Rpt Nrº 05-04

Ministry of Energy
Republic of Kenya

FEASIBILITY STUDY
ON
SMALL HYDROPOWER PROJECT
FOR 12 SITES FOR TEA FACTORIES
IN KENYA

Final Report

Volume IV
Supporting Report (3)
(Environmental Impacts Assessments)

ENVIRONMENTAL IMPACT ASSESSMENT PROJECT REPORT FOR THE PROPOSED KIRINGA SMALL-HYDROPOWER STATION IN KABARE LOCATION, GICHUGU CONSTITUENCY, KIRINYAGA EAST DISTRICT

AUGUST 2009

Q-Energy
Que Energy Limited
Nairobi, Kenya

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This Report consists of

Volume IV Supporting Report (3)

(Environmental Impacts Assessments)

This Study was fully Supported by Government of Kenya in a 10 month Feasibility Assessment of some 12 sites for Tea Factories in Kenya.

DOCUMENT AUTHENTICATION FORM

I/We….....JOSEPH K. KURAUKA …….....as Environmental Expert to:

Proponent……..Ministry of Energy…….on Project: Environmental Impact Assessment Project Report for the Proposed Kiringa Small-Hydropower Station in Kabare Location, Gichugu Constituency, Kirinyaga East District.

Do hereby certify that this report was prepared on the information provided by the Ministry of Energy as well as that collected from other primary and secondary sources and on the best understanding and interpretation of the facts by the environmental assessors. It is issued without any prejudice.

1. Name ….. JOSEPH K. KURAUKA ……..

NEMA Reg. No. ……0673……..

License No.. ……246 ……..

Signature……

PROJECT PROPONENT:

The Study was supported by the Government of Kenya through the Ministry of Energy for supporting the tea factories in developing small hydropower resources within their reach. Single or Joint venture proponents may emerge

Estimated cost of the project: Ksh. 220,000,000

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ABREVIATIONS AND ACRONYMS

AEZ	Agro-ecological Zones
BOD	Biological Oxygen Demand
DEO	District Environmental Officer
DO	District Officer
DRSRS	Department of Resource Surveys and Remote Sensing
EIA	Environmental Impact Assessment
EA	Environmental Audit
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
EHS	Environmental Health and Safety
GOK	Government of Kenya
KPLC	Kenya Power and Lighting Company
KTDA	Kenya Tea Development Agency
LH	Lower Highland
LM	Lower Midlands
NEMA	National Environment Management Authority
NEAP	National Environmental Action Plan
MoE	Ministry of Energy
NGO	Non-Governmental Organization
NPEP	National Poverty Eradication Plan
OHS	Occupational Health and Safety
PRSP	Poverty Reduction Strategy Paper
PEC	Poverty Eradication Commission
UH	Upper Highland
UM	Upper Midland
TOR	Terms of Reference
KWS	Kenya Wildlife Service
MENR	Ministry of Environment and Natural Resources
MOW&I	Ministry of Water and Irrigation

ACKNOWLEDGEMENT

We, the EIA Study Team for the proposed Small-Hydropower station within Kirinyaga East District, would like to register our appreciations to all those who contributed information or advice towards developing and drafting this report. This include the Management of the Ministry of Energy at the headquarters in Nairobi; The heads of Departments at the DC's office in Kerugoya, and the community of the Kabare Location, where the proposed site of the proposed Small-Hydropower station is sited.

Many other individuals; professionals and other interested partners have immensely contributed to the EIA Study of the proposed Small-Hydropower station; directly and indirectly and the list is too long to produce here. To them all, we say thank you very much for their constructive efforts, support, cooperation and understanding.

EXECUTIVE SUMMARY

The Ministry of Energy is proposing to construct a Small-Hydropower station within Kirinyaga Tea Zone. The Small-Hydropower station will process the neighbouring tea factory green leaf and also supply power to the local community in the location. The proposed Small-Hydropower station is expected to supply energy within Kenya Tea Development Agency (KTDA) factories while enabling them to achieve self-reliance. The Small-Hydropower station is also envisaged to serve the surrounding communities as well as provide employment which will improve the socioeconomic status of the local communities. The river has three main water falls that will produce power. The construction is estimated to cost **Ksh. 220,000,000**. The estimated cost of Environmental mitigation measures is **Ksh. 4,495,000** (Table 7.1).

In conformity with the Environmental Management and Coordination Act (EMCA) of 1999, such a project is subject to Environmental Impact Assessment (EIA) before commencement. The purpose of the EIA study was to investigate potential impacts of the proposed Small-Hydropower station on the biophysical, social and natural environment in Kabare location in particular and the country in general. The study has proposed mitigation measures, including an Environmental and Social Management Plan (ESMP).

The EIA study employed several methods and techniques in data collections including:

- Literature review
- Consultations with Ministry of Energy management in Nairobi and its field management in Kerugoya
- Discussions with Kirinyaga District Departmental Officer
- Consultations and public Participation (CPP) using key informants and baraza.
- Focus group discussions (males, females and youth)
- Households socioeconomic survey
- Observations and photography

Data collection instruments used in the study were:

- Checklist (for preliminary survey)
- Discussions guide for district departmental heads,
- Focus group discussion drawn from the community.
- Household, questionnaire for heads of households.
- Questionnaire for Ministry of Energy field officers
- Observations guide for site walkthrough inspection e.t.c.
- Data analysis, using SPSS, tabulations and line graphs to facilitate interpretations

The main findings of the study were as follows:

The local community has an overwhelming support for the project. There is a high expectation of employment for the youth and improvement in the household incomes, infrastructure and general delivery of social services.

1. The community expects the proposed Small-Hydropower station to reduce losses related to frequent power blackout at the nearby KTDA's Kimunye tea factory.
2. Traditionally, tea factories have used heavy fossil oil for the boilers. However, in recent times due to escalating oil prices, there has been a major shift to use of fuel wood as a source of energy. In this respect, Ministry of Energy has commissioned a feasibility study on 12 Small-Hydropower stations in the country.
3. Residents/ community are concerned about the following:

Meeting with the community and other stakeholders. Discussions on the proposed Small-Hydropower station but not limited to the following:

- Ø Social impacts of the project
- Ø Economic aspects of the project
- Ø Impacts of construction on Biodiversity, especially medicinal plants and the indigenous knowledge of conservation.
- Ø Potential conflicts due to encroachment on private land during construction
- Ø Discuss potential impact on human health

Visit relevant Government Officers and KTDA management. Topics to proposed Small-Hydropower station on but not limited to the following:

- Ø Assessment of water source points
- Ø Reservoir characteristics
- Ø Physical landscape
- Ø Soil-water run-off characteristics
- Ø Land use activities in the location
- Ø Biodiversity conservation and environmental issues
- Ø Social and cultural issues
- Ø Conservation and political issues
- Ø Recap and consolidation of the day's discussions.
- Ø Analysis of the days discussions
- Ø Hold discussions with local agricultural, physical planning and land officers on rural land-use systems management, human resettlement and compensation

Meeting with the community and other stakeholders. Discussions on raising the dam but not limited to the following:

- Ø Social impacts of the project
- Ø Economic aspects of the project
- Ø Impacts of construction on Biodiversity, especially medicinal plants and the indigenous knowledge of conservation.
- Ø Potential conflicts due to encroachment on private land during construction
- Ø Discuss potential impact on human health
- Ø Analysis of the days discussions

4. The stakeholders supported the proposed project

The following recommendations are made:

1. The Proponent should put in place all proposed mitigation measures and as outlined in ESMP matrix.
2. The Ministry of Energy to facilitate agroforestry through the neighbouring tea factory extension services. In addition, the Ministry in collaboration with other government departments and agencies need to build the capacity of local community to engage in afforestation activities of the catchment areas.
3. Ministry of Energy and KTDA to take maintenance role of the proposed Small-Hydropower station.

CHAPTER ONE: INTRODUCTION

1.1 Background

Energy consumption and sources of energy

At national level, biomass (mostly wood fuel) accounts for about 68 percent of the total primary energy consumption, followed by petroleum at 22 percent, electricity at 9 percent and others at about less than 1 percent. In rural areas, the reliance on biomass is over 80 percent3. Only approximately 15 percent of Kenyans have access to grid electricity. Access to affordable modern energy services is constrained by a combination of low consumer incomes and high costs. In the rural areas where only about 4 percent of the population has access to electricity, the scattered nature of human settlements further escalates distribution costs and reduces accessibility.

The majority of Kenyans live in rural areas where traditional biomass (mainly wood fuel) has remained the leading source of energy (both for cooking, and at times for lighting). However, the potential of biomass has not been effectively utilised in the provision of modern energy for a variety of reasons. One is the failure to exploit the opportunities for transforming wastes from agricultural production and processing into locally produced modern energy. High incidence of poverty is another constraint to shift from traditional to modern biomass energy utilisation.

Continued over-dependence on unsustainable wood fuel and other forms of biomass as the primary sources of energy to meet household energy needs has contributed to uncontrolled harvesting of trees and shrubs with negative impacts on the environment (deforestation). Environmental degradation is further exacerbated by climate variability and unpredictability of rainfall patterns. In addition, continued consumption of traditional biomass fuels contributes to poor health among users due to excessive products of incomplete combustion and smoke emissions in the poorly ventilated houses common in rural areas. Biogas is an energy technology that has the potential to counteract many adverse health and environmental impacts connected with traditional biomass energy in Kenya. The purpose of this study is to assess the feasibility of promoting biogas in Kenya.

According to to the Ministry of Energy (2007), the current sources of electrical power generation are hydro 3,025 Gwh (51.2%), thermal oil 1,819 Gwh (30.8%), geothermal 1,046 Gwh (17.7%), cogeneration 6 Gwh (0.09%), wind 0.3 Gwh (0.01%) and imports 11 Gwh (0.2%). Petroleum fuels are imported in form of crude oil for domestic processing and also as refined products, and are mainly used in the transport, commercial and industrial sectors. The domestic consumption of petroleum products are as follows: light diesel oil 1,035,600 tonnes (34.1%), fuel oil 664,600 tonnes (21.9%), aviation spirit and jet fuel 595,300 tonnes (19.6%), motor spirit 358,200 tonnes (11.8%), illuminating kerosene 279,200 tonnes (9.2%), liquefied petroleum gas 64,600 tonnes (2.1%) and heavy diesel oil 40,700 tonnes (1.3%).

Development projects recommended under Vision 2030 and overall economic growth, will increase demand on Kenya's energy supply. Currently, Kenya's energy costs are higher than those of her competitors. Kenya must, therefore, generate more energy and increase efficiency in energy consumption. The Government is committed to continued institutional reforms in the energy sector, including a strong regulatory framework, encouraging **private generators of power**, and separating generation from distribution. New sources of energy will be found through renewable energy sources, and connecting Kenya to energy-surplus countries in the region.

This Environmental Impact Assessment (EIA) Project Report was carried out in conformity with the requirements of the Environmental Management and Co-ordination Act, 1999 and the Environmental (Impact Assessment and Audit) Regulations, 2003 and the new Wastes disposal Regulations. According to section 58 and 138 of the EMCA, 1999 and section of the Environmental (Impact Assessment and Audit) Regulations 2003 (Legal No. 101), buildings require an environmental impact assessment report and submitted to the National Environment Management Authority (NEMA) for

review and eventual licensing before the development commencement. In preparing this report, reference has been made to environmental guidelines of Kenya, World Bank guidelines and other International Conventions on the Ecosystems.

1.2 A Brief Background of the Proponent (Ministry of Energy)

2.2.1. *Policy and enabling environment*

Ministry of Energy:

The Ministry of Energy (MoE) was first established in 1979 to oversee the development and implementation of policies to ensure energy from various sources was made available to meet demand. MoE plays a largely facilitative role in energy supply, which includes taking leadership in the development of policy as well as legal and regulatory framework for the sector. In addition it has an oversight responsibility over the provision of reliable and adequate energy generation and distribution.

The Ministry has 10 Energy Centres spread around the country and has core staff complement of approximately 270, spread across three core departments -Geoexploration; Electric Power and Renewable Energy and three support departments-Planning, Finance and Administration. The Energy Centres provide basic information and technical advice on biogas and materials needed and also conduct demonstrations. They can also refer potential customers to credible local technicians. It is estimated that through the ministry's biogas promotion programme about 1300 biogas plants have been established, but there are no records available to verify this estimate. It is also estimated that through the ministry's efforts about 50 biogas units are constructed every year. According to MoE the technical potential for biogas is highest in the high population density areas where zero grazing is practiced (Central Kenya, Kisii, Kericho, Meru, Western Kenya etc).

The MoE's strategic plan (2004-2009) has provision for conducting a national biogas survey to establish the actual status of the industry in Kenya during the financial year 2007/2008. The ministry works with other actors such as the Ministries of Agriculture, Livestock and Fisheries Development and Environment and Natural Resources. However, institutional arrangements have not been very strong.

1.3 Small Hydro power plant

1.3.1. Introduction

Hydro power is a renewable energy, clean and non polluting energy with high conversion efficiency showing spectacular operational flexibility and operational and economic superiority over other energy production means.

Depending on the site and layout of the scheme, temporal and permanent impacts have been reported to occur during construction and operational phases of SHP plants. The effects on downstream water supply and drainage has been identified as one of the main causes that can be well addressed. Along with other compensatory measures like providing separate drinking water, water for irrigation and priority in power connections to the affected households.

1.3.2. Building a Small Hydro power Plant:

Identify Sites with potentially good water resources. A sufficient quantity of falling water must be available. Determine the amount of power that you can obtain from the flowing water on your site. The power available at any instant is the product of what is called flow volume and what is called head. The best sites have a reliable water supply year-round and a large vertical drop in a short distance.

A rough estimate of the power available at a specific micro-scale site can be calculated from the equation:

1. Power (kW) = 6 X Head (m) X Flow (m^3/sec)
2. Head = the vertical flow of the water, essential for hydropower generation
3. Flow = volume of water passing per second

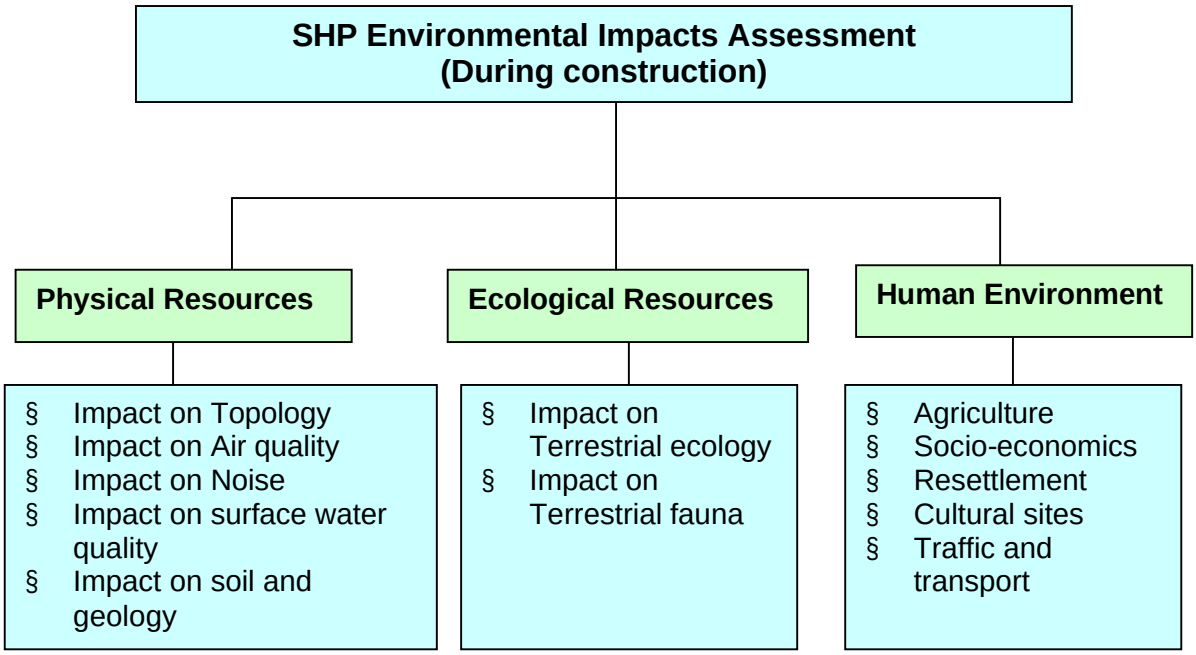
Note: *Heads less than 2m are liable to be uneconomic.*

1.3.3. Benefits of Small Hydro power plants:

1. The SHP combines the advantages of sustainable hydropower with centralized power generation.
2. Capable of complementing power source to intermittent renewable energy sources e.g. (wind and solar) as the flow can be either regulated to reserve generating capacity during peak demand periods or when the capacity of other renewable sources becomes limited.
3. Can be integrated into existing irrigation structures, flood control and dams reservoirs well suited to construction of small engineering works.
4. Electrify to remote communities and industries away from the grid supply in decentralized manner.

