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Impacts of the Alalobad Geothermal Project on Wild Life

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ABSTACT

Geothermal energy is one of the most significant alternate sources of energy, with a much higher output of electricity production per MW of capacity as compared to wind or solar. It is created by harnessing geothermal energy from the earth. Resources of geothermal energy range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma. Geothermal energy produces no pollution, reduces our alliance on fossil fuels. It also results in significant cost savings as no fuel is required to harness energy from beneath the earth. These advantages make geothermal energy as one the best alternative energy source. It's clean and sustainable. Resources of geothermal energy range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma.

Ethiopia has potential of generating 10,000mw from Geothermal Energy. The Ethiopia Geothermal Sector Development Project (GSDP), with a funding of US$ 219 million, became effective on August 5, 2014 and is scheduled to close on June 30, 2020. The GSDP is being implemented by the Ethiopian Electric Power (EEP) in the role of Owner. The GSDP, in accordance with the original scope of work, was subdivided into four components.

Component 2 -Alalobeda Geothermal Site Development- includes the development of the geothermal resources in the Alalobeda prospect through the implementation of a program of drilling and testing of 4 deep wells. The Alalobeda prospect has been the object in the years 2014-2016 of a program of geoscientific investigations financed by the Government of Iceland through ICEIDA and NDF. This program was implemented by ELC Electroconsult and included geological, geochemical, gravimetric,electromagnetic and micro-seismic surveys.

This study aims to identify the impacts of the project on wild life and implementation mitigation measures concerning the impacts. Based on the environmental and social impact assessment report there are some wild animals which exist around the project area.this animals are also benifiary from the streams alalobad hot ground water steams.

Finally, the study will come up with a possible solution for the environmental management plan of the impact.

1. INTRODUCTION

The Alalobeda1 geothermal prospect is located in Dubti Wareda (district), Afar Regional State, in the NE part of Ethiopia, some 600 km NE of Addis Ababa. The prospect falls within the Tendaho Graben, a major structure 50 km wide, which extends in NNW-SSE direction. Two additional geothermal prospects are found within this graben, namely Dubti, also called Tendaho, 20 km to the NE, and Ayrobera, 30 km to the NNE.

The Ethiopia Geothermal Sector Development Project (GSDP), with a funding of US$ 219 million, became effective on August 5, 2014 and is scheduled to close on June 30, 2020. The GSDP is being implemented by the Ethiopian Electric Power (EEP) in the role of Owner. The GSDP, in accordance with the original scope of work, was subdivided into four components. This report refers to component n.2, Alalobeda Geothermal Site Development, which includes the development of the geothermal resources in the Alalobeda prospect through the implementation of a program of drilling and testing of 4 deep wells.

In consideration of the clear indications derived from the surface exploration and of the opportunity to speed up the development of the Alalobeda resources, it was suggested to proceed with the underground exploration by drilling full-size wells, which may be fully tested and can be in principle exploited for feeding on a temporary basis a 2-3 MW portable back-pressure turbine.

Six potential well sites have been identified and a drilling strategy outlined, to be implemented in accordance with the results progressively acquired from the wells, although the location of the initial two wells is fixed.

This Project is large scale one and it is located in an area that represents a reserve of water and livelihood for local communities and ecosystem and that may be irreversibly affected by the drilling activities.

The geothermal area characterized by the manifestation of hot water ponds which become source of drinking water for wild animals after it become cooled. Some of the wild animals observed at day time and some at night to drink the water from the cooled ponds.

The local people has belief that the water has some kind of medicinal value for their domestic animals so they pass by the manifestation of the ponds 500 cattle’s per average per day.

2. STATEMENT OF THE PROBLEM

Geothermal energy is renewable and clean compared to other energy source, has less impact on the environment and social surrounding. In Ethiopia using this alternative source of energy is important for the sustainable growth of the country.

Geothermal energy in its stage of exploration and drilling has impacts on the it's surroundings, especially on the environment starting from the plants most of Green plants is not adoptable to the hot water which is the result of the manifestation of the fumaroles, similarly it does have its own impact on the animals too.

Alalobad area found in afar region, Ethiopia, the area is resourceful with geothermal energy as it is indicated in its exploration study report. But apparently the area is also resourceful with the wild animals and also used as a source of a drinking water from the manifestation of the fumaroles of the steam. In alalobad the wild animals appear at night around the manifested hot water for drinking because at day time there are cattles and herders passing by the hot waters.

During the drilling process starting from the clearance of land will cause habitat loss and feeding ground, fragmentation of ecosystems on the environment though the significance might be low considering the area being used might be small. But for terrestrial wildlife and mammals the noise impact is significance because they are highly sensitive to the change in the environment.

