polluting materials, etc.	Before Drilling starts	Throughout construction	Contractor	Engineer
	Contractor to be required to pay all costs associated with clearing and to any pollution caused by his activities and to pay full compensation to those affected.	Post use of the site	"	"	"
	If necessary solid waste from the camp shall be disposed off in a sanitary landfill.	Camp site	"	"	"

Archaeological sites	Fence off archeological sites, if any sighted /uncovered "*chance findings*" during construction and report it to EEPCo and the appropriate authority.	At all drilling sites	Prior to the commencement of works and throughout construction	Contractor	Engineer

Socio-environmental issues	Inform and advise the local community on project plan in advance of construction and involve them in the site construction planning process.	During whole drilling time	Prior to commencement of works.	Contractor	Engineer
	Identify cultural sensitive areas and avoid disturbing them.	At all drilling sites	Prior to commencement of and throughout construction	"	"
	Control run-off and manage sediment near residential areas.	For the whole project duration	Throughout construction	"	"
	Arrange for local people to be employed and trained.	During the implementation period	Prior to commencement of and throughout construction	"	"
	Include women, poor and vulnerable groups in the implementation of the project activities.	"	"	"	"
	Negotiate and agree with community about disposal areas and stockpiles sites.	"	"	"	"
Distance of water pond	Preparation of water well for community's use in the project area	Gurmudale and Hayideru village	During Construction	EEPCo	EEPCo

Drainage	Construct all designed drainage works prior to, during or immediately following excavation work in order to minimize erosion hazard.	Throughout drilling period	Beginning with and continuing throughout construction	Contractor	Engineer
	Inspect all works and ancillary sites for drainage and erosion problems after each major storm event during the period of construction. Repair all failed drains and take other appropriate action as directed by the Engineer.	"	Throughout construction	"	"

Disposal of materials	Instruct the construction workforce on approved fill /material disposal locations and strictly supervise the correct placement of fill at these sites.	Throughout project site	Throughout construction	Contractor	Engineer
	Identify, peg and seek approval from the Engineer for permissible /appropriate disposal locations.	"	"	"	"
	Inspect and approve all correctly located disposal locations.	"	"	"	"

Reinstatement of services	Take inventory of all services to be reinstated.	Throughout drilling site	Prior to interruption of any service	Contractor	Engineer
	Progressively re-instate or repair all interrupted services to their previous capacity.	"	Following construction	Engineer	EEPCo/Engineer
	Inspect and certify for adequate reinstatement of services.	"	"	"	"

Stockpiling of construction materials	Locate, peg and seek approval from SE for the use of stockpile site.	Throughout drilling site	Whenever encountered during construction	Contractor	Engineer / EEPCo
	Obtain written permission from Kebele Administrator for stockpiling on the temporarily acquired land.	Prior to commence-ment of activity	Prior to commence-ment of activity	"	Engineer
	Inspect and approve all correctly located stockpile sites.	Throughout drilling site	Throughout drilling	Engineer	EEPCo /Engineer
	Site plans shall include all drainage provisions for construction sites.	Prior to commence-ment of activity	Prior to commence-ment of activity	Contractor	"
	Locate stockpile or spoil heaps so there is no blocking of drainage lines.	Throughout drilling site	Throughout drilling	"	"

Work force Camps	Locate, peg and seek approval from the SE for work force camp sites.	Construction camp area	Throughout construction	Contractor	Engineer/ EEPCo
	Inspect and approve correctly located campsites.	"	"	Engineer	"
	Provide and maintain proper drinking water, worker's health check-up and waste disposal facilities at the camps.	"	"	Contractor	"
	Recycle or dispose of solid wastes as directed by the SE.	"	"	"	"

Work force Management	Ensure workers act in a responsible manner to local people and do not harvest or take personal resources, forest products or wildlife.	Near camp sites	Before and during building of construction camps.	Contractor	Engineer/ EEPCo.
	Ensure that no wood is burnt by any construction worker on or off site.	"	"	"	"

