



LAKE TURKANA WIND POWER PROJECT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY REPORT

July 2009

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- Ms. Pauline Ikumi – Socialist
- Mr. Frank Msafiri – Resource Assessment Expert/ Botanist

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ABBREVIATIONS AND ACRONYMS

AfDB	African Development Bank
AIDS	Acquired Immuno-deficiency Syndrome
AIC	African Inland Church
ALRMP	Arid Lands Resource Management Project
ASAL	Arid and Semi-arid Land
BoD	Board of Directors
BOD	Biochemical Oxygen Demand
BOOT	Build, Own, Operate and Transfer Scheme
BP	Before Present
CAHWS	Community Animal Health Workers
CAPEX	Capital Expenditure
CBD	Convention on Biological Diversity
CBO	Community Based Organization
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CFC	Credit Finance Corporation
CH ₄	Methane
CICU	Chemical and Industrial Consultancy Unit
CIFA	Community Initiatives Facilitation Assistance
CITES	Convention on International Trade in Endangered Species
CO ₂	Carbon Dioxide
COD	Chemical Oxygen Demand
COP	Conference of Parties
CSR	Corporate Social Responsibility
CSRP	Corporate Social Responsibility Programme
CV	Curriculum Vitae
dBA	Decibels
DDC	District Development Committee
DEO	District Environmental Officer
DDO	District Development Officer
DDP	District Development Plan
DFI	Development Finance Institutions
DO	Dissolved Oxygen
DO	District Officer
DOE	Designated Operational Entity
DNA	Designated National Authority
DRSRS	Department of Resource Surveys and Remote Sensing
€	Euro
EA	Environmental Audit
EB	Executive Board of the Clean Development Mechanism
EBITDA	Earnings Before Interest Tax Depreciation Amortisation
EC	Electrical Conductivity
EMCA	Environmental Management and Coordination Act
Eo	Average Annual Potential Evaporation
EER	Emerging Energy Research
EHS	Environmental, Health and Safety Guidelines
EIA	Environmental Impact Assessment
EPFI	Equator Principles Financial Institutions

ERB	Electricity Regulatory Board
ERC	Electricity Regulatory Commission
ERPA	Emission Reductions Purchasing Agreement
ERS	Economic Recovery Strategy
ESMP	Environmental and Social Management Plan
ESIA	Environmental and Social Impact Assessment
EU	European Union
FBO	Faith Based Organizations
FHI	Food for Hungry International
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GoK	Government of Kenya
GWh	Giga Watts per Hour
GTZ	German Technical Agency
Ha	Hectare
HFCs	Hydrofluorocarbons
HH	Household
HIV	Human Immuno – deficiency Virus
IFC	International Finance Corporation
IGA	Income Generating Activities
ILO	International Labour Organization
IPAL	Integrated Project in Arid Lands
IPP	Independent Power Producers
IRR	Internal Rate of Return
ISO	International Standards Organization
IT	Information Technology
JI	Joint Implementation
KenGen	Kenya Energy Generating Company
Kg	Kilogramme
KNBS	Kenya Bureau of Statistics
Km	Kilometre
KPLC	Kenya Power and Lighting Company
KSh	Kenya Shilling
kV	Kilovolts
kW	Kilowatts
KWS	Kenya Wildlife Service
l	litre
£	British Pound
LDC	Location Development Committee
Ltd	Limited
LTWP	Lake Turkana Wind Power Project
m	metre
MAB	UNESCO Man and Biosphere Programme
m asl	metres above sea level
mg/l	milligram per litre
mm	millimetre
MoE	Ministry of Energy
MoENR	Ministry of Environment and Natural Resources
MoH	Ministry of Health
MoNPD	Ministry of National Planning and Development

MOSARETU	El Molo, Samburu, Rendille and Turkana Women Group
MoU	Memorandum of Understanding
µS	micro Siemens
Mt.	Mountain
MW	Mega Watt
N	North
NASCOP	National Aids Control Programme
NEAP	National Environmental Action Plan
NEMA	National Environmental Management Authority
NGO	Non Governmental Organizations
NMK	National Museums of Kenya
O ₂	Oxygen
OHS	Occupational Health Safety
OHSAS	Occupational Health and Safety Standards
OP	World Bank Operational Policy
PAP	Project Affected Persons
PAYE	Pay As You Earn
PDD	Project Design Document
PFCs	Perfluorocarbons
PIN	Project Idea Note
PISP	Pastoralist Integrated Support Programme
PPA	Power Purchase Agreement
PPE	Personal Protective Equipment
PRA	Participatory Rural Appraisal
r	Average Annual Rainfall
RAP	Resettlement Action Plan
ROW	Right of Way
RPF	Resettlement Policy Framework
RPM	Rounds per Minute
SF ₆	Sulphur hexafluoride
SME	Small and Medium Enterprise
STD	Sexually Transmitted Diseases
STD	Subscribers Telephone Services
SS	Suspended Solids
TB	Tuberculosis
UNCCD	United Nations Convention to Combat Desertification (UNCCD)
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children Educational Fund
UNESCO	United Nations Education, Scientific and Cultural Organization
US\$	United States of America Dollars
VAT	Value Added Tax
VER	Verified Emission Reduction
VIP	Ventilated Improved Pit Latrine
V52	Vestas 52 Turbine
WB	World Bank
WC	Water Closet
WFP	World Food Programme
WHO	World Health Organization
WRMA	Water Resources Management Authority

0. EXECUTIVE SUMMARY

0.1 Introduction

This report is the Executive Summary of the Environmental and Social Impact Assessment (ESIA) Study prepared by a team of consultants, including Professor Francis M. Muthuri, Environmentalist/Team leader, Ms. Pauline Ikumi, Sociologist and Mr. Frank Msafiri, Natural Resource Assessment Expert/Botanist for Lake Turkana Wind Power (hereafter the Project) on behalf of the Lake Turkana Wind Power Ltd. (hereafter the developer) in the context of the Feasibility Study of the Lake Turkana Wind Power (LTWP) Project.

The objectives of the Environmental and Social Impact Assessment (ESIA) Study are to identify and evaluate the environmental and social (with a gender disaggregated analysis) effects, which could arise from the proposed construction and operation of the project's activities. The study team, consulted with a wide range of stakeholders including the Government authorities, community leaders, relevant organizations and interest groups involved directly and indirectly with the proposed project in order to seek their views on the impacts of the proposed project on the environment and socio-economic characteristics of the project area.

The methodology underlying the preparation of the ESIA Study included a multi-stage approach, namely the preparation of a biophysical and social scoping review, including consultative meetings with National Environment Management Authority (NEMA), government departments (e.g. Livestock, Fisheries), para-statal organizations (Kenya Wildlife Service, National Museums of Kenya, etc.), provincial administration and local community leaders in Loiyangalani Division (e.g. including the Yammo Manyatta Community (Turkana), Nakuame Kwi Manyatta (Turkana), Kiwanja Ndege Manyatta (Samburu and Rendille) and El Molo Community (originally from Komote Laiyeni Village) as well as gender and youth-based groups, including the Mosaretu Women Group, Kifaru Women Group and Nayori Environmental Conservation Rehabilitation Youth Group, and NGOs among other relevant stakeholders.

A field trip in the project area (Loiyangalani Division) was undertaken from November 15 to 25th, 2007. During the field trip and immediately thereafter, several activities including collection and identification of plant specimen, biological survey, sampling of water and subsequent laboratory chemical and biological analysis, social surveys, exhaustive literature review and data collection were carried out. Following the compilation of the ESIA draft report, public disclosure of the findings was carried out for a period of three weeks. On April 21st and 22nd, 2008 a well represented Stakeholders Workshop (53 participants) was conducted at the Palm Shade Lodge, Loiyangalani where the ESIA report was extensively discussed and endorsed.

0.2 Project Description

The Lake Turkana Wind Power Project involves the construction and operation of a 300 MW wind power facility in the greater Marsabit District (now Laisamis District) near Lake Turkana in the Eastern Province of Kenya. The proposed wind farm facility will comprise 365 turbines of 850Kw capacity each to maximize the very high wind speed prevalent in the project area.

In 2005, LTWP contracted DEWI, a leading international wind energy consulting firm to carry out extensive wind tests using a dedicated wind measuring station situated in the envisaged wind farm. Wind speed measurements were recorded every ten minutes at heights of 43, 62, 81, and 83 meters above the ground. Wind measurements revealed an impressive wind speed of 11 m/s (as compared with a high average in Europe of 7 m/s). LTWP subsequently submitted a proposal to the Kenya Government who welcomed the project, granting LTWP the exclusive

rights to survey the project area and to study the wind resources and subsequently signed a Memorandum of Understanding (MOU) between the Kenya Power and Lighting Company (KPLC) and the LTWP 10th April 2008.

Following the transportation of different power components, Vestas will assemble and install the power generating units at the project site. The proposed wind farm facility is expected to consist of 365 turbines, each with an installed capacity of 850 kW. The selected wind turbine is Vestas V52. The total foreseen power generated by the project will amount to 310 MW. This is 25% of the existing electric energy capacity currently available in the country. The project is scheduled to be constructed in one phase but will come on line as follows:

- 240 Turbines and full connection to the grid in 2011; and
- 125 turbines added to the park in 2012.

The lifespan of the proposed project is expected to be 25 years.

0.3 Project Rationale and Justification

Currently the electricity sector in Kenya reaches only a small (14%) percent of the population. Further electricity generation is therefore necessary in order to reach a greater percentage of the population and support economic growth. The situation is aggravated by the over reliance (approximately 60%) on hydropower which has been often unreliable especially in the dry seasons. For example the 1999 -2002 drought in Tana Catchment area and the subsequent lack of water supply greatly affected the power production of the hydroelectric dams which had a crippling effect on the economy. As such, the proposed project will increase the resilience of the Kenya power generation vis-à-vis potential climate risk variations in Kenya. The entry of the Lake Turkana Wind Power Project into the Kenya power scenario will help the country to address power shortage and enhance further economic growth. Towards this objective, the implementation of the proposed Lake Turkana Wind Power Project will provide the country with 300 MW of a relatively cheap source of energy.

However, the development of large scale production of power as projected in the Lake Turkana Wind Power Project is likely to have site-specific and limited impacts on the bio-physical and social environment of the project area. As a result, an Environmental and Social Impact Assessment (ESIA) Study for the proposed project was carried out in accordance to the guidelines stipulated in the Kenya's Environmental Management and Coordination Act (EMCA, 1999).

0.4 Policy, Legal and Administrative Framework

Environmental Impact Assessment Study for the proposed project has been carried out in accordance with the 2nd Schedule of the Environmental (Impact Assessment and Audit) Regulations of 2003, contained in Kenya Gazette Supplement No. 56, Legal Notice 101. The ESIA report has mainly been prepared in line with the outline contained in Part IV, Section 18 (1) of the above regulations stating:

- The proposed location of the project;
- A concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project;
- The objectives of the project;
- The technology, procedures and processes to be used, in the implementation of the project;
- The materials to be used in the construction and implementation of the project;
- The products, by-products and wastes generated by the project;

- A description of the potentially affected environment;
- The environment effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated;
- Alternative technologies and processes available and reasons for preferring the chosen technology and processes;
- Analysis of alternatives including project site, design and technologies and reasons for preferring the proposed site, design and technologies.
- An Environmental and Social Management/Monitoring Plan (ESMP) proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment; including the cost, time frame and responsibility to implement the measures;
- Provision of an Action Plan for the prevention and management of foreseeable accidents and hazardous activities in the cause of carrying out activities or major industrial and other development activities;
- The measures to prevent health hazards and to ensure security in the working environment for the employees and for the management of emergencies;
- An identification of gaps in knowledge and uncertainties which were encountered in compiling the information;
- An economic and social analysis of the project;
- An indication of whether the environment of any other state is likely to be affected and the available alternatives and mitigating measures; and
- Such other matters as NEMA may require.

Pursuant to the EMCA, its Second schedule and the Environmental (Impact Assessment and Audit) Regulations 31 and 35, NEMA reviewed and approved the ToRs of the ESIA Study of the proposed project September 20, 2007.

While the Environmental Management and Coordination Act (EMCA) supersedes all other environmental legislation, numerous other laws and regulations have influenced the various aspects and activities of the proposed Lake Turkana Wind Power Project. The most important legislation that will guide the development and implementation of this Project is the Electric Power Act (1998). Other relevant legislation with regard to this project includes: Workmen's Compensation Act (rev. 1988); Geothermal Resources Act (1982) and Regulations (1990); Public Health Act (rev 1972); Physical Planning Act (1996); Water Act (2002); Wildlife (Conservation and Management) Act (1985) ; Building Code (1997); Local Government Act (rev. 1998); Local Government Regulations (1963); Factories Act (rev. 1972); and Lakes and Rivers Act (rev. 1983) among other pieces of legislation.

Several international conventions and agreements are relevant to this study, including, among others, the Convention on Biological Diversity (CBD); the Convention on the wetlands of international importance (Ramsar); the Convention on the conservation of migratory species of wildlife animals; and the African convention on the conservation of nature and natural resources.

Environmental and social requirements of Development Financial Institutions (DFIs), such as the African Development Bank (AfDB), World Bank (WB) and the International Finance Corporation (IFC) were consulted as baseline requirements to this the study. Finally, compliance with the Equator Principles has also been taken into account in the preparation of the ESIA.

0.5 Description of the Project Environment

The project area for the Lake Turkana Wind power Project is situated in the Loiyangalani / Mt. Kulal locations of Loiyangalani Division in the greater Marsabit District (now Laisamis District) of the Eastern Province of Kenya. On a closer view, the project area is located between the foot slopes of Mt Kulal and the south-eastern end of Lake Turkana. The project site covers an area of 150 km² (15km by 10km). The project area has been leased from the Government of Kenya (GoK) for a period of 99 years. The leased land runs south east from the south eastern shores of Lake Turkana and passes between Mts. Kulal and Nyiru. The area has unique geographical conditions in which daily temperature fluctuations generate strong predictable wind streams between the Lake Turkana (with relatively constant temperature) and the desert hinterland (with steep temperature fluctuations). The project area covers a valley between Mt Kulal and Mt. Nyiru that effectively acts as a funnel in which the wind streams are accelerated to high speeds.

Climate - The climatic conditions prevailing in the project area and other areas of the Marsabit District are summarized in table below. The climate of the project area is hot and very dry. The whole of the project area belongs to what is referred to as Agro Climatic Zone VII. This zone is characterized by very low rainfall and very high evapotranspiration rates.

Main Features of the Agro Climatic Zones in Marsabit District

Zone	r/Eo (%)	r (mm)	Eo (mm)	Climatic designation
III	50-55	900 - 960	1750 - 1800	Semi-humid
IV	40 - 50	750 - 900	1800 - 2095	Semi-humid to semi-arid
V	25 - 40	525 - 750	11890 - 2095	Semi-arid
VI	15 - 25	320 - 525	2095 - 2150	Arid
VII	<15	170 - 320	2150 - 2280	Very arid

Source: A.J. van Kekem: Soils of the Mt. Kulal Marsabit Area

Legend:

r – Average annual rainfall (mm)

Eo – Average annual potential evaporation (mm)

Rainfall - The general patterns of rainfall in several areas in Marsabit District are characterized by a distinct bimodal distribution pattern. Based on the rainfall characteristic of the Agro Climatic Zone VII as recorded in the North Horr Meteorological Station, the project area rainfall is also very low, with a mean annual rainfall of less than 300mm. It is noted that there are no operational meteorological stations in the project area (covering the Agro Climatic Zone VII). For comparison, the nearest station with long-term records is North Horr which shares the same Agro Climatic zone (VII) with the project area and where rainfall records have been collected since 1959. The main wet season normally starts in March/April and lasts until May. The short rains start in October/November and last until December. An important characteristic of the rainfall in the project area is the high variability

Temperature - Generally, temperatures of the project area are high. The temperature patterns usually follow the general trends in the tropics where diurnal changes are greater than annual temperatures. The mean monthly temperatures of the project area are in the range of 27- 29°C, the mean minimal lie around 13 – 20°C and the mean maxima are 26– 35°C. The coolest months are July and August while February, March and October are the hottest months.

Wind - Wind is an important factor with regard to the development of the proposed project. Compared to the rest of Kenya, winds in the project area are very strong. The winds are generated by a low level jet called the Turkana Channel jet. The jet stream (discovered in 1981 by J. Kinuthia of the Kenyan Meteorological Department), is caused by the much larger East African low level jet. The Turkana Channel jet blows all year round from the South East through the valley between the East African and the Ethiopian Highlands stretching from the Ocean to the deserts in Sudan. The generated wind stream is accelerated locally between Mt. Kulal (2300m asl) and the Mt Nyiru Range (2750m asl). Due to thermal effects, the wind slows down during mid-day and is at full force during the night.

Lake Turkana Wind Power Project has been measuring wind speeds and frequency in the project area for the last 30 months at 40, 60 and 80 meters altitude. The average wind speed in the project area has been recorded to be 11 meters per second. These are among the highest wind speed averages recorded in the world.

Topography - The project area lies between 450 metres at the shore of Lake Turkana to 2,300metres above sea level (masl) on the foot slopes of Mt. Kulal. The topographical features of the project area are quite variable. The common features of the project area include plains, foot slopes, plateaus, hills and minor scarps and foot ridges.

Hydrology - Occurrence of surface water is very rare in the project area. Only after heavy rains, shallow pools and seasonal water courses may be filled with water probably up to a maximum of a few weeks. The drainage ways in the project area are dry river beds, referred to as laggas. These drainage ways have bouldery and stony riverbeds. Many laggas in the project area seem to be too wide for the existing climatic conditions. They have wide beds with braided characteristics and changing stream channels. Sometimes (once in every 5 to 10 years), the laggas are filled up completely. The Lagga Yammo and Lagga Sirima are important drainage ways in the project area.

Despite the scarcity of water in the project area, there are, however, several sources of water that consist of permanent springs, boreholes and waterholes dug in the riverbeds. An important source of permanent water is Loiyangalani Spring that provides water for the community around this area. There is also permanent surface water on the top of Mt. Kulal but this source of water is outside the project area.

Lake Turkana (6,750 km²) is the largest body of water in the project area. This lake has been in existence since at least early Miocene but has varied in size since then. For example it was greatly expanded between 9000 and 7500 B.C. when it covered the Lotikipi Plains to the west and drained to the Nile. It was this temporary connection that permitted the ingress of a nilotic fauna to the lake. The lake is fed by 12 principal rivers of which the largest affluent is the Omo River. This river originates from the Ethiopian highlands, flows south down the Rift Valley and enters the northern extremity of the lake through a large and swampy delta. The Omo River contributes more than 90% of the total riverine inflow. The Kerio and Turkwell Rivers, although perennial in the upper reach, discharge into the lake for only a few months each year.

It is noted that the salinity of the Lake Turkana water is at a level critical to various fauna. This lake is interesting in the fact that it is the most saline lake in East Africa containing a normal fish fauna. In addition, the lake is at the extinction limit for mollusks and at higher salinities, dwarfism of fish would occur.

Water quality - In the project area where water scarcity is very high, the importance of the quality of available water supplies can not be overstated. Biological, chemical and physical analyses of several parameters of water have been carried out from various sources. Even of greater significance is the fact that the lake water is used by a section of local community for domestic purposes and for watering of livestock. Indeed the El Molo and the Turkana already attribute some of their health problems to the use of water from Lake Turkana. Lake Turkana water has high concentrations of total dissolved solids (2381Mg/l) and high pH values (9.56). Although moderately soft, it is saline and requires demineralization and pH adjustment before being used for domestic consumption. Water from the Loiyangalani Springs (both the tap water and surface flowing water) is chemically suitable for domestic purposes. However, samples carried out during field investigations have demonstrated that both the tap water and the flowing surface water are contaminated with coliforms. Therefore, it requires disinfection/boiling in order to render it suitable for drinking.

Results of water analysis also show that many sources of water in the project area and surroundings have higher levels (1.7– 3.8 mg / l) of fluoride than maximum values (1.5mg / l) recommended for drinking water by the World Health Organization (WHO). Other water constituents that exceed guidelines recommended for drinking water are hardness for Nguruset (476 mg/l) and sodium levels for Muliko Springs (2600 mg/l) and Loiyangalani Beach (807 - 1300 mg/l). There is therefore a need to conduct regular chemical, physical and biological water analysis of the available water sources and advice the local community on suitability for human consumption.

Current environmental degradation - The project area has undergone tremendous natural degradation in form of erosion. Erosional processes, including gully, rill and stream bank erosion are common features in the project area. In addition, erosional processes by strong winds are rampant. Although the erosional processes are basically natural events, the inhabitants of the project area and their livestock have enhanced the degradation in this area. The cutting of trees and shrubs by the pastoralists for construction of houses and for fuel is a major cause of degradation. In addition, overstocking of the fragile area causes unbalanced use of vegetation by livestock thus causing overgrazing and degradation of the environment of the project area. Increased insecurity brought about by conflicts among certain ethnic groups in the area and subsequent increased settlements close to Loiyangalani where adequate security is available also contributes to the degradation of the area. This trend is currently causing high demand for fuel wood and building materials.

Biodiversity - The most prominent biodiversity components of the project area are the terrestrial flora and fauna and the fish of Lake Turkana. Lake Turkana to the west of the project area harbours a great variety of aquatic animals, including crocodiles, hippos, fish and birds. It is also an important water bird site. Eight four bird species, including 34 Palearctic migrants, have been recorded in and around the shores of Lake Turkana. Twenty three (23) aquatic bird species, including Goliath Heron and African Skimmer breed on the shores of the lake.

Flora - There are large areas of barren land where vegetation is very scarce in the project area. However, most of the project area is covered by deciduous dwarf shrubs, such as *Indigofera spinosa*, *Duosperma eremophilum*, *Sericocomopsis hildebrandtii*, *Acacia reficiens*, *Acacia mellifera* and *Commiphora africana*. The most prominent trees of the project area are *Acacia tortilis* and *Delonix alata* which are found along the laggas. Annual grasses that are common during the rainy season include *Aristida mutabilis*, *Aristida adscensionis* and the species of *Eneopogon* and *Cenchrus*. Along and close to Lake Turkana, the salt tolerant grass *Sporobolus*

spicatus is common.

Although the vegetation is scarce and under great pressure of exploitation by livestock, plants play an important role in the life of pastoralists of the project area. They provide firewood, materials for the construction of the houses and livestock enclosures and feed for livestock including camels, sheep and goats. The plants found in this area are also valued for edible and medicinal products and as a valuable source of fiber for rope making and gum. Uses of some common plants in the project area are outlined below as follows:

- *Acacia reficiens* is relatively unpalatable but is the main source wood for pastoralist communities;
- The foliage of *Acacia tortilis* and *Acacia mellifera* is browsed by camels and goats while the fallen leaves and flowers are eaten by sheep;
- The fruits of *Acacia tortilis* are eaten by all livestock species;
- *Salvadora persica*, *Cordia sinensis*, *Sericocomopsis hildebrandtii*, *Indigofera spinosa* and *Acacia senegal* provide browse for livestock;
- Thorny trees, such as *Acacia* and some *Commiphora* are lopped to provide boma materials;
- Soft-timber trees, such as *Delonix*, *Commiphora* and *Erythrina* are used for making milk pots, bowls, stools and drinking troughs.

Fauna - The project area suffers from paucity of wildlife. This is mainly due to increasing population with subsequent increase in poaching activities, especially for the big game. For example, elephants (*Loxodonta africana*) and black rhinoceroses (*Diceros bicornis*) were once plentiful on the lower slopes of Mt. Kulal until 1976 but have now been exterminated by poaching. Other wildlife species including Greater kudu (*Tragelaphus strepsiceros*) Oryx (*Oryx beisa*), Gerenuk (*Litocranius walleri*), Grant's gazelle (*Gazella granti*), Giraffe (*Giraffa camelopardalis*) and Grevy's zebra (*Equus grevyi*) occurred on the middle and upper slopes of Mt. Kulal but are now locally extinct. The last buffaloes (*Syncerus caffer*), which lived in the higher levels of the montane forest, were seen in 1976 and the species is apparently extinct on Mt. Kulal now.

The exceptionally low densities of wildlife, especially the megafauna within the project area, are attributed to poaching and intense competition between the wildlife and livestock. The project area, however has many species of reptiles, including venomous snakes, such as saw scaled viper, night and puff adder and cobra and lizards. The scorpions and other invertebrate fauna are also common in the project area. Outside the project area in other parts of Marsabit District, there is a variety of animal species protected in Marsabit National Park and Reserve, Sibilo National Park, Central Island and South Island National Parks.

Socio-economic environment - The project area is located in a rather remote part of the country where services (like all other areas in Marsabit District) are poor. Most of the available basic services are concentrated in Loiyangalani Town situated to the west of the project area. There are no tarmac roads in the project area and Loiyangalani is connected to other areas through dry weather roads connecting Loiyangalani to North Horr, Loiyangalani to Baraga (to the south), Loiyangalani to Gatab and the Loiyangalani to Marsabit via Kargi. In many areas, these roads are prone to seasonal floods, which make them impassable during heavy rains. Loiyangalani is served by an air strip which is used for non scheduled air services by light aircraft. The project area does not have electric power connection. However, electricity is

generated by diesel powered generators in several institutions, including schools, missionary stations, hospitals, tourist facilities and in some private households.

Population and community attributes - The project area is inhabited by four main ethnic groups, including the Turkana, Samburu, Rendille and El Molo. According to population census of 1999, population in the Loiyangalani Division was 16,965 people with a density of 1.1 people per km², the lowest population density in Marsabit District. The population is now estimated to be in the tune of 20,000 people with a density of a 1.32 persons per km². The low population density in the project area is attributed to harsh climatic conditions and insecurity prevailing in the area.

Loiyangalani is one of the poorest divisions in Marsabit District which itself is one of the poorest districts in Kenya. Acute poverty prevailing in the project area creates a situation where individuals or households cannot afford basic food and non-food items as well as their basic needs, such as food, shelter, clothing, health and education for their children. Local communities in the project area highly depend on relief food distribution which has significant social implications for the future of the communities.

The status of education in the project area is poor with only two schools (Loiyangalani Primary and Secondary schools). Analysis by gender shows that there has been a consistent trend of having fewer girls enrolled due to socio-cultural factors and the pastoralist's bias in favour of boys' education and the long distance to schools.

Poor health conditions are prevalent in the project area. The three most common diseases of the project area are upper respiratory diseases, malaria and diarrhoea. It should be pointed out that the Loiyangalani Health Centre does not record incidences of HIV/AIDS, a disease/condition that is currently affecting a large section of community in Kenya. The situation of the poor health conditions of the project area is aggravated by the poor nutritional status prevalent in the project area.

Community livelihoods - The project area being a rangeland, the nomadic pastoralism is the main occupation of the local residents (e.g. livestock rearing of the camels, goats and sheep). Donkeys are mainly used for carrying water and other transport purposes. Fisheries are an alternative occupation of the inhabitants of the project area and surroundings, especially among the El Molo and the Turkana communities. The fisheries are confined to Lake Turkana which lies to the west of the project area. This lake has vast fishing potential but currently it is poorly exploited. According to the Marsabit District Development Plan (1997-2001), the lake has potential of producing 170 tons of fish annually. However, fish production is impeded mainly by inadequate fishing boats, local unavailability of nets and hooks, poor handling methods, lack of cold storage and the poor conditions of the roads to the lake town of Loiyangalani. This situation discourages potential investors. Hence the fish resources of the lake are under utilized.

The local trees, especially the *Acacias*, found in the project area are exploited to meet the energy requirements of the local population. Firewood collected in the area is utilized mainly for domestic use although some firewood is sold in Loiyangalani market. Charcoal produced in the project area is mainly for income generation as the charcoal burners usually do not use charcoal in their homes. The charcoal burners who are mainly Turkana women use a very inefficient mode of burning charcoal with tremendous waste of biomass. .

The absence of financial institutions (banks, credit institutions) at Loiyangalani and in the project area drastically limits commercial activities. The project area, however, has a fisherman's cooperative society, the Loiyangalani Fisheries Cooperative Society although its management and operations are suboptimal. In accordance with the District Development Plan (2002-2008), priority areas for development include fisheries, environment conservation and development of natural resources and cooperatives.

0.6 Project Alternatives

Electric power alternatives - The generation of adequate and affordable electricity is a very crucial factor for the economic development of Kenya. Indeed the current energy policy puts emphasize on the need for energy availability and accessibility at cost effective prices. There are several alternatives for generation of electric power including, hydro, geothermal, thermal, solar energy, bio gas, and wind and power alcohol options. However, the bulk (60%) of the electric power capacity in Kenya is, based on hydropower while geothermal and thermal powers virtually supply the rest of the power requirements. Faced with the current situation where Kenya's electricity supplies are unreliable and expensive, the installation of Lake Turkana Power Project will play a significant role in the stabilization of power situation in the country. More importantly, the introduction of 310 MW in the national grid will alleviate power outages, especially during the dry seasons, and help to reduce the country heavy reliance on the power production from the oil and diesel power generators.

Project siting - A quick look at the National Wind Resource Atlas compiled by the Ministry of Energy (MoE) shows that, as a whole, Marsabit District is well endowed with potential extractable wind power to the tune of 450 – 750 Watts m⁻². Based on this information, several sites in Marsabit District were explored for suitability of wind power generation. The present site in Loiyangalani Location was selected due to several suitable attributes, including the strength and stability of the winds prevailing in the area, security of the area, fresh water availability and road accessibility among other suitable characteristics. In order to avoid impacts of birds' collisions with turbines, the Project Developer has adopted strict measures in the design and siting of the wind park facility. The wind park design has allowed for wide corridors between clusters of turbines. In addition, the wind park is being sited away at least 10km from the shore of Lake Turkana and at least 1km away from the nearest canyon associated with the foot slopes of Mt. Kulal. .

Choice of the technology - The choice of the wind turbines to be used in the Lake Turkana wind park takes into account the latest technology in the market. The choice is based on the following criteria:

- Technology that is widely utilized and has proven reliability in practice under the most difficult circumstances;
- Technology that is able to operate under the prevailing extreme conditions of dust, high temperature and high wind speeds;
- Low maintenance; and
- Technology with reliable supplier with local servicing possibilities, excellent track record and able to secure maintenance continuity.

The Vestas V 52 turbine with a capacity of 850KW will be used in the proposed wind park facility. The novelty of the Vestas V 52 turbine is its transmission technology which has been improved significantly since its first launch in Sweden in 2001. The main shaft of the turbine is better supported over a longer length and less torsion occurs in the shaft. Occurring forces on the shaft are also better absorbed over the length. The Vestas V 52 uses new and better

materials. Finally, the aerodynamics attributes have been improved, resulting in a decreased total weight.

0.7 Potential Impacts and Mitigation/Enhancement Measures

The implementation of the Lake Turkana Wind Power Project in the project area will lead to a variety of socio-economic benefits. At the national level, the project benefits will include:

- **Stabilization of electricity access and reduction of power outage in Kenya** - At its completion, the project is expected to add an extra 310 MW into the country's national grid. This will bolster Kenya's plan to expedite rural electrification programs in different parts of the country. The end result is an attendant multiplier effect on the socio-economic parameters of the whole country and stable power supply network;
- **Reduction of the cost of the power** - The power generated from the project will cost far less than from any other existing sources on the long-term as its production cost will not increase thereafter. In effect, this implies that the project has the potential to usher the country into a low-power tariff regime in the long run. This has not only a positive effect on the cost of the energy production but will also lead to economic gains through improved competitiveness;
- **Diversification of power sources** - Implementation of the project presents Kenya with an opportunity to rely less on the expensive diesel-powered alternatives;
- **Promotion of renewable energy and reduction of carbon dioxide equivalent** – The proposed project will achieve CO₂ emission reduction by replacing electricity generated by fossil fuel fired power plant connected to the national grid with the carbon credit potential of the project ranging between 565,920 and 1,264,320 CO₂ tonnes equivalents (or carbon credits) per year.
- **Contribution to the Government revenue** – The project will generate income to the Government through various taxes including the corporation tax (at 30% of net income), EIA license fee of 0.05% of the total cost of the project fee to NEMA, withholding tax from remuneration paid to employees at graduated scale rates, Pay as You Earn (PAYE) and Value Added Tax (VAT).

Due to the remoteness of the project site especially in an area of high poverty levels, the project will have significant positive economic and social impacts for the marginalized communities in the project area. The positive benefits include:

- Employment opportunities for the local community during the construction and operation phases of the project (e.g. masons, carpenters, cooks and indirect spins-off, such as livestock and fish trade, ecotourism, etc.);
- The rehabilitation of existing road networks will facilitate the transportation of livestock and fish products to external markets;
- Installation of two sub-stations in Loiyangalani and Maralal will facilitate the distribution of electricity on a cost-recovery basis, to the surrounding communities, governmental institutions, including schools, hospitals, hotels;
- Assistance in acquisition of cold storage facilities for the fish caught in Lake Turkana. This will facilitate better storage for the fish, eliminate the need for sun drying of fish and increase the returns from the fisheries sector;
- The project will ensure that the marginalized communities have access to good quality water for domestic use since some sections of the local community use the lake water for domestic purposes; and

- The project will provide human and financial assistance in the development of health and education facilities in order to improve health conditions and literacy of local community, especially the marginalized groups, the women and the youth.

Against the above positive benefits brought about by the project, there will be some negative impacts emanating from both the construction and operation activities of the proposed project. From a socio-economic perspective, the project will significantly increase the number of people in the project area (ranging from 600 workers during the peak construction phase to an average of 300 workers under normal situation and 150 workers during the operational phase) This will lead to a number of negative socio-economic impacts, including cultural contamination from influx of construction employees, increased exploitation of natural resources, increased insecurity and community conflicts, increased incidences of diseases, visual intrusion, potential challenges and impacts of labor force management, and increased accidents and occupational hazards (e.g. machine/equipment injury risk, occupational noise and vibration, fire risk, risk of exposure to electro-magnetic radiation, risk of electrical shock, etc.). There is no expected resettlement envisioned within the scope of this project. Finally, no visible archeological remains, with scientific, cultural, public, economic, ethnic and historic significance, have been observed in the project area.

The project activities are likely to cause the following minor and site-specific negative impacts on the bio-physical environment of the project area:

- **Increased soil erosion** - Increased soil erosion is likely to occur in the project area during the road rehabilitation, operations of borrow pits and quarries, construction of the wind park and buildings and installation of turbines. The presence of loose earth (resulting from the above activities) coupled with prevailing strong winds and occasional rains could lead to acute and chronic soil erosion problems in the project area;
- **Increased siltation of the lacustrine habitats** - Some of the excavated sediments from the project site and the construction spoils emanating from excess excavated material and construction debris are likely to impart negatively on the environment of the project area and any nearby aquatic habitat associated with Lake Turkana. Subsequently increased siltation of the lake water will have some limited ecological implications on the aquatic habitat. However, this will depend on the closeness of the impacted area to Lake Turkana;
- **Ponding** - The road rehabilitation, wind park construction and other project activities may lead to creation of stagnant water bodies in quarries, borrow pits and depressions created during the construction works. The resultant stagnant water bodies are likely to be suitable habitats for the breeding of mosquitoes and snails that are disease vectors for malaria and bilharzias respectively;
- **Loss of habitat** - The presence of wind turbines may indirectly affect local fauna and bird populations by decreasing the area of habitat available to breeding, feeding, nesting, resting etc. This will mainly be brought about by land taken for the construction of infrastructure including staff houses, access roads, turbine bases and substations;
- **Destruction of floral communities** - Although this is an arid area, the existing vegetation plays an important role in maintenance of life in the project area and its surroundings. Indeed it is the resource upon which the pastoralist and their livestock populations depend on for their survival. Project activities are likely to destroy some vegetation with subsequent loss of some trees, shrubs and grasses from the area of operation albeit on a small scale;
- **Impact on terrestrial fauna** - This project will not have any significant impact on the terrestrial fauna of the project area due to the general paucity of fauna in the area;

- **Impacts on avifauna** - The project has the potential to affect the avifauna of the project area. This is mainly through ecological disturbance leading to displacement or exclusion of birds; and collisions of birds with wind turbines. However, the wind turbines will be located at least 10km from the shore of Lake Turkana on the plateau behind the Ongipi massif. Since migrating and over wintering birds are normally associated with Lake Turkana shoreline and aquatic habitats, collision risk of birds is expected to be very low;
- **Impacts on protected areas** - The protected areas (Mt. Kulal Biosphere Reserve and the South Island National Park) are situated away to the east and west of the project area respectively and project activities will have minimal impacts on them;
- **Potential disturbance in livestock activities** - The livestock activities are likely to be disturbed by both construction, presence of wind turbines and operations of project activities. The project may indirectly affect livestock by decreasing the grazing area due to land taken for the construction of infrastructure including access roads, turbine bases, staff houses and substations. Livestock movements especially towards the watering points are likely to be affected by fencing of the project area. Since the project area will not be fenced, the impact on the livestock is likely to be minimal;
- **Increased noise levels** - Noise levels are likely to increase in the project area both during the construction and operation phases of the proposed project. High levels of noise will prevail in the project area due to the use of heavy machinery in road construction activities and operations at the quarries, borrow pits and crushing plants. However, it should be noted that modern Vestas turbines are associated with low noise levels and hence the project will have minimal noise impacts on workers during the operational phase;
- **Air emissions** - Pollution through air emissions in the project area will emanate from road construction activities especially from exhaust pipes for vehicles and machinery used and the activities associated with the operation of the power plant;
- **Dust pollution** - Road rehabilitation activities and to some extent the wind park construction activities have the potential to generate high levels of dust in the project area especially where construction is taking place, and in both quarries and borrow pits sites. The crushing plant also has great potential to generate high quantities of dust thus creating a hostile environment and a health hazard to the workers;
- **Potential increase in pollution from solid wastes and effluent discharge** - The labor campsites are expected to produce considerable quantities of domestic effluents and solid wastes containing a wide range of substances which have high potential to pollute the environment if not properly disposed of.

Perhaps the most serious negative impact the project is likely to have on the project area is the potential for birds' mortality through collisions with the turbines, since migrating and over wintering birds are normally associated with Lake Turkana shoreline and the associated aquatic habitats. However, as mentioned previously, the project is not likely to interfere with migration of birds. The project area is more than 10km from Lake Turkana.

Social cumulative impacts encompass the likely increase in incidences of HIV/AIDS and increased cultural contamination among the local communities in the project area. Cumulative impacts of the wind farm installations may be considerable if bird movements are consequently displaced leading to the disruption of ecological links between feeding, breeding and roosting areas. However, the type of design for the proposed wind park and its siting are highly unlikely to cause any significant cumulative and long-term impacts in the project area.

The ESIA study has proposed several measures to reduce negative impacts, including amelioration of social and health negative impacts, noise abatement, waste management, reduction of visual intrusion, restoration of habitat and biodiversity, reduction of soil erosion and siltation and prevention of accidents and health hazards. In addition, measures have been proposed with regard to the siting of the wind park in order to reduce collision of birds with turbines. A summary of the affected key environmental and social variables and the intensity of impacts is found in the following Environmental and Social Impact Matrix:

Environmental and Social Impact Matrix:

Environmental Parameters	Intensity of Impact
Stabilization of electricity sector	+3
Promotion of economic growth	+3
Contribution to the Government revenue	+3
Potential for carbon market	+3
Increased employment	+2
Improved communication	+2
Visual intrusion	-1
Cultural contamination	-1
Increased incidence of diseases	-1
Labour force management challenges	-1
Increased risk of accidents	-1
Loss of habitat	-1
Destruction of flora and fauna	-1
Disturbance to livestock	-1
Soil erosion and siltation	-1
Pollution	-1
Ponding conditions (in the quarries and borrow pits)	-1
Increase in noise levels	-1
Birds' mortality through collisions with turbines	-2

Interpretation:

- +3 Highly Positive Impact – Impact with national or international benefits
- +2 Moderately Positive Impact – Likely to impact on quality of life within the region / project area
- +1 Light Positive impact – Minor impact but of significant local benefit
- 0 No Impact
- 1 Light Negative Impact – Minor negative impact at the local level
- 2 Moderate Negative Impact – A negative impact likely to adversely affect the environment or quality of life in the region / project area if not mitigated
- 3 Severe negative impact with national or international implications

0.8 Environmental Hazard Management

Implementation of the proposed project will definitely increase volume of human and motor traffic in this remote area. The increase in human and motor traffic will be aggravated by the transportation of construction materials and plant accessories and other equipment required to install the wind park. This is likely to result in a higher risk of accidents occurring in the area of operation during the road rehabilitation, wind park construction and operation phases, and during the construction of the transmission lines. Safety measures and emergency plans to contain accidents risk associated with project activities including vehicular transport, operation of machinery, equipment and other related activities will be developed and implemented through the training of the construction workers, provision of Personal Protective Equipments (PPE), and

inclusion of specific Environmental, Health and Safety (EHS) clauses into contractors contracts (e.g. spill mitigation equipment, water spraying of roads, etc.).

0.9 Environmental and Social Management / Monitoring Plan

Environmental and Social Management Plan (ESMP), including monitoring plan, has been identified as an important process in the protection of environment of the project area. This will reveal changes and trends brought about by the presence and operations of the installed wind park facility.

The monitoring programme will involve the following: a) collection and analysis of appropriate environmental data; b) preparation of periodic reports including an annual environmental and social performance report to AfDB and liaison with other relevant bodies (e.g. NEMA); c) identification of unexpected environmental impacts; and d) formulation of mitigation measures for the unexpected negative impacts.

Key environmental and social variables to be regularly monitored include changes in biodiversity, avifauna mortality, changes in livestock's activities, and changes in water quality, soil erosion and siltation, noise levels, increase incidence of STDs and changes in socio-economic status of affected communities among other variables. In addition, an exhaustive one-year field baseline study will be undertaken to determine the use of the wind park by birds and to identify, if any, birds species that may be adversely affected.

The total cost for the implementation of the ESMP and other socio-economic activities is estimated at KSh.26,410,000 (€241,814) for the first year project operation. Cost estimates for subsequent years will be determined by the recruited Environment and Social Development Manager as well as the entry into force of the Lake Turkana Wind Power's Corporate Social Responsibility Programme. The break down of the cost estimates for the implementation of the environmental and social management plan / monitoring programme is presented in the Table below:

Cost Estimates for the Environmental and Social Management Plan/Monitoring Programme

Project Activity		Cost Estimate (KSh)
1	Remuneration for the Environment and Social Development Officer to implement the ESMP and the Grievance Mechanism	2,500,000
2	Purchase of a vehicle and other transportation requirements for the Environmental and Social Development Officer	4,500,000
3	Support for on-going community awareness throughout project implementation and sensitization program on cultural impacts from population influx during the construction and operational phases (including of security guards)	1,500,000
4	Lake Turkana Wind Power Project's Foundation for the implementation of the Corporate Social Responsibility (CSR) Program. Priorities programs include the support for education, health, potable water and sanitation. Maximizing SMEs opportunities (e.g. fisheries, afforestation, provision of energy efficient stoves, etc.) will also be considered and supported	4,000,000
5	Cost of monitoring activities including a one-year baseline field study on impacts of the wind park on birds.	1,500,000
6	Sample water analysis (chemical and biological, and other samples)	100,000
7	Purchase of consumables (computer, sampling apparatus, field equipment, Protective Personal Equipments for employees, etc.)	300,000
8	Purchase of stationery, documentation and report writing	100,000

9	General landscaping works, including construction of silt traps, terracing and landscaping (rehabilitation of quarries & borrow pits), planting of binding grasses on slopes and trees (acacia)	1,500,000
10	Liquid and solid waste management activities, including septic tanks and pit latrines installation at labor camps, purchase of an incinerator for non-degradable domestic wastes,	2,000,000
11	Construction of a sewage treatment plant and other waste management facilities.	5,000,000
	Total Cost	23,100,000
12	Contingencies (10% of the total cost of the proposed Environmental and Social Management Plan)	2,310,000
Total Estimated Cost for the Environmental and Social Management Plan		KSh 26,410,000

The overall responsibility for the implementation of the ESMP lies with the Sponsor. Implementation of the ESMP and of the Grievance Mechanism will be ensured through the recruitment of an Environmental and Social Development Officer to be stationed at Loiyangalani. The proposed environmental and social development officer will put in place mechanisms to initiate and operationalize the proposed mitigation measures and monitoring plan. As indicated above, the Project contractors under supervision from LTWP Ltd.'s agents (project engineer, architect and consultant environmentalist) is expected to implement relevant environmental mitigation measures, including rehabilitation of quarries and borrow pits and landscaping (grassing and planting of trees) among other relevant activities. The Contractor should ensure that all the installations are functional at least for a period of one year after the completion of construction activities.

