

**THE CLEAN DEVELOPMENT MECHANISM IN KENYA: A CASE STUDY OF THE
OLKARIA GEOTHERMAL PROJECT.**

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DECLARATION

This research project is my original work and has not been presented for examination to any other university.

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DEDICATION

To my dad Lawrence Mbogo, because you believed.

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I would like to thank Almighty God for the gift of life and the capacity to carry out this study, my employer KenGen not only for according me the time to study but also assisting me with the resources I needed for this study and my family for believing in me. Much appreciation to my supervisors Dr. Musingi and Mr. I. Ndolo for their guidance, support and encouragement to this end.

ABSTRACT

The Clean Development Mechanism (CDM) is one of the key components of the Kyoto Protocol. Being an offshoot of the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol is a legally binding global agreement to combat climate change through a reduction of greenhouse gas (GHG) emissions as well as to help non annex one countries achieve sustainable development. The study used Olkaria Geothermal Project as case study to assess the contribution of CDM projects to sustainable development. Specific objectives were to assess the contribution of CDM projects towards community social development using community participation in decision making and women empowerment as indicators of social development; to determine the contribution of CDM projects to local environmental development; and to assess the contribution of CDM projects towards local economic development using employment creation and infrastructure improvement as indicators.

The study adopted a survey research design witha target population of 9,194 households of Olkaria sub-location, where a sample of 75 households was drawn. Quantitative data was collected using semi structured questionnaire administered to households and unstructured questionnaires administered to 10 key informants (Olkaria Geothermal Project employees).The collected data was coded, cleaned and analyzed using SPSS (Statistical Package for Social Sciences) in which the hypotheses were also tested. From the findings, the study found out that the level of community engagement in decision making with regard to community development projects to be collaborative with the Olkaria Geothermal Project while the main mode of promoting women empowerment is through provision of scholarships to the girl child (at least two annually) for secondary and university education. The study also established that social afforestation and environmental awareness creation through environmental seminars and participation in important days in the environmental calendar were the major initiatives by the Project to enhance environmental development. The study also established that the Olkaria Geothermal Project engages the use of Environmental Management Plans to counter the effects of its activities on the environment followed by environmental audits. In its contribution to economic development the study established that the Project is involved in local community infrastructure improvement through provision of clean drinking water to the community, establishment of water pans for watering livestock, grading of community access roads and building and renovation of classrooms in some of the community schools. With regard to employment creation the study established that there are indirect income generation activities in the Project as well as direct employment. Employment opportunities for unskilled labour are reserved for the local community.

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LIST OF ACRONYMS AND ABBREVIATIONS

CDM	-	Clean Development Mechanism
GHG	-	Green House Gas
CER	-	Certified Emission Reduction
CO ₂	-	Carbon Dioxide
CO ₂ e	-	Carbon Dioxide Equivalent
UNFCCC	-	United Nations Framework Convention on Climate Change
CBP	-	Community Benefits Plan
PDD	-	Project Design Document
COP	-	Conference of the Parties
MOP	-	Meeting of the Parties
QERLCs	-	Quantified Emission Reduction and Limitation Commitments
CH ₄	-	Methane
N ₂ O	-	Nitrous Oxide
HFCs	-	Hydrofluorocarbons
PFCs	-	Perfluorocarbons
SF ₆	-	Sulphur Hexafluoride
GWP	-	Global Warming Potential
USA	-	United States of America
EDRC	-	Energy and Development Research Centre
NGOs	-	Non-Governmental Organisations
NEMA	-	National Environment Management Authority
UNICED	-	United Nations International Children's Emergency Fund
UNDP	-	United Nations Development Programme
WCED	-	World Commission on Environment and Development
ADB	-	Asian Development Bank
IPCC	-	Intergovernmental Panel on Climate Change
WRI	-	World Resources Institute
WB	-	World Bank
FDI	-	Foreign Direct Investments
DOE	-	Designated Operational Entity

CHAPTER ONE: INTRODUCTION

1.1 Background

The global mean surface temperature has increased by about 0.07°C per decade in the past 100 years with the increase being more rapid—at about 0.18°C per decade in last 25 years. The last decade (2001–2010) has been recorded as being the warmest with the average temperatures being 0.46°C above the 1961–1990 mean, and 0.21°C warmer than the previous decade (1991–2000) (IPCC, 2007). Consistent with the global warming, mountain glaciers and snow cover have declined in both hemispheres, the global average sea level has risen since 1961 at an average rate of 1.8 mm per year (IPCC, 2007). Significant increase in precipitation has been observed in the eastern parts of North and South America, northern Europe and northern and central Asia. The frequency of heavy precipitation events has increased over most land areas, which is consistent with warming and increases in atmospheric water vapour. At the same time, there has been some drying in the Sahel, the Mediterranean, southern Africa and parts of southern Asia (IPCC, 2007). Widespread changes in extreme events have been observed. For example, cold days, cold nights and frost are less frequent, while hot days, hot nights, and heat waves are more frequent. More intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and sub-tropics (IPCC, 2007).

Meanwhile in Africa, most parts have experienced temperature increase (about 0.70°C) in the last century (IPCC, 2001). On regional scales, observation shows increases in temperature over the Sahel, tropical forests, southern Africa, eastern Africa and North Africa (AMCEN, 2011). Africa has been drier in the last few decades with some regions having experienced a decrease in rainfall while some have experienced an increase in rainfall (AMCEN, 2011).

While decreases in precipitation may lead to drought, increases in precipitation can lead to floods. In Africa, the frequency and severity of droughts and floods have increased over the past 30 years. Droughts have increased in frequency and intensity in Eastern Africa where frequent droughts have occurred in each decade over the past 50 years in the region (IPCC, 2001).

As part of the international response to climate change the United Nations Framework Convention on Climate Change (UNFCCC) established an international policy framework for reducing greenhouse gas emissions (UNFCCC, 1997). Adopted at the third Conference of Parties(COP-3), the Kyoto Protocol set binding obligations to developed countries and countries in transition to a market economy (Annex 1 countries) to reduce their overall emissions of green

house gases by at least 5% below 1990 levels with specific targets varying from country to country (Olsen, 2007).

The Clean Development Mechanism (CDM) was established under Article 12 of the Kyoto Protocol. CDM is a market mechanism in which the price of a certified emission reduction (CER), measured in tonnes of CO₂e, is negotiated between buyers and sellers (Olsen, 2007). Annex 1 countries with emission reduction targets – or authorised public or private entities within these are allowed to invest in project activities that reduce GHG emissions and contribute to Sustainable Development in non-Annex 1 countries, (Sirohi, 2007; Pelzer, 2004).

Energy being central to economic development in Africa, it was anticipated that most of the CDM projects for Africa would concern various aspects of energy improvements in the region. This would be; energy technology transfer, newer renewable forms of energy and improvement in energy efficiency (Odingo, 2001).

Kenya signed the Kyoto Protocol on 12th June 1992, ratified it on 30th August 1994 as a Non Annex 1 country (UNFCCC, 2014). This means that Kenya has no obligations for reduction of green house gas emissions and is eligible to host CDM projects. Kenya's National Delegated Authority is the National Environment Management Authority (NEMA) and its main role is to assess the sustainability of CDM projects. In Kenya, there are 19 registered CDM projects as at February, 2014 (NEMA, 2014).

With the government of Kenya prioritising the use of renewable energy for present and future power generations through the Ministry of Energy and Petroleum's mission: "To Facilitate Provision of Clean, Sustainable, Affordable, Competitive, Reliable and Secure Energy Services at Least Cost while Protecting the Environment" gives hope for the future of renewable energy based CDM projects. This is also illustrated by the direction the government has taken to put its focus into investment of renewable energy projects. Meanwhile, Kenya's vision 2030 unveiled flagship projects are going to be energy intensive as shown in Table 1.1 below:

Table 1.1: Vision 2030 flagship projects

Project	Completion date	Estimated demand (MW)
ICT Park	2012 – 2014	440
Second container terminal and a free port at the Mombasa port	2014	2
Standard gauge railway(Juba-Lamu)	2014	9
Lamu port	2014	4
Special economic zones	2015	50
Iron and steel smelting industry in Meru area 2015-2021	2015 – 2021	315
Standard gauge railway(Mombasa- Nairobi-Malaba, Kisumu)	2017	8
Light rail for Nairobi and suburbs	2017	33
Resort cities (Isiolo, Kilifi and ukunda)	2017	30

Source: Government of Kenya, 2011

Renewable energy sources have been fronted as the main source of energy that will power the 2030 projects (Government of Kenya, 2011). Renewable energy is derived from naturally occurring resources, principally the movement of wind and water, the heat and light of the sun, plant material and animal waste, and geothermal (the heat in the earth's crust). Much focus has been put to present and future generation of electricity from the vast geothermal resources (Government of Kenya, 2011) that lie in the East African Rift System and is associated with intense volcanism and faulting which have resulted in development of geothermal systems. It is estimated that in Kenya, more than 14 high temperature potential sites occur along Rift Valley with an estimated potential of more than 10,000 MWe (Ministry of Energy and Petroleum, 2014). One of such sites is Olkaria Geothermal Project located at Olkaria which forms the case study for this research project.

1.2 Problem Statement

Sustainable development was defined by the World Commission on Environment in 1987 as development that meets the needs of the present generation without compromising the needs of the next generation, this came as a result of the need to try and solve the conflicts between environmental and developmental goals (Harris, 2003; Parris *et al.*, 2005). Since then the concept has been expanded to comprise 3 dimensions/elements which include environmental, social and economic (Harris, 2003; Parris *et al.*, 2005). Assessing sustainable development thus involves all the 3 dimensions mentioned above. Sustainable development has since become a widely recognized goal for global developments and so is the need to check the presence or absence of sustainability (Bossel, 1999).