Dust Nuisance	Water / sprinkle roads to reduce dust problem for heavy truck delivering materials.	Throughout project site	Beginning with and continuing through out construction.	Contractor	Engineer

Noise	- Periodically maintain vehicles to keep noise at minimum	Throughout drilling period	Beginning with and continuing through out construction.	Contractor	Engineer
	- Noise level shall be kept within acceptable limits and practiced	"	"	"	"
	- Workers in the vicinity of high level noise have to wear protective device	"	Throughout construction.	"	"
	- Schools and other noise sensitive areas shall be notified at least 5 days before construction is due to commence.	Prior to commence-ment of activity	Beginning with and continuing through out construction.	"	"

Siltation	Construction materials containing fine particles e.g. aggregates, limestone etc. will be stored in an enclosure away from water bodies to ensure that sediment laden water does not drain into nearby water courses.	Near cross-drainage structures and water bodies	Through construction	Contractor	Engineer

Alteration of Drainage	In sections along water courses, earth and construction waste will be properly disposed of so as not to block rivers and streams, resulting in adverse impact on water quality.	Near cross-drainage structures	Whenever encountered during construction	Contractor	Engineer
	All necessary measures will be taken to prevent earth works from impeding drainage of rivers/streams, canal/existing irrigation and drainage systems.	Near cross drainage structures	Whenever encountered during construction	Contractor	Engineer

Contamination from wastes	All justifiable measures will be taken to prevent waste water produced at construction camps from entering directly into rivers and irrigation systems. A minimum distance of any sewage source or toilet facility should be 100 m from water sources.	Near camps drainage structures and rivers/ streams	Through drilling activity	Contractor	Engineer

Contamination from fuel and lubricants	Vehicle maintenance and refueling will be confined to construction camps designed to contain spilled lubricants and fuels. Waste petroleum products must be collected, stored and taken to selected and approved disposal sites, according to FEPA regulation.	Construction camp area	Through construction	Contractor	Engineer

Sanitation and waste disposal in construction camps	Camps shall be located at a minimum distance of 100 m from any water sources.	At camp sites	Before and during building of construction camps.	Contractor	Engineer
	Sufficient measures will be taken in the construction camps, septic tanks and sanitation facilities including soak away pits. Waste in septic tanks will be cleared periodically.	"	Throughout construction period	"	"
	Potable drinking water shall meet national standards.	"	"	"	"
	Garbage will be collected in covered bins and disposed of daily.	"	"	"	"
	Special attention shall be paid to the sanitary condition of camp.	"	"	"	"
	The contract document shall specify the proper disposal of waste during construction period.	"	"	"	"

Increase in Water-borne, Insect-borne Communicable Diseases	Make certain that there is good drainage at all construction areas, to avoid creation of stagnant water bodies especially in old tires, truck footprints, etc. to prevent insect breeding. Provide adequate health care for workers and locate camps away from vulnerable groups.	At all drilling and camp sites	During construction	Contractor	Engineer

Cultural Resources	If archaeological relics or remains are discovered i.e., "*Chance findings*", the appropriate authority should be notified immediately. The construction should be stopped until the authorized organization assesses the remains and approves the continuation of work after appropriate measures are implemented.	Whenever such archaeological remains are discovered	Throughout drilling activity	Authority for Research and Conservation of Cultural Heritage (ARCCH)	Engineer EEPCo

Hazards and Hazardous Materials	Safely handle and store hazardous materials.	Throughout construction period	Throughout construction as and when required	Contractor	Engineer
	Provide disposal directions to the contractor when requested.	"	"	"	EEPCo
	Clean up spills of hazardous materials immediately.	"	"	"	Engineer
	Suppress fires on or adjacent to construction or ancillary sites.	"	"	"	Engineer
	In case of spill of hazardous materials, relevant departments will be informed at once and will deal with it in accordance with the spill contingency plan.	"	"	"	EEPCO
	Chemicals and fuel shall be stored in storage tanks within secured compound. All chemicals and fuels shall be stored in accordance with manufacturer's instructions.	"	"	"	EEPCO
	Comply with standard fire safety regulations	"	"	"	EEPCo