0.9 Public Consultations and Disclosure

Public consultation was viewed as an important activity of this study. It was conducted in order to help the ESIA study team to get the stakeholders' views on the perceived environmental and social effects of the project on the project area including their ideas on how the negative impacts can be mitigated. Following the completion of field study and drafting of the EIA study report, copies of the draft report were distributed to a wide cross section of stakeholders to review and communicate their comments to the Team Leader within a period of three weeks. A stakeholders' meeting was subsequently held in Loiyangalani between 21 and 22nd April 2008 and attended by fifty three (53) participants.

Generally speaking, the local population is very positive about the project and they welcomed its installation in the project area. Indeed the people feel that the project is an event that will solve their many challenging problems, including their "relief dependency syndrome". The project, however, is likely to create very high expectations among the local community in the project area and surroundings. Peoples' expectations will especially be related to 1) employment opportunities for the local community during the construction and operation phases of the project; 2) rehabilitation of existing poor roads in the area – thus facilitating the local community to access external markets for their livestock and fish products; 3) assistance in acquisition of cold storage facilities for the fish caught in Lake Turkana in order to facilitate better storage for the fish, eliminate the need for sun drying fish and increase the returns from the fisheries sector; 4) provision of good quality water for the marginalized community since some sections of the local people use the lake water for domestic purposes; and 5) assistance in the development of health facilities in order to improve health conditions of local community, especially the marginalized groups.

During the stakeholders' workshop, several issues touching on the proposed project, including the project negative impacts on livestock, fisheries of Lake Turkana, the siting of the wind farm,

job opportunities and other benefits to the community among other issues, were exhaustively discussed. Minutes of the Stakeholders meeting are found in Appendix 10 – Minutes of the EIA Stakeholders' Meeting.

1.0 Complementary Initiatives

In addition to the construction and operation of the wind park facility in the project area, there are additional and necessary infrastructures which will be require implementation. The main complimentary initiatives include roads' rehabilitation and transmission line.

- **Roads' rehabilitation** - The site for the proposed wind park facility is located in Loiyangalani which is approximately 1,200km from the sea port of Mombasa from where the wind park equipment will be transported by road to site. The last stretch, consisting of approximately 196km and starting in Laisamus require realignment, rehabilitation and repair works to enable the mast and blades of the wind mills to be transported without damage and for the roads to handle an 8 ton axle load. The scope of these works will entail building culverts, vertical realignment, filling, grading, leveling and general repairs. It is estimated that the civil works will cost approximately US\$ 20M. In addition to providing transport access for the cargo to the wind park site and access road for communities living in the project area, it will potentially increase economic development. There is no expected resettlement involved in this rehabilitation since the road concession is within an existing right-of-way.
- **Transmission line** – The proposed project is unique in that the wind park is located in an area that is presently not serviced by any transmission line network. In order for the proposed project to be able to supply power to the national grid, LTWP has entered into a 25-Year “take-or-pay” Power Purchase Agreement (PPA) with Kenya Power and Lighting Company (KPLC). It is also necessary for the LTWP to build a transmission line from Loiyangalani to Suswa where the power from the wind park will interconnect to the national high voltage network. A power integration and economics study was undertaken by Schicon (2008) to evaluate the most optimal routing of the transmission line for integration into the existing grid network. Of six options studied, the most favorable was the construction of a new double-circuit 400 kV line from the Turkana wind farm in Loyangalani via Baragoi, Maralal, Rumuruti, Nyahururu, Gilgil, and Naivasha to Suswa. This option has the benefit of providing a transmission network that maximizes the potential for future interconnection of planned geothermal plants, including Barrier, Namarunu, Emurangogolak, Silali and Korosi. It also uses existing ‘rights-of-way’ from the existing KPLC line from Maralal to Olkaria. Under the terms of an Agreement with the Ministry of Energy and the Kenya Power and Lighting Company, LTWP has been authorized to seek financing for the transmission network on their behalf and to develop the transmission network under a Build, Own, Operate & Transfer (BOOT) scheme.

1.1 Carbon Potential

The proposed project will achieve CO₂ emission reduction by replacing electricity generated by fossil fuel fired power plants connected to the national grid. The carbon credit potential of the project is estimated to range between 565,920 and 1,264,320 CO₂ tons equivalents (or carbon credits) per year. Assuming a 10-year crediting period, this will result in a total of 5,659,200 to 12,643,200 carbon credits over the course of the project. Based on the Certified Emission Reduction (CER) price estimate of 2007 that was around €10, the carbon credit value of the project could be in the range of €56,592,000 to €126,432,000 for the entire project. The carbon credit earned by the project will be transferred to KPLC in order to reduce the end-consumer tariff.

1.2 Resilience to Climate Variations Risks

The existing energy power production in Kenya over relies on hydropower (approximately 60%) which is negatively affected by increasingly erratic climate changes, including high incidence of drought. Over the last seven years or so the country has paid a high price over heavy reliance on single source of hydro power along the Tana River system. In 1999 and again in 2002, severe droughts nearly brought the Kenyan economy to a standstill after the hydro – power dams dried out leaving power rationing in its wake. This experience has underscored the need to diversify the power sources in Kenya. As such, the proposed project will increase the resilience of the Kenya power generation vis-à-vis potential climate risk variations in Kenya.

1.3 Impact of the Dam Construction (GIBE Project) on the Project Area

The Federal Government of Ethiopia through the State owned electricity utility, Ethiopian Electric Power Corporation (EEPCCO), has currently embarked on the construction of the Gibe III Hydropower Dam. The Gibe III Hydropower scheme comprises a 240 m high dam which will create a huge reservoir of 200 km² with a live storage of 11,750 million cubic metres. This dam is expected to generate 1870 MW of hydropower on the Omo River. The project site is located about 80 km downstream from the confluence of the tributary Gilgel-Gibe and the Gibe River and is situated 503 km south of Addis Ababa in Wolayta-Dawro Province of Ethiopia. This power plant will be the third project on the Omo-Gibe river basin, which already has an operational 184 MW Gilgel Gibe I plant and a 420 MW Gilgel Gibe II plant that is currently under construction.

The development of hydropower project along the basin of the Omo River is likely to affect the proposed the project area for the Lake Turkana Wind Power Project albeit in an indirect way. It should be noted that the Omo River is of tremendous significance to the hydrology of the Lake Turkana. It is the largest affluent to the lake and contributes some 18.6 billion m³ of water each year which is more than 98% of the total riverine inflow into the lake.

While the above project has tremendous economic benefits to the Government of Ethiopia, the presence and operations of the reservoir and the regulation of the Omo River hydrological regime will cause some quite significant negative impacts on the downstream impacted area as outlined below:

- Cessation of the annual floods would be detrimental to the communities that practice flood recession agriculture in the lower Omo Valley. This will directly affect ethnic communities such as Dasenich, Karo, Hamer, Mursi, Murle, Mugugi and Hyangatom that rely on flood recession and river delta crops, as well as livestock for their subsistence. The potential loss of flood recession crop area, as well as grazing, would reduce their food supply and could possibly lead to conflicts over grazing areas which could spill over to Kenya.
- Construction of the Gibe III may cause reservoir trapping of sediments, thus creating oligotrophic conditions in Lake Turkana with subsequent reduction in lake productivity. This is likely to have negative effect on the downstream fisheries including reduction of fish yield and extinction of some fish species that strictly require floodplains for breeding.
- In addition, the reduction of the strength or loss of the seasonal flood pulse from the Omo River could reduce the rate of migratory and other spawning fish that would, subsequently result in decreased recruitment of fish stocks both in the flood plains and in

Lake Turkana. This will have far reaching effects not only on the fishing communities around L. Turkana but also on other communities including those in the project area.

- The cessation or any abrupt decrease in the extent of floods will negatively affect the pastoral semi-nomadic way of life on the Lower Omo River, the Omo delta and the area around northern L. Turkana. Most of the negative impacts would be felt on the extensive floodplains of the Dasenech which are grazed for a substantial number of months both by the Dasenech tribe and the neighbouring ethnic groups. This is likely to instigate multiple conflicts in the utilization of dwindling natural resources, with related intensification of raiding parties and killings that is likely to be felt around Lake Turkana and beyond.

It is also important to note that the above dam development is taking place at a time when Lake Turkana is currently undergoing a natural drawdown. Due to the current decreasing inflow from the rivers feeding the lake hydrological system, the present levels of Lake Turkana show a worrying tendency to decrease with its surface gradually shrinking. Consequently this will result on a progressive retreat of the shoreline that implies a reduction of the exploitable waters for fish resource exploitation. The downstream impact of the Gibe III upon Lake Turkana, a water body that is currently receding and the overall cumulative impacts upon the ecology and socio-economic dynamics on the surrounding area is an interesting subject for the attention of the local community, Government of Kenya (GoK) and development partners.

1.4 Conclusion

The findings of the Environmental and Social Impact Assessment (ESIA) Study indicate that the socio-economic benefits of the proposed Lake Turkana Wind Power Project far outweigh the limited and site-specific social and environmental costs, when enhancements/mitigation measures are effectively and timely undertaken. Most of the impacts are easily mitigable with conventional industry best practices.

The local population is very positive about the project and they welcomed its installation in the project area. Indeed the people feel that the project is an event that will solve their many problems, including relief dependency syndrome. With explicit and tangible commitment of the LTWP Ltd. in the establishment of the Lake Turkana Wind Power Project's Foundation for the implementation of a comprehensive Corporate Social Responsibility (CSR) Programme, and the carrying out of the recommended one-year baseline study on impacts of the wind park on avifauna, it is felt that this project is environmentally sound and socially acceptable.

Since the ESIA Study for the wind park and the EIA for the transmission line have now been approved by the NEMA (Annex 9 - NEMA's Conditions of Approval of the EIA Study Report for Wind Project and Annex – 10 NEMA's Conditions of Approval for the EIA Study Report for Transmission Line), the Project Developer has complied with an important condition for loan disbursement by the African Development Bank.

1. INTRODUCTION

Lake Turkana Wind Power Project (LTWP) will be the biggest energy project involving exploitation of wind resource in Kenya and the whole of Africa Continent. The project is located on the south eastern border of Lake Turkana in the northern Kenya. The proposed project will generate 300MW from wind energy to be injected into the Kenyan national grid.

1.1 Project Background

The Lake Turkana Wind Project preparatory phase effectively started towards the end of 2005 when the project location was first visited by the principal investors (KP&P, ANSET Africa Ltd and Mr. Dolleman) with subsequent signing of the Memorandum of Understanding (MoU) for joint cooperation. Thereafter, the project partners requested and were granted (in April 2006) exclusive rights by national authorities to study the wind resources in the area concerned. In order to facilitate the wind study, an 80 metre high guy mast was erected with all the necessary equipment for measuring and recording wind resources at prescribed heights. Wind measurements for 12 months commenced in November 2006. In the same year, an initial infrastructure review was made by the Dutch Company, Mammoet. This involved an assessment of the route from the seaport of Mombasa to Lake Turkana in order to determine the effort required for logistical operation of transporting the masts and turbines. In addition, initial review of electricity grid was carried out. Finally discussions were held with Kenya Power and Lighting Company (KPLC) and a letter of interest to purchase the power generated by the Lake Turkana Wind Power project was subsequently issued.

Having successfully completed the preparatory phase, the project entered the feasibility phase from November, 2006. Since then several project activities have been either initiated or are currently in various stages of development. They include:

- Wind measurements on site;
- Economic feasibility;
- Electricity grid analysis;
- Environmental impact assessment; and
- Carbon potential and market opportunities.

1.2 The Need for the Project

The current energy policy objectives in Kenya emphasize the need for energy availability and accessibility at cost effective prices. The policy also supports sustainable socio-economic development while protecting and conserving the environment. The main sources of energy in Kenya are electricity, wood fuel, petroleum and renewable energy. Of the total energy requirements in the country, the bulk (68%) of the country's primary energy consumption comes from wood fuel and other biomass sources. This is followed by petroleum at 22%, electricity at 9% and other sources at 1%.

Of the above main sources of energy in Kenya electricity is very crucial for the economic development of the nation. The provision of inexpensive and reliable supply of electricity is the lifeblood of the economy. However, today Kenya's electricity supplies are unreliable and expensive. This has arisen for a variety of reasons including ineffective management of power purchase agreements leading to extremely high tariffs of privately generated power, inequitable distribution of operating costs, weak and ineffective management of power, bloated workforce, wasteful and cost ineffective procurement, failure to invest in system reinforcement, poor maintenance and distribution infrastructure and poor governance among other problems afflicting the energy sector.

Since 1994, however, a number of reforms have been carried out to streamline the electric power sector. These include review of tariff, retrenchment in the key utility institutions, liberalization of the electric power generation and separation of power distribution from generation and regulatory services. The public sector organizations in the electric power sub-sector have been re-organized into one company for generation (KenGen) and a company for transmission and distribution (KPLC). The electric Power Act of 1997 provided for the establishment of the Electricity Regulatory Board (ERB), Electricity Regulatory Commission (ERC) whose functions include setting and reviewing consumer tariff, approving power purchase agreements, and promoting environmental health and safety regulations. It should be noted that the Kenya Government has started restructuring the electricity sector focusing on ending the public monopoly of KPLC over the distribution of electricity. In addition a need has been expressed to privatize the organization over the medium term.

One of the strategies to streamline the power sector is to implement liberalization of the power generation. Towards the implementation of this strategy, there are at present four (4) operational private and independent power producers (IPPs). The IPPs include Iberiafrica Power, Westmont Power, Orpower 4, and Tsavo Power Company. However, the IPPs serve only a small fraction of the power market with a combined installed capacity of 187MW when compared to Kenya's total installed capacity of 1267MW.

Currently the electricity sector in Kenya only reaches an estimated 10% of the population. Further electricity generation is therefore necessary in order to reach a greater percentage of the population and support economic growth. The situation is aggravated by the fact that 60% of the electric power produced is based on hydropower which has been often unreliable especially during the dry seasons. For example in 1999 and 2002, severe droughts greatly affected the power production of the hydroelectric dams and nearly brought economic activities to a standstill. The above experience underscores the need to increase power production and to diversify the power sources. The entry of the Lake Turkana Wind Power Ltd into the Kenya power scenario will help the country to address power shortage and enhance further economic growth. Towards this objective, the implementation of the proposed Lake Turkana Wind Power Project will provide the country with a large (310MW) and relatively cheap source of energy.

1.3 Project Objectives

The aim of the Turkana Wind Power Project is to construct a power plant (south east of Lake Turkana in Laisamis District) in order to generate electricity from wind powered turbines to feed into national grid. This project mainly involves developing a wind park which consists of three hundred and sixty five (365) V52 turbines each with a capacity of 850kW. The total power that the project will generate amounts to 310MW. This power output amounts to 25% of the existing capacity (1267MW) that is currently available in Kenya. The project is scheduled to be constructed in the following phases:

- 240 Turbines and full connection to the grid in 2011;
- 125 turbines added to the park in 2012

The Lake Turkana Wind Park will be built and operated by Lake Turkana Wind Power Ltd. The KPLC has expressed the interest to buy this capacity at rates which will be favourable to the consumer. Despite the remoteness of the project location, the wind park will be incorporated into the national grid through the connection to the Ol Karia Geothermal Power Station, near Naivasha.

1.4 Study Objectives

As stated above, the entry of the Lake Turkana Wind Power Ltd into the Kenya power mix will help the country to address power shortage and enhance further economic growth. Towards this objective, the implementation of the proposed Lake Turkana Wind Power Project will provide the country with a large (310MW) and relatively cheap source of energy. However, large scale production of wind power as projected in the Lake Turkana Wind Project is likely to have significant impact on environment of the project area. Hence a need to carry out Environmental Impact Assessment (EIA) for the proposed project in accordance to the National Environment Management Authority (NEMA) Guidelines.

2. LEGAL, REGULATORY AND ADMINISTRATIVE FRAMEWORK

2.1 Introduction

Kenya is a developing country where about 80% of population live in rural areas and derive their livelihood from agriculture through crop and livestock production, fishing, forestry and exploitation of other natural resources. According to the 1999 population census report, Kenya's population was about 28.4 million people, and is projected to reach 37.5 million people by the Year 2010. About 70% of Kenyan population lives in 12% of the total land area (referred to as high potential area) while the remaining 30% of the population live in arid and semi-arid areas (ASALs), which account for 88% of the total land area in Kenya.

Today Kenya is faced with grave environmental problems and challenges that include land degradation, loss of biodiversity, environmental pollution, water management and desertification among other challenges. There is a growing concern that many forms of development activities cause damage to the environment and the natural resources upon which the bulk of national economy is based. A major national challenge today is how to maintain sustainable development without damaging the environment. It is now accepted both nationally and globally that development projects must be economically viable, socially acceptable and environmentally sound. In order to protect the environment from negative impacts of development, it is a condition of the Kenya Government for the developers and proponents of projects to conduct environmental impact assessment on the proposed development projects and environmental audits for the ongoing projects.

Until recently, Kenya did not have a consolidated legislation for the protection and management of environment. The legal provisions on environmental protection were scattered in 77 statutes, which touched on various aspects of environment. This set up did not offer adequate protection of the environment mainly due to weak legal and institutional frameworks. Significant progress has, however, been accomplished towards arresting this situation. The turn of events commenced with the finalization of the National Environmental Action Plan (NEAP) in 1993.

2.2 The National Environmental Action Plan

In 1993, National Environment Environmental Action Plan (NEAP) was finalized under the Ministry of Environment and Natural Resources (MoENR). NEAP addressed environment and conservation challenges, through appropriate legislative and institutional mechanisms. It provided not only a strategy for achieving sustainable development in Kenya but also served as a basis for domesticating Agenda 21 – the Global Programme of Action on Environment and Development. NEAP's main objectives were to coordinate stakeholders in the preparation of a national environmental legislation and establish a single institution with legal authority to coordinate the management of environmental resources that were at that time managed by different sectoral statutes. The adoption of the NEAP in 1994 marked an important step towards integrating environmental matters in the development planning process. Following the adoption of NEAP, the Environmental Management and Coordination Act (EMCA) of 1999 was enacted.

2.3 Environmental Management and Co-ordination Act

The main objective of the Environmental Management and Coordination Act (EMCA) is to provide for the establishment of an appropriate legal and institutional framework for the management of the environment in Kenya. EMCA further aims to improve the legal and administrative co-ordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for effective environmental management. In addition, the Act is set to harmonize the 77 sector specific legislations touching on the environment in a manner

designed to ensure greater protection of the environment in line with national objectives. The ultimate objective is to provide a framework for integrating environmental considerations into the country's overall economic and social development. The major institution established to implement and operationalize the objectives of EMCA is the National Environmental Management Authority (NEMA)

2.4 National Environmental Management Authority

In July 2002, the Government established the National Environmental Management Authority (NEMA), a body corporate under the Ministry of Environment and Natural Resources for the purpose of the administration of EMCA. The NEMA is headed by a Director General appointed by the President. Its functions include coordination of various environmental management activities, initiation of legislative proposals and submission of such proposals to the Attorney General. NEMA is involved in conducting research, investigations and surveys in the field of environment. In addition, NEMA has instituted Environmental Impact Assessments (EIAs) and Environmental Audits (EAs) as normal practices in Kenya.

2.5 Environmental Impact Assessment

The EMCA makes it mandatory for any person being a proponent of a project to submit a project report to NEMA in a prescribed format. Of immediate relevance with regard to conducting EIA are Part VIII, Section 58 (1&2) and the Second Schedule of the EMCA. Section 58 (1) states that: "Notwithstanding any approval, permit of licence granted under this Act or any other law in force in Kenya, any person, being a proponent of the project, shall before financing, commencing, proceeding with, carrying out, executing or conducting or causing to be financed, commenced, proceeding with, carried out, executed or conducted by another person any undertaking specified in the Second Schedule to this Act, submit a project report to the Authority in the prescribed form, giving the prescribed information and which shall be accompanied by the prescribed fees".

Section 58(2) states that the proponent of a project shall undertake or cause to be undertaken at his own expense an environmental impact assessment study and prepare a report thereof. In accordance to the Section 147 of the above Act, Environmental and (Impact Assessment and Audit) Regulations, 2003 have now been formulated and gazetted in Kenya. Gazette Supplement No. 56. Part IV, Section 18 (1) states that a proponent shall submit to the Authority, an environmental impact assessment study report incorporating but not limited to the following information:

- The proposed location of the project;
- A concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project;
- The objectives of the project;
- The technology, procedures and processes to be used, in the implementation of the project;
- The materials to be used in the construction and implementation of the project;
- The products, by-products and waste generated by the project;
- A description of the potentially affected environment;
- The environment effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated;
- Alternative technologies and processes available and reasons for preferring the chosen technology and processes;

- Analysis of alternatives including project site, design and technologies and reasons for preferring the proposed site, design and technologies.
- An environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment; including the cost, time frame and responsibility to implement the measures;
- Provision of an action plan for the prevention and management of foreseeable accidents and hazardous activities in the cause of carrying out activities or major industrial and other development activities;
- The measures to prevent health hazards and to ensure security in the working environment for the employees and for the management of emergencies;
- An identification of gaps in knowledge and uncertainties which were encountered in compiling the information;
- An economic and social analysis of the project;
- An indication of whether the environment of any other state is likely to be affected and the available alternatives and mitigating measures; and
- Such other matters as the Authority may require.

2.6 Other Relevant Legislation

While the Environmental Management and Coordination Act supersedes all other environmental legislation, numerous other laws and regulations will influence the various aspects and activities of the proposed Lake Turkana Wind Power Project. The most important legislation that will guide the development and implementation of this project is the Electric Power Act (1998). Other relevant legislation with regard to this project includes:

- Workmen's Compensation Act (rev. 1988);
- Public Health Act (rev 1972);
- Physical Planning Act (1996);
- Water Act (2002);
- Geothermal Resources Act (1982)
- Wildlife (Conservation and Management) Act (1985)
- Building Code (1997);
- Local Government Act (rev. 1998);
- Local Government Regulations (1963);
- Factories Act (rev. 1972); and
- Lakes and Rivers Act (rev. 1983) among other pieces of legislation.

There are also several World Bank documents that are relevant to this study. They include:

- OP 4.01 Environmental Assessment;
- OP 4.04 Natural Habitats;
- Environmental Assessment Sourcebook; and
- Pollution Prevention and Abatement Handbook, 1998.

2.7 Relevant International Conventions and Agreements

Several international conventions and agreements are relevant to this study. The most notable include:

- Convention on biological diversity (CBD);
- Convention on the wetlands of international importance;
- Convention on the conservation of migratory species of wildlife animals; and
- African convention on the conservation of nature and natural resources among other conventions as outlined below.

2.7.1 Convention on Biological Diversity

The purpose of this convention is to ensure the conservation and sustainable use of biodiversity. Kenya signed the convention on 5th June 1992 and ratified the same on 26th July 1992. The National Environment Management Authority (NEMA) is the national focal point to this Convention on Biological Diversity. The provisions of this Convention have now been integrated in many laws of Kenya.

2.7.2 Wetlands of International Importance as Waterfowl Habitats

The Convention on Wetlands of International Importance as Waterfowl Habitats is also referred to as Ramsar Convention. Its main objective is to promote conservation and wise use of wetlands by national action and international cooperation as a means to achieving sustainable development throughout the world. Kenya ratified the Convention on 5th June 1990.

2.7.3 Conservation of Migratory Species of Wildlife Animals

This Convention is also referred to as Bonn Convention. It is intended to ensure that migratory species of wild animals spelt out on Appendix I and II to that convention are protected from extinction. The Convention requires inter-governmental cooperation to ensure that the species are allowed to migrate as their nature and their habit is preserved. The Convention was adopted on 23rd June 1979 and came to force on 1st November 1983.

2.7.4 Convention on International Trade in Endangered Species

This Convention on International Trade in Endangered Species (CITES) was adopted on 3rd March 1973 and came into force on 1st July 1975. The purpose of the Convention is to regulate the international trade in wild plants and animals that are at risk of extinction as a result of trade. The Convention seeks to control trade not only in live species but also in dead specimen and their derivatives. The Kenya Government ratified CITES on 13th December 1978. The lead agency for the CITES in Kenya is the Kenya Wildlife Service (KWS).

2.7.5 United Nations Convention to Combat Desertification

The above Convention was adopted on 17th June 1994 in Paris and came into force on 26th December 1997. Kenya ratified the Convention in 24th June 1997. The purpose of the UNCCD is to address the problem of the degradation of land by desertification and the impact of drought particularly in arid and dry semi-humid areas. NEMA is the focal point for the Convention in Kenya.

2.7.6 Convention on the Conservation of Nature and Natural Resources

The African Convention on the Conservation of Nature and Natural Resources reaffirms the importance of natural resources both renewable and non renewable, particularly the soil, water, flora and fauna. The main objective is to facilitate sustainable use the above resources. The above Convention was adopted in Algiers on 15th September, 1968 and came into force on 16th June 1969.

2.7.7 United Nations Framework Convention on Climate Change

The primary purpose of the Convention is to establish methods to minimize global warming and in particular the emission of the greenhouse gases (GHG). The UNFCCC was adopted on 9th May 1992 and came into force on 21st March 1994. The Convention has been ratified by 189 states. Kenya ratified the Convention on 30th August 1994.

2.7.8 The Kyoto Protocol

The Kyoto Protocol to the United Nations Framework Convention on Climate Change requires signatories to the Convention to reduce their green house emissions levels to 5% below 1990 levels by the year 2012. The Protocol came into force on 16th February 2005, after it received the pre-requisite signatures. However, major countries like United States, China, India, and Australia are not signatories to the Protocol. NEMA is the national focal point for this Protocol.

2.7.9 Millennium Development Goals

Whilst there is no mention of energy in each of the eight MDGs, energy services are inevitably an essential input to achieving all the eight goals. This is due to the fact that in order to implement the goal accepted by the international community, to halve the proportion of people living below the poverty line, by 2015, access to affordable energy services is a prerequisite.

2.7.10 Convention for the Protection of World Cultural and National Heritage

The above Convention was adopted in Paris on the 21st November, 1972. Presently the Convention has 178 signatories. Its primary purpose is to preserve cultural and national which includes monuments, architectural works, cave dwellings, painting and natural formations that are universally outstanding. Kenya ratified the Convention on 15th June, 1991. The national Museums of Kenya is the national focal point for the Convention.

2.8 The Equator Principles

In addition to the NEMA Guidelines stipulated above, this report has been compiled to conform to the Equator Principles. Equator Principles refer to a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing. As a member of the Equator Principles Financial Institutions (EPFIs), the African Development Bank (AfDB), an important sponsor for the project demands that the projects it finances must be developed in a manner that is socially responsible and reflect sound environmental management practices. In doing so, negative impacts on project affected ecosystems and communities are avoided whenever possible, and if the impacts are unavoidable, they need to be reduced, mitigated and/or compensated for appropriately. In accordance to Equator Principles, potential social and environmental issues to be addressed in Social and Environmental Assessment documentation include the following:

- Assessment of the baseline social and environmental conditions;
- Consideration of the feasible environmentally and socially preferable alternatives;
- Requirement under the host country laws and regulations, applicable international treaties and agreements;
- Protection of human rights and community health, safety and security (including risks, impacts and management of project's use of security personnel);
- Protection of cultural property and heritage;

- Protection and conservation of biodiversity, including endangered species and sensitive ecosystems in modified, natural and critical habitats, and identification of legally protected areas;
- Sustainable management and use of renewable natural resources (including sustainable resource management through appropriate independent certification systems);
- Use and management of dangerous substances;
- Major hazards assessment and management;
- Labour issues and occupational health and safety;
- Socio-economic impacts;
- Fire prevention and life safety;
- Land acquisition and involuntary resettlement;
- Impacts on affected communities, and disadvantaged or vulnerable groups;
- Impacts on indigenous peoples, and their unique cultural systems and values;
- Cumulative impacts of existing projects, the proposed project, and anticipated future projects;
- Consultation and participation of affected parties in the design, review and implementation of the project;
- Efficient production, delivery and use of energy; and
- Pollution and prevention and waste minimisation, pollution controls (liquid effluents and air emissions) and solid and chemical waste management.

2.9 The Environmental and Social Impact Assessment

Environmental and social impact assessment (ESIA) for the proposed Lake Turkana Wind Power Project was carried out in accordance to the guidelines of NEMA and Equator Principles as stipulated above. A major objective of the proposed ESIA is to ensure that the proposed wind park development in Loiyangalani in Laisamis District will be environmentally sound and sustainable, and that any environmental issues or consequences of the proposed development are recognized early and taken into account in the project design.

3. APPROACH AND METHODOLOGY

3.1 General Methodology

The methodology adopted for the environmental and social study for the proposed project follows the conventional pattern for EIA studies and meets the requirements for the National Environment Management Authority (NEMA).

In executing this assignment, the consulting team started by conducting scoping exercise with various stakeholders as well as securing and reading through several documents that deal with the wind power resource and environmental characteristics of the project area. A list of documents consulted in the course of this study is presented in the list of references (15-References) at the back. Environmental conditions of the project area were investigated during the field trip made into the project area, Loiyangalani Location between 16th to 25th November, 2007. During the above field trip, the team made relevant observations and carried out detailed survey of appropriate attributes of the project area including physical and biological parameters. Photographs of interesting characteristics of the project area were taken where appropriate. The environmental attributes of the project area captured during the field study are presented in a series of photographic plates in Annex 1-Photographic Plates Showing the Salient Features of the Project Area.

3.1 Stakeholder Consultations

In order to acquire further information, the consulting team employed consultative approach through meetings, interviews and focused discussions with a wide range of stakeholders. In particular the team held interviews and discussions with the following key organisations and people:

- National Environmental Management Authority (NEMA): Meetings with Director, Compliance and Enforcement and District Environmental Officer, Marsabit District.
- Government Departments: Ministry of Cooperatives, Livestock and Fisheries, Office of the President - Arid Lands Resource Management Project (ALRMP) in Marsabit, District Development Officer (DDO), Marsabit, and Department of Social Development, Gender and Sports, Marsabit.
- Parastatal organisations including the Kenya Wildlife Service (KWS).
- Provincial administration and local community leaders including meeting with the Chief, Loiyangalani Division, and the Assistant Chief for Loiyangalani and Moyet sub locations.
- Non Governmental Organizations: Food for the Hungry International (FHI), Community Initiatives Facilitation Assistance (CIFA) and Pastoralist Integrated Support Programme (PISP).
- Lake Turkana Wind Power Ltd Management.

3.2 Meetings with the Local Community

The team held meetings and interviews with local communities in the project area including the Yammo Manyatta Community (Turkana), Nakuame Kwi Manyatta (Turkana), Kiwanja Ndege Manyatta (Samburu and Rendille) and El Molo Community (originally from Komote Laiyeni Village) that are likely to be affected in one way or another by the project. In this regard key informant interviews and the focal group discussions were held with the youth, women and men groups to be served by the project. The team held meetings with several CBOs in the project area where concerns about the proposed project were discussed. The CBOs consulted included Mosaretu Women Group, Kifaru Women Group and Nayori Environmental Conservation

Rehabilitation Youth Group. Most of people interviewed raised concerns related to employment opportunities, potential accidents from the project, negative impacts of the project on livestock and social considerations including supply of water and support for enhancement of fisheries in the project area. A list of people and organizations consulted in the course of conducting the environmental impact study are presented in Annex 2- People and Institutions Consulted during the Study Process

3.3 Plant Identification and Water Analysis

Plant specimens collected in the project area were identified at the herbarium at the Department of Resource Surveys and Remote Sensing (DRSRS) and the East African Herbarium at the National Museums of Kenya (NMK).

Analysis for water quality from Lake Turkana and Loiyangalani Spring (the water sources likely to be affected by the operations of the proposed project) was carried out at the Chemical & Industrial Consultancy Unit (CICU) of the University of Nairobi, Chemistry Department, Chiromo Campus. This laboratory is recognized by the NEMA as having adequate capacity and competence to carry out water quality analysis in accordance to Section 119 of the EMCA. Results of the chemical analysis of water are presented in Annex 3a&b - Analysis of Waters from Loiyangalani Springs and Lake Turkana

3.4 Information Disclosure

Following the completion of field study and drafting of the EIA study report, copies of the draft report were distributed to a wide cross section of stakeholders (Annex 4a – List of Persons Invited to Attend the ESIA Stakeholders' Meeting) to review and communicate their comments to the Team Leader within a period of three weeks. A stakeholders' meeting was subsequently held in Loiyangalani between 21 and 22nd April 2008 and attended by fifty four (54) participants (Annex 4b – Participants of the ESIA Stakeholders' Meeting on 21-22 April 2008). Several issues touching on the proposed project including the project negative impacts on livestock, Lake Turkana, vegetation and other natural resources, the siting of the wind farm, job opportunities and other relevant matters to the community among other issues were exhaustively discussed during the workshop. Issues discussed in the Stakeholders' Meeting were recorded in the minutes presented in Annex 5 – Minutes of the ESIA Stakeholders' Meeting.

4. BASELINE INFORMATION OF THE PROJECT AREA

4.1 The Location of the Project Area

The project area for the Lake Turkana Wind Power Project is situated in the Loiyangalani / Mt. Kulal Locations of Loiyangalani Division in the greater Marsabit District (now Laisamis District) of the Eastern Province of Kenya. On a closer view the project area is located between the foot slopes of Mt Kulal and the south-eastern end of Lake Turkana in Loiyangalani Location as shown on the Maps 1 – 4. The project site covers an area of 150 km² (15km by 10km). The project area has been leased from the Government of Kenya (GoK) for a period of 99 years. The leased land runs south east from the south eastern shores of Lake Turkana and passes between Mts. Kulal and Nyiru. The area has unique geographical conditions in which daily temperature fluctuations generate strong predictable wind streams between the Lake Turkana (with relatively constant temperature) and the desert hinterland (with steep temperature fluctuations). In this regard, the project area covers a valley between Mt Kulal and Mt. Nyiru that effectively acts as a funnel in which the wind streams are accelerated to high speeds.

4.2 Climatic Conditions

The climatic conditions prevailing in the project area and other areas of the Marsabit District are summarised in Table 1. The climate is basically hot and very dry. The whole of the project area belongs to what is referred to as Agro-climatic Zone VII. This zone is characterised by very low rainfall and very high evapotranspiration as seen in Table 1.

Table 1. Main Features of the Agro- climatic Zones in Marsabit District

Zone	r/Eo (%)	r (mm)	Eo (mm)	Climatic designation
III	50-55	900 - 960	1750 - 1800	Semi-humid
IV	40 - 50	750 - 900	1800 - 2095	Semi-humid to semi-arid
V	25 - 40	525 - 750	11890 - 2095	Semi-arid
VI	15 - 25	320 - 525	2095 - 2150	Arid
VII	<15	170 - 320	2150 - 2280	Very arid

Source: A.J. van Kekem: Soils of the Mt. Kulal Marsabit Area

Legend:

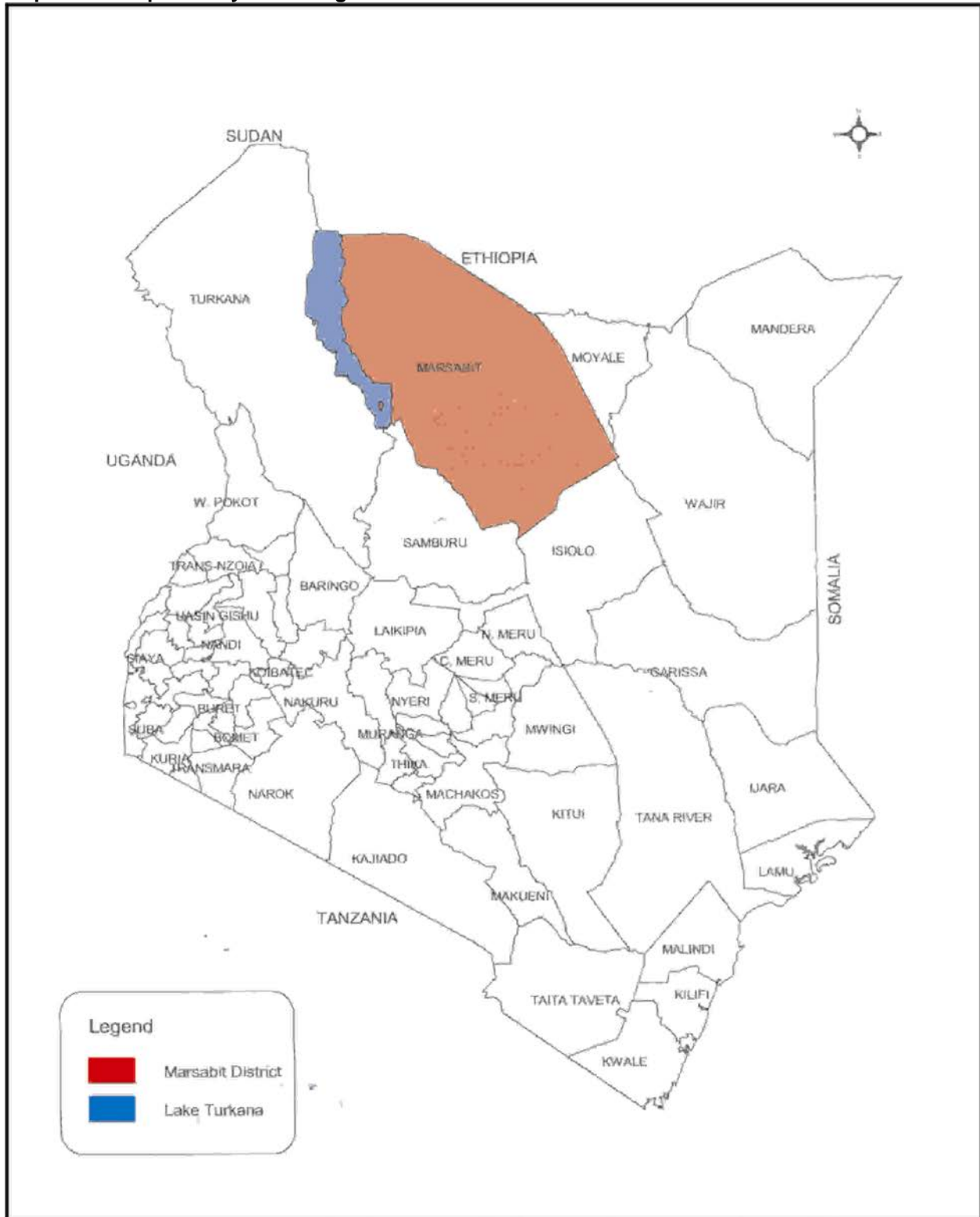
r – average annual rainfall (mm)

Eo – average annual potential evaporation (mm)

4.2.1 Rainfall

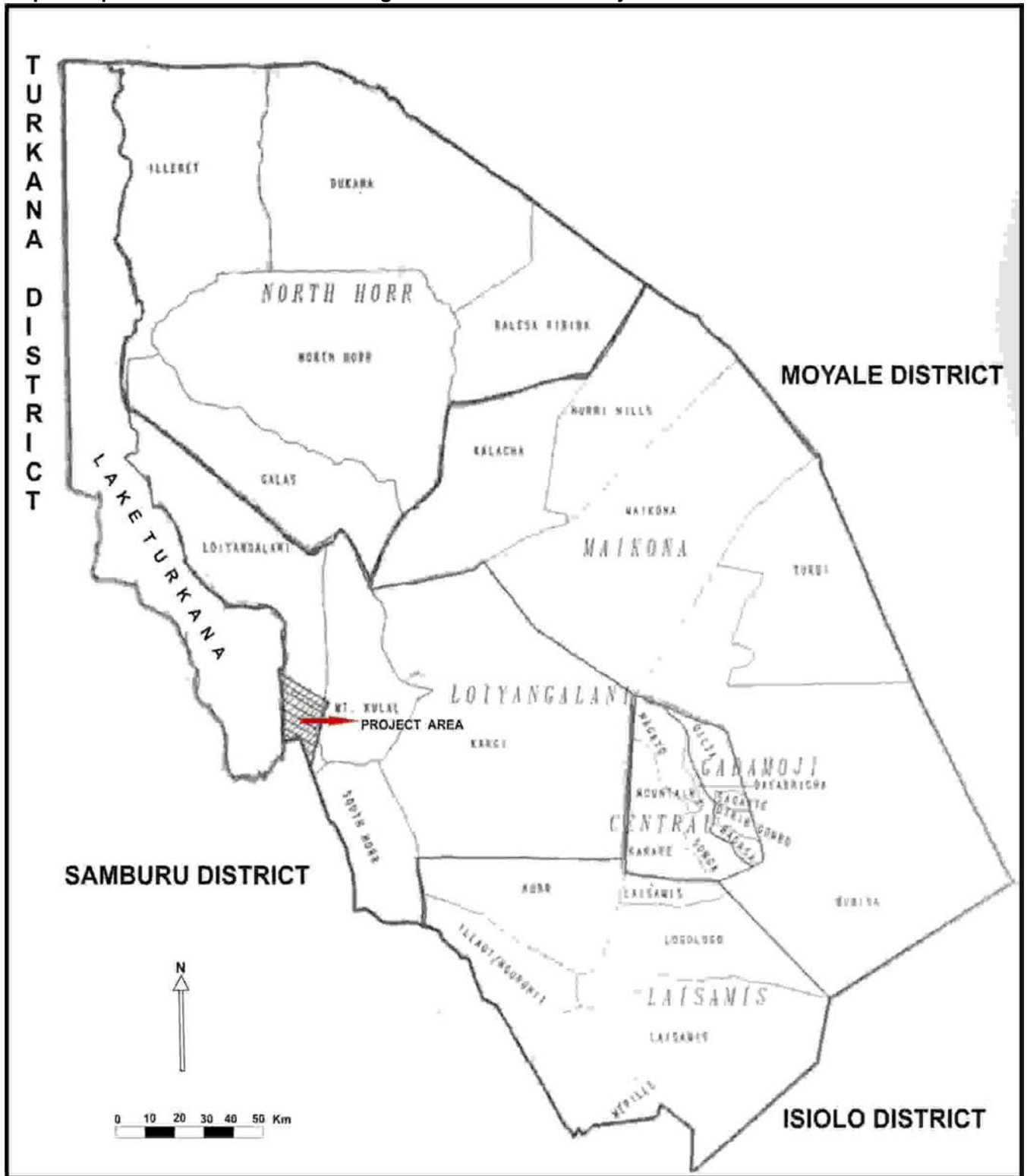
The general patterns of rainfall in several areas in the greater Marsabit District are presented in Table 2. It is noted that there are no operational meteorological stations in the project area (covering the Agro-climatic Zone VII). For comparison the nearest station with long-term records is North Horr which shares the same Agroclimatic zone (VII) with the project area and where rainfall records have been collected since 1959. Based on the rainfall characteristic of the Agro-climatic Zone VII as recorded in the North Horr Station, the project area rainfall is also expected to be very low, with a mean annual rainfall of less than 200mm.

Map 1. The Map of Kenya Showing Marsabit District



Source: Adapted from ETC East Africa, 2002.

Map 2. Map of Marsabit District Showing the Location of the Project Area



Source: Marsabit Development Plan 2002 – 2008

The rainfall of the project area shows a distinct bimodal distribution pattern. The main wet season (long rains) normally starts in March/April and lasts until May. The short rains start in October/November and last until December. In addition to the low rainfall received in the project area, an important characteristic of the rainfall received is the high variability. This includes monthly rainfall variability or deviations from the mean as well as variability in altitude and spatial distribution. Although no data is available for the project area, it is evident that evaporation is very high and the crop water requirement exceeds rainfall in all months of the year.

Table 2. Rainfall Patterns of Marsabit District

Station	Period of Record	No. of Years	Rainfall (mm)		
			Mean	Maximum	Minimum
North Horr	1959 - 1981	22	157	385	5
Moyale	1915 – 1981	64	713	1290	387
Marsabit	1918 – 1981	53	859	1816	324
Lodwar	1919 - 1981	62	178	498	19

Source: A.J. van Kekem: Soils of the Mt. Kulal Marsabit Area

4.2.3 Temperature

Generally temperatures of the project area are high. The temperature patterns usually follow the general trends in the tropics where diurnal changes are greater than annual temperatures. The mean monthly temperature of the project area are in the range of 27 - 29°C, the mean minimal lie around 13 – 20°C while the mean maxima are 26 – 35°C. The coolest months are July and August while February, March and October are the hottest months.