The noise can be generated by different activities including excavation process, transportation and by the construction works. In addition emissions of dust gases from those activities are obvious depending on the construction works.

While compared to other source of energy the environmental impact of the geothermal energy is favourable because can be mitigated easily through applying environmental regulations and standards, though the probability of high risk impacts are low in geothermal plants.

2.1 Objective

2.1.1 Main objective

The general objective of the research is to assess the impacts of the Alalobad Geothermal drilling project on the wild animals.

2.1.2 Specific objective

- ✓ To understand the impacts of the drilling project on the wild project.
- ✓ To identify and recommend mitigation measures for the existing impacts.

2.2 Scope of the study

The study covers from assessment of impacts of the Alalobad drilling project on the wild animals, to understand existing problem concerning wild animals and to recommending mitigation measures.

2.3 Significant of the study

This study is expected to increase to acknowledge and up to date information for individuals who are interested to study further on habitation, feeding of the wild animal's status in study area. Mainly the output of this study data for any interested body, especially researchers who need to deal in the same area. Generally the result will be used for decision making for related development activities that are carried out in the study area furthermore. It will help to draw possible suggestions and recommendations in order to improve for the sustainable existence of the wild animals in the area.

3 LITERATURE REVIEW

3.1 Geothermal energy and the environment

Geothermal energy has been used for centuries throughout the world. Recently, because of a push to diversify forms of energy away from fossil fuels, geothermal energy has been researched and utilized to great effect. Geothermal energy is power derived from the earth's own internal heat. This heat, or thermal energy, is contained within the earth's rocks and in the fluids and water that are under the crust of the earth. Geothermal energy can be found at varying depths from the surface, from fairly shallow reservoirs to very deep ones. The hottest depository of heat is the molten rock or magma. Because it is clean and renewable, geothermal energy is being promoted as one of the best alternatives to fossil fuels. [Luis D. Berrizbeitia,2014].

Geothermal energy utilization as an energy alternative source is gaining momentum in both developed and developing countries around the world in the age of higher environmental awareness. Though biological and physical impacts of geothermal siting are well understood, socioeconomic impact is still an unknown quantity. In order for geothermal energy to achieve popularity, as a renewable energy alternative, there is need to clearly identify the social and environmental impacts of its development.

This is achievable through environmental and social impact assessments/monitoring from project initiation to operation phase. The integration of social concerns into the decision making, planning and management of any geothermal project is required by international agreements/protocols, national laws, policies of bilateral agencies and international financing institutions. Including the cost of social and environmental benefits in the overall project cost would be one way of enhancing the competitiveness of geothermal energy against other alternative sources.[.[Pacifica F. Achieng Ogola,2005]

3.2 Legal frame work and legislation

Clear energy and environmental policies and regulations are of paramount importance for the development of renewable energy sources. The institutional framework, legislation and legal constraints are borderlines to delimit development, especially in view of environmental protection. Within these limits there should be unequivocal administration of law. In reality, governments often lack clear energy policies and environmental policy does not address energy sources but rather the mitigation of their effects. Geothermal energy in general and geothermal resources in particular, are usually not well defined in legal terms, and the regulation of their development and utilisation is correspondingly diffuse. In many countries, the geothermal resources are dealt with in the Mining Law whereas the production of geothermal fluids from the subsurface is regulated by Water Protection legislation. This implies that responsibilities are assigned to different Ministries, with often limited cooperation and interaction between them.

According to the environmental impact assessment Law and related regulations, the need for an EIA is determined by the scale of the planned project. However, assessment is required for a small to medium project as well, if the project is expected to have great impact on the environment. In case of geothermal projects, although the range of adverse impacts is low but most scientists consensus that the EIA report and monitoring is needed for the sustainable development. Generally, studies of physical, chemical, biological and socioeconomic impacts are carried out for an EIA. [Hossein Yousefi SAHZABI1 and Sachio EHARA]

There is a debate as to whether geothermal resource development and wildlife conservation are compatible. The Olkaria power plants located in Hells Gate National Park are a classic example of such compatibility of the two land uses. This area was gazetted as a park in 1984 after construction of the Olkaria I power plant. This has been perceived as the best decision made by the conservationists at that time in view of the fact that the area was going to be opened up following the construction of a power plant. Since then, Kenya Wildlife Service (KWS) and KenGen developed a Memorandum of Understanding (MoU) to govern geothermal power operations within the park. The MoU also covers Orpower 4 (an independent power producer). The KWS and KenGen are currently working on the revision of the MoU following the commissioning of Olkaria II in 2004, which is also within the same park. The main concerns of the Kenya Wildlife Service and other conservationists include; effluent disposal, emissions, animal accidents (traffic), loss of habitat, harassment of animals, blockage of seasonal animal migration routes, noise and odour. In order to minimize impacts caused by geothermal development activities in the park, several studies have been carried out. These studies include the establishment of animal migratory routes, breeding grounds, tourist circuits and protected plants and wildlife species. The plant operations have maintained conservation of unique scenic features and wildlife species within the park.