The Clean Development Mechanism is one of the key components of the Kyoto Protocol which is an offshoot of the United Nations Framework Convention on Climate Change (UNFCCC). Article 12 of the Kyoto Protocol to the United Nations Framework Convention on Climate Change defines the purpose of the CDM as being to help Annex 1 countries (countries with emission reduction targets) in complying with the Kyoto Protocol emission reduction targets while also contributing to the sustainable development of non-Annex 1 countries. The non-Annex 1 countries happen to be the host countries of these CDM projects (Pelzer, 2004).

By not defining clearly the Sustainable Development criteria required for the CDM, the United Nations Framework Convention on Climate Change (UNFCCC) allows for certain flexibility for the host-country of a CDM project to adjust those criteria according to the national Development priorities. On the other side, much uncertainty and inconsistency could arise from such an uncoordinated approach. The sustainable development content reflects host country decisions regarding national priorities and needs to be determined at the time of project registration with the CDM authority (Munn, 1998). According to Schneider (2007), sustainable development also needs to be an ongoing project function. The host country governments should have the ultimate responsibility for determining a project's compatibility with sustainable development criteria, as a matter of sovereignty, but that it would be desirable for the CDM to develop and provide an indicative, not restrictive, list of quantifiable sustainable development indicators/benchmarks.

Many studies have been undertaken to find out if CDM projects are sustainable and the results are varied with most studies concluding that the sustainability objective has been unfulfilled (Olsen, 2007; Schneider, 2007; Sirohi, 2007 and Sutter & Parreno, 2007) while a few point out that some considerable sustainable benefits have been achieved (Alexeew *et al.*, 2010). This coupled with the absence of international standards of sustainable development in the approving of CDM projects-countries have been left to judge if proposed projects will contribute to sustainable development has weakened the objective of sustainable development (Sutter and Parreno, 2007). Assessing CDM projects to establish if they are achieving their core objective-sustainable development becomes a necessity.

Even in the absence of international standards of assessing the sustainability of CDM projects, some studies such as Kirkman *et al.* (2012) and Olsen and Fenann (2008) have advanced indicators of sustainable development to assist in the assessment of the contribution of CDM projects to sustainable development. These indicators represent each of the dimensions of development. Some of these include; Community or local/regional involvement in decision-making, promotion of health and safety, promotion of education, empowerment of women (social dimension), stimulation of local economy, improvement of infrastructure, jobs creation (economic dimension) and reduction of pollution, preservation of natural resources and promotional of reliable and renewable energy (environmental dimension) (Kirkman *et al.*, 2012).

It is against this background that this study endeavours to assess the contribution of the Olkaria Geothermal Project to sustainable development. Indicators of sustainability from the 3 dimensions of development will form the basis of this assessment study; they shall be measured and evaluated in an attempt to evaluate the contribution of the project to sustainable development.

1.3 Research Questions

- i. What are the initiatives of CDM projects to enhance community social development?
- ii. Does the level of education by parents in a household influence the woman/wife's role in making decisions in the family?
- iii. What and how is the contribution of CDM projects towards local environmental development?

- iv. How has CDM projects contributed towards local economic development?
- v. How does distance from the location of the CDM project influence economic benefits in the community villages?

1.4 Research Objectives

The general objective of this study is to assess the contributions of CDM projects to sustainable development efforts in Kenya through Olkaria Geothermal project. The specific objectives include;

- i. To evaluate the contribution of CDM projects towards community social development
- ii. To determine how education level attained by parents influence the woman/wife's role in decision making for the family
- iii. To determine the initiatives of CDM projects towards local environmental development
- iv. To determine the contribution of CDM projects towards local economic development
- v. To determine the effect of distance from the CDM project's location on economic development benefits gained by the community villages

1.5 Research Hypothesis

H₀₁: Local economic development by CDM projects is independent of community villages' distance from the CDM project

H₀₂: Household leader decision making is independent of education level attained

1.6 Justification of the study

Most of the empirical studies that have attempted to study the contribution of CDM projects to sustainable development have used the approach of analyzing the contents of the PDDs (Project Design Documents). This view is illustrated by Kirkman *et al.* (2012) who points out that since the registration of the first CDM in 2004 all the studies that have attempted to understand the contribution of CDM to sustainable development have focused their studies on the information provided by the project documents. Besides, Sutter (2003) states that it could be misleading to evaluate project performance with regard to sustainability only through project documentation as there is the possibility of project proponents being biased in selecting participants for stakeholders participation. This research study endeavours to use a different approach- going to

the field and collecting relevant information and analyze it. This approach will therefore provide new input into the knowledge concerning the contribution of CDM projects to sustainable development.

Besides, all these studies attempt to study a host of CDM projects collectively thereby providing their findings in a generalized manner. There is thus a necessity to assess the contribution of CDM projects to sustainable development using varied approaches and maybe attempt to assess these projects one by one. This study endeavours to focus on one project and its contribution to sustainable development. By adopting a different view in assessment this study shall provide more light on the contribution of CDM to sustainable development.

1.7 Scope of the Study

This study seeks to assess the contribution of the CDM projects in Kenya. The study will use Olkaria Geothermal Project to assess its contribution to sustainable development. This study will focus on three dimensions of sustainable development which are social, environmental and economic development dimensions. Although Olkaria Geothermal Project is not wholly a registered CDM project, it shall be viewed as an unregistered CDM project for the purpose of this study. Geographically, the study shall be limited to Olkaria sub-location.

1.8 Study Limitations

The PDDs submitted to UNFCCC citing the sustainable development benefits to be accrued were generalized; (provision of local employment during construction and operation of power plants, construction of roads that will improve transport infrastructure in the locality, under the corporate responsibility, allocation of funds to fund community projects aimed at improving the standards of the surrounding community, stimulation of market activity near the site- support from several local businesses in the purchasing of consumables, operation and maintenance of equipment and subcontracting services). The study could not get exact quantities to compare the findings against.

1.9 Definition of Terms

Clean Development Mechanism (CDM): Is a project-based flexible offset mechanism under the Kyoto Protocol that allows the crediting of emission reductions from greenhouse gas (GHG) abatement projects in developing countries. The CDM has two purposes: it should assist developing countries to achieve sustainable development and help industrialised countries to reduce the costs of greenhouse gas abatement. Companies and governments in Annex 1 countries can buy emission reduction credits, called Certified Emissions Reductions (CERs), from CDM projects instead of reducing their own emissions.

United Nations Framework Convention on Climate Change (UNFCCC): Is a multilateral agreement adopted on 9 May 1992 in New York and signed at the 1992 Earth Summit in Rio de Janeiro. Its main objective is the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

Kyoto Protocol: This is an international agreement linked to the UNFCCC which commits its parties by setting internationally binding green house gas emission reduction targets. The Kyoto was adopted at the Third Session of the Conference of the Parties (COP) in 1997 in Kyoto and entered into force on 16th February 2005.

Conference of Parties (COP): Refers to the supreme body of the UNFCCC, comprising countries with the right to vote that have ratified or acceded to the convention.

Annex 1 Countries\parties: These include industrialized countries that were members of the OECD (Organisation for Economic Co-operation and Development) in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation. These countries committed themselves to the aim of returning individually or jointly to their 1990 levels of green house gas emissions.

Non Annex 1 countries\parties: The countries that have ratified or acceded to the UNFCCC but are not included in Annex I. These are mostly developing countries. Certain groups of developing countries are recognized by UNFCCC as being especially vulnerable to the adverse impacts of climate change, including countries with low lying coastal areas and those prone to desertification and drought. Others (such as countries that rely heavily on income from fossil fuel production and commerce) feel more vulnerable to the potential economic impacts of climate change response measures.

Green House Gases (GHG): Are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds. This property causes the green house effect.

Sustainable Development: Development that meets the needs of present generations without compromising the ability of future generations meeting their own needs. Also defined as a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional changes are all in harmony and enhance both current and future potential to meet human needs and aspirations.

Infrastructure: fundamental facilities and systems serving the country, city, or area, such as transportation and communication systems, power plants and schools.

Community Participation: A process by which people are enabled to become actively and genuinely involved in defining the issues of concern to them, in making decisions about factors that affect their lives, in formulating and implementing policies, in planning, developing and delivering services and in taking action to achieve change.

Empowerment: A process of awareness and capacity building leading to greater participation, to greater decision making power and control and to transformative action.

Resettlement Action Plan: A resettlement exercise that was carried out by KenGen at the Olkaria Geothermal Project to resettle some of the local community members living close to the locations of new power stations being constructed by the company. This would ensure project activities do not adversely affect the local community members. This exercise involved acquisition of land for resettlement, building of houses and other social amenities for the displaced people.

CHAPTER TWO: STUDY AREA

2.0 Introduction

The Olkaria Geothermal Project is located within Olkaria sub-location, Hells Gate Location, Naivasha Central Division, Naivasha District, Nakuru County. It is accessed from the main Nairobi-Naivasha highway through Moi South Lake road, with an entry through the Olkaria Gate of the Hell's Gate National Park (Mwangi-Gachau, 2011). It is owned by the Kenya Electricity Generating Company (KenGen) Ltd.

2.1 Demographics

Table 2.1: Population Distribution by some Administrative Units in Naivasha

Sub-location	Male	Female	Total Population 2009	Household	Area/square	Density
Hells gate	32,565	32,081	64,646	22,147	436.7	148
Olkaria	13,011	12,426	25,437	9,194	345.5	74
Kongoni	2,054	2,050	4,104	1,209	86.3	48
Maiella	4,416	4,804	9,220	2,124	41.9	220

Source: Republic of Kenya 2009 Kenya Population and Housing Census

2.2 Climate

Olkaria area and its environs fall under Eco-climatic Zone IV which is characterized as semi-humid to semi-arid with 40-50% moisture content and annual rainfall varying between 600 and 1100 mm with averages of approximately 650mm (Stein, 2009) . The precipitation pattern is bi-modal with rainy seasons in the periods March-May and October-November. The area is described as being environmentally fragile and prone to land degradation. The mean monthly temperature in the project area has been recorded to range from 15.9 - 17.8°C with a mean of 16.8°C (Somow & Barasa, 2012).