4.2.4 Wind Conditions

Wind is an important factor with regard to the development of this project. Compared to the rest of Kenya, winds in the project area are very strong. The winds are generated by a low level jet called the Turkana Channel jet. The jet stream (discovered in 1981 by J. Kinuthia of the Kenyan Meteorological Department), is caused by the much larger East African low level jet. The Turkana Channel jet blows all year round from the South East through the valley between the East African and the Ethiopian Highlands stretching from the Ocean to the deserts in Sudan. The wind is accelerated locally between Mt. Kulal (2300m asl) and the Mt Nyiru Range (2750m asl). Due to thermal effects the wind slows down during mid day and is at full force during the night.

Lake Turkana Wind Power Project has been measuring wind speeds and frequency in the project area for the last 12 months at 40, 60 and 80 metres altitude. The average wind speed in the project area has been recorded to be 11 metres per second. These are among the highest wind speed averages recorded in the world.

4.3 Topography

The project area lies between 450 metres above sea level (m asl) at the shore of Lake Turkana and 2300 m asl on the foot slopes of Mt. Kulal. The topographical features of the project area are quite variable. The common features of the project area as described by van Kekem (1986) include plains, foot slopes, plateaus, hills and minor scarps and footridges.

4.3.1 Plains

Around Loiyangalani Township and bordering Lake Turkana the topographical features are mainly dissected lacustrine plain, floodplain and piedmont plains. The plains have a relief intensity of 5-20 and slopes of 0-8%. The relief of the plains ranges from flat to very gently undulating, gently undulating and undulating.

4.3.2 Hills and minor scarps

To the south of the plains around the Ongipi massif and bordering Lake Turkana the main topographic features are hills and minor scarps with relief intensity of 50 to 300m and slopes from 8 to 30%. The relief of the area is rolling to hilly.

4.3.3 Plateaus

South of the Ongipi massif in the vicinity of the Sirima Lagga and the area further south, the main relief is mainly non-dissected plateaus with relief intensity of less than 20m and slopes of 0-5%. The relief of the plateau is flat to very gently undulating to gently undulating. This feature covers a greater part of the project area than any other feature.

4.3.4 Foot slopes

Towards the east of the project area between the hills and minor scarps of the Ongipi massif to the north and the plateaus in the south and the lower reaches of Mt. Kulal, the topographic features are dominated by foot slopes. These are the foot slopes of Mt. Kulal with relief intensity of less than 10m and slopes of 1-8%. The relief of the foot slopes is mainly very gently undulating, gently undulating and undulating.

4.3.5 Footridges

To the east of the project area and above the southern foot slopes of Mt. Kulal the main topographic features are footridges. These are mainly the dissected middle slopes of Mt. Kulal where relief intensity is 50-200m. The slopes of the crests of the footridges are 2-8% while the slopes of the valley sides are over 16%. The slopes of the footridges range from gently undulating, undulating, and rolling to hilly.

4.4 Geology

Although geological surveys have been carried out in the South Horr (Dodson, 1963) and Laisamis (Randel, 1970) region, the geology of the Loiyangalani part of the greater Marsabit District, including the project area has not been systematically mapped and is therefore only partially known. Much of what is known is, however, derived from the work of van Kekem (1986) - Soils of Mt. Kulal Marsabit Area. Some information was derived from earlier geological surveys of Northern Kenya by Dixey (1948). From these references, it is evident that the rocks underlying the project area and surroundings fall within three main categories, the Precambrian (Basement) system, the relatively recent volcanic rocks and sedimentary rocks. The main geological features of the project area are presented in Map 4.

4.4.1 Precambrian rocks

The Precambrian rocks underlie the project area and surroundings. These rocks belong to the Basement System and represent metamorphosed sequence of several types of rocks. The less

resistant members of the Basement rocks have been eroded to lowlands in the course of successive geological cycles while the more resistant types form rock intrusions, upland masses and isolated plateaus bearing evidence of peneplanation.

4.4.2 Volcanic rocks

During the Paleozoic and Mesozoic eras, erosion and peneplanation took place periodically in the Marsabit area and this continued up to early Tertiary. The onset of volcanic activity in Miocene to Holocene dramatically changed the physiography of this area. In the initial stages, basaltic extrusions from fissures and small vents formed lava plateaus. For example, massive basaltic plateaus form large aprons at the foot of Mt. Marsabit, Mt. Asie and Mt. Kulal (which is in the vicinity of the project area). The second phase in the development of volcanic activity is marked by formation of the shield volcanoes of Mt. Asie, Mt. Kulal and Mt. Marsabit. These multicentre volcanoes developed over the pre-existing plateau lavas and have characteristic parasitic cones and explosion craters on their flanks. The volcanoes form basaltic ranges in more or less linear fashion as they erupted along zones of crustal weakness parallel to the Lake Turkana axis.

4.4.3 Sedimentary rocks

The basins in the project area and the surroundings contain sediments derived from Precambrian Basement system of rock mixed with sediments originating from erosion of Cenozoic volcanic material. Sedimentary cover over the bedrock varies in thickness from 30m at the periphery to more than 200m in the centre of basins. At different altitudes along the shore of Lake Turkana, lake sediments are found, sometimes in between or mixed with volcanic layers. Paleo-lake sediments are found near Loiyangalani at about 100m above the present lake. The occurrence of peperites in the Loiyangalani sediments shows that volcanic extrusion products were deposited in the paleo lake together with lacustrine sediments.

4.5 Soils

Detailed soil mapping is lacking in the project area. The soil description given below is based on the reconnaissance soil survey of Mt. Kulal area conducted by van Kekem (1986). The distribution of soil types is largely determined by physiography and parent material. Soil types of the project area are presented in Map 4. The nomenclature of soil types in the project area follow the physiographic units described in Section 4.3.2 – Topography. They include:

- Soils of the hills and minor scarps;
- Soils of the plateaus;
- Soils of the footridges;
- Soils of the foot slopes, and
- Soils of the plains.

4.5.1 Soils of the hills and minor scarps

Soils developed on the hills and scarps include the Regosols and Vermosols.

- **Regosols** - Soils developed on pyroclastic rocks (calcaric Regosols – HP2P) - Excessively drained, shallow, reddish brown to brown, strongly calcareous, slightly sodic, very stony and gravelly, sandy loam to clay.
- **Yermosols** - Soils developed on various volcanic rocks (haplic Vermosols - HVP) - Somewhat excessively drained, shallow to deep, dark reddish brown, friable, strongly

calcareous, rocky, stony to very stony clay, with an exceedingly bouldery surface; in places moderately saline and sodic.

4.5.2 Soils of the plateaus

Soils developed in the plateaus of the project area include haplic Vermosols and orthic Solonetz and Orthic Solonchanks.

- **Vermosols** - Soils developed on various volcanic rocks (haplic Vermosols – LnV3p) – Very well drained, moderately deep, reddish brown to dark reddish brown, very friable, strongly calcareous, slightly sodic, very stony and / or very gravely to slightly gravely, clay loam.
- **Orthic Solonetz and Orthic Solonchanks** - Moderately well drained, moderately deep to very deep, dark reddish brown, friable, strongly calcareous, slightly to strongly saline, strongly sodic, clay loam to clay with an exceedingly bouldery and/ or exceedingly stony surface; in places very stony (LnV4p).

4.5.3 Soils of the foot slopes

Soils developed on various volcanic rocks (calciic Vermosols - FVIP) – Somewhat excessively drained to well drained, shallow to moderately deep, reddish brown to dark brown, very friable, strongly calcareous. Slightly to moderately saline, slightly to strongly sodic, stony and very gravely, sandy loam to sandy clay.

4.5.4 Soils of the footridges

Soils developed on various volcanic rocks. The soils of the footridges form an association of Phaeozems, Cambisols and Xerosols (RVA).

- **Phaeozems** – Well drained, moderately deep, dark reddish brown to dark brown, very stony, clay loam to clay, with a stony to exceedingly stony surface; in some places strongly calcareous. Mainly haplic and calcaric phaeozems.
- **Cambisols** – Well drained, shallow to deep, dark reddish brown, friable, very bouldery to stony, clay loam to clay; in some places moderately to strongly calcareous; on middle to upper slopes. Mainly eutric and chromic Cambisols.
- **Xerosols** – Well drained, shallow to moderately deep, dark reddish brown to dark brown, very friable, strongly calcareous, very stony and or very gravely, sandy loam to sandy clay with a very stony and /or very gravely surface on the lower slopes.

4.5.5 Soils of the plains

There are several soils that are developed on the plains of the project area. They include the loamy soils, Fluvisols and Yermosols.

- **Soils developed on sediments derived from various parent materials** - These soils are a complex of excessively drained to well drained, shallow to deep, dark brown to yellowish brown, loose to friable, strongly calcareous, moderately to strongly saline, moderately to strongly sodic, very stony and / or very gravely, loamy sand to clay and in certain places stratified - (PldXC).

- **Soils developed on alluvial deposits** – Somewhat excessively drained very deep, dark brown, loose, moderately calcareous, stratified, very stony and very gravely, loamy sand. The soils are also referred to as calcaric Fluvisols (AA1)
- **Soils developed on colluvium and alluvium derived from various volcanic rocks** – These are well drained, moderately deep to very deep, brown, very friable, strongly calcareous, slightly saline moderately sodic, very stony, to very gravely sandy clay loam, with an exceedingly stony surface. Usually referred to as calcic Yermosols (YVlp).
- **Soils developed on various volcanic rocks** – Somewhat excessively drained to well drained, shallow to moderately deep, reddish brown to dark brown, very friable, strongly calcareous, slightly to moderately saline, slightly to strongly sodic, stony and very gravely, sandy loam to sandy clay. (calcic Vermosols FV1P). In addition there is a soil type of drained, moderately deep to deep, dark reddish brown, very friable, strongly calcareous, slightly to moderately sodic, very rocky clay, with an exceedingly bouldery surface; in places very stony and / or cracking (Haplic Vermosols - FV2p)

4.6 Hydrology

Occurrence of surface water is very rare in the project area. Only after heavy rains, shallow pools and seasonal water courses may be filled with water for a few and probably up to a maximum of a few weeks. The drainage ways in the project area are dry river beds referred to as laggas. These drainage ways have bouldery and stony riverbeds. Many laggas in the project area seem to be too wide for the existing climatic conditions. They have wide beds with braided characteristics and changing stream channels. Sometimes, once in every 5 to 10 years, the laggas are filled up completely. The Lagga Yammo and Lagga Sirima are important drainage ways in the project area.

There are a variety of sources of water for the population and livestock in the project area. They consist of permanent springs, boreholes and waterholes dug in the riverbeds. An important source of permanent water is Loiyangalani Springs that provides water for the community and livestock around this area. Permanent surface water is found on the top of Mt. Kulal but this source of water is outside the project area.

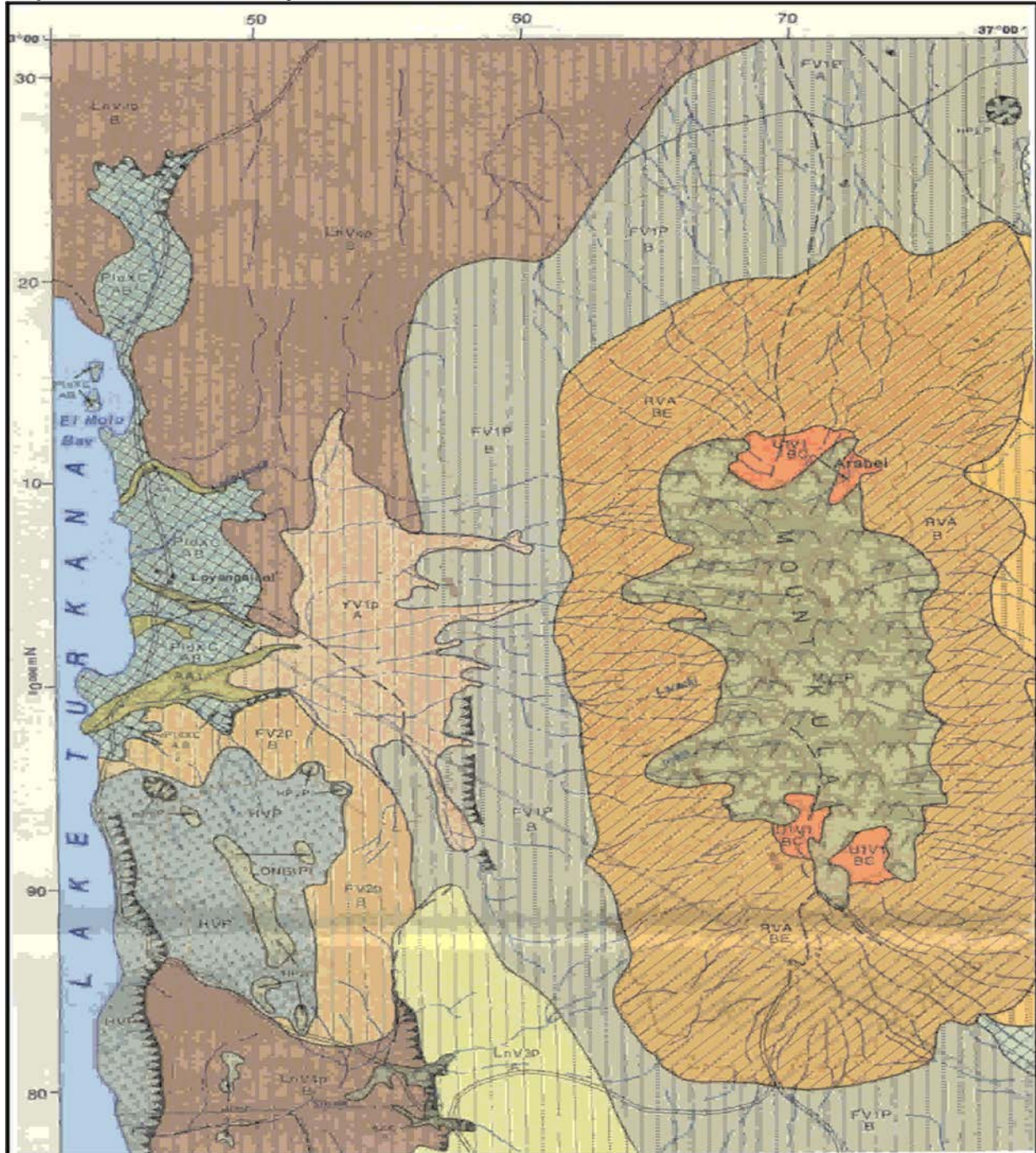
Lake Turkana (6,750 km²) is the largest body of water in the project area. This lake has been in existence since at least early Miocene but has varied in size since then. For example it was greatly expanded between 9000 and 7500 B.P. when it covered the Lotikipi Plains to the west and drained to the Nile. It was this temporary connection that permitted the ingress of a nilotic fauna to the lake. The lake is fed by 12 principal rivers of which the largest affluent is the Omo River. This river originates from the Ethiopian highlands, flows south down the Rift Valley and enters the northern extremity of Lake Turkana through a large and swampy delta. The Omo River contributes more than 90% of the total riverine inflow of the lake. The Kerio and Turkwell Rivers, although perennial rivers in the upper reach, both discharge into the lake for a few months each year.

4.7 Water Quality

In the project area where water scarcity is very high, the importance of the quality of available water supplies can not be overstated. Even of greater significance is the fact that the lake water is used by a section of local community for domestic purposes and for watering of livestock. Indeed the El Molo and the Turkana already attribute some of their health problems to the use of water from Lake Turkana. Results of biological, chemical and physical analysis of several

parameters of water sampled from various sources in the project area are presented in Annex 3a (tap water and surface flowing water from Loiyangalani Springs and Lake Turkana Lake water) and 3b (water from other sources in the project area).

Map 4. The Soils of the Project Area



Source: Soils of the Mt. Kulal Marsabit Area based on van Kekem (1986).

4.7.1 Water quality of Loiyangalani Springs

Water from the Loiyangalani Springs (both the tap water and surface flowing water) is chemically suitable for domestic purposes. However, both the tap water and the flowing surface water are contaminated with coliforms. In this regard the surface flowing water carries a heavier load of contamination (770 coliforms per 100 ml and 32 *E.coli* per 100 ml). The tap water has less contamination with 28 coliforms per 100 ml and no *E. coli* contamination. Coliform bacteria are usually used as indicator organisms for bacteriological water quality. When coliform bacteria are found in water it indicates fairly fresh faecal contamination. During the field trip it was found that the area surrounding the Loiyangalani Springs is polluted with human material of faecal origin. This is likely to be the source of water contamination. Water from Loiyangalani therefore requires disinfection / boiling in order to render it suitable for drinking.

4.7.2 Water of Lake Turkana

Lake Turkana water has high concentrations of total dissolved solids (2381Mg/l) and high pH values (9.56). Although moderately soft, it is saline and requires de – mineralization and pH adjustment before being used for domestic consumption. The northern end of the lake, however, tends to be less saline and more productive than the southern end. The lake is well oxygenated and well mixed due to strong winds which blow over the lake every morning.

It is noted that the salinity of the Lake Turkana water is at a level critical to various fauna. This lake is interesting in the fact that it is the most saline lake in East Africa containing a normal fish fauna. In addition the lake is at the extinction limit for molluscs and at higher salinities, dwarfism of fish would occur.

4.7.3 Water from other sources

The above analysis shows that many sources of water in the project area and surroundings have higher levels (1.7 – 3.8 mg / l) of fluoride than maximum levels (1.5mg / l) recommended for drinking water. Other water constituents that exceed guidelines recommended for drinking water are hardness for Nguruset (476 mg / l) and sodium levels for Muliko Springs (2600 mg / l) and Loiyangalani Beach (807 - 1300 mg / l). There is therefore a need to conduct chemical, physical and biological; water analysis of the available water sources and advice the local community on their suitability for human consumption.

4.8 Environmental Degradation

Both natural and human induced environmental degradation is currently taking place in the project area.

4.8.1 Natural degradation

The project area has undergone tremendous natural degradation in form of erosion. Erosional processes including gully, rill and stream bank erosion are common in the project area. In addition, erosional processes by strong winds (Aeolian) in the project area are quite rampant.

- **Gully erosion** – Steeper slopes with increased runoff are susceptible to gully erosion. The foot slopes and footridges (mainly outside the project area) are mainly affected by this type of erosion.
- **Rill erosion** – Rill erosion is common all over the project area. The process of rill erosion becomes more serious where natural vegetation has been damaged. In such

cases small rills resulting from splash and rill wash erosion may join and form the beginning of somewhat deeper rills.

- **Stream bank erosion** – Fluvial processes are limited to riverbeds especially the laggas in the project area. A decrease in vegetation cover increases runoff and the amount of eroded materials especially during heavy rains. This has a net effect of enhancing stream bank erosion. During heavy floods the riverbeds often change their courses.
- **Wind (Aeolian) erosion** – Due to the strong winds prevailing in the project area, aeolian processes are common. Presence of aeolian erosion in the project area is also an indication of overgrazing and desertification. To the south of the project area winds move sand with subsequent accumulation around dwarf shrubs thus forming small obstacle dunes as seen in Annex 1, Plate 17.

4.8.2 Human induced degradation

Although the above erosional processes are basically natural, the inhabitants of the project area have enhanced degradation in this area. The cutting of trees and shrubs by the pastoralists for construction of houses and for fuel is a major cause of degradation in the project area. In addition, overstocking of the fragile area causes unbalanced use of vegetation by livestock thus causing overgrazing and degradation of the environment of the project area.

Around Loiyangalani, trees such as *Acacia tortilis*, *Salvadora persica* and *Hyphaene compressa* are under tremendous pressure of exploitation for building materials. In addition the area is now being polluted with heterogeneous solid wastes, including paper, plastic ware, metallic cans, pieces of textiles, broken bottles, bottle tops and other forms of solid wastes. In addition, this area and areas surrounding manyattas are polluted with material of faecal origin.

An interesting development in the project area is the introduction of an alien invasive species commonly referred to as prosopsis (*Juliflora prosopsis*). This plant is currently spreading in the project area and has already covered substantial areas in Loiyangalani township where there is availability of water. At Loiyangalani, the plant is utilized as live fences in several compounds. If no steps are taken to eradicate it, prosopsis may turn out to be an environmental and health hazard in the area of project operation. This has happened in other areas such as Baringo, Turkana and Tana River districts. In these districts, the plant has extensively established itself and colonises large areas to the exclusion of indigenous plants. It has been reported that livestock at times die upon feeding on the pods and wounds inflicted by the thorns are difficult to heal.

4.9 Biological Environment

The biological environment of the project area mainly encompasses the biodiversity of the terrestrial arid area and the aquatic life in and around Lake Turkana.

4.9.1 Flora

The annotated flora of the project area and surroundings is presented in Annex 6- Common Flora Identified within the Project Area and Surroundings. Most of the project area is covered by deciduous dwarf shrubland. There are also large areas of barren land where vegetation is very scarce. The common plant species of the project area include shrubs such as *Indigofera spinosa*, *Duosperma eremophilum*, *Sericocomopsis hildebrandtii*, *Acacia reficiens*, *Acacia mellifera* and *Commiphora africana*. The most prominent tree of the project area is the *Acacia tortilis* which is found along the laggas and along the drainage areas. Occasionally *Delonix alata*

is also found along the laggas. Around Loiyangalani area where there are water springs, *Hyphaene compressa* is well established. Annual grasses are common especially during the rainy season. They include *Aristida mutabilis*, *Aristida adscensionis* and the species of *Eneopogon* and *Cenchrus*. Along and close to Lake Turkana the salt tolerant grass *Sporobolus spicatus* is the common.

Although the vegetation is scarce, plants play an important role in the life of pastoralists of the project area. They provide firewood, materials for the construction of the houses and livestock enclosures (Photo 1) and feed for livestock including camels, sheep and goats. The plants found in this area are also valued for edible and medicinal products and as a valuable source of fibre for rope making and gum. Uses of some common plants in the project area are outlined below as follows:

- *Acacia reficiens* is relatively unpalatable but is the main source wood for pastoralist communities.
- The foliage of *Acacia tortilis* and *Acacia mellifera* is browsed by camels and goats while the fallen leaves and flowers are eaten by sheep.
- The fruits of *Acacia tortilis* are eaten by all livestock species.
- *Salvadora persica*, *Cordia sinensis*, *Sericocomopsis hildebrandtii*, *Indigofera spinosa* and *Acacia senegal* provide browse for livestock ;
- Thorny trees such as *Acacia* and some *Commiphora* are lopped to provide boma materials.
- Soft-timber trees such as *Delonix*, *Commiphora* and *Erythrina* are used for making milk pots, bowls, stools and drinking troughs.

The vegetation of the project area is currently under great pressure of exploitation. Based on discussions with members of local community, human and livestock population of the project area has been growing steadily in recent years. This is mainly due to increased insecurity brought about by conflicts among certain ethnic groups in the area and subsequent increased settlements close to Loiyangalani where adequate security is available. This trend is currently causing high demand for fuel wood and building materials. As the human and livestock pressure increases, there is sharp increase in over harvesting of plant materials further away from Loiyangalani. The increased resource utilization and degradation has brought about dwindling vegetation cover and encroachment of desertification related phenomenon. Indeed the local community looks back with nostalgia when the project area used to have sufficient vegetation cover and along the laggas there were sufficient woodland stands, the community preferred to call forests.



Photo 1. Use of Local Plant Material in Construction of a Turkana Boma in the Project Area

4.9.2 Fauna

The project area suffers from paucity of wildlife. This is mainly due to increasing population with subsequent increase in poaching activities especially for the big game. For example, Elephants (*Loxodonta africana*) and black rhinoceroses (*Diceros bicornis*) were once plentiful on the lower slopes of Mt. Kulal until 1976 but have now been exterminated by poaching. Other wildlife species including Greater kudu (*Tragelaphus strepsiceros*) Oryx (*Oryx beisa*), Gerenuk (*Litocranius walleri*), Grant's gazelle (*Gazella granti*), Giraffe (*Giraffa camelopardalis*) and Grevy's zebra (*Equus grevyi*) occurred on the middle and upper slopes of Mt. Kulal. The last buffaloes (*Syncerus caffer*), which lived in the higher levels of the montane forest, were seen in 1976 and the species is apparently extinct on Mt. Kulal now. However, in the course of this EIA field survey, it was reported by the residents that two buffaloes had been sighted on top of Mt. Kulal. The same were later reported to have moved further north towards El Molo Gulf and there was fear that they might be poached as well.

During the field study, we were only able to see an occasional dikdik and hare within the project area. However, the team saw gerenuk, striped hyaena, jackal and ostrich between the project area (Loiyangalani) and Marsabit (outside the project area). The exceptionally low densities of wildlife especially the megafauna within the project area is attributed to poaching and intense competition between the wildlife and livestock.

The project area, however has many species of reptiles including venomous snakes such as saw scaled viper, night and puff adder and cobra and lizards. The scorpions (Photo 2) and other invertebrate fauna are also common in the project area.

Photo 2. A Scorpion in the Project Area

Lake Turkana to the west of the project area harbours a great variety of aquatic animals including crocodiles, hippos, fish and birds. It is also an important waterbird site. Eighty four bird species including 34 Palearctic migrants have been recorded in and around the shores of Lake Turkana. In this connection, twenty three (23) aquatic bird species including Goliath Heron and African Skimmer breed on the shores of the lake. The common aquatic birds found in Lake Turkana including the project area are presented in Annex 7 - .

Outside the project area in other parts of the greater Marsabit District, there is a variety of animal species protected in Marsabit National Park and Reserve, Sibiloi National Park, Central Island and South Island National Parks. For example, Marsabit National Park and Reserve is a refuge for elephant, buffalo, Oryx, genet cat, klipspringer, caracal, common duiker, Grant's gazelle, bush buck, Grevy's zebra, lion and several monkey species. In addition, over 66 species of birds are protected in the Marsabit Forest. Wildlife to the north of the project area is protected in Sibiloi National Park covering an area of 10,000 km². This park also contains pre-historic sites where important fossils of early man and animals have been discovered. The South Island National Park (38km²), to the west of the project area, has a unique herd of wild goats. It is also an important breeding ground for crocodiles and other aquatic life.

4.9.3 Aquatic life

Aquatic life of the project area is mainly confined to Lake Turkana, the largest of the Kenyan Rift Valley lakes. Around the shore of the lake, grasses such as *Sporobolus spicatus* and *Paspalidium geminatum* cover the seasonally exposed shallows and provide important nurseries for fish. Although the lake does not support any significant growths of aquatic macrophytes, beds of potamogeton (*Potamogeton pectinatus*) are found in most sheltered muddy bays. The open lake contains an array of phytoplankton, the main link in primary production of the lake ecosystem. The phytoplankton assemblage is dominated by cyanophytes of which *Microcystis aeruginosa* is the most common. Other important phytoplankton species include *Anabaena criminalise* and *Botryococcus braunii*.

The zooplankton of Lake Turkana is an important component of the lake ecosystem. Many species of fish (at least during some part of their lives) feed on the zooplankton. The zooplankton of the lake is dominated by the crustaceans and protozoans. By far the most abundant zooplankton in terms of biomass is the calanoid copepod (*Tropodiptomus banforanus*). Other important zooplankton of the lake include the herbivorous cyclopoid copepod (*Thermocyclops hyalinus*), the carnivorous cyclopoid copepod (*Mesocyclops leuckarti*), cladocera (*Diaphanosoma excisum*, *Ceriodaphnia rigaudi* and *Moina brachiata*), rotifera (*Hexarthra* sp. , *Brachionus pala*, *Felinia limnetica*) and various types of planktonic protozoa (loricate protozoa – *Thuricola folliculata*, vorticellid protozoa and the fillipod - *Raphidiophrys* sp.).

The lake invertebrate fauna form a particularly important link between primary production and fish production. There are two shrimps, *Caradina nilotica* and *Macrobrachium niloyicum*. The benthic fauna is poor but widespread. It mainly consists of five species of gastropod molluscs two of the most common being *Cleopatra pirathi* and *Melanooides tuberculata*. It should be noted that molluscs in Lake Turkana are actually struggling (their shells are thinner) against low calcium levels (due to precipitation associated with high conductivities) prevalent in the lake. In addition the lake supports four species of chironomids and five species of ostracods. Oligochaetes like other benthic invertebrates are sparse in the lake.

Lake Turkana is rich in fish species. Forty eight fish species have been identified in the lake of which 30 are widespread Soudanian types, 8 have restricted distribution and 10 are endemic. Common species include *Alestes baremose*, *Alestes dentex*, *Bagrus bayad*, *Barbus bynni*, *Citharinus citharus*, *Clarias lazera*, *Haplochromis rudolfianus*, *Hydrocynus forskalii*, *Lates longispinis*, *Lates niloticus*, *Serotherodon niloticus* and *Synodontis schall*. The fish in turn support a large population of the Nile Crocodile (*Crocodylus niloticus*). It is noted that prior to the upper Pleistocene, the lake level was higher than present level and its waters overflowed to the northwest into the Nile River through Sobat River. This past connection to the Nile river system explains the characteristic nilotic fish fauna in Lake Turkana.

4.5 Socio-economic Environment

The socio-economic characteristics of the project area are discussed in terms of existing services, population, education, health, poverty situation, land use, commercial / economic activities and identified development strategies.

4.5.1 Existing services

The project area is located in a rather remote part of the country where services (like all other areas in Marsabit District) are poor. Most of the available basic services are concentrated in

Loiyangalani Town (Photo 3) situated to the west of the project area. There are no tarmac roads in the project area and Loiyangalani is connected to other areas through dry weather roads connecting Loiyangalani to North Horr, Loiyangalani to Baraga (to the south), Loiyangalani to Qatab and the Loiyangalani to Marsabit via Kargi. In many areas, these roads are prone to seasonal floods, which make them impassable during heavy rains. Loiyangalani is served by an air strip which is used for non scheduled air services by light aircraft.



Photo 3. Loiyangalani Town from the Air

Loiyangalani is not served by subscribers (STD) telephone services but has sub-post offices which offer postal and bank services. Safaricom provides a reliable cell phone communication service in the area. The project area does not have electric power connection. However, electricity is generated by diesel powered generators in several institutions including schools, missionary stations, hospitals, tourist facilities and in some private households. Commercial activities involving exchange of goods and services are carried out mainly in the Loiyangalani market centre. Educational services are mainly provided by Loiyangalani primary and secondary schools while health services are available at the Loiyangalani Health Centre.

The major tourist facility in the project area is provided by the Oasis Lodge. This facility is located towards the southern end of Lake Turkana at Loiyangalani town. The lodge offers 15 luxury bungalows (with private bath and electricity), two spring - fed swimming pools and car

and boat hire facilities. There are other (low cost) tourist facilities including the Palm Shade Camp (Annex 1, Plate 1.).

4.5.2 Population

The project area which falls in Loiyangalani Location of Loiyangalani Division in the greater Marsabit District (now Laisamis District) is inhabited by four main ethnic groups including the Turkana, Samburu, Rendille and El Molo. According to population census of 1999 (Table 3 a-b), population in the Loiyangalani Division was 16,965 people with a density of 1.1 people per km², the lowest population density in the greater Marsabit District. The population is now estimated to be in the tune of 20,000 people with a density of a 1.32 persons per km². The low population density in the project area is attributed to harsh climatic conditions and insecurity prevailing in the area.

Table 3a. Population Distribution and Density in Marsabit District

Division	Male	Female	Total	No. HH	Persons/HH	Density (persons per km ²)
Central	12,644	12,436	25,100	5,583	5	17
Laisamis	11,148	12,863	24,011	6,482	4	3
Maikona	10,051	9,467	19,518	4,916	4	1
Loiyangalani	8,339	8,626	16,965	4,161	4	1
North Horr	12,656	10,833	23,539	6,097	4	1
Gadamoji	5,184	7,685	12,869	7,052	4	13

Source: Central Bureau of Statistics 2001 (HH=Household(s))

Table 3b. Population Density Projections (persons per km²) by Division

Division	1999	2002	2004	2006	2008
Central	18.1	19.2	20.1	21	22
Gadamoji	21.3	22.7	23.65	24.67	25.73
Laisamis	3.2	3.4	3.55	3.7	4.0
Maikona	1.1	1.17	1.22	1.27	1.32
Loiyangalani	1.1	1.17	1.22	1.27	1.32
North Horr	1.1	1.7	1.22	1.27	1.32
Average	2.0	2.13	2.22	2.31	2.41

Source: District Planning Unit, Marsabit, 2001

4.5.3 Education

Education is not well developed in the project area. Although the data is not current, education facilities in Loiyangalani Division are few when compared to other divisions of the Marsabit District (Table 4) and the rest of the country. In both primary and secondary schools, enrolment has always been low. Analysis by gender shows that there has been a consistent trend of having fewer girls enrolled in all the institutions. This is influenced mainly by preference of parents to educate boys since they argue that education of girls will only benefit the in-laws. However, this view is now changing, but at a very slow pace.

Loiyangalani Primary School in Loiyangalani is an important educational facility in the project area. Table 5. shows the enrolment characteristics of the above school. As is common in the district and many other parts of arid and semi-arid areas in Kenya, there are generally fewer girls enrolled in Loiyangalani Primary School than the boys. This low enrolment is more drastic as the girls approach classes 7 and 8. This is attributed to the fact girls leave the school to get married.

Table 4. Distribution of Education Facilities in Marsabit District

Division	Pre-Primary	Primary	Secondary	Youth-Polytechnic	Total
Central	39	11	3	1	54
Gadamoji	21	9	-	-	30
Laisamis	19	7	1	-	27
Loiyangalani	12	6	1	-	18
Maikona	6	6	1	-	13
North Horr	5	7	1	-	13
Total	102	46	7	1	155

Source: District Education Office records 2001

Table 5a. Loiyangalani Primary School Enrolment (2003)

Class	1	2	3	4	5	6	7	8	Total
Boys	54	33	28	49	29	23	23	17	256
Girls	58	28	27	32	15	18	9	7	194
Total	112	61	55	81	44	41	32	24	450

Source Loiyangalani Primary School

Table 5b. Loiyangalani Primary School (2004)

Class	1A	1B	2A	2B	3	4A	4B	5	6	7	8	Total
Boys	26	27	16	16	25	25	27	26	20	21	15	244
Girls	30	30	24	25	33	17	12	22	20	13	05	230
Totals	56	57	40	41	58	42	39	48	40	34	20	471

Source Loiyangalani Primary School

Table 5c. Loiyangalani Primary School (2006)

Class	1	2	3	4	5	6	7	8	Total
Boys	53	33	25	37	50	27	28	21	274
Girls	52	34	39	32	37	12	17	05	238
Totals	105	67	64	69	87	39	45	26	512

Source Loiyangalani Primary School

A combination of several factors brings about serious impediment to the learning process in the project area. They are outlined below as follows:

- Social cultural factors such as early marriages, forced marriages, early pregnancies and early initiation into adulthood;
- The children accompany their parents during the long distance treks in search of water and pasture.
- Formal education is not considered a priority to the pastoralists and the prevailing school curriculum has no immediate relevance to the pastoralist community source of livelihood.
- To the community, education is a long term investment which has no immediate returns especially in the current situation where lack of employment is rampant.
- Long distance to school is a deterrent factor to consistent school attendance.

4.5.4 Health conditions of the project area

Information on the health conditions of the project area are derived from the records maintained at the Catholic Church supported Loiyangalani Health Centre. The causes of out patient morbidity in the project area in 2007 as recorded by the above facility are shown in Table 6. The three most common diseases of the project area are upper respiratory diseases, malaria and diarrhoea. Of the above ailments, the diseases of the upper respiratory system are the leading

cause of out patient morbidity. Most of the diseases are caused by a combination of different factors including poor living conditions, drinking of contaminated water and poor sanitation. It should be pointed out that the Loiyangalani Health Centre does not record incidences of HIV/AIDS, a disease/condition that is currently affecting large sections of community in Kenya.

Table 6. Disease Incidence at Loiyangalani Health Centre (Catholic Mission) Jan – Oct 2007

Disease	Disease Incidence									
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Diseases of the upper respiratory system	137	84	41	38	62	61	86	81	64	63
Malaria	57	57	82	27	98	36	35	74	37	44
Diarrhoea	35	28	21	27	98	36	55	42	43	36
Skin diseases	88	24	23	15	28	26	23	18	24	22
Eye infections	28	22	10	5	11	5	14	16	13	14
Accidents	17	22	11	7	22	11	14	14	13	11
Rheumatism	20	14	0	7	14	4	7	6	6	7
Gonorrhoea	7	4	7	7	7	0	6	4	7	6
Snake / Scorpion bites	0	0	11	13	7	8	3	3	3	5
Urinary tract diseases	3	4	3	1	6	7	4	3	4	5
Pneumonia	12	4	10	5	5	9	2	14	3	3
Ear infections	4	11	5	4	2	0	6	4	4	3

Source: Loiyangalani Catholic Mission Health Centre November 2007

The situation of the poor health conditions of the project area is aggravated by the poor nutritional status prevalent in the project area. According to Food for the Hungry International (FHI) relief report for 2001, many people in arid and semi-arid areas experience acute food shortage. Virtually, there is a total household food deficiency in the pastoral communities, a situation that also affects the project area. Consequently, local communities in the project area depend on relief food distribution. Indeed during the field study we observed a high dependency on relief food among the local communities in the project area. Although relief food is a welcome respite during times of severe drought, it must be emphasized that relief food dependency has significant social implications for the future of the communities in the project area.

4.5.5 Poverty situation

Loiyangalani is a poverty stricken area. It is one of the poorest divisions in Marsabit District which itself is one of the poorest districts in Kenya. Acute poverty prevailing in the project area creates a situation where individuals or households cannot afford basic food and non-food items. Thus they cannot satisfy their basic needs such as food, shelter, clothing, health and education for their children. The main causes of poverty in the project area include:

- Severe droughts;
- Inadequate water for domestic and non-domestic use;
- Undeveloped livestock/livestock products markets and unwillingness to sell livestock;
- Lack of employment opportunities;
- Over-dependency on relief food;
- Socio-political conflicts including ethnic clashes, banditry, cattle rustling, illiteracy and gender inequality.

4.5.6 Land use

The land use of the project area is determined by the climatic conditions and the natural resources available in the area. Being a rangeland, the nomadic pastoralism is the main occupation of the local residents in the in the project area. The majority of the pastoralists found in the project area are the Turkana community who derive their livelihood from keeping of the camels, goats and sheep. The donkeys are mainly used for carrying water and for other transport purposes.

Fisheries is a main occupation of the inhabitants of the project area especially among the El Molo and the Turkana communities. The fisheries is confined to Lake Turkana which lies to the west of the project area. This lake has vast fishing potential but currently it is poorly exploited. Twelve of the forty eight fish species found in the lake are of various economic importance. They include *Labeo horie*, *Serotherodon niloticus*, *Lates niloticus*, *Barbus bynni*, *Bagrus bayad*, *Synodontis schall*, *Citharinus citharas*, *Elastase* spp, *Heterodontis* spp, *Distichodus niloticus*, *Hydrocyrius forskali* and *Clarias lezera*. In Loiyangalani, however, the main fish species harvested for commercial purposes are *Serotherodon niloticus* (tilapia), *Labeo horie* (labeo) *Lates niloticus* (Nile perch) and *Barbus bynni* (barbus). Tilapia is particularly numerous on the eastern shore and forms significant proportion of the fisherman's catch. The main landing beaches are at Loiyangalani. Processing is mainly through sun-drying along the shores of the lake. The fish so processed is sold mainly to traders outside the district in Kisumu. Details of the type of the fish caught, their dry weight (Kg) and value (KSh) between 2006 and 2007 are presented in Annex 8- . According to the Marsabit District Development Plan (1997 - 2001), the lake has potential of producing 170 tons of fish annually. However, fish production is impeded mainly by inadequate fishing boats, local unavailability of nets and hooks, poor handling methods, lack of cold storage and the poor conditions of the roads to the lake town of Loiyangalani. This situation discourages potential investors. Hence the fishery resources of the lake are presently under utilized.

The local trees especially the *Acacias* found in the project area are exploited to meet the energy requirements of the local population. Firewood collected in the area is utilized mainly for domestic use although some firewood is sold in Loiyangalani market. Charcoal produced in the project area is mainly for income generation as the charcoal burners usually use firewood in their homes. The charcoal burners who are mainly Turkana women use a very inefficient mode of burning charcoal.

4.5.7 Commercial / economic activities

Commercial activities involving exchange of goods and services are carried out mainly in Loiyangalani market centre. There are several traders in the market selling a wide range of products including foodstuff, clothes, beverages and household goods among other products. Although livestock rearing is the main economic activity of the project area, the off take of livestock is low. Many pastoralists are reluctant to sell their stock since the numbers of livestock is a measure of wealth and status among the local community of the area. However, there are some livestock traders involved in selling stock out of the project area for the local consumption of meat and to larger markets in Marsabit and other outlets. As a whole there are a number of constraints to effective market flow of livestock from the project area including:

- Lack of stable terminal markets;
- Poor roads;
- Difficulties associated with long hours of livestock trekking;
- Frequent quarantine restrictions;

- Lack of reliable market information;
- Scarcity of handling facilities; and
- Poor terms of trade for pastoral procedures.

There are no financial institutions including banks, insurance and credit institutions at Loiyangalani and the rest of the project area. Consequently, borrowing capacity of the majority of the population from the banks is quite low as most of them lack the security required like buildings or land. Most of the traders do not even operate bank accounts and prefer keeping the money to themselves. The project area, however, has a fisherman's co-operative society, the Loiyangalani Fisheries Cooperative Society although its management and operations are suboptimal.

4.5.8 Development strategies in the project area

In accordance to the current District Development Plan (2002 – 2008), several priority areas for development have been proposed for Loiyangalani Division which in many ways represents the project area. Priority areas for development include the three main sectors including fisheries, environment conservation and development of natural resources and cooperatives.

Fisheries improvement

Currently the fisheries sector of the project area is fraught with many constraints including lack of patrol boats and vehicles for effective management of lake resources, inaccessibility to credit facilities by the fishing community/groups, inadequate technical personnel, very poor access roads, absence of promotional schemes for fish and fish products, inadequate capacity building for all resource users, negative cultural attitudes of some of the pastoralists with regard to fish eating, insecurity and lack of fishing equipments. There is therefore a need to put in place strategies to improve sustainable exploitation of fish resources as outlined below:

- Improvement of the supervision/management of lake resources and revenue collection;
- Improvement of fish harvesting efficiency in order to increase income and revenue;
- Improvement of technical services closer to the fishing communities;
- Improvement of shelf life of fish/ fish products on shore and en-route to distant markets;
- Training of fishermen and fish traders on sustainable fishing methods, water safety (boating) gear technology, preservation in stores and transport; and
- Development of physical access to the lake and markets.

Environmental conservation and development of natural resources

The project area suffers from inadequate physical structures leading to low sectoral performance. In addition, there is public ignorance in conservation aspects and unsustainable exploitation natural resources. There is a need therefore to improve natural resources utilization and management. This can be achieved through promotion of natural resources conservation, provision of adequate personnel to enforce protection of forest resources, create awareness in conservation needs and extend rural afforestation.

Promotion of cooperatives

Some of the factors that affect cooperative movement in Loiyangalani Division include expensive transportation costs, mismanagements and low market prices. In order to promote cooperative movement in the project area, there is a need to improve relevant marketing avenues and enhance natural resources production. There is also a need to mobilize and conduct training to cooperative members on several aspects of management.

5. PROJECT DESCRIPTION AND ANALYSIS OF ALTERNATIVES

This chapter describes a wide range of related issues with regard to the project components, technology used in developing the wind park facility, procedures employed and the processes of the developed plant operations. Other related attributes of the chapter includes materials used in the construction phase, products and by-products and wastes generated by the project. In addition, it covers analysis of alternatives including technologies, project sites, project design and environmental and social classification of the project.

5.1 Project Components

The proposed project comprises several components including preliminary activities, installation of masts, road improvements, equipment transportation, and development of wind farm, power generation and transmission.

5.1.1 Preliminary activities

Several preliminary project activities have already been carried out. Having identified the project area, one of the first priorities of the project developer was to secure the exclusive rights from the relevant national authorities to study the wind resources of the area of interest. The exclusive rights were formally granted by the Ministry of Energy (MoE) in April 2006. Later on there followed favourable discussions with Kenya Power and Lighting Company (KPLC) which subsequently resulted in a letter of interest to purchase the power generated by the wind park. The following feasibility studies have also been finalised:

- Economic feasibility of the project;
- Environmental impact assessment of the wind park facility and power transmission line;
- Assessment for the potential for the carbon market; and
- Assessment of the national electricity grid.