Steam pipelines on major animal routes were looped to provide easy movements for the wildlife such as giraffes within the park. High voltage lines and silencers are a potential danger to birds and as such they were constructed to avoid right angle crossing of known bird flying routes. To avoid animal accidents in the park, a speed limit of 40km/h is observed while game-proof fencing is used to keep the animal away from brine pools.

The ownership of resources in the ground is attached to a private land, while on public land resources in the ground are the property of the State of Iceland, unless others can prove their right of ownership. Even though the ownership of resources is based on the ownership of land, research and utilisation is subject to licensing according to the Act on Survey and Utilisation of Ground Resources, No. 57/1998 (Resource Act) and the Electricity Act, No. 65/2003. Survey, utilisation and other development pursuant to these Acts are also subject to the Nature Conservation Act, Planning and Building Act, Environmental Impact Assessment Act and other Acts relating to the survey and utilisation of land and land benefits.[Ketilsson et al.,april 2015].

In Germany, the geothermal energy use is mainly in small plants (ground-coupled heat pumps, commonly for individual space heating), with 400 MWt installed capacity, in addition to larger plants (district heating systems) with 65 MWt. Balneological or agricultural use is not reported. Laws exist both on the federal level (Bund) and on the state level (Länder). Geothermal energy in Germany is governed by the Federal Mining Act (Bundesberggesetz, or BBergG for short). According to § 3 BBergG, geothermal energy is not a property of the land owner, but belongs to the federal administration (bergfreier Rohstoff). Exploration and exploitation of these kinds of resources, like coal, various types of ore, oil, or natural gas, are regulated by the authorities and granted to an applicant, usually with a certain regular payment to be made according to the amount of the resource exploited (Förderzins). However, for geothermal energy, because of the still poor economics and the wish to foster environmentally benign energy, a royalty payment is not required.[IGC,2003]

3.3 Geothermal developments around the world

Geothermal resources are not distributed evenly around the globe, and certain regions are blessed with resources while others are relatively barren. It is not surprising that the ten leaders in generating electricity from geothermal resources are in areas of active volcanism.

Geothermal utilization is commonly divided into two categories, i.e. electricity production and direct application. Conventional electric power production is commonly limited to fluid temperatures above 180°C, but considerably lower temperatures can be used with the application of binary fluids (outlet temperatures as low as 70°C). The ideal inlet temperatures into buildings for space heating is about 80°C (Fridleifsson et al. 2008), but by application of larger radiators in houses, or the application of heat pumps or auxiliary boilers, thermal water with temperatures only a few degrees above the ambient temperature can be used beneficially. There are quantified records of geothermal utilization in 72 countries. Electricity is produced from geothermal energy in 24 countries. Geothermal energy generally makes a small contribution to the energy needs of the major developed countries but makes a significant contribution in a number of developing countries, including the Philippines, Mexico, Indonesia, El Salvador and Kenya (Yousefi et al. 2007).

Geothermal systems commonly produce hot springs and fumaroles as surface expressions of underlying hot reservoirs. Hot and mineral springs have been valued for their therapeutic qualities. Hot springs and fumarole areas have been exploited for sulfur and other minerals. During the middle Ages, the commercial value of Italian hot spring deposits led to wars among local republics. Electricity was first produced from a steam well at Larderello, Italy, in 1904, and commercial electricity was first marketed in 1913. Since that time, geothermal power has been developed by many countries as an alternative to burning imported or domestic fossil fuels

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Geothermal energy is a source of electricity generation worldwide. Currently geothermal power supplies energy needs in more than 24 countries and most of the energy needs in Iceland (2, 3). The United States is the world's largest producer of geothermal energy, with a current capacity of 3,093 megawatts (MW). The largest geothermal development in the world is located at the Geysers north of San Francisco, in Sonoma County, California. The second largest producer of geothermal energy is the

Philippines which produces 1,904 mega watts per year. Indonesia is also a primary producer of geothermal energy producing 1,197 mega watts of energy. Like the west coast of the United States, Indonesia and the Philippines are located along the ring of fire making them very suitable countries to harness the potential geothermal energy that lies beneath them. Mexico, Italy, New Zealand, Iceland and Japan follow (4). The total world production is 10,715 MW in 24 countries (5) In the United States geothermal generation is the largest of any other country in the world amounting to more than 3,000 megawatts in eight states with 80% of this capacity in the State of California which derives 5% of its electricity needs from geothermal plants (2).