Compaction of Soil	Construction vehicles should operate within the demarcated and avoid damaging (compacting) soil and vegetation	Throughout drilling especially in productive areas	During construction	Contractor	Engineer

Loss of trees	Tree clearing outside the project site should be avoided beyond what is required for construction activities and /or to provide adequate clearance.	Throughout construction	During clearing/grubbing activities	Contractor	Engineer
	All vegetated areas cleared for temporary work sites will be re-vegetated with indigenous tree species.	Areas of proposed tree plantings	After completion construction activities	Contractor	Engineer
	Plantation of trees along the gully /sensitive areas and erosion prone areas.	"	"	"	"

Post Construction Stage					
Re-vegetation	Re-vegetation will be undertaken with local indigenous plants, grass, shrubs and trees.	Throughout project lifespan	After completion construction activities	Contractor	Engineer
	Progressively sow all disturbed construction and ancillary site surfaces with a cover crop mix immediately following final use of each ancillary site.	"	"	"	"
	Progressively implement re-vegetation works commencing in the correct planting season (where necessary).	"	"	"	"
	Regularly monitor the effectiveness of re-vegetation measures	"	"	"	"

Site decommissioning	Involve local community and the Woreda Agricultural Office to provide materials and implement re-vegetation.	An ancillary sites	Immediately following completion of construction work	Contractor	Engineer

Ancillary site Rehabilitation	Rehabilitate ancillary sites such as borrow areas, camp sites, material storage sites etc. within one month of the final use, including the removal of structures, refuse, stock piles and other temporary features. Re-vegetate the sites with a cover crop mix and permanent vegetation as appropriate.	At all ancillary sites “	Within 1 month of final use of the ancillary site “	Contractor “	Engineer “

XI. ENVIRONMENTAL MONITORING PLAN

Environmental monitoring is an essential component of project implementation. It facilitates and ensures the follow-up of the implementation of the proposed mitigation measures, as required. It helps to anticipate possible environmental hazards and /or detect unpredicted /unforeseen impacts over time.

Methods of monitoring includes: -

- Visual observation.
- Selection of environmental parameters at specific locations.
- Sampling and regular testing of these parameters.

Monitoring provides a very useful feedback, which permits to correct the incidence of environmental problems at the right moment during the project construction and operation periods.

a. Water Quality Monitoring

Construction camps are often sources of significant surface and ground water pollution if not managed and sited properly. It is recommended, therefore, that the contractor should undertake monitoring of any effluent, wastewater or rainfall run-off drains from campsite. This would encourage the contractor to implement proper wastewater treatment facilities in the site through the use of settling /sedimentation, evaporation and treatment ponds.

b. Noise Level Monitoring

During construction, noise is expected to be one of the major problems. Periodic sampling of contractor's equipment at work sites should be undertaken to confirm that it is according to standard. Noise level monitoring could be supplemented by consulting project affected people to identify the level of monitoring required.

c. Soil Erosion Monitoring

During earth excavation for temporary and permanent access roads construction, camp site and storage facilities, it will exacerbate soil erosion. It will therefore be the responsibility of the contractor to effectively handle erosion control measures. Focus should be given to work sites where soil is disturbed and its immediate environs during and after vegetation clearing.

d. Vegetation Clearing Monitoring

Unique patches of indigenous tree types should not be removed for this purpose. The Contractor's environmental inspectors should make sure that any unique and endangered tree species identified during the study should not be removed.

Monitoring rehabilitation of work sites, the contractor should ensure that areas used as temporary campsite for workers are progressively rehabilitated, as they are no longer required. Once a site is rehabilitated, it should be "signed off" by EEPCo's environmental staff.

e. Monitoring of Accidents

The contractor must make sure that appropriate signs are posted at appropriate locations /positions to minimize /eliminate risk of accidents /incidents and electrocutions.

In addition to this, the contractor should make sure that:

- Measures to create awareness regarding sexually transmitted infections (STIs), HIV/AIDS, and other such as malaria, schistosomiasis, leishmaniasis and onchocerciasis are taken,
- Preventive measures to reduce /eliminate malaria, schistosomiasis, leishmaniasis, and onchocerciasis infections where ever and whenever appropriate and measures are put in place,
- Periodic health survey should be carried out during the implementation period.

Monitoring Rehabilitation of Work Sites

The contractor should ensure that areas used as temporary campsite for workers are progressively rehabilitated, as they are no longer required. Once a site is rehabilitated, it should be "signed off" by EEPCo's environmental staff.

f. Monitoring Responsibilities

EEPCo will have an overall responsibility to oversee that all environmental measures are put in place and that regulations are enforced. The construction consultant should assist EEPCo in this process in order to make sure that the contractor fulfills the environmental requirements. Some relevant stakeholders, like the Ministry of Water and Energy (MoWE), Federal or Regional EPA, ARCCH and other relevant sector ministries may also conduct joint monitoring as deemed necessary.

g. Monitoring Indicators

The following parameters could be used as indicators:

- Presence of posted visible signs.
- Presence of sanitary facilities at camp sites.
- Level of awareness of the community pertaining to danger /risk associated with drilling.

- Presence /absence of unique stands of indigenous trees in the proposed project site; and

- Accident /incident report records on actual accidents associated with the project and kept compiled with the help of local peasant association officials, teachers /students of local schools.

h. Social Monitoring

Social monitoring will be a continuous process. EEPCo will continuously monitor for any unforeseen impacts on the environment.

The actors in the monitoring process include:

- The EMT Environmental and Social experts of EEPCo (for planning and monitoring)

- Woreda Administration (for monitoring and evaluation)

- Project Affected Persons (PAPs')

Field visit by the Project Office expert shall be conducted at least once in a month. Woreda Administration will conduct their own monitoring, but when possible, this will be done together with Project Office and EMT.

(Please refer to Environmental and Social Clauses, Annex III)

Table 19:- Synthesis of Environmental Monitoring Matrix

Activity Phase	Resource	Environmental Components	Environmental Indicators	Weight Effect	Standardization	Location of the observations	Observation frequency
I: Pre- construction	Site survey	Forest in proposed project site	Plant damage	e	The width of the damaged plant area.	Areas around foundation pads and ponds	Once
	Land acquisition	The community's grazing land	Society complaint	b	The land acquisition is suitable with the rules.	Areas around foundation pads	Time before and after land acquisition
II: Construction	Labor, equipment and material mobilization	Workers' recruitment	Society complaint	D	Level of labor recruitment	Around and close to project site	Once every six month
		Air quality	Dust pollution	d	Air quality standard	Foundation pads and ponds close to residence	Once every six month
		Noise	Noise	b	Noise quality standard	Part of foundation pad and ponds close to residence	Once every six month
	Route clearance	Community's land	Plant damage	0	New land functions	Part of foundation pads and ponds close to residence	Once
III: operation	Electric power transmission	Free area (ROWs)	EMF	0	Free area according to the rules (Right off Ways)	Around the transmission line route	At the beginning of operations and every six months
	Maintenance	Society's plants	Plant damage	e	How many plants are damaged	Foundation pads and ponds close to residence	Once every six months
		Excavation activity	Land slide /erosion	e	How much erosion occurs	Foundation pad	Once every 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
c = Important
d = Fair Important
e = Less Important

O = No important

XII. ESTIMATED MITIGATION COSTS

Enhancement and mitigation Cost

The total budget cost for implementing the Environmental and Social Management/Mitigation Plan is estimated to be Birr 2,197,100.00 (USD 109,850.00**).** The total mitigation cost covers the cost for Environmental management, enhancement, environmental and social monitoring, procurement of IT equipment, monitoring equipment and vehicles for Environment Monitoring Team.

No	Items	Quantity	Method	Production Quintal/ha	Average unit price (Birr)	Estimated Total Cost (Birr)	Cost USD
1	**Tree plantation**		1ha	--	86,000.00	86,000.00	4,591.56
2	Water pipe and water distribution centre + cattle trough		For one kebele	--	2,000,000.00	2,000,000.00	100,000.00
	Sub total				2,086, 000.00	2,086, 000.00	104,591.56
	Monitoring and valuation						
1	Monitoring and evaluation		Lump sum	Lump sum		96,000.00	5,125.47
2	Valuation committee per diem		Lump sum	Lump sum		15,000.00	800.85
	Sub Total					111,000.00	5,926.32
	Total					2,197,100.00	109,850.00

- Exchange Rate: 1 USD≈ 20.00 ETH. Birr
- There is no land acquisition cost; land is a common property of the Nations, Nationalities and Peoples of Ethiopia (Article 49, 3 of the Constitution).

XIII. CONCLUSION AND RECOMMENDATION

a. Conclusion

The major environmental improving effect of this Project is the reduction of CO_2 emission for electricity generation using renewable geothermal energy as compared with other fossil-fired power generation.

The geothermal energy is considered clean energy for the following reasons:

- Emissions associated with generating electricity from geothermal technologies are negligible because no fuels are combusted.
- Geothermal power plants usually re-inject brine (spent geothermal fluids), eliminating impacts of pollution of surface and ground water resources, and
- Geothermal power plants can co-exist successfully with other land uses.

Furthermore, geothermal energy is considered to be renewable because the reservoirs are continuously being replenished. These sources are also sustainable which will replenish naturally into the future and faster than they can be used.

The proposed geothermal project has great significance in increasing the power supply of the country and the energy mix is an important factor where energy supply is dominated by hydropower generation.

The proposed geothermal development would encourage investors to invest in the country, ultimately creating more job opportunities. As a result, it will effectively enhance the income of the society, reduce production costs and increase the purchasing power of the consumer and contributes to poverty reduction effort of the government both at local and national level. Improved economy and availability of sufficient social services due to the development will rapidly change the way of life of the community.

Therefore, the proposed geothermal development project will have great contribution for the socio economic development at both local and national levels.

The study has also shown few potentially insignificant negative environmental and social consequences that the project activities are likely to induce. The negative impact of the project is on health and safety issues as well as the hot springs that are found within the project boundary. Mitigation measures have been recommended to address these problems.

No serious social impact is anticipated as there is no village near and around the project site.

The project should comply with national laws and the World Bank's environmental and social policies which seek to ensure that the geothermal resource development work does not adversely affect the environment and community resources.

With proper implementation of the Environmental and Social mitigation measures indicated in this ESIA, any adverse impacts induced by the project can be mitigated.

Cost for implementing the environmental and social mitigation is estimated to be Birr 2,197,100.00 (USD 109,850.00**).** The total mitigation cost covers the cost for environmental protection, prevention of malaria, environmental and social monitoring.

Provided the recommended mitigation measures and environmental management measures are effectively implemented during the implementation of the project, it can be concluded that the anticipated negative impacts will have low significance.

As the project move towards implementation, the following recommendations are given.

b. Recommendations

- The Project Office of EEPCo, shall make thorough follow-up, to make sure that Environmental Management Plan are properly implemented.

- The Project Office will be responsible for the inclusion of the Environmental and Social Clauses to the contract document and make sure that Health and safety Manual /method statement/ prepared and implemented during the implementation of the Project.

- The Project Office will make further consultation regarding hot springs that are found near the project area and which is considered as potential tourist attraction.

- Public consultation and disclosure plays an important role in enabling the public to participate in the planning and implementation of the project. It is very important that the public consultation process continue throughout the project implementation period and that local resident's feel that they are involved in the project and their views and concerns are being adequately considered as an input in the project planning and implementation process.

- Grievance resolution mechanism should be put in place to ensure that any unforeseen problems are addressed promptly and efficiently.

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