5.1.2 Installation of a mast

Following the granting of the exclusive rights to study the wind resources of the project area, several 50 meter – high guy masts have been erected with all the necessary equipment and data registration facility to measure the actual characteristics of the wind resources of the project area. The wind measurements (for a period of at least 12 months) of variables such as wind speed, wind direction, temperature and other attributes commenced in March 2008.

5.1.3 Equipment transportation

Several equipment including the mast, turbine, wind blades and other equipment and components of the wind park facility will be carried out by the Kenyan branch of SDV Transami, using normal trucks and trailers. However, the present road conditions of the project area are very poor. The project will therefore undertake to improve the roads in order to facilitate smooth transportation of wind power equipment. The rehabilitated road will also improve communication and help in the subsequent operations of the installed wind park facility. Towards this endeavour, an initial infrastructure review has been made. It involved the assessment of the route in order to determine the efforts required for the logistical operation of transporting the masts and turbines from the sea port of Mombasa to project area near Lake Turkana. The route to be rehabilitated will stretch from Laisamis Ngurunit, South Horr to Loiyangalani. This represents a total of 170 km of road to be upgraded.

5.1.4 Installation of wind farm and power generation

Following the transportation of different power components, Vestas will assemble and install the power generating units at the project site. The proposed wind farm facility is expected to consist of 365 turbines, each with an installed capacity of 850 kW. The selected wind turbine is Vestas V52. The total foreseen power generated by the project will amount to 310 MW. This is 25% of the existing electric energy capacity currently available in the country. The project is scheduled to be constructed in one phase but will come on line as follows:

- 240 Turbines and full connection to the grid in 2011; and
- 125 turbines added to the park in 2012.

5.1.5 Complementary initiatives

In addition to the construction and operation of the wind farm facility, the project will implement other necessary initiatives including roads rehabilitation and the construction of the power transmission line.

Roads rehabilitation.

The proposed wind farm facility will be located approximately 1,200km from the sea port of Mombasa from where the wind farm equipment will be transported by road to site. The last stretch, consisting of approximately 196km and starting in Laisamus require realignment, rehabilitation and repair works to enable the mast, turbine and blades of the wind mills to be transported without damage and for the roads to handle an 8 ton axle load. The scope of these works will entail building culverts, vertical realignment, filling, grading, leveling and general repairs. It is estimated that the civil works will cost approximately US\$ 20M and will, in addition to providing transport access for the cargo to the wind farm, also provide an access road for communities living in the area and potentially increase economic development. There is no expected resettlement involved in this rehabilitation since the road concession is within an existing right-of-way;

Transmission line.

The Project is unique in that the wind farm is located in an area that is presently not serviced by any transmission line network. In order for the project to be able to supply power to the national grid through Kenya Power & Lighting Company Ltd (KPLC) - with which LTWP has entered into a 25-Year "take-or-pay" Power Purchase Agreement (PPA), it is necessary for the simultaneous development of a transmission line from Loiyangalani to Suswa where the wind farm will interconnect to the national high voltage network. A *Power Integration and Economics Study* was undertaken by Schicon to evaluate the most optimal routing of the transmission line for integration into the existing grid network. Of six options studied, the most favorable was the construction of a new double-circuit 400 kV line from the Turkana wind farm in Loiyangalani via Baragoi, Maralal, Rumuruti, Nyahururu, Gilgil, and Naivasha to Suswa. This option has the benefit of providing a transmission network that maximizes the potential for future interconnection of planned geothermal plants, including Barrier, Namarunu, Emurangogolak, Silali and Korosi. It also uses existing 'rights-of-way' from the existing KPLC line from Maralal to Olkaria. Under the terms of an Agreement with the Ministry of Energy and the Kenya Power & Lighting Company Ltd, LTWP has been authorized to seek financing for the transmission network on their behalf and to develop the transmission network under a Build, Own, Operate and Transfer (BOOT) scheme.

5.2 Technology

The technology that will be employed in the development of the proposed wind farm in the project area is discussed in terms of historical advancement of the wind turbines, the choice of the wind turbines, and the basic attributes of the preferred Vestas V52 850 kW turbine.

5.2.1 Historical advancement of the wind turbines

For centuries humans have utilized wind energy through traditional windmills. The Netherlands has played a prominent role in the development of this sector due to its geographical conditions. The traditional windmill has for long kept its original design comprising a horizontal shaft connected to the wind vanes, which in turn is connected to a vertical shaft through right angle transmission.

Towards the end of 1970s and early 80s the windmill was developed into modern turbine for generating electricity. Subsequently, various test wind parks were built that became a remarkable alternative method for generation of electricity. However, the first significant wind turbines had only a small capacity of 100 kW and were driven by steel wind blades.

Since 1990s, developments in wind technology have accelerated tremendously. Computer systems have been incorporated to optimize the utilization and efficiency of the wind turbines. The turbine capacity has increased significantly with new, larger mills and better materials. The safety of the turbines has also drastically improved by using stronger but lighter materials. In addition the advancement in knowledge and insight of the wind streams and climatological circumstances has further allowed modern wind turbines to better withstand the rapidly changing conditions during showers, storms and other turbulent situations.

The size and scale of today's wind turbines have also continued to grow. Whereas the largest wind turbine in 1990 had a capacity of 225kW, today's turbines are in range of up to 6 MW each. In addition, the diameter of the rotor has increased from 27 to 112 metres, and the shaft height (hub height) from 30 to 125 metres. The latest turbine models are equipped with sensors to gauge undesired vibrations and allow the computer controlling system to take preventive measures. The sensors also control the rotors individually, adjusting the angle per blade independently during each rotation thus improving the turbine efficiency.

5.2.2 The choice of the wind turbine for the proposed project

The criteria used for selection of wind turbines for the Lake Turkana Wind Power Project took the following into consideration:

- The technology employed should be widely utilized and have proven reliability under the most difficult circumstances;
- The turbine must be capable of operating under extreme conditions (i.e. dust, high temperatures, high wind speeds);
- Low maintenance for the equipment; and
- The supplier should be reliable with local servicing possibility, excellent track record and ability to secure maintenance continuity.

Based on the above criteria, Vestas (a global market leader in wind turbines) has been selected as a suitable candidate to supply the preferred turbines (Vestas 52). A Vestas wind turbine (Photos 4-5) consists of the following five main components:

- Foundation unit;
- Tower;

- Blade;
- Nacelle (turbine housing); and
- Rotor.

LTWP intends to use wind turbines manufactured by Vestas, the world's leading supplier of wind power solutions. Vestas commands a global market share of 23 percent and has over 35,500 wind turbines installed worldwide. The Vestas V52 turbine with a capacity of 850 KW has been identified for the project because of its superior price/performance ratio, relative ease of maintenance and its track record. It also uses fluid-based cooling techniques that have the advantage that the turbine is better protected against heat and dust in comparison to other similar models in the market, a feature very much needed in the project site which is close to Chalbi desert where the turbines will be build.

The Vestas V52 turbine is a 3 bladed upwind wind turbine generator that uses pitch control and a doubly fed induction generator (50Hz version). The Vestas V52 – 850 kW has a rotor diameter of 52 m with a generator rated at 850 kW. The turbine utilises the OptiTip and the variable speed concepts. With these features rated power will be maintained even in high wind speeds, regardless of air temperature and air density, and the wind turbine is able to operate the rotor at variable speed (RPM). At low wind speeds the OptiTip system and variable speed operation maximise the power output by giving the optimal RPM and pitch angle, which also minimises the sound emission from the turbine.

5.3 Procedures and Processes

5.3.1 Procedures

The procedures for operationalizing the Lake Turkana Wind Power Project are covered in the section 5.1 – Project Components. They include initiation of preliminary activities, installation of the mast, road improvements, equipment transportation, and development of wind farm, power generation and power transmission. Two of the above procedures including preliminary activities and installation of the mast have already been accomplished.

5.3.2 Processes

Once installed, the process of generating electricity in the proposed wind farm facility is triggered by the blades which capture the wind and turn. The turbines begin to produce energy when wind speeds reach about 4m/s. When the wind strikes the blade, there is positive pressure on the front of the blade and negative pressure behind it. As the wind pushes against the front edge, it creates a suction effect behind the blade, which makes the rotor turn. The turbine stops when the wind exceeds a speed of 25m/s, since wind speeds above this level place too much strain on turbine components. The generator is connected via the turbine's electrical control system. The electrical output is led through a high voltage transformer to the grid, which supplies electricity to the users.

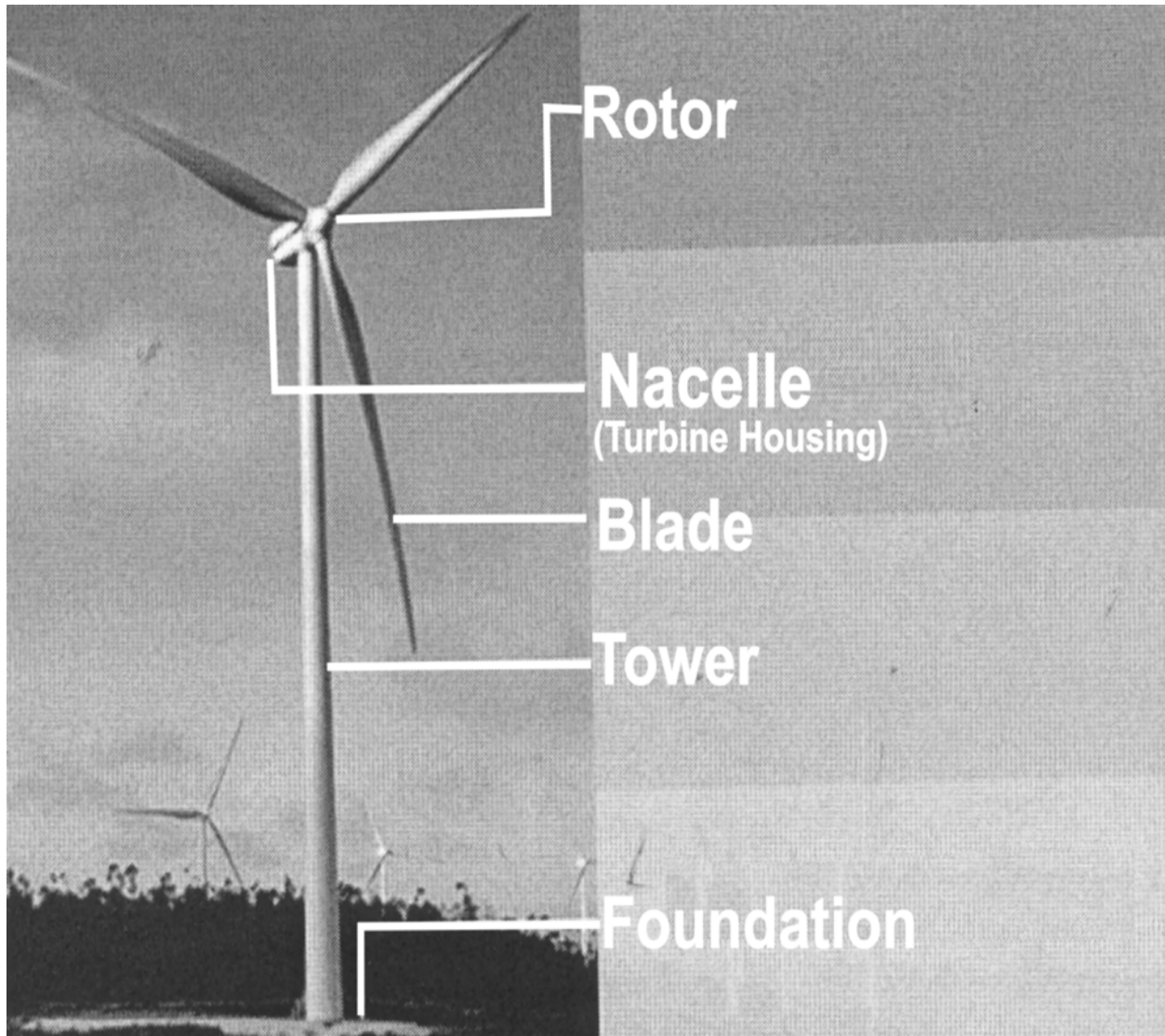


Photo 4. Components of a Vestas Wind Turbine

5.4 Design of the Wind Park Facility

The proposed wind park facility will be situated between the foot slopes of Mt Kulal and Mt Nyiru as shown on the Map 5. The project site covers an area of 100 km² (16km by 6km). The distance to the nearest turbine to the shore of Lake Turkana is about 10 km.

The design of the proposed wind park will be based on the proven technology of the Vestas V52 wind turbine. The turbine foundation will be a round disk with a diameter of about 4 meters and a depth of 1 metre. Each of the foundation will require 120 cubic meters of concrete to build.



Photo 5. Vestas V52 Turbine

The satellite picture (Map 5) shows a possible lay-out of the wind farm where each red cross represents the position of a wind turbine. Shown in the map are also the noise contours (in green) that result from the noise emission from the turbines. The outer contour represents noise levels of 40 dBA, the middle contour denotes 45 dBA while the inner contours show noise levels of 50 dBA. Since no people live within the noise contours (project site), this lay-out design complies with international standards for noise near dwellings.

In addition to the area occupied by the turbines, the wind park facility will accommodate several ground level flat buildings. The buildings will comprise an office block, storage area, workshop, control room and a restaurant. The total floor area for the buildings will be about 400 m². In addition to the above buildings there will be living quarters for permanent staff. The wind park facility will also include a fenced area for a substation.

Map 5: View of Wind Park Facility between L.Turkana (left) and the Slopes of Mt. Kulal (right)



Source: Goggle Map

5.5 Raw Materials

Use of raw materials in the development of the Lake Turkana Wind Power Project will be employed in the context of the installation of the mechanical equipment, construction of buildings and rehabilitation of roads.

5.5.1 Mechanical equipment

The mechanical equipment for the Lake Turkana Wind Power Project mainly consists of the various components of the wind turbine which consists of the following four large main parts:

- Foundation unit;
- Tower (mast);
- Nacelle (turbine housing);
- Rotor; and
- Blades.

Except for the foundation unit, the other components including the tower, nacelle, rotor and blades will be imported from Denmark, Italy, Germany and other European countries. The foundation unit will be a concrete structure constructed from the local materials. This will include

ballast and sand from Loyangalani and cement from either Bamburi Cement or East Africa Portland Cement in Nairobi.

5.5.2 Buildings

All the project buildings will be constructed in masonry walls, brick roofing and finished in paintwork. Floors will be finished in concrete and polyvinyl in office areas, terrazzo for toilets and polyvinyl finish for residential houses for the members of staff. Low cost options for the building include the use of simple concrete and wall finishes using plaster and screed mortar. Stones for the masonry work will be sourced locally in Loiyangalani where possible while paints, polyvinyl, terrazzo and other materials will be procured in either in Marsabit or in Nairobi.

5.5.3 Roads and paved areas

Rehabilitation of the roads will be done to murrum grading level. In some sections, however, there will be use of concrete especially in the construction of bridges and drifts across the laggas. Murrum, ballast and sand for road rehabilitation will be sourced locally while cement will be procured from the companies mentioned above.

In the project built up area, paved areas will be completed in medium duty concrete blocks for vehicular traffic and light duty concrete blocks for walk ways. There will be no use of tar as a type of finish on the roads or paved areas.

5.6 Products and By-products

The product of the Lake Turkana Wind Project is the generation of power amounting to a total of 310MW at completion. The power generated will mainly be fed to the national grid. There will be no by-products of the proposed power development.

5.7 Wastes Produced and Methods of Waste Disposal

The proposed facility will produce three main types of wastes including solid wastes, waste water and domestic sewage. However, due to the nature of the project and the very few personnel required for the operation and maintenance of the wind farm facility, the wastes produced will be minimal.

A combination of methods will be utilized in the disposal of generated wastes as follows: The bulk of solid wastes will be efficiently burned through use of an incinerator. Human sewage and waste water will be channelled into septic tanks. The details of disposal of wastes generated by the proposed facility are contained in Section 9.1.6 – Waste management.

5.8 Analysis of Alternative Considerations

Analysis of feasible environmentally and socially sound alternatives for this project touches on several aspects including a no project development option, the wind power intervention option, the main electric power source alternatives prevailing in the country, wind power technology alternatives, alternative sites for the exploitation of wind resources in Marsabit, timing and scheduling and environmental classification alternatives.

5.8.1 No project development option

Although this is really not a practical option, it is appropriate to cover it here in order to draw attention to the plight of the project area in a situation where this project is not implemented.

The “no project option” implies that this marginalised area will lose an opportunity to realize development and improvement of people’s livelihoods. Especially important will be a missed opportunity to develop the fisheries potential. In addition, the “No Project Option” also implies that the main road in the project area will not be improved and that they would be left in their present poor state as characterized by the following defects.

- Lack or inadequate bridge / culvert facilities
- Eroded road surfaces; and
- Unmotorable in many sections especially during the rain season.

Altogether, a case where the proposed intervention will not be implemented will perpetuate the present high poverty levels in the project area where individuals and households can not satisfy basic needs such as food, water, shelter, clothing, health, education, etc.

5.8.2 Electric power alternatives

As discussed earlier in the report (Section 1.2 – Need for the Project), generation of adequate and affordable electricity is a very crucial factor for the economic development of the country. Indeed the current energy policy puts emphasize on the need for energy availability and accessibility at cost effective prices. Currently, there are several alternatives for generation of electric power including, hydro, geothermal, thermal, solar energy, bio gas, wind power and power alcohol. The bulk (60%) of the electric power capacity in Kenya is, however, based on hydropower while geothermal and thermal power virtually supplies the rest of the power requirements. Faced with the current situation where Kenya’s electricity supplies are unreliable and expensive, the installation of Lake Turkana Wind Power Project will play a significant role in the stabilization of power situation in the country. More importantly, the introduction of 310MW in the Kenyan grid will alleviate power outages especially during the dry seasons and help to reduce the country heavy reliance on the power production from the oil and diesel power generators.

5.8.3 The wind power intervention option

Following the implementation of the “wind power intervention option”, the project area is likely to experience significant socio-economic development. The proposed project will open up the remote area, improve the roads, increase employment opportunities, provide electricity, help to develop fisheries industry, etc., all leading to improved quality of life to the local communities. In addition, there will be improved health conditions of the communities in the project area among other many benefits.

5.8.4 Technology alternatives

Wind energy has been used in Kenya primarily for water lifting since the beginning of the 19th Century. However, its use declined with the advent of the oil fired internal combustion engines. This situation is now changing due to the rising cost of oil, a factor which is making the exploitation of wind energy attractive. Nevertheless, use of wind turbines for the generation of electricity in Kenya is currently at rudimentary stage. Only a few wind turbines are known to be operational in the country especially in Marsabit and Ngong areas. The wind turbines currently in use are all of previous generation of wind turbines. The technology of the wind turbine (Vestas V 52) that will be employed in this project is much more advanced than the above turbines that are currently operational in the country.

5.8.5 Alternative project sites

A quick look at the National Wind Resource Atlas as compiled by the Ministry of Energy (MoE) shows that as a whole Marsabit District is well endowed with potential extractable wind power to the tune of 450 – 750 Watts m⁻². Based on this information several sites in Marsabit District were explored for suitability of wind power generation. The present site in Loiyangalani was selected due to several suitable attributes including the strength and stability of the winds prevailing in the area, security of the area, fresh water availability and road accessibility among other suitable characteristics.

5.8.6 Timing and scheduling.

The proposed wind park is scheduled to be constructed in accordance to the following schedule:

- 240 turbines and full connection to the grid in 2011; and
- 125 turbines added to the park in 2012.

The timing of the proposed wind power project is quite appropriate as the country is currently in dire need for more power. Presently the hydro power dams along the Tana River are experiencing very low water levels. Indeed KenGen has already closed down the Masinga dam and there are indications that other downstream dams such as Kamburu may also close if the water situation in the Tana Catchment does not improve. Hence a need for more stable power sources including the wind and geothermal power.

5.8.7 Environmental and social classification alternatives

Environmental classification for this project has been done in accordance with the NEMA and Equator Principles environmental screening procedures.

According to the Environmental Management and Coordination Act (EMCA), 1999, this project falls in the category (Electrical infrastructure) of the undertakings specified in Second Schedule to the Act that needs to be subjected to Environmental Impact Assessment.

The Equator Principles Financial Institutions (EPFIs) use a system of social and environmental categorisation, based on International Finance Corporation's (IFC's) environmental and social screening criteria to reflect the magnitude of impacts. The categories are:

- **Category A** – These are projects with potential significant adverse social and environmental impacts that are diverse, irreversible or unprecedented;
- **Category B** – Projects with potential limited adverse social or environmental impacts that are few in number, generally site specific, largely reversible and readily addressed through mitigation measures; and
- **Category C** – Projects with minimal or no social or environmental impacts.

The African Development Bank (one of the main sponsors for the proposed project), criteria for categorising environmental and social impact assessment is as follows:

- **Category 1** – Projects likely to have the most severe environmental and social impacts and require a full Environmental and Social Impact Assessment (ESIA);

- **Category 2** – Projects likely to have detrimental and site – specific environmental and social impacts that can be minimised by application of mitigation measures included in Environmental and Social Management Plan (ESMP);
- **Category 3** – Projects that do not induce any adverse environmental and social impacts and do not need further Environmental and Social Impact Assessment action; and
- **Category 4** – Projects that involve investment of Bank’s funds through Financial Intermediaries (FIs) in subprojects that may result in adverse environmental or social impacts. Specific requirements for this type of project include an assessment of FI capacities to handle environmental and social considerations.

Although the development of the Lake Turkana Power Project is likely to have some limited adverse social and environmental impacts mainly in the project area, the negative impacts will readily be addressed through mitigation measures. Based above criteria for screening projects, the proposed wind power project falls in Category B in accordance to the Equator Principles criteria and Category 2 in accordance to the African Development Bank environmental guidelines.

6. CONSULTATIONS WITH STAKEHOLDERS

6.1 Introduction

Public consultation was viewed as an important activity of this study since it would help the ESIA study team to get the stakeholders' views on the perceived environmental and social effects of the project on the project area and their ideas on how the negative impacts can be mitigated. Participatory public consultation for this project was carried out with a wide range of stakeholders in the project area, relevant government institutions, Non Governmental Organizations, Community Based Organizations and other interested parties. It is expected that consultations for this project will continue throughout the project implementation phase. The basic objective of the consultations is to raise awareness, get feedback from the stakeholders and improve decision-making by tapping on local knowledge and information through the involvement of individuals, groups and organisations with a stake in the proposed project.

6.2 Methodology

The consulting team started by conducting scoping exercise with various stakeholders as well as securing and reading through several documents that deal with the wind power resource and environmental characteristics of the project area. Environmental conditions of the project area were investigated during the field trip made into the project area, Loiyangalani Location between 16th and 25th November, 2007. In order to acquire further information, the consulting team employed consultative approach through meetings, interviews and focused discussions with a wide range of stakeholders. In particular the team held interviews and discussions with the several key organisations and people including the National Environment Authority (NEMA), Government Departments, parastatal organisations including the Kenya Wildlife Service (KWS), National Museums of Kenya (NMK) and Kenya Power and Lighting Company (KPLC), Provincial administration and local community leaders including meeting with the Chief, Loiyangalani Division, the Assistant Chief for Loiyangalani and Moyet sub locations, Non Governmental Organizations including Food for the Hungry International (FHI), Community Initiatives Facilitation Assistance (CIFA) and Pastoralist Integrated Support Programme (PISP) and Lake Turkana Wind Power Ltd Management.

The team held meetings and interviews with local communities in the project area including the Yammo Manyatta Community (Turkana), Nakuame Kwi Manyatta (Turkana), Kiwanja Ndege Manyatta (Samburu and Rendille) and El Molo Community (originally from Komote Laiyeni Village) that are likely to be affected in one way or another by the project. In this regard key informant interviews and the focal group discussions were held with the youth, women and men groups to be served by the project. The team held meetings with several CBOs in the project area where concerns about the proposed project were discussed. The CBOs consulted included Mosaretu Women Group, Kifaru Women Group and Nayori Environmental Conservation Rehabilitation Youth Group. A list of people and organizations consulted in the course of conducting the environmental impact study are presented in Annex 2 – People and Institutions Consulted during the Study Process.

6.3 Public Consultations

Generally speaking, the local population is very positive about the project and they welcome its installation in the project area. Indeed the people feel that the project is an event that will solve their many challenging problems, including their “relief dependency syndrome”. The project, however, has created some concerns including very high expectations among the local community in the project area and surroundings

6.3.1 Stakeholders' appreciation of the proposed project

As stated above, all the stakeholders interviewed in the project area welcomed the proposed project. Their perceived benefits of the proposed wind power project is summarised below as follows:

- Increase in employment opportunities for the local community during the construction and operation phases of the project;
- Rehabilitation of existing poor roads in the area – thus facilitating the local community to access external markets for their livestock and fish products;
- Assistance in acquisition of cold storage facilities for the fish caught in Lake Turkana in order to facilitate better storage for the fish, eliminate the need for sun drying fish and increase the returns from the fisheries sector;
- Provision of good quality water for the marginalized community since some sections of the local people use the lake water for domestic purposes;
- Assistance in the development of health facilities in order to improve health conditions of local community, especially the marginalized groups; and
- Increased economic benefits including spin-off effects that will benefit sellers through provision of food, goods and services for the project's labour force.

6.3.2 Stakeholders' concerns

As a whole many of the stakeholders, especially members of the local community, did not have any serious reservations or concerns about the proposed wind power project. Some of the stakeholders, however, raised concerns related to potential accidents from the project, negative impacts of the project on livestock and social considerations as outlined below:

- Loss of grazing land and subsequent negative impacts on livestock;
- Influx of people including the Contractor's labour force in the project area with subsequent increase in social vices such as armed robberies, commercial sex, teenage pregnancies and spread of STDs especially HIV/AIDS;
- Increase in charcoal burning both during the road construction and operation phases; and
- Increased accidents related to the siting, installation and operation of the wind turbines;

6.4 Issues Raised by various Stakeholders of the Project Area

Several communities including the Turkana, Rendile, Samburu and El Mollo and representatives of various institutions operating in the project area expressed the following views and concerns with regard to siting and operations of the proposed project.

6.4.1. The Yammo Manyatta Community

This was a marginalised Turkana community near the Yammo Lagga. They lost most of their livestock during drought and mostly depend on relief food which they get once a month. Some

of the men in the manyatta are fishermen and they sell their fish at Loiyangalani town. They use the lake as a source of domestic water supply and watering for their livestock. Despite free education, most of the children do not go to school and instead assist their parents in looking after the livestock. Women travel long distances to collect firewood from the mountains which they sell at KSh 20-70 per a pile in Loiyangalani. They use the money for mainly buying food stuff to supplement the Government food relief.

A few of the elders of the community heard about the proposed project through a chief's **baraza**. Although they did not expect to have electric power in the manyatta, they expression the following expectations from the project:

- Employment as unskilled labourers for both men and women especially in the road construction activities; and
- Assistance to acquire fish cold storage to facilitate them fetch higher prices for the caught fish.



Photo 6. Meeting with the Yammo Manyatta Community

6.4.2 Turkana Community at Nakuame Kwi Manyatta

Like the Yammo community, this community lost a large percentage of the livestock during drought and tribal raids. They also have fishermen in the community. The community also depends on relief food which they get once a month. The community has heard about the project from community elders who attended the barazas where the project was discussed. They felt that as long as the project did not interfere with livestock activities they see no problem with its implementation. The community, however, felt that the proposed development is likely to bring the following problems in the project area:

- The youth will imitate outsiders and their cultures may start to change; and
- There will be an increase in prostitution and HIV / AIDS.

The community, however, cited several areas where the community could benefit from the proposed project including:

- Employment of youth as unskilled labourers
- Improvement of the roads in order to reduce transport costs and promote business in the project area especially the enhancement of livestock trade;
- Assistance of women in income generating activities (IGA);
- Assistance to fishermen to acquire fish cold storage facilities.

6.4.3 Samburu and Rendille Elders of Kiwanja Ndege Manyatta

This was a mixed manyatta consisting of members of both Samburu and Rendille communities situated near the Loiyangalani Airstrip. Although they are pastoralists, a few of them have become fishermen. This community also depends on relief food which they get once a month. Women from this manyatta travel long distances to collect firewood which is sold in Loiyangalani. Some of the money from the sale of firewood is utilized in the purchase of food for supplementing the relief food.

The elders of this manyatta have heard about the proposed project although they did not have details. They were not sure whether they really understood the benefits of the wind project but they believed that it would bring development to the project area. Their major concern related to the fencing a big area since this would interfere with grazing activities of their livestock. They expressed their expectations from the project as follows:

- Increased employment opportunities for the youth;
- Assistance to procure fish storage facilities so as to sell them fresh and for a higher price;
- Improvement of roads in order to promote trade in livestock products;
- Assistance to develop schools and the dispensaries; and
- Promotion of income generating activities including the production of ballast from local stones available.

6.4.4 Meeting with the EI- Molo Community

The EI-Molo is a marginalised community that originally came from Komote Laiyeni Village away to the north of the project area. However, due to insecurity situation in their area, they moved temporarily to Loiyangalani in October 2007 following tribal raids. The men of EI-molo are mainly fishermen although a few of them own some livestock. Women are engaged in domestic chores but some women are now engaged in buying and selling fish. Due to lack of fresh water sources, the EI Molo use water from the lake for their domestic purposes. Like all other

communities in the project area, the El Molo receive the relief food on a monthly basis. They expressed concerns on the following:

- The project is likely to increase the incidences of diseases such as HIV/AIDS;
- The youth will copy outside culture and forget their rich cultural attributes; and
- Accidents could occur during project installation and hurt people;

The El Molo community, however, felt that the proposed project will have several positive attributes. They stand to benefit from opportunities such as:

- Assistance to the fishermen to procure cold storage facilities for their fish;
- Promotion of income generating activities (IGA) including ballast production;
- Employment of youth as unskilled labourers in road construction and other construction work;
- Promotion of tourism activities especially the production of beads and curios for sale to tourists;

6.4.5. The Mosaretu Women Group, Loiyangalani

Mosaretu is a woman group comprising of over 50 members. It stands for El-Molo, Samburu, Rendille and Turkana women group. This group runs a tourist camp and a curio at Loiyangalani. In addition the members organize traditional dances for tourists and prepare traditional food for visitors. The group felt that the project will bring positive impacts in the project area including:

- Provision of electricity in Loiyangalani, a development that will promote tourism and attract more visitors in the project area, all leading to an increase in income of the group and other tourism operators;
- Improvement of the road will also bring in many more visitors to the project area with resultant boost in local tourism activities;

However, the group felt that with the implementation of the project, there will be an increase in prostitution and sexually transmitted diseases such as HIV / AIDS. They suggested that the local community should be sensitized and educated through songs and drama on the dangers of such diseases in the project area. Due to their past experience, the group felt that they actually could play the role of sensitizing and educating the community.

6.4.6. Kifaru Women Group at Loiyangalani

This group has 40 members who are active in curio selling, vegetable gardening and development of tourist **bandas** and camps. Generally the group was very positive about the project. They felt the project will bring the following benefits to the project area:

- Provision of electricity to the tourist camps and other areas;
- Increase in direct employment opportunities and source of income to the local communities;
- Increase in economic spin-off effects including the production of ballast; and
- Increase in income from the provision of services to the project workers.

The group, however, cautioned against negative impacts of the project especially the increase in HIV / AIDS and other sexually transmitted diseases (STDs) and the need to sensitize the local community raise levels of awareness and education in the project area.

6.4.7. Nayori Environmental Conservation Rehabilitation Youth Group

This is a youth group registered as a Community Based Organization (CBO) in 2005. The group is currently involved in improving the environment and fighting desertification in the project area through planting indigenous trees. This group identified a wide range of project benefits to the local community as follows:

- Provision of electricity will promote small businesses such as hotels, tourist facilities, salons, small garages and barber shop among others. In addition electricity will benefit school and hospital activities;
- Installation of cold storage facilities for fish caught in Lake Turkana and subsequent improvement in fish sales;
- Improvement of roads will promote livestock trade in the project area;
- Increase in employment opportunities during road rehabilitation and construction activities.

The group, however, felt that the development of the project will have some limited negative impacts including contamination of local culture, increase in diseases and drug abuse among other negative effects.

6.4.8 Mr. Christopher Kayema Lepakana, Senior Chief of Loiyangalani

The Senior Chief Lepakana was very positive about the project. He confirmed that the project has been discussed in several fora by the community elders, administration and the Lake Turkana Power Company. He believes the proposed project will bring benefits in the project area and surroundings. He gave an example where the improvement on the roads will trigger an increase in business activities especially in livestock and fish products. This would also increase the flow of commodities especially from Nyahururu to Loiyangalani.

He recommended that during the construction the elders need to be consulted for their inputs before implementation of project activities in order to avert any misunderstandings between the developer and the local community.

With regard to social considerations, the Sr. Chief strongly felt that the project should give priority for certain marginalised communities in the project area. Such consideration should, however, be given following consultations with the community elders and other relevant stakeholders. He singled out water supply as a crucial target area where the project assistance would make a difference in improving the welfare of the marginalised groups.

6.4.9 Sr. Maria Antonia Pira of Loiyangalani Health Centre

The Sister felt that problems affecting the local communities in the project area are scarcity of firewood, water and food. Transport is also a problem especially during the rainy season. Health conditions are poor with malaria, diarrhoea and respiratory diseases being the major causes of morbidity in the project area.

The Sister felt that the proposed project could contribute in improving the welfare of the people of the project area. The community in the project area, which currently rely on relief food, should be taught how to invest on their livestock property in order to come out of the dependency syndrome. The project could play a significant role in educating and encouraging the local communities in the project area on how to become self reliant.



Photo 7. Interview with Sr. Chief Loiyangalani Location, Mr. Christopher K. Lekapana.

6.4.10 Madam Leparsanti S. Teresalba – Loiyangalani Primary School

Like other stakeholders we interviewed, Madam Teresalba has positive views about the project. She felt that the Loiyangalani Primary School stands to benefit from supply of electricity since the students will have more reading activities at night. The project will also create job opportunities in the project area.

Against the background of positive impacts Madam Teresalba, was concerned about the increase in noise levels, occurrence of accidents and fencing of the area and its potential negative impacts on livestock activities.

She proposed that there was need to educate the children especially the youth on the negative and positive impacts of the proposed project who will in turn take the information back to their parents

6.4.11 Mrs. Jane Orbora, Assistant Fisheries Officer, Loiyangalani

Mrs. Orbora painted a grime picture of the fisheries of the Loiyangalani. Most of the fishermen are poor and fishing is done on a small scale. Although the fishermen are served by the Loiyangalani Fisheries Cooperative Society (mainly in storing fish), returns from the fish sales are very low. The marketing of the fish is poorly developed. Most of the fish caught from the lake

are sun dried and sold in Kisumu (the only market for sun dried fish). The situation is aggravated by poor road system in the project area which is made worse when it rains.

Mrs. Orbora was very positive about the proposed project. The project will promote the fisheries of the Loiyangalani. The provision of electricity and the subsequent installation of cold storage facilities will help to store fish for longer periods and sell them fresh. This improvement will empower the fishermen to sell their fish to wider markets and for higher prices. The rehabilitated road will facilitate quick transport of fresh fish to various destinations and at the same time encourage fish traders to come to Loiyangani to procure fish.

6.4.12 Assistant Chief Loiyangalani – Mr. Sarai Fecha

Mr. Fecha was aware of the proposed project and indeed several meetings were held between the community elders and the Lake Turkana Wind Power Project management. He said initially there were concerns about the potential negative impacts of the project including interference in livestock grazing activities and accidents to the inhabitants of the project area. However, after discussions with representatives of the project developers, the community is positive about the project especially after being assured that there would be no fencing and the livestock would graze freely.

Mr. Fecha felt the local community would benefit from the implementation of the project in several ways including:

- Increase in employment opportunities especially for the unskilled labourers;
- Increase in spin-off economic activities including ballast production using the local rock material;
- Rehabilitation of the road will improve communication in the project area and promote trade in livestock and fisheries;
- Provision of electricity in the project area will stimulate economic growth.
- Electricity will facilitate installation of fish cold storage facilities and improve the fisheries of Loiyangalani; and
- The tourist camps will expand following provision of electricity in the project area.

Mr. Fecha, however, expressed concern that following the implementation of the project, the local community may be exposed to accidents from the installed facility and that the influx of people in the project area may result in cultural contamination as the youth imitate the culture of other people. He hoped the project in conjunction with the administration will play their role sensitizing the local community on the negative effects of the project.

6.5 Public Disclosure

Following the completion of field study and drafting of the EIA study report, copies of the draft report were distributed to a wide cross section of stakeholders (Annex 4a) to review and communicate their comments to the Team Leader within a period of three weeks. Thereafter, a stakeholders' meeting was subsequently held in Loiyangalani between 21 and 22nd April 2008 and attended by fifty four (54) participants (Annex 4b – Participants of the ESIA Stakeholders' Meeting on 21-22 April 2008) Several issues touching on the proposed project including the project negative impacts on livestock, Lake Turkana, vegetation and other natural resources, livestock, the siting of the wind farm, job opportunities and other benefits to the community among other issues were exhaustively discussed during the workshop. Issues discussed in the Stakeholders' Meeting were recorded in the minutes presented in Annex 5 – Minutes of the ESIA Stakeholders' Meeting.



Photo. A Section of the Participants at the Stakeholders' Meeting (21-22 April 2008)

7. THE PROJECT AS A CASE OF CLEAN ENERGY PRODUCTION IN KENYA

7.1 Introduction

Wind power is today a mature technology, which at windy sites is economic and competitive with conventional power generation technologies especially when taking into account the impacts on environmental. At the end of 2004, there were more than 73,800 wind turbines installed world wide corresponding to about 47,900 MW accumulated capacity.

At present the energy power production in Kenya over relies on hydropower (approximately 50%) which is negatively affected by increasingly erratic climate changes, including higher incidence of drought. As such, the proposed Turkana Wind Power Project will increase the resilience of the Kenya power generation vis-à-vis potential climate risk variations in Kenya.

Today wind energy has been identified as one of the energy sources that can contribute to sustainable development. In addition, the development of wind energy reduces the emission of greenhouse gases (GHG) and contributes to solving the long-term problem of climatic change as stipulated in relevant international agreements including the United Nations Framework Convention on Climatic Change.

7.2 United Nations Framework Convention on Climatic Change

Over a decade ago, most countries joined an international treaty – the United Nations Framework Convention on Climatic Change (UNFCCC) to begin to consider what can be done to reduce global warming and to cope with whatever temperature increases are inevitable. The primary purpose of the convention is to establish methods to minimize global warming and in particular the emission of the greenhouse gases. The ultimate objective of the Convention is the stabilization of the greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

The UNFCCC was adopted on 9th May 1992 and came into force on 21st March 1994. The Convention has been ratified by 189 states. Kenya ratified the Convention on 30th August 1994. More recently, a number of nations approved an addition to the treaty, the Kyoto Protocol, which has more powerful and legally binding measures for the reduction of greenhouse gases.

7.3 Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climatic Change. The main feature of the Kyoto Protocol is the setting of binding targets for 37 industrialized countries and the European Community for reducing greenhouse gas (GHG) emissions. The target set amount to an average of five percent (5%) against 1990 GHG levels over the five year period (2008-2012). The major distinction between the Kyoto Protocol and the Convention is that while the Convention encouraged the industrialized countries to stabilize the GHG emissions, the Protocol commits them to do so.

The Kyoto Protocol was adopted in Kyoto, Japan, on 11th December 1997 and entered into force on 16th February, 2005, after it received the pre-requisite signatures. However, major countries like United States, China, India and Australia are not signatories to the Protocol. In Kenya NEMA is the national focal point for the Kyoto Protocol.

As stated above, the central feature of the Kyoto Protocol is the requirement that countries limit or reduce their green house emissions. In order to help countries meet emission targets, and to

encourage the private sector and developing countries to contribute to emission reduction efforts, negotiations on the Protocol included three market based mechanisms including:

- Emissions trading;
- Clean development mechanisms; and
- Joint implementation (not applicable to the developing countries).

7.4 Emissions Trading – Carbon Market

Emissions trading, as set out in Article 17 of the Kyoto Protocol, allow countries that have emission units to spare to sell the excess capacity to countries that are over their targets. Thus, a new commodity was created in the form of emission reduction or removals. Since carbon dioxide is the principal greenhouse gas, people speak simply of trading in carbon. Hence carbon is now tracked and traded like any other commodity. This is known as the “carbon market”.

More than actual emissions units can be traded and sold under the Kyoto Protocol’s emission’s trading scheme. The other units which may be transferred under the scheme, each equal to one tonne of CO₂, may be in form of the following:

- A removal unit on the basis of land use, land use changes and forestry activities such as reforestation;
- An emission reduction unit generated by a Joint Implementation (JI) project; and
- A certified emission reduction (CER) generated from a clean development mechanism (CDM) project activity.

7.4.1 The carbon credit potential of the Lake Turkana Wind Power Project

In 2008, a feasibility study was carried out by a CDM Consultant (Adrian, 2008) with the purpose of assessing the carbon market potential of the proposed Lake Turkana Wind Power Project.

Following the relevant CDM methodologies and tools for the calculation of the emission reduction and carbon credit potential of the project, the above study has shown that the carbon credit potential of the project would range between 565,920 and 1,264,320 carbon credits per year. Assuming a 10-year crediting period this would result in a total of 5,659,200 to 12,643,200 carbon credits over the course of the project. The above assessment indicates that the project can meet all the necessary requirements to become a carbon project under the Clean Development Mechanism (CDM).

7.4.2 The carbon credit value of Lake Turkana Wind Power Project

Several factors play a role in the determination of the prices for carbon credits. The value of carbon credits can vary depending on whether the project has just started or has already been registered by the CDM Executive Board. In addition, certification by certain carbon standards can also significantly increase the price of the carbon credit. Based on the average price for a Certified Emission Reduction (CER) of €10 in 2007, the carbon credit value of the proposed project will be on the range of €56,592,000 to €126,432,000.

7.5 Clean Development Mechanism

The Clean Development Mechanism (CDM) was one of the three mechanisms established by the Kyoto Protocol in 1997 to meet the Climate Convention objective of stabilizing greenhouse gases (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with climate system. The other two mechanisms are Emission Trading and Joint Implementation, both of which are not applicable to the developing countries.

In this connection, the Clean Development Mechanism (CDM) is an arrangement under the Kyoto Protocol allowing industrialised countries with a greenhouse gas reduction commitment (called Annex B Countries) to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their countries. A crucial feature of an approved CDM carbon project is the establishment that the planned reductions would not occur without the additional incentive provided by emission reductions credits - a concept known as “additionality”. The CDM is supervised by the CDM Executive Board and is under guidance of the Conference of Parties (COP) of the United Nations Framework Convention on Climate Change).

In this regard, a CDM project must qualify through a rigorous and public registration and issuance process designed to ensure real, measurable and verifiable emission reductions that are additional to what would have occurred without the project. The mechanism is overseen by the CDM Executive Board, answerable ultimately to the countries that have ratified the Kyoto Protocol. In order to be considered for registration, a project must first be approved by the Designated National Authority (DNA). Operational since 2006, the CDM Executive Board has registered more than 1,000 projects. It is anticipated that the mechanism will produce CERs amounting to more than 2.7 billion tonnes of CO₂ equivalent in the first commitment period of the Kyoto Protocol, 2008-2012.

An eligible CDM project fits in any one of the following categories:

- End-use energy efficiency improvement;
- Supply-side energy efficiency improvements;
- Renewable energy (wind, solar, small hydro, biomass etc.);
- Fuel switching;
- Agriculture (reduction of CH₄ and N₂O emissions);
- Industrial processes (CO₂ from cement etc., HFCs, PFCs, SF₆); and
- Sinks projects (afforestation and reforestation).

7.5.1 CDM project process

An industrialised country that wishes to get credits from a CDM project must obtain the consent of the developing country hosting the project and that the project will contribute to sustainable development. Then using the methodologies approved by the CDM Executive Board (EB), the applicant (the industrialised country), must make the case that carbon project would not have happened anyway (establishing additionality), and must establish a baseline estimating the future emissions in absence of the registered project. The case is then validated by a third party agency, called a Designated Operational Entity (DOE) to ensure the project results in real, measurable, and long-term emission reductions. The EB then decides whether or not to register (approve) the project. If the project is registered and implemented, the EB issues credits, called the Certified Emission Reductions (CERs) commonly known as carbon credits, where each unit is equivalent to the reduction of one metric tonne of CO₂ or its equivalent.