2.3 Land use

Owing to the climatic conditions in Olkaria area and its environs, there is support for multiple land use systems consisting of ranching, flower and horticultural farming, tourism, wildlife conservation, human settlement and infrastructure. To the south and southeast of the Olkaria Geothermal Project, are situated large tracts of land covering mainly the Kedong and Longonot

Ranches, which primarily rear cattle. These ranches form important dispersal areas for wildlife from the Hell's Gate and Longonot National Parks (Somow *et al.*, 2012).

2.4 Geology of Olkaria

The surface geology of Olkaria area is dominated by pyroclastic type of volcanic rocks that comprises of volcanic ashes, volcaniclastic sediments, pumiceousclasts, lithic fragment and lava such as the Olbutot comenditic lavas (Girma *et al.*, 2001; Somow & Barasa, 2012). These volcanic materials have undergone hydrothermal alteration, oxidation and weathering to yield superficial deposits products such as clays that are enriched with silica and Iron oxides. These are generally loose and unconsolidated hence easily eroded by action of water or wind, hence the presence of numerous gullies and eroded surfaces in the area.

2.5 Topography

The Olkaria area where the Geothermal Project is located comprises volcanic features that consist of steep sided domes formed from pyroclastic rock and lava flows. Olkaria Domes enclose an approximately circular depression that has been cut by the OlNjorowa Gorge, which was formed by out-flowing water from Lake Naivasha. The Olkaria I and II Power stations are located in the centre of the depression. Construction for Olkaria I units IV and V and Olkaria IV is on (Somow *et al.*, 2012).

To the north of Olkaria, the topographical features are dominated by depressions of four water bodies including the Crescent Island, Lake Naivasha, Lake Olidien and Crater Lake.

2.6 Soils

The soils are of volcanic origin, mainly of mixed assemblage of acid and basic lavas. Superficial soils occur in the fault troughs of the grid-faulted area. The soils in Olkaria are very porous resulting in the aridity of the land (Somow & Barasa, 2012).

Where pyroclastics are of very recent volcanic activity the soils present are very deep, dark reddish-brown to dark brown well drained andosols. They are very friable and smearable with a texture of clay loam to clay, with thick acid humic topsoil. The planosols and phaezeoms soils are found on the plateaus of 8 per cent average slope on a high level flat to gently undulating structural plain. These soils are developed on volcanic ashes and pyroclastics of recent volcanoes (Girma *et al.*, 2001).

The poorly drained planosols are mottled clay under silty loam layer. The well drained phaezeoms are a complex of deep of 80-120 cm thick soils to very deep of 120-180 cm of very dark grayish brown to black that are firm and moderately calcareous cracking clays. Cambisols are found on the minor hill scarps. They are mainly clay loam in texture and well drained with a few outcrops (Somow *et al.*, 2012).

2.7 Biodiversity

The prominent vegetation types around the Olkaria Geothermal Project are: woodland, bushland and wetlands with vegetation dominated by *Tarchonanthus camphoratus* and *Acacia drepanolobium*. The grass species comprise of star and couch grass. Fauna include buffalos, giraffes, warthogs, zebras, grants gazelle, baboons, monkeys, snakes, waterbuck and more than 80 species of birds (Somow *et al.*, 2012).

KENYA COUNTY MAP



Figure 1: Map showing Area of Study within the counties of Kenya

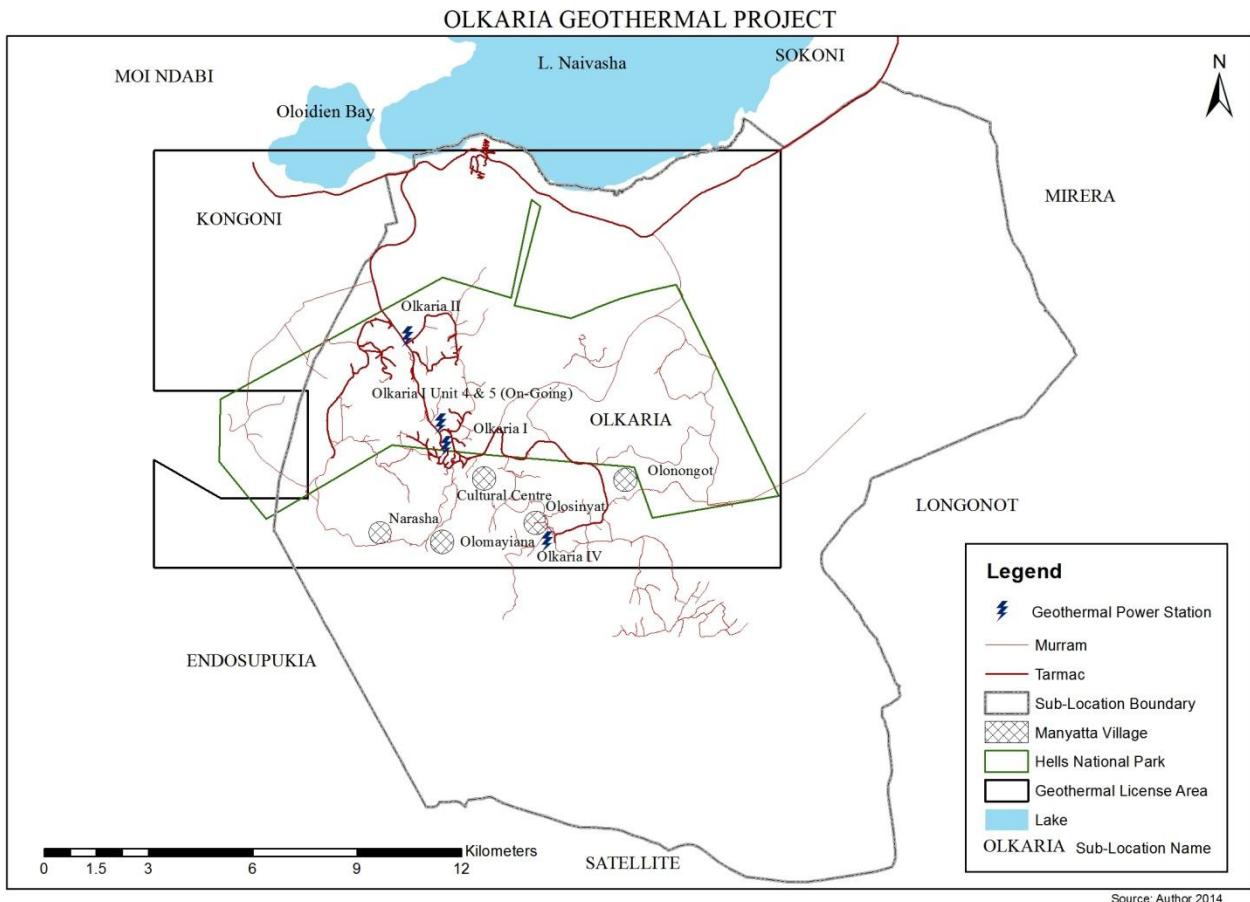


Figure 2: Map of the Olkaria Geothermal Project

CHAPTER THREE: LITERATURE REVIEW

3.1 Introduction

This chapter will review studies that have been done in the past that are relevant to this research study on the contribution of CDM projects to sustainable development. The chapter will explore the concept of CDM and the indicators that are used in assessing the contribution of CDM to sustainable development so as to narrow the indicators so as to achieve the study objectives.

3.2 Clean Development Mechanism (CDM)

The Clean Development Mechanism (CDM) is the outcome of lengthy and delicate international negotiations. It represents a compromise between the aspirations of developing countries for Development on the one hand and the wish for industrialized countries to meet their emission target in an economically efficient way on the other. The CDM was created as a means of assisting governments and private businesses to reach their GHG reduction targets in a cost-effective manner, while contributing to the Sustainable Development priorities of developing countries, as stated in the article 12 of the Kyoto Protocol (Pelzer, 2004). The dual-objective of the CDM reflects the compromise of the negotiations with the industrialized countries looking for flexible options in order to meet to emission targets, while at the same time developing countries being preoccupied by Climate Change policies which might be viewed as impeding their Development path. The CDM originally raised high expectations, especially in the developing countries, for its potential of delivering sustainable benefits triggered by foreign investments, technology transfer, and for its possible contribution to poverty alleviation (Olsen, 2007).

According to Sirohi (2007), CDM is not a single institution but a mechanism, legal and institutional set-up of which will be determined by the Conference of the Parties (COP). The set-up includes a variety of entities, including Parties, international institutions and private entities. The set-up also includes rules, standards and procedures linking these components in fulfilment of the CDM objectives. According to the Article 12 of the Kyoto Protocol to the United Nations Framework Convention on Climate Change, Clean Development Mechanism is supposed to stimulate sustainable development and emission reductions by facilitating the development of clean technologies to replace the dirty ones that have caused the climate crisis. In practice,

however, the CDM often invests in dirty, discredited, and unsustainable technologies – some of which increase, rather than decrease, GHG emissions (UNFCCC, 1997: Article 12).

The CDM allows Annex I countries (mostly developed countries) to acquire certified emissions reductions (CERs) by undertaking greenhouse gas (GHG) mitigating project activities in non-Annex I countries (mostly developing), while contributing to sustainable development in the host country (Odingo, 2001). Annex I Parties can use CERs to contribute to compliance with part of their quantified emission limitation and reduction commitments (QERLCs) under Article 3 of the Kyoto Protocol. Private entities may also participate in CDM activities in order to advance these objectives. The Conference of the Parties (COP) to the UN Framework Convention on Climate Change (UNFCCC) and the Meeting of the Parties to the Kyoto Protocol (MOP) are together mandated to determine the legal and constitutional structure within which these objectives will be achieved.

Odingo (2001) observes that 5 years after the signing of the Kyoto Protocol in 1997, nothing much had changed for Africa since the majority of the CDM projects that had been implemented in countries that have resources excluding Africa.

The CDM creates a commodity (GHG/carbon equivalent units) and aims to provide mutually shared benefits for investors and hosts. As a mechanism intended to channel private sector investment towards climate friendly projects, the CDM aims to support the development of a new set of international arrangements for public/private partnership. This aspect inevitably will have implications for the design and operation of the CDM procedures and institutions, including its Executive Board and operational entities and the scope for participation by non-party entities in decision making and dispute resolution.

3.2.1 The Kyoto Protocol

Within the framework of the Climate Change Convention, governments acknowledged the fact that the issue of Climate Change deserved stronger and more detailed commitments, especially on the part of the industrialized countries. After long and intense negotiations, the Kyoto Protocol was adopted during the third Conference of the Parties (COP) in Japan, 11 December 1997. The open items of the Protocol's implementation were discussed in subsequent meetings and figure in, most importantly, the Bonn Declaration and the Marrakesh Accords (UNFCCC

2005a). For the Protocol to enter into force, a minimum of 55 Parties needed to ratify it, including enough Annex 1 countries so as to cover at least 55% of that group's carbon dioxide emissions in 1990 (UNFCCC 1997, art. 25, 1). The Kyoto Protocol entered into force 16 February 2005, after the Russian Federation's ratification (UNFCCC 2005a), and currently represents one of the most internationally supported treaties in history with 162 states having ratified it, representing 61.6 % of the total anthropogenic GHG emissions.

The Kyoto protocol creates a legally binding set of obligations for 38 industrialised countries, and 11 countries of Central and Eastern Europe, in order to reduce their emissions of Greenhouse Gases to an average of 5.2% below their 1990 levels over the commitment period 2008-2012. Some media describe this international agreement as representing the most ambitious attempt to tackle an environmental issue in history (Pomeroy, 2005). The Protocol lists 6 Greenhouse Gases, namely Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulphur Hexafluoride (SF_6). Those gases, which each have a different potential greenhouse effect, are aggregated together with the Global Warming Potential (GWP) factor¹³ in order be comparable in a common unit, the Carbon Dioxide equivalent (CO_2eq). Excluding the countries with Economies in Transition, out of the group of Annex 1 Parties, only few industrialised countries have ratified the UNFCCC but not the Kyoto Protocol to date, some of them having officially announced their intention not to do so in the future (UNFCCC 2005a). In order of importance in terms of total Greenhouse Gases emissions¹⁴, these countries are the USA, Australia, Turkey and Monaco. Their main arguments repose on the fact that legally binding emissions reduction would undermine domestic economic performances and therefore prejudice national interests

The Kyoto Protocol establishes three cooperative mechanisms to allow for Annex 1 Parties to reduce their costs of meeting the targets by trading emission certificates or undertaking corrective actions abroad rather than domestically. These are: International Emissions Trading, Joint Implementation and Clean Development Mechanism. Because Greenhouse Gases are spread out in the atmosphere around the globe, the geographical location of the emissions, or the emission cuts, doesn't significantly matter from an emission concentration point of view. Therefore, the effects of measures, wherever undertaken, are equally valuable from a mitigation

of anthropogenic Climate Change point of view. This study focuses only on the third flexible mechanism, the CDM.

3.3 Dimensions of CDM to Sustainable Development

3.3.1 Social Development

Social sustainability can be broadly defined as “the maintenance and improvement of well-being of current and future generations” (Chu & Chiu, 2003). It should incorporate; identity, sense of place and culture, empowerment, participation, access, health and safety, social capital, wellness, happiness and quality of life (Mak & Peacock, 2011). Harris (2003) points out that social equity, fulfilment of basic health and educational needs and participatory democracy are crucial elements of development and are interrelated with environmental sustainability.

In Kenya, the first development priority is poverty eradication. The country aims at achieving this rather challenging target through quick industrialization by 2030. CDM projects, especially the ones that will generate new activities within local communities, will meet one of the major requirements of the economic and social policy of the Kenya Government: the generation of new jobs. Economic activities arising from the implementation of CDM projects may also create capacity in local communities for raising per capita well-being (EDRC, 2003). This may be achieved in many ways, from the improvement of infrastructures like roads, electric connections, and telecommunications to enhance knowledge through technology import.

The Energy and Development Research Centre (EDRC) (2003) brings another important aspect of social development which resides in the proper and equitable allocation of resources, both across the various layers of society and within each class of population. In Kenya there is a major problem of gender inequity, therefore projects that allow a more even distribution of wealth and bring the empowerment of women would target one of the country’s critical social issues (EDRC, 2003). People’s capabilities to participate effectively in local development are determined not only by individual resource endowments, but also by social capital that provides the basis for collective action (EDRC, 2003).

Agenda 21 states that for sustainable development to be achieved empowerment of the local community and community groups is essential (UNICED, 1992). Empowerment increases people’s opportunities and capabilities to make and express choices and to transform those

choices into desired actions and outcomes. UNICED (1992) further points to the fact that the roadmap towards sustainable development is a complex system within which problems of development and the ecosystem are linked, and calls for the development of new approaches in support of the developmental processes which integrate production with resource conservation and enhancement with assurances of sustainable livelihood. One of the mechanisms through which this can be achieved through community empowerment which gives communities the capacity to deal with the interaction between ecosystem, political and socio-political changes that affect their livelihoods adversely (Singh & Vangile, 1995).

Community participation in decision making is key in achieving community empowerment (Mak & Peacock, 2011) especially in the development of projects that are likely to impact these communities. The levels of participation in decision making are discussed by (ILEC, 2005) as information sharing (which is one way), consultation (which is two way), collaboration where there is shared control over decisions and resources and empowerment which involves transfer of control over decisions and resources to the community in a project cycle.

In regard to social development and women empowerment, Principle 20 of the Rio Declaration states that “Women have a vital role in environmental management and development. Their full participation is therefore essential to achieve sustainable development” thus recognizing the role women have to play in the achievement of sustainable development (Warth & Koparanova, 2012). UNDP (2010) defines an empowered woman as a woman who has a sense of self worth, who can determine her choices, has access to opportunities and resources providing her with an array of options she can pursue, has control over her own life within and outside the home and has the ability to influence the direction of social change to create a more just social and economic order, both nationally and internationally.

Several international conventions such as the Universal Declaration of Human Rights and the Programme of Action of the 1994 International Conference on Population and Development have emphasized the importance of education, the 4th World Conference on Women held in Beijing in 1995 concluded that the key to an empowered woman’s participation in decision making in society and her improved family wellbeing lies in her literacy (Roudi-Fahimi & Moghadam, 2003). The Millennium Development Goals cite the importance of education as a

foundation in sustained economic growth. All these point to the realization that education is a key factor for women empowerment.

A study by Sonowal (2013) on the impact of education on women empowerment established that illiterate women were equally backward in social decision making, economics, health and family welfare aspects and this greatly hampered rural development in that area. Warth and Koparanova (2012) recognizing the vital role of women in environmental management and development calls for the full participation in decision making processes at all levels, a gender sensitive approach to all policy areas and training programs that are tailored for women's needs. Karl (1995) argues that women empowerment can be enhanced by improving access be it of access to health and education services, decent housing, affordable childcare and employment. Karl (1995) further suggests the need for women to be organized, articulate, persistent and representative in order to have an impact and thus calls for women to speak for themselves and not let others speak for them.

In the study of market and rural women empowerment in Southern Nigeria Mwanesi (2006) established that women who were extensively engaged in economic activities and micro-credit financing played a major role in enhancing rural women's participation in production and trade. Women were also found to have some control over their loans although household decisions were solely the prerogative of the male head of the family. Younger married women were found to have some restrictions in terms of time and distance due to customs sanctions, household obligations and social infrastructures.

There are direct implications of women empowerment with regard to the welfare of children. This is illustrated in a study by Durrant and Sathar (2000) which aimed to establish the relationship between women's empowerment and investing in children in Pakistan, it was established that empowered women/those with higher status made positive investments in their children thus raising their children's chances of survival during infancy and increased their likelihood of attending school. This was especially so in rural Punjab where it was established that improving a woman's standing in the household enhanced a child's survival, doing that at the community level improved chances of the girl child attending school. It was also established that women who had lower individual status and had faced abuse by husbands had limited access to financial resources.

3.3.2 Environmental Development

Improvement of infrastructure is one of the key indicators of sustainable development in the economic dimension Kirkman *et al.* (2012). This is also echoed by Fay *et al.* (2010) who states that: “Infrastructure is essential for economic progress and reducing poverty”, he also adds that: “it delivers major benefits in economic growth, poverty alleviation, and environmental sustainability but only when it provides services that respond to effective demands and does so efficiently”. While infrastructure is essential for economic development, it also plays an important role in determining environmental sustainability since it locks in consumption patterns. This means that even as CDM projects invest in infrastructure improvements of the local area, they must also focus on environmental sustainability.

In order to assess the impacts of CDM projects on environmental development, Krey (2005) established that two sets of indicators have to be chosen; one for contribution at the global level while the other at the local level. The impact on the global environment needs to be positive, as it reflects the reductions in GHG emission that are achieved through CDM activity (Krey, 2005).

At the local level, the issue to be addressed with regard to environmental resources is whether the earth’s ecosystem can sustain the high pressure that would result if a country was to adopt a development path similar to that of most developed countries (Krey, 2005). Many different theories give different answers to this crucial question; nonetheless, it is certain that some environmental resources are vulnerable to irreversible damage if excessive pressure is exerted on them (Krey, 2005). (United Nations, 2000) states that Kenya has already experienced degradation of its natural resources, especially forests, soil and water resources and the consequences of this cannot be ignored any longer; therefore an indicator to account for efficiency in resource management has been adopted. It is necessary to point out that a relevant part of the inefficient utilization of natural resources derives from traditional use, therefore there is scope for introducing new and more efficient technologies to reduce the pressure exerted on the environment (United Nations, 2000).

Empowerment affirms the need to build the capacity of communities to respond to a changing environment by inducing appropriate change internally as well as externally through creativity, innovation and commitment to attaining sustainable development. People’s capabilities to participate effectively in local development are determined not only by individual resource

endowments, but also by social capital that provides the basis for collective action. The National Empowerment Partnership (2008) provides a list of five dimensions that provide a framework for planning a project which is empowering for communities. These include: nurturing confidence, including community in decision making, organize the community into teams, encourage cooperation among them and encourage the group to influence decisions.

UNDP (2012) notes that in one of the Rio principles that environmental issues are best handled with participation of all citizens concerned even in the quest for sustainable development. The principle states further the importance of the public having access to information regarding the environment and being accorded the opportunity to participate in decision making processes (UNDP, 2012). Community participation is based on the premise that in a community there is knowledge, skills, attitudes and resources on which people can build (Ymker, 1991 as quoted by Watermeyer, 1995). Thus, development groups should be formed with the purpose of empowering people to make better use of skills, knowledge and attitudes and resources to assist them to improve their quality of life. Development should be seen as a process rather than an end in itself.

3.3.3 Economic development

Infrastructure Improvement and Employment creation

Kirkman *et al.* (2012) states that infrastructure is one of the key indicators of sustainable economic development. “Infrastructure is essential for economic progress and reducing poverty” notes Fay *et al.* (2010) and “it delivers major benefits in economic growth, poverty alleviation, and environmental sustainability—but only when it provides services that respond to effective demands and does so efficiently”. Infrastructure can be defined as “physical assets, which are defined as the “fundamental facilities and systems serving the country, city, or area, as transportation and communication systems, power plants, and schools” (UNDP, 2010)

While infrastructure is essential for economic development, it also plays an important role in determining environmental sustainability since it locks in consumption patterns for decades to come, an example is developing highways in preference to mass transit systems implies heavy future fossil fuel demand for personal modes of transport. This means that even as CDM projects invest in infrastructure improvements of the local area, they must also focus on environmental sustainability.

The concept of sustainable infrastructure could be seen as designing and maintaining buildings, structures, and other facilities with an eye towards resource conservation over the life of the infrastructure.

After evaluating 12 bio energy project types by examining project design documents for 76 Clean Development Mechanism (CDM) bio-energy projects in India, Brazil and Sub - Saharan Africa, Lee and Lazarus (2011) established that employment opportunities would be direct (as in working in the CDM project establishments) or supplemental income generation opportunities, such as from gathering residues. Employment opportunities for CDM projects can be direct or indirect.

Sirohi (2007) notes that wage employment programs, particularly for construction of rural roads, digging of wells, for soil conservation have been an integral part of poverty alleviation and CDM projects offer employment by providing wage employment in construction and operation of the project activities and through stimulating rural non-farm employment as a response to growth opportunities created by the project, particularly for self-employed non-agricultural activity.

3.4 Gaps Identified in the Literature

Most of the studies that have undertaken to study the contribution of CDM projects to sustainable development have used a generalized approach with which each study adopting to assess many projects combined; Sirohi (2007) 65 projects, Schneider (2007) 93 projects, Sutter and Parreno (2007) 16 projects and Alexeeew *et al.*(2010) 40 projects. None of the studies singled out and focused on any single project. The literature reviewed indicated that most of the studies applied a qualitative methodology in their approach and solely depended on the Project Design Documents (PDDs) submitted by project proponents (Olsen, 2007; Krey, 2005; Alexeeew *et al.*, 2010and Sutter and Parreno, 2007). There was no single study that was based on CDM projects from Kenya or East Africa as most studies based their case studies from Asia and South Africa (Durrant and Sathar, 2000).

3.5 Theoretical Framework

The theoretical framework for this study is a summary of the relationship between climate change and sustainable development as illustrated by an Integrated Assessment Modelling (IAM) framework developed by IPCC working group II (IPCC, 2001). It illustrates the relationship between climate change and sustainable development to be cyclic (IPCC, 2001). Each socio-economic development path (driven by the forces of population, economy, technology, and governance) gives rise to different levels of greenhouse gas emissions. These emissions accumulate in the atmosphere, increasing the greenhouse gas concentrations and disturbing the natural balance between incident solar radiation and energy re-radiated from the earth. Such changes give rise to the enhanced greenhouse effect that increases radiative forcing of the climate system. The resultant changes in climate will persist well into the future, and impose stresses on the human and natural systems (IPCC, 2001). Such impacts will ultimately have effects on socio-economic development paths, thus completing the cycle.

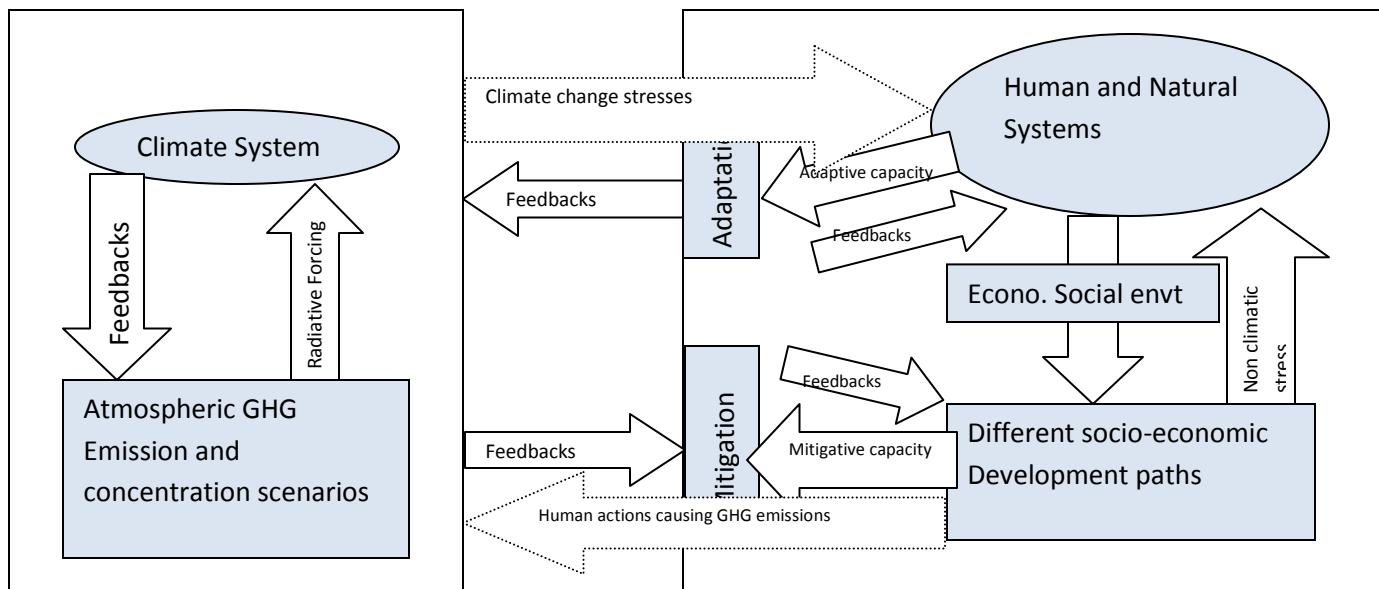


Figure 3: The theoretical framework

Adapted from IPCC, 2001

3.6 Conceptual Framework

CDM is one of the socio-economic paths that has been undertaken by the international community to help reduce the emissions of GHG into the atmosphere while at the same time contributing to sustainable development in the host countries. In the absence of international standards to assess the sustainability of CDM projects, some studies have put forth indicators for dimension of development that can be used to ascertain if CDM projects indeed contribute significantly to sustainable development (Kirkman *et al.*, 2012 and Olsen & Fenhann, 2008). Under the social dimension indicators include, women empowerment, infrastructure improvement, community empowerment, proper and equitable utilisation of resources, under environment we have green house gas reduction, impact of the CDM activities on the environmental development at all levels and accounting for leakage, under economic category indicators include energy efficiency, technology transfer and income generation. This study selected two indicators from the social dimension (women empowerment and community involvement in decision making), two from economic dimension (employment creation and community infrastructure development) and environmental development initiatives by the CDM project under study. Figure 4 shows a schematic diagram of the conceptual framework adopted in this study.

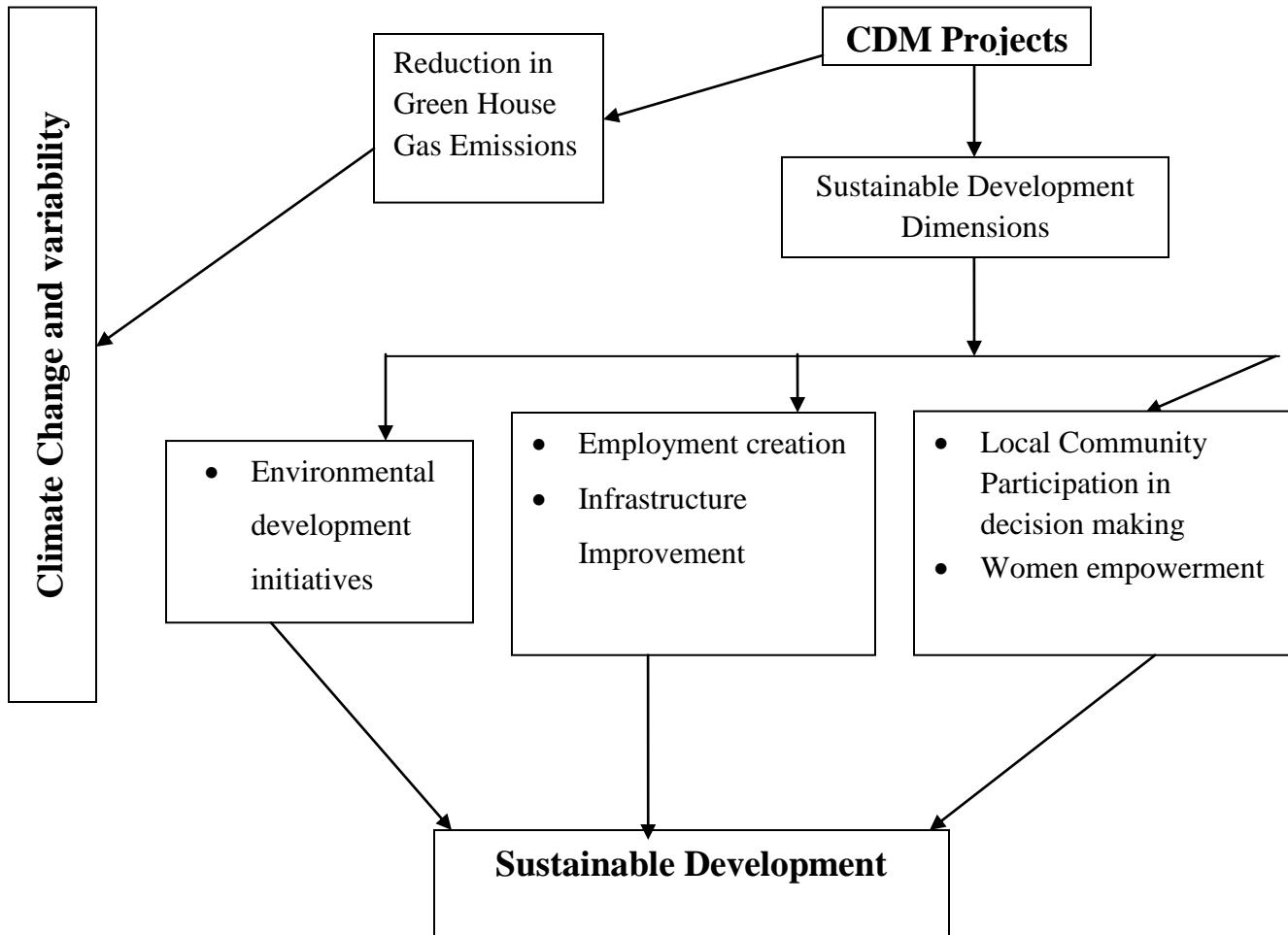


Figure 4: The conceptual framework

Modified from Olsen & Fenann (2008) &
Kirkman *et al.* (2012)

CHAPTER FOUR: RESEARCH METHODOLOGY

4.1 Introduction

This chapter describes the methodology that was employed in data collection and analysis. Specific aspects shall include; sources and methods of data collection, sampling, data collection tools and data analysis techniques to be employed in this study.

4.2 Target population

The study targeted community residents of Olkaria sub-locations where the Olkaria Geothermal Project is located. The target population was approximately 9,194 households according to the 2009 census.

4.3 Sampling Techniques

The sampling frame for the purpose of this study was all households within Olkaria sub-location since the local community dwells in villages namely; OloSinyat, OloNongot, Cultural Centre, Narasha and OloMayiana. Equal proportions stratified sampling technique was employed.

The sample size is determined scientifically by the formula

$$n=N/(1+Ne^2)$$

Where

n= desired sample size for the study area

N=total no. of house-holds in the study area

e=desired margin error

Source: (Israel, 1992)

A margin error of 0.05 is selected since it is logically difficult to deal with a larger sample size (Mugenda and Mugenda, 2003)

$$\text{Thus } n=9194/(1+9194*0.05^2)$$

$$n=383$$

Due to financial and logistical constraints 25% of the sample size was used in this research study. The study therefore utilized a sample size of 99 households with each stratum having a random sample size of 20 units.

4.4 Data collection

Primary data formed the main data source for this study with supplementary secondary data from appropriate existing literature. Field survey formed the main of primary data acquisition and was supplemented with observations and photography. Secondary data was obtained from the UNFCCC website detailing the contents of the Projects Development Documents submitted by KenGen on behalf of the Olkaria Geothermal Project showing sustainable development benefits to be accrued from the CDM project. This information was used to compare with the findings from the primary data sources to establish how much had been done by the Olkaria Geothermal Project to contribute to sustainable development.

4.4.1 Data Collection Tools

Questionnaires: Semi structured and unstructured questionnaires formed the basic tools of primary data collection. 99 semi structured questionnaires were administered to local community respondents while unstructured questionnaires were administered to key informants from the Olkaria Geothermal Project.

Digital Camera: A digital camera was used to capture various scenes relevant to the study

Field Notebooks: were used to record observations made during the period of field study

4.5 Data Organization

The researcher perused the completed research instruments and documented analysis recording sheets. Both Descriptive and quantitative statistics was used.

The test of dependence/independence between household leader decision making and education level attained and economic development by CDM projects and village distance from the Project were calculated using chi-square test of independence\dependence.

$$\chi^2 = \sum^r \sum^c ((O - E)^2 / E)$$

Where χ^2 is the calculated chi square value

Where O=observed frequencies

E= Expected frequencies

Degrees of freedom = $(r-1)(c-1)$ where r and c refer for rows and columns

The chi square test was used to test the null hypotheses because the data met the required conditions for the chi square test.

The significance level of 0.05 was used to let the null hypotheses for this study.

CHAPTER FIVE: RESULTS AND DISCUSSIONS

5.1 Introduction

In chapter one, background about the contribution of the CDM projects to sustainable development was discussed. Study objective and the hypotheses of the study were set in the chapter. Chapter three discussed the concepts and theoretical literature about the sustainability of CDM projects. In order to address the research objective, a study was conducted to provide an understanding of the contributions of CDM projects to sustainable development. The purpose of this chapter is to present responses obtained from various participants in the research project.

5.2 Response Rate

The research was conducted on a sample of 99 respondents who were household residents of Olkaria sub-location to which questionnaires were administered. However, out of the issued questionnaires, 75 were returned duly filled in making a response rate of 75.76%, which was sufficient for statistical reporting. 10 unstructured questionnaires were also administered to Olkaria Geothermal Project employees as key informants. Based on this response rate, the researcher commenced the process of data analysis. The following section presents findings as arranged on the research instrument.

5.3 General information

The study sought to ascertain the information on the respondents involved in the study concerning the gender, age, marital status, education level and the village they belong. The bio data points at the respondents' suitability in answering the questions.

From the findings, majority of the respondents (75%) were male and 25% were female. This implied that most of the responses were from the males.

The respondents were requested to indicate their level of academic qualification. Figure 6 illustrates the study findings.

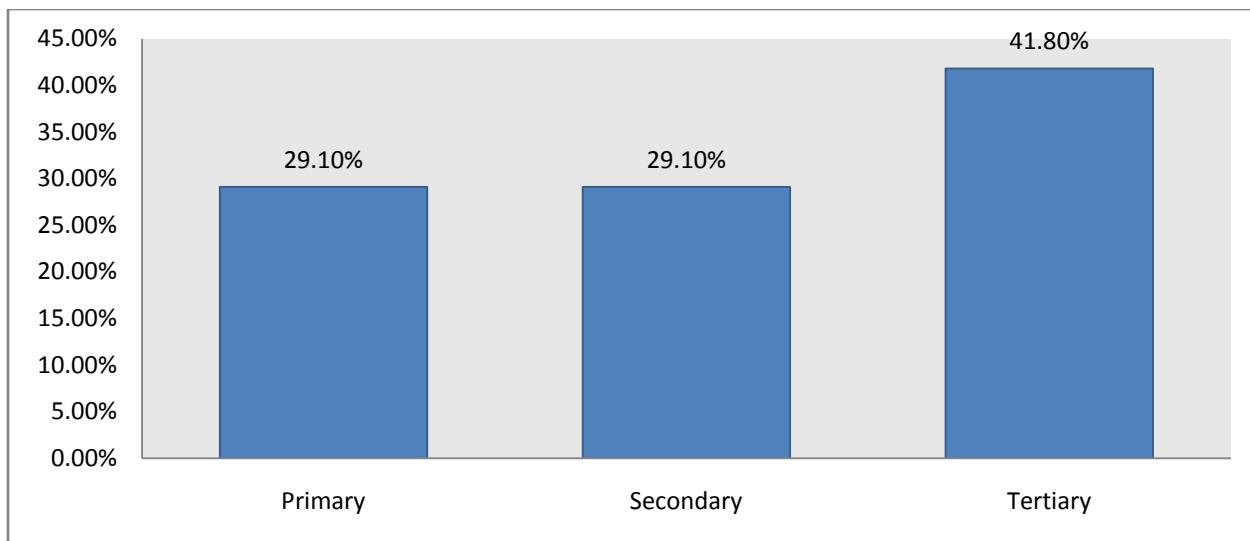


Figure 5: Respondents' Educational Level

Source: Fieldwork 2013

From the findings above, majority of the respondents (41.8%) had reached tertiary level, 29.1% had reached primary level and 29.1% had secondary level.

5.3.5 Respondents' Village Name

The respondents were requested to indicate the village they belong and Table 5.1 illustrates the study findings.

Table 5.1: Respondents' Village Names and Frequencies

Village	Frequency	Percentage
Oloosinyat	13	17.3
Oloonongot	16	21.3
Cultural Centre	13	17.3
Narasha	15	20.0
Olomayiana	18	24.0
Total	75	100%

Source: Fieldwork2013

As per the findings above, 24% of the respondents were from Olomayiana, 20% were from Narasha, 17.3% from Cultural Centre, 21.3% from Oloonongot and 17.3% from Oloosinyat.

5.4 Contribution of the Olkaria Geothermal Project to Sustainable Development

The study in this section sought information about the contribution of Olkaria geothermal project to sustainable development. Findings are presented in tables, figures and percentages.

5.4.1 General Contribution to Development

The study requested respondents to generally rate the contribution of Olkaria geothermal project to development in his/her community. Results are presented in Table 5.2 below.

Table 5.2: Olkaria Geothermal Project's general contribution to sustainable development

	Frequency	Percent (%)
A great deal	35	47.3
Quite a bit	30	40
A little	7	9.1
None	3	3.6
Don't know	0	0
Total	75	100%

Source: Fieldwork2013

From the findings, majority of the respondents (47.3%) indicated A great deal, 40% indicated Quite a bit, 9.1% indicated a little while 3.6% none. Not one respondent indicated they didn't know.

5.4.2 Activities that have been implemented by Olkaria Geothermal Project to enhance community development

The respondents were asked to give a listing of activities that have been implemented by the Olkaria Geothermal Project to enhance community development. The activities listed most include water projects, construction of water pans for watering livestock, renovation of community access roads, building and renovation of schools and Resettlement Action Plan. The respondents were further asked to list the activities that impacted them the most of which they reported water projects and the Resettlement Action Plan (RAP). Their reasons for the above included provision of clean water had improved their standards of living and health as also to their livestock, the Resettlement Action Plan was going to give them better housing social infrastructure like school, dispensary and water away from their present residence which is in and around the Hell's Gate National Park which has no security of tenure. Figures 7 and 8 show some of the community facilities under the Resettlement Action Plan (RAP)program.



Figure 6: Resettlement ActionPlan Sample House



Figure 7: A primary school under construction as part of the Resettlement Action Plan

5.4.3 Involvement of the Community in Decision Making

The section requested respondents to indicate how often Olkaria Geothermal Project involves the community in arriving at the community development projects to implement. Findings are presented in Table 5.3below.

Table 3.3: Community Involvement in Decision Making

	Frequency	Percent
Always	27	36.4
Most of the time	41	54.5
Sometimes	3	3.6
Rarely	4	5.5
Never	0	0
Total	75	100

Source: Fieldwork 2013

From the findings, majority of the respondents (54.5%) indicated that the Project most of the time involves the community in arriving at the community development projects to implement while 36.4% of them indicated that the company always involves the community. Further, the study asked respondents to describe how the Olkaria Geothermal Project involves the community in arriving at the community development projects to implement. Majority of the respondents indicated that they happen through community chairman, through Olkaria Geothermal Project community liaison office, public barazas and community sensitization meetings organized by the Project.

The study sought to find out how projects for community development are selected by the Olkaria Geothermal Project. The respondents described that the process begins with the community presenting various proposals detailing which areas/projects that they would like the Project to implement. The proposals are then submitted to the Project's Corporate Social Responsibility (CSR) committee who prioritize among the proposals what to implement for the community. Therefore, the level of community participation in decision making can be described to be collaborative.

5.4.4 Women Empowerment Initiatives

The respondents were asked to indicate the frequency with which the Project organizes women empowerment programs for the local community. The results are indicated in Table 5.4 below:

Table 5.4: Establishment of Women empowerment programs

	Frequency	Percent
Most of the time	7	9.1
Sometimes	25	32.7
Rarely	40	54.5
Never	3	3.6
I don't know	0	0
Total	75	100

Source: Fieldwork 2013

On the issue of how often Olkaria Geothermal project organize women empowerment programs in the community, majority of the respondents (54.5) indicated that rarely does the company organize such programs. The key informants indicated that there are no direct initiatives by the project for women empowerment except that in provision of scholarships for secondary and university education for bright and needy students, at least one for each is reserved for girls. Occasional distribution of sanitary towels to schools was also pointed out by the respondents.

5.4.5 Decisions in Family Household

The study requested respondents to indicate how they arrive at decisions in their family household. Findings are presented in Figure 9.

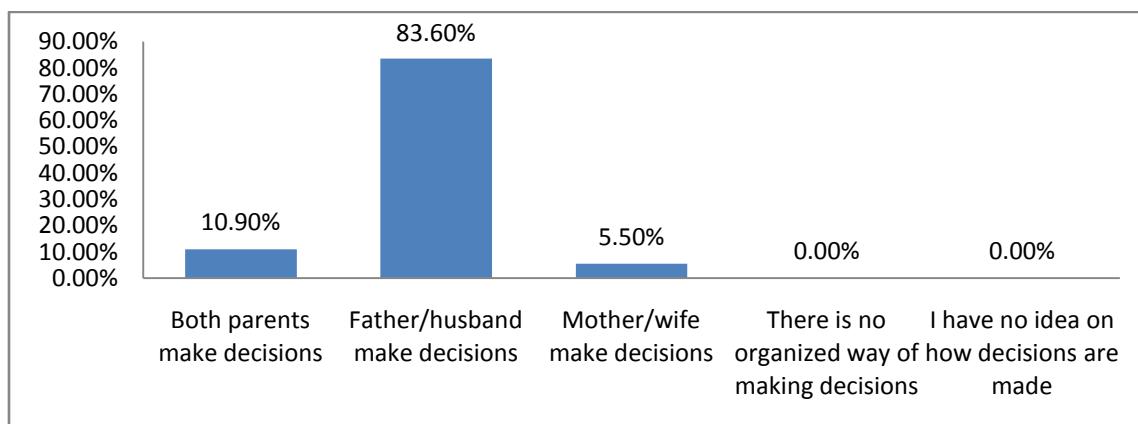


Figure 8: Decision making at household level

Source: Fieldwork 2013

From the findings, majority of the respondents (83.6%) stated that father/husband make decisions in the family, 10.9% indicated that both parents make decisions in the family while

5.5% stated that mother/wife make decisions in their family. This response gives an indication women in this community are not yet empowered; they have no or limited input on the decisions of running their households with very little if any consultation from their partners. An indication the limitation of women empowerment in this community is also highlighted by the response to the study questionnaires as the female gender represented only 25%, besides, most women were not willing to fill the study questionnaires.

5.5 Environmental Development

The study in this section sought information on how the Olkaria Geothermal Project has contributed to environmental development. Findings in this section are presented using Tables.

5.5.1 Contribution of Olkaria Geothermal Project towards Environmental Development

Respondents in this section were requested to indicate the extent Olkaria Geothermal project has contributed towards environmental development. Table 5.5 presents the findings.

Table 5.5: Contribution of Olkaria Geothermal Project to Environmental Development

	Frequency	Percent
A great deal	10	12.7
Quite a bit	38	50.9
A little	23	30.9
None	4	5.5
I don't know	0	0
Total	75	100%

Source: Fieldwork 2013

From the findings, majority of the respondents (50.9%) indicated that Olkaria Geothermal project has contributed towards environmental development quite a bit, 30.9% rated its contribution as little, 12.7% a great deal while 5.5% said there was no contribution to environmental development.

Project's Participation Improving the Environment

The respondents were asked if the Olkaria Geothermal Project was involved in the improvement of the environment and 93% indicated that there have been activities by the Olkaria Geothermal Project in improving the environment while 7% indicated otherwise. The study requested the respondents to give a listing of such activities. The activities as stated by respondents were: environmental workshops; provision of tree seedlings; planting of trees; environmental seminars/ trainings; participating in world clean-up day; world environmental day; environment

conservation awareness and establishment of tree nurseries. This is also highlighted by the key informants who stated that Social Afforestation is the Project's main mode of engaging the community in environmental development. The Project has set up and maintains tree nurseries within the locality of which they freely avail tree seedlings to community members. At present there are tree nurseries at Iseneto, Karagita, G.K Prison Naivasha and EwasoKedong. There is also a tree nursery in the Project which serves the project's employees who are encouraged to pick tree seedlings for planting in their homes and wherever they wish. The local community is encouraged to pick seedlings from these tree nurseries so they can plant in their farms and neighbourhoods. Figure 10 shows a tree nursery in the Project.



Figure 9: Tree Nursery at the Olkaria Geothermal Project

Source: Fieldwork, 2013

The key informants were asked by the study on how they ensured that their usual activities didn't impact the environment and were quick to point out that for each and every activity carried out by the Olkaria Geothermal Project there is an accompanying Environmental Management Plan implemented to take care of environmental impacts as per stipulation in the Environmental Management and Coordination Act (EMCA). The Olkaria Geothermal Project has the

Environmental department which is tasked with supervision and ensure adherence to the EMP by periodically carrying out environmental audits. The audits are moderated by external auditors.

5.6 Economic Development

The study in this section sought information about Olkaria Geothermal Project's contribution to economic development which is an integral pillar of sustainable development. Findings in this section are presented using Tables.

5.6.1 Contribution to Economic Development

The study requested the respondents to rate the contribution of Olkaria Geothermal Project to economic development. Findings are presented in Table 5.6 below:

Table 5.6: Contribution to Economic Development

	Frequency	Percent
A great deal	5	7.3
Quite a bit	55	72.7
A little	14	18.2
None	1	1.8
I don't know	0	0
Total	75	100%

Source: Fieldwork 2013

From the findings, majority of the respondents (72.7%) indicated that the Project's contribution to economic development is quite a bit, 18.2% a little, 7.3% a great deal while 1.8% of the respondents said none.

5.6.2 Employment opportunities in the Project

The study asked respondents to give their views on how Olkaria Geothermal Project has fared with regard to creating employment opportunities for the local community, the results are shown in Table 5.7.

Table 5.7: Creation of employment opportunities for the local community

How has the Olkaria Geothermal Project faired/accomplished in providing employment opportunities to the local community?	Percentage	
	A great deal	12.7
	Quite abit	49.1
	A little	34.5
	None	3.6
	I don't know	0

Most of the respondents 49.1% felt quite a bit had been done by the project to create employment opportunities for them while 34.5% said the project had done little and 12.7% indicated that a great deal had been done.

The study requested respondents to indicate to their best knowledge if they knew anybody from the local community who is/are employed in the project.

Majority of the respondents (95%) indicated that they knew at least someone from the local community who works for the Project.

The study sought to find out the employment opportunities that have risen as a result of the project and respondents indicated that apart from direct employment, there were indirect income generation opportunities. Income generation activities could include food provision for workers in the project, offering transport to various workers in the project and provision of various construction materials in the project.

Direct employment opportunities for both skilled labour (professionals) and unskilled labour with the former being offered on an equal opportunity to all while the latter is offered with preference to local community members.

When questioned how the Project ensures local community members get the jobs for unskilled labour, the respondents stated that the local community is represented by a committee (the Stakeholders Committee) in the project. The committee is made up of local community members voted in by the community. The committee is notified of available employment opportunities and then tasked with finding community members who can fill in the positions.

5.6.3 Local Community Infrastructure Improvement

The study sought to find out if there are initiatives by the project to improve local community infrastructure. Majority of the respondents (92%) indicated that there are initiatives by the project to improve local community infrastructure. Respondents were further asked to give a list of such initiatives and these they stated as; provision of clean drinking water, water pans for watering livestock and improving access roads. This is also reflected by the key informants who stated the initiatives as being; the Olosingate water pan for watering livestock, construction of a waterline from Maiella to Tank Mpya, grading of community access roads and drifts including the roads to Iseneto, Inkilonkosi, Oltepesi, Karagita and Moi South Lake therefore improving

accessibility, renovation of classrooms including 3 classes at Mvuke, Oloirowua and Nkampaani primary schools.

The figures 11 to 13 show some of the community infrastructure improvement initiatives that have been implemented by the project:



Figure 10: Olosingate Water pan for watering livestock



Figure 11: Community Waterline from Maiella to Tank Mpya



Figure 12: A classroom under construction at Oloiruwua Primary School

5.7 Discussion of findings

The PDDs submitted by Olkaria Geothermal Project included; construction of roads to improve community transport infrastructure, employment during construction and operation of power plants and community development projects through social corporate responsibility (UNFCCC, 2006). The study established that there was upgrading of community access roads, construction of waterlines for clean water provision for the community, construction of classrooms, construction of water pans for watering livestock among others.

5.8 Hypotheses Testing

The study enlisted the use of chi-square in order to test the research null hypotheses. Under chi-square, if the calculated value is greater than or equal to the critical value then you reject H_0 .

5.8.1 Hypothesis One

H_0 : Local economic development by CDM projects is independent of community villages' distance from the CDM project

In order to test this hypothesis, the study sought to establish the number of people who were employed in the Project from each of the villages versus the village distances from the project.

Calculated value for chi (χ) was 0.23 while the critical value at a significance level of 0.05 is 9.49.

The calculated value was found to be less than the critical value hence no sufficient evidence to reject the H_0

This could mean that community economic development by the Olkaria Geothermal Project is not influenced by the distance between the villages and the Olkaria Geothermal Project.

5.8.2 Hypothesis Two.

H_0 : Household leader decision making is independent of education level attained

To test this hypothesis, community respondents were asked to state how decisions were made in their family (If the male figure, female figure or joint decisions were and the respective education level attained by the decision maker). The results were cross tabulated and a chi test calculation done.

Calculated value for chi (χ) was 8.45 while the critical value at a significance level of 0.05 is 9.49.

The calculated value was found to be less than the critical value hence no sufficient evidence to reject the H_0

Education seems to play a major role in household decisions although not significant statistically for this study.

CHAPTER SIX: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

The study assessed the contribution of CDM projects to sustainable development and used a case study of the Olkaria Geothermal Project. It looked at three objectives which were to assess the contribution of CDM projects towards community social development which in which community participation in decision making and women empowerment were considered; to determine the extent to which CDM projects have contributed towards local environmental development in which the study sought to establish the Project's initiatives to enhance environmental development; and to assess the contribution of CDM projects towards local economic development in which the study considered the Project's contribution to creation of employment and local community infrastructure improvement. The study also tested three hypotheses according to the study objectives.

With regard to the first objective, the study established that the level participation in decision making can be termed as collaborative since the Project allows the local community to make proposals of projects they would want to be implemented in their locality and the Project only prioritizes the project to be implemented through its CSR committee, the study also established that there is a stakeholders committee that represents the community and a liaison office within the community that handles day to day issues affecting the community. Besides there are public barazas held between the community and the Project so the community can air their issues. As for women empowerment the study established that the Project's only initiative to empower women is by offering at least two scholarships to the girl child annually for secondary and university education.

With regard to local environmental development initiatives, the study established that social afforestation is the main mode of engaging the community in environmental development. Environmental awareness is also enhanced by the Project through participation in environmental seminars/ and important days in the environmental calendar such as world clean-up day and world environmental day. The study also established that the Project employs the use of Environmental Management Plan (EMP) to take care of negative environmental effects of Project activities.

With regard to the Project's contribution to local economic development, the study established that there are direct and indirect employment opportunities for the local community members. Employment opportunities for unskilled labour are reserved for the local community members and the committee representing the local community is tasked with the task of finding community members to fill up the positions. The study also established that there are initiatives by the Project to improve local community infrastructure. The main initiatives established include, improving the condition of the community's access roads, construction of water pans for watering community livestock, provision of clean drinking water and renovation of classrooms for some schools in the community.

6.2 Conclusions

The study concludes that the contribution of Olkaria geothermal project to community social development is considerable since it has enhanced community empowerment by sharing with them decisions regarding community development projects (the level of community participation in decision making can be regarded as collaborative). By offering scholarships for secondary and university education to the local community and reserving at least two of these scholarships for female students indicated the Project's effort to empower women through education.

The Project's contribution to local environmental development is through carrying out social afforestation and promoting environmental awareness through participation in important days in the environmental calendar such as world environmental day and engagement in environmental workshops. The Project minimizes the negative environmental effects of its activities by implementing an Environmental Management Plan for these activities. Internal and external environmental audits are carried out to evaluate adherence to the Environmental Management Plans.

The Project's contribution to local economic development is through direct and indirect income generation activities with employment opportunities for unskilled labour being a reserve for the local community. There are initiatives by the Project to improve local community infrastructure by improving the condition of community access roads, provision of clean drinking water for the community, construction of water pans for watering livestock and construction and renovation of some local schools classrooms in the community.

6.3 Recommendations

Further research is necessary as the findings were based on a relatively small sample that may have influenced the nature of results that were obtained. There is need to expand on the sample size and carry out similar research in other locations.

The study did not explore all the indicators of sustainable development fronted by various studies (Olsen & Fenhann, 2008) on the various dimensions of development. Further studies focusing on the other indicators for the same case study and other similar case studies can be helpful in shedding more light on the contribution of CDM projects to sustainable development.

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APPENDICES

Appendix One: Questionnaire for Community Members.

1. Gender Male []

Female []

2. Education Level Primary []

Secondary []

Tertiary []

3. Village name

OloMayiana []

OloSinyat []

OloNongot []

Narasha []

Cultural Centre []

4. What activities/measures have been carried out by Olkaria geothermal Project to enhance community development

.....
.....
.....
.....

Give a listing of these community development projects

.....
.....
.....

Which of these projects has impacted you most positively?

.....

Why?

Section B: Contribution of CDM Projects to Sustainable Development

5. a) How would you describe the frequency of community involvement by Olkaria Geothermal Project managers in arriving at the community development projects to implement?

Always []
Most of the time []
Sometimes []
Rarely []
Never []

- b) Exound on a) above
-
-

6. How often does Olkaria geothermal expansion project organize women empowerment programs in the community?

Most of the time []
Sometimes []
Rarely []
Never []
I don't know []

7. A). How you arrive at decisions in your family household?

Both parents make decision jointly []
Father/husband (lead male in household) makes decision []
Mother/wife (lead female in household) makes decision []
There is no organized way of making decisions []
I have no idea on how decisions are made []

B). Please state the education level in a) above

Primary [], Secondary [], Tertiary []

8. To what extent has Olkaria geothermal project contributed towards environmental development in your locality?

A great deal []

Quite a bit []

A little []

None []

I don't know []

9. Has Olkaria geothermal project participated in any activity of improving our environment?

Yes [] No []

b). Give a listing of such activities

.....
.....
.....
.....

10. To what extent has Olkaria geothermal project contributed towards economic development in your locality?

A great deal []

Quite a bit []

A little []

None []

I don't know []

11. Do you know people from the local community who work for the Olkaria Geothermal Project?

Yes [] No []

12. A). Are there initiatives by the Olkaria Geothermal Project to improve community infrastructure?

Yes [] No []

B). Give a listing of such initiatives

13. How has the Olkaria Geothermal Project faired/accomplished in providing employment opportunities to the local community?

- A great deal []
- Quite a bit []
- A little []
- None []
- I don't know []

14. In your own opinion does the Project's provision of employment and development of community infrastructure equal across the villages?

Yes [] No []

Appendix 2: Questionnaire for key informants-Olkaria Geothermal Project Employees

1. Employment

- a. How many employees does the project have?
- b. Apart from direct employment in the project, are there indirect employment/income generation activities in the project?
- c. How does the Project ensure inclusion of local community members?
- d. What is the criteria for employment especially semi and non skilled labour?
- e. Are there job opportunities reserved for the local community?

2. Infrastructure Improvement

- a. Are there initiatives by the Project to improve local infrastructure for the community?
- b. Give a list of a. above
- c. How often does the Project implement community development projects?
- d. What is the criterion used to decide which community development projects to implement?

3. Community Participation in Decision Making

- a. What mode of communication does the Project employ while engaging with the community?
- b. How does the community access the Project for any queries or any information?

- c. What measures does the company employ to empower the community with regard to decision making? i.e when the Project wants to implement a community development initiative?
- d. Describe the structure of engaging the community in decision making processes with regard to anything that affects them

4. Women Empowerment

- a. Are there initiatives by the Project to empower women in the local community?
- b. What are these initiatives?

5. Environmental Development Initiatives

- a. Are there environmental sustainability initiatives by the Project?
- b. Give a listing of these in a. above
- c. Does the Project involve the local community in environmental management and improvement?
- d. What is the mode of operation?
- e. What are these initiatives that the Project employs in involving the community in environmental development?
- f. How does the Project counter the negative environmental activities of its activities?