INTEGRATION OF ENVIRONMENTAL ASSESSMENT IN GEOTHERMAL RESOURCE DEVELOPMENT PROCESS: A CASE STUDY OF OLKARIA GEOTHERMAL FIELD

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ABSTRACT

Geothermal energy is considered clean in comparison with other sources of energy like coal and diesel due to minimal emission of greenhouse gases into the atmosphere. Despite this advantage, exploitation of geothermal resources has the potential of generating environmental and social impacts. This paper attempts to discuss the significant role of Environmental Assessment in informing decisions pertaining to sustainable development of geothermal resources at Olkaria Geothermal field. The paper focuses on how Environmental Impact Assessment (EIA), Social Impact Assessment (SIA) and Strategic Environmental Assessment (SEA) have been applied from the time the first power plant was constructed in 1981 up to date. The author has highlighted lessons learnt and proposed appropriate recommendations to fill the gaps. The findings will go along way towards enhancing the quality of environmental assessment studies at Olkaria and other geothermal fields.

Key words: *Olkaria, Environmental Assessment, Geothermal Resource, Sustainable Development.*

1. INTRODUCTION

In many countries, before energy projects are implemented, Environmental Risk and Impact Assessment activities are mandatory. The type, scale, and location of a project guides the scope and level of effort devoted to the risk and impact identification process (IFC, 2012). Although geothermal energy is considered a clean source of energy, its exploitation is accompanied with environmental and social impacts that need to be identified and managed from the early stages of resource development (ESMAP, 2012). Sound environmental management is needed to ensure that the benefits of geothermal projects are maximized and the negative impacts are avoided or minimized on an ongoing basis during the life of the project. Environmental Impact Assessment (EIA), Social Impact Assessment (SIA) and Strategic Environmental Assessment (SEA) are a basket of critical planning tools used for managing risks and impacts associated with geothermal resource exploitation in various countries endowed with the resource. In most of these countries, application of these tools is a mandatory legal requirement.

The major goal of the Government of Kenya is to have sustainable supply of affordable and appropriate energy to spur socioeconomic development by the year 2030. Geothermal energy resource provides a solution to this problem by acting as a stable source of base load energy (Government of Kenya, 2007). KenGen currently owns four conventional geothermal power plants at Olkaria Geothermal field located in Naivasha subcounty. The company has been undertaking stepwise development of the geothermal resource from 1970s. The overall objective of this paper is to discuss how KenGen has been able to integrate EIA, SIA and SEA into the development process at Olkaria Geothermal field. The specific objectives are to:

i. Discuss the general procedure of carrying out Environmental Assessment in Kenya;

ii. Conduct a desktop study of the existing Environmental Assessment reports for geothermal energy projects at Olkaria Geothermal Field;
iii. Identify existing gaps in carrying out Environmental Assessment for geothermal projects at Olkaria and
iv. Recommend appropriate measures to address the gaps.

Good quality Environmental Assessment study reports have an advantage of contributing towards development that is sustainable by optimizing resource use and sound environmental management opportunities.

2. BACKGROUND OF THE STUDY

2.1 Overview of Environmental Assessment

The growing acceptance of sustainable development as an over-arching policy goal has stimulated interest in assessing the impact of particular interventions on sustainable development at aggregate, sectoral or project levels (Centre for Good Governance, 2006). Table 1 provides a summary of the levels of decision-making in environmental assessment.

Table 1: Levels of Decision-Making in Environmental Assessment (Partidario, 2003)

Level of Decision-Making	Description
Policy	Road-map with defined objectives, set priorities, rules and mechanism to implement objectives.
Planning	Priorities, options and measures for resource allocation according to resource suitability and availability, following the orientation, and implementing, relevant sectoral and global policies.
Programme	Organized agenda with defined objectives to be achieved during programme implementation, with specification of activities and programmes investments, in the framework of relevant policies.
Project	A detailed proposal, scheme or design of any development action or activity, which represents an investment, involves construction works and implements policy/planning objectives.

Resource development brings change in the sense that projects have the potential to negatively impact the environments, communities and economies overlying and surrounding developments. Conversely, projects can also bring opportunities through the conversion of the natural resource into financial resources, the development of social capacities and skills, infrastructure and business development, and the investment of those resources into environmental and social programs (Franks, 2012). The process of risk and impact identification may comprise a full-scale environmental and social impact assessment, a limited or focused environmental and social assessment, or straightforward application of environmental siting, pollution standards, design criteria, or construction standards (IFC, 2012).