7.5.2 Eligibility of the Lake Turkana as a CDM project

In addition to fitting into the above categories, the Lake Turkana Wind Power Project needs to meet specific requirements covered under the so called Project Design Document (PDD). Preparation of the PDD is necessary in order to answer the following questions about the project:

- Has the project been approved by the parties involved especially the host country?
- Will the project result in reductions of greenhouse gas emissions that are additional?
- Has an appropriate baseline and monitoring plan been developed.

Host country approval

Authorising and approving participation in a CDM project is done by the country's Designated National Authority (DNA). In Kenya, the DNA has been established within the National Environment Management Authority (NEMA). The following procedures have been set out for approving the CDM projects in Kenya:

- As a first step the Kenya DNA needs to be informed about the project through a Project Idea Note (PIN). Based on the PIN, initial discussions will take place with the DNA on how to move ahead with the project;
- If the DNA has given a green light to go ahead, a Project Design Document needs to be developed. Based on the developed PDD, the DNA will then assess whether the project is in line with the sustainable development plans in Kenya, and, if necessary, require some further details and clarification; and
- As soon as the DNA approves the project, it will write a letter of approval, which needs to be submitted with the Project Design Document to the Executive Board of CDM.

With regard to eligibility of Lake Turkana Wind Power Project as a CDM project, some progress has been made. Discussions have already taken place with the host country (Kenya) during which the NEMA (DNA) have expressed its commitment to support the project.

Additionality

A crucial prerequisite for an emission reduction project is proof of its additionality, i.e. evidence that the project would not have been implemented without the revenues from carbon credits. The basic idea of additionality is that those project activities that would also occur without the CDM, i.e. that are business as usual, should not be certified under the CDM. This provision, though contentiously debated aims at ensuring the environmental integrity of the CDM.

In order to evaluate the additionality of the proposed Lake Turkana Wind Power Project, the latest version of the approved United Nations Framework for the Climatic Convention on Climate Change (UNFCCC) "Tool for the demonstration and assessment of additionality –Version 05" has been used. Analysis of alternatives show that revenues from the CDM activities are vital in overcoming tariff barriers and in successfully negotiating a Power Purchase Agreement (PPA) with KPLC and therefore the project will result in reductions of greenhouse gas emissions that are additional .

Baseline and monitoring plans

The baseline scenario for the proposed project was described in accordance with the baseline methodology procedure described in AMC0002. Based on the existing power situation and the planned capacity, the baseline in Kenya will be a continuation of the existing power situation where the hydro power dominates the scene with a slightly increased role of the thermal power in the near future.

7.6 The Way Forward

The initial evaluation indicates that the proposed Lake Turkana Wind Power Project can meet all the necessary prerequisites to be eligible as a CDM project. However, in order to generate maximum benefit from the carbon market, the following recommendations need to be taken into account:

- Lake Turkana Wind Power Project should aim at the development of Certified Emission Reductions (CERs) under the CDM rather than the Verified Emission Reductions (VERs) for the Voluntary Market since the CERs will give the project access to a much wider market segment as well as higher prices;
- Before entering into selling agreements with potential buyers, it is best to develop the project as far as possible. This includes writing a Project Design Document (PDD) and getting it through the process of validation and registration. Registration of the project will lower the risk associated with the project and will put the project in a better position to negotiate a better Emission Reductions Purchasing Agreement (ERPA);
- Given the high uncertainties in the carbon market, it may be advisable to wait entering into an Emission Reductions Purchasing Agreement with potential buyers until there is more clarity about how the carbon markets will develop over the coming years. An international agreement still needs to be negotiated and may take time to conclude. Key decisions are expected to be taken at the UNFCCC Conference of Parties (COP) in December 2009 and detailed modalities of any new agreement will take more time to conclude.
- The project might consider applying for certification by the Gold Standard which has currently emerged as an attractive choice for compliance buyers of projects that demonstrate strong local benefits. This will increase the value of the emission reductions and might also increase the visibility of the project.

8. SOCIO-ECONOMIC ANALYSIS OF THE PROPOSED PROJECT

The socio-economic analysis of the Lake Turkana Wind Power Project touches on several related attributes including social trends in Kenya, social synthesis in the project area, trends in national economy, trends in generation of electricity in Kenya and economic analysis of the proposed project.

8.1 Social Trends in Kenya

Kenya covers an area of 587,000 km² of which 576,000 km² comprises land surface and 11,000 km² water. This is a developing country where about 80% of population live in rural areas and derive their livelihood from agriculture through crop and livestock production, fishing, forestry and exploitation of other natural resources. According to the 1999 population census report, Kenya's population was estimated to be 28.4 million people. Currently the Kenyan population estimated at 33 million people and is projected to reach 37.5 million people by the Year 2010. The capital city, Nairobi has an estimated population of 2.7 million people. About 70% of Kenyan population lives in 12% of the total land area while the remaining 30% of the population live in dry lands, which account for 88% of the total land area in Kenya. Population density is unevenly distributed. The high potential areas in Kenya including central highlands, western Kenya, parts of Rift Valley are characterized by high population density of about 300 people per km² while the dry lands are sparsely populated with as low as 3 people per km². Among the urban settlements, Nairobi has the highest density of 3,079 persons per km².

Poverty remains perhaps the single most critical barrier to the socio-economic development in Kenya. It hinders population access to basic needs such as health care, nutrition and education. A great percentage of Kenyan population lives below the poverty line (less than one US Dollar per day) and today the situation seem to be worsening. The population in absolute poverty was estimated to be 44.7% in 1992, 52% in 1997 and 56% by 2002. Major sources of poverty in Kenya include poor economic performance, low agricultural productivity, unemployment and low incomes, HIV/AIDS pandemic, landlessness, poor physical infrastructure, gender imbalance and poor governance, natural disasters, internal human/ ethnic conflicts, human/wildlife conflicts and effects of climatic change. Given the fact that Kenya's economy depends on natural resources, poverty eradication remains the greatest challenge to sustainable development.

Kenya's population is characterized by high mortality rates, low and declining life expectancy, increased fertility rates, high infant mortality and death rates and declining population growth rates (probably attributed to the HIV/AIDS pandemic). Presently the country is faced with a high dependence burden with over 50% of the population below 15 years of age. This has resulted in high dependency ratios placing high demands on food and social services such as primary education and health care.

The growth in human population in Kenya has increased pressure in the natural resource base. This has resulted in migration of people from the high potential areas to marginal lands. The regions experiencing noticeable emigration are Central and Nyanza Provinces, while those receiving proportionally large immigrants include Laikipia, Kajiado and Narok. Due to population pressure, conflicts over natural resource use have been on the increase due mainly to shortage of arable land, pasture/forage and water supply. Consequently, the resource use conflicts have caused destruction of property and displacement of persons.

8.2 Social Analysis of the Project

The proposed project is located in a remote part of the country characterised by poor communication, low population density, poor health and education services and high levels of poverty.

8.2.1 Integration of social issues

To a large extent social analysis for this project has been integrated into Chapter 4. Baseline Information and Description of the Potentially Affected Environment, where several social attributes including local administrative set up, population and demographic characteristics, land use and health profile have been extensively described. Other aspects of social analysis are discussed in Chapter 9 – Positive Impacts of the Proposed Project, Chapter 10 – Negative Impacts of the Proposed Project and Chapter 12 – Proposed Environmental Management Plan.

8.2.2 Public consultations

Public consultation was viewed as an important activity of this study. The team carried out public consultations with the local community with the main objective of getting the stakeholders' views on the perceived social effects of the project on the project area and their ideas on how the negative impacts can be mitigated. In this regard, the consulting team held several meetings with a wide range of stakeholders as discussed in Chapter 3 - Approach and Methodology. A list of all stakeholders consulted is presented in Annex 2 – People and Institutions Consulted during the Study Process. Based on the feedback from the public consultations, it is evident that the local communities are very poor. The poverty levels are so severe that most of the populations of the project area are now dependent on relief food.

The local population is very positive about the project and they welcome its installation in the project area. Indeed the people feel that the project is an event that will solve their many problems including relief dependency syndrome. The project, however, is likely to create very high expectations among the local community in the project area and surroundings. It was also noted that despite all the consultations and awareness raising about the project, community has still “fear of unknown” about the project. This is mainly due to the fact that:

- the project has no precedent in the area;
- the local community is still very conservative; and
- The community suffers from lack of exposure on what is happening to the rest of the country and beyond.

8.2.3 Social considerations

Due to the remoteness of the project area, the high levels of poverty and other prevailing problems, it will be important for the project developer to put in place mechanisms for social considerations in order to enhance the welfare of the marginalised communities in the project area. In this respect, the local community has expressed a dire need to be considered for assistance in the following areas:

- Employment opportunities for the local community youth during the construction and operation phases of the project;
- Rehabilitation of existing poor roads in the project area and surroundings in order to facilitate the local community to access external markets for their livestock and fish products.

- Assistance in acquisition of cold storage facilities for the fish caught in Lake Turkana. This will facilitate better storage for the fish, eliminate the need for sun drying fish and increase the returns from the fisheries sector.
- Since some sections of the local community use the lake water for domestic purposes, the marginalised communities have expressed a need for the project to help them acquire good quality water for domestic use.
- Assistance in the development of health facilities in order to improve health conditions of local community especially the marginalised groups.

Full details of the nature and magnitude of social considerations will be discussed and agreed upon between the local community and the project developer especially during the proposed Participatory Project Appraisal (PRA).

8.2.4 Need for stakeholders' meeting

Due to the importance of this project to the Client, the local community in the project area and the nation at large, a need was identified to convene a stakeholders' workshop for the project in Loiyangalani. This would provide a forum for all interested parties and individuals to discuss the project openly and give views on pertinent issues associated with the project development, presence and operations of the proposed wind farm facility. It is therefore envisioned that the Client would formally invite all the major stakeholders and make available the environmental impact assessment report for a reasonable period of time for their perusal prior to the commencement of the proposed stakeholders' workshop at Loiyangalani. The consulting team would assist in facilitation of the stakeholders' meeting.

Indeed a stakeholders' meeting was held in Loiyangalani between 21 and 22nd April 2008 and attended by fifty four (54) participants (Annex 4b - Participants of the ESIA Stakeholders' Meeting on 21-22 April, 2008). Several issues touching on the proposed project including the project negative impacts on livestock, Lake Turkana, vegetation and other natural resources, siting of the wind farm, job opportunities and other benefits to the community among other issues were exhaustively discussed during the workshop. Details of issues discussed in the Stakeholders' Meeting were recorded in the minutes presented in Annex 5 - Minutes of the ESIA Stakeholders Meeting.

8.3 Trends in National Economy

The Kenyan economy is largely agricultural-based, with the sector accounting for 25% of the Gross Domestic Product (GDP). The agricultural sector contributes over 80% of employment and 57% of national income both directly and indirectly. The number of people living below poverty line and who subsist predominantly on environment resources was about 57% in 2002. Although Kenya achieved most of its development targets in the first decade after independence, the subsequent three decades recorded dismal performance. GDP growth declined to 2.5% between 1990 and 1995 and to 1.98 between 1996 and 1999. After posting a positive growth of 1.2% in 2001 (from negative of 0.2% in 2000), the economy grew by 1.1% in 2002. In all these years, economic growth has consistently been lower than population growth rate. A survey of 2005 (MoNPD, 2005), however, shows that the economy has been on a recovery path since 2002. Gross Domestic Product (GDP) expanded by 4.3% in 2004 as compared to 2.8% in 2003. The sectors that made a major contribution to this impressive growth were manufacturing (4.1%), construction (3.5%), trade (9.5%), tourism and hotels (15.1%) as well as transport and communications (9.7%). In 2005 GDP expanded to 5.7% and in 2006 the economy posted a GDP of 6.4%. In 2007, the economy sustained its growth momentum that

started in 2003 to register a real Gross Domestic Product (GDP) growth estimated to have expanded by 7.0 per cent compared to a growth of 6.4 per cent in 2006. The renewed expansion was mainly due to the economy's resilience, improved business confidence, stable macro-economic environment, and a rebound of global economy. The major sources of growth for the year 2007 were transport and communication, taxes on products, whole sale and retail trade, and manufacturing that contributed 23.2, 23.2, 15.7, and 8.8% respectively (KNBS, 2008). The economic growth momentum that started in 2003 was restrained by a number of both internal and external factors that took place in 2008. These factors included the 2008 post election violence, the global financial crisis, the high fuel and the high food prices among other factors. A combination of the above factors slowed down the economic growth from 7.1% in 2007 to 1.7% in 2008.

The relatively slow rate in economic growth in the 1990s and early 2000s coupled with increasing inequality in the distribution of income has led to a rise poverty levels such that about 17 million Kenyans (56%) of the population live below the poverty line (ERS, 2005). With 500,000 job seekers entering the job market, every year, while only about, 80,000 formal sector jobs were created in the last six years or so, unemployment rates continue to rise. Today the economy faces the challenge of creating adequate and gainful employment opportunities for a rapidly growing labour force. In addition, the rising poverty levels and poor performance of agricultural sector have worsened food security situation in the country. However, the recent improved performance in various sectors of the economy has been reflected in the creation of new jobs in both the modern and informal sector. Overall the economy generated 469,000 new jobs in 2006, an increase of 5.7% from 2005 levels (KNBS, 2007). Again all these gains in the job market have greatly been eroded by the post election violence of 2007-2008 which has left tourism, agriculture, commercial and industrial sectors reeling from the impact of the violence. In 2008 employment creation was adversely affected by the slow economic growth. The number of new jobs created by the domestic economy declined from 485,500 jobs in 2007 to 467,300 in 2008. In particular the number of new jobs created in the private sector declined from 74,000 in 2007 to 23,800 in 2008.

8.4 Analysis of Electricity Generation in Kenya

It is noted that the proposed project will contribute significantly to energy development, a factor that influences the country's socio-economic advancement. Hence a need for analysis of electricity generation in Kenya.

The most important electricity producer in Kenya is the state owned parastatal, Kenya Electricity Generating Company (KenGen). Besides KenGen there are four (4) Independent Power Producers (IPPs) including Iberiafrica, Westmont, Tsavo Power and Orpower. The Kenya Power and Lighting Company (KPLC), a state owned parastatal has the monopoly over the transmission, distribution and sale of electricity in Kenya. The power regulator in Kenya is the Electricity Regulatory Board (ERB) now Electricity Regulatory Commission (ERC).

Table 7. presents existing power production in Kenya. At present Kenya produces a total of 1267.9 MW of electricity. Most of this production (719.0 MW) is hydro power. Most of the hydro power is generated in several stations along the Tana River at Masinga, Kamburu, Gitaru, Kindaruma and Kiambere power stations. Other hydro power stations include the Turkwell Gorge and Sondu Miriu power stations and other minor stations including the Gogo, Sosiani and Mesco stations. The geothermal power station at Olkaria near Naivasha produces 128.0 MW. The diesel/ oil plants with a capacity of 418.9 MW are located at the Coast and Nairobi. Kenya imports 20-40 MW of power from Uganda.

Table 7. Trends in Power Production in Kenya (1919-2008)

Name of Power Station	Power in (MW)	Type of Power	Location	Year of Commissioning
Olkaria I	45	Geothermal	Hells Gate	1981
Olkaria II	70	Geothermal	Hells Gate	2003
OLkaria III	13	Geothermal	Hells Gate (IPP)	2000
Subtotal Geothermal Power	128			
Kipevu 6	30	Diesel	Mombasa	1972
Kipevu 7	33	Diesel	Mombasa	1976
Kipevu 1	73.5	Heavy oil	Mombasa	1999
Kipevu GTI	31	Diesel	Mombasa	1987
Kipevu GT2	32	Diesel	Mombasa	1990
Nairobi South	13.5	Diesel	Nairobi	1972
Subtotal Thermal Power	213			
IPP - Kipevu II Diesel Tsavo	74.5	Heavy oil	Mombasa	2001
IPP - Kipevu Westmont	44	Diesel	Mombasa	
IPP - Iberafrika	56	Diesel	Mombasa	
Others	31.4			
Subtotal Thermal IPP Power	205.9			
Subtotal Oil Power	418.9			
Cogeneration	2.0			
Total Cogeneration	2.0			
Gogo	2	Hydro	Migori	1952
Sosiani	0.4	Hydro	Sosiani	1955
Mesco	0.38	Hydro	Maragua	1919
Ndula	2	Hydro	Thika	1924
Ndula	2	Hydro	Thika	1924
Sagana	1.5	Hydro	Tana River	1952
Turkwel Gorge	106	Hydro	Turkwel River	1991
Wanjii	7.4	Hydro	Maragua	1955
Tana	14.4	Hydro	Tana River	1940 / 53
Masinga	40	Hydro	Tana River	1981
Kamburu	94.2	Hydro	Tana River	1974
Gitaru	225	Hydro	Tana River	1978
Kindaruma	40	Hydro	Tana River	1968
Kiambere	144	Hydro	Tana River	1988
Sondu Miriu	60	Hydro	Sondu Miriu River	2008
Imports from Uganda and others	39.72	Hydro	Jinja in Uganda	
Subtotal Hydro Power	719.0			
Total Power Production	1267.9			

Source: Feasibility for Turkana Wind Park in Kenya, 2007

Further to the above power production, the country has planned an additional 422 MW generation capacity within the next three years as follows:

- 210 MW thermal power;
- 110 MW hydro power; and
- 72.5 MW geothermal power.

It is noted that nearly 60% of the current power capacity is hydro. Over the last seven years the country has paid a high price over heavy reliance on single source of power, the Tana River system. In 1999 and again in 2002, severe droughts nearly brought the Kenyan economy to a standstill after the hydro – power dams dried out leaving power rationing in its wake. This experience has underscored the need to diversify the power sources in Kenya.

Table 8. presents details of recently installed capacity and generation of electricity by different producers in the period 2004-2008. Total installed capacity rose by 6.0% in 2008 compared to 1.7% in 2007. The rise in the installed capacity was the result of increases in thermal oil and hydro installation from 389.3MW and 677.3 MW in 2007 to 418.9MW and 719.0 MW, respectively, in 2008. The increase in hydro installation resulted from the commissioning Sondu-Miriu hydro project with installed capacity of 60MW. Geothermal and cogeneration installed capacity remained unchanged over the last three years.

Table 8. Installed Capacity and Generation of Electricity in Kenya (2004-2008)

Year	Installed Capacity (MW)					Generation (GWh)								
	Hydro	Therm Oil	Geoth	Cogen	Total	Hydro	Thermal Oil				Geoth	Cogen	Wind	Total
							KenGen	IPP	EPP	Total				
2004	667.3	392.8	128.0	0.0	1,198.1	3,169.2	416.4	621.8	0.0	1,038.3	986.6	0.0	0.4	5,194.5
2005	677.3	351.3	128.0	0.0	1,156.6	3,038.9	580.2	926.0	0.0	1,506.2	1,001.6	0.0	0.3	5,547.0
2006	677.3	369.8	128.0	2.0	1,177.1	3,024.8	544.6	942.4	331.6	1,818.5	1,045.7	5.6	0.3	5,894.9
2007	677.3	389.3	128.0	2.0	1,196.6	3,591.5	365.0	847.5	523.3	1,735.8	988.9	8.3	0.1	6,324.6
2008	719.0	418.9	128.0	2.0	1,267.9	3,271.8	521.4	883.0	741.0	2,145.4	1,039.0	4.0	0.2	6,460.4

Total electricity generation recorded a decelerated growth of 2.1% 2008 compared to a growth of 7.3% in 2007. This was largely due to an 8.9% decline in electricity production from hydro generation power sources. The decline in hydro power generation was attributable to low water levels at the hydro electricity power generation dams. Generation from thermal oil and geothermal plants rose by 23.6 and 5.1% in 2008 compared to declines of 4.5% and 5.4%, respectively, in 2007. The increase in thermal generation was necessary in order to compensate for the significant drop in hydro electric power generation.

8.5 Economic Analysis of the Project

The economic analysis of the proposed project is presented in terms of its technical feasibility and financial feasibility.

8.5.1 Project technical feasibility

Based on the success and versatility of the of Vestas Wind Systems A/S of Denmark, the proposed project will be technically feasible. Vestas Wind Systems A/S based in Randers, Denmark, is among the world leaders in wind technology and a pioneer in the development of the wind power industry. Today Vestas Wind Systems A/S has installed more than 30,000 wind turbines in over 50 countries. The company had registered a turnover of approximately £ 2.5 billion in 2005 and currently has a global market share of 35%. The success experience of the Vestas Wind Systems and lessons learnt from many parts of the world will be replicated in the Lake Turkana Wind power Project.

8.5.2 Project financial feasibility

A recent financial analysis made by Emerging Energy Research (EER), on behalf of Vestas Wind Systems A/S concludes that based on economic and risk analysis of power generation; wind technology can no longer be marginalised in the power mix. Thus wind power should be supported in its penetration of the conventional power market to ensure a cleaner, more balanced energy supply in future. The EER analysis makes the following conclusions:

- In a carbon constrained world, wind power can be competitive with several conventional power technologies; and

- All things considered, wind power is a superb supplement to the current power mix as it increases the supply of electricity, reduces the consumption of conventional fuels, has little or no carbon footprint and is an inexhaustible local resource.

With regard to the proposed power development, so far no serious setbacks have been encountered that pose a vital threat to feasibility of the project. The potential for the Lake Turkana Wind Power Project to materialize look most promising. Indeed the energy sector in particular renewable energy is an attractive sub sector that has and will continue to attract investors in Kenya.

Economic feasibility study of the proposed project is now complete. The internal rate of return (IRR) for the proposed project is estimated to be 28%. The proposed project is therefore financially viable. Consequently investment funds are now being raised with relevant institutions including African Development Bank (AfDB).

9. POSITIVE IMPACTS OF THE PROPOSED PROJECT

In investing in the project area, the Turkana Wind Power Project is in line with the current Government strategic plan of developing the Arid and Semi-arid Lands (ASALs) areas of Kenya. The proposed project will have significance positive environment impacts when compared to other forms of power production including the thermal power production which involves the burning of fossil fuel. The major positive impacts of the project will include stabilization of electricity in Kenya, potential for carbon market, promotion of economic growth in the country, contribution to the Government revenue, increased employment and improvement of roads in the project area among other positive benefits.

9.1 Stabilization of Electricity

The development of the Lake Turkana Power Project will play a significant role in the stabilization of power situation in the country. The project will add 310MW into the national grid representing 25% of total power production in Kenya. This will be a relatively cheap power source (second cheapest source of power in Kenya after hydro power). Despite the fact that hydro power development is relatively cheap, there is a scarcity of suitable hydropower sites for exploitation in Kenya. Furthermore hydro power is proving to be very unstable due to the variability of the hydrological regime in the Tana River catchment. The introduction of 310MW in the national grid will alleviate power outages especially during the dry seasons and help to reduce the country heavy reliance on the power production from the oil and diesel power generators. At its full capacity production (operation of 365 wind turbines, each with a capacity of 850 kW), the project will create a major positive impact especially during dry years when hydro power production is at its lowest production.

9.2 Potential for Carbon Market

A recent assessment indicates that the project can meet all the necessary requirements to become a carbon project under the Clean Development Mechanism (CDM). The proposed project will achieve CO₂ emission reduction by replacing electricity generated by fossil fuel fired power plant connected to the national grid. The carbon credit potential of the project ranges between 565,920 and 1,264,320 CO₂ tonnes equivalents (or carbon credits) per year. Assuming a 10-year crediting period, this will result in a total of 5,659,200 to 12,643,200 carbon credits over the course of the project. This represents carbon credit value in the range of €56,592,000 to €126,432,000 for the entire project.

9.3 Promotion of Economic Growth

This project will play a significance role in stimulating economic growth in Kenya. The power input will contribute significantly to the Kenya's Rural Electrification Programme which has potential to promote spin-off effects on rural economy in Kenya. The project also has power export potential to the neighbouring countries including Uganda, Tanzania and Southern Sudan.

Today the energy situation in Kenya is unsatisfactory as evidenced by the frequent unplanned power outages, an important circumstance which slows down the economic development in the country. Power produced by this project will to a large extent change this situation.

Nearly 60% of the power capacity in Kenya is based on hydropower. Over the last ten years or so the country has paid a heavy price for over reliance on hydropower. For example, between 1999 and 2002, severe droughts nearly brought economic activity in Kenya to a standstill after the hydropower dams along the Tana River nearly dried out leaving power rationing in its wake. Reduction of hydro power production during the dry spells was compensated by increasing the

power production of the diesel plants and of course rationing of power. This increased the cost of power production. In addition there was a resultant loss of economic production due to rationing. In 2000 (a very dry year), KenGen rented 100MW extra diesel generators. The total extra cost for power generation was US\$ 632 million and the lost production due to rationing was estimated to be US\$ 1,400 million. These experiences have underscored the need to diversify the power sources in Kenya. Installation of this project will enhance promotion of economic growth at a time when Kenyan economy is showing signs of recovery and increase in growth rate.

9.4 Increased Employment Opportunities

This project will create job opportunities in the project area and beyond. Direct job opportunities will be available for high calibre professionals including engineers, information technology (IT) personnel, mechanics and consultants. It is, however, unlikely that the local community will benefit from this calibre of specialised job market. Of greater relevance to the local community will be job opportunities involving unskilled and semi-skilled labour especially during the rehabilitation of the roads and the construction of the wind park and staff buildings. During the road rehabilitation and construction phases of the project, over 400 hundred members of local communities in the project area will be hired by the project as drivers, masons, loaders, carpenters, cooks, security personnel and other assorted personnel.

Indirectly the project will create opportunities for self employment in the project area especially during the rehabilitation of the roads and the construction of the wind park facility. Since the project will require local materials for the above project activities, the local community stand to benefit from their engagement in several activities including the making of ballast, collection of sand, mining of murrum, cutting of building stones, making of concrete blocks and transportation of goods and building materials. Other employment opportunities in the project area will spring from spin-off activities including trade, accommodation, and supply of goods and services to both the skilled and unskilled labour.

9.5 Increased Contribution to Government Revenue

The project will contribute toward the boosting of Government revenue in the form of tax revenue. Lake Turkana Wind Power Project will pay corporation tax at 30% of net income. The project will generate income to the Government through EIA license fee of 0.05% of the total cost of the project (to a minimum of KSh 10,000 and a maximum of KSh 1,000,000) fee to NEMA and withholding tax from remuneration paid to employees at graduated scale rates. Through engagement of employees, the project will generate revenue for the Government in the form of Pay as You Earn (PAYE). The project will pay Value Added Tax (VAT) at most of the items bought. In addition, there will be other taxes including operating licences.

9.6 Improvement of Roads in the Project Area

Currently the road conditions of project area are in a very poor state. In order to facilitate smooth transportation of wind power equipment, the project will improve the roads from Marsabit Town via Kargi to Loiyangalani. The rehabilitated road will improve communication in the project area and promote economic activities including livestock trade. A major beneficiary of an improved roads system will be the Loiyangalani fisheries. This sector has a huge potential which has never been exploited due to poor roads conditions between the lake and potential markets. Due to the poor road system the fishermen are not able to sell fresh fish. Instead, the local fishermen sun dry the caught fish and sell them to the only available market for dry fish, Kisumu. It is noted that the total fish catch from Loiyangalani for the year 2006 was 156,998 Kg dry weight earning a total of KSh 6,181,122. With a rehabilitated road system the Lake Turkana

fishermen will be able to transport fresh fish to Marsabit and other markets including Nairobi and fetch a higher price for them.

9.7 Provision of Electricity in the Project Area and Surroundings

Although the bulk of electric power generated from the proposed project will be connected to the national grid, some power will be distributed in the project area and surrounding areas. This will generate economic and trade opportunities among the marginalised communities in the northern Kenya. Although many members of local community will not afford the power (power will be sold at commercial rates), it will, nevertheless make a significant positive impact in the project area and the surroundings. Many institutions, including the schools, hospitals, government offices, tourist facilities, hotels, shops and some private homes will benefit from the power connection. For example, the Loiyangalani fisheries will realize tremendous enhancement from the power connection. Availability of power in the project area will facilitate the Loiyangalani Fisheries Cooperative Society to install cold storage facilities. Consequently the caught fish will store for a longer period. Subsequently, the fresh fish can be sold to other market destinations (other than Kisumu) including Marsabit, Isiolo, Moyale, and Nairobi and for a higher price than the sun dried fish.

10. NEGATIVE IMPACTS OF THE PROPOSED PROJECT

Although this project will realise tremendous economic benefits and other positive impacts as outlined above, it will also have negative effects on the environment of the project area. The negative impacts of the project are discussed in three broad categories including socio-economic negative impacts, biophysical negative impacts and impacts beyond national boundaries.

10.1 Negative Impacts on Socio-economic Environment

The socio-economic negative impacts of the project will be triggered mainly by the increased population in the project area following the commencement of the proposed wind power project. As the local community and other people from outside the project area respond to employment opportunities, the project area will witness an increase in human population in this remote area. This influx of people is likely to lead to a number of negative socio-economic impacts including cultural contamination, increased incidences of diseases, increased insecurity and community conflicts, challenges of labour force management, increased accidents and occupational hazards.

10.1.1 Cultural contamination

The implementation of this project will facilitate interaction of people of different cultures in the project area. Although the local community is fairly a conservative society, influence from outsiders is likely to impact negatively on the local community cultural norms and practices. To some extent, there will be changes in community values, clothing, behaviour and other attributes. Based on experiences from other projects, the project workers from different cultures are likely to introduce unfavourable social behaviour including theft, increase in the consumption of alcohol, production of illegal brews and introduction commercial sex among other vices. This will promote cultural contamination in the project area leading to long-term erosion of the normal community way of life.

10.1.2 Increased exploitation of natural resources

As stated above, during the project's construction phase there will be high number of people in the project area. The increased number of workers will make high demand on fuel wood resources of the project area. This demand will be made at a time when the local people are currently experiencing an acute shortage of fuel wood especially around Loiyangalani town. Due to the aridity of the project area, and subsequent scarcity of wood trees, there will be a dire need to explore alternative source of energy for workers during the implementation of the project.

10.1.3 Increased insecurity and community conflicts

Although Loiyangalani Division including the project area, is a relatively a calm zone, to the north of the project area, insecurity brought about by tribal clashes is a big problem. For example, in the October 2007, El Molo were invaded and left their home area to seek refuge in Loiyangalani Township close to the project area. Indeed the displaced El Molo community was still camped in Loiyangalani during the course of the field trip for this study. Given the traditional livestock rustling among the communities in northern Kenya and normal competition for scarce resources in arid areas, the relationships among pastoral communities are in many situations

restrained to some extent. The proposed project could exacerbate this delicate situation if it is perceived to benefit certain communities more than others. This could lead to community conflicts and an increase of insecurity in the project area.

10.1.4 Increased incidences of diseases

The influx of people in the project area and environs is likely to increase the incidences of diseases between Marsabit and Loiyangalani. The situation will be aggravated by the entry of commercial sex workers into the area following the commencement of project activities. There is therefore the risk of contracting sexually transmitted diseases (STDs) especially the dreaded Human Immuno-deficiency Virus / Acquired Immuno-deficiency Syndrome (HIV/AIDS) among the project workers. This could have serious health implications for the project workers and the local community in the project area and surroundings.

10.1.5 Visual intrusion

The road rehabilitation activities are likely to create disfigured landscapes along the road route and around the sites of the quarries and borrow pits of the project area. In addition there will be large spoils along the road, around the quarries and periphery of the borrow pits. The resultant disfigured landscapes and mounds of spoils are visually intrusive. Wind power construction activities will also lead to landscape disfiguration. In addition the soil mounds, presence of machinery, and other equipments and materials on the project site will be visually intrusive.

The completed wind park facility in otherwise an unspoilt natural environment could be visually intrusive to some people and has the potential to detract observers from the normal scenery. However, the wind park is not an ordinary sight and being a novelty, could be appealing to a wide cross-section of local community, other Kenyans and even foreign visitors. Indeed it could as well be a local attraction drawing many observers beyond the project area.

10.1.6 Potential impact of labour force

Depending on the mode of human management on the project site, the project workers especially during the road rehabilitation phase and the wind park construction stages are likely to indulge in activities that are likely to cause negative impacts on the environment of the project area. The construction of the labour camps may require building materials from the project area. Consequently this is likely to result in harvesting wood resources from the plant communities around the project area. The constructed labour camps are usually fraught with sanitation and waste disposal problems that are likely to have negative impacts on the environment. Wastes generated by the construction workers including food remains and human wastes could attract animal pests and vermin including rats, crows, flies etc. to the construction sites with resultant implications on the spread of diseases. As a whole the establishment of labour camps in the project area and along the road earmarked for rehabilitation will definitely present serious management challenges to the Contractor and Resident Engineer.

10.2.7 Potential increase in pollution from solid wastes and effluent discharge

It is expected that various solid and liquid waste streams will be generated from activities associated with the road rehabilitation, construction and operation of the power plant. It is envisaged that the major waste streams are likely to be:

- Domestic effluent; and
- Miscellaneous solid wastes.

The labour campsites are expected to produce considerable quantities of domestic effluents containing a wide range of substances which have high potential to pollute the environment if not properly disposed of. Solid wastes generated from the labour campsites will have diverse composition of material including paper, glassware, plastic material, food remains, metallic cans and other heterogeneous material. Solid wastes have potential to pollute the environment since they cause visual intrusion and form suitable breeding sites for flies and vermin which can transmit diseases to human beings in the project area.

10.1.8 Increased accidents and occupational hazards

Implementation of the project will definitely increase volume of human and motor traffic in this remote area. The increase in human and motor traffic will be aggravated by the transportation of construction materials and proposed wind plant accessories and other equipment required to install the wind park facility. This is likely to result in a higher risk of accidents occurring in the area of operation during the road rehabilitation, wind park construction and wind park operation phases.

During the implementation of the road rehabilitation and wind park construction phases, several activities including vehicular transport, operation of heavy machineries and blasting of hard rock in quarries have potential for accidents risks both among the project workers and the local community. Factors that may exacerbate this situation are inadequate appropriate working gear for project workers including the helmets, overalls, boots and gloves.

Due to the nature of technology involved, the wind park operation and maintenance activities will be minimal. Nevertheless, there are potential occupational hazards with regard to work force engagement in both day-time and/or night-time activities albeit on a small scale. The nature of occupational hazards will include:

- Machine/equipment injury risk;
- Occupational noise and vibration;
- Fire risk;
- Risk of exposure to electro-magnetic radiation;
- The risk of electrical shock; and
- Miscellaneous hazards.

10.2 Negative Impacts on Bio-physical Environment

Project activities during the road rehabilitation and construction of the wind park and subsequent operation of the same will cause negative effects on the bio-physical environment of the project area albeit on a limited scale. The site preparation activities for the installation of the wind park and subsequent construction activities of the proposed project facilities will to some extent alter the present salient features of the project area. These activities involve the clearing and trampling of vegetation, excavation of soils and other geological formations, levelling of landscape and construction work. The above activities will have immediate negative impacts including loss of habitat, destruction of floral and faunal communities, soil erosion and other

related impacts. In addition there is likely to be far-reaching effects on the adjacent lacustrine habitat associated with Lake Turkana through the potential effect of run off and subsequent siltation processes and pollution effects.

10.2.1 Potential impacts of wind turbine on external environment

External environment in this context pertains to situations associated with the project but outside the project area. Potential impact of the wind turbine on the external environment is divided two phases as outlined below:

- The production phase, which covers the period from obtaining the raw materials to the production of turbine and other components; and
- Transport of equipment components to the project site.

Impacts during production phase

The production phase of wind turbine and other equipment covers the extraction of raw materials as well as production of wind turbine and other components by suppliers. This is perhaps the phase that generates the greatest impact on the environment. The external environment is affected particularly by extraction of iron ore for the production of steel. The manufacture of epoxy materials (made using crude oil) used in blade production is another aspect of the production phase that generates environmental impact. It should, however, be emphasized that the production of the wind turbines and the components are made in Europe and impacts associated with wind turbine production phase are confined elsewhere and will not affect the project area.

Impacts associated with transport of equipment to the site

Impacts associated with the transport of the wind turbine components (blades, masts, nacelle and other components) and subsequent erection phase mainly involves fuel consumption and subsequent gaseous emissions. Gaseous emissions emanate from lorries and other vehicles used in transportation and the cranes used in loading and erection of the turbine itself. However, this type of impact is not confined to the project area alone. Gaseous emissions will be dissipated all the way from the port of Mombasa to the project area.

10.2.2 Increased soil erosion

Increased soil erosion is likely to occur in the project area during the road rehabilitation, operations of borrow pits and quarries, construction of the wind park and buildings and installation of turbines. Although the project area is very arid, soil erosion could turnout to be a significant negative impact depending on prevailing environmental conditions during the implementation of the above activities. The presence of loose earth (resulting from the above activities) coupled with prevailing strong winds and occasional rains could lead to acute and chronic soil erosion problems in the project area. The situation is aggravated by the poor vegetation cover in the whole of the project area.

10.2.3 Increased siltation of the lacustrine habitats

Some of the excavated sediments from the project site and the construction spoils emanating from excess excavated material and construction debris are likely to impact negatively on the environment of the project area and the nearby lacustrine habitat associated with Lake Turkana. Despite the fact that this is a dry area, it is likely that the generated spoils and other excavated material could be washed into the shore of Lake Turkana through an occasional runoff and the

effect of winds. Subsequently increased siltation of the lake water will have some limited ecological implications on the aquatic habitat. Siltation effect, however, will depend on the closeness of the impacted area to Lake Turkana.

The silt particles entering Lake Turkana aquatic system through runoff and silt laden winds can increase water turbidity and reduce the lake water transparency. The suspended material will cut down light penetration thus reducing the photosynthetic capabilities of the primary producers including the phytoplankton, benthic algae, periphyton and other aquatic flora. However, the amount of silt emanating from the project is likely to be low when compared with the volume of water in the lake. There is also a long distance involved (shortest distance between the project site and lake shore is about ten kilometres) between the project site and the shore of Lake Turkana.

10.2.4 Ponding

The road rehabilitation, wind park construction and other project activities may lead to creation of stagnant water bodies in quarries, borrow pits and depressions created during the construction works. Although water collected in the depressions may be a respite for the pastoralist in this dry are, the resultant stagnant water bodies are likely to be suitable habitats for the breeding of mosquitoes and snails that are disease vectors for malaria and bilharzia respectively.

10.2.5 Loss of habitat

Although wind turbines may not directly cause mortality, the presence of wind turbines may indirectly affect local fauna and bird populations by decreasing the area of habitat available to breeding, feeding, nesting, resting etc. Habitat loss is mainly brought about by land taken for the construction of infrastructure including staff houses, access roads, turbine bases and substations. This brings about the fragmentation of populations of terrestrial fauna and avifauna. However, this impact is of greater significant where large number of turbines is sited on sensitive habitats such as forests, wetlands and sandbanks. This will not be the case for this project as the siting will be located on a rocky substrate close to the foothills of Mt. Kulal (see Map 5). Due to the small area occupied by the wind farm facility, the loss of or damage to habitat resulting from wind farm infrastructure is generally not perceived to be a significant environmental concern in the project area.

10.2.6 Destruction of floral communities

Due to the aridity of the project area, vegetation is scanty. Nevertheless, it must be emphasized that the existing sparse vegetation plays an important role in maintenance of life in the project area and its surroundings. It is the resource upon which the pastoralist and their livestock populations depend on for their survival. Despite the importance of vegetation in the project area, project activities are likely to destroy some vegetation with subsequent loss of some trees, shrubs and grasses from the area of operation. The plants likely to be affected mostly are trees such as *Acacia tortilis* and shrubs such as *Acacia reficiens*, *Indingofera spinosa* and *Sericocomopsis hildebrandtii*. Destruction of the floral community will result in the loss of habitat for some animals such as dikdiks and the hare, the avifauna, insect community and other forms of life found in the project area. In addition there will also be a loss of feed for the livestock especially the camels, goats, sheep and donkeys. The local community will also lose an invaluable source for firewood, building material for the manyatta and fencing material for

animal enclosures (see Photo 1). However, it should be noted that the actual area covered by the turbine foundations is only 1-2 acres of land. This area is a very small amount of land lost when compared to the land covered by the project area and surroundings that cover thousands of acres.

10.2.7 Impact on terrestrial fauna

This project will not have any significant impact on the terrestrial fauna of the project area. Other than the presence of livestock including the camels, goats, sheep and donkeys, the project area has a pronounced scarcity of charismatic wild fauna. During the field study, the study team was only able to see an occasional dikdik and hare within the boundaries of the project area. However, the project may have some impacts on the migration of avifauna as described below.

10.2.8 Potential disturbance in livestock activities

The major land use of the project area is livestock keeping especially the rearing of camels, goats, sheep and donkeys. The livestock activities are likely to be disturbed by both construction, presence of wind turbines and operations of project activities. During the project construction stage there will be increased disturbance to livestock emanating from increased number of people, vehicles and machinery in the project area. The project may indirectly affect livestock by decreasing the grazing area due to land taken for the construction of infrastructure including access roads, turbine bases (foundation), staff houses and substations. Livestock movements especially towards the watering points are likely to be affected by fencing of the project area.

It should, however, be noted the above impacts are minor. The project area will not be fenced and livestock will move freely in the project area. Only about 0.5 acre will be fenced only for the substation.

10.2.9 Impacts on avifauna

The project is likely to interfere with migration of birds. The project area is close to Lake Turkana which is an Important Bird Area in Kenya. Eight four (84) waterbird species including thirty four (34) Palearctic migrants have been recorded around Lake Turkana (Bennun and Njoroge, 1999). According to Rose and Scott (1997), over 100,000 Little Stints (representing more than 10% of entire East African / South East Asia population may winter here. Lake Turkana also supports many wintering Palearctic migrants and is a key stopover site for birds on passage.

From experience in other parts of the world, it is known that wind turbines pose a risk to birds. The potential impacts on bird populations could be serious if the turbines are built in areas where large concentrations of birds occur especially migrating birds, large raptors or other large soaring bird species especially eagle and vulture populations. The main potential hazards to birds from wind farms are:

- Disturbance leading to displacement or exclusion of birds; and
- Collisions.

Disturbance

Disturbance potentially may arise from increased human activity in the vicinity of wind farm especially during construction, maintenance visits and facilitation of access roads in the project area. The presence of turbines and the presence of noise from turbines may also deter birds

from using the area close to the turbines. This, however, may not affect the migrating birds that are associated with Lake Turkana including the shoreline aquatic habitats.

Collisions

Following the construction of the wind park, it is likely that birds may be killed when colliding with turbines while others will be killed by collision with power cables at the wind park. Collision mortality of birds at poorly sited wind farms is likely to have negative impacts on the populations of the susceptible species. Cumulative mortality from multiple wind installations may also contribute to population decline. It should, however, be noted that several factors including wind speed and direction, air temperature and humidity, flight type, distance and height, time of day and topography, all influence the risk of collisions. The bird species type, age, behaviour, and stage of the bird's annual cycle also influence the risk of collision. Collision risk is greatest in poor flying conditions, such as strong winds, that affect the birds' ability to control flight manoeuvres, or in rain, fog, and on dark night when visibility is reduced. Lighting of turbines has the potential to attract birds, especially in bad weather, thereby potentially increasing the risk of collision. The lit turbines and other lit structures at night disorientate the nocturnal migrant birds thus increasing the collision mortality.

It should, however, be noted that the turbines will be located at least 10km from the shore of Lake Turkana on the plateau behind the Ongipi massif. Since migrating and over wintering birds are normally associated with Lake Turkana shoreline and aquatic habitats, collision risk of birds is expected to be low.

10.2.10 Impacts on protected areas

The nearest protected areas to the project area are Mt. Kulal Biosphere Reserve and the South Island National Park which are situated away to the east and west of the project area respectively.

Mt. Kulal Biosphere Reserve

Mt. Kulal lies 25km east of the southern end of Lake Turkana. It is an isolated volcanic mountain that rises abruptly from the surrounding semi-desert plain to an altitude of 2,300m asl. Mt. Kulal and its surroundings are designated as a Biosphere Reserve under the UNESCO Man and Biosphere (MAB) programme. Mt. Kulal Reserve does not have high concentrations of megafauna. However, Greater Kudu (*Tragelaphus strepsiceros*) are recorded in the forest. The African Elephant (*Loxodonta africana*) may occur in the forest from time to time. Mt. Kulal Forest used to hold a population of Black Rhinoceros (*Diceros bicornis*) but is now locally extinct.