Geothermal power is considered a cost effective, reliable, sustainable, and an environmentally friendly alternative to fossil fuels. Because of its dependence on areas of heat transfer that are accessible from the earth surface geothermal plants have usually been located in the vicinity of tectonic plate boundaries.[Luis D. Berrizbeitia2014]

4. MATERIALS AND METHODS

4.1 Description of the study area

4.1.1 Physical environment

The Alalobeda18 geothermal prospect is located in Dubti Wareda (district), Afar Regional State, in the NE part of Ethiopia, some 600 km NE of Addis Ababa. The prospect falls within the Tendaho Graben, a major structure 50 km wide, which extends in NNW-SSE direction.

The project site is characterized by flat land in the northern part and hills and valleys in the southern part. Soil analysis carried out on surface soil samples, collected at a depth of 0-20 cm inside the project area (Dubti Plantation) appeared to have low contents of organic matter and nutrients.

Fig 1

The soil is essentially alkaline with a good cations exchange capacity owing to the high clay content. It consists of sand 50.7%, silt 19.1%, and clay 30.2% (Aquater, 1996).

Under the geothermal exploration project and cooperation with Ethiopia, GSE and EEP, a surface exploration study has been carried out in the Tendaho Alalobeda Geothermal prospect, by ELC Electro consult. The immediate objective of the study was to define four potential drilling targets and well design based on the conceptual model developed under agreement for exploration drilling stage of Alalobeda geothermal System.

This study refers only to the activities related to the Drilling of Geothermal Wells in Alalobeda Site, it includes the development of the geothermal resources in the Alalobeda prospect through the implementation of a program of drilling and testing of 4 deep wells. Eight potential well sites have been identified and a drilling strategy outlined, to be implemented in accordance with the results progressively acquired from the wells, although the location of the initial two wells is fixed. Proposed wells are either vertical or directional and have a vertical depth of approximately 1,850 m, with the aim to penetrate into the reservoir some 800 m. The objectives of such drilling program can be summarized as follows: To successfully drill and complete 4 wells at Alalobeda using one drilling rig.

- To properly log and test the 4 drilled wells and manage the production and reinjection operations.
- To use best drilling practices, to ensure safe working conditions and provide protection for the environment.

- To conduct all drilling, completion and testing activities in such a manner as to achieve highest possible efficiency and prudent usage of equipment and consumables.
- To maintain a close working relationship between the company and its staff and the staff and contractors of EEP.

It should be underlined that boron content is higher than the average value recorded in Ethiopia, which is normally in the range of 0.2-1 ppm. Also chloride and arsenic values of the soil are high.

Earthquake occurred in central Afar in March and April 1969 with a maximum surface wave magnitude of 6.3 and destroyed the town of Serdo (about 40 km from the studied area). Others earthquakes (MS 5.5-6.5, MS 4.5–5.5 and hundreds of smaller events) occurred in August 1989 with epicentres located some 100 km away from the studied area.

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 Alalobeda geothermal exploration field is designated as a hot zone. Daytime conditions are torrid, and daily temperatures vary significantly. Although the hot zone's average annual daytime temperature is about 27°C, mid-year readings in the Alalobeda area often soar to more than 40°C. The moisture content of the air through most of the year is very low.

4.1.2 Biological environment

A total of 78 bird species within 41 families were detected during the field activities and by means of literature consultation (scientific papers and reports). Part of the birds' species that are present in the project area (namely 11 species) are migratory from Europe.

During the survey and by means of scientific and report literatures, has been defined 79 species of birds and 11 species of mammals that stand on or transit in the project area. About the birds, 76 species have to be considered species of Least Concern (IUCN). Among the remaining, the Neophron percnopterus and the Necrosyrtes monachus (Vulturidae), are considered Endangered (at different grade) whereas the Necrosyrtes monachus is Critically Endangered.

Fig 2 Gazella soemmering

Regarding the mammals, within the 12 species recognized, two of these (Gazella soemmeringi and Gazella dorcas) are Vulnerable according to IUCN vulnerability level. The species Hyaena hyaena is considered Threatened. The other species are of Least Concern.

5. MITIGATION MEASURES

5.1 Environmental Management and Monitoring Plan

The main purpose of the Environmental and Social Management and Monitoring Plan (ESMMP) is to specify the measures to mitigate the environmental and social impacts identified in this Environmental Impact Assessment of the Alalobeda Geothermal Prospect. Some impacts will be mitigated through the application of proper mitigation actions or management measures, other aspects of project implementation shall be controlled and monitored. Experience has shown that a monitoring program is essential to incorporate the protecting measures in the planning stages and to implement them in construction and operation stages. Moreover, monitoring is necessary to assess the actual effects of the project on the environment compared to the projected ones, to

identify immediate protection measures, to offset the negative effects and to propose their implementation to the decision makers. Monitoring provides a very useful feedback, which permits to correct any environmental problem due to the project at the right moment, meanwhile acquiring experience in planning future projects.

The monitoring program shall indicate where changes to procedures or operations are required, to reduce impacts on the environment. This ESMMP is addressed to the Client as tool to control the project environmental performances and will serve as set of guidelines/requirements to be included in the bidding documents for the selection of contractors who will have to define, quote and implement their own specific ESMMP. Contractor ESMMP shall be submitted to the Client for approval prior the commencement of any activities at site and revised any time site conditions change.

It is assumed that these plans will be elaborated by the Client to complement its existing Environmental, Health and Safety Management System specifically for the Project. Where relevant and under respective contracts, drilling contractors should be required to implement corresponding arrangements.

- Some of the environment Management could be
    - ✓ Biodiversity management should be approached to protecting and preserving them by minimizing impact on features of ecological value focusing on the wild animals
    - ✓ Development of wild life monitoring plans
    - ✓ Minimize illegal hunting around the project areas
    - ✓ Prevention and safe disposal of waste

6 SOCIO ECONOMIC SETTINGS

The project area is free from settlements. Awash irrigation dam and Tendhao Sugar cane factory are the main infrastructures in the surroundings (See Annex A). Two settlements are linked to the project area: Gurmudale and Hayideru kebeles. These two kebeles are actually combined together and demographic data in this report are presented together. Population is main pastoralist or agro pastoralist. The Awash River is the main source of water for livestock, domestic purposes and irrigation. There are both large-scale government state farms and investor farms. Tendaho sugar cane and Middle Awash Agriculture Development farm are the main state farms providing casual employment opportunities to the local community and immigrant workers.

Dubti woreda hosts a total population of 65,342 of which 34,893 are male whereas the remaining 30,449 are female. The number of males outnumbered the number of females. Almost an equivalent number of people live in rural and urban areas. Dubti is the second highest urbanized woreda next to Awash Fentale71. There is a total of 31 regular schools across Dubti woreda, 21 schools are grade 1 to 4, whereas the remaining 10 are grade 1 to 8. There is a total of 6,357 students, 2,712 (42%) of which are female.

Project site Kebele – Gurmudale and Hayideru - hosts only 2 schools of first level cycle with 144 students.The total population of Gurmudale and Hayideru kebele is 3,393 of which 1,688 are male and the remaining 1,705 are female.

There are different levels of health facilities in Dubti Woreda. One hospital is in Dubti woreda. Three health centers are in different parts of the Woreda. In addition, there are 12 health posts in different kebeles of the woreda. According to the information from woreda health office only 10 of the 12 health posts are currently functional. The health post at Gurmudale and Hayideru unfortunately is one of the two non-functional health posts. According to the health office of the woreda, the health coverage in Doubti Woreda was indicated to be 83 %.It has been also reported that it takes more than 1 hour to fetch water for the community set closer to the river and the time of fetching water goes up to 4 hours round trip for community that live furthest. The community of Gurmudale and Hayideru should travel 1 and half hour to access geothermal water pond in Alalobeda. As per Afar National Regional State Socio Economic Study, households who have access to water pipe as major water source is 1% of the households in Dubti Woreda indicating distribution of pure water supply is almost nil75. Housing unit in Project Kebeles is mainly characterized by mobile houses. This type of house is traditionally known as Dihbora, it is usually made of light and cheap materials including light flexible woods, plastic, carpet made of grasses. Toilets do not exist in the Kebele. The water source for household consumption is exclusively dependent on Awash River. There is no an improved water source. As a result, people directly use the water from Awash River which is potentially hazardous to human health since it is untreated. The community of the project Kebele rely on livestock. According to a small community interview, all interviewees rear animals and very few practice some sort of farming. The farming practice is also mainly a recent phenomenon as part of villagization program. Goats, sheep and camels are the major livestock owned and reared by each family unit. These livestock fulfil milk and meat needs of households. The expenses for purchasing cereals are also basically covered by the money acquired through livestock selling. There are few NGOs in Dubti woreda. These are GIZ, Save the Children, and Farm Africa. They support the community mainly in livelihood improvement.

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