2.2 Types of Environmental Assessment Tools

SEA, EIA and SIA are the key planning instruments used to anticipate, manage and respond to environmental, social and health risks of particular interventions on sustainable development. SEA is required for policy, plans and programmes whereas EIA and SIA are required for projects.

2.2.1 Definitions

SEA is a strategic framework instrument that helps to create a development context towards sustainability, by integrating environment and sustainability issues in decision-making, assessing strategic development options and issuing guidelines to assist implementation (Partidario, 2012). SIA is the process of analyzing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions (Vanclay, 2003). It focuses on the human dimension of environments, and seeks to identify the impacts on people who benefits or loses (Centre for Good Governance, 2006). EIA on the other hand is the umbrella term for the process of examining the environmental risks and benefits of project-level proposals (NEMA, 2012).

2.3 Objectives of Environmental Assessments

SEA, in a strategic thinking approach, has three very concrete objectives (Partidario, 2012):

i. Encourage environmental and sustainability integration (including biophysical, social, institutional and economic aspects), setting enabling conditions to nest future development proposals;
ii. Add-value to decision-making, discussing opportunities and risks of development options and turning problems into opportunities and
iii. Change minds and create a strategic culture in decision-making, promoting institutional cooperation and dialogues and avoiding conflicts.

According to International Association for Impact Assessment (IAIA) 1999, the specific objectives of carrying out EIA are to:

i. Ensure that environmental considerations are explicitly addressed and incorporated into the project development decision making process;
ii. Anticipate and avoid, minimize or offset the adverse significant biophysical, social and other relevant effects of development proposals;
iii. Protect the productivity and capacity of natural systems and the ecological processes which maintain their functions; and
iv. Promote development that is sustainable by optimizing resource use and management opportunities.

2.4 General EIA Procedure

In some countries, the word “environment” is interpreted in its broadest context comprising all dimensions of the environment (social, biophysical, economic, political, cultural, governance, etc) whereas in others the interpretation is narrower, equating mainly to the biophysical elements of the environment. In such cases, the social environment is viewed separately. These interpretations are relevant as they lead to two different approaches to SIA. In the case of the former, SIA becomes a study within a larger EIA, while, in the latter, SIA takes on the proportions of an EIA (ACER, 2007). Many international project financiers like World Bank, European Investment Bank (EIB), and KfW Development Bank require integration of SIA into EIA as part of their standard procedure for financing projects thus the name Environmental and Social Impact Assessment (KfW, 2012, EIB, 2013 and IFC, 2012). ESIA is the process of identifying, predicting, evaluating a project’s positive and negative environmental and social impacts on the biophysical and human environment as well as identifying ways of avoiding, minimizing, mitigating and compensating, including offsetting in the case of the environment and remedying in the case of social impacts, by applying the mitigation hierarchy (EIB, 2013).

EIA standards differ between countries because natural conditions and emphasis are different, but generally they are based on the United States (U.S) model (Hongying, 2000). The steps followed when carrying out EIA are similar across many applications and include (UNEP, 2006):

i. Screening;
ii. Scoping;
iii. Impact and risk analysis;
iv. Mitigation and impact management;
v. Reporting to catalogue and track the results of EIA;
vi. Review of EIA report and decision making; and
vii. Implementation and follow-up.

Screening is the preliminary appraisal, done to determine the environmental and social relevance of a project whereas scoping is the process of defining the scope of the assessment, where the project has been found to be environmentally and/or socially relevant, in order to identify and assess the project's environmental and social consequences and risks more accurately (KfW, 2014). Stakeholder engagement is the basis for building strong, constructive, and responsive relationships that are essential for the successful management of a project's environmental and social impacts (IFC, 2012). Involving affected communities and other stakeholders in the analysis of impacts and in the planning of mitigation and benefit strategies is essential since it enables the project to gain a social licence to operate (Vanclay et al, 2015). Stakeholder involvement/participation in environmental assessment aims to provide a process of improved decision-making whereby interested and affected parties, technical specialists, authorities and the project proponent work together to produce better decisions than if they had worked independently (ACER, 2007). The general EIA procedure is provided in figure 1.

As part of impact and risk identification process, the EIA study should collect and provide, at a minimum, the following information (EIB, 2013):

i) the project description, including the physical characteristics of the whole project and, where relevant, its area of influence, during the construction and operational phases;
ii) a description of the location of the project, with particular regard to the environmental sensitivity of the geographical area likely to be affected and social aspects;
iii) a description of the environmental and social aspects, including impacts on human rights, likely to be significantly affected by the proposed project;
iv) an analysis of the communities likely to be impacted by the project, and of other relevant stakeholders of the project;
v) an assessment of the likely significant effects of the proposed project on the environment, population and human health resulting from: (a) the expected residues, emissions and the production of waste, (b) the use of natural resources, in particular soil, land, water, and biodiversity, including any hydromorphological changes, (c) any expropriation, land acquisition and easements and/or involuntary resettlement of people and likely restrictions on access to land, shelter and/or livelihood and subsistence strategies;
vi) a description and justification of the measures foreseen to avoid, prevent or reduce any significant adverse effects on the environment, human health and well-being.

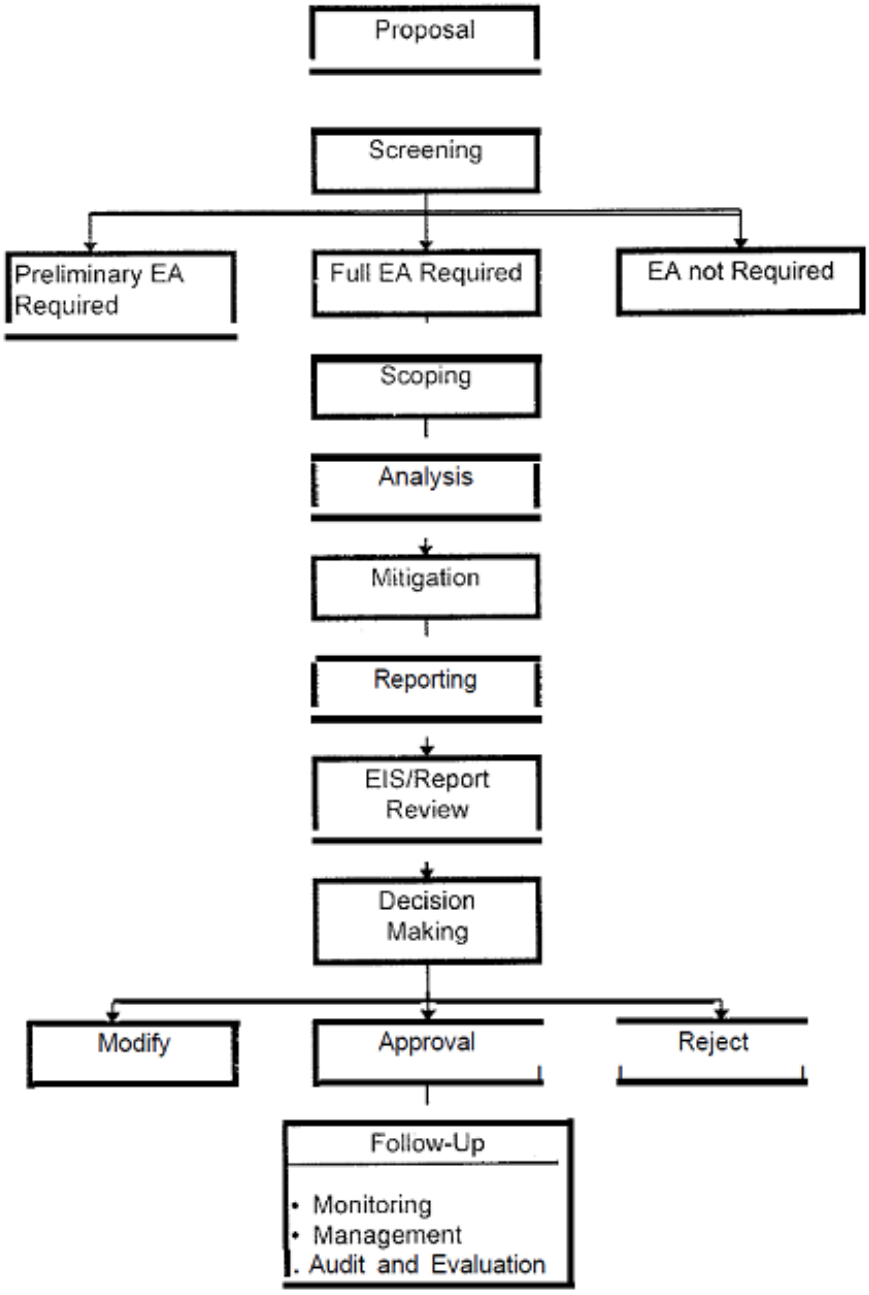

Figure 1: General EIA Procedures, (Sadler, 1996)

The management actions arising from EIAs are usually defined and translated into an Environmental and Social Management Plan (ESMP) for the design, construction, operation and/or decommissioning phases of a project. The ESMP documents key environmental and social impacts and risks, and the measures to be taken to address them adequately following the mitigation hierarchy (EIB, 2013). Thus, the ESMP is expected to:

i) prevent the negative impacts that could be avoided;
ii) mitigate the negative impacts that could not be avoided but could be reduced;
iii) compensate/remedy the negative impacts that could neither be avoided nor reduced; and
iv) enhance positive impacts.

Enhancing benefits covers a range of issues, including: modifying project infrastructure to ensure it can also service local community needs; providing social investment funding to support local social sustainable development and community visioning processes to establish strategic community development plans; a genuine commitment to maximizing opportunities for local content (i.e. jobs for local people and local procurement) by removing barriers to entry to make it possible for local enterprises to supply goods and services; and by providing training and support to local people (Vanclay et al, 2015). Where people are resettled to enable a project to proceed, it is essential to ensure that their post-resettlement livelihoods are restored and enhanced.

3. INTEGRATION OF ENVIRONMENTAL ASSESSMENT INTO GEOTHERMAL RESOURCE DEVELOPMENT

Environmental assessment is required as part of regulatory approval processes for development of geothermal resources in most of the countries endowed with the resource. Baba, 2003 did a comparison of application of EIA in development of geothermal resource in Germany, El Salvador, Iceland, Indonesia, Italy, Japan, Kenya, New Zealand, Philippines, Turkey and USA. Ármannsson, 2014 discussed step-by-step EIA for the proposed Bjarnarflag power plant in Námafjall, NE Iceland from 1995 to 2003. Hongying, 2000 also examined application of EIA in development of geothermal resources in China in comparison with Italy, USA, UK, New Zealand, Philippines and Iceland. Haraldsson, 2011 wrote a paper on the need and approach for environmental monitoring of geothermal power plants during operation phase. Mwangi, 2005 mentioned in his report about the history of EIA process at Olkaria Geothermal field. Geothermal projects generally go through the overall process of exploration, development and operation as summarized in figure 2.

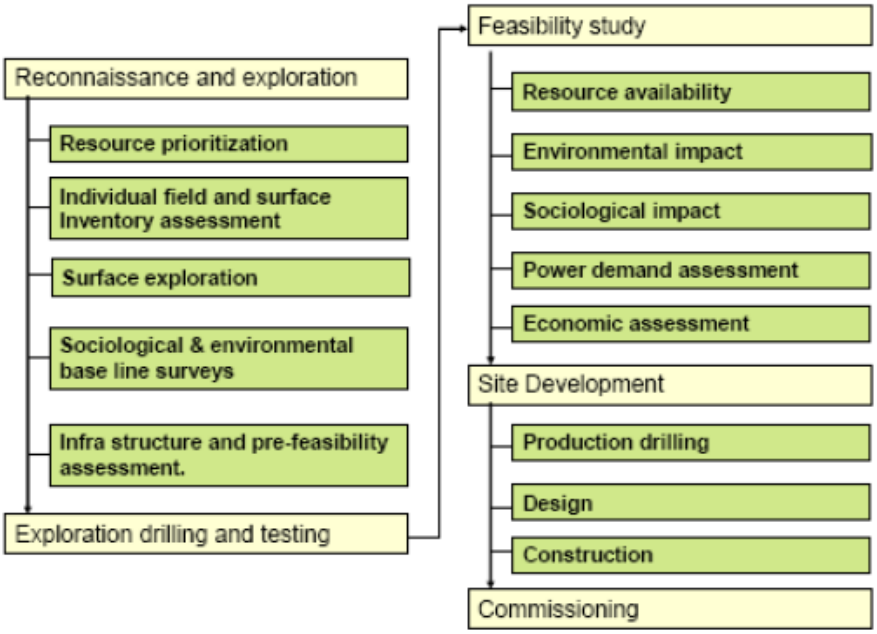

Figure 2: Schematic Flow Diagram for Geothermal Energy Development (Steingrimson, 2009).

Haraldsson, 2011 observed that the greatest impacts are brought about during the design and construction phase, when the local environment in the geothermal field and at the power plant site may change significantly with the clearing of land and the construction of man-made structures, when wells are being flow tested and the economic and social effects of the power plant are felt most profoundly in the neighboring communities. This observation justifies the need for carrying out environmental assessment prior to site development. Figure 3 below provides hypothetical relative degrees of the environmental impacts of the different phases of geothermal resource development.

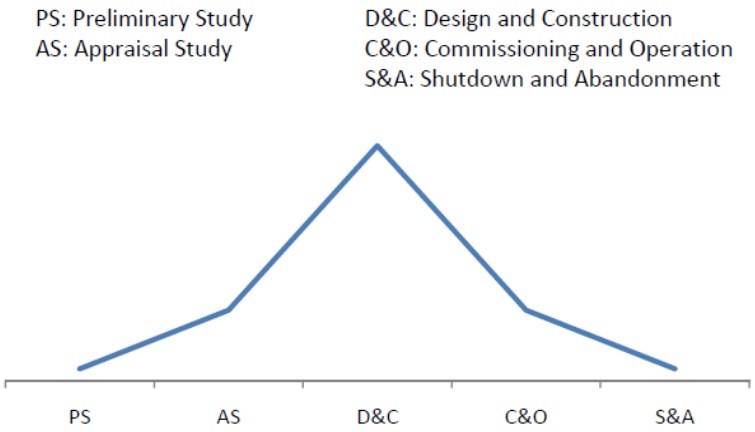

Figure 3: Relative Degrees of Environmental Impacts of Different Phases of Geothermal Development (Haraldsson, 2011)

Sahzabi and Ehara (2007) concluded that in order to develop a sustainable geothermal energy resource, it is highly recommended to accomplish a standard format of geothermal EIA process to the program before starting exploration drillings. However, stakeholder involvement should commence at the reconnaissance phase especially where the geothermal resource boarders local communities.

4. ENVIRONMENTAL ASSESSMENT IN KENYA

4.1 Brief History

The country's commitment to environmental management has been demonstrated through various initiatives. Key among them was the establishment of the National Environmental Secretariat (within the Ministry of Environment and Natural Resources) in 1972 to coordinate environmental activities within Kenya and the adoption of Environmental Management Policy in 1979 (Baba, 2003). The requirement for National Development Plans from 1974 and Environmental Action Plan from 1994 to address environmental issues are other initiatives. EIA as a regulated process in Kenya commenced in 2002 following the establishment of National Environment Management Authority (NEMA) as a vehicle for implementing the Environmental Management and Coordination Act (EMCA), 1999 (NEMA, 2005).

4.2 Applicable Legal Requirements

4.2.1 The Geothermal Resources Regulations, 1990

The Geothermal Resources Regulations of 1990 is a subsidiary legislation to the Geothermal Resources Act No. 12 of 1982. According to clause 3 of these Regulations, any person who is to be issued with a license to develop a geothermal resource for commercial exploitation is required to submit to the Energy Minister the following:

- Proposals for the prevention of pollution, the treatment of wastes, the safeguarding of natural resources, the progressive reclamation and rehabilitation of lands disturbed by prospecting or production operations and for the minimization of the effect of such operations on adjoining or neighbouring lands; and
- a statement of any significant adverse effect which the carrying out of production operations would be likely to have on the environment and proposals for controlling or eliminating that effect.

The requirement of the above regulation implies that prior to the enactment of EMCA, 1999 all geothermal resource project developers were required to assess the potential impacts associated with

geothermal resource development and put in place adequate measures to promote environmentally sustainable development. The only shortcoming with this requirement was failure to incorporate stakeholder participation in the process of identification of environmental and social risks as is currently stressed by EMCA, 1999.

4.2.2 Environmental Management and Coordination (Amendment) Act, No. 5 of 2015

This is an act of parliament to amend EMCA, 1999 which is the legal framework for managing the environment in Kenya. Clause 43 of the act amends section 58 of EMCA, 1999 by providing that the proponent of any project specified under the second schedule shall undertake a full EIA study and submit the EIA report to NEMA prior to being issued with any license by the authority. The second schedule to this act provides a list of projects that are supposed to undergo EIA study. Among these projects are:

- electricity generation stations;
- electrical transmission lines;
- electrical sub-stations; and
- pumped-storage schemes.

Section 42 of the act provides that all policies, plans and programmes (PPPs) for implementation shall be subject to SEA.

4.2.3 The Environmental (Impact Assessment and Audit) Regulations, 2003

This is a subsidiary legislation to EMCA, 1999 that governs administration of the EIA procedure in Kenya. According to clause 11, an EIA study shall be carried out in accordance to the terms of reference developed during scoping exercise by a project proponent and approved by NEMA. Clause 13 provides that an EIA study shall be carried out by a lead expert registered and licensed to operate by NEMA. Pursuant to clause 16, an EIA study shall take into environmental, social, cultural, economic and legal consideration and shall:

a. Identify the anticipated environmental impacts of the project and scale of the impact;
b. Identify and analyse alternatives to the proposed project;
c. Propose mitigation measures to be taken during and after the implementation of the project and
d. Develop an environmental management plan with mechanisms to monitoring and evaluating the compliance and environmental performance which shall include the cost of mitigation measure and the time frame of implementing them.

Clause 17 requires the project proponent to seek the views of the persons who may be affected by proposed projects when carrying out EIA studies. Clause 42 requires lead agencies, in consultation with NEMA, to subject all proposals for public policies, plans and programmes to SEA in order to determine which ones are the most environmental friendly and cost effective when implemented individually or in combination with others.

4.2.4 National Guidelines for Strategic Environmental Assessment in Kenya

These guidelines were developed by NEMA in 2012 and are anchored on the Environmental (Impact Assessment and Audit) Regulations, 2003 which requires lead agencies to subject all public policies, plans and programmes to SEA (NEMA, 2012). However, the scope has been expanded to include both public and private organizations. SEA helps to streamline and strengthen project-specific EIAs.

5. APPLICATION OF ENVIRONMENTAL ASSESSMENT AT OLKARIA GEOTHERMAL FIELD

5.1 Location of Olkaria Geothermal Field

Olkaria geothermal field is located within Hells' Gate location in Naivasha Sub-county, Nakuru County. KenGens' geothermal licensed area measures 204 KM^2 and is one of the prospects located along the Kenyan Rift Valley. Part of the concession area lies within Hell's Gate National Park which measures approximately 68.25KM^2. Olkaria geothermal field neighbours Lake Naivasha, which is a Ramsar site, flower farms and some villages inhabited by the Maasai community who are pastoralists.

5.2 History of Geothermal Resource Development and EIA Application at Olkaria

Table 2 provides details of conventional geothermal power plants that are operated by KenGen at Olkaria Geothermal Field including their commissioning dates.

Table 2: KenGen's Conventional Power Plants at Olkaria Geothermal Field

Plant	Installed Capacity (MWe)	Units	Commissioning Dates
Olkaria I unit 1,2 & 3	45	3 x 15MWe	1981, 1982 & 1985
Olkaria II	105	3 x 35MWe	2003 & 2010
Olkaria I unit 4 & 5	140	2 x 70MWe	2015
Olkaria IV	140	2x 70MWe	2014
Total	**430**		

Olkaria II was the first station to be subjected to a full EIA study. This was done to fulfil the World Bank financing requirements and also to take care of the concerns of Hell's Gate National Park which was gazetted in 1984. The EIA study was conducted by Sinclair Knight and RPS in 1994. Environmental considerations made the transmission line route to be changed several times and this happened at the time when NEMA had not even been established (Mwangi, 2005). However by then, the World Bank had introduced the Environmental Assessment (EA) policy, Operational Directive (OD) 4.00, for the first time in 1989 (Baba, 2003) and later on amended it as OD 4.01 in 1991, where environmental assessment became a standard procedure for the projects financed by the bank (Sahzabi and Ehara, 2007). This was the basis against which the ESIA for Olkaria II unit 1 and 2 was conducted. Olkaria I unit 1, 2 and 3 was not subjected to an ESIA study because by then the World Bank, which was financing the project, had not developed the EA policy. Ogola, 2004 conducted SIA for appraisal drilling at Olkaria Geothermal field. Her study pointed out the following risks which were likely to result from appraisal drilling: risk to water resources, risk to soil resources, risk to air resources and noise, risk to biodiversity and occupational health and safety risks. Table 3 provides information on the ESIAs carried out for projects operated by KenGen at Olkaria Geothermal Field.

One of the EIA license conditions for drilling of 80 wells was the recommendation for KenGen to subject its nine (9) years geothermal expansion programme to SEA. KenGen undertook SEA for Olkaria and Eburru geothermal expansion programmes covering the period 2012-2020 (5 Capitals Environmental Management Consultants, 2014). According to the programme, a total of 1,110MWe of geothermal energy is to be added to the national grid by 2020. SEA was undertaken in 2014 and approved by NEMA in September 2015.

Table 3: ESIAs Carried out for KenGen Projects at Olkaria Geothermal Field

Project	Description	ESIA Carried by	Dates
Olkaria II	Unit 1 and 2 conventional power plant (70MWe)	Sinclair Knight and RPS (Consultant)	1994
Olkaria II	Unit 3 conventional power plant (35MWe)	GIBB Africa (Consultant)	2004
Drilling of appraisal wells	Drilling of 6 appraisal wells at Olkaria Domes	KenGen	2004
Olkaria I	Unit 4 and 5 conventional power plant (140MWe)	GIBB Africa (Consultant)	2009
Olkaria IV	Unit 1 & 2 (140MWe)	GIBB Africa (Consultant)	2010
Olkaria Direct Use and Demonstration Centre	Geothermal spa, museum and conference facility	KenGen	2010
Drilling of geothermal wells	80 wells contract	KenGen	2012
Resettlement project	Resettlement Facilities for Olkaria IV Project Affected Persons	KenGen	2012
Geothermal Complex	Office block and laboratories	Gibb Africa	2012
Geothermal Workshops	Five workshop buildings	GIBB Africa	2012
Olkaria I	Unit 6 (70MWe) conventional power plant	KenGen	2013
Olkaria V	Unit 1 and 2 (140MWe) conventional power plant	GIBB Africa	2013
Asbestos containment	Facility for safe containment of asbestos roofing sheets	KenGen	2013
Olkaria I	Proposed rehabilitation of unit 1,2 & 3 conventional power plant	LOG Associates (Consultant)	2014

5.3 Implementation of EIA Procedure at Olkaria

KenGen has been certified on ISO 14001:2004 Environmental Management System standard. In line with the requirement of this standard, the company has documented EIA procedure for projects located at Olkaria Geothermal field (Barasa, 2015). The company has a fully fledged operational environment section with some of the staff registered and licensed with NEMA as Lead EIA/Audit experts. These experts are the ones who implement the EIA procedure either on their own or in conjunction with the appointed consulting firms. KenGen has integrated SIA into EIA due to the close proximity of some local communities to KenGen installations.

6. DISCUSSION

Kenya is among the countries that have integrated EIA into geothermal resource development by virtue of enactment of the Geothermal Resources Act, 1982 and EMCA, 1999. The ESIA procedure at Olkaria Geothermal Field has been evolving over time. The process has been enhanced by incorporation of the World Bank and JICA standards since this is one of the financing conditions that must be fulfilled prior to disbursement of the loans. KenGen had not fully integrated SIA into EIA until recently when EIAs for Olkaria IV and Olkaria I unit 4 and 5 power projects were carried out. These EIAs incorporated air quality and noise dispersion modeling studies as part of baseline data collection. Based on the modeling studies, the EIA reports recommended involuntary resettlement of 150 Maasai households due to the negative effect of noise and hydrogen sulphide gas emissions. NEMA and World Bank recommended preparation of a Resettlement Action Plan (RAP) which was to aid in the resettlement of the project affected persons. This compelled KenGen to contract a social safeguard adviser to guide preparation and implementation of the RAP. Resettlement is usually the largest and single most important negative impact on the social environment, necessitating the formulation of resettlement programmes, preferably within a development paradigm to encompass

wider community benefits whilst attaining the restoration of livelihoods of the directly affected people (ACER, 2007).

Recently the biodiversity conservation groups have expressed concerns over the expansion of geothermal energy programme at Olkaria. This has been done through the media and by forwarding written complaints to KenGen. As a result, the approval process of ESIA reports submitted by KenGen to NEMA is sometimes delayed in order to accommodate such concerns. A good example is ESIA for Olkaria V power plant which took six (6) months to be approved instead of the usual three (3) months. NEMA formed a Technical Advisory Committee to review the ESIA report, visit the proposed site at Olkaria and make recommendations with respect to biodiversity impacts. All future ESIA studies should therefore incorporate a biologist in the team of experts if biodiversity impacts are to be identified and addressed adequately.

Accelerated expansion of geothermal energy development at Olkaria calls for the need to add or expand the existing power transmission lines to pave way for the increased load. The energy sector in Kenya is structured in such a way that the role of constructing and managing power plants lies with KenGen whereas that for constructing transmission lines lies with Kenya Electricity Transmission Company (KETRACO) Limited. In the same way ESIA studies for power plants are carried out by KenGen whereas those for power transmission lines are done by KETRACO. This complicates the issue since the approach for carrying out ESIAs by the two companies varies especially when it comes to stakeholder engagement approaches. KenGen having operated at Olkaria Geothermal field for many years is well positioned to carry out ESIA studies for both the power plants and transmission lines, as one project, especially if the social and biodiversity issues are to be fully addressed. The approach should be synonymous to the EIA for the proposed Bjarnarflag power plant and transmission line in Námafjall which was covered in one report as discussed by Ármannsson, 2014. This provides an opportunity for the decision makers and stakeholders to make informed decision about the project. If this approach has to materialize, KenGen and KETRACO should enter into a memorandum of understanding (MOU) that will guide the process of integration. Alternatively, the Ministry of Energy and Petroleum can assume the overall mandate of coordinating and funding the ESIA process.

Another challenge for ESIA studies carried out internally by KenGen has been lack of enough staff who have trained as social scientists (sociologists). When forming the ESIA team, KenGen incorporates one of the Human Resource Managers who holds a degree in sociology. This is because for NEMA to approve terms of reference for carrying out full ESIA studies, at least one of the team members should be a social scientist. Since the sociologist has other parallel engagements and she is based at the headquarters, sometimes it becomes difficult to receive her full support whenever an ESIA study is being conducted. This calls for the need for KenGen to recruit some social scientists to be based at Olkaria. Alternatively the community liaison officers can be sponsored by the company to undertake post graduate studies in sociology. This will go along way towards ensuring full integration of SIA into EIA studies for Olkaria Geothermal projects. On the part of NEMA, there is need to review the Environmental (Impact Assessment and Audit) Regulations, 2003 to incorporate registration and licensing of SIA Experts the same way it applies for EIA experts. Such experts will become handy especially when it comes to preparation and implementation of Resettlement Action Plans (RAPs) for geothermal resource projects.

Involvement of the Olkaria environment section has contributed positively towards enhancing the quality of ESIA studies carried out for geothermal resource development both internally and externally. Inclusion of resident social scientist will create a more positive change on the basis of the fact that the local community has been enlightened on exercising their rights as provided for by the Kenyan Constitution, 2010 and World Bank Guidelines. The success of SEA was as a result of capacity building of four environmental scientists from KenGen prior to commissioning of the study. The team attended a three weeks short course on SEA and EIA Applying Systems Analysis and Spatial Support tools held at the University of Twente in the Netherlands. The approved SEA for Olkaria and Eburru geothermal expansion programme will serve as a framework against which future

ESIA studies for individual geothermal resource projects will be conducted thereby ensuring sustainable development.

7. CONCLUSIONS

Environmental Assessment for Olkaria Geothermal projects has been improving from the moment it was first launched. The process has been strengthened by the existence of a fully fledged environmental department. Integration of environmental assessment into geothermal resource development has contributed towards effective stakeholder relationships and promotion of environmentally sustainable development. Implementation of the recommended measures provides a new opportunity for enhancing the process thereby improving further the quality of the reports.

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