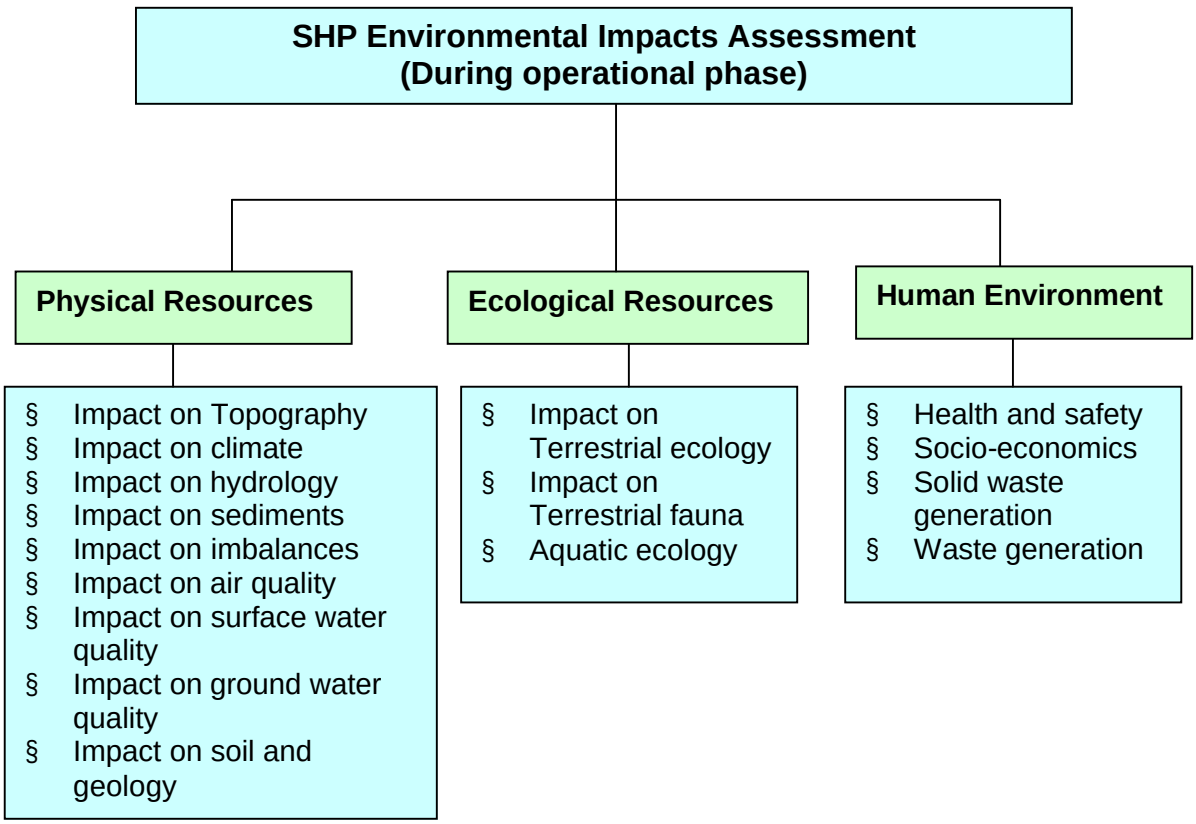
The impacts accessed during pre-construction, construction and operational phase are categorized into 3 basic resources as per details given in the chart below:

Figure 1 The impacts accessed construction phase



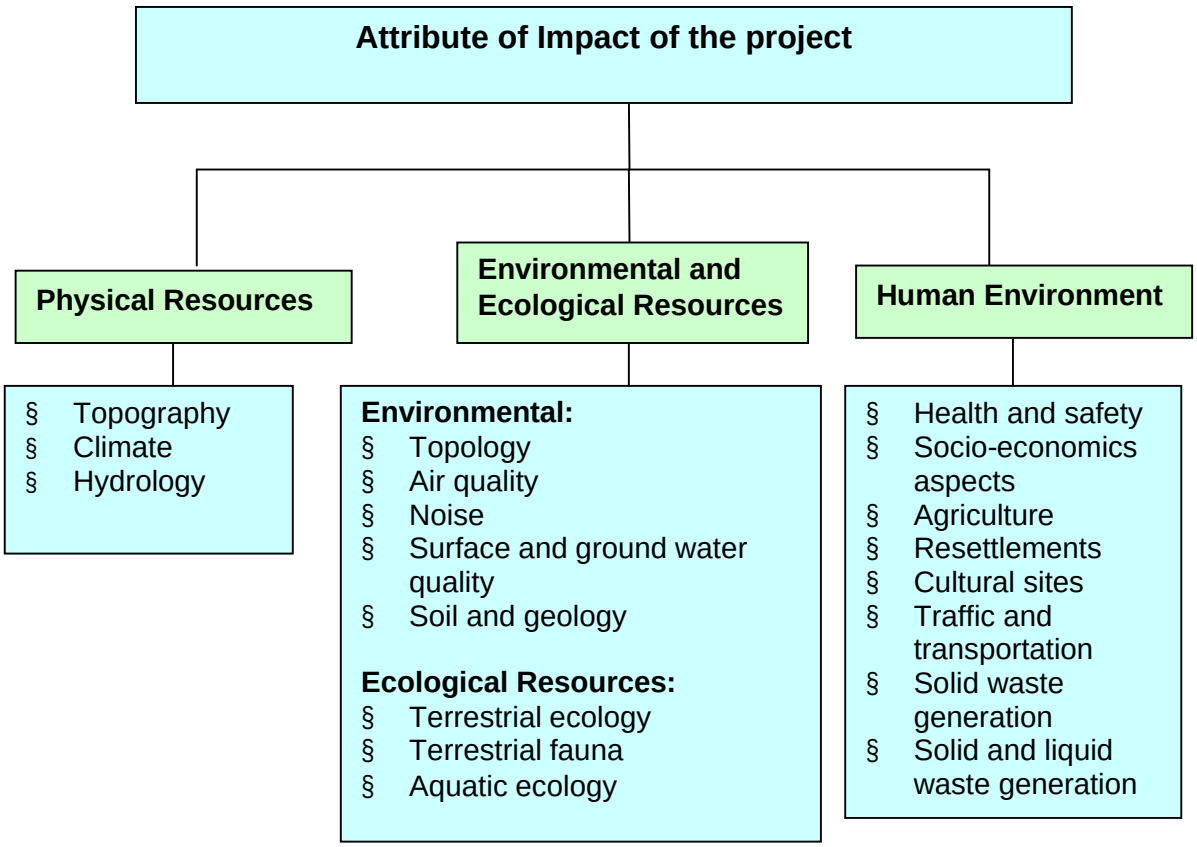
The impacts accessed during pre-construction, construction and operational phase are categorized into 3 basic resources as per details given in the chart below:

Figure 2 The impacts accessed during operational phase



The impacts accessed during pre-construction, construction and operational phase are categorized into 3 basic resources as per details given in the chart below:

Figure 3 Attribute of Impact of the project during pre-construction, construction and operational phase



1.4 Environmental Impacts of project

Based upon the predictions of impact detailed above, impact assessed without and with the proposed project has been conducted and the results are reported in the Table 1.1 below:

Table 1 Predictions of impact detailed above, impact assessed without and with the proposed project:

No.	Parameter	Environmental Impact units			
		Without project	*With project*	*Net change*	*Magnitude*
1	Crops	Nil	Negative	Small	Low
2	Natural vegetation	Nil	Negative	Small	Medium
3	Forests	Nil	Negative	Small	Medium
4	Land use	Nil	Negative	Small	Medium
5	Natural Reserves	Nil	Negative	Small	Low
6	Fisheries	Nil	Negative	Small	Medium
7	Wildlife	Nil	Negative	Small	Low
8	Rare species	Nil	Negative	Small	Low
9	Endangered species	Nil	Negative	Small	Low
10	Species diversity	Nil	Negative	Small	Low
11	Water pollution	Nil	Negative	Small	Low
12	Air pollution	Nil	Negative	Small	Low
13	Noise pollution	Nil	Negative	Small	Low
14	Solid waste	Nil	Negative	Small	Low
15	Land pollution	Nil	Negative	Small	Low
16	Soil erosion	Nil	Negative	Small	Medium

17	Eutrophication	Nil	Negative	Small	Medium
18	Health	Nil	Positive	Big	High
19	Benefit to Economy	Nil	Positive	Big	High
20	Over abstraction of water upstream	Nil	Negative	Small	Low
21	Displacement/ encroachment of private land	Nil	Negative	Small	Low

1.5 Project location

The proposed Small-Hydropower station is about 18 Kilometres from Kerugoya town. It is located at Njuku Sub-location, Kabare Location, Kirima Division, Gichugu Constituency in Kirinyaga East district. The proposed Small-Hydropower station is located 4 kilometres from Mt. Kenya forest, 2 kilometres from Kimunye tea factory along river Kiringa. The river has three water falls that will produce power namely Gicheru, Kathiri and Itirire.

Plate 1 Project proposed intake captured from the southern side of the Kiringa river

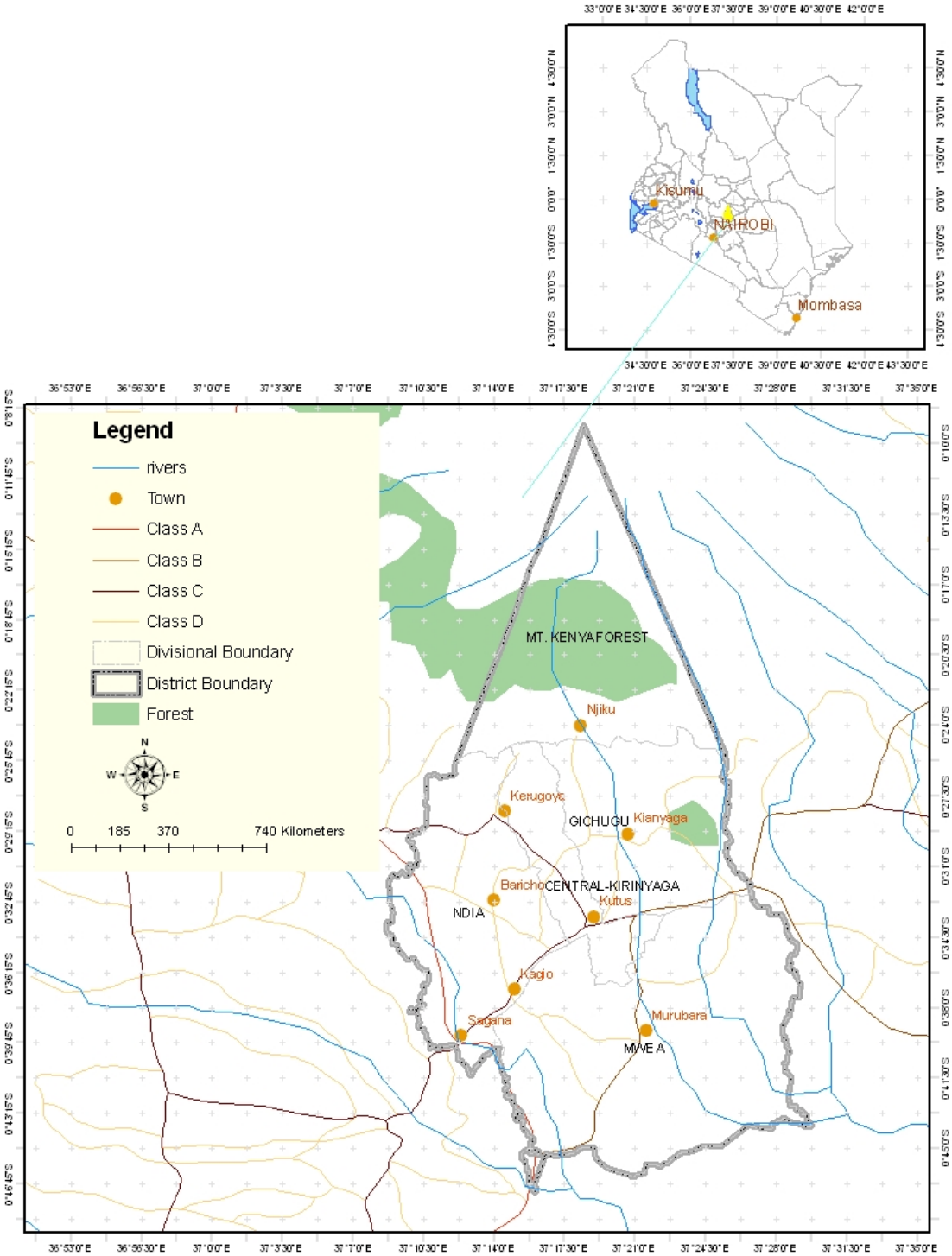


Figure 4 Map of Kenya Showing Location of larger Kirinyaga District

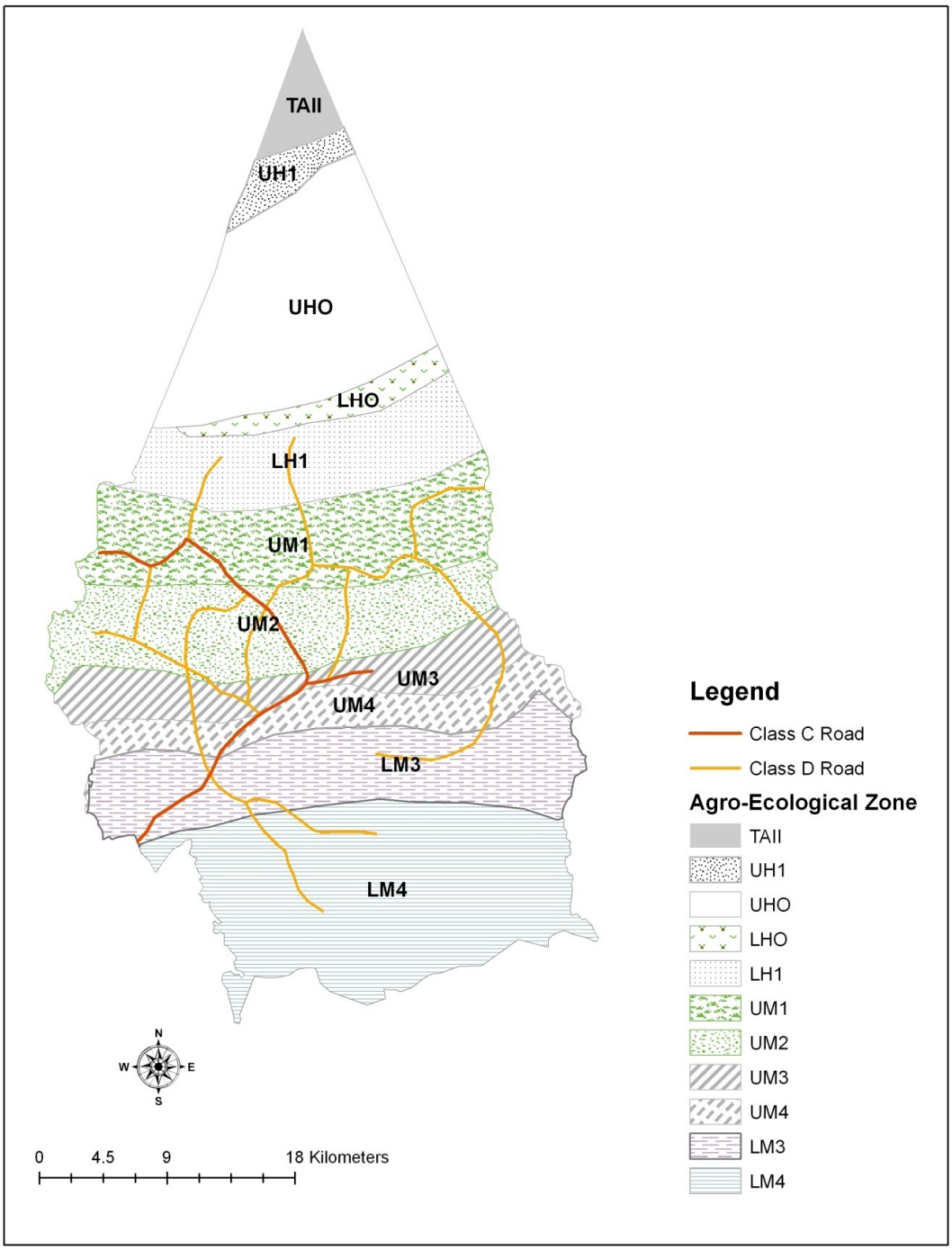


Figure 5 Map of larger Kirinyaga District showing agro-ecological zones

1.6 Summary of project design and description

Table 2 Project design and description (Kiringa River has three water falls namely Gicheru, Kathiri and Itirire)