The avifauna of Mt. Kulal forest is typical of the Afro tropical highlands biome but remains impoverished (Bennun and Njoroge, 1999). However, Mt. Kulal is unusual among Kenya's northern 'island' forests in having an endemic bird taxon, the Kulal White Eye (*Zosterops kulalensis*). The Kulal White Eye is recognised as a globally threatened and restricted range species. Hence its conservation significance can not be overstated.

South Island National Park

The South Island National Park was established in 1983 mainly to protect the island's crocodile population, the venomous snakes, hippos and a wide range of avifauna. Crocodiles breed on the shore of the South Island National Park between April and May. There are many species of reptiles including saw scaled viper, night and puff adder and cobra. The Island provides a suitable feeding and breeding habitat to large concentration of birdlife. The goliath heron and

African skimmer breed here while the African open-billed stork duck and gulls feed on the shores. In addition the diverse habitats of the South Island National Park attract the lesser flamingo and birds of prey.

As seen from Map 4. the two protected areas are located away from the project area. The nature of the project activities during the road rehabilitation, construction of the wind park and subsequent operation of the installed facility are unlikely to affect either the Mt. Kulal Biosphere Reserve or the South Island National Park.

10.2.11 Increased noise levels

The proposed facility has the potential to generate noise levels which could affect close residential areas and other noise-sensitive receptors. Noise levels are likely to increase in the project area both during the construction and operation phases of the proposed project.

High levels of noise will prevail in the project area due to the use of heavy machinery in road construction activities. In addition the operations at the quarries, borrow pits and crushing plant will generate high levels of noise. During the construction phase increased noise levels will emanate from the road rehabilitation activities, turbine installation activities and general construction work.

During the operation phase, there will be wind turbine noise that will emanate from several sources including:

- Cooling fans;
- Generators;
- Blades;
- Power converter;
- Hydraulic pumps;
- Yaw motors; and
- Bearings.

However, it should be noted that modern Vestas turbines are associated with low noise levels. In addition these turbines mainly emit low frequency sound or the so called infrasound in which human beings require high levels for perception.

Perhaps of particular importance in this project is whether the noise levels produced by project activities reach the staff houses or houses (Manyattas) belonging to the local community in the project area. According to the WHO guidelines, noise impacts within dwellings include annoyance, speech interference and sleep disturbance. WHO considers that for bedrooms, the critical effect is sleep disturbance. Guidelines values for bedrooms are 30 dBA for continuous noise. This happens to be the magnitude of noise the Vestas 52 wind turbines would produce at the wind park site. Considering that for most types of dwelling the noise attenuation through the walls of the building is at least 10 dBA, a noise level of 40 dBA is acceptable at the walls outside dwellings. In general distance between the wind turbines and the nearest dwelling should be at least about 400 meters. In the project area the distance between the turbines and the nearest dwelling will be 40 km or so. It is therefore unlikely that there will be any noise disturbance emanating from the presence and operations of the proposed wind park facility in the project area.

10.2.12 Air emissions

Road construction activities will contribute to air pollution through gaseous emissions. This will emanate mainly from exhaust pipes for vehicles and machinery used in road construction. The construction and operation of the power plant is likely to release air emissions from construction machinery, turbines, vehicles, diesel generators, workshops and camps sites. The composition of gases released to the environment will include carbon dioxide, water vapour, organic acids, ammonia and traces of carbon monoxide, nitrogen oxides and sulphur oxides among other substances.

10.2.13 Dust pollution

Road rehabilitation activities and to some extent the wind park construction activities have the potential to generate high levels of dust in the project area. The situation will be aggravated by the aridity and the scarce vegetation cover in the project area. Areas where high dust production is likely to take place include sections where construction is taking place and in both quarries and borrow pits sites. The crushing plant also has great potential to generate high quantities of dust thus creating a hostile environment and a health hazard to the workers.

10.3 Health and Occupational Hazards

Health and occupational hazards associated with the proposed project are cross cutting issues which may occur in the project area due to a combination of several project processes including influx of workers, creation of ponding conditions, increased human and motor vehicle traffic and operations of the installed wind park facility as outlined below:

- Creation of stagnant water bodies in quarries, borrow pits and other depressions are likely to be suitable habitats for the breeding of mosquitoes and snails that are disease vectors for malaria and bilharzias respectively;
- The influx of people in the project is likely to increase the incidences of diseases including sexually transmitted diseases (STDs) especially the dreaded Human Immunodeficiency Virus / Acquired Immuno-deficiency Syndrome (HIV/AIDS) among the project workers;
- Following the commissioning of the project and subsequent increase in the volume of human and motor traffic in the project area there is likely to be an increase in human and motor traffic resulting in a higher risk of accidents occurring in the area of operation;
- Several activities including driving, operation of heavy machineries and blasting of hard rock in quarries and operations in borrow pits are likely to result in increase in accidents risks both among the project workers and the local community. Occurrence of accidents is likely to be exacerbated by lack of or provision of inadequate working gear among project workers including the helmets, overalls, boots and gloves; and
- Occupational hazards are likely to occur due to the work force engagement in both day-time and night-time activities. In this regard, workers will be exposed to machine/equipment injury risk, occupational noise and vibration, fire risk, risk of exposure to electro-magnetic radiation, the risk of electrical shock and other miscellaneous hazards and risks.

10.4 Impacts on Cultural Property and Heritage

The project area including the actual area impacted by the road construction and the wind park siting has so far not been reported to have any cultural property including archaeological discoveries. In addition, the project area is located far away from the area rich in archaeological artefacts which is situated in the Sibiloi National Park in the

upper Turkana basin, 200 km or so from the of the project area. This is where Hominid fossils comprising both relatively recent *Homo sapiens* as well as Plio-Pleistocene fossils of *Australopithecus robustus* and *Australopithecus afarensis* have been found.

10.5 Impacts on Land Acquisition and Involuntary Settlement

Although the acquired project land is fairly large (150 km²) the extent of the land that will be used for the establishment of the wind park is very small indeed. It should be noted that the actual area that will be covered by the proposed 365 V52 turbine foundations will amount to a total of about 1-2 acres of land. This represents a very small amount of land lost when compared to the land covered by the project area that covers thousands of acres. The project area will not be fenced (with the exception of power substation) and the pastoralists can access the project area for grazing purposes and settlement. The proposed road rehabilitation will follow the current Right of Way (ROW) for the existing road and therefore there will virtually be no displacement of communities and destruction of property including the community manyattas.

As discussed earlier in this report, the project area is sparsely populated. The population of Loiyangalani Division (where the project area is located) is estimated to be in the tune of 20,000 people with a density of a 1.3 persons per km², the lowest population density in the Marsabit District and one of the lowest in the country. The human population in the project area is very low probably in the tune of 200-500 inhabitants or so scattered over 150 km² of land area. The proposed project will not displace any member of the local community. In addition the proposed project it will not destroy any of the manyattas in the project area.

10.6 Cumulative and Long-term Impacts

Cumulative impacts are impacts on the environment that result when the effects of implementing the project's activities are added to the effects of other past, present and reasonably foreseeable future actions. Cumulative impacts are important because impacts of individual projects may be minor when considered in isolation but quite significant when the projects are viewed collectively. Currently there are no other wind projects of this magnitude in Kenya. However, in future the Marsabit area is likely to be associated with the establishment of other wind power projects.

As discussed earlier in the report, the whole of Marsabit District is well endowed with potential extractable wind power to the tune of 450 – 750 Watts m⁻². Therefore the prevailing suitable wind attributes in the area are likely to attract other developers to install wind park facilities near the project area. A situation where other wind development projects are established close to the project area, will lead to cumulative and long-term impacts in the project area, far beyond what has been predicted for this project. If this happens, the country in general and the project area in particular are likely to be beneficiaries of cumulative positive impacts of the additional wind park facilities including further improvement in transportation, provision of employment and social benefits and enhancement of economic growth. However, increased projects close to the project area may enhance the negative impacts including loss habitats and biodiversity, increased pressure on natural resources, increased insecurity and unplanned settlements, visual intrusion and increased pollution among other negative impacts. In addition, the likely increase in incidences of HIV / AIDS and increased cultural contamination among the local community in the impacted area are likely to cause long-term and cumulative social impacts if no attempts are carried out to contain the situation at an early stage of project development.

Establishment of additional wind park facilities in this area are likely to enhance cumulative and long-term effects of bird movements. This may lead to the disruption of ecological links between feeding, breeding and roosting areas. In addition, cumulative loss of or damage to sensitive habitats may be significant, if multiple, large developments are sited in such locations, e.g. in sandbanks in shallow waters or in wetlands. Further, direct habitat loss may be additive to disturbance exclusion. The type of design for the additional wind park facilities and siting have potential to cause cumulative and long-term impacts in the project area.

10.7 Impacts of Project De-commissioning

Generally the disposal of the turbine components during project de-commissioning has the potential to affect the environment. However, this may not be the case for the project area. It is likely that the turbine will be dismantled and re-exported, since 88% (by weight) of the turbine can be re-used. This means that the environment is spared extra extraction of non renewable resources. However, there will be wasted energy used to break down the turbine from the project site. In addition, de-commissioning activities will cause some minor negative impacts on the flora and physical environment of the project area. Following the de-commissioning of the turbines, buildings belonging to the project will either be acquired by the Government or other selected stakeholders in the project area. It is important to note that the proposed wind farm will be in the project area for a fairly long time. It is expected that after 20-25 years, new wind mills will replace the old ones. The project buildings will last about 50 years before they are replaced.

10.8 Impacts Beyond National Boundaries

The proposed Lake Turkana Wind Power Project will be located in the greater Marsabit District of the Eastern Province of Kenya. The project area is situated more than 200 km from Ethiopia border, the nearest country to the project area. The impacts of this project are not likely to adversely affect the environment of Ethiopia or any other country.

However, it should be noted that some of the avifauna that visit Lake Turkana have migrated from other countries. For example, thirty four (34) Palearctic migrants have been recorded around Lake Turkana and over 100,000 Little Stints (representing more than 10% of entire East African / South East Asia bird population) may over winter here. There is therefore the potential that the proposed project may affect the over wintering birds and the migration of birds on passage to other countries. As discussed above, the design and siting of the proposed wind park facility is unlikely to have any impacts birds. It is also unlikely that there will be any impacts of the proposed project beyond the national boundaries.

10.9 Impact of other Projects (Gilgel Gibe III Dam) on the Project Area

The development of hydropower development project along the basin of the Omo River in Ethiopia may affect the proposed Lake Turkana Wind Power Project albeit in an indirect way. The Federal Government of Ethiopia through the State owned electricity utility, Ethiopian Electric Power Corporation (EEPCCO), has currently embarked on the construction of the Gilgel Gibe III (Gibe III) Hydropower Dam. The Gibe III Hydropower scheme comprises a 240 m high dam which will create a huge reservoir of 200 km² with a live storage of 11,750 million cubic metres. This dam is expected to generate 1870 MW of hydropower on the Omo River. The project site is located about 80 km downstream from the confluence of the tributary Gilgel-Gibe and the Gibe River and is situated 503 km south of Addis Ababa in Wolayta-Dawro Province of Ethiopia. This power plant will be the third project on the Omo-Gibe river basin, which already has an operational 184 MW Gilgel Gibe I plant and a 420 MW Gilgel Gibe II plant that is currently under construction.

The construction of the proposed hydropower plant (Gibe III) is currently underway with over 30% of works completed. In this development, the Government of Ethiopia ("GoE") is planning to monetize its vast hydropower resources by exporting power to the sub-region. Approximately 3,100 GWh/annum shall be exported to Kenya, Sudan and Djibouti with the remainder made available for domestic use. The main purpose of the Gibe III Project is therefore to support the above plans by increasing the electricity generation capacity of the country in order to boost export revenues from the hydro electric power sales.

Like all the large dams, construction of the Gibe III dam on the Omo River is expected to cause both positive and negative environmental and social impacts on the main reservoir area, the power plant and camp sites and down stream area (EEPSCO, 2008). Indeed the impacts of the dam construction and operations are most likely to be felt all the way along the downstream Omo basin into Lake Turkana in Kenya. It should be noted that the Omo River is of tremendous significance to the hydrology of the Lake Turkana. It is the largest affluent to the lake and contributes some 18.6 billion m³ of water each year which is more than 98% of the total riverine inflow into the lake (Hughes and Hughes, 1992). The water inflow into Lake Turkana through the Omo River emanates from the rainfall received from the south-western highlands of Ethiopia.

Based on the information contained in the Gibe III Hydroelectric Project: Environmental and Social Impact Assessment Report (EEPSCO, 2008), it is evident that the current hydrological regime of the Omo River, is characterised by the following extreme critical events:

- Large and sudden floods (peak flows of up to 5,200m³/sec. with a return period of 30years at Gibe III site); and
- Extended drought periods (average flows down to 820m³ /sec at Gibe III site).

10.9.1 Positive impacts of the Gibe III Dam

The main impact of the Gibe III project on the Omo River is the regulation of the downstream hydrological regime. In this regard there will be an increase in the flows during the dry season and a reduction of the flows during the wet season due to:

- Control of the large and sudden floods occurring during the wet years (up to 5200 m³/sec at Gibe III with a return period of 30 years);
- Reduction of the extended drought periods (as the 1986-1987 ones); and
- Reduction of the evaporation losses which contribute to the current recession of Lake Turkana.

10.9.2 Negative impacts of the Gibe III Dam

While the above project has tremendous economic benefits to the Government of Ethiopia, the presence and operations of the reservoir and the regulation of the Omo River hydrological regime will cause some quite significant negative impacts on the downstream impacted area as outlined below:

- Cessation of the annual floods would be detrimental to the communities that practice flood recession agriculture in the lower Omo Valley. This will directly affect ethnic communities such as Dasenich, Karo, Hamar, Mursi, Murle, Mugugi and Hyangatom that rely on flood recession and river delta crops, as well as livestock for their subsistence. The potential loss of flood recession crop area, as well as grazing, would reduce their food supply and could possibly lead to conflicts over grazing areas.

- Construction of the Gibe III may cause reservoir trapping of sediments, thus creating oligotrophic conditions in Lake Turkana with subsequent reduction in lake productivity. This is likely to have negative effect on the downstream fisheries including reduction of fish yield and extinction of some fish species that strictly require floodplains for breeding.
- In addition, the reduction of the strength or loss of the seasonal flood pulse from the Omo River could reduce the rate of migratory and other spawning fish that would, subsequently result in decreased recruitment of fish stocks both in the flood plains and in Lake Turkana. This will have far reaching effects not only on the fishing communities around L.Turkana but also on other communities including those in the Turkana Wind Power Project area.
- The cessation or any abrupt decrease in the extent of floods will negatively affect the pastoral semi-nomadic way of life on the Lower Omo River, the Omo delta and the area around northern L. Turkana. Most of the negative impacts would be felt on the extensive floodplains of the Dasenech which are grazed for a substantial number of months both by the Dasenech tribe and the neighbouring ethnic groups. This is likely to instigate multiple conflicts in the utilization of dwindling natural resources, with related intensification of raiding parties and killings.

It is important to note that the above dam development is taking place at a time when Lake Turkana is currently undergoing a natural drawdown. Due to the current decreasing inflow from the rivers feeding the lake hydrological system, the present levels of Lake Turkana show a worrying tendency to decrease with its surface gradually shrinking. Consequently this will result on a progressive retreat of the shoreline that implies a reduction of the exploitable waters for fish resource exploitation. The downstream impact of the Gibe III upon Lake Turkana, a water body that is currently receding and the overall cumulative impacts upon the ecology and socio-economic dynamics on the surrounding area, is an interesting subject for the attention of the local community, Government and development partners.

10.10 Impact Evaluation and Significance

It should be noted that the impacts described above do not carry the same weight and some impacts have more serious implications than others. Having predicted both positive and negative changes that are likely to affect the various ecological, physical and social components of the environment, it is logical to evaluate their relative significance. However, the significance of the identified impacts as used in this report is a subjective matter. It is based on the professional judgement of the Consultant which in turn is based on the accumulated knowledge and experience from other projects. The terms “significant positive and negative impacts” as used in this study are defined as follows:

- Significant Positive Impact - Highly positive impact with substantial benefits leading to improvement of living standards of communities in the project area and beyond; and
- Significant Negative Impact - Severe negative impacts leading to major socio-economic losses and systems disruption which requires major mitigation measures.

The magnitude of the positive and negative environmental impacts of the development of proposed wind power project are summarised below in Table 9. The interpretation of the impacts ranking is presented in Table 10.

Based on the above ranking of the magnitude of impacts, stabilization of electricity sector, promotion of economic growth and potential for carbon market are the three major or significant positive impacts (+3) emanating from the development of the proposed wind power project. Medium positive impacts (+2) will be associated with increased employment, contribution to the

Government revenue, improved communication especially the rehabilitation of roads and provision of electricity in the project area and surroundings.

There are no significant negative impacts associated with the proposed wind power project. However, medium negative impacts (-2) of the project are likely to arise from birds' mortality through collisions with the turbines. Implementation of the proposed project is likely to cause a wide range of minor negative impacts (-1) including increased cultural contamination, noise levels and increased incidences of diseases, labour force management challenges, increased accident risks, loss of habitat, destruction of flora and fauna and disturbance to livestock activities among other negative impacts.

Table 9. Significance of the Main Environmental and Social Impacts

Nature of Impacts	Magnitude of Impacts	Remarks/Comments
Socio-economic Impacts		
Stabilization of electricity	+3	The introduction of 310MW in the national grid will alleviate power outages especially during the dry seasons and reduce heavy reliance on thermal power.
Promotion of economic growth	+3	This project will contribute to rural electrification, stimulate economic growth in Kenya and boost the growth of local economy.
Potential for carbon market	+3	The proposed project has the potential to generate immense carbon credit value in the range of €56,592,000 - €126,432,000.
Increased employment opportunities	+2	The local community will benefit from job opportunities for the semi-skilled and unskilled cadres who will form the bulk of the labour force
Increased contribution to Government revenue	+2	The project will contribute towards the boosting of Government revenue through corporation tax, EIA licence, PAYE and VAT among other taxes.
Provision of electricity in the project area and surroundings	+2	Power distributed in the project area and surroundings will stimulate economic and trade opportunities among the local people.
Improvement of roads in the project area	+2	Rehabilitated roads will improve communication in the project area and promote economic activities including livestock trade and fisheries.
Cultural contamination	-1	The labour force in the project area, may introduce unfavourable social behaviour leading to cultural contamination of the local community.
Increased exploitation of natural resources	-1	The increased number of workers is likely to make high demand on fuel wood resources of the project area.
Potential negative impacts of labour force	-1	The labour force is likely to indulge in harvesting of trees and charcoal making activities to the detriment of the environment of the project area.
Increased health and occupational hazards	-1	Increased involvement in the project's activities is likely to lead into increased occupational and health hazards
Increased accidents	-1	Over-speeding on the rehabilitated roads and increased project activities may lead to increase in accidents in the project area.
Increased insecurity and community conflicts	-1	Rehabilitation of the roads and opening up of the project area may lead to increased insecurity including increased incidences of armed crimes.
Increased incidences of diseases	-1	Influx of workforce in the project area is likely to lead to increased incidences of HIV/AIDS and other sexually transmitted diseases.
Visual intrusion	-1	Visual intrusion will be prominent during construction phase when project activities will result in deep cuts and accumulation of spoils in several sites of the project area.
Physical Impacts		
Increase in noise levels	-1	Increase in noise levels will mainly occur during the use of heavy machinery along the roads and in borrow pits

Increase in dust	-1	Increase in dust pollution will mainly emanate from road construction activities and operations in quarries and borrow pits in the project area.
Increased ponding conditions	-1	Likely to occur in the borrow pits and other areas where the road activities create excavations leading to depressions.
Gaseous air emissions	-1	Level of gaseous emissions will depend on the state of technology and the level of servicing of the vehicles, machinery and diesel generators used in the road rehabilitation activities.
Increase in soil erosion and siltation of lacustrine habitats	-1	Soil erosion will occur along the exposed road surface and other areas due to the effect of the runoff. The situation will be aggravated by the gradient of the terrain.
Biological / Ecological Impacts		
Impacts on avifauna	-2	Likely to arise from collisions of birds with the turbines in the wind park facility.
Loss of habitat and destruction of biodiversity	-1	The loss of habitat and biodiversity will mainly occur in the areas cleared to give way to the turbine foundation, power substation and staff houses.
Disturbance of livestock activities	-1	Livestock activities are likely to be disturbed by construction activities, fencing, and presence of wind turbines and operations of project activities.

Table 10. The Ranking of the Magnitude of Environmental Impacts Presented in Table 9.

Magnitude of Impact	Nature of Impact	Description	Ranking
Minor Impact	Minor Positive Impact	Slight benefits especially to local communities	+1
	Minor Negative Impact	Minor negative impacts at local level	-1
Medium Impact	Medium Positive Impact	Benefits likely to positively change (improve) quality of life in the project area	+2
	Medium Negative Impact	Impacts likely to adversely affect environment or quality of life in the project area if not mitigated	-2
Significant/ Major Impact	Highly Positive Impact	Substantial benefits leading to improvement of living standards of communities in the project area and beyond.	+3
	Major Negative Impact	Severe negative impacts leading to major socio-economic losses and systems disruption in the project area and beyond. Requires major mitigation measures.	-3

11. PROPOSED MITIGATION MEASURES

In order to alleviate negative impacts emanating from the implementation of the proposed wind project, promote sustainable development, and maintain a healthy environment in the project area, the developer through the contractor, environmental manager and other relevant agents, will undertake to institute several measures to reduce or alleviate the negative impacts of the project as presented below. In the application of mitigation measures, the project developer will basically adopt the International Finance Corporation (IFC) Environment, Health and Safety (EHS) Guidelines for the protection of the environment, the workers and the local community in the project area.

11.1 Mitigation of Negative Social-economic Impacts

11.1.1 Amelioration of socio-economic negative impacts

In order to maintain harmony among various communities in the project area, there will be a dire need to raise awareness about the project. Of special importance is awareness with regard to project benefits that different communities stand to gain. The project management should, however, guard against raising expectations that can not be met. All communities need to be kept abreast of all project development activities and should sufficiently be consulted on all matters that concern them. The project should engage a neutral person who is accepted by all the communities in the project area to interact with communities, raise awareness on the project activities and to resolve any conflicts that may arise between the project and the communities involved.

11.1.2 Reduction of the utilization of wood resources

As stated in the report, the increased population in the project area will make high demand of fuel wood resources. There is therefore a need for the provision of alternative source of energy during the implementation of the project to ensure that uncontrolled utilization woody resources does not take place in the project area. In addition there will be a need to explore more efficient ways of making charcoal through efficient kilns and saving energy through the use of efficient stoves such as **Kuni Mbili**. The project should encourage the local population through support of the relevant local CBOs to conserve the plant resources including participation in planting of trees in the project area.

11.1.3 Reduction of incidences of diseases

With regard to the influx of commercial sex workers into project area following the project activities, the project should be prepared for an increase in the prevalence of HIV/AIDS. To prevent the spread of HIV/AIDS in the project area, the developer and other stakeholders including the administration, community leaders, opinion leaders, and other stakeholders must organize and support education programmes to increase awareness and change public attitudes towards HIV/AIDS and other sexually transmitted diseases (STDs). In order to protect the project workers, there will be a need for the project developer to supply the workers with STD prevention devices including the male and female condoms.

11.1.4 Reduction of visual intrusion

All degraded areas resulting from the road rehabilitation and wind park construction activities including the quarries, borrow pits, cuts and fills and other disfigured

surfaces in the project area and environs, need to be landscaped and suitable grass, shrubs and trees planted to blend with the environment.

The presence of the wind park facility in otherwise an unspoilt natural environment is likely to be visually intrusive to some people. It has the potential to detract observers from the normal scenery. It is therefore necessary to paint the turbine, mast, blades and other components with colours that blend with the environment especially shades of pale green, brown and gray in order to further reduce visual intrusion in the project area.

It may, however, be noted that the wind park is not an ordinary sight and being a novelty, could be appealing to a wide cross-section of local community, other Kenyans and even foreign visitors. Indeed it could as well be a local attraction drawing many observers from beyond the project area.

11.1.5 Management of labour force

The labour force engaged in the rehabilitation of the road and construction of the wind park facility have potential to degrade the environment of the project area as discussed in earlier sections of the report. The project management should therefore put in place mechanisms to deter the work force from engaging in cutting of trees for fuel wood, charcoal burning, and building material and for any other purposes. Due to the sensitivity and vulnerability of the project area, the developer / contractor should use pre-fabricated material (which can later be retrieved at the end of the project) in building the labour camps. This will deter the labour force from unnecessary cutting and trampling of vegetation and enhance the protection of the scanty natural vegetation of the project area.

In order to maintain a healthy environment for the labour force, the project management should put in place suitable measures to clean the environment associated with labour camps. This will include proper disposal of human waste. The developer / contractor needs to put in place mechanisms for the collection of all wastes generated (solid wastes, organic wastes, food remains, garbage etc.), in the labour camps, segregate the various wastes and arrange for subsequent disposal through either efficient incineration or disposal in a sanitary landfill.

11.1.6 Compliance with national and international labour laws and policies

The proposed project will comply with the Kenya laws that protect labour standards and the employment guidelines stipulated in the Labour Relations Act (2007) and the Employment Act (2007).

1. **The Labour Relations Act (2007)** – An Act of Parliament to consolidate the law relating to trade unions and trade disputes, to provide for the registration, regulation, management and democratization of trade unions and employers organizations or federations, to promote sound labour relations through the protection and promotion of freedom of association, encouragement of effective collective bargaining and promotion orderly and expeditious dispute settlement, conducive to social justice and economic development.
2. **The Employment Act (2007)** – An Act of Parliament to declare and define the fundamental rights of employees, to provide basic conditions of employment of employees and to regulate employment of children. In this regard, the Project Developer will comply with the legal conditions set to

protect the rights of employees with special attention to gender equality and representation; all forms of discrimination, employee entitlement to normal leave, maternity leave and sick leave; sexual harassment; forced/compulsory and child labour and working hours

The project will also be in conformity with the International Finance Corporation (IFC) policies on labour especially forced labour and child labour. IFC will not support projects that use forced labour or harmful child labour as defined below.

1. **IFC Policy on Child Labour** - Employment of children that is economically exploitive, or is likely to be hazardous to, or interfere with the child's education, or harmful to the child's health, or physical, mental, spiritual, moral and social development.
2. **IFC Policy on Forced Labour** - All work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty.

In addition the project will comply with labour norms based on standards set by international conventions and the International Labour Organization (ILO).

11.1.7 Waste management

During the operation phase of the project, waste management will mainly involve disposal of solid wastes and human wastes. The project therefore needs to put in place procedures for the collection of solid material from the staff houses, offices and other areas of the wind park facility for subsequent disposal either through burning in an efficient incinerator or disposal in a landfill facility.

The main concern with regard waste management is the human waste. There will be a need to keep living quarters in the area of operation in a satisfactory degree of sanitation in order to prevent outbreak of diseases. The management of human waste in the project area should be done through use of suitable disposal systems including a combination of septic tanks and pit latrines as found appropriate. Septic tanks will be appropriate where there is excellent permeability of soils. In addition there should be availability of sufficient water for WC flushing. Pit latrines are essentially appropriate for low cost dwellings. The pit latrines should be deep, clean and without any offensive smell. They should also be free of fly and mosquito nuisance. This sanitation facility should consist of what is now referred to as a ventilated improved pit latrine (VIP) with good quality concrete floor slabs.

11.1.8 Resettlement action plan

In a project of this magnitude where the developer has to contend with the acquisition of a large area of land, involuntary resettlement of displaced local communities becomes a thorny issue. In such cases the donors would prefer that the developer follows the guidelines contained in the World Bank (WB) Operational Policy on Involuntary Settlement (OP 4.12) in the resettlement of the project affected persons (PAPs). The WB guidelines recognize that involuntary resettlement brought about by development projects, if unmitigated, is likely to cause severe economic, social and environmental risks. The policy addresses direct economic and social impacts that are caused by the involuntary taking of land, resulting in:

- Relocation or loss of shelter;
- Loss of assets or access to assets; and

- Loss of income sources or means of livelihood, whether or not the affected persons must move to another location.

For projects that involve involuntary taking of land, Bank requires the preparation of a resettlement policy framework (RPF) to guide the project as sub-projects are selected and specific resettlement action plans (RAPs) for each sub-project are prepared. The RPF must be ready, accepted and publicly disclosed before the Bank will appraise the project and it is expected to define the principles and procedures for resettlement operations: land acquisition, valuation, compensation and reporting for the wind sector investment in accordance with national and Bank safeguard policies related to involuntary resettlement; (OP 4.12).

The Bank's policy advocates that where feasible, involuntary resettlement should be avoided or minimized. In addition, the resettlement must be conceived and executed as a sustainable development program, providing sufficient investment resources to enable persons displaced by the project share in project benefit. In this case persons displaced must be:

- Meaningfully consulted and should have opportunity to participate in the planning and execution of the resettlement;
- Compensated for their losses at full replacement cost prior to civil works;
- Assisted with the move and supported during the transitional period in the resettlement site; and
- Assisted in their effort to improve their former living standards, income earning capacity and production levels or at least to restore them.

Although the acquired project land in the proposed Lake Turkana Wind Power Project is quite large (150km²), the extent of the land that will be used for the establishment of the wind park is very small indeed. It should be noted that the actual area that will be covered by the proposed 365 turbine foundations will amount to a total of about 1-2 acres of land. This represents a very small amount of land lost when compared to the total land covered by the project area that amounts to thousands of acres. It should also be emphasized that the project area will not be fenced (except for the substation) and the pastoralists can access the area for grazing purposes and settlement.

Project activities connected with the road rehabilitation will not displace local communities in the project area or any section traversed by the earmarked road between Marsabit and Loiyangalani. The proposed road rehabilitation will follow the current Right of Way (ROW) for the existing road and therefore, there will virtually be no displacement of local people and destruction of property including the community manyattas.

The population of the local communities affected by the proposed project is very low. The population of Loiyangalani Division is estimated to be in the tune of 20,000 people with a density of a 1.3 persons per km², the lowest population density in the Marsabit District and one of the lowest in the country. The estimated population of the project area is also very low probably in the tune of 200 inhabitants or so scattered over 150 km² of land area. The nature of the proposed project (as explained above) is such that it will not displace any member of the affected local community. In addition, the project will not destroy any of the manyatta or any other property in the project area. Hence there is no need to develop a resettlement action plan (RAP) for the proposed wind project in the project area.

11.2 Action Plan for Occupational Health and Safety

During the construction, operation and decommissioning phases of the proposed project, the project developer will mainly adopt the IFC Occupational Health and Safety (OHS) Guidelines for wind energy projects in the prevention of accidents, containment of health hazards and management of security and fire outbreaks among other contingencies in the project area.

11.2.1 Prevention of accidents

Implementation of the project will definitely increase volume of human and motor traffic in this remote area. The increase in human and motor traffic will be aggravated by the transportation of construction materials and plant accessories and other equipment required to install the wind park. This is likely to result in a higher risk of accidents occurring in the area of operation during the road rehabilitation, wind park construction, wind park operation and de-commissioning phases. Since accidents could result in loss of work time, different levels of disability and fatalities, the project developer should put in place mechanisms to reduce the number of accidents among the project workers (whether directly employed or subcontracted) to a rate of zero. The project developer should design and implement safety measures for the prevention of accidents. In addition, there will be a need to develop emergency plans to contain accident risks associated with project activities including vehicular transport, operation of machinery, equipment and other related activities.

Project workers need to be educated on the use of unfamiliar machinery, equipment and tools that may cause a danger to the users. In addition, the workers should be provided with safety instruction manuals and other essentials to contain accidents. Proper and appropriate road traffic signs, markings, and road furniture should be installed on the rehabilitated road sections. Workers should be provided with protective clothing (nose and mouth masks, ear muffs, overalls, industrial boots and gloves) and helmets.

In addition to the above measures, the following precautions should be taken to minimize the impacts of accidental oil leakages and spills, if they ever occur during the course of project implementation and de-commissioning. Proposed precautions include:

- Establishment of an appropriate preparedness programme;
- Training of relevant personnel; and
- Provision of relevant spill mitigation equipment including adsorbent material, leakage plugging devices, foam cover spraying equipment and oil skimmers and water spraying equipment among other measures to contain accidents.

11.2.2 Health issues

During the construction, operation and de-commissioning phases of the proposed project, attention must be focused on the health of workers in order to attain health conditions that will permit them to lead socially and economically productive lives. Proper disease control, disease prevention and treatment and methods of raising awareness must be employed among the project workers in order to minimize disease incidences and reduce morbidity.

Of particular importance to the project workers are health issues relating to HIV/AIDS in the project area. AIDS (Acquired Immunodeficiency Syndrome) was first diagnosed in Kenya in 1984 and now has become a serious health and economic

problem in the country. The project workers and the surrounding local community must be educated on the strategies of minimizing the risk of contracting HIV/AIDS including the use of male and female condoms.

In order to enhance health conditions in the project area, there is need for the Lake Turkana Wind Power Project to set up a local medical unit to provide health care to both the project workers and the local community.

In addition the project developer should provide a conducive working environment including integrity of workplace, adequate lavatory facilities, potable water supply, clean eating area, lighting, appropriate access, first aid among other facilities as recommended in the IFC Environmental, Health and Safety (EHS) Guidelines (IFC, 2006).

The developer should put in place mechanisms for the provision of adequate health care for workers, safety of workers and compensation to employees for work related injuries and diseases contracted in the course of their employment, in accordance to the laws of Kenya and as stipulated in the Public Health Act (2007), Occupational Safety and Health Act (2007) and Work Injury Benefits Act (2007).

1. **The Public Health Act (1986)** – An Act of Parliament to make provision for securing and maintaining health.
2. **The Occupational Safety and Health Act (2007)** – An Act of Parliament to provide for the safety of workers, and all persons lawfully present at work places.
3. **The Work Injury Benefits Act (2007)** – An Act of Parliament to provide for compensation to employees for work related injuries and diseases contracted in the course of their employment.

11.2.3 Security

Despite the fact that Loiyangalani including the project area is a relatively peaceful area, the surrounding areas especially to the north are fraught with insecurity problems. The developer should therefore take precautions to beef up the security of the wind park and the staff quarters. There will be a need to hire services of the local guards. However, the local guards will need to be reinforced by a more professional security force from the leading security firms in Kenya. In addition an alarm system should be installed as a back up for the above outlined security measures. Even more important, the project management should cultivate harmonious co-existence between itself and the local communities in the project area.

11.2.4 Fire protection

All the building should be designed constructed and operated in full compliance with local building codes and regulations and should be in conformity with internationally accepted life and safety standards. In addition, adequate measures should be taken against the potential fire hazards in the project area. They include installation of functional fire protection systems such as water based fire fighting system with water hydrants strategically placed to cover the whole wind park premises. In addition, CO₂ based portable and fixed fire extinguishers need to be sited at strategic positions to cover the staff premises. The above fire protection systems should be backed by a reliable service provider to service the appliances at least on a quarterly basis.

11.2.5 Other measures to enhance occupational health and safety

Other measures to enhance occupational health and safety in the project area include:

- Provision of a fully equipped first aid kits in the project area during the project construction and operational phases ;
- Provision of medical cover for all staff in order to enhance health standards at the wind park facility;
- The health staff, environmental manager and other relevant workers should be well trained to act as Safety Officers after acquiring adequate knowledge and experience on first aid training and excellent knowledge of safety regulations;
- The Contractor should have Workmen's Compensation Cover for the workers;
- The project should conduct health and safety audits regularly for all the workers on an annual basis;
- Take measures against risks of electrical shock;
- Conduct environmental audits for the wind park in accordance to the requirements of NEMA;
- Put in place mechanisms aimed at acquiring ISO 14001 certification on environmental management and Occupational Health and Safety Standard Certification (OHSAS 18001) for the proposed wind park facility;
- Conduct training programmes covering several aspects of safety, customer care, defensive driving, first aid, HIV/AIDS, environmental awareness, swimming and life saving activities among other training aspects.

11.3 Compliance with IFC Performance Standards

The International Finance Corporation (IFC) Performance Standards are environmental and social standards IFC applies to all the projects it finances to minimize their impacts on the impacted environment and the affected communities. The Project Developer is expected to comply with the eight IFC standards throughout the project life. The standards are listed below as follows:

1. Performance 1 – Social and Environmental Assessment and Management System;
2. Performance 2 – Labour and Working Conditions;
3. Performance 3 – Pollution Prevention and Abatement;
4. Performance 4 – Community Health, Safety and Security;
5. Performance 5 – Land Acquisition and Involuntary Settlement;
6. Performance 6 – Biodiversity Conservation and Sustainable Natural Resource Management;
7. Performance 7 – Indigenous Peoples; and
8. Performance 8 – Cultural Heritage.

11.4 Mitigation of Impacts on Physical Environment

11.4.1 Control of dust and gaseous emissions

The dust particles and the chemical substances contained in gaseous emissions may cause eye and throat irritations even at low levels. Respiratory illness, lung damage and other health hazards are likely to occur when the workers are exposed to high concentrations of the dust and gaseous emission pollutants and for a long time.

To mitigate air quality impacts during the implementation of the road rehabilitation wind park construction activities, emissions of dust, smoke and other substances should be limited through good practices. These include watering of access routes,

deviations and other disturbed sites, use of dust extractors and covering of lorries and other vehicles transporting construction materials. Appropriate selection of machinery will also minimise pollution from the gaseous emissions. Workers involved in construction activities that generate dust and gaseous emissions should be provided with appropriate protective devices to cut down on dust and gaseous emissions inhaled. These will include masks, helmets and appropriate overalls.

Gaseous emissions produced during the operations of the wind park facility will be minimal. Wind energy is very clean energy option when compared to other modes of energy. For example, it has been shown that wind turbine produces 8 grammes of carbon dioxide (CO₂) when generating 1KWh of electricity, while the corresponding amount for the coal fired power station is 826 grammes of CO₂.

11.4.2 Reduction of ponding conditions

The road rehabilitation, wind park construction and other project activities may lead to creation of stagnant water bodies in quarries, borrow pits and other depressions created during the construction works. Although water collected in the depressions may be a respite for the pastoralist, the resultant stagnant water bodies are likely to be suitable habitats for the breeding of mosquitoes and snails that are disease vectors for malaria and bilharzias respectively. Measures should therefore be put in place to improve impeded drainage in the project area through landscaping and filling in the created depressions.

Although the project area is situated in an arid zone, occasional high volume of runoff in the laggas should be adequately accommodated in the road design which should allow for bridges, culverts and drifts at appropriate locations. In addition, the road design should also provide side drains, and mitre drains to direct the runoff away from the rehabilitated road.

11.4.3 Reduction of soil erosion and siltation

As seen from above, activities associated with the implementation of this project may stimulate increased soil erosion in the project area. This will mainly emanate from the road rehabilitation activities, operations of borrow pits and quarries, construction of the wind park and installation of turbines and other related activities. There is therefore, a need to carry out a serious programme to rehabilitate the degraded environment. A major environmental problem will emanate from the disposal of loose earth which is likely to be a source of silt in the run off especially during the rainy season. Immediate action should therefore be taken to address the issue of soil erosion and the potential for the siltation of the shore environment of Lake Turkana. In this connection the following measures need to be carried out:

- Silt traps to be installed to prevent sediments from entering the laggas leading into Lake Turkana;
- Proper terracing and landscaping of the affected area; and
- Planting of sediment binding grasses such as *Sporobolus spicatus* and other suitable grasses on the exposed slopes and other surfaces.

11.4.4 Noise abatement

Relatively high noise levels in the project area will mainly emanate from the road rehabilitation activities and during the construction of the wind park facility. In addition, high levels of noise are likely to prevail in the project area due to use of motor vehicles and heavy machinery especially at the quarries, borrow pits and

crusher plant. Noise control measures should be implemented if noise levels in the project area exceed 90 dBA for 8 hours. Protection at the individual level against the effect of noise should also be provided. Sound levels reaching the inner ear may be effectively attenuated by the use of hearing protective devices such as ear plugs and ear muffs particularly when noise levels exceed 85-90 dBA. In addition, regular audiograms should be conducted for employees as proof that sound control and hearing protection measures are effective in preventing hearing loss.

The Project Developer should comply with IFC Environment, Health and Safety (EHS) Guidelines especially the Noise Limits for Various Working Environments. Under the above IFC Guidelines, no employee should be exposed to a noise level greater than 85 dBA for a period of more than 8 hours per day without hearing protection.

As discussed above in Section 10.2.11 - Increased noise levels, modern Vestas turbines are associated with low noise levels. These turbines mainly emit low frequency sound or the so called infrasound in which human beings require high levels for perception. It is therefore unlikely that there will be any noise disturbance emanating from the presence and operations of the proposed wind park facility in the project area. The proposed project should meet the IFC conditions for the noise limits for various working environments especially 45-50 dBA for open offices, control rooms, service counters or similar environments and 40-45 dBA for individual offices.

11.5 Mitigation of Impacts on Biological Environment

11.5.1 Restoration of habitat and biodiversity

Following the implementation of the project activities, the natural vegetation in the disturbed areas have virtually no chances of survival. The project management should therefore undertake to restore the lost biodiversity on the disturbed area. This needs to be done through planting of appropriate trees such as *Acacia tortilis* and shrubs such as *Acacia nilotica*, *Acacia reficiens*, *Indigofera spinosa* and *Sericocomopsis hildebrandtii* on the landscaped area in order to increase plant biodiversity and enhance aesthetic value of the wind park.

11.5.2 Measures to avoid disturbance of livestock activities

Since the major land use of the project area is livestock keeping, measures should be put in place to avoid disturbance of livestock activities especially grazing/browsing and access to watering points. In addition, the wind park should be designed in such a way that it will not significantly decrease the livestock grazing/browsing area. In order to avoid any disturbance to livestock activities, the project developer should not undertake to fence the wind park, thus allowing the livestock to graze/browse and move freely within the project area. However, a small area (10mX10m) around the turbine foundation will be fenced to avoid interference of the wind turbines by the livestock or other animals. The developer will avoid siting the wind park facility across the livestock watering pathways.

11.5.3 Reduction of impacts of wind park on birds

The main environmental concerns when constructing wind parks has been birds colliding with the turbines especially in areas where large numbers of migratory birds pass. Most of the potential impacts of wind park on birds can be reduced to acceptable levels through careful siting, design and mitigation as outlined below:

- It should be noted that cumulative effects of large wind farm installation may be considerable especially where wind park acts as a barrier and bird movements are consequently displaced. This may lead to the disruption of ecological links between feeding, breeding and roosting areas. A suitable wind park design can alleviate barrier effect to birds by allowing wide corridors between clusters of turbines.
- In order to avoid or minimize birds' collisions, the project developer should retain unattractiveness of the wind park site and its vicinity to birds. For example within a radius of 2-5 km around the wind park, the developer should avoid any introduction of open water habitats, sewage ponds, or open dumps.
- Perhaps the most important mitigation measure against birds' collisions in the project area is the siting of the wind park. Siting of the wind park should be done as early as possible in the planning stage. The wind park should be sited away several kilometres (at least 3km) from Lake Turkana shore and also away from the forested areas of Mt Kulal (at least 1km) and other mountains and hills of the project area.
- Lighting of turbines has the potential to attract birds, especially at night and in bad weather, thereby potentially increasing the risk of collisions. Any intensive lighting of the wind turbines should be avoided to reduce attractiveness to nocturnal bird migrants.

12. PROPOSED ENVIRONMENTAL MANAGEMENT PLAN

Environmental Management Plan (EMP) should fully be integrated with the overall management of the proposed Lake Turkana Wind Power Project. Its effective planning and implementation will be the responsibility of the project developer. Its aim is to develop an efficient implementation instrument and support tool for sustainable environment management of the project area and the immediate surroundings.

12.1 Objective of the Environmental Management Plan

The main objective of the environmental management plan (EMP) is to provide guidance on how to protect the environment during the project implementation and thereafter. The EMP outlines the procedures for the implementation of the proposed mitigation measures and other procedures that will be undertaken to ensure environmental protection of the project area in compliance with environmental laws and regulations. The EMP will be carried out during all the stages of the project implementation from pre-construction right through to decommissioning. In addition, it will involve all relevant stakeholders in the environmental management of the project.

12.2 Organizational - set up for the Implementation of the Management Plan

The Project Developer will have executive responsibility for the implementation of the EMP. The Project Developer will, however, be assisted by a core of several experts including the Contractor, Resident Engineer and the Environmental and Social Development Manager on day to day aspects of decision making in the implementation of the EMP. In addition to the above in-house team, other relevant stakeholders will have an important role to play in the environmental management. They include representatives of the National Environmental Management Authority (NEMA) as represented by the District Environmental Officer (DEO) in Marsabit/Laisamis, Kenya Wildlife Service (KWS), the local administration including the District Officer (DO) Loiyangalani and Mt. Kulal Divisions, the Chief and Assistant Chief, Loiyangalani Location, relevant Government officers (Fisheries Officer, Livestock Officer, Cooperatives Officer), Member of Parliament for the Laisamis Constituency, community (Turkana, Rendille, Samburu, El Molo and Gabra) representatives and opinion leaders, faith based organizations (FBOs), NGOs, CBOs and other interested parties will also play their different roles in the implementation of the EMP. Details on the implementation of the environmental management plan are contained in Table 11 while the cost estimates for the proposed EMP are contained in Table 12.

12.3 The Need for Environmental Monitoring

Environmental monitoring will also be a responsibility of the Project Developer since it is an essential tool in relation to environmental management. Environmental monitoring provides the basis for rational management decisions regarding impact control and mitigation. Monitoring is envisioned as an important process in the protection of environment of the project area. It will reveal changes and trends brought about by the presence and operations of the installed wind park facility. By using the information collected through monitoring, impact mitigation and benefit enhancement measures can be improved and projects works or operations will be modified or halted when necessary. The project management will therefore undertake to conduct sustained environmental monitoring of the project area during the life of the Lake Turkana Wind Park Project.

12.3.1 Basic attributes of environmental monitoring

As stated above, environmental monitoring is envisioned as an important process in the proposed management plan. It will reveal changes and trends brought about by the presence and operations of the proposed Lake Turkana Wind Power Project. The project developer or the appointed agents and other relevant parties will undertake to conduct sustained environmental monitoring of the project area putting into consideration the following attributes:

- Monitor changes in the environmental conditions of the project area through collection and analysis of appropriate environmental data through out the life of the project;
- Check the extent to which the mitigation and benefit enhancement measures have been adopted and their effectiveness in practice;
- Provide a mechanism whereby unforeseen or unexpected impacts during the ESIA study can now be identified and provide measures to mitigate the unexpected negative impacts;
- Prepare periodical reports and liaise relevant bodies and authorities through an established forum in order to discuss and resolve issues arising from the monitoring process; and
- Prepare the annual Environmental Audit (EA) report to NEMA and implement any subsequent recommendations arising from the EA report.

12.3.2 Significance of environmental monitoring

The significance of monitoring stems from the fact that the inputs derived from the Environmental Impact Assessment (EIA) into the project design and planning, including mitigation measures and environmental management plan are largely based on “predictions”. It is therefore essential that the basis for the choices, options and decisions made in formulating or designing the project and other environmental and social safeguard measures are verified for adequacy and appropriateness during the monitoring process. Monitoring verifies the effectiveness of impact management, including the extent to which mitigation measures are successfully implemented. The results of environmental monitoring will determine the success and efficacy of the proposed mitigation measures in protecting the environment.

12.3.3 Monitoring arrangement and the way forward

Environmental monitoring will commence following the securing of permit from NEMA and the recruitment of the project Contractor, the Resident Engineer and Environmental Manager. Once the project is underway, the developer (as represented by the Environmental and Social Development Manager and Resident Engineer) and representatives of NEMA, local administration, relevant Government officers, community leaders and other relevant stakeholders will regularly visit the project area to review and ascertain that the clauses and conditions set by NEMA for the protection of the environment (as stipulated in Annex 11 - NEMA’s Conditions of Approval of the EIA Study Report) are adhered to by the Contractor.

As part of regular project activity, monitoring will involve systematic collection of data through a series of repetitive measurements and observations. Monitoring reports

prepared by Environmental Manager will be reviewed by NEMA to ensure that proposals contained in the EMP are being carried out by the Contractor as required. The project will also conduct periodic interviews with project beneficiaries and other stakeholders in order to assess their opinions with regard to the implementation of the project. Details on the responsibility for monitoring and monitoring indicators are presented in Table 11 – Proposed Environmental Management Plan. Finally the Environmental and Social Development Manager will analyse the collected data and information collected and subsequently compile and formalize the monitoring report in accordance with the set guidelines and timeframes and submit it as the Annual Environmental Audit Report (EA) to NEMA.

12.3.4 Focus areas for monitoring

The developer is expected to will carry out monitoring on both terrestrial and aquatic environments of the project area and surroundings including Lake Turkana with a focus on the following key environmental variables:

- Changes in biodiversity;
- Occurrence of avifauna mortality;
- Any changes in livestock activities;
- Changes in water quality including increase in pollution;
- Soil erosion and siltation;
- Noise levels;
- Local community dynamics
- Spread of diseases
- Increase in social problems; and
- Other relevant ecological, socio-economic and environmental attributes.

A brief on what needs to be carried out on key environmental and social attributes of the proposed monitoring programme is given below as follows:

Baseline field study on avifauna

It should be emphasized that during the monitoring process, there will be a need to carry out investigations to verify predictions made during the course of environmental impact assessment study especially the impacts on the avifauna of the project area. In this regard it is proposed that a minimum one-year baseline field study should be undertaken to determine the use of the study area by birds and to identify, any bird species that may be adversely affected by wind park presence and operations. With respect to the ecology of birds, the proposed baseline study will encompass at least the following:

- Effects of habitat loss, disturbance and displacement on birds of the project area;
- Impact of the wind park as a barriers to birds' movement;
- Occurrence of birds' mortality through collision with turbines;
- Effectiveness of wind park siting and turbine design on the mitigation of negative impacts.

Movement of livestock

Disturbance of livestock activities by the proposed wind project was one of the main concerns raised by the local community during the stakeholders' consultations in the project area. Although there will be no fencing (except for the turbine foundation and substation), it is still necessary to conduct monitoring of any impacts the project may have on livestock activities including any effect on livestock watering passages.

Climatic variables

Climatic factors constitute important and fundamental environmental variables that constitute an essential component of the proposed monitoring programme. In this respect, rainfall, relative humidity, temperature and wind movements are key climatic elements that need to be monitored in the project area. This is of particular importance since the project area currently does not have any reliable basic climatic data.

Hydrology and water quality

Currently the Water Resources Management Authority (WRMA) has not installed any gauging stations or any laboratory to monitor hydrological and water quality parameters on Lake Turkana or any other water resources of the project area. The project should therefore develop a programme for water sampling and liaise with a reputable laboratory for the analysis of hydrological and water quality parameters of the water resources of the project area.

Soil erosion and wind erosion

Already the local community has raised concern over the erosive dynamics of the laggas in the project area. Hence the importance of conducting regular monitoring of soil erosion including sheet wash, rill and gully erosion, fluvial erosion, lateral river channel changes, mass movements and wind erosion in the project area. Monitoring of soil and wind erosion will provide valuable information not only on the local erosion rates but will also serve as an important indicator of environmental degradation in the project area.

Changes in human population and social dimensions

Following the commissioning of the proposed project, it is expected that more people are likely to be attracted to the project area in search of employment opportunities. Due to the social implications the proposed project is likely to have, the project should monitor changes in the human population, changes of life styles, increase of unplanned settlements and other related social attributes in the project area.

Increase in disease incidences

With the influx of people in the project area including the project workers and the service and material providers, it is expected there will be an increase in diseases incidences especially the sexually transmitted diseases (STD) including HIV/AIDS. Hence the importance of monitoring this health aspect since the local health facility currently does not have any data on the HIV/AIDS.

Other parameters.

In addition to the above described parameters, there is a need to monitor the following variables:

- Changes in water and air quality;
- Siltation of riverine and lacustrine systems;
- Changes in resource use and charcoal burning activities;
- Noise levels;
- Dust and gaseous emissions;
- Increase in accidents; and
- Any other relevant changes in ecological, socio-economic and environmental attributes.

12.3.5 The Need to recruit an environmental and social development manager

In order to conduct a sustainable environmental monitoring of the project area and thus protect environment from negative impacts of operations of the proposed project, there will be a need to engage an Environmental and Social Development Manager to be stationed at the project area. This officer will initiate and operationalize the proposed mitigation plan and make plans to conduct environmental monitoring on a regular basis. In addition he /she will make plans to sensitize the local community on the socio-economic impact of the wind park development and operationalize a grievance mechanism in the project area. The recruited manager will possess appropriate training and experience on environment and socio-economic background with at least a Masters degree in environmental sciences, socio-economics or natural resources management.

12.3.6 Terms of reference for environmental and social development manager

The main responsibility of the proposed Manager is to carry out a sustainable environmental management of the project area and ensure a healthy environment for the project workers. He /she is expected to carry out the following main duties:

- Conduct surveys and monitor the environment of the wind park facility on a regular basis;
- Facilitate regular collection and analysis water, waste water and other ecological samples through use of suitable laboratories;
- Liaise and establish networks for exchange of information and ideas with relevant institutions including the KenGen, KPLC, Government Chemist, National Environmental Management Authority (NEMA), Nature Kenya, KWS, Universities, Meteorological Department, Marsabit County Council, and the National Museums of Kenya among other relevant institutions on matters concerning environment;
- Prepare environmental reports and briefs to the project management on the state of the environment of the project area and emerging trends if any; and
- Formulate strategies and counter measures to protect the environment from unforeseen impacts.
- Educate and raise awareness among the local community on the environmental challenges facing the project area and mobilize their support in environmental conservation.

12.4 Cost Estimates of Environmental Management

The cost estimates for the proposed environmental management will include variables such as remuneration for the proposed environmental officer, transport expenses, construction of silt traps, landscape of relevant areas in the project area, waste management, purchase of incinerator, purchase of consumables, payments for sample analysis, report writing and other documentation and miscellaneous expenses. The total cost for the protection of the environment and other related activities is estimated at KSh 26,410,000 (€241,814). A summary of cost estimates is presented below in Table 12.

Cost estimates for subsequent years will be determined by the recruited Environment and Social Development Manager as well as the entry into force of the Lake Turkana Wind Power Corporate Social Responsibility Programme.

Table 11. Environmental Management Plan for the Proposed Project

Item	Environmental Impact	Mitigation Measures	Responsibility for Implementation	Site of Implementation	Implementation Schedule	Responsibility for Monitoring	Monitoring Indicators
1	Reduction of cultural contamination	Raise awareness among the local community on potential impacts of interacting with the labour force.	LTWPP/ Contractor/ Local Administration	In the project area and along the towns and settlements between Marsabit and Loiyangalani.	Before commencement and during the project implementation periods.	The Chief, Ministry of Culture, NEMA, Resident Engineer, Environmental Manager	No. of meetings to raise awareness; Cases of anti-social behaviour reported; Cases abuse of drugs and illicit alcohol reported.
2	Negative impacts of labour force	Put in place mechanisms to deter the work force from engaging in poaching of wildlife and cutting of trees for fuel wood, charcoal burning and building material. Use pre-fabricated material (which can later be retrieved at the end of the project) in building the labour camps.	Contractor Contractor	Along the rehabilitated road, around borrow pits and in the vicinity of the wind park facility.	During the project implementation period.	Ministry of Labour, NEMA, Resident Engineer, Environmental Manager.	No. of complaints received; No. of structures built with pre-fabricated materials; No. of charcoal kilns on in the project area, number of trees cut. .
3	Pollution from labour camps	Use suitable human waste disposal systems including a combination of septic tanks, solar and pit latrines as found appropriate Segregate solid wastes in the RE, Contractor and labour camp units and arrange for subsequent disposal through either efficient incineration or disposal in a sanitary landfill.	Contractor Contractor	In the Resident Engineer/ Contractor camps and labour camp units	During project construction and implementation stages	NEMA, Resident Engineer, Environmental Manager and Ministry of Health.	No. of WC, solar and pit latrines constructed; No. of solid waste receptacles installed; No. and type of incinerators installed; Landfill facility identified and utilized.
4	Increase in accidents and occupational hazards	Design and implement safety measures and emergency plans to contain accidents risks Install appropriate road traffic	LTWPP/ Contractor	Along the road to be rehabilitated, borrow pits, within the wind park facility and other sites of the	During construction and operation stages of the proposed project.	Ministry of Health, Resident Engineer, NEMA, Environmental Manager.	No of complaints from workers and local community; No. of traffic accidents; No. and

		signs, markings and road furniture on the rehabilitated road. Provide workers with protective clothing (nose and mouth masks, ear muffs, overalls, industrial boots and gloves) and helmets as applicable.		project area where project activities will be taking place.			type of protective clothing and gear provided to workers.
5	Increased incidences of diseases such as HIV/AIDS	Raise awareness and support mechanisms to prevent and control spread of diseases among the project workers and local communities.	LTWPP/ Contractor/ Local Authority/ Ministry of Health	Along the road to be rehabilitated, labour camps and residential areas of senior project workers.	Before the commencement of the road rehabilitation, during construction stage and in the operation stage.	Ministry of Health, Health centres, National AIDS Council, NEMA and the Environmental Manager.	Incidences of STDs among workers and local community; No. of cases treated; No. condoms dispensed to workers and local community; No of meetings held to raise awareness on HIV/AIDS.
6	Visual intrusion	Rehabilitate all degraded areas through landscaping and subsequent planting of suitable grass, shrubs and trees to blend with the environment.	Contractor	Along the rehabilitated road, access roads, around borrow pit sites and other sites that have been affected by project activities.	After the completion of project construction activities.	NEMA, Resident Engineer, Environmental Manager.	No. of sites landscaped and terraced; No and type of trees and shrubs and amount of grass planted.
7	Increase in noise levels	Use of protective hearing devices such as ear plugs and ear muffs among workers when noise levels exceed 85-90 dBA. Selection of appropriate machinery and regular servicing of machinery and vehicles.	Contractor	In areas where project activities are taking place.	During construction and operation stages.	NEMA, Contractor/ Resident Engineer, Environmental Manager.	No. of complaints from local residents; Noise Levels recorded; No. and type of protective hearing devices dispensed to workers.

8	Increased ponding conditions	Improve impeded drainage through landscaping and filling in the created depressions.	Contractor	Along the access roads, around borrow pits and quarries and all the sites where project works have created depressions.	Immediately after construction stage.	NEMA, Resident Engineer, Environmental Manager.	No. of drains and depressions rehabilitated
9	Increased soil erosion and siltation	Where applicable install silt traps to reduce sediment load directly entering riverine environments. Carry out terracing and landscaping of the disturbed sites as appropriate Plant sediment binding grasses, shrubs and trees on the exposed slopes and other surfaces as appropriate.	Contractor	In disturbed sites where there are cuts and fills in the vicinity of bridges and culverts, around borrow pits and exposed slopes.	During construction	NEMA, Environmental Manager, Resident Engineer.	Number of silt traps; No. of sites landscaped; Levels of turbidity recorded in the receiving waters.
10	Increase in dust levels	Limit levels of dust through good practice such as watering of access routes, construction sites, deviations and other disturbed sites and cover lorries transporting construction materials. Provide workers with appropriate dust protective gear including masks and overalls.	Contractor	Along the access roads, at borrow pit sites and other sites where project works are taking place.	During construction stage and in other phases where dust levels are emitted	NEMA, Resident Engineer, Environmental Manager.	Complaints from local residents; number of water bowsers used; number and type of dust protective gear supplied to the labour force.
11	Increase in gaseous emissions	Reduce gaseous emissions by selection of appropriate machinery and regular servicing of vehicles. Provide workers with appropriate protective gear including masks to cut down on gaseous emissions inhaled.	Contractor	Along the access roads, quarries and borrow pits and other sites where project works are taking place.	During construction and operation stages.	NEMA, Resident Engineer, Environmental Manager.	No. of complaints from local residents; Levels of nitrogen and sulphur oxides; Carbon monoxide; Occurrence of smog.

12	Loss of habitat and biodiversity	<p>Discourage any wanton destruction of vegetation and habitats beyond the designed project works.</p> <p>Restore lost biodiversity on the disturbed area through planting of appropriate trees and shrubs and protection of fauna species and their habitat.</p>	Contractor	Along the access roads, canal and furrows and around dams, quarries and borrow pits and other areas where biodiversity has been destroyed.	During construction, operation and the implementation of other project activities.	NEMA, Environmental Manager.	No. of key trees left intact; No. of tree nurseries established and seedlings planted in the disturbed areas; No of disturbed sites rehabilitated.
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Table12. Cost Estimates for the Proposed Environmental Management Plan (one year operation)

Item	Mitigation Measures/ Activities	Unit	Quantity	Rate (KSh)	Estimated Amount (KSh)	Remarks/Comments
1	General landscaping works including construction of soil traps				1,500,000	Also covered under the works contract as part of Contractor's cost estimates for drainage and structures.
2	Support for community awareness, sensitization and education programme	Meeting/ Workshop	10 meetings/ Workshops	150,000	1,500,000	Meetings/workshops held mainly among the communities of the project area during the construction period
3	Corporate social responsibility programme				4,000,000	Support to fisheries, community water supply, environmental conservation, health, education etc.
4	Construction of a sewage treatment plant and other waste management facilities.	Lump sum			5,000,000	Also covered under works contract
5	Purchase and installation of an efficient incinerator	Lump sum			2,000,000	Though an important component of waste management, many incinerators installed by many developers do not work efficiently thus becoming a source of gaseous pollution.
6	Collection and sample analysis (water, soil, biological and other samples)	Lump sum	2	100,000	200,000	Bi-annual sampling and analysis coordinated by the Environmental Manager.
7	Purchase of consumables (computer, sampling apparatus, field equipment) etc.	Lump sum			300,000	Needed for the support of Environmental Manager operations.
8	Purchase of furniture, stationery, documentation and report writing material.	Lump sum			100,000	Facilities necessary to furnish the Environmental Manager's working place.
9	Remuneration for Environmental Manager				2,500,000	Total remuneration package for Environmental Manager.
10	Purchase of a vehicle and other transportation requirements for environmental officer	Lump sum			4,500,000	Total expenditure for the purchase of 4X4 Vehicle, insurance and maintenance.
	Baseline field study	Lump sum			1,500,000	One-year baseline field study to determine the use of the study area by birds and to identify any bird species are adversely affected by wind park presence and operations.
11	Total				23,100,000	
12	Contingencies				2,310,000	Contingencies at 10% of the total cost of the environmental management.
13	Total Cost of the Implementation of the EMP				KSh 26,410,000	

12.5 Community Social Responsibility Programme

As discussed in Chapter 8 – Socio-economic Analysis of the Proposed Project, a need to conduct a participatory rural appraisal (PRA) within the project area was identified in order to determine the local community felt needs. As a follow up to the above realization, the project developer has now initiated a process to commence a corporate social responsibility (CSR) programme for the Lake Turkana Wind Power Project. Corporate social responsibility is the management of business processes in a socially responsible way in order to achieve an overall positive impact on the work force, their families as well as the local community and society at large. In this context, Lake Turkana Wind Power Project will make part of their earnings to re-invest in communities in which the company's earnings are generated.

In May, 2009, the project developer commissioned a study to identify activities and actions that can be implemented as part of the proposed Corporate Social Responsibility Programme (CSR) in the project area. Analysis of the current livelihood situation conducted by the study (Scoping and Pre-identification Study for Corporate Social Responsibility Programme) has revealed a wide range of complex range of obstacles and challenges including:

- High illiteracy levels and low levels of access to education;
- Inadequate access to water and health services;
- Poor infrastructure, especially roads, transport and communication facilities;
- Perennial food insecurity mainly due to insecurity, frequent droughts, environmental degradation and heavy reliance on relief food;
- Low levels of income and rampant and widespread unemployment; and
- General insecurity due to incessant livestock raids, poor facilities for the security forces and tribal animosity.

The study has proposed four broad areas for consideration in the implementation of the proposed Corporate Social Responsibility Programme. The proposed sectors are outlined below as follows:

12.4.1 Social sector

This sector will cover social services and focuses on strategies that will improve access to education, enhance access to potable water and sanitation and improve access to quality promotive, preventive and curative health services.

12.4.2 Physical infrastructure

This sector will focus on improving the physical infrastructure of the project area. This encompasses roads, telecommunications and electricity. Also targeted in this sector are amenities that make the area attractive for highly qualified officers to be attracted to work in the area over reasonable period of time.

12.4.3 Production

Strategies to improve incomes and food security especially in the short and medium term are deemed critical in order to achieve positive impacts in the livelihoods of the local community. A case in point will be strategies for the enhancement of food security such as establishment of livestock markets and value addition activities. For example, establishment of a meat factory or an abattoir in the project area, will catalyze trade, increase local incomes enhance off take, create jobs, and eventually improve household food security. Other strategies will include:

- Preserving milk especially during the wet season for use in the dry season;
- Support for training and facilitation of community animal health workers (CAHWS) in promoting animal wealth;
- Support environmental and range rehabilitation, especially in degraded areas;
- Facilitate establishment of a fish cooling/processing plant;
- Support extension activities in fisheries, livestock and tourism sectors; and
- Improve access to foodstuffs mainly through construction of roads and maintenance of roads and facilitating access to electricity.

Other strategies to improve the production sector include establishment of revolving funds for income generation activities targeting community groups (men, women and youth), establishment of vocational training centres for skills enhancement and support for the diversification of sources of incomes.

12.4.4 Improvement of Security

Improvement of general security in the project area will entail:

- Establishment of an enabling environment and facilities for security officers; and
- Strengthening of the existing community peace committees.

12.4.5 Funding of the proposed Corporate Social Responsibility programme

As discussed above, the total cost for the implementation of the Environmental and Social Management Plan (ESMP) and other socio-economic activities is estimated at KSh.26,410,000 (€241,814) for the first year project operation. Cost estimates for subsequent years will be determined by the recruited Environment and Social Development Manager as well as the entry into force of the Lake Turkana Wind Power's Corporate Social Responsibility Programme.

The establishment of the proposed Foundation has been officially approved by the Board of Directors of the Lake Turkana Wind Power Project. Its immediate objective is to support the following three key developmental sectors/priorities in the project area:

1. Improvement of education through the construction and operation of schools and vocational training centers;
2. Provision of health facilities through the construction of medical clinics, improvement of maternal and infant health and funding of operational costs of medical clinics ; and
3. Distribution of potable water for human consumption and installation of water points for livestock.

The Foundation will try, to the extent possible, to maximize Small and Medium Enterprises (SMEs) opportunities in order to help local communities in moving out of the "relief dependency syndrome". Financial resources for the proposed Foundation's programme will emanate from a percentage of profit generated by the Project (an estimated 1.0 -1.5 million Euros per year for 25 years). The proposed Foundation will be staffed by a Director and two Project Managers. It will operate under the guidance of the Lake Turkana Wind Power Project's Board of Directors (BoD).

13. GAPS IN KNOWLEDGE AND UNCERTAINTIES ENCOUNTERED

Gaps in knowledge and uncertainties associated with the environmental impact assessment of this project and compilation of the report touch on two main aspects including acquisition of data and information and consultations.

13.1 Acquisition of Data and Information

In carrying out this assignment, the consulting team made extensive use of the secondary data and information. For obvious reasons this section will be treated in a general format and no actual examples will be given. Acquisition of required secondary data and information presented unique challenges to the consulting team. In many cases the available data was scanty and whatever was available was scattered in several repositories. Hence the consultants spend valuable time in several institutions trying to acquire bits and pieces here and there. This situation was aggravated by the extensive protocols and bureaucracy involved in getting permission to acquire the relevant data and information from the relevant officers. This situation was also complicated by the many appointments that for one reason or another were not honoured and the many cancellations effected on very short notices.

It should be emphasized that collection of data involves resources and several government institutions do not have adequate resources to collect data on a sustainable basis. Consequently many gaps do exist in the available data bases. For example there was no data available in the following areas:

- Rainfall data pertaining to the project area;
- Hydrological data pertaining to the project area;
- Detailed geological and soil surveys conducted in the project area; and
- Data taken on HIV/AIDS status of the inhabitants of the project area.

In other cases there was no current data and the consultants had to do with data collected several years back which may not adequately reflect the current environmental situation. Against this background, there was the issue of the quality of the data available to the consultants. Due to constraints in time and lack of other alternatives the consultant had to do with available data and information.

13.2 Public Consultations

The main objective of public consultations is to sensitize the stakeholders on the proposed project and get their views on the perceived social effects and impacts of the proposed development on the local community. In addition public consultations are conducted to get the people's ideas on how the negative impacts of the proposed project can be mitigated. During public consultations with the local community who are mainly pastoralists, the consultants were faced with the challenge of communication. To get the message across, the consulting team had to rely on local interpreters. At times it was not clear whether the consultants' explanation of the project's workings, the impacts generated and the mitigation measures proposed were well understood by the local members of the local community in the project area.

14. CONCLUSIONS AND RECOMMENDATIONS

14.1 Conclusions

The following conclusions are drawn with regard to the environmental assessment of the proposed Lake Turkana Wind Power Project:

1. The major positive impacts of this project will include stabilization of electricity in Kenya, promotion of economic growth in the country, contribution to the Government revenue, increased employment, improvement of roads in the project area, improvement of medical services and promotion of improvement of environment in the project area.
2. The proposed project will achieve CO₂ emission reduction estimated to range between 565,920 and 1,264,320 CO₂ tons equivalents (or carbon credits) per year by replacing electricity generated by fossil fuel fired power plants connected to the national grid.
3. The increase in number of people in the project area following the commissioning of the project will lead to a number of negative socio-economic impacts including cultural contamination, increased incidences of diseases, insecurity and community conflicts, challenges of labour force management and increased accidents and occupational hazards.
4. The project activities are likely to cause albeit on a small scale loss of habitat, destruction of floral and faunal communities, disturbance to livestock, soil erosion and potential siltation of aquatic habitat, pollution, ponding conditions and increase in noise. Perhaps the most serious negative impact is the potential for birds' mortality through collisions with the turbines.
5. The study has proposed several measures to reduce negative impacts including amelioration of social negative impacts, noise abatement, waste management, reduction of visual intrusion, restoration of habitat and biodiversity, reduction of soil erosion and siltation, prevention of accidents and health hazards and provision of health care services. In addition, measures have been proposed with regard to the siting of wind park in order to reduce collision of birds with turbines.
6. Monitoring has been identified as an important process in the protection of environment of the project area since it will reveal changes and trends brought about by the presence and operations of the installed wind park facility.
7. The total cost for the protection of the environment is estimated at KSh. 26,410,000 (€241,814)

14.2 Recommendations

The Consultants have proposed the following recommendations that will enhance sustainable implementation of the proposed project and protect the environment of the project area:

1. Due to the increased population in the project area and the subsequent high demand of fuel wood resources, there will be a need to encourage the workers to use alternative source of energy during the implementation of the project in order to protect the scarce wood resources of the project area.

There will be a need also to explore more efficient ways of making charcoal through efficient kilns and use of efficient stoves including **Kuni Mbili** stoves.

2. Given the high level of expectations among the local community about the project, it is recommended that the communities' expectations are managed by having candid dialogue with them right from the start.
3. It is recommended that broad community sensitization regarding potential cultural contamination and other negative impacts of the proposed project need to be carried out in the project area, in order to prepare the people to develop a coping mechanism.
4. As part of its social responsibility, the project should put in place mechanisms to assist the marginalised communities in the project area, in accordance to the identified needs of the community. However before any social responsibility work is carried out, a Participatory Rural Appraisal (PRA) should first be carried out to identify the community felt needs.
5. The developer needs to support the implementation of environmental management (including mitigation plan and monitoring) in order to protect the environment of the project area from the negative impacts of project implementation.
6. In order to conduct a sustainable environmental management in the project area, there will be a need to engage an Environmental Officer to be stationed at Loiyangalani. The engaged officer will put in place mechanisms to initiate and operationalize the proposed mitigation plan and environmental monitoring on a regular basis.
7. Since the major land use of the project area is livestock keeping, measures should be put in place to avoid disturbance of livestock activities especially grazing/browsing and access to watering points. Except for the small areas (10mX10m) around the turbine foundation, there should be no fencing of the wind park facility.
8. In order to avoid impacts of birds' collisions with turbines, the project developer should put in place mechanisms for a careful design and siting of the wind park. The wind park design should allow for wide corridors between clusters of turbines. The wind park will need to be sited away at least 3km from the shore of Lake Turkana and at least 1km away from the nearest canyon.
9. The project needs to carry out investigations to verify predictions made during the course of environmental impact assessment study especially with regards to the impacts on the avifauna of the project area. In this regard it is recommended that a minimum one-year baseline field study needs to be undertaken to determine the use of the study area by migrating and over wintering species of birds and to identify species that may be adversely affected by wind park presence.

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16. ANNEXES

- Annex 1. Photographic Plates Showing the Salient Features of the Project Area.**
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Annex 1. Photographic Plates Showing the Salient Features of the Project Area



Plate 1: Palm Shade Camp, a local tourist facility in Loyangalani



Plate 2: A water spring at Loyangalani



Plate 3: Community consultative meeting at Yammo Manyatta, Loyangalani.



Plate 4: A Turkana Community receiving water from the Consulting Team



Plate 5: Loyangalani Road close to southern end of Lake Turkana.



Plate 6: Lake Turkana Windpower mast at Loyangalani.



Plate 7: A Fisherman with a fish catch on the shore of Lake Turkana



Plate 8: Turkana Fishermen set on a fishing mission. On the foreground is Southern Island



Plate 9: The area around the southern shoreline of Lake Turkana. The dominant shrub is *Sericocomopsis*.



Plate 10: Shoreline of Lake Turkana. Note the paucity of aquatic vegetation



Plate 11: Lagga Yammo. The large trees are *Acacia tortilis* and the dwarf shrub is *Sericocomopsis*



Plate 12: Lagga Sirma with *Acacia tortilis* trees



Plate 13: Camels in the Project Area.



Plate 14: Goats grazing in the Project Area



Plate 15: A water hole in the Project Area



Plate 16: Earth dam for the watering of cattle at the periphery of the project area on the way to Qatab, Mt Kulal region



Plate 17: Miniature sand dunes to the south of the project area. The dwarf shrub is *Jatropha*.



Plate 18: *Acacia reficiens* near Kaisut area.



Plate 19: Acacia (*Acacia drepanolobium*) woodland to the east of the project area on the way to Qatab.



Plate 20: Mt. Kulal Forest to the east but outside of the project area.

Annex 2. People and Institutions Consulted During the EIA Study Process

1. Aggrey Ogosi: Finance Assistant, Farm Africa, P.O.BOX 159, Marsabit, Tel. 0721412747.
2. Benedict Leurare: Loiyangalani Catholic Mission, Tel. 0723867205.
3. Benedict Orbora: Manager, Palms Shade Camp, Loiyangalani, Tel. 0728966620.
4. Benina Ekusi (Mrs.): Resident Loiyangalani, Tel. 0710 734281.
5. David Muriuki Njamweah: District Cooperative Officer, Marsabit, Tel. 0722 562702.
6. C.K. Lekapana: Senior Chief, Loiyangalani Location, P.O. Loiyangalani, Tel No. 17 Loiyangalani.
7. Dominic Mbuvi: Livestock Coordination Officer, Food for the Hungry, Kenya, dmbuvi@fhi.net, P.O.BOX 125, Marsabit.
8. El Molo Community in Loiyangalani
9. Esther E. Chiwe: District Gender & Social Development Officer, Marsabit, Tel. 0725769706.
10. Frederick Mbithi Kitema: District Officer (DO1) Marsabit, Tel. 0722894298.
11. Gabriela Lakapana (Nurse), Loiyangalani Health Centre (catholic Mission), Loiyangalani.
12. Godona J. Doyo: Arid Lands Development Project (AIRMP), Marsabit, Tel. 0724369880.
13. Ibrahim Adan: Chief Executive Officer, Community Initiative Facilitation and Assistance (CIFA), Tel. 0734 168010.
14. Kifaru Women Group, Loiyangalani.
15. Jacinta Alia Lebasha, Teacher and Member of Kifaru Womens Group, Loiyangalani.
16. Jane Saka Orbora: Assistant Fisheries Officer Loiyangalani, Tel. 0728 966620
17. Jeremiah Omechi Onchera: District Development Officer, Marsabit, Tel. 0725995812.
18. Jim L. Teasdale: African Inland Church (AIC) Pastor at Loiyangalani, Tel. 0722-790264.
19. John Kagwi: Assistant Director, Northern Conservation Area, Tel. 0722 293216.
20. Juma Makopa: Chemistry Department, University of Nairobi.
21. Leparsanti S. Teresalba: Teacher, Loiyangalani Primary School, Tel. 0728626812.
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24. Nachukul Longolob Ekal: Kenya Wildlife Service Ranger, Sibiloi National Park (Southern Island National Park), Tel 0720222774.
25. Nayori Environmental Conservation Rehabilitation Youth Group, Loiyangalani.
26. Peter Lengewa: Loiyangalani Fishermen Cooperative Society, P.O. BOX 13 Loiyangalani.
27. Peter N. Gakunyi: Pastoralist Integrated Support Programme (PISP), Tel. 0692201.
28. Rebecca Lepalat Lebasha, Forest Department, Loiyangalani Division
29. Samburu and Rendille Elders of Kiwanja Ndege Manyatta, Loiyangalani.
30. Turkana Community at Nakuame Kwi Manyatta, Loiyangalani.

31. Turkana Yammo Manyatta Community, Loiyangalani
32. Veronica Lenges (Mrs.): Resident Loiyangalani Town, P.O. BOX 1, Loiyangalani.

3a. Analysis of Waters from Loiyangalani Springs and Lake Turkana

Parameters	Unit	Results		
		Tap Water – Palm Shade Camp - Loiyangalani	Surface Flowing Spring Water - Loiyangalani	Lake Turkana Water - Loiyangalani
pH	pH scale	8.52	8.75	9.56
Colour	mgPt/l	< 5	< 5	< 5
Turbidity	NTU	1	6	7
Permanganate value (20 min boiling)	MgO ₂ / l	< 0.4	1.58	1.58
Conductivity (25°C)	μS / cm	247	385	3840
Iron	Mg / l	0.03	0.14	0.09
Manganese	Mg / l	< 0.01	< 0.01	0.01
Calcium	Mg / l	7.2	7.2	0.8
Magnesium	Mg / l	15	23.3	33.5
Sodium	Mg / l	19	34.2	807
Potassium	Mg / l	1.4	2.4	20
Aluminium	Mg / l	0.29	0.34	0.43
Total Hardness	Mg / CaCO ₃	80	114	140
Total Alkalinity	Mg / CaCO ₃	100	150	1364
Chloride	Mg / l	9	15	345
Fluoride	Mg / l	0.3	0.28	0.26
Nitrate	MgN / l	0.8	2.5	6.2
Nitrite	MgN / l	< 0.01	0.04	< 0.01
NH ₃	Mg NH ₃ / l	1.25	1.02	1.94
Lead	Mg / l	0.04	0.04	0.03
Sulphate	Mg / l	5.7	10.9	38
Free Carbon Dioxide	Mg / l	Nil	Nil	Nil
Total Phosphorus	Mg / l	0.04	0.08	0.18
Total Dissolved Solids	Mg / l	239	1347	2381
Coliforms	Per 100 ml	28	770	2419
<i>E. coli</i>	Per 100 ml	Nil	32	Nil

Annex 3b. Water Quality in the Project Area and Surrounding Areas

Physico-Chemical Parameters	Source of Water Samples							
	Loiyangalani Springs	Adab Well	Muliko Springs	Arapal Springs	Allya Abbay Beach	Ileret Well	Nguruset Springs	Loiyangalani Beach
pH	8.23	7.72	8.69	6.37	7.51	7.62	8.06	8.63
Odour	None	None	None	None	None	None	None	None
Aluminium	0.1						0.01	
Ammonia	24.5	10.5		15.75		2.63	7.0	20.13
Calcium	22.0	45.0	3.6	2.9	52.0	29.0	27	4.9
Chlorides	12.0	44.0	432.0		108	4.0	4.0	198
Fluorides	2.1	2.3	3.8	1.7	2.5	2.0	2.2	3.0
Hardness	52.0	88.0	852.0	8.0	76.0	72.0	476	468
Iron	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Magnesium	23	47	35	0.8	53	4.8	12	100
Manganese						0.08		0.02
Nitrates	1.46	0.93			2.98	0.71	0.62	0.09
Phosphorus	2.9	4.3	4.3	3.2	4.2	2.7	3.7	5.0
Potassium	8.3	3.7	80	2.8	2.1	6.6	2.8	46
Sodium	82	150	2600	11	230	120	19	1300
Sulphates	7.89	15.78	218		30	7.89		88.41
Zinc		0.03	0.01	0.04	0.45	0.02		0.02
Coliforms	1			1				
E. coli	1	1	1	1	1	1	1	1

Source: Conservation and Community Development Programme – Lake Turkana, 2003.

Annex 4a. A List of Persons Invited to attend the ESIA Stakeholders' Meeting

1. Aggrey Ogosi: Finance Assistant, Farm Africa, P.O.BOX 159, Marsabit, Tel. 0721412747 / Director Farm Africa
2. Benedict Orbora: Manager, Palm Shade Camp, Loiyangalani, Tel. 0728966620.
3. Chairman, Marsabit County Council
4. C.K. Lekapana: Senior Chief, Loiyangalani Location, P.O. Loiyangalani, Tel No. 17 Loiyangalani.
5. Councillor Marko Ekale, Loiyangalani Ward
6. David Muriuki Njamweah: District Cooperative Officer, Marsabit, Tel. 0722 562702.
7. David Loburgiali, Nayori Environmental Conservation Rehabilitation Youth Group.
8. District Fisheries Officer, Marsabit District
9. District Livestock Officer, Marsabit District
10. District Officer, Loiyangalani Division
11. Dominic Mbuvi: Livestock Coordination Officer, Food for the Hungry, Kenya, dmbuvi@fhi.net, P.O.BOX 125, Marsabit.
12. Esther E. Chiwe: District Gender & Social Development Officer, Marsabit, Tel. 0725769706.
13. Father Andrew Ndirangu, Catholic Mission, Loiyangalani
14. Frederick Mbithi Kitema: District Officer (DO1) Marsabit, Tel. 0722894298 / District Commissioner, Marsabit District.
15. Fatuma Kurewa, Chairlady, Kifaru Women Group, Loiyangalani
16. Godona J. Doyo: Arid Lands Development Project (ALRMP), Marsabit, Tel. 0724369880.
17. Hon. Joseph Lekuton, Member of Parliament, Laisamis Constituency
18. Ibrahim Adan: Chief Executive Officer, Community Initiative Facilitation and Assistance (CIFA), Tel. 0734 168010.
19. Jacinta Alia Lebasha, Teacher and Member of Kifaru Womens Group, Loiyangalani
20. Jane Saka Orbora: Assistant Fisheries Officer Loiyangalani, Tel. 0728 966620
21. Jeremiah Omechi Onchera: District Development Officer, Marsabit, Tel. 0725995812.
22. Jim L. Teasdale: African Inland Church (AIC) Pastor at Loyangalai, Tel. 0722-790264.
23. John Kagwi: Assistant Director, Northern Conservation Area (KWS), Tel. 0722 293216.
24. Leparsanti S. Teresalba: Teacher, Loiyangalani Primary School, Tel. 0728626812. / Headmaster Loiyangalani Primary School
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26. Nachukul Longolob Ekal: Kenya Wildlife Service Ranger, Sibiloi National Park (Southern Island National Park), Tel 0720222774.
27. Peter Lengewa: Loiyangalani Fishermen Cooperative Society, P.O. BOX 13 Loiyangalani.
28. Peter N. Gakunyi: Pastoralist Integrated Support Programme (PISP), Tel. 0692201. / Coordinator PISP.
29. Rebecca Lepalat Lebasha, Forest Department, Loiyangalani Divison

30. Sarai Fecha, Assistant Chief, Loiyangalani Location
31. Sister Maria Antonia Pira, Loiyangalani Health Centre (Catholic Mission)
32. Sendeo Baltor, Chairlady, Mosareto Women Group, Loiyangalani
33. Wolfgang Deschler, Managing Director, Oasis Lodge, Loiyangalani

Annex 4b. Participants of the ESIA Stakeholders' Meeting (21-22 April 2008)

LAKE TURKANA WIND POWER PROJECT

EIA Stakeholders' Workshop List of Participants (21st April 2008)

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LAKE TURKANA WIND POWER PROJECT

EIA Stakeholders' Workshop List of Participants (21st April 2008)

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18					
19					
20					
21					
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	NAME:	TEL:	E-MAIL	BOX NO:	SIGNATURE:
24	STEPHEN MAKENO	0720077689	-	-	<i>[Signature]</i>
25	DAVID LOBURITAI	07 -	-	BOX 1	<i>[Signature]</i>
26	CORNELIUS EBUKIT	0725819860	-	-	<i>[Signature]</i>
27	Rebecca Reeta	0728510234	-	BOX 4	<i>[Signature]</i>
28	ORBORA STEPHEN	0728804635	-	BOX 28 MBT.	<i>[Signature]</i>
29	JAMES TAPZDARE	0722-790-264	timtecastale@cuples.com	21028 UBI	<i>[Signature]</i>
30	Rita Lemu	0725696003	-	-	<i>[Signature]</i>
31	Asha mohamed	0723070276	-	BOX 15 LOIYAJALANI	ASHA MOHAMED
32	Rembes Leaburia	0723	-	BOX 15 LOIYAJALANI	Rembes
33	Saadha mohamed	-	-	BOX 15 LOIYAJALANI	Saadha
34	Apita EKidor	-	-	BOX 15 LOIYAJALANI	Apita Edor
35	JANE ORBORA	0728966620	-	BOX 84, MBT	<i>[Signature]</i>
36	MRS FAUMA KIRAN	0729958751	-	BOX 1 LOIYAJALANI	<i>[Signature]</i>
37	REBECA LEPULAT	0727086880	-	BOX 1 LOIYAJALANI	<i>[Signature]</i>
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Annex 5. Minutes of the ESIA Stakeholders' Meeting

Venue of the Meeting: The Palm Shade Camp (Conference Hall), Loiyangalani.

Date of the Meeting: 21 – 22 April 2008

Attendance: Full List of Attendants is attached in Annex 4b. .

Facilitator / Translator: Pastor James Teasdale (Africa Inland Church – Loiyangalani)

Rapporteur: Mr. Adrian Babault

Project Proponent Representatives: Mr. Willem Dolleman and Mr Harry Wassenaar

ESIA Study Team Leader and Report Presenter: Professor Francis M. Muthuri

Apologies

1. Member of Parliament for the Laisamis Constituency - Honourable Joseph Lekuton
2. District Environmental Officer, Marsabit District – Mr. Mamo Boru Mamo
3. Marsabit County Council Officials: The Vice Chairman, Treasurer and the Clerk to the County Council.

Notes

1. Meeting attendants had received a draft copy of the Environmental Impact Assessment Report two weeks prior to the meeting.
2. The Meeting started at 2.45pm, after a lunch session for the attendants.

Meeting Deliberations

Resource Person / Participant	Comment / Issues Raised
Facilitator	Brief introduction of the project and thanked those who travelled far to attend the stake holders' meeting.
	Invited a participant to lead the meeting in prayer.
	Conveyed apologies from the Hon. Joseph Lekuton, the Member of Parliament for the Laisamis Constituency
Rapporteur	Introduction of the people who travelled all the way from Marsabit to attend the meeting.
Presenter	Started by thanking all the participants for attending the meeting.
	Emphasized that sustainable development involves projects that are economically viable, socially acceptable and environmentally sound.
	Outlined the project objective: To build a wind farm for generation of 300MW of electric power to feed into national grid.
	Outlined the study objective: Carry out environmental impact assessment in accordance to the NEMA guidelines.
	Introduced the project area: 150 km ² of land located between footslopes of Mt. Kulal and south-eastern Lake Turkana mainly in Loiyangalani Division of new Laisamis District.
	Emphasized that the project area was much larger than the actual area to be occupied by the proposed wind farm.
Asst. Chief Moite	Asked whether the turbines will be scattered over the area or whether they will be in one place.
Mr. Willen Dolleman	That they will in a line facing the prevailing wind and that each will have a footprint of 8m x 8m.
Mr. William Ebkot	Asked what the existing masts are doing in the project area
Presenter	The masts are currently used for recording wind data to help in choosing the specific site.
Mr. William Ebkot	Wanted to know the number of windmills to be erected in the project area.
Presenter	100 wind turbines are planned to be erected in the project area, although the project is considering the alternative of installing more than 100 wind turbines with each producing less power, with a total power production of 300MW.
Rapporteur	Drew attention to the arrival of the attendants from Gatab (Mt Kulal Location).
Snr. Chief, Mr. Lenaragusho	Apologised for their late arrival and asked the Presenter to briefly recount what they missed.
Presenter	Summarised the deliberations as requested.
Mr. William Ebkot	Suggested that since the issues presented are very important, the meeting should be extended to cover 2 to 3 days.
Presenter	It was assumed that all the participants had read draft EIA Report. The Team had not received any comments on the despite the request on the cover letter.
Snr. Chief Loiyangalani, Mr. C.K. Lekapana	Recommended that the Presenter should continue with the presentation of the EIA findings.
Loiyangalani Cllr., Marko Ekale	Defended the project as essential to the development of the area. He wondered whether adequate consultations were carried out with regard to this project.
Presenter	The Team Leader felt that adequate consultations with regard to this project had been made. Prior to the EIA study several meetings had been held between administration and local community and the project proponents. During the EIA study, the team visited the administration, local community in their manyattas, all CBOs operating in the in the project area, church

	leaders, community leaders and health and schools leaders among other stakeholders. Relevant Government institutions and NGOs were consulted in Marsabit District. On the whole over 30 organisations were consulted. He assured the meeting that raising awareness on the project was constantly ongoing.
Snr. Chief, Mr. Lenaragusho	Commented that the 3 new masts are in his location, Mt. Kulal location.
Presenter	Replied that the masts were only recording data and in total they occupied less than an acre of land.
Headmaster, Gatab Primary School	Emphasized that 1 acre of the land is important to pastoralists.
Facilitator	Stated that the Professor be allowed to continue with his report.
Mr. William Ebkot	Commented that this was their (stakeholders) meeting and that they could take a week over it if they so wished.
Presenter	Continued and elaborated on the physical characteristics of the potentially affected environment of the project area including (climatic conditions – rainfall, temperature and wind), topography, geology, soils and hydrology.
	Elaborated on the terrestrial flora. He emphasized the importance of floral resources including shrubs and trees of <i>Acacia</i> , <i>Commiphora</i> , <i>Indigofera</i> , <i>Salvadora</i> etc. to livestock and the local communities.
	Emphasized the paucity of wild fauna in the project area to the extent that only an occasional dikdik and hare were observed as representatives of wildlife in the project area.
	Depicted Lake Turkana as an important habitat for an abundant crocodile population, 84 bird species including 35 Palearctic migrant bird species and 48 species of fish. He spoke of the phytoplankton, zooplankton, invertebrate fauna and their crucial role in the aquatic food chain of the lake. He elaborated on the importance of fish such as Tilapia, Nile Perch, Barbus and Labeo in the fisheries of Loiyangalani beach.
	Briefly described socio economic environment of the project area including population, existing services, education, health, poverty, land use and commercial and economic activities.
	Emphasized pastoralism the crucial land use and source of livelihood for the local community of the project area.
	Concluded that the description of the environmental characteristics of the project area was an important yardstick against which future variances could be used as measures of the impact of the project
	Described the positive impacts of the project including stabilization of electricity, promotion of economic growth, increased employment opportunities, increased contribution to government revenue, improvement of roads in the project area and surroundings and provision of electricity in the project area and surroundings. The Presenter stressed that the electricity produced in this project will stabilise Kenya’s power supply and will reduce the dependence on hydro power produced on Tana River system especially during the dry seasons.
	Further stated that the wind project will contribute significantly in the promotion of the Kenya’s Rural Electrification Programme and the Vision 2030.
A Lady Participant	Stated that she didn’t understand English and wanted the presentation translated into Swahili.
Facilitator	Provided a summary in Swahili.
Presenter	The Presenter continued with the positive impacts stating that there would be significant job employment opportunities in the project area. He further said that although the “ high calibre” labour would be imported, the stakeholder community would

	benefit more from semi skilled and unskilled opportunities and that many jobs would be created from “spin offs” and “multiplier effects” including sand collecting, gravel making and the huge increase in trade and accommodation needs.
Facilitator	Carried out the translation and added that the proposed laboratory that was planned to be built in Loiyangalani in conjunction with the Kijabe Hospital could not be built without a reliable power source, a problem this project will solve when completed.
Presenter	Asserted that the benefits would be much greater than the predicted 400 or more direct jobs created.
Ms. Jacinta Lebasha, Kifaru Womens Group.	Asked whether the production of gravel would be detrimental to the environment.
Presenter	The issue was addressed as a component of negative impacts.
Loyangalani Cllr., Mr. Marko Ekale	Asked whether the benefits would include the improvement in the districts roads. He suggested that contracts should be awarded to groups and not concentrate on the employment of people.
Presenter	Replied that transport links may improve but that that would be secondary to fact that the roads would be built primarily to transport project materials.
Facilitator	Carried out the translation and supported comments made by the councillor and suggested that as many contracts as possible should be awarded locally.
Mr Benedict Orbora	Stated that the report showed that the primary access road would branch of the main Marsabit – Isiolo road at Laisamis, and would head to the project area via the towns of Kargi.
Facilitator	Cautioned that that the road survey had not been completed but that it was unlikely that the project materials would ascend Mt. Marsabit.
Presenter	Continued with the presentation of positive impacts stating that the project would contribute substantially to government revenue through taxes such as VAT and PAYE. He specifically mentioned that 0.1% of the project cost would be paid to NEMA.
Facilitator	Translation
Presenter	Continued presentation and stated that the Consultant Road Engineer will define the access route, but that whichever route was chosen the improved access would improve transport with benefits in the transportation fish and livestock. Especially fish could be transported frozen as electricity from the project would power cold storage.
Facilitator	Carried out the translation and added that currently cattle and camels could not be transported by road since the livestock broke their legs due to the poor road surface. A situation that would be overturned by better roads.
Presenter	He added that local power provision would supply schools, hospitals, hotels and private homes but cautioned that it would have to be paid for at normal rates. Stated the project would extend social responsibility and highlighted marginalised communities like that at El Molo as potential beneficiaries of social schemes.
Facilitator	Translation.
Mr. William Ebkot	Asked who would distribute the electricity.
Presenter	The Kenya Power and Lighting Company (KPLC) would distribute the electricity. He added that Turkana Wind Power Project would only generate electricity.

Facilitator	Translated and added that KPLC had published an offer for private sector partners to generate electricity on their behalf. He also enlightened the attendants that Turkana Wind Power Project partners had risked their own money and were busy raising huge sums of money more for the project for the benefit of all the stakeholders. He also reminded the audience that wind power was clean power as opposed to diesel and oil generators. He also stated that electricity would be charged according to the law.
	He added that Safaricom wasn't free yet most people still used their services. He went on to say Loiyangalani had too much to gain from the project to also ask for discount for the electricity they use.
Presenter	Introduced the negative impacts of the project. Highlighted the influx of people in the project area and the subsequent increase in exploitation of natural resources as the underlying key processes that will cause social negative impacts.
Mr. Lotorobo Makambo	Added that the project will also use water as a natural resource.
Presenter	Added that an increase in insecurity in the area could occur if the project was perceived to benefit certain communities more than others. He said the communities in the neighbourhood of the project area are prone to conflicts and described how during the EIA field survey in November, 2008, the El Molo community had taken shelter in Loiyangalani following attacks from another community from further north.
Facilitator	Translated and added that the jealousy of the project of non beneficiary surrounding communities may induce revolt.
Presenter	Continued with social negative impacts and added that an increase in sexually transmitted diseases in the project area was likely with an increase in migrant workers and influx of the commercial sex workers.
	He highlighted visual intrusion emanating from disfigured landscapes associated with earth works, spoils, quarries and borrow pits. He stated that although some people may view the wind farm as visually intrusive, the wind farm could turn out to be a spectacle that would draw tourists from as far away as Mombasa.
Facilitator	Translated and added that Holland, whose wind farm experts were very involved in this project, was the home of Windmills where they had been made for the last 600 years. He also added that many tourists were attracted to Holland just to see the windmills there and that the proposed wind farm may also have a similar effect.
Presenter	Continued with the presentation of negative impacts and added that the influx of migrant labour force would lead to an increase in effluent and domestic waste. He cautioned that this would need careful management. In addition, an increased population would add to the pressure on already depleted resources.
	The Presenter spoke of increased accident numbers and occupational hazards following the commissioning of the project.
Facilitator	Translation
Presenter	Introduced the bio-physical impacts of the project including physical environmental damage and trampling on plants.
	He added that an increase in soil erosion and siltation were likely in the project area and emphasized the threat posed to aquatic life from the effect of siltation at the Lake Turkana shore line.
Facilitator	Translation
Presenter	He described the dangers caused by ponding in the project area since creation of stagnant waters in depressions could serve as breeding grounds for snails and mosquitoes that are vectors of bilharzia and malaria respectively. He described that a main environmental impact when constructing the proposed wind park could be collision of birds with turbines.

	Stated that disturbance to livestock will not constitute any appreciable negative impact in the project area since there will be no fencing.
Loyangalani Cllr., Mr. Marko Ekale	He felt that ponds left after road construction activity could provide water for livestock in the project area.
Presenter	He agreed with the Councillor and illustrated how whole communities had benefited from water filled pits left after the construction of the Garsen Cause Way in the Tana River District near Lang la Simba.
Facilitator	He cautioned that areas around waterholes could trigger overgrazing.
Presenter	Reminded the participants that sustainable projects are socially acceptable, economically viable and environmentally sound. He felt that the wind project has the potential to be sustainable.
Facilitator	Added that the Global Development Forum in New York considered this project as one of the top priority 100 development projects worldwide. And of the 100 projects it attained 1 st position.
Presenter	Presented on the computer display of the Environmental Impact Matrix and described its relevance in depicting the intensity of the predicted positive and impacts of the project.
Facilitator	Supported the Presenter's use of the environmental impact matrix as a good measure for depicting the magnitude of the proposed environmental impact of the project.
Presenter	Introduced Environmental Management Plan to the participants.
Mr. William Ebkot	Was concerned the meeting was more of a lecture than a discussion.
Facilitator	Reminded the participants that any one was free to interrupt the Presenter and make a comment or ask any question. He suggested that the meeting continue the following morning at 9 am to provide the attendants with more time to participate.
Presenter	Continued with the proposed Environmental Management Plan introducing important processes such as environmental mitigation and monitoring.
Snr. Warden Marsabit Park, Mr. Matthias Mauvita	Requested that in the process of implementing environmental management plan, the project should develop a tree nursery to combat desertification in the project area.
Presenter	The Presenter agreed with the Senior Warden. He outlined proposed measures to reduce or alleviate negative impacts including reduction Sexually Transmitted Diseases, reduction of the utilization of wood resources, community awareness, reduction of visual intrusion and management of labour force among other negative impacts.
Facilitator	Translation.
Presenter	Highlighted noise abatement and stressed that most noise will emanate from the road construction activities. He further stated that Vestas turbines are associated with low noise levels and therefore it was unlikely that noise levels will cause any disturbance during the operation of the wind farm.
Facilitator	Translated and added that modern trucks should be used as they are better silenced.
Presenter	Spoke of dust control measures including watering of the roads and use of protective cover such as masks, helmets, goggles and overalls to protect workers. He suggested measures to reduce ponding through landscaping and filling in the created depressions. He further recommended planting of indigenous and appropriate trees, shrubs and grasses in order to restore

	the habitat and biodiversity.
Facilitator	Translation.
Presenter	Assured the participants that the project will virtually have no effect on livestock since there is no fencing. Also he said the area taken by the construction of the wind farm is extremely very small.
	Introduced mitigation measures against potential effects to birdlife. He stated that the wind farm will be sited no closer than 3km from Lake Turkana and 1 km away from mountains. He also suggested that aspects of the project that attracted birds like ponds and dumps should be eliminated.
	Emphasized the importance of environmental monitoring and outlined the focus areas for monitoring in the project area.
	Recommended the hiring of an Environmental Officer supervise the monitoring of the environment with specific attention to changes in biodiversity including baseline field study on birds.
	Explained to the audiences the breakdown of the proposed cost for environmental management plan including environmental monitoring as detailed in EIA report.
	In conclusion, the Presenter stated that the environmental impact assessment study of the proposed project has not come across any negative impact that can not be mitigated.
	He once again thanked the participants for attending the meeting and said he was privileged to have had the opportunity to speak to them.
Facilitator	He thanked the participants and closed the day's session at 7.20 p.m. .
Meeting Resumes at 9.50am on the 22nd of April 2008	
Facilitator	Made introductory remarks and invited a participant to lead the meeting in prayer.
Participant	Led the meeting in prayer.
Presenter	Did a recap of the previous day deliberations and outlined the objective of the day's meeting: receive inputs and views from the stakeholders which eventually would be incorporated into the final EIA report that would be submitted to NEMA.
Facilitator	Did the translation and challenged all the participants to speak up including even those with negative and divergent views and perceptions on the proposed project.
Snr Warden Marsabit Park, Mr. Matthias Mauvita	Felt that the Lake Turkana Wind Power Project was a good project for the project area and surroundings and will be essential for the development of the area. He was however, concerned about the natural resources of the area including the siltation threat to Lake Turkana and concerns over the birdlife.
	In addition, he expressed concern over the current depletion of vegetation cover in the area due to increased production of charcoal and collection of firewood. He requested the project to assist Nayori Conservation Group to start tree nurseries in order to rehabilitate the degraded environment and increase the biodiversity of the area. He further requested the project to work with the local community and help them in capacity building and empower them in sustainable development.
Presenter	Assured the Senior Warden of the commitment of the project proponent to environmental conservation of the project area. He added that this commitment is captured in the Environmental Management Plan contained in the EIA Report including strategies to arrest soil erosion and siltation, location of the wind farm away from the lake, the recruitment of environmental officer and the proposed funding of tree nurseries as part of the environmental management plan.
Facilitator	Translation.

District Development Officer, Marsabit	Stated that the project was good and would improve the economy of the area. He however, cautioned that the project has not been registered in his office as required by the District Development Committee (DDC). He suggested a closer relationship between the project and his office.
Presenter	The Presenter agreed that the proponent should make a follow up on this issue and register the project with DDO. He insisted, however, that meetings and barazas with the local administration had been regularly held and that steady consultations with Marsabit County Council had ensured their constant involvement in the project. He added that during the EIA study, the district administration and government department in the Marsabit District were intensively consulted.
Facilitator	Carried out the translation and also emphasised the openness of the project in whose record was extensive coordination. In comparison, he felt that this project was much better in distributing information than various aid projects.
District Development Officer Marsabit	Said that the project coordinator should sit with DDO committee and get its endorsement. A meeting should have been held with the Location Development Committee (LDC) to seek its endorsement prior to approaching the District office.
Presenter	Once again the Presenter agreed that the project will fulfil DDO requirements.
Facilitator	Did the translation of the issues raised and added that a meeting with LDC was held and that the minutes were available.
Loyangalani Cllr., Mr. Marko Ekale	Stated that the DDO cannot endorse a motion without local agreement and that the County Council was the 'custodian of the land'. Suggested that the project should conduct research on the fish stocks in the lake and the human population in the project area.
Presenter	The Presenter reminded the participants that approach and methodology for conducting the EIA study is contained in the Draft EIA report. A great percentage of information used in the compilation of the EIA report comes from secondary data sourced from Government Departments and other institutions. For example the Loiyangalani fish data (2006 – 2007) used in the report was derived from the Fisheries Department while population records were derived from the Government 1999 Census and subsequent projections.
Facilitator	Translation.
Mr. Collins Orage, DO2 Marsabit District	Stated he was very impressed with the EIA report. He appreciated the naming of plants in the project area both by their scientific names and Turkana names. However, he wondered what would happen to the project area following the destruction of plants.
Presenter	The Presenter confirmed that some plants especially along the road where construction will take place will be destroyed. He, however assured the participants that there were no rare, threatened or endemic plant species that were likely to be destroyed in the project area. The plants likely to be destroyed commonly occur in the arid and semi-arid of the northern Kenya. He reminded the participants that Environmental Officer would carry out plant restoration in the affected areas as recommended in the EIA report.
Facilitator	Translation.
Mr. William Ebkot	Asked if minutes of the meeting were being taken. He added that data collection also needs to be done at the 'grassroots' level. He stated that the fish data at the Fisheries Office did not include those fish caught for local consumption. Stated that the stakeholders wanted to see the proposed site of the wind farm. He also asked whether it was a wind farm or a wind park as he understood that a farm was a small area but that a park was enormous.

Presenter	Quelled Ebkots fears of the size of area and described how the masts would be laid out in rows. There was no difference between a wind farm and a wind park and the two terms can be used interchangeably.
Mr. William Ebkot	He was concerned that the park should not be located on religious or burial site or on an area that harboured rare wildlife or that contained good grazing.
Presenter	Replied that the wind farm area will be located on the plateau behind the Ongip massif but the exact wind farm site has not been selected yet. The local community will be consulted and involved on the actual selection of the specific wind farm site in due course.
Mr. William Ebkot	Suggested that the site be identified and debated immediately.
Presenter	Stated that at present only the general location of the wind farm site could be considered.
Loyangalani Cllr., Mr. Marko Ekale	Said that the real cause of concern over the site was that the local community were not consulted prior to the installation of the existing masts.
Mr. Benedict Orbora	He felt the presentation had been excellent and that the stakeholders were well informed of the details of the project to convey to the rest of the population. He went on to say that the local people feared the unknown and were originally baffled and concerned by the huge amount of information in the EIA draft report. However, the Presenter had translated most of the technicality into something which everyone could relate.
Mr. Willem Dolleman	Told the meeting of how the data collected from the existing masts was helping to narrow the area for the wind farm site location. When the data collected had reduced the area into a specific site then the local community would be informed and consulted.
Facilitator	Translated the issues raised and added that the individual turbines at the site will be 400 metres apart to ensure each received 'clean air'. He spoke of the area behind Ongipi massif as a barren site covered with volcanic lava and unproductive for livestock grazing. Stated he had lived among local community for enough years to feel he was worthy of trust particularly as he had tried to be a good neighbour. He went on to say that as an American he originally came from a power dependant society well aware of the costs of electricity, and added that nobody else could ever afford to supply power to this area. With that in mind the local community should work out means of encouraging the project proponents to establish a sub station in Loiyangalani.
Snr. Chief Loiyangalani, Mr. C.K. Lekapana	Confirmed that the whole of Loiyangalani wanted the project. He requested that more information needs to be provided and more meetings should be held in the future. He requested that a copy of the EIA report be left in the school library as reference material. He added that project was at its very beginning.
Loyangalani Cllr., Mr. Marko Ekale	Felt that the report did not mention much about the history of the area and that environmental management budget did not provide enough for local sensitisation on the project.
Presenter	Felt that the allocation was adequate since the proposed figures referred only to the first year of operation of the proposed environmental management plan.
Mr. Loyangalani Cllr. Mr. Marko Ekale	Suggested the budget should include allocation for the Chief's barazas.
Mr. Wijass Owour, District Cooperatives Officer, Chalbi	He started by saying that he was proponent of "Integrated Development" and that Lake Turkana Wind Power Project (LTWPP) was a very good project. He added that in the new District Development Plan prepared by the Laismis District Office, the

District	<p>LTWPP was of the highest priority followed by tourism and livestock development projects.</p> <p>He was, however, concerned that the local population are likely to be spectators and not participants in the project. He illustrated the benefits of the project by predicting that the current district earnings of 6.1million from fish sales would increase to 24 million following the improved roads and the provision of electricity for fish storage facilities. He requested the project to help in finding alternative energy sources to fuel wood. He described how successful the reforestation programmes around the town of Korr had been achieved and how he hoped to see the same in this project.</p>
Presenter	Added that there could be a window of opportunity for other parties including development partners, the Government and NGOs to provide further funding in order to expand the environmental management programme.
Coffee / Tea Break	
Mr. David Nyamweah, District Cooperative Officer – Marsabit	Started by saying that from experience in the Kiambere Hydro Power project, he was confident that most of the benefits projected in this project would be realised. He also felt that an uplift in the standard of living of the local people should be one of the objectives of the social responsibility of the project. He proposed that the support from the project should be given to institutions that govern quality of life, like cooperatives.
Mr. Benedict Lengui, Loiyangalani Peace Committee	Felt that the community was slow to react to the potential of the project and should show its support by readily facilitating of the project.
Mr. Sarai Fetcha, Assist. Chief, Loiyangalani	Asked how the power distribution will be done as was concerned about of the dangers of high voltage cables.
Facilitator	Stated that the cables from the generators would run underground to a collection centre, and then over ground cables on pylons would transmit electricity to the national grid.
Mr. M. Masinga Natapana, Rtd Education Officer	Wanted to see more emphasis on assistance to pastoralists and livestock in the project.
Presenter	He appreciated many of the stakeholders concerns and suggested that there was a need for a Participatory Rural Appraisal (PRA) to facilitate the local community identify felt needs.
Facilitator	Carried out a translation of the raised issues and added that social responsibility will be implemented with full participation of the local community.
Mr. Steven Naikeino	Wanted to find out the project component that will be implemented first and when the implementation will commence. Requested that the project include training of local people as a priority.
Presenter	The Presenter deferred to Willem Dolleman (one of the project partners), on the issue of project timings.
Mr. Willem Dolleman	Stated that the execution of the project would start when all agreements and licences were in place. He perceived that the road construction would constitute the first phase, followed by the transmission line and then the installation of the wind turbines.
Facilitator	Translation.
Mr. David Lobujula	Asked how funds would be raised for the community development.
Mr Benedict Orbora	Extended Mr. Lobujula's thoughts by suggesting that that the salaries of the employees should be taxed and the monies generated to be used for community development.
Mr. William Ebkot	Warned the project against using child labour. He was concerned youngsters are likely to leave school for job opportunities in

	the project. He wanted to be given more time to read the EIA report.
Mr. Willem Dolleman	Stated that as an investor and partner in the project, he would ensure that international law would be applied particularly in areas such as the prevention of child labour.
Presenter	Reminded the participants that they had the EIA report for the last here weeks. He informed them he wanted to submit the revised EIA report within the coming week or so. He requested the participants to give him any further comments before then.
Facilitator	Translated the raised issues and added that Loiyangalani should move fast to keep pace with the rest of the world.
Presenter	Upon requests for out of pocket allowance for the participants, the Presenter felt it was not a sustainable practice. However, he invited the project partner to make a comment on the issue.
Mr. Willem Dolleman	Added that huge sums of money had already been spent and that the community should encourage the proponents to establish the project. He felt the provision of lunches for the stakeholders and payments for accommodation and for the conference room were good gestures from the project.
Snr. Chief Loiyangalani, Mr. C.K. Lekapana	Asked when the PRA would take place. Proposed that the community would prepare a list of priorities that could be discussed in another stakeholders meeting.
Presenter	Was pleased to hear what the chief said. PRA would commence with the commissioning of the project. He added that the community's proposal for the PRA would be well received by the project.
Facilitator	Translation
Loiyangalani Cllr., Mr. Marko Ekale	The Councillor summarised many issues that had been previously raised. He appealed to project to help the community protect the lagga banks which were currently widening and posed a threat to buildings. He spoke of the increase of population in Loiyangalani and requested the project to help in planning the town. He was concerned about the stalled museum project. He felt that the project needed a presence in Loiyangalani and that a project office needs to be opened. In addition the project needs to print project T shirts and banners. He raised the issue of whether the project will be located in Loiyangalani or Mt Kulal locations. He predicted some tension over location of the project.
Presenter	Referred the Councillor to the Environmental Management Plan contained in the EIA report. Added that the proposed Environmental Officer would work with the community to address a wide range of environmental issues of the project area including the problem of the laggas. In this case, there may be a need to prepare a proposal for funding from the Government and other development agents. He appreciated the problems raised by the Councillor but cautioned the participants against high expectations as the Lake Turkana Wind Power Project was a commercial initiative and should not be equated to an aid agency. Reminded the Councillor that the decision on the actual location of the wind farm site has not been decided.
Facilitator	Translated the response from the Presenter and extended his concern over the issue of the widening lagga by voicing his support for action to halt its spread.
Presenter	Again the Presenter thanked the participants and wished stakeholders success in the implementation of the environmental management in collaboration with the project.
Facilitator	Without any further business the Facilitator closed the stakeholders' meeting at 1.57 pm on the 22 nd of April 2008.

Annex 6. Common Flora Identified within the Project Area and Surroundings.

CAPPARACEAE

- ***Boscia coriacea* Pax** (Eedung-Turkana): Short tree, seeds edible by local communities (Turkana) especially during severe drought. Common in the project site within the deciduous shrubland
- ***Cadaba farinosa* Forssk** (Eireng-Turkana): Shrub growing to 3m in height. Occasional in deciduous woodland. Good browse by cattle.
- ***Cadaba glandulosa* Forssk.** Emakak (Turkana): Short evergreen shrub found in riverbeds. Forage liked by camels due to its salt content.
- ***Capparis tomentosa* Lam.** Ekorokorait (Turkana) : Shrub on rocky outcrops and within deciduous woodland
- ***Maerua crassifolia* Forssk.** Ereng (Turkana): Short shrub, 2-3m. Good browse by camels. Occasional on rocky outcrops.
- ***Maerua decumbens* (Brongn.) De Wolf** Eerut (Turkana): Shrub to 3m in height. Common on dry river beds. Fruit said to be edible.
- ***Maerua oblongifolia* (Forssk.) A. Rich.** : Epipa (Turkana): Shrub to 4-7m in height. Occasional among *Acacia reficiens* shrubland

MORINGANGACEAE

- ***Moringa rivae* Chiov.** : Small tree, 3-5m in height. Found only in lava areas east of L. Turkana

POLYGALACEAE

- ***Polygala erioptera* DC.** : Annual or short-lived herb found on rocky dwarf shrubland areas.

AIZOACEAE

- ***Gisekia pharnaceoides* L.:** A trailing or shortly erect hairless annual with oblong-linear leaves. Common in dwarf shrubland dominated by *Indigofera spinosa* and *Sericocomopsis hildebrandtii*.
- ***Zaleya pentandra*(L.) Jeffrey:** A spreading or erect sub-succulent annual herb. Leaves narrow-or broad-elliptic. Rarely in rocky outcrops and on sand dunes.

PORTULACACEAE

- ***Portulaca oleracea* L.:** A hairless annual with many prostrate branches and alternate, obovate to spoon-shaped leaves. Used as green vegetables. Common in dwarf wooded shrubland and semi-deciduous bushland
- ***Portulaca quadrifida* L.:** A prostrate annual or stoloniferous perennial herb. Common in wet places and within dwarf shrubland areas and semi-deciduous bushland

- ***Talinum portulacifolium* (Forsk.) Schweinf.:** A hairless, loosely rooted perennial herb or small shrub. Leaves narrow, fleshy. Flowers purple-pink and in long terminals. Common in woodland and along river channels.

POLYGONACEAE

- ***Oxygonum sinuatum* (Meisn.) Dammer:** Annual herb with oblanceolate or obovate leaves. Flowers pink. Common in abandoned manyattas, roadsides and semi-deciduous bushland

CHENOPODIACEAE

- ***Chenopodium opulifolium* Koch & Ziz.:** Annual or perennial herb often woody below. Common in deciduous woodland and in abandoned manyattas.

AMARANTHACEAE

- ***Achyranthes aspera* L.:** An annual or perennial, short- or long-hairy, herb or shrub. Leaves lanceolate. Common in abandoned manyattas.
- ***Aerva lanata* (L.) Schultes:** A woolly erect woody herb or shrub with few branches. Leaves often spoon shaped. Flowers woolly-white. Common as a weed in abandoned manyattas and in semi-deciduous bushland
- ***Sericocomopsis hildebrandtii* Schinz:** A much branched bushy shrub with obovate to spatulate leaves and terminal racemes of sessile cymes. The inflorescence is white unlike in *S. pallida*. Good browse for camels and goats. Common among *Duosperma eremophilum* and *Indigofera spinosa* in semi-deciduous bushland
- ***Sericocomopsis pallida* (S. Moore) Schinz:** A much branched, bushy dwarf shrub with white hairs on ovate-elliptic leaves. Inflorescence grey. Common in wooded dwarf shrubland

ZYGOPHYLLACEAE

- ***Tribulus terrestris* L.:** A hairy annual herb with trailing branches and leaves bearing 4-8 pairs of leaflets. Fruits almost spherical with sharp horned spines that are nuisance on bare foot. Common in deciduous woodland
- ***Tribulus cistoides* L.:** A trailing perennial or annual herb with unequal leaves bearing 4-8 pairs of leaflets. Fruits with two pairs of wicked spines. Common in grasslands with shrub such as *Acacia*, *Commiphora* and *Jatropha*

GERANIACEAE

- ***Pelargonium alchemilloides* (L.) Ait.f.:** A perennial hairy herb with slightly swollen rootstock. Leaves alternate below, opposite above. Found in evergreen & semi-deciduous bushland

NYCTAGINACEAE

- ***Boerhavia coccinea* Mill.:** A prostrate or scrambling, annual herb. Flowers pink. Common in saline soil and in deciduous shrubland.

PASSIFLORACEAE

- ***Adenia venenata* Forssk.** - Olmurrilengiron, Loisinkiriatshoi (Samburu): Creeper or climber 4-8m from a bottle-shaped swollen lower trunk with many branches arising from its top. Leaves 3-5-lobed. Flowers cream. Rare in deciduous wooded bushland (*Acacia-Commiphora* community).

CUCURBITACESE

- ***Coccinia grandis* (L.) Voigt:** Hairless perennial from a tuberous rootstock, the stems develops corky bark when mature. Leaves 3-5-lobed. Flowers yellow to orange, fruits normally egg-shaped, edible. Found in wooded dwarf shrubland and along dry riverbeds.
- ***Cucumis prophetarum* L. :** Perennial herb with bristly, not spiny, hairs; leaves kidney-shaped in outline; fruit yellowish densely covered with bristle-tipped, often curved projections. Found in wooded shrubland.
- ***Kedrostis gijef* (J. F. Gmel.) C. Jeffrey** - Sokodume(Samburu), Eiyarabos (Turkana): Climber with ridged stems. Leaves 3-5-lobed; flowers yellow; fruit orange or red. Common in mixed shrubland; used by Turkana as eye medicine; root used to neutralize snake poison.
- ***Momordica boivinii* Baill.:** A hairy climber from tubers, with simple or divided tendrils and heart-shaped leaves. Found in deciduous woodland and along dry riverbeds.

OCHNACEAE

- ***Ochna ovata* F. Hoffm.:** Shrub or tree 9m in height; Leaves reddish when young, slightly ovate. Flowers yellow; fruits with black drupelets. Common in shrubland and on rocky outcrops.

COMBRETACEAE

- ***Combretum aculeatum* Vent.** - Ekabekebeke (Turkana): Shrub with curved spines. Common in *Acacia-Commiphora-Duosperma* wooded dwarf shrubland
- ***Combretum molle* G. Don** - Eguren, Ekamiro (Turkana): Tree, 8m in height; bark greyish, rough/fissured; young leaves and flowers appearing at the same time. Flowers yellow, in axillary spikes. Common on rocky areas on the slopes of Mt. Kulal in *Acacia-Commiphora* woodland.

TILIACEAE

- ***Grewia nematopus* K. Schum. (*G. tembensis* Fres.):** Shrub, 5m in height with virgate branches. Leaves elliptic to slightly obovate, margin serrated; flowers white tinged pink. Common in *Acacia-Commiphora* mixed bushland.
- ***Grewia tembensis* Fres.** - Irii (Samburu), Emalaker (Turkana): Shrub 4m. Leaves slightly obovate, elliptic or almost round, margin serrate slightly sandpapery above; flowers white, pink or pale lilac. Common in bushland and along riverines.

- ***Grewia tenax* (Forsk.) Fiori** - Iri, Lairipai (Samburu), Eng'omo (Turkana): Shrub 3-5m in height. Leaves round, obovate, base rounded; flowers white; fruits orange-red. Found in bushland and on dry river courses and wooded dwarf shrubland
- ***Grewia bicolor* Juss.** - Siteti (Samburu), Ekali (Turkana): Shrub 7m in height with dark purple-brown bark, deeply fissured and peeling. Leaves obovate, base unequal; flowers yellow, in few-flowered axillary cymes; fruits orange or red brown-edible. Common in wooded dwarf shrubland.
- ***Grewia villosa* Willd.** - Lpupoi (Samburu), Epongai (Turkana): Shrub 5m in height. Leaves round or broadly elliptic, base subcordate, margin serrate sandpapery or pubescent above; flowers yellowish, fruit orange or red, edible. Common in *Commiphora-Acacia* deciduous woodland.
- ***Grewia trichocarpa* A.Rich.** - Siteti (Samburu): Shrub or tree 6m in height. Bark silver grey. Leaves elliptic, base (unequally); flowers yellow; fruits orange-edible. Common in riverine woodland.
- ***Triumfetta flavescens* A. Rich.** - Ekwiyen (Turkana): Shrub 2m in height. Older branches with black lines often forming a characteristic reticulation. Leaves broadly ovate; flowers yellow, in a long terminal or leafy-opposed spike-like inflorescence; fruit ellipsoid with short bristles. Common in mixed bushland.

STERCULIACEAE

- ***Hermannia kirkii* Mast.**: A glandular hairy annual herb or shrub with oblong-lanceolate leaves; flowers pink-purple. Grassland with dwarf shrubs associated with *Acacia* and *Commiphora*
- ***Melhania ovata* (Cav.) Spreng.** - A grey-hairy woody herb or shrub with ovate or circular leaves; flowers sulphur yellow to orange. Common in mixed woodland.
- ***Sterculia africana* (Lour.) Fiori** - Etete (Turkana): Shrub or tree to 8m in height. Bark grey or liver red, smooth, flaking to show yellow-green under bark. Leaves spaced on young shoot; flowers in clusters terminal panicles; fruit with three-5 follicles. Bark yields fibre used to make strings. Rare in wooded bushland.
- ***Sterculia stenocarpa* H. Winkl.** - Ikalaasia (Samburu): Shrub or tree to 10m in height. Bark smooth (reddish purple or grey) flaking or peeling to show a pale green or grey under bark; trunk sometimes swollen. Leaves clustered on short shoots. Flowers yellow-green with reddish streaks. Fruit grey-green of 4-5 follicles. Rare in *Acacia/Commiphora* mixed bushland and wooded dwarf shrubland.

MALVACEAE

- ***Abutilon mauritianum* (Jacq.) Medic.**: Woody herb or shrub, 3m in height; leaves broadly ovate, base cordate. Flowers yellow. Occasional in bushland and along river channels.

- ***Hibiscus fuscus* Garcke:** An erect, sparsely-branched woody herb or shrub. Leaves ovate-triangular, simple or rarely 3-lobed; flowers white or purple. Common in mixed bushland under shade.
- ***Pavonia arabica* Boisso** - A densely glandular-hairy annual or short lived perennial; leaves ovate; flowers pink. Occasional in wooded dwarf shrubland of *Commiphora* and *Jatropha*.
- ***Sida ovata* Forsk.** - A densely hairy shrub, or short-lived perennial or woody; leaves ovate-elliptic, blunt ended; flowers pale orange-yellow. Rare in deciduous woodland.

MALPIGHIACEAE

- ***Caucanthus albidus* (Niedenzu) Niedenzu.** - Nakora (Turkana): Shrub or scrambler 2-4m in height; leaves obovate or circular, densely silvery-hairy beneath. Flowers white or cream, in racemes; fruit with a circular wing. Occasional in *Acacia reficiens-Duosperma rocky shrubland*.

EUPHORBIACEAE

- ***Acalypha fruticosa* Forssk.** - Eteteleit (Turkana): Short shrub to 2m in height. Locally found along the river channels. Used locally by Turkana to heal wounds.
- ***Clutia abyssinica* Jaub. & Spach** - Echiato (Turkana): Shrub to 2m in height. Leaves turning orange when drying. Common within *Acacia-Commiphora* mixed bushland.
- ***Croton dichogamus* Pax** - Kekelwa (Turkana): A multi-stemmed shrub or low tree with silvery leaves beneath. A common shrub forming thickets within mixed bushland.
- ***Croton somalensis* Vatke & Pax;** Shrub to 2m in height. Leaves silvery beneath and also turning orange like in *C. dichogamus*.
- ***Erythrococca bongensis* Pax** - Ekoromwai (Turkana): Shrub or tree 4m in height; bark pale brown, flaking in small sections; leaves ovate or elliptic; fruits yellow or red, 3-lobed. Common shrub in bushland especially along riverbeds.
- ***Euphorbia candelabrum* Kotschy** - Yoopong (Turkana): Succulent milky stout tree to 5m in height. Common in bushland along the slopes of Mt. Kulal.
- ***Euphorbia cuneata* Vahl - Lokilei** (Turkana): Spiny shrub with lots of latex. Common in *Acacia-Commiphora-Duosperma* bushland.
- ***Euphorbia gossypina* Pax** - Scrambling shrub with cylindrical branches. Branches break easily producing white sap. Common in the eastern part of project area dwarf shrubland.
- ***Euphorbia heterochroma* Pax** - Succulent spiny shrub, 4-6 angled. Common on rocky outcrop in eastern side of the project area.

- ***Jatropha pelargoniifolia* Courb.** - Ebulon (Turkana): Shrub to 1.5m in height, sap pale yellow turning reddish. Leaves palmately 3-5 lobed. Flowers yellow-green. Common on rocky areas.
- ***Jatropha parvifolia* Chiov.** - Ebulon (Turkana): Shrub 2m in height. Bark purple, sap clear to reddish yellow. Spines slightly curved, leaves clustered on short shoots. Flowers yellow-green, fading to pink. Common on *Acacia/Commiphora* rocky shrubland.
- ***Jatropha dichter* Mic Bv.** - Laparana (Samburu), Etirah (Turkana): Shrub with many erect branches from the base, bark dark reddish-purple, papery-peeling, latex clear, milky or red. Spines straight, flowers pale yellow, fading to pink. Occasional in *Commiphora* mixed shrubland and on sand dunes.
- ***Jatropha fissispina* Pax.** - Short shrub 0.5m high. Leaves palmately lobed, flowers yellow-green. Common on flood prone rocky areas with silt deposited soil.
- ***Phyllanthus fischeri* Pax:** Shrub 3m in height, sometimes scrambling. Leaves elliptic, base rounded or slightly cuneate. Flowers yellow-green or greenish white in few-flowered fascicles. Common in bushland and along dry riverbeds.
- ***Flueggea virosa* (Willd.) Voigt. [*Securinega virosa* (Willd.) Baill.]** - Elakis (Turkana): Shrub (rarely a tree) 5m in height. Leaves obovate, base cuneate; flowers yellow-green or cream, in sparse to very densely axillary fascicles; fruits white. Common in dwarf shrubland

LEGUMINOSAE

Sub family: CAESALPINIOIDEAE

- ***Delonix elata* (L.) Gamble** - Ekurinchanait (Turkana): A common tree over 10m in height and with spreading crown. Flowers white with yellow petals. A very striking tree along riverbeds and on rocky wooded dwarf shrubland. Also commonly found in the eastern part of project area.

LEGUMINOSAE

Sub family: MIMOSOIDEAE

- ***Acacia mellifera* (Vahl) Benth.** - Embenyo (Turkana): Multi-stemmed shrub. Common in all types of habitat especially in the eastern part of the project area. .
- ***Acacia senegal* (L.) Willd.** - Ekunoit (Turkana): Shrub to 4m in height and with prickles emerging below the nodes. Common in *Acacia-Commiphora* bushed woodland.
- ***Acacia brevispica* Harms:** Scrambling shrub commonly found in semi-deciduous bushland
- ***Acacia drepanolobium* Sjoestedt:** Eiyellel (Turkana): Tree with purple (young) or black (mature) swollen base (gulls). Common on the eastern side of Mt. Kulal forming good woodland.

- ***Acacia ethaica* Schweinf.** - Eliwo (Turkana): Short tree, sometimes becoming a tree to 4m in height. Common in rocky outcrops and in deciduous woodland
- ***Acacia nilotica* (L.) Del.** - Ekapelimen (Turkana): Tree to 4m in height. Crown flat or umbrella-shaped. Bark fissured in narrow strips. Fruit black. A common *Acacia* in deciduous woodland
- ***Acacia reficiens* Wawra** - Shrub to 3m in height forming obconical and flat topped crown. A very common *Acacia* in the eastern part of the project area.
- ***Acacia tortilis* (Forsk.) Hayne** - Tree to 15 m in height. Common on dry riverbeds forming riverine woodland, fruit pale brown, twisted or contorted. Pods liked by goats and local community shake the branches to let the pods drop for the goats.

LEGUMINOSAE

Sub family: PAPILIONOIDEAE (FABACEAE)

- ***Rhynchosia minima* (L.) DC.** - A short-hairy trailing or twining herb with stiff leaflets. A rare occurrence in the project area.
- ***Vigna frutescens* A. Rich.** - Perennial with a woody tuber and stems trailing; inflorescences long-stalked; flowers lilac-mauve. Herb in rocky wooded dwarf shrubland bushland
- ***Indigofera hochstetteri* Bak.** - Hairy annual herb; leaflets 3-5; racemes many-flowered; pods hanging, curved, flat. Common in dwarf wooded grassland.
- ***Indigofera schimperi* Jaub. & Spach** - Perennial, 1m with dense appressed silvery hairs; leaflets 5-10, alternate; raceme-many flowered. Occasional in semi-deciduous bushland
- ***Indigofera spinosa* Forsk.** - Very branched silvery shrublet hardly 0.5m in height with dense appressed hairs. A very common dwarf shrub in the entire project area. Good browse for all browsers.
- ***Indigofera cliffordiana* Gillett** - Silvery shrublet to 50cm; leaflets 3, raceme 10-20-flowered, orange. Locally dominant on shallow river channels. Commonly associated with *Indigofera spinosa*, *Duosperma* and *Acacia reficiens*.
- ***Ormocarpum trichocarpum* (Taub.) Engl.** - Shrub or tree 5m in height often with twigs. Leaves in tufts, with 7-15 leaflets; flowers mauve-blue or cream with blue veins; fruit oblong, straight and covered in stiff golden-brown hairs. Common in dwarf wooded shrubland.

MORACEAE

- ***Ficus sycomorus* L.** - Tree to over 15m in height, bark yellowish; leaves ovate or elliptic, margin entire and sandpapery above. Figs in leaf-axils; figs yellow or reddish. Common riparian tree on the slopes of Mr. Kulal and on rocky outcrops.

CELASTRACEAE

- ***Maytenus heterophylla* (Eckl. & Zeyh.) N. Robson** - Ekalamoran (Turkana): Shrub or small tree. Occasional on dry bushland and along riverbeds.
- ***Maytenus senegalensis* (Lam.) Exell** - Ekaburu (Turkana): Shrub to 8m in height. Common along riverine and bushland.

SALVADORACEAE

- ***Salvadora persica* L.** - Esokon (Turkana): Semi-scandent evergreen shrub. Branchlets used as teeth-braches. Fruits edible. Twigs used for construction of local community housed.

OLACACEAE

- ***Ximenia americana* L.** - Elamai (Turkana): Shrub to 3m in height. Leaves alternate or clustered on spur shoots. Fruit orange-red. Common in mixed bushland and on rocky outcrops.

SANTALACEAE

- ***Osyris lanceolata* Hochst. & Steud.** - Shrub to 4m in height. Leaves bluish green or yellow green. Usually on rocky outcrops especially on the slopes of Mt. Kulal. The wood is used as a substitute for sandalwood. Endangered species. Occasionally harvested illegally as sandalwood. There was no sign of such harvesting in the project site although the communities claim that it is used as a substitute for tea-leaves.

RHAMNACEAE

- ***Helinus integrifolius* (Lam.) Kuntze** - Ekaburu (Turkana): Climber or decumbent shrub to 5. in height. Common in bushland as a scrambler.
- ***Scutia myrtina* (Burm. f.) Kurz** - Shrub, often forming impenetrable bush due to its hooked spines. Common on the slopes of Mt. Kulal in semi-deciduous bushland. Fruits edible.
- ***Ziziphus mauritiana* Lam.** - Ekalale (Turkana): Shrub or tree with pairs of thorns on its nodes. Common in riverine woodland.
- ***Ziziphus mucronata* Willd.** - Amaleri (Turkana): Shrub or tree to 10m in height. Bark grey-brown, reticulate-scaly. Young branches zigzag with thorