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ENVIRONMENTAL IMPACT ASSESSMENT – GENERAL PROCEDURES

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ABSTRACT

Despite geothermal energy being considered a clean source of energy, its exploitation has the potential of generating environmental and social impacts that need to be identified and managed from the early stages of resource development. Some of the environmental and social aspects associated with geothermal resource development include noise, non condensable gaseous emissions, thermal fluid discharges, biodiversity impacts, land disturbance and involuntary resettlement of local communities. Sound environmental management is therefore 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 projects. It is against this background that Environmental Impact Assessment (EIA) for geothermal resource development has been made a mandatory legal requirement in many nations that are endowed with the resource.

This paper discusses the application of EIA as a tool for decision making in geothermal resource development. The focus is on the general procedure of carrying out EIA in nations with applicable legislation. The key role in the procedure is played by environmental protection bodies, the project proponent and the communities likely to be affected by the projects thus making stakeholder engagement an integral part of the assessment.

1. INTRODUCTION

Environmental assessment is required as part of regulatory approval processes for development of geothermal resources in most of the countries endowed with the resource. Various studies, highlighting how EIA has been integrated into geothermal resource development in both developed and developing nations, have been carried out. Baba, 2003 compared 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. According to the literature review, there is a common understanding on how environmental assessment is integrated into the geothermal development process and this is indicated in Figure 1 below:

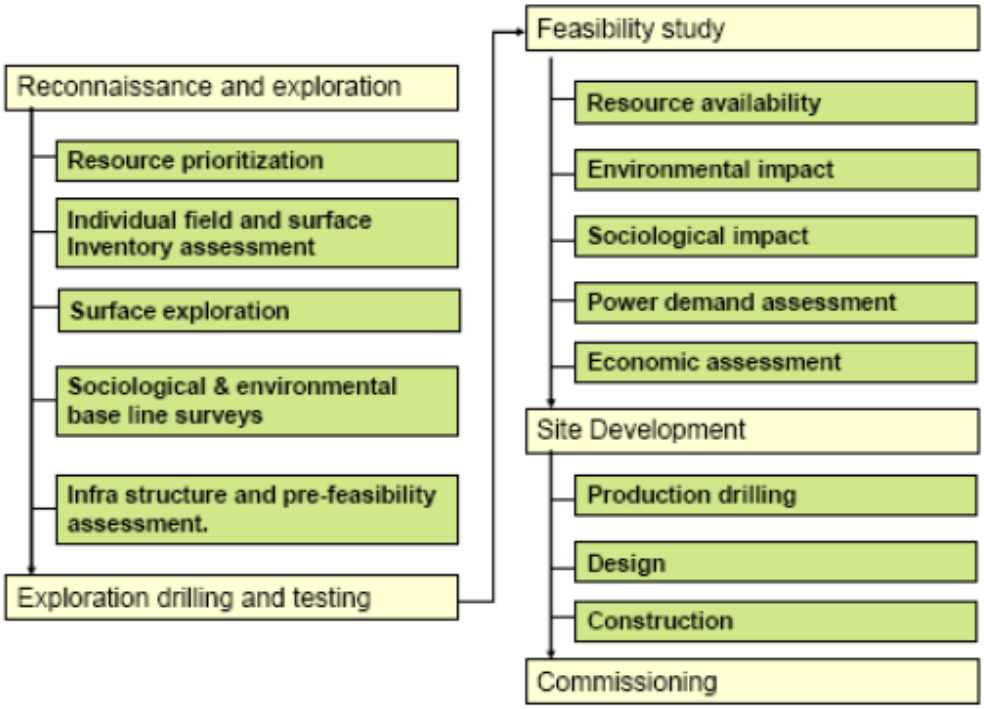

FIGURE 1: Schematic flow diagram for geothermal development (Steingrímson, 2009)

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 2 below provides hypothetical relative degrees of the environmental impacts of the different phases of geothermal resource development.

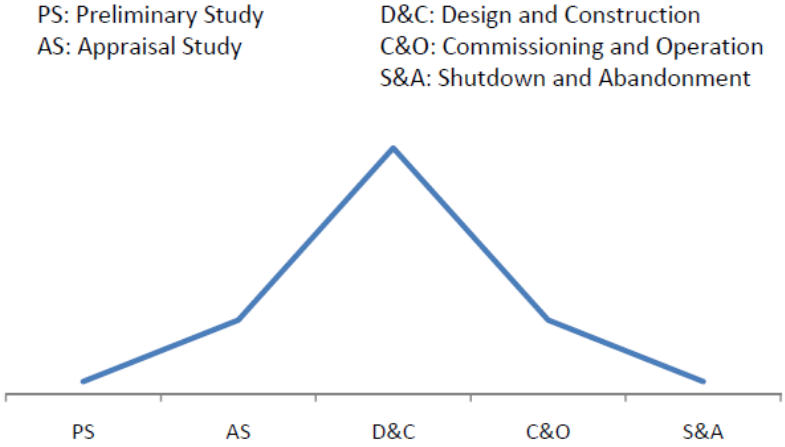

FIGURE 2: Relative degrees of environmental impacts of different phases of geothermal resource development (Haraldsson, 2011)

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, in order to minimize conflicts, stakeholder involvement should commence at the reconnaissance phase especially for the case where the geothermal field boarders or is inhabitated by the local communities.

2. 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 below provides a summary of the levels of decision-making in environmental assessment (Partidario, 2003).

TABLE 1: Levels of decision-making in environmental assessment

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.

Geothermal resource development brings change. The reason is because projects have the potential to negatively impact the environments, communities and economies overlying and surrounding developments. Conversely, they also can 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).

2.1 Types of environmental assessment tools

Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) are some of the critical 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. The relationship between the three instruments is shown in Figure 3 (Partidario, 2003).

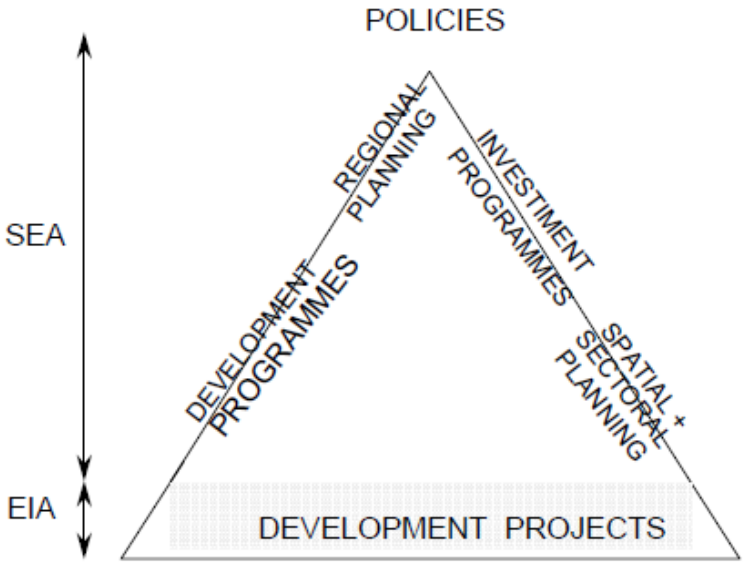

FIGURE 3: Integration of environmental assessment in development projects

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). Normally SEA forms a framework against which future EIAs are carried out for the individual projects that form part of the policy, plan or programme.

SIA is the processes 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). It is thus a procedure that identifies, predicts and evaluates potential impacts of a proposed project or activity on the environment as well as describing means of mitigating significant impacts prior to major decisions or commitments being made (Sadler, 1996; Common Ground, 2005; UNEP, 2008).

2.2 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, avoiding conflicts.

Equally, according to 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.

3. GENERAL EIA PROCEDURE

The most useful tool for understanding and managing the risks and impacts of a particular project is EIA. The term EIA describes a procedure that must be followed for certain types of projects before they can be given ‘development consent’. The procedure is a means of drawing together, in a systematic way, an assessment of a project’s likely significant environmental effects (Department for Communities and Local Government, 2000). The emphasis in EIA is on a systematic, holistic, and multidisciplinary assessment of the potential impacts of specific projects on the environment (Li, 2008). 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, the 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, 2014, 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). From a social standpoint, EIA incorporates interests of public and private stakeholders, residents and communities in the planning and approval process of projects (Government of Rwanda, 2006). The key role in the procedure is played by environmental protection bodies, the project proponent and the community likely to be affected by the project (Wiszniewska, et al, 2002). The integration of economic, social and environmental concerns in the development process in a balanced way ensures the attainment of sustainable development.

3.1 Evolvement of EIA procedure

EIA arose out of the pollution and unnecessary degradation of natural resources caused by rapid population growth, industrialization, agricultural development and technological progress (UNEP, 2006). The foundations of the Environmental Assessment (EA) process were established by the United States (US) through the enactment of the National Environmental Policy Act (NEPA) in 1969 (Sadler, 1996). The EA process had two major purposes: ensuring that decision makers are making informed choices regarding impacts on the environment and opening the process to citizen involvement (World Bank, 2011). NEPA has proven to be one of the most widely imitated statutes. Since its enactment, it has served as a template for domestic EIA legislation in more than 130 nations around the globe (Kersten, 2009).

The high level meeting of the African Ministerial Conference on the Environment (AMCE) on EIA in Durban June, 1995 was a landmark event in the development of EIA in Africa. The meeting set down an agenda for capacity building in EIA and identified the promotion of EIA capacity building, based on the use of African expertise and institutions, as a priority action (Economic Commission for Africa, 2005). The use of EIA as a tool for evaluating the impacts of a proposed project has gained more acceptance as the actual or potential problems produced by development projects become more evident and the need for ensuring environmental sustainability increases (McCalla, 1994).

3.2 EIA step-wise procedure

EIA standards differ between countries because natural conditions and emphasis are different, but generally they are based on the 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.

The general step-wise EIA procedure is summarized in Figure 4 below.

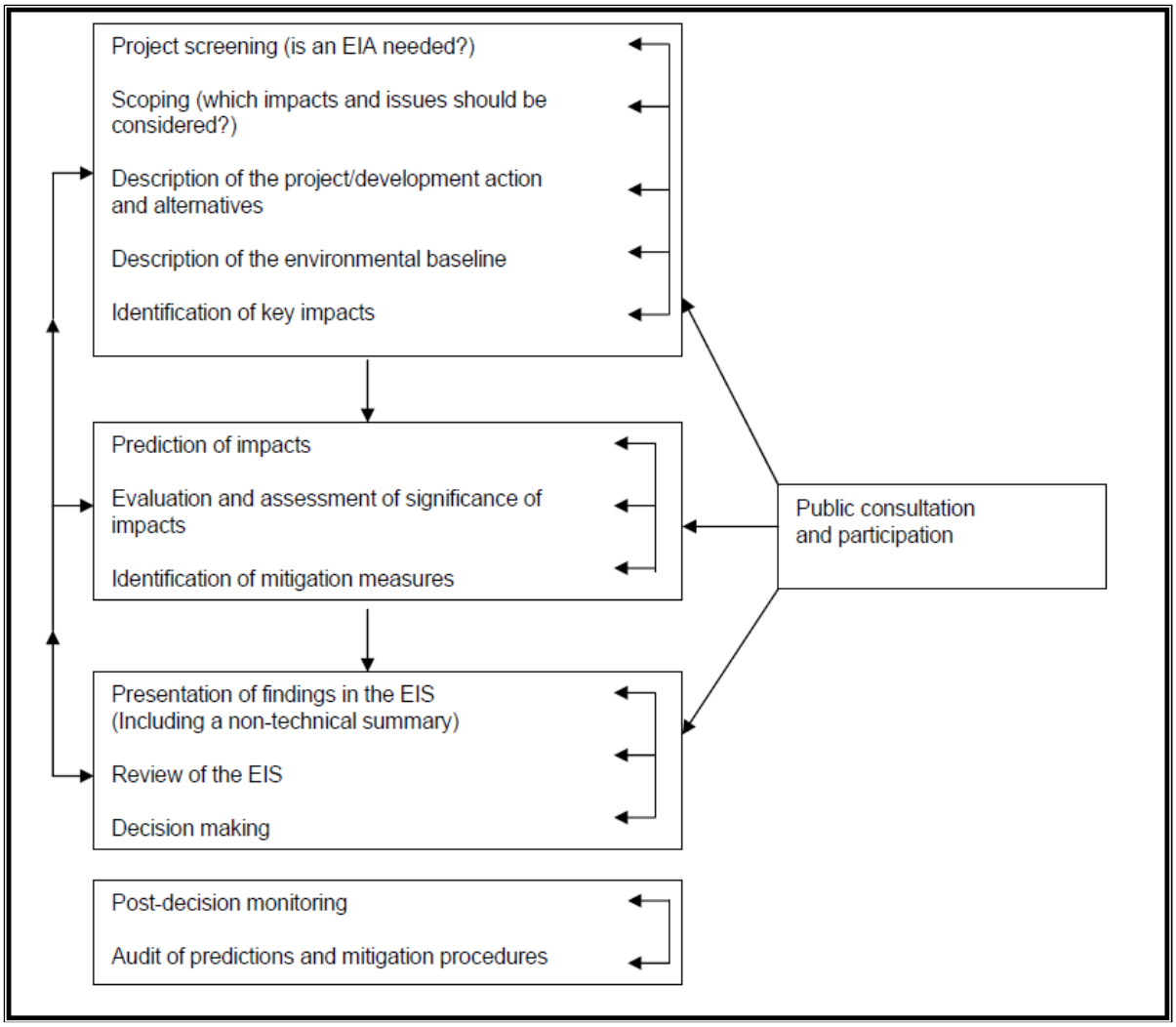

FIGURE 4: General step-wise EIA procedure (Glasson et al., 2005)

3.2.1 Stakeholder engagement in EIA

It is worth noting that public consultation and participation is an integral component of the EIA procedure that features throughout the EIA process as highlighted in figure 4 above. Public participation entails a wide range of activities that can range from providing information, through consultation to direct involvement of the public in aspects of the decision-making process (Common Ground, 2005). A key element in participatory development is the ability to identify stakeholders, their needs, interests, relative power and potential impact on project outcomes (African Development Bank, 2001). Social analysis techniques and methods can be used in identifying stakeholders, their needs, aspirations and concerns regarding the project (World Business Council for Sustainable Development, 2005).

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 the social licence to operate. 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 development proponent work together to produce better decisions than if they had worked independently (ACER, 2007).

3.2.2 Project screening

Screening is the preliminary appraisal done to determine whether or not an EIA is required for a particular project (KfW, 2014; UNEP, 2008; Republic of Kenya, 2002). The decision is based on a set of developed guidelines or criteria (McCalla, 1994). Screening tools include positive lists that identify activities that require EIA; negative lists that identify activities that are excluded from EIA; expert judgments; or a combination of lists and expert judgments. Screening could also include analysis of impacts and risks, such as in the United States, where EIA applies to investment activities that can pose significant negative impacts (World Bank, 2011). The screening procedures can be broadly classified into two approaches: a standardized approach, in which projects are subject to or exempt from EIA defined by legislation and regulations; and a customized approach, in which projects are screened on a case by case base, using indicative guidance (UNEP, 2008).

Screening is carried out by the Competent Authority and the outcomes are threefold:

- Requirement for full EIA study;
- Requirement for preliminary assessment; and
- No EIA requirement.

3.2.3 Scoping

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). By doing this it helps to determine the content and extent of the EIA studies (Common Ground, 2005). Scoping procedures may vary considerably in different states. For example, scoping may either be carried out to fulfil a legal requirement or as good practice in EIA, or it may either be undertaken by the competent authority or by the project proponent (UNEP, 2008). Scoping is the foundation for effective EIA study and involves input of relevant stakeholders. It is the role of the developer through EIA experts to undertake scoping (Government of Rwanda, 2006 and United Republic of Tanzania, 2001).

The purpose of scoping is to determine the following (Sadler, 1996):

i. Information necessary for decision making;
ii. Important issues and concerns (interests);
iii. Significant effects, factors and alternatives to be considered;
iv. Conditions and the expected output of an EIA study i.e. Formulate a detailed terms of reference (tor) for carrying out EIA study; and
v. Appropriate boundaries of an EIA study.

3.2.4 Impact identification and analysis

This is the phase where potential impacts of the proposed development are identified, analysed and their significance predicted (Common Ground, 2005). Where possible, an EIA should try to predict all potential impacts, including those directly and indirectly related to a project, as well as cumulative impacts with other projects or activities, and transboundary effects (UNEP, 2008). Evaluating the significance of environmental effects is perhaps the most critical component of impact analysis. The interpretation of significance bears directly on project approvals and condition setting (Sadler, 1996). Both positive and negative potential environmental impacts of the given project should be evaluated. For this reason, impact analysis necessitates an interdisciplinary approach, covering different natural and environmental science disciplines (UNEP, 2008).

The EIA should be based on current information, including an accurate description and delineation of the project and any associated aspects, and environmental and social baseline data at an appropriate level

of detail sufficient to inform characterization and mitigation of impacts. For this reason, the EIA shall identify, describe and assess, in each individual case, the potential direct or indirect impact of an intended project on the following (Government of the Republic of Montenegro, 2005):

i. Human life and health;
ii. Flora and fauna;
iii. Land, water, air, climate and landscape;
iv. Material assets and cultural heritage; and
v. Mutual relations of elements listed above.

The following general criteria should be taken into account when examining potentially significant adverse effects (UNEP, 2008):

i. Nature of impacts (direct/indirect, positive/negative, cumulative, transboundary);
ii. Time span (short/medium/long term, permanent/temporary, frequent/seldom);
iii. Extent (geographical area, size of affected population/habitat/species);
iv. Magnitude (severe, reversible/ irreversible);
v. Probability (high/medium/low probability); and
vi. Possibility to mitigate, avoid or offset significant adverse impacts.

3.2.5 Mitigation and impact management

This phase entails developing measures to avoid, reduce or compensate for negative environmental effects. However, all mitigation efforts should focus first on how to avoid social and environmental impacts in the initial stages of planning. The reason is because this has much greater beneficial effect than remedial action that comes later (World Business Council for Sustainable Development, 2005). At the more detailed level of the process, alternatives may also merge into mitigating measures, where specific changes are made to the project design or to methods of construction or operation to 'prevent, reduce and where possible offset any significant adverse effects on the environment (European Commission, 2013).

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.

The ESMP will also specify the environmental or social monitoring arrangements during project implementation (which may result in further adaptive management measures being applied) and any capacity development necessary to support these measures (FAO,2012). 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. ESMP thus builds continuity into the EIA process and helps to optimize environmental benefits at each stage of project development (UNEP, 2008).

3.2.6 Reporting

EIA is geared at providing a basis for decision making thus the information generated during the study must be presented in a manner that is clear enough to make an informed decision on the project under consideration. Many agencies establish registers for consultants, or technical specialists, or firms that carry out EIA and prepare related reports (World Bank, 2011). The EIA report should therefore provide an adequate, accurate, and objective evaluation and presentation of the risks and impacts, prepared by qualified and experienced persons. The EIA report must not be of scientific character and it should be understandable by people who are not particularly familiar with specific technical issues or who are involved in environmental protection matters. Therefore, the requirement of including the summary of the EIA report in a non-specialized language is so crucial (Wiszniewska et al, 2002). The executive summary sums up the essential points and results of the EIA in a concise and non technical manner. It is a crucial part of the EIA – in fact, it is often the only part of the comprehensive document that decision makers and the general public will read (UNEP, 2008).

The EIA report should 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: (i) the expected residues, emissions and the production of waste, (ii) the use of natural resources, in particular soil, land, water, and biodiversity, including any hydromorphological changes, (iii) 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; and
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.

3.2.7 Review of EIA report and decision making

The review of the EIA report is usually carried out by one or a combination of the following: the technical staff of the EIA administrative institution; an intergovernmental committee; a multi-stakeholder committee; and/or external reviewers depending on the complexity of the study and expertise available (Economic Commission for Africa, 2005).

Information gathered during the procedure should constitute sufficient grounds, with relation to environmental protection, to issue the decision whether and in what way a particular project may be carried out (Wiszniewska et al, 2002). The competent authority will form its own judgment on the proposed project based on the EIA report, the analysis of stakeholder interests and statements from collaborating agencies, and decide on approval or rejection of the proposed project. The competent authority through the Review Committee may recommend that (McCalla, 1994):

i. The EIA is inadequate and requires further investigation, in which case it will refer the EIA back to the developer for further investigation within a specified period;
ii. Further public consultation is necessary;
iii. The development should not proceed for specified reasons; and
iv. The development proceeds subject to certain conditions.

The competent authority will typically impose conditions if the project is approved, such as mitigation measures, limits for emissions or environmental standards to be observed (UNEP, 2008).

3.2.8 Implementation and follow-up

Once the proposed development has been approved by the Competent Authority, follow-up follows. This entails implementation of the ESMP for construction, operation and in some cases, decommissioning of the project by the developer. Follow-up involves the following (Sadler, 1996):

i. Monitoring to check actions are in compliance with terms and conditions, and impacts are within the ranges predicted;
ii. Management to address unforeseen events or unanticipated impacts; and
iii. Audit/evaluation to document results, learn from experience, and improve EIA and project planning.

The purpose of environmental monitoring is to detect change that takes place in the environment over time and involves the measuring and recording of physical, social and economic variables associated with development impacts (Department of Water Affairs and Forestry, February 2005b). By doing this, it provides information that will aid impact management; help achieve a better understanding of cause-effect relationships and improve EIA impact prediction and mitigation methods.

In order for the monitoring process to be effective, there is need to develop a monitoring program that is as specific as possible. This will ensure generation of measurable and comparable data that would help illustrate trends and allow decision makers to take any further action for mitigating adverse impacts (World Bank, 2012). The monitoring programme should identify objectives and specify the type of monitoring required. It should also describe environmental performance indicators which provide linkages between impacts and mitigation measures identified in the EIA report, parameters to be measured, methods to be used, sampling location and frequency of measurements, detection limits and definition of thresholds to signal the need for corrective actions (Southern African Power Pool, 2007). In the project context, environmental performance indicators are used as a management tool to help the project manager predict environmental change, mitigate or promote those changes, and follow the development in order to be able to manage the project in an optimal way from an environmental perspective (Swedish International Development Cooperation Agency, 2002).

Environmental audits help in assuring the accuracy and relevance of environmental monitoring, and the identification of issues via the audit process may also lead to environmental standards that exceed regulatory requirements (Department of Water Affairs and Forestry, 2005a).

4. CONCLUSION

EIA ensures the integration of economic, social and environmental concerns in the geothermal resource development process thus contributing to sustainable development. For this reason, the use of EIA as a tool for evaluating the impacts of geothermal development projects has gained more acceptance as the actual or potential problems produced by the projects become more evident and the need for ensuring environmental sustainability increases. EIA is tailored to the specific project and to the legal requirements, environmental and social conditions where the proposed project is situated hence ensuring that potential impacts are adequately addressed at the local level. However, EIA has little value unless follow-up is carried out because without it the process remains incomplete and the consequences of EIA planning and decision-making will be unknown. Environmental monitoring ensures that progress towards the set targets is followed, that any necessary changes are made to the ESMP developed during EIA study and that achievement is celebrated and replicated in future geothermal projects.

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