No.	Item	Description
1.	Tea Factories	Mungania
2.	River	Thuci
3.	Location	Nithi/Embu
4.	District	3
5.	Estimated Design Flow (m^3/s)	150
6.	Head (m)	RCC
7.	Proposed Canal Type	5000
8.	Canal Length (m)	330
9.	Penstock length (m)	not gven
10.	Transmission Distance (km)	3600
11.	Indicative Power (kW)	65
12.	Designed Firm Flow rate (%)	5.1
13.	Estimated Nr^o of Factories on full load	Mungania
	Notes:	
	1. A typical Tea Factory has peak load of 700 kW	

1.7 Report Objective

The broad objectives and scope of this report were to:

- Study the baseline environmental conditions in the project area, such as biological, physical and socio-economic environment;
- Study the positive and negative impacts of the proposed Small-Hydropower station in the society living within the influence of the location including, but not limited to, job creation and improvement in the livelihood;
- Assess environmental and social impacts of the project and suggest suitable mitigation measures for the adverse impacts;
- Study the project conditions and requirements in terms of location, construction and operation requirements;
- Study issues arising from the proposed project for example land compensation (along the canal), desiltation, rehabilitation of vegetation affected and physical environment.
- Prepare an environmental management plan for implementation and monitoring of mitigation measures along with budgetary estimates, institutional and reporting requirements.

1.8 Methodology

The environmental impact assessment is based on field trips, document review and discussion with the project proponent and project architects, surveyors and engineers. The project architects provided the proposed project structural design details. While preparing the EIA report, care has been taken to identify the potential negative impacts and their mitigation measures in terms of:

- Impacts due to project location;
- Impacts from project design and during construction;
- Impacts during the operation of the proposed Small-Hydropower station.

1.9 Consultation and Public Participation (CPP)

Public participation was conducted to inform the stake-holders and surrounding community on the proposed Small-Hydropower station, and ask them about the problems they anticipate with the project and how these can be overcome. The study involved some of the neighbouring individuals who gave their views on the proposed Small-Hydropower station.

1.10 Structure of the report

This report has been structured in the following procedure:

1. Introduction: This chapter gives the background information relevant to the proponent, project and describes the objectives and requirements of the study;
2. Policy, legal and administrative framework: This chapter outlines the Kenyan Government policy on the environment, the relevant legislation relating to natural resource management and environmental protection and institutions that deal with various aspects of environmental management;
3. Methodology: This chapter gives the methods and procedures adopted in carrying out this assignment;
4. Baseline Information: Description of the existing environment: This chapter provides a description of the existing environment in order to provide an understanding of the bio-physical and social environmental setting;
5. Description of the proposed Small-Hydropower station: This gives the location and design.
6. Results analysis: This chapter presents the various findings considered to reach the project's objectives;
7. Potential impacts and mitigation measures: This chapter presents the major negative, positive and social-economic impacts associated with this project and the mitigation measures,
8. Environmental management and monitoring plan: This chapter presents the negative impacts, their mitigation measures, institutional/individuals responsible for mitigation, estimate mitigation cost and monitoring means;
9. Conclusion and recommendations: The conclusion briefly presents the environmental and social acceptability of the project, taking into consideration the impacts and measures identified during the assessment process.

CHAPTER TWO: POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Environmental Policy

The Kenya's' Government environmental policy aims at integrating environmental aspects into the national development plans. The broad objectives of the national environmental policy include:

Optimal use of natural land and water resources in improving the quality of human environment;
Sustainable use of natural resources to meet the needs of the present generation while preserving their ability to meet the needs of the future generation;
Integrate environmental conservation and economic activities into the process of sustainable development;

Meet national goals and international obligations by conserving biodiversity, arresting desertification, mitigating the effects of disasters, protecting the ozone layer and maintaining ecological balance on the earth.

EIAs are carried out in order to identify potential positive and negative impacts associated with the proposed project with a view to taking advantage of the positive impacts and developing mitigation measures for the negative ones. The guidelines on EIAs are contained in sections 58 to 67 of the Act.

According to section 68 of the environmental management and coordination Act (EMCA) 1999, The Authority shall be responsible for carrying out environmental audits on all activities that are likely to have a significant effect on the environment.

Environmental auditing (EA) is a tool for environmental conservation and has been identified as a key requirement for existing facilities to ensure sustainable operations with respect to environmental resources and socio-economic activities in the neighbourhood of the facilities.

The government has established regulations to facilitate the process on EIAs and environmental audits. The regulations are contained in the Kenya Gazette Supplement No. 56, legislative supplement No. 31, and legal notice No. 101 of 13th June 2003.

In the past, the government has established a number of National policies and legal statutes to enhance environmental conservation and sustainable development.

The Proposed Small-Hydropower station construction will need to observe the provisions of the various statutes that are aimed at maintaining a clean and healthy environment.

Some of the policy and legal provisions are briefly presented in the following sub-sections.

2.2 Policy Paper on Environment and Development (Sessional Paper No. 6 of 1999):

The key objectives of the Policy include: -

To ensure that from the onset, all development policies, programmes and projects take environmental considerations into account,
To ensure that an independent environmental impact assessment (EIA) report is prepared for any industrial venture or other development before implementation,
To come up with effluent treatment standards that will conform to acceptable health guidelines.

Under this paper, broad categories of development issues have been covered that require a "sustainable development" approach. These issues relate to waste management and human settlement. The policy recommends the need for enhanced re-use/recycling of residues including wastewater, use of low or non-waste technologies, increased public awareness rising and appreciation of a clean

environment. It also encourages participation of stakeholders in the management of wastes within their localities. Regarding human settlement, the paper encourages better planning in both rural and urban areas and provision of basic needs such as water, drainage and waste disposal facilities among others.

2.3 Legal Aspects

The key national laws that govern the management of environmental resources in the country have been briefly discussed in the following paragraphs. Note that wherever any of the laws contradict each other, the Environmental Management and Coordination Act 1999 prevails.

2.3.1 The Environment Management and Coordination Act, 1999

Part II of the Environment Management & Coordination Act, 1999 states that every person in Kenya is entitled to a clean and healthy environment and has the duty to safeguard and enhance the environment.

According to section 58 of the Act an Environmental impact assessment study needs to be carried out on projects specified in the second schedule of the Act that are likely to have a significant impact on the environment. This project is considered to fall under the second schedule of the Act.

Part VII, section 68 of the same Act requires operators of projects or undertakings to carry out environmental audits in order to determine level of conformance with statements made during the EIA. The audit report should be submitted to NEMA.

Part VIII section 72 of the Act prohibits discharging or applying poisonous, toxic, noxious or obstructing matter, radioactive or any other pollutants into aquatic environment. Section 73 requires that operators of projects which discharges effluent or other pollutants to submit to NEMA accurate information about the quantity and quality of the effluent. Section 74 demands that all effluent generated from point sources are discharged only into the existing sewerage system upon issuance of prescribed permit from the local authorities.

Section 87 sub-section 1 states that no person shall discharge or dispose of any wastes, whether generated within or outside Kenya, in such a manner as to cause pollution to the environment or ill health to any person, while section 88 provides for acquiring of a license for generation, transporting or operating waste disposal facility. According to section 89, any person who, at the commencement of this Act, owns or operates a waste disposal site or plant or generate hazardous waste, shall apply to the NEMA for a license.

Sections 90 through 100 outline more regulations on management of hazardous and toxic substances including oils, chemicals and pesticides. Section 102 states that subject to provisions of the civil aviation Act, any person who emits noise in excess of the noise emission standards established under this part commit an offence.

2.3.2 Energy Act, 2oo6

ELECTRICAL ENERGY

Licensing

Requirements for a licence or permit.

27. (1) Subject to the provisions of this Act, a licence or licences as the case may be, shall be required for the–
(a) generation, importation or exportation, transmission or distribution of electrical energy;

(b) supply of electrical energy to consumers:
Provided that for undertakings involving a capacity not exceeding 3,000 kW, the provisions of subsections (2), (3) and (4) shall apply.
(2) A Permit shall be required in respect of all undertakings–
(a) intended for the supply of electrical energy to other persons or consumers; and
(b) with a generating plant of over 1000 kW intended for own use.
(3) Any undertaking operating pursuant to a permit granted under this Act shall–
(a) in any case where conveyance of electrical energy to or from any transmission or distribution network is possible, meet the minimum requirements of the owner or operator
of the transmission or distribution network as approved by the Commission, and the owner or operator of any such undertaking shall inform the network owner or operator of all connected load and generation equipment that might have material effect on the network; and
(b) be subject to such conditions as may be specified by the Commission.
(4) A permit shall not be required in the case of installations with a generating plant of a capacity not exceeding 1000 kW and connected within the premises of any person in such a manner that conveyance of electrical energy to a transmission system or a distribution system cannot occur.
(5) A person who contravenes the provisions of this section commits an offence and shall, on conviction, be liable to–
(a) in the case of contravention of subsection (1) a fine not exceeding two million shillings, or to a maximum term of imprisonment of two years, or to both; and
(b) in the case of contravention of subsections (2), (3)and (4), a fine not exceeding one million shillings, or to a maximum term of imprisonment of one year, or to both.

Application for a licence or permit.

28.(1) An application for a licence or permit, (including an application for amendment, transfer or renewal), shall be made to the Commission in the form and manner prescribed by regulations made by the Minister under this Act. (2) Before making any application for a licence, the intending applicant shall give fifteen days notice, by public advertisement, in at least two national and one regional newspaper of wide circulation and within the time specified for its publication of the intended application.
(3) In addition to the notice required under subsection (2), the intending applicant shall serve a notice in writing with the particulars of the application on every local authority in the area or proposed area of supply and in any other area concerned in the application, but, where the intending applicant is a local authority and the application to be made relates to an area in the jurisdiction of the intending applicant, the provision as to notice to the local authority shall not apply.
(4) Every notice under subsection (2) or (3) shall state that any person or body of persons desirous of making any representation on or objection to the application or to the grant of the licence shall do so by letter addressed to the Commission and marked on the outside of the cover enclosing it “Electric Power Licence Objection”, on or before the expiration of thirty days from the date of the application as stated in the notice and that a copy of such representation or objection shall be forwarded to the applicant.
(5) The Commission shall, within fifteen days after receipt of the application, inform the applicant in writing whether the application is complete.
(6) The Commission may hear any objections in public, at a time and place of which not less than fifteen days notice shall be given to the applicant and to every objector and the Commission shall make known its decision regarding any objection within thirty days after the hearing. Commission may invite applications for a licence or permit.

29. The Commission may, through a fair, open and competitive process in accordance with procedures prescribed by the Minister by regulations, invite applications for a licence or permit under this Act. Factors to be considered in an application.

30.(1) The Commission shall, in granting or rejecting an application for a licence or permit, take into consideration–
(a) the impact of the undertaking on the social, cultural or recreational life of the community; No. 8 of 1999.
(b) the need to protect the environment and to conserve the natural resources in accordance with the Environmental Management and Coordination Act of 1999;
(c) land use or the location of the undertaking;
(d) economic and financial benefits to the country or

38.(1) A person shall not carry out any electrical installation work unless the person is licensed by the Commission as an electrician or an electrical contractor.
(2) To be licensed by the Commission as an electrical contractor a person must–
(a) be a licensed electrician registered under the Institute of Engineers of Kenya; or
(b) have in his employment, a licensed electrician.
(3) A person who desires to be licensed as an electrician or an electrical contractor shall make an application in the form and manner prescribed by the Commission.
(4) The Commission shall process all applications contemplated under subsection
(3) expeditiously and in any case, not later than ninety days from the date of the application, and it may–
(a) grant the licence or registration applied for accordingly, either without conditions or subject to such conditions as it may deem fit, or
(b) refuse to grant the licence or registration applied

2.3.3 The Water Act (2002)

Part II section 18 of this Act provides for national monitoring and information systems on water resources. Following on this, sub-section 3 allows the Water Resources Management Authority to demand from any person or institution, specified information, documents, samples or materials on water resources. Under these rules, specific records may require to be kept by a site operator and the information thereof furnished to the authority.

Sections 44 of the Act deals with groundwater conservation areas and Section 45, the Fourth Schedule has effect with respect to the abstraction of groundwater and works thereof.

Groundwater conservation

The Water Act 2002 vests the rights of all water to the State, and the power for the control of all body of water with the Minister. The powers are exercised through the Minister and the Director of Water Resources in consultation with the water catchments boards. The Act aims at among others:

Provision of conservation of water;

Appointment and use of water resources.

The Water Act 2002 states the following in relation to groundwater conservation and protection:

Where the Water Resources Management Authority is satisfied that, in any area, special measures for the conservation of groundwater are necessary in the public interest: For the protection of public water supplies or for the protection of water supplies used for industry, agriculture or other private purposes; it may following public consultation, by order published in the Gazette declare area to be a groundwater conservation area;

The Water Resources Management Authority may impose such requirements, and regulate or prohibit such conduct or activities, in or in relation to a ground water conservation area as it may think necessary to impose, regulate or prohibit for the protection of the area and its groundwater.

Section 73 of the Act allows a person with license (licensee) to supply water to make regulations for purposes of protecting against degradation of water sources. Section 75 and sub-section 1 allows the licensee to construct and maintain drains, sewers and other works for intercepting, treating or disposing of any foul water arising or flowing upon land for preventing pollution of water sources within his/her jurisdiction.

Section 76 states that no person shall discharge any trade effluent from any trade premises into sewers of a licensee without the consent of the licensee upon application indicating the nature and composition of the effluent, maximum quantity anticipated, flow rate of the effluent and any other information deemed necessary. The consent shall be issued on conditions including payment of rates for the discharge as may be provided under section 77 of the same Act.

Section 94 of the Act makes it an offence to throw or convey or cause or permit to be thrown or conveyed, any rubbish, dirt, refuse, effluent, trade waste or other offensive or unwholesome matter or thing into or near to water resource in such a manner as to cause, or be likely to cause pollution of the water resource.

2.3.4 The Forest Act (Act Number 7 of 2005)

This is law was enacted by Parliament in 2005 to provide for the establishment, development and sustainable management including conservation and rational utilization of forest resources for the socio-economic development of the country. Parts of the project area consist of indigenous forests. Section 8 of the Act requires all indigenous forests and woodlands to be managed on a sustainable basis for the purposes inter alia of conservation of water, soil and biodiversity, riverline and shoreline protection, sustainable production of wood and non-wood productions.

Community participation as provided for under Section 46 of the Act should be encouraged. The most appropriate would be initiation of participatory forest management in these forest reserves so that the local community and organization such as Ministry of Energy can have a significant input with Kenya Forest Services (KFS) office playing a coordination and guidance role.

2.3.5 The Public Health Act (Cap. 242)

Part IX, Section 115 of the Act states that no person/institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Section 116 requires Local Authorities to take all lawful, necessary and reasonably practicable measures to maintain areas under their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable for injurious or dangerous to human health.

Such nuisance or conditions are defined under section 118 waste pipes, sewers, drains or refuse pits in such a state, situated or constructed as in the opinion of the medical officer of health to be offensive or injurious to health. Any noxious matter or waste water flowing or discharged from any premises into a public street or into the gutter or side channel or watercourse, irrigation channel or bed not approved for discharge is also deemed as a nuisance. Other nuisances are accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbour rats or other vermin.

On the responsibility of local authorities, Part XI section 129 of the Act states in part “It shall be the duty of every local authority to take all lawful, necessary and reasonably practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its district has a right to use and does use for drinking or domestic purposes…”.

Section 130 provides for making and imposing regulations by the local authorities and others the duty of enforcing rules in respect of prohibiting use of water supply or erection of structures draining filth or noxious matter into water supply as mentioned in section 129. This provision is supplemented by Section 126A that requires local authorities to develop by-laws for controlling and regulating among

others private sewers, communication between drains and sewers and between sewers as well as regulating sanitary conveniences in connection to buildings, drainage, cesspools, etc. for reception or disposal of foul matter.

Part XII Section 136 states that all collections of water, sewage, rubbish, refuse and other fluids which permits or facilitate the breeding or multiplication of pests shall be deemed nuisances and are liable to be dealt with in the manner provided by this Act.

2.3.6 The Local Government Act (Cap. 265)

Section 160 helps local authorities ensure effective utilization of the sewerage systems. It states in part that municipal authorities have powers to establish and maintain sanitary services for the removal and destruction of, or otherwise deal with all kinds of refuse and effluent and where such service is established, compel its use by persons to whom the service is available.

Section 163 (e) gives powers to the local Authorities to prohibit businesses which by reason of smoke, fumes, chemicals, gases, dust, smell, noise, vibration or other cause, may be or become a source of danger, discomfort or annoyance to the neighbourhood. Development will need to observe these requirements during the construction period.

Section 170, allows the right of access to private property at all times by local authorities, its officers and servants for purposes of inspection, maintenance and alteration or repairs of sewers. To ensure sustainability in this regard, the local authority is empowered to make by-laws in respect of all such matters as are necessary or desirable for the maintenance of health, safety and well being of the inhabitants of its area as provided for under section 201 of the Act.

Section 173 states that any person who, without prior consent in writing from the council, erects a building on; excavate or opens-up; or injures or destroys a sewers, drains or pipes shall be guilty of an offence. Any demolitions and repairs thereof shall be carried out at the expense of the offender.

The Act under section 176 gives power to the local authority to regulate sewerage and drainage, fix charges for use of sewers and drains and require connecting premises to meet the related costs. According to section 174, any charges so collected shall be deemed to be charges for sanitary services and will be recoverable from the premise owner connected to the facility. Section 264 also requires that all charges due for sewerage, sanitary and refuse removal shall be recovered jointly and severally from the owner and occupier of the premises in respect of which the services were rendered. This in part allows for application of the “polluter-pays-principle”.

2.3.7 The Physical Planning Act (Cap 286)

The Local Authorities are empowered under section 29 of the Act to reserve and maintain all land planned for open spaces, parks, urban forests and green belts. The same section, therefore, allows for prohibition or controls the use and development of land and buildings in the interest of proper and orderly development of an area.

Section 30 states that any person who carries out development without permission will be required to restore the land to its original condition. It also states that NO other licensing authority shall grant license for commercial or industrial use or occupation of any building without a development permission granted by the respective local authority.

Finally, section 36 states that if in connection with a development application, local authority is of the opinion that the proposed development activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an environmental impact assessment (EIA) report. EMCA, 1999 echoes the same by requiring that such an EIA is approved by

the National Environmental Management Authority (NEMA) and should be followed by annual environmental audits.

2.3.8 The Land Planning Act (Cap. 303)

Section 9 of the subsidiary legislation (The development and use of land regulations 1961) under this Act requires that before the local authorities submit any development plans to the Minister for approval, steps should be taken as may be necessary to acquaint the owners of any land affected by such plans.

Particulars of comments and objections made by the landowners should also be submitted. This is intended to reduce potential conflict between the interests of the authorities and those of land owners in respect of settlement, social and economic activities.

2.3.9 The Building Code (2000)

Section 194 requires that where a sewer exists, the occupants of the nearby premises shall apply to the local authority for a permit to connect to the sewer line and that all wastewater must be discharged into the sewers. The code also prohibits construction of structures or buildings on sewer lines.

2.3.10 The Penal Code (Cap. 63)

Section 191 of the Penal Code states that any person or institution that voluntarily corrupts or foils water for public springs or reservoirs, rendering it less fit for its ordinary use is guilty of an offence. Section 192 of the same act says a person who makes or vitiates the atmosphere in any place to make it noxious to health of persons/institution in dwellings or business premises in the neighbourhood or those passing along public way commit an offence.

2.3.11 The Agriculture Act (Cap 318)

This is an Act of parliament for the promotion and maintenance of a stable agriculture, to provide for the conservation of soil and its fertility and to stimulate the development of agricultural land in accordance with accepted practices of good land management and good husbandry. Under Section 184 of the Act the Minister may make general rules for the preservation utilization and development of agricultural land. The concession land in general is agricultural and is therefore subject to this Act.

2.3.12 The Factory Act (Cap 514)

The Act specifies that an authorized factory inspector should inspect air receivers once every twenty four to twenty six months.

Part V section 39 of the factory Act provides guidelines on the safety of compressed air receivers (vessels).

Before any premises are occupied, or used a certificate of registration must be obtained from the chief inspector. The occupier must keep a general register. The Act covers provisions for health, safety and welfare.

Health

The premise must be kept clean, daily removal of accumulated dust from the floor, free from effluvia arising from any drain, sanitary convenience or nuisance and without prejudice to the generality of foregoing provision. A premise must not be overcrowded, there must be in each room 10 metres of space for each employee/occupant, not counting space 14 feet from the floor and a 9 feet floor-roof height. There must be sufficient and suitable lighting in every part of the premise in which persons are working or passing.

Safety

Fencing of premises and dangerous parts of other machinery is mandatory. Training and supervision of inexperienced workers, protection of eyes with goggles or effective screens must be provided in certain specified processes. Floors, passages, gangways, stairs, and ladders must be soundly constructed and properly maintained and handrails must be provided for stairs.

Welfare

An adequate supply of both quantity and quality of wholesome drinking water must be provided. Maintenance of suitable washing facilities, accommodation for clothing not worn during working hours must be provided. Sitting facilities for workers whose work is done while standing should be provided to enable them take advantage of opportunity for resting.

2.4 Policy, Legal and Administrative Framework Compliance Matrix

Table 3 Policy, Legal and Administrative Framework Compliance Matrix

POLICY	COMPLIANCE
1. Environmental policy	The proponent has contracted environmental experts to come up with an E.I.A.
2. National environmental action plan	The proponent has contracted environmental experts to offer guidance on the same
3. National policy on water resource management	They proponent has put in place waste water disposal systems. They also have mechanisms for discharge effluent standards.
4. EMCA	The proponent has contracted environmental experts to come up with an E.I.A.
5. Water Act	The facility gets water from the water services board and this is rightly licensed
6. Forest Act	The proponent will provide for the establishment, development and sustainable management including conservation and rational utilization of forest resources for the socio-economic development of the country.
7. Public health Act	The workers will be trained on safety issues and first aid equipment be installed.
8. Local government Act	The proposed Small-Hydropower station plan to be approved by the Kirinyaga Municipal council.
9. Physical planning act	The facility to be duly licensed and the facility plans are rightly acquired
10. Land planning Act	The facility has all the legal documents as required by the Ministry of lands
11. Agriculture Act	The proposed Small-Hydropower station plan to be approved by Physical Panning Department

CHAPTER THREE: METHODOLOGY

3.1 Terms of Reference for the Project Report

The terms of reference developed by the proponent, the Ministry of Energy for the EIA project report were the following:

- Review the activities that shall be undertaken in establishing the Small-Hydropower station.
- Identify the possible physical, biological and social impacts of establishing the proposed Small-Hydropower station.
- Review conservation policies and development strategies of the Ministry.
- Facilitate stakeholders' advocacy forums at the national level and within the vicinity of the Small-Hydropower station.
- Review existing documentation on the establishment of a Small-Hydropower station and other related policies.
- Propose mitigation measures for the predicted impacts.
- Evaluate various sites and activity options/alternatives.

3.2 Specific objectives

Specific objectives of this report for the proposed Small-Hydropower station are as follows:

- To collect and collate baseline information on the construction of the proposed Small-Hydropower station and associated developments.
- To identify and assess significant environmental economic, social and health impacts likely to be generated by the proposed Small-Hydropower station and associated works.
- To propose the necessary mitigation measures to minimizing the negative environmental impacts.
- To develop the Environmental Management Plan (EMP) for the proposed project.
- To draw appropriate conclusions and recommendations.

3.3 Design and Methodology

Kenya has developed EIA Regulations, which must be adhered to by proponents of all development projects. These regulations have been clearly spelt out in the Environmental Management and Coordination Act (EMCA) no. 8 of 1999 and the Environmental Impact Assessment (EIA) Regulations. These documents provide guidance on environmental and social issues/factors, which must be considered during an EIA study and preparation of the study report.

In conformity with the EMCA 1999 and the EIA Regulations, The Ministry of Energy has accordingly engaged the services of the experts to conduct the necessary study and prepare an EIA report. For the purpose of this study and preparation of the report, the following approaches and methodologies were employed:

- Desktop studies. This involved thorough review and analysis of literature for acquisition of secondary data
- Environmental screening, in which the project was identified as among those requiring environmental impact assessment under schedule two (2) of EMCA, 1999
- Environmental scoping that provided the key environmental issue at the site of construction.
- Physical inspection of the site and surrounding areas. Necessary photographic evidence at the sites was captured for the report.
- Conducted interviews involving all necessary stakeholders for collection of primary data
- Administration of household questionnaires to the community around the proposed site
- Conducted public meetings with the community members in the location to collect views of the people

- Identification of potential impacts
- Confirmation and sharing of findings with various stakeholders (Stakeholders' Workshop), including District Heads of Departments and opinion/community leaders.
- Reporting

3.4 Tools for Collection of Primary and Secondary Data and Procedures

The main tools and procedures used for the collection of data were designed and vetted by all consultants prior to administration in the field in order to ensure that the data collected was properly verified. The following gives a brief description of the tools used, and the procedures employed in their administration

3.4.1 Collection of Secondary Data:

Literature Review

To begin with, the consultants compiled a list of potential sources of data and information for this study. The list was used as a guide for identification of relevant literature from the Ministry of Energy Headquarters in Nairobi, Kirinyaga District relevant government officers.

3.4.2 Collection of Primary Data:

Interviews and Discussion with the Ministry of Energy Management and District Departments

Interviews and discussions were held with Ministry of Energy management officials at the Headquarters in Nairobi and the District office in Kerugoya. Discussions were also held with the Heads of relevant District Government Departments in Kerugoya. These included Environment and Natural Resources, Education, Social Services, Agriculture, Water, Statistics, Labour, Employment, Survey, Physical Planning, Public Health, Public Works, and Roads. The Provincial Administrators, such as the Chief of the area as well as residents of the location of the Proposed Small-Hydropower station, including other stakeholder such as manager of the Kimunye KTDA factory and the landowners of the site and along the canal of proposed Small-Hydropower station. Detailed discussions centered mainly on environmental, energy situation and socio-economic concerns in the location and the anticipated impacts of the proposed Small-Hydropower station and mitigation measures.

All the consultants were involved in the discussions and took notes of the proceedings. At the end of the discussions, the consultants consolidated and analyzed the data.

Table 4 The list of officers interviewed from Ministry of Energy (Nairobi & Kerugoya) and District Government Offices in Kerugoya

No.	NAME OF STAFF	GENDER	AFFILIATION	POSITION	LOCATION
1	Mr. Njoroge	M	Kimunye Tea Factory	Manager	Kirinyaga
2.	Mr.	M	"	Technical Officer	"

3.5 Field Study Visit to the Location of the Proposed Small-Hydropower station

Walk-through Inspection of the proposed Small-Hydropower station site

The consultants made and recorded observations during field study visit to the location of the proposed Small-Hydropower station. The observations focused on physical environment (topography,

geology and hydrology), the vegetation cover, land availability, land use pattern (especially the proportion of individual farm lands allocated for tea farming), agricultural practices, accessibility of the site, proximity to other infrastructure amenities, centrality with respect to the green leaf catchments area and environmental concerns, potential sources of energy, socio-cultural environment, employment and labour market.

On the site of the proposed Small-Hydropower station, further detailed observations centered on the *biological environment* (flora and fauna types and diversity, endangered species, sensitive habitats etc.).

Plate 2 Agricultural activities on hilly land along river Kiringa

Plate 3 The proposed canal along river Kiringa

Plate 4 One of the team members collecting water samples at the project proposed intake

Plate 5 The bridge near the proposed intake along river Kiringa

Plate 6 Gicheru waterfall: The 1st one along river Kiringa

Plate 7 Kathiri waterfall: The 2nd one along river Kiringa

Plate 8 Itirire waterfall: The 3rd one along river Kiringa

Plate 9 Land use activities along river Kiringa

Plate 10 Some of bird species found along river Kiringa

Plate 11 Food crop grown along river Kiringa

CHAPTER FOUR: BASELINE INFORMATION

4.1 Introduction

The expected social and economic gains must be weighed in light of possible negative impacts on the environment and tenable measures that have been proposed to mitigate against such impacts. The baseline information for this project was gathered from both secondary sources and the field visits described in next chapters.

4.2 Location of the Proposed Project

4.2.1 District Background Information

Kirinyaga district occupies an area of 1437 km of which 70% is arable. The district borders Nyeri, Muranga, Embu, and Mbeere districts. The district has a population of approximately 500,000 people with 109,900 farm families with an average holding of 0.9 ha. The major source of livelihood is Agricultural activities with tea, horticulture, coffee, rice, maize bananas and Dairy being the major enterprises. The district lies within various AEZ, which ranges from LHI at Mt. Kenya forest to LM 4 in the lower parts of the district. The district has 4 administrative divisions namely Gichugu, Mwea, Ndia and Central (Refer to Figure 1.1).

4.2.2. Kirinyaga district socio-economic household data

Table 5 Kirinyaga district socio-economic household data

Area	1478 Km^2
Number of divisions	4
Number of locations	22
Number of sub-locations	80
Population	489000
Population density	309/km2
Life expectancy	-
Men	58.3 years
Female	67.3 years
% population < 18years	43.6
% population > 55 years	8.4
Average household size	4
Number of farm families	114450
Average farm size	0.9 Ha
Male headed households	66.6%
Female headed house holds	33.4 %
Potential agricultural land	1150 km2
Number of irrigation schemes	105
Total irrigated land	11330ha

Table 6 Kirinyaga district divisional data

Kirinyaga Divisions	Total Area (Km²)	Arable Land (ha)	Cultivated area (Ha)	Irrigated area (Ha)	Annual Rainfall (mm)	Dominant Soils	Population 1999 Census	Farm Families (Holdings)	Average Holding Size (Ha)	% Rural Poverty
***Gichugu**	**229.7**	**16079**	**14471.1**	**65**	**1400-2150**	**Volcanic loam**	**121,738**	**29,220**	**1.02**	**27**
Ndia	276.4	19348	17413.2	145	1400-1700	Nitosols	135,337	34,363	1.04	27.5
Central	108.5	9765	8788.5	55	1700-2150	Nitosols	74,068	19,316	0.76	29.5
Mwea	512.8	35896	30511.6	7790	950-1200	Ferrasols	125,962	31,540	2.26	37.5
Mt. Kenya Forest	350.7	-	-	-	2150-2200	Lithosols	--	-	-	-
District Total	**1478.1**	**81088**	**71184.4**	**8055**	**950-2200**	**Nitosols and Ferrosols**	**457,105**	**114,439**	**1.27**	**30.4**

*** Focus Division**

Table 7 Gichugu Division Locations population data

Location	Population
Ngariama	18,234
Kabare (proposed Small-Hydropower station location)	14,758
Kirima	21,334
Baragwi	19,547
Karumandi	24,217
Njukine	23,648
Total	**121,738**

***Source: 1999 population and housing census**

4.3. Physical and Climatic Conditions

4.3.1. Rainfall data

Table 8 Rainfall data

Station	Amount of rainfall (mm)	No of wet days
Wanguru	1212.4	60
Kimbimbi	1273.6	65
Kangaita	2549.8*	189*
Kerugoya	2146.8	147
Kianyaga	1588.5	124
Sagana	1494	128

***Rainfall data for Kangaita does not include figures for Dec 2006**

4.3.2. Geology and Soils

Gichugu - Volcanic loam, Ndia – Nitosols, Central – Nitosols, Mwea – Ferrasols, Mt. Kenya Forest – Lithosols

4.3.3. Forestry

The vegetation of Kirinyaga District is determined by altitude, soil and amount of rainfall. However, it has been modified greatly by human activity and settlement. In the lower altitudes, natural flora is scarce and dominated mostly by the food and cash crops grown by the farmers. Gradually, vegetation cover increases with altitude, culminating in the thick tropical forest on the slopes of Mt. Kenya. The forest cover can be classified into three categories; Mt. Kenya Castle Forest, Njukiini Forest lsland and Rural Afforestation Extension Scheme (RAES) in Mwea, around Gathigiriri and on Murinduko Hill slopes.

Mt. Kenya Forest lies between Rupingazi River on the mountain slopes to the east and Rwamuthambi river to the west. The Mt. Kenya forest is a gazetted forest and starts from the Alpine bamboo and grassland region below the glacier, running all the way to the Nyayo Tea Zone. In between the alpine moor land and tropical forest, the bamboo forest area is found. Mt. Kenya forest is dominated by a canopy of vegetation and indigenous type of liana vegetation. This forest is endowed with various fauna and flora which attracts tourists to the region.

The amount of rainfall is sufficient and climatic conditions are ideal for faster growth of trees, which encourages the promotion of lumbering. The forest covers an area of 308 sq km. Njukiini forest, which falls under trust-land forest, consists of indigenous trees supplemented by exotic rural forestation, planted after the felling of the original trees for timber and other uses. The forest covers an area of 92 sq. km. The remaining forests have been created through the efforts of the Rural Afforestation Extension Scheme in areas where originally there were no trees or bushes. These areas include the steep sides of Kamuruana and Murinduko hills.

The natural forest of Mt. Kenya and Njukiini have not as yet been affected by human intrusion. This is mainly due to government efforts to control deforestation by the control of grazing in forested areas, control of fire outbreaks and prevention of indiscriminate settlement and logging activities. The forest extension and services covers the whole district outside gazetted forest reserves and trust-land forests.

Wildlife

Kirinyaga District is rich in wildlife, concentrated in the forested Mt. Kenya area. This area provides the right habitation for various species of animals like elephant, buffalo, bush-buck, duiker, monkeys and birds. Other areas with notable wildlife are in the South Ngariama and Mwea Division, which have impala, Thomson’s gazelle, Kongoni, baboons, leopards and jackals. Makutano area and Sagana River are common sites for baboons, monkeys, hippopotamus and crocodiles. Mwea Irrigation Settlement Scheme has plenty of birds. Wildlife has become a menace, especially in the Mt. Kenya Forest and in the Mwea plains.

Commercial Minerals and other Materials

Kirinyaga District does not have a mineral endowment of economic significance. The only exploitation of importance is the quarry stones used locally and exported to the neighbouring districts. Quarrying is mainly concentrated in the Mwea Division around Sagana, Makutano and Murinduko. Sand harvesting is not abundant, and this forces the local users to import it from Embu and Murang'a Districts in order to satisfy the local demand.

4.4. Main Crop Production

4.4.1 Industrial Crops

Tea

The area under tea is about 5,500 ha. With about 23,000 growers. Yields/bush is about 1.4 kgs. Prices have been low over the last two (2) years averaging 16 – 20 Kshs./kg of green leaf. Production (2005/2006): -

Table 9 The area under tea is about 5,500 ha. With about 23,000 growers.

KTDA factory	Area (ha)	Growers (No.)	Gross Production (Kgs)	Value (Kshs)	G.L Estimates	Average Payment (Kshs)
Kangaita	899	4836	6652292	126060933	12,525,000	18.95
Kimunye	1364	6434	9104601	182092020	16,000,000	20.00
Mununga	1451	7380	8121771	14619187	18,870,622	18.00
Ndima	1230	50,306,752,562	11715695	154266850	15770199	17.35
Kiringa	1618	8269	8917159	154266860	15770199	17.30
Total	**6562**	**31949**	**94957598**	**145153726**	**70361676**	**18.32**

Coffee

The coffee sub sector in the district is gradually on its way to recovery from depressed market prices. During the year 2005/06 coffee prices improved and this had positive response to adoption of good agricultural practices at farm level and good processing practices at Small-Hydropower station. Low coffee production and poor quality was singled out to be the major drawbacks in coffee business. However with the current prices and better returns to the farmers, much attention has been paid to coffee crop. With introduction of coffee second window marketing system along with the central/auction system farmers are encouraged to produce more because of competitive markets. Introduction of coffee development fund will also assist in offering credit facilities to the farmers.

Field Activities

Coffee maintenance:

- Weeding, pruning change of cycle handling de-suckering pests and disease control as well as fertilizer and manure application
- Coffee picking and processing.
- Coffee deliveries to the millers.

Coffee statistics

Table 10 Area under coffee

Sector	Area	Growers	Remarks
Co-operatives	13620	86348	Under Review
Estate	850 ha	440	Active
Total	**1440**	**86788**	**359 farmers have left coffee business due to urbanization**

MACADAMIA

The produce prices have reduced drastically to 30-60/= per kg. The major buyers remain Kenya Farm Nut, Kenya Nut and a Co-operative Society in Embu. The limiting factor for expansion remains the small land sizes and supply of improved planting seedlings.

COTTON

Cotton is mainly grown in the Agro Ecological Zones (AEZ), Low Midlands (LM3) and LM4 found in Mwea division and Ndia. Under rain fed conditions the area is characterized by unreliable rainfall, which gives cotton a head start to other crops in terms of draught tolerance.

During the year 2005/06, the government allocated funds towards revival of cotton industry. Poor prices coupled with low productivity had caused a decline in cotton gross margins and farmers in the district were given support in form of seed and training. There has however been an improvement in the payment time after produce delivery. Technical input has been put in place towards improvement of the cotton quality at farm level, with emphasis on value addition. It is hoped that this intervention will enable farmers reap more income from cotton at farm level.

During the ended season (2005/2006), the prices were 22/= AR and 10/=/kg BR.
Hectarage under cotton during the 2005/2006 season is 422 ha within Kirinyaga district.
The district has a potential to achieve 200 ha of cotton but constraints related to production costs and producer prices hinder. On average a farmer produces 60% AR grade of seed cotton.

Table 11 Cotton Production Trend

Year	Hectarage	Production (tons)	Price/kg (Kshs)
2002/2003	350	210	AR-20/= BR-10/=
2003/2004	300	200	AR-20 BR-10/=
2004/2005	240	140	AR-19/= BR-9/=
2005/2006	422	228	AR-22/= BR-10/=
2006/2007	-	-	-

4.4.2 Food Crops

Maize

During long rains maize crop has better harvest. However the declining low soil fertility coupled with use of uncertified seed causes low yields/unit area. Maize is mainly produced for domestic consumption. This contributes to most farmers growing it for food security at household level. However due to the fact that the crop fetches a lot of money when green, most farmers have started concentrating on growing and marketing it when green. At this stage 1 cob is sold for 5/=. In areas where irrigation is done especially Mwea division, maize is intercropped with French beans so that there is a continuous supply in the division and the district at large. There are few incidences of maize streak virus infection. Though most farmers plant certified seed, a few planted local varieties. The long rains average yields - 50bags/ha, while short rains average yields - 40bag/ha.

Sorghum

This is a drought tolerant crop grown mainly in the lower areas as a boundary crop in maize/beans intercrop. It is grown under a very small area as compared to other crops. The main establishment of the crop is done on the onset of the long rain season. Most of the crop in the short rain season is the

ratoon crop. Poor husbandry practices and recycling of planting seed has had a negative effect on the performance of the crop.

Millet

The hectare under the crop continues to decline over the years like sorghum where lack of certified planting materials (seed) and adoption of utilization are the main constraints to full potential. This is a crop farmers are urged to take seriously in terms of food security especially in the lower areas. The average yields are 4 bags/ha. The price at the markets range from 2800-3200/= per 90kg bag.

Rice

The area under this crop increased due to expansion of the out growers. However, area under ratoon crop in the main scheme decreased due to decline in water levels. Every wetland especially in the lower areas is being put under rice as farmers try to improve their farm income level. In the main scheme, NIB has developed an annual cropping programme for the units, to try and address the problem of water.

Planting continues from May to December for the main crop. The Mwea Irrigation Agriculture Development Centre (MIAD) bulked seeds with farmers for the new NERICA rice variety (New Rice for Africa) which is a highland crop that requires low moisture as compared to the current paddy rice varieties in use. This was sold to farmers across the district.

The yield in the main scheme (Pishori) is 65bag/ha and 60 bags/ha for out growers. The mixture in seed varieties has caused the decline both in production and quality for rice. About 80% of the rice is milled privately by use of small diesel rice hullers. The main variety grown is Pishori due to the high prices it fetches for the growers. During the 2005/6 period 12450 ha was achieved of an approximate value of 2 billion. Monitoring of the quelea quelea continued throughout the year.

Beans

Production in the period under review was good. During the long rains the crop performance is good due to adequate well distributed rainfall. In the short rain season, the performance is poor due to too much rainfall. Too much water encourage root rot infection leading to the dying out of most of the crop. The wet weather also encourage flower abortion in the beans, which were already flowering thus drastically reducing the yields. The crop is mainly grown as an intercrop with maize on small scale. The price of beans remained high throughout the year.

Pigeon peas

This crop is grown as an intercrop with other crops e.g. maize, beans or cowpeas. At least over 30% of the farmers plant the medium varieties e.g. 60/8. However, poor crop management especially in pests control has resulted to low yields and productivity. The district has a deficit in terms of requirements partly because the crop is mainly planted during the short rains season.

Cowpeas

This crop is grown both for green leaf vegetables and seed. It is mainly grown as an intercrop with other food crops e.g. maize. Pests and diseases damage due to poor crop husbandry has contributed to low yields. The average yield is 5 bag/ha. Plant population is usually low unless where the crop is under irrigation whereby the crop is grown mainly as a vegetable.

Soya beans

This is a crop whose area in the district has drastically declined. This is mainly attributed to its low utilization at household level. Training on food utilization was focused on to improve the production

of Soya bean. The current yields are 3 bags/ha. The crop has the advantage of being drought tolerant and can withstand water logging in black cotton soils.

Green grams, Black grams

The green gram is more popular than the black grams. The crop is grown in the lower areas of the district. Pests and diseases have been the main factor to low production, as well as Horticultural activities. The district has a deficit in production and gets almost 80% of its requirements from neighboring districts like Mbeere and Meru south. The average yield is 4 bags/ha and the district has a potential of producing over 50% of its requirements annually.

Sweet potatoes

This crop has become important both for farm incomes and as a food security crop. However, declining soil fertility has affected its performance both in yields and productivity. It is grown widely throughout the district. The main pest is the sweet potato weevil. The crop performance during the period 2005/6 was good due to adequate well distribute rainfall. Yields averaged at 6.0 tons/ha, and the prices were ranging from 1300 – 1600/= per 110 kg bag.

Cassava

It is mainly grown on small scale as a food security crop. Utilization options remain limited to boiling at household level despite affirmative promotion by the technical staff. It is mainly grown as an intercrop. Some farmers are drying and marketing it in Nairobi.

Irish Potatoes

The crop is widely used as a food crop in the district. Diseases especially the bacterial blight continues to be a major threat to farmers. In addition, the lack of clean planting material has caused the spread of the disease. The average yields have declined to 30 bags/ha. In the upper areas of the district, expansion of tea has decreased the hectarage under Irish potatoes. The district imports potatoes to meet its annual requirements.

Yams

Hectarage continues to decline mainly due to little research towards improvement of the crop. The crop is grown on very small scale as an intercrop. Yams fetch good prices both at farm and open market level.

Arrowroots

The crop is grown on very small scale mainly for household consumption. Area under the crop continues to decline especially in the lower zones as farmers cultivate rice in the wet areas instead of the traditional arrowroot. Prices of arrowroots have shown an increase due to the decline in supply especially at the market level. One kilogramme tuber retailed at 20-30/=.

Table 12 Crops Statistics Summary (2005)

Crop	Long rain target (Ha)	Short rain target (Ha)	Long rains achieved (Ha)	Short rains achieved (Ha)	Long rains achieved production (ton)	Short rains achieved production (tons)	Total production (tons)
Maize	14050	12080	12774	11450	57483	41220	98703
Sorghum	40	30	36	13	12.96	4.68	17.64

Millets	50	30	45	14	16.2	5	21.2
Rice	Annual	12660	Annual/achieved	12450	-	-	72832.5
Beans	14100	10300	11790	9880	4244	3121	7365
P/peas	-	2	-	1.2	0.86	0.65	1.5
Cowpeas	270	195	248	164.5	134	74	208
Green grams	40	36	12	25.2	5.4	9	14.4
Soya beans	20	16	15	8.2	13.57.2	20.7	11
Sweet potato	350	288	315	228	208	150.5	358.5
Cassava	30	25	26	12	343	132	475
Arrowroots	3	3	3	1	33	44	77
Yams	2	1.5	1	1	6.6	6.6	13.2
Irish potato	2900	2330	2610	1936	5742	3095	8837
Bananas	Annual	3900	3690(20)	3700(10)	14760	9290	24050
	NB (20) Hectarage achieved during the season						

4.4.3 Horticultural Crops

Tomatoes

Weather conditions for the year characterized by extreme chilly conditions, inadequate distribution of rainfall in the long rains season and too much rainfall in the short rain season is unfavorable for tomato growing due to increased incidences of diseases and pests thus contributing to low yields hence low supply leading to high prices throughout the year ranging from Kshs. 800/- to 1500/-per 60 kg crate.

French Beans

The crop was adversely affected by the weather conditions hence low yields. Contracted farmers' groups for different varieties and different prices mostly grow the crop. Prices for fresh export produce ranged from Kshs. 25-35 per kg while that of canning went at Kshs.20-35 per kg. The bean rust and bean fly remained the major problem for the growers.

Kales/Spinach

Kale production both for home consumption and local markets is on increase in Kirinyaga district. Diamond black moth and cabbage sawfly are the major reported pests. Prices were fair at Kshs.10 per kg in the year 2005/6.

Cabbages

The crop is mainly grown in the middle and upper zones of the district mainly for local markets. Diamond back moth (DBM) and black rot have been reported as the major problems.

Capsicum

The main type being "HoHo" grown by few contracted farmers in the lower zones of the district. The crop that survived the wet weather conditions in the year 2005/6 was in high demand fetching as high as Kshs. 80 -100 per 6 kg carton.

Onions

Area under the crop has remained relatively low due to poor rainfall distribution. Thrips infestation and Downey mildew remains the major problems with growers.

Melons

The crop has become very popular both for local consumption and marketing thus increasing the production levels especially in the lower zones of the district. The prices are also attractive at Kshs. 6-15 per kg at farm gate level and Kshs. 20-25 per kg in various market outlets. Cases of melon fly and mildew are reported as the main problems.

Butternuts

The crop has gained popularity both for local consumption and marketing thereby increasing in production. Prices ranges between Kshs.10-20 per kg depending on demand and supply.

Paw Paw

The crop is picking up very well as a cash earner especially in the lower zones of the district. The popularity is as a result of drought tolerance and ready market in the local markets.

Passion Fruits

The crop is mainly grown for commercial purposes since it has got a ready market locally and outside. Some companies such as Greenland exporters have engaged some farmers on contract farming with prices ranging at Kshs. 120 -180 per carton. The main growing problems continue to be Fusarium wilt & brown leaf spot, which is widespread.

Mangoes

Majority are local varieties with few improved varieties picking up. Some few farmers are adopting new technologies to improve on local varieties. Most of the improved fruits come from Mbeere district with prices here ranging at Kshs. 5 -15 per piece.

Banana

The crop is grown on small scale both as a food crop and for income generation. The declining soil fertility and retention of old stools (re-planting) has continued to decline in yields and production. The crop is grown commercially due to the ready markets with middlemen coming mainly from Nairobi. Currently most farmers are going for tissue culture banana plantlets for planting in fear of spreading the fusarium wilt disease and other diseases. Panama disease and the banana weevil pest have caused considerable damage to the crop.

Avocado

The crop is scattered all over the district majority of which are local varieties. However there are few farmers growing improved varieties especially Fuerte and Hass.

Table 13 Horticulture Crop Production in Kirinyaga District

Crop type	Target (ha)	Achieved ha	Average production tons/ha	Cumulative ha	Expected production (Tons)	Expected value Kshs.

Tomatoes	2250	470	5	1855	9275	154.58M
French beans	3300	647	2	2678	5356	193.92M
Kales/spinach	525	139	30	469	11340	211..05M
Cabbages	165	39	25	150	3750	37.5M
Capsicum	45	14	5	39	195	3.9M
Onions	105	29	10	90	900	13.5M
Melons	40	9	10	31	310	7.00M
Butternut	35	9	10	31	310	7.75M
Passion fruit	146(12)	96.6(3.5)	5	96(8.5)	507.5	10.15M
Mangoes	160(9)	160(2.2)	5	160(2.2)	811	16.22M
Macadamia	544.5(12)	544.5(2.7)	4.5	544.5(7)	1452.6	43.54M
Bananas	2422(22)	2422(9)	25	2422!2.2)	60630	606.3m
Avocado	272(13)	272.5(0.2)	3	272.5(5.2)	821.1	8.21M

CHAPTER FIVE: DESCRIPTION OF THE PROPOSED KIRINGA SMALL-HYDROPOWER STATION

5.1 Introduction

The proposed Small-Hydropower station in Kabare Location, Gichugu Division in Kirinyaga District.

Plot Ownership

The proposed Small-Hydropower station intake will be at Kiringa river at Gicheru point and the canal will follow the contour line along mainly private.

5.2 Justification of the Proposed Small-Hydropower station project

Energy is one of the infrastructural enablers of the three "pillars" of Vision 2030. The level and intensity of commercial energy use in a country is a key indicator of the degree of economic growth and development. Kenya is therefore expected to use more energy in the commercial sector on the road to 2030. As incomes increase and urbanization intensifies, household demand for energy will also rise. Preparations have been made to meet this growth in demand for energy under the Vision.

Commercial energy in Kenya is dominated by petroleum and electricity as the prime movers of the modern sector of the economy, while wood fuel provides energy needs of the traditional sector including rural communities and the urban poor. At the national level, wood fuel and other biomass account for about 68% of the total primary energy consumption, followed by petroleum at 22%, electricity at 9% and others including coal at about less than 1%. Solar energy is also extensively used for drying and, to some extent, for heating and lighting. Electricity remains the most sought after energy source by Kenya society and access to electricity is normally associated with rising or high quality of life.

However, its consumption in Kenya is extremely low at 121 kilowatt hours (khw) per capita (compared to 503khw in Vietnam or 4,595khw for South Africa) and national access rate at about 15%. The access rate in the rural areas is estimated at 4%. All that is changing rapidly as the country invests more resources in power generation, in addition to policy and institutional reforms in the sector, bring in new providers. Tea factories have been experiencing power supply problem hence incurring loses when they turn to other sources of energy. The proposed project will target the nearby Kangaita and Kimunye tea factories for energy supply and also the local community.

5.3 Characteristics of the Sites of the Proposed Small-Hydropower station

Table 14 Kiringa River has three water falls (Gicheru, Kathiri and Itirire)

No.	Item	Description
1.	Estimated Design Flow (m^3/s)	1.88
2.	Head (m)	77
3.	Proposed Canal Type	RCC
4.	Canal Length (m)	
5.	Penstock length (m)	147
6.	Transmission Distance (km)	2.2
7.	Indicative Power (kW)	1180
8.	Designed Firm Flow rate (%)	65
9.	Estimated Nr^o of Factories on full load	1.7

CHAPTER SIX: CONSULTATION AND PUBLIC PARTICIPATION (CPP)

6.1 Highlights of discussion with the stakeholders Management

The outcome of the discussions with the Ministry of Energy Management and the relevant District Government Officers enabled development of appropriate tools for acquisition of relevant information/data for this project report. The major concerns that crystallized out of the discussions included the expectations of the community members from the proposed Small-Hydropower station, environmental, social, health, and economic concerns in the location and the anticipated impacts of the proposed Small-Hydropower station and mitigation measures.

6.2 Responses from some District Heads of Department

Below summarizes concerns expressed by some Kirinyaga District heads of Departments (Agriculture, Physical Planning Officer, Public Health, Kenya Forest Service, Social Development Services and the District Environment Officer).

The Department of Physical Planning:

- Whether the project site is ideal for the project
- To check compatibility of land use with the topography and the environment
- To check whether land is enough for the intended purpose
- To check how the various mitigation measures will be addressed

Public Health Office

The public health department indicated issues that must be taken into consideration during implementation:

- Efficient water
- Provision of protective clothing to workers
- Machineries should be well guarded to protect workers from injuries
- Employment of medically fit individuals who should produce valid medical certificates from government hospitals before being recruited.
- The proponent to ensure the proposed plan passes through public Health Officer for approval.

Kenya Forest Service Office

- The farmers around the site should be encouraged to plant trees (engage in agroforesty).
- The Ministry of Roads needs to ensure that the roads serving the Small-Hydropower station are passable and in good state.
- Effluent from the Small-Hydropower station must be properly disposed.
- The relevant authorities must be contacted when determining the source of water for the Small-Hydropower station. The Ministry of water Resources Management and Development is responsible for advising on installation of intake and piping, checking whether the water is adequate and conducting survey of the routes to ensure free flow. The director of forests should give authority of getting water from the forest. This is done while taking care of the environment by ensuring Minimum negative impact on vegetation.

Social Development Services

§ Community members should be given priority for employment
§ Potential increase in school-dropout rate as the result of the available employment opportunities (canal construction)
§ Potential increase in diseases, especially HIV/AIDS due to influx of employment seekers from outside and also indirectly due to improved income.

District Environment Office

§ Depletion of the forest cover along the canal.
§ Environmental pollution due to inappropriate disposal of solid and liquid wastes and air pollution.

District Agricultural Office

The Officer was in agreement that the proposed Small-Hydropower station would provide reliable energy to the nearby Kimunye tea factory. He elaborated on the negative and positive impacts of the proposed Small-Hydropower station as the following: encroachment of farmland during canal construction.

Table 15 Summary of impacts of the Proposed Small-Hydropower station

Positive Impacts	**Negative Impacts**
• Improved energy supply • Increased formal and informal sectors opportunities	• Siltation along the canal • Air, water, noise and cultural pollution. • Encroachment of farmland during canal construction • Health and diseases. • Poor school enrolments.

CHAPTER SEVEN: PREDICTED IMPACTS AND PROPOSED MITIGATION MEASURES

7. Predicted Environmental, Health and Social-Economic Impacts

This chapter presents a description of the potential environmental impacts likely to arise from the proposed project.

7.1 Physical Environment

7.1.1 Geology and Soils

The potential impacts of the proposed project on the soil and geology of the project site are mainly associated with water impoundment and construction activities. However, the impacts are expected to be minimal because the geology of the proposed project site is stable. Seismic activities have not been recorded in the area and therefore such activities are not anticipated from the proposed smaller reservoir.

Blasting during construction of the power station and other works such as the diversion canal may cause loosening of some rocks and soils of the area though this is anticipated to be minimal.

7.1.2 Climate

The development of the proposed project shall not cause any significant changes to the climate of the project area. Increased evaporation from the impounded water shall result into micro climate modifications which may result in cooling effects of the surrounding area. The availability of cleaner hydroelectric energy, when the factory is electrified, will reduce pressure on forestry products for energy which will contribute positively to climate change aspects as more trees will be preserved which provide important carbon sink.

7.1.3 Hydrology

Major impacts on the hydrology of the project area shall be the transformation of the flows of the Kiringa River into the impoundment of the reservoir. However, flows downstream the weir may experience changes during construction and operations.

7.1.4 Water Quality

Water quality impacts that shall be experienced include temperatures changes in the water profile, a thermocline shall be experienced due to stratification in the reservoir waters. This will further show differences in the Oxygen content, depending on the depth and oxygen depletion as a result of high organic content. Other chemical parameter changes, such as Conductivity, / TDS and TSS, due to organic degradation of plant material during the first few years shall be experience resulting in differences in organoleptic test results of the water. The other parameter that may alter is Turbidity due to Suspended Solids at filling of the reservoir. Construction works involving earth removal, blasting and other human activities around the project area, shall affect sediment loads in the Kiringa River during the construction phase.

The project area is endowed with a lot of surface water. The population of the surrounding settlements with their subsistence agricultural activities have adequate amount of domestic water and shall not compete for the Kiringa River water resource. The proposed project design shall be of a low water demand and flows shall be allowed in order not to alter the river natural flows. This shall allow the population downstream to have their natural water flows and amounts.

7.1.5 Water Quality

The quality of air of the project area shall not be greatly impacted by the proposed project. However, it is anticipated that air quality may be impacted upon during the construction phase. Activities such as blasting, earth moving, heavy trucks and construction machinery movements, shall result in dust, gases and particulate emissions at the civil work sites.

7.1.6 Ambient Noise Quality

The potential impact on the ambient noise quality of the project site shall be experienced during the construction. Heavy machinery, blasting as well as traffic from utility vehicles shall contribute to the noise pollution in the project area.

7.1.7 Waste

Most of solid waste will be generated during construction phase. These wastes will include rubble from the blasted rocks, concrete, steel bars, bolts, nuts, cables, cable drums, waste oils, paper, plastics, metal and woody vegetation. The project is also expected to generate domestic waste such as left over foodstuffs and human waste, especially at the camping sites for workers.

7.2 Biological

7.2.1 Flora and fauna

The impact of the proposed project on the flora and fauna of the project site is mainly related to preparatory activities such as clearance of vegetation, excavation and stripping; and during clearing of the way leave for the transmission lines. During these processes, the plants and animal life will be disturbed.

7.3 Socio-economic Environment

7.3.1 Population

There will be a temporal increase in population during the construction of the power station, as some of the skilled and semi-skilled workers will be employed outside the project area. During operational phase, only a few operational staff will be retained, therefore in the long term, the impact on population will be minimal. The influx of people in the project area may breed social problems like prostitution and an increase in crime rate.

7.3.2 Local Economy

The introduction of electricity in the area will give the local communities an opportunity to improve production capacities in various sectors of the local economy carpentry, farming and trade. Employment of local people shall be encouraged for this will lead to an improvement in the income levels and in turn in the standard of living.

7.3.3 Energy

The introduction of power will improve the lives of the immediate neighbors. The rural health centres and schools will benefit from the power. Health centres will use electricity to preserve the vaccines to maintain the cold-chain whereas schools will be able to use computers and other equipment.

The tea factory will shit from using expensive diesel generators to hydro electricity and will not only reduce the operations of the factory, but also improve the general environment of the area because carbon dioxide emissions will be minimized.

7.3.4 Health

The impact on health is viewed on two ways; occupation health impacts related to the construction and operation activities and non occupational health impacts occasioned by the execution of the proposed project.

The occupational health impacts occur to the workers during their respective duties. During construction phase, the workers will be exposed hazards such as machine cuts, and repetitive injuries from use of tools and equipment among others.

The anticipated non occupational health impacts will be expected with the use of labour from outside and impoundment of the river. The use labour from outside the project site may cause spread of communicable diseases such as dysentery, HIV/AIDS and other sexually transmitted diseases.

The impoundment of water in the project river may lead to the increase in breeding ground for mosquitoes which may lead to increased incidence of malaria. The water in the reservoir may also serve as habitat for snails that are carriers of the bilhazia parasites.

7.4 Highlights of Consultation with the Ministry of Energy Management

During the initial phases of the preparation of the EIA study, of the proposed Small-Hydropower station in Kiringa, meeting was held between the consultant and the Ministry of Energy management. Some of the officers consulted at the head Office included the project engineers and planners. From these consultations, the consultants were able to embark on the study. Some of the issues discussed during these consultations included feasibility study of the proposed sites, Small-Hydropower station design, environmental, social and economic impacts.

7.5 Summary of Possible Environmental Impacts and suggested mitigation measures

Construction of the proposed Small-Hydropower station may have the following possible environmental impacts. They have been described along with respective recommended mitigation measures in Table 7.1 below.

Table 16 Possible Environmental Impacts and suggested mitigation measures

Environmental aspect	Proposed mitigation measure and objective of measure	Responsibility	Estimated Cost (Ksh)	Time Schedule
1. Biological Diversity (Flora and Fauna): Negative ecological impacts on the construction site (soil erosion, destruction of flora and faunal interference). Small Organisms may be killed and destruction of grass. Trees and shrubs likely to be destroyed are as follows: *Croton megalocarpus, Markhamia lutea, Pinus* sp., *Grevillea robusta* (Mukima), *Eucalyptus* spp. (Mutimbao), *Prunus Africana* (Muiri), *Vitex keniensis* (Meru Oak), *Cupressus* spp. (Cypress), *Juniperus procera* (Cedar), *Ocotea usambarensis* (Camphor), *Casuarina equiselifolia, Calliandra calothyrus, Newtonia buchananii* (Mukui), *Acacia mearnsi* Shrubs: *Lantaria caImenti, ferns* among others. Grass: Kikuyu grass, nappier grass Fruit trees: Avocado, Guava Cash crop: Coffee, Macadamia	• All trees uprooted to pave way for canal construction should be replanted. • Planting of grass and trees species that would be destroyed, flowers and grass within the Proposed Small-Hydropower station site. • Planting of trees, grass and flowers has been done and will continue to be done to improve on the landscape quality of the Small-Hydropower station site and also act as windbreakers. • Special attention paid to propagation of the endangered tree species especially *Prunus africana.* • Tree species to be planted to rehabilitate the site and improve the aesthetic value of the Small-Hydropower station site. • Promote the development of community nurseries and educate on need of planting trees to mitigate impact of global warming in the region. • Emphasis to be on indigenous such as *Cordia Africana, Cordia Abbysicca, Dovyalis abyssinica, Vitex keniensis* (Meru Oak), *Prunus africana, Podo carpus, Olea spp, Croton macrostachyus, Junisperus procera, Milicia excelsa, Ocotea usambarensis* (Camphor), *Casuarina equiselifolia, Calliandra calothyrus, Ficus spp., Uvariodendron anasitum, Celtis mildenbracdtii* and *Newtonia buchananii* (Mukui), . Other recommended fruit tree species along the canal include: *Carica papaya* (pawpaw), citrus fruits, *Citrus sinensis* (Orange) Mango (Mangifera indica), *Psidium guava* (Guava) among others.	Proponent, Kenya Forest Service, Ministry of Agriculture and community	Ksh. 250,000	During construction
2. Land degradation due to increased soil erosion - Clearing of grass, shrubs and other bushes for construction of	• Terraces to be constructed at appropriate places at the site and suitable plants and grass species planted. • Extra roads to be constructed as narrow as possible and along the contour in consultation with Kenya Forest Service (KFS) and	Proponent, Kenya Forest Service, Ministry of	Ksh. 300,000	During construction

Small-Hydropower station, footpaths and parking spaces increases the vulnerability of the land/site to soil erosion.	Ministry of Roads and Public Works as necessary. • Rip-off compacted for planting of trees. • Footpaths to be protected with appropriate grass species, stones or appropriate environmentally friendly measures that would prevent soil erosion. • Avoid use of heavy machinery. • Use water bowsers to Minimize dust pollution control earth works.	Agriculture and community		
3. Increased water Demand/extraction, Supply & Water Quality	• Observe the Water Act 2007 and the 30% water rights for the downstream users. • Water intake to comply with the recommended cubic metres if possible not affecting users downstream. • Keep natural water channels free from obstruction • Support tree planting programmes to enhance water catchment in the area	Proponent and community	Ksh. 150,000	During construction
4. Siltation	• Ensure desilting is done regularly • Divert storm water from canal to reduce siltation • Construction of recommended silt traps	Proponent and community	Ksh. 400,000	During construction
5. Physical environmental destruction (land scarification)	• Avoid use of heavy machinery • Use water to minimize dust pollution • Control earth works • Construction of embankment especially around the powerhouse to control soil eroson • Storm water drainage to be properly managed. • Roads rip-off and establishing vegetation after construction.	Proponent and community	Ksh. 450,000	Through out the project
6. Waste Management (disposal) Types of typical solid and liquid wastes expected at the Small-Hydropower station site would include but not limited to the following: These are as follows: Papers, Polyethylene bags, Plastic containers, broken glasses,	The proposed Small-Hydropower station is addressing the problem as follows:A waste management plan will be put in place • Waste disposal containers will be placed at strategic places where wastes are sorted out into biodegradable, and non-biodegradable. • Solid wastes such as plastics, papers, and bottles will be collected for recycling. While papers and other wastes that cannot be recycled are burnt in the compost pit or incinerator. • Wastes such as green leaves will be used to produce compost manure for flower gardens to improve soil fertility and also planting trees and	Contractor, Proponent and community	Ksh. 250,000	During construction

foodstuff remains, green leaves from clearing of site, human wastes, dirty water machinery, etc.	flowers later at the Small-Hydropower station site. • Waste water to be disposed into water sanitation system and exhausted for disposal as need arises. • Construction of iko toilets OR flush toilets to be designed and sited appropriately for use by the construction workers and visitors.			
7. Environmental Pollution through oil, petrol and diesel spillage	• Minimize accidental spillage of oils, petrol and diesels • Ensure direct capuling of turbine and generator to avoid grease mixing with water. • Where they occur, immediate collection and treatment of site is recommended. • Dispose wastewater using environmentally sound methods. • Dispose machinery pollutants using environmentally sound methods. • Ensure machinery and equipment are well serviced to reduce leaks. • Construct storage fuel tanks away from regular activities in compliance with Energy bill, 2003.	Proponent and community	Ksh. 150,000	During construction
8. Occupational health hazards or issues during construction and after	• Provision of adequate personal protective gear/equipment to workers such as gloves and gum boots to workers during construction work. • Conducting relevant training to workers • Use of water to reduce effect of dust on workers and the environment. • Erect warning signs • Fence where necessary • Building a permanent bridge to the powerhouse • Close contact with the nearest health facility to send ambulance immediately incase of emergency • Ensure night shifts in case the construction will be done over night • HIV and AIDS, VCT and Health Support Clinic within the Small-Hydropower station area.	Contractor, Proponent and community	Ksh. 150,000	During construction
9. Personal Safety such as workforce accidents by unsafe working practices	• Guard all moving parts of machines; provide personal protective clothing and ensure they are used; • Display for all to read health, safety and environmental management policies • Compliance to the provisions of the EHS management plan to	Contractor, Proponent and community	Ksh. 170,000	During construction

	safeguard workers • Prepare and print safety manual for distribution to workers. • Contract an EHS Consultant to police workers with the view to ensure provisions of the EHS regulations are adhered to. • Provide protective gear for example overalls, hard hats (helmets), and safety boots among others. • Safety rules and warning signs including emergency procedures, evacuation mechanism in case of fire will be displayed at strategic open places within the small hydro power station.			
10. Accidents from heavy, long trucks	• Assign a vehicle specifically for emergencies. • Put signs at the front and the rear of the hydro power equipment trucks e.g. WIDE LOAD-KEEP DISTANCE • Notices at the sites warning people prone to accidents.	Contractor, Proponent and community	Ksh. 50,000	During construction
11. Water quality: Pollutants may be swept away into the downstream hence endangering human lives and that of aquatic life.	• Provision of potable water (for workers) within the proposed facility should be as per the NEMA, Ministry of water and WHO Standards (Appendix 1-3) • Ensuring effective discharge of waste water into the septic tank.	Contractor, Proponent and community	Ksh. 30,000	During construction
12. Surface run off into the river	• Terraces and cut-off drain to be done. • Planting of suitable flowers and grass to control surface run-off around the project site.	Contractor, Proponent and community	Ksh. 125,000	During construction
13. Aesthetics of the project site	• Guard against degradation and pollution of the environment • Landscaping • Tree planting	Contractor, Proponent and community	Ksh. 150,000	During construction and operation
14. Air, dust and noise pollution	• Dust masks to be provided to workers to limit inhalation of the dust. • Contractor will give prior notice of activities and time durations to neighbouring households. • Watering dusty ground before excavation begins • Measures will be put in place to ensure use of serviced and greased equipment and earmuffs by operators. • Switch off engines when not being used • Generators to be well insulated or placed in enclosures to Minimize noise levels.	Contractor, Proponent and community	Ksh. 250,000	During construction

	• Sprinkling of water on graded routes to reduce dust. • Provide earmuffs to workers. • Use of appropriate devices to filter toxic emissions from the smoke before released to the atmosphere. • Screening/fencing the site to avoid spread of dust and ensuring all noisy work is done during daytime to avoid disturbance to neighbors.			
15. Encroachment of private land and impact on transport access	• Ensure involvement of all the affected households during canal construction and fully compensating them. • Ensure construction does not affect movement of people by construction appropriate bridge where canal crosses road or public path. • Give priority to the affecting households when allocating power supply • Facilitate proper maintenance of major roads to the Small-Hydropower station.	Contractor, Proponent	Ksh. 525,000	During construction
16. Other cultures (personnel who will be posted to work in the area)	• Sensitisation and education of communities on other cultures, their potential impacts and coping mechanisms	Contractor, Proponent and community	Ksh. 45,000	During construction and operational stage
17. Security issues	• Promoting community policing. • Small-Hydropower station to provide adequate security for plant and machinery.	Contractor, Proponent and community	Ksh. 150,000	During construction and operational stage
18. Encroachment of private land and impact on transport access	• Ensure involvement of all the affected households during canal construction and fully compensating them. • Ensure construction does not affect movement of people by construction appropriate bridge where canal crosses road or public path. • Give priority to the affecting households when allocating power supply • Facilitate proper maintenance of major roads to the Small-Hydropower station.	Proponent and community	Ksh. 50,000	During construction and operational stage

19. Employment opportunities	• Give preference to local community on employment and business opportunities unless skills required are not available. • Where possible offer women equal employment opportunities to men.	Proponent and community	Ksh. 800,000	During construction

7.6 Decommissioning

This is an important phase in a project cycle which comes when the lifespan of a project has come to an end. If by any unforeseen circumstances the operation of the proposed Small-Hydropower station ceases, the removal of facilities and structures will entail demolition of buildings, slabs, foundations and other structures within the built area of the Small-Hydropower station, and proper disposal and/or re-use of demolition materials followed by backfilling, grading, and re-vegetation of the site. All underground storage tanks and any facility containing hazardous liquid shall be located and removed. Disposal of such materials shall be governed by the national standards. The following should be undertaken to restore the aesthetic value of the environment.

7.6.1 Small-Hydropower station machinery, structure and waste

- The proponent to employ integrated solid and liquid waste management system
- The proponent together with the local council will select disposal locations based on properties of particular wastes generated.
- Removal, recycling, re-use or selling of scrap materials
- All disposals should be done according to legal requirements.

7.6.2 Rehabilitation of project site

- Re-vegetation of the site to restore the aesthetic value of the environment.
- Proper erosion control measures during re-vegetation
- Proper monitoring and inspection of the site for indications of erosion
- Fencing and signs restricting access to Minimize disturbance.

7.6.3 Socio-economic impacts

- Ensure safety of workers
- Offer advice and counseling to employees on other livelihood opportunities
- Assist with re-employment and job-seeking of the involved workforce
- Compensation and suitably recommend the project workers in seeking employment opportunities elsewhere.

CHAPTER EIGHT: ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAMS

8.1 Environmental Monitoring

The project may have minimal adverse environmental effects, provided that recommendations and mitigation measures identified in this report are incorporated into all the contracts and followed by both the developer and the contractor.
During operation of the proposed project there will be need for monitoring of air quality, water quality, and ambient noise quality. The purpose of environmental monitoring is to ensure that the state of environment of the project area is maintained at a level equal to or better than pre-construction conditions.

8.2 Environmental auditing

In compliance with Legal Notice No. 101 of 2003, the Proponent will undertake environmental auditing of the proposed project. The Proponent will develop a comprehensive environmental monitoring programme that will be used to:

- Ensure protection of the environment
- Ensure that personnel exercise due diligence in carrying out activities
- Evaluate the effectiveness of the measures used to prevent or minimize environmental impacts.

CHAPTER NINE: CONCLUSIONS AND RECOMMENDATIONS

9. Conclusion and Recommendation

9.1 Conclusion

In accordance with the Environmental Management and Coordination Act 1999 and The Environmental (Impact and Audit) Regulations, 2002, the findings of the environmental impact assessment carried out for this indicate that possible environmental impacts generated during operations and decommissioning phases will be addresses effectively by the proponent as mitigation measures indicated in the matrix above. As per the above analysis of the aspects of both positive and negative environmental impacts of the project's development, we, the **experts found no significant negative impacts that could pose adverse effects to the extent of the proposed project not being implemented.** However the minor potential negative impacts of the proposed project could be managed with the suggested environmental and social mitigation management plans.

9.2 Statutory Compliance

The proponent and the contractor shall ensure that they implement statutory provision of the statutes mentioned in Chapter Two.

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APPENDICES

Appendix 1a: Some examples of drinking water 'action levels' (World Health Organization)

CHARACTERISTIC	**'ACTION LEVEL'**	
ARSENIC	0.05	mg/l
CADMIUM	0.005	mg/l
CHROMIUM	0.05	mg/l
CYANIDE	0.1	mg/l
FLUORIDE	1.5	mg/l
LEAD	0.05	mg/l
MERCURY	0.001	mg/l
NICKEL	0.1	mg/l
NITRATE & NITRITE NITROGEN	10	mg/l
NITRITE NITROGEN	1.0	mg/l
SELENIUM	0.01	mg/l
CHLORIDE	250	mg/l
SULPHATE	400	mg/l
HARDNESS AS $CACO_3$	500	mg/l
TOTAL DISSOLVED SOLIDS	1000	mg/l
ALUSMALLUM	0.2	mg/l
COPPER	1.0	mg/l
IRON	0.3	mg/l
MANGANESE	0.1	mg/l
SODIUM	200	mg/l
ZINC	5.0	mg/l
CHLOROPHENOLS	0.1	ug/l
CHLOROFORM	30	ug/l
COLOUR	15	TCU
TURBIDITY	5	NTU
TASTE	NOT OBJECTIONABLE	
PH	6.5 to 8.5	

Appendix 1b: Ministry of Water Effluent Standards for Acceptance

pH	6.0-9.0
BOD (5 days at 20ºC) not to exceed	20 mg/1
COD not to exceed	50 mg/1
Total suspended solids not to exceed	30 mg/1
n-hexane extract not to exceed	30 mg/1
Oils (Mineral, Animal and Vegetable)	5.0 mg/1
Total phenol not to exceed	2.0 mg/1
Copper (Cu) not to exceed	0.05 mg/1
Zinc (Zn) not to exceed	0.5 mg/1
Lead (Pb) not to exceed	0.1 mg/1
Arsenic (As) not to exceed	0.002 mg/1
Total mercury (Hg) not to exceed	0.005 mg/1
Alkyl mercury not to exceed	0.001 mg/1
PCB (polychlorinated Biphenyls) not to exceed	0.003 mg/1
Pesticide residues not to exceed	0.05 mg/1
Sulphates not to exceed	500 mg/1
Dissolved manganese (Mn)	1.0 mg/1
Chromium (total)	0.1 mg/1
Chloride not to exceed	1000 mg/1
Flouride not to exceed	2.0 mg/1
Coliform bacteria	1000/100 mg/1
Free ammonia not to exceed	0.2 mg/1
Sulphides (S) not to exceed	0.1 mg/1
Cadmium (Cd) not to exceed	0.05 mg/1
Cyanide (CN) not to exceed	0.1 mg/1
Organic phosphorus not to exceed	1.0 mg/1
Chromium (six) (Cr^{6+}) not to exceed	0.00 mg/1
Total Dissolved Solids not to exceed	1200 mg/1
Selenium (Se) not to exceed	0.005 mg/1
Nickel (Ni) not to exceed	1.0 mg/1
Barium (Ba) not to exceed	2.0 mg/1
Temperatures not to exceed	37ºC+/-2ºC
Oil/grease	Nil (no trace)
Toxic substances	Nil
Odour	Not objectionable to the nose
Colour	Not objectionable to the eyes OR not to exceed 5 mg Pt/1

Appendix 1: Socio-economic data

Feasibility Study on Small-Hydro power station within Kabare Location, Gichugu Constituency, Kirinyaga East District

Questionnaire No. _____
Date of Interview _____
Name of Enumerator _____

GPS Coordinates (Northings & Eastings):

Latitude ……..…..

Longitude ……..……..

Section I: Background Information of sample area:

i). District _____

ii). Constituency _____

iii). Division _____

iv). Location _____

v). Sub-location _____

vi). Village _____

Section II: Background Information of the respondent:

Q1. i. Name of the Respondent (optional) _____

ii. Identification Card Number (optional) _____

Q2. Gender 01= Male [ ] 02=Female [ ]

Q3. Age of the Respondent _____

Q4. Marital status 01= Married [ ] 02=Single [ ] 03=Widow or Widower [ ]

Q5. Respondents **position** in the household:

Codes for Respondents Relationship to **Head** of Household

01=HEAD [ ]
02=WIFE / HUSBAND [ ]
03=SON/ DAUGHTER [ ]
04=OTHERS (Please indicate) ……..

Q6. What is the highest level of education?

None (No formal)……...…….01 [ ]
Primary (1-8)…..…….……02 [ ]
Secondary..…….…..…..04 [ ]
Tertiary/University…….…….……05 [ ]

Section III: Background Information about the Household

Q.7 (a). Household Size of your family (Total Number including parents)? _____

(b). Gender composition of the **HH** members?

Male No. _____ Female No. _____

Q8 (a). What is your **MAIN** source of livelihood?

Cash crop farmer..……..…..…01 [ ]
Food crop farmer ……..…….…....02 [ ]
Livestock/Dairy farming.…...…….…….03 [ ]
Trading/Marketing.…….……04 [ ]
Salaried Employee……..…...05 [ ]
Fishing……..…...06 [ ]
Artisan……..……07 [ ]
Herbalist.……..……08 [ ]
Other (Specify)……..

Q9 (b). What is your **SECOND** source of livelihood?

Cash crop farmer..……..…..…01 [ ]
Food crop farmer ……..…….…....02 [ ]
Livestock/Dairy farming.…...…….…….03 [ ]
Trading/Marketing.…….……04 [ ]
Salaried Employee……..…...05 [ ]
Fishing……..…...06 [ ]
Artisan……..……07 [ ]
Herbalist.……..……08 [ ]
Other (Specify)……..

Q10 (a). What is the **MAIN** crop in your farm?

Maize …….....01 [ ]
Beans ……..…….....02 [ ]
Banana …. ……03 [ ]
Mango ….……...…….……..04 [ ]
Peans ….……05 [ ]
Greengrams…….…….....06 [ ]
Cassava…….……..…….....07 [ ]
Avocado …….……..……08 [ ]
Other (Specify)……..

Q11 (b). **Other** crops in your farm? (Please tick as appropriate)

Maize …….....01 [ ]
Beans ……..…….....02 [ ]
Banana …. ……..…03 [ ]
Mango ….……...…….……..04 [ ]
Peans ….……05 [ ]
Greengrams…….…….....06 [ ]
Cassava…….……..…….....07 [ ]
Avocado …….……..……08 [ ]
Other (Specify)……..

Q12. Names of **MAIN** tree species in your farm? (Please tick as appropriate)

Grevillea.. ……01 [ ]
Eucalyptus ……..….02 [ ]
Pinus ….……..…….03 [ ]
Acacia ……..……04 [ ]

Other (Specify)……..

Q13. What is your land size?

Farm Size (Acres)

1 = < 0.25 [ ]
2 = 0.25 – 0.5 [ ]
3 = 0.5 – 1.0 [ ]
4 = 1.0 – 2.0 [ ]
5 = 2.0 – 2.5 [ ]
6 = 2.5 – 3.0 [ ]
7 = 3.0 – < 4.0 [ ]
8 = • 4.0 [ ]

Q14. Who is the owner of this land?

Farm ownership

1 = Household head [ ]
2 = Husband [ ]
3 = Wife [ ]
4 = Daughter [ ]
5 = Son [ ]
6 = Relative [ ]
7 = Other (specify) _____

Land tenure

1 = Freehold (Title deed) [ ]
2 = Rented [ ]
3 = Communal (Traditional) [ ]
4 = Other (specify) _____

Section IV: Background Information about the Household/Homestead status

Q.15 What is the house constructed of (Roof, Wall, others)?

i). Roof

1 = Thatch [ ]
2 = Iron sheets [ ]
3 = Tiles [ ]
4 = Others (Specify) ……...

ii). Walls

1 = Mud [ ]
2 = Wood [ ]
3 = Stone/bricks [ ]
4 = Iron sheets [ ]

5 = Others (specify ……..……..

iii). <u>Floor</u>

1 = Mud [ ]
2 = Wood [ ]
3 = Cement [ ]

4 = Others (specify ……..……..

Q.16 Which of the following items does the household possess? (Tick as appropriate).

1=Piped-water ( )
2=Water tank ( )
3=Telephone ( )
4=Working radio ( )
5=Electricity ( )
6=Working TV ( )
7=Working clock ( )
8=Armchair sets ( )
9=Wheelbarrow ( )
10=Hand cart ( )
11=Animal drawn cart ( )
12=Bicycle ( )
13=Motor cycle ( )
14=Tractor ( )
15=Car/Pick-up ( )

16 = Others (specify) ……..……

Q.17 Where is the **Main** source of your **Household** water?

1=Piped-water [ ]
2=Nearby stream [ ]
3=Spring well [ ]
4=Boreholes [ ]
5=Earth dams [ ]
6=Pan [ ]

7=Others (specify) ……

Q.18(a). What is your **Main** source of your **Household** energy?

1=Fuelwood [ ]
2=Kerosene [ ]
3=Cooking Gas [ ]
4= Electricity [ ]
5= Biogas [ ]

6=Other (specify) ……

Q.19 (b). If **fuelwood**, what is the source?

1= Coconut bark [ ]
2= Mangrove [ ]
3=Other tree species [ ]

4=Other(s) (specify) ……

Q. 20 (a) What is your **Main** source of **Primary** health care?

1=Government Health centres [ ]
2=Private clinics/hospitals [ ]
3=Mission hospitals [ ]
4=Herbal medicines [ ]

5=Other(s) (specify) ……

Section V: Community based Income Generating Activities

Q.21. Do you belong to any community income-generating group(s)? 1=Yes [ ], 2=No [ ]

If yes specify or give their name [……....]

1 = Self Help group [ ]
2 = Cooperative [ ]
3 = Income generating [ ]
4 = Small Company [ ]
5 = Conservation based group [ ]
6 = Others (specify) ……

Section VI: The use of forest resources

Q.22. Do you use nearby **forest** for any purpose? 1 = Yes [ ], 2 = No [ ]

Q.23. How long have you depended on this forest?

1=1-5 yrs [ ] 2=6-10 yrs [ ] 3=11-15 yrs [ ]

4=16-20 yrs [ ] 5= > 20 yrs [ ]

Section VII: Infrastructure

Q.24. What is the distance and which means of transport do you normally use from your homestead to:

Place and Code	**Name**	**Distance from home (Km)**	**Normal mode of transport**	**Mode of Transport**	**Distance (Km)**
				1 = Walk	1 = < 1.0
				2 = Bicycle	2 = 1- 5
1 = Nearest town (Trading centre)				3 = Motor cycle	3 = 5-10
2 = Nearest co-operative society				4 = Public Transport	4 = 10-15
3 = Nearest Self-Help Group				5 = Own vehicle	5 = >15
4 = Nearest Market				6 = Other (specify)	
5 = Nearest main road					
6 = Nearest School					
7 = Nearest Hospital					
8 = Agric. Office					

The Road Network

Q.25 How far do you live away from the **roads** below?

ROAD TYPE	**CODES**	DISTANCE (KM)
NEAREST TARMAC ROAD		CODES:
NEAREST MURRAM ROAD		**1 = < 1.0**

NEAREST SEASONAL ROAD	**2 = 1- 5** **3 = 5-10** **4 = 10-15** **5 = >15**

The Education Facilities

Q.26 How far do you live away from the Education Facilities below?

EDUCATION FACILITIES TYPE	**CODES**	DISTANCE (KM) CODES: **1 = < 1.0** **2 = 1- 5** **3 = 5-10** **4 = 10-15** **5 = >15**
NEAREST PUBLIC PRIMARY SCHOOL		
NEAREST PUBLIC SECONDARY SCHOOL		
NEAREST PUBLIC YOUTH POLYTECHNIC OR TRAINING COLLEGE		

Q.27 What is your estimated household **annual income** [Gross]? Ksh. _____

Appendix 2: Environmental Checklist

Feasibility Study on Small-Hydro power station within Kabare Location, Gichugu Constituency, Kirinyaga East District

Checklist No. _____

Observation date _____

Name of Consultant _____

SECTION I: BACKGROUND INFORMATION OF SAMPLE AREA:

i). District _____

ii). Constituency _____

iii). Division _____

iv). Sub-location _____

v). Village _____

GPS Coordinates (Northings & Eastings):

Latitude ……..…..

Longitude ……..……..

SECTION II. SITUATION WITHIN 5 KM RADIUS FROM SAMPLE SITE

1. Physical characteristics (e.g. topography, soil type, erosion potential, presence of streams and ground water characteristics).

i). General topography ……..……..

ii). Soil type ……..……

iii). Erosion potential ……..…..……..

Main Reasons:

Poor farming methods..……..…..…01 [ ]

Deforestation ……..……..…...02 [ ]

Overstocking..……..…….03 [ ]

Quarrying.…….…..……04 [ ]

Human settlements…..…….....…...05 [ ]

Canal construction…..…..…….……..…...06 [ ]

Other (Specify)……..

iv). Presence of streams ……..…..……

v). Natural drainage pattern ……..…

vi). Ground water characteristics:

a). Ground water table, rate of recharge present restrictions on drawal, available yield,

quality of water (physical, chemical, biological)

…….……..…….……

vii). Flood prone areas ……..…….

viii). Geological features including seismic zone ……...……...…..…

b). Surface water location, source and yield, present use (for human consumption, industry, etc.)

..……..……..……..……

2. General climatic information (e.g. annual rainfall patterns, flood and drought cycles, wind patterns).

i). Annual rainfall (mm)……..……..

ii). Flood and drought cycles ……..……

iii). Altitude (m.a.s.l.) ……..……..

iv). Temperature ……..……...……..

v). Other general meteorological data (wind direction, speed etc)

……..……...……...……..

3. Type and status of habitats present (e.g. wetlands, forests, freshwater lakes, riverine habitats)

i). Tree cover-prominent species

1 = *Eucalyptus* spp. (Mutimbao)	[ ]	
2 = *Grevillea robusta* (Mukima)	[ ]	
3 = *Prunus Africana* (Muiri)		[ ]
4 = Acacia spp	[ ]	
5 = *Vitex keniensis* (Meru Oak)	[ ]	
6 = Jacaranda		[ ]
7 = *Cupressus* spp. (Cypress)	[ ]	
8 = *Juniperus procera* (Cedar)	[ ]	
9 = *Ocotea usambarensis* (Camphor)	[ ]	
10 = *Casuarina equiselifolia*		[ ]
11 = *Calliandra calothyrus*		[ ]
12 = *Newtonia buchananii* (Mukui)		[ ]
13 = Acacia mearnsi (wattle/*muthanduku*)		[ ]
14 = *Milicia excelsa*		[ ]

15 = Other (s) (specify) ……

ii). Freshwater lakes ……..……..

iii). Fauna-wildlife ……..……..……..……

iv). Domesticated ……..……...

v). Aquatic life…….…….....

vi). Riverine habitats (e.g. Avifauna, etc).……..……..……...

4. Biological characteristics (e.g. animal and plant species present and their significance, i.e. endangered species, food source for the people)

……..……..

……..……..

5. Existing land use (to include agricultural & non-agricultural uses, commercial, industrial dense, human settlements, water bodies, transport systems etc.)

i). Predominant activities e.g. residential, institutional, commercial, agricultural, etc

……..……

ii). Special features:

(Such as tourist spots, monuments/archaeological sites, hospitals, schools, institutions, religious places, heritage areas and places of other interests)

……

iii). Specific environmental problems, if any (such as water and air pollution, land spoliation by natural & manmade factors, endemic diseases, loss of tree cover, open spaces etc.)

……..……

6. Key demographic information

i). Population of study area (Locational): ……

ii). Population density: ……..……..……

iii). Average HH size: ……..…..……..……

iv). Annual growth rate: ……..……..……..…

v). Gender composition: Male No. _____ Female No. _____

vi). Health: Endemic diseases:

……..……

7. Conservation NGOs, community based groups (CBOs) and other stakeholders:

i). List of Conservation NGOs:

……..……

ii). List of Community Based Conservation groups (CBOs):

……..……

iii). List of government departments and state corporations involved in Conservation in the area:

…..……..……..……

iv). List of other stakeholders involved in Conservation:

……..……

Asante Sana

Appendix 3: Environmental Impacts Checklist

Feasibility Study on Small-Hydro power station within Kabare Location, Gichugu Constituency, Kirinyaga East District

Checklist No. _____

Observation date _____

Name of Consultant _____

Predictions of impact detailed above, impact assessed without and with the proposed project:

		Environmental Impact units			
No.	**Parameter**	***Without project***	***With project***	***Net change***	***Magnitude***
1	Crops				
2	Natural vegetation				
3	Forests				
4	Land use				
5	Natural Reserves				
6	Fisheries				
7	Wildlife				
8	Rare species				
9	Endangered species				
10	Species diversity				
11	Water pollution				
12	Air pollution				
13	Noise pollution				
14	Solid waste				
15	Land pollution				
16	Soil erosion				
17	Eutrophication				
18	Health				
19	Benefit to Economy				
20	Over abstraction of water upstream				
21	Displacement/ encroachment of private land				

Appendix 4: Questionnaire for the heads of households neighbouring the Proposed Small-Hydropower station site

Question 1: What are the possible environmental impacts of the proposed project?

Question 2: What are the possible mitigation measures to be put in place to address the negative impacts?

Question 3: Do you support the proposed project?

1 = Yes
2 = No

Appendix 5: Focused Group Discussion/interview guide of the Households surrounding the Proposed Small-Hydropower station in Kirinyaga District

The focus group interview will be guided by a discussion/interview guide, which comprised the sub-topic of:

1. Expectations from the proposed Small-Hydropower station
2. Employment opportunities expected following this project
3. Employment expectations
4. Available social amenities
5. Water for domestic use
6. Impact of Small-Hydropower station (social-economic, cultural, environmental, etc).
7. Other comments and recommendations.

SUBMISSION OF EIA REPORT TO NEMA

Form 1a (r 8)

Application Reference No:……..

For official use

THE ENVIRONMENT MANAGEMENT AND COORDINATION ACT

SUBMISSION OF PROJECT REPORT

Part A: DETAILS OF PROPONENT

A1 Name of proponent (organization) ……... **Ministry of Energy**……..……

A2 PIN No. ..……..……

A3 Address **48552–00100, Nairobi** ……...……...……

A4 Name of contact person.……..……**Permanent Secretary**……...…..……

A5 Telephone No. …**(020) 219376, 216777**…….…..……..……

A7 E-mail ….……..…….……...

Part B: DETAILS OF THE PROJECT REPORT

B1 Title of the proposed project ……Environmental Impact Assessment for Small-Hydropower station at Kirinyaga …….…...……..……

B2 Objectives and scope of the project ……Assessment of environmental compliance, management and mitigation within the Small-Hydropower stationurroundings.

B3 Description of the activities … identify the potential impacts on the physical, biological and socio-economic environment and subsequently propose appropriate mitigation measures for any negative impacts and enhancement measures for the positive impacts resulting from this development…….……..……...

B4 Location of the proposed project …….. **Njuku Sub-location, Kabare Location, Gichugu Constituency in Kirinyaga district** ..……..

Part C: DECLATION BY THE PROPONENT

I hereby certify that the particulars given above are correct and true to the best of my knowledge.

Permanent Secretary

…….. ……..… ……

Name Position Signature

On behalf of ……..… Ministry of Energy ……..…

Date..……..……...…..……
(Firm name and seal)

Part D: DETAILS OF ENVIRONMENTAL IMPACT ASSESSMENT EXPERT

Name (individual/firm)……. **Joseph K. Kurauka** …….
…….**(Lead Expert)**…….…….
Certificate of registration No……...…**0673**…….……..

Address……**P. O. Box 17586-00100**
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…
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E-mail: ……..**jkurauka@gmail.com**…..…….…….

Part E: FOR OFFICIAL USE

Approved/not
approved…….
Comments:
……...…….……
…
……
…
…… Officer

Sign…… Date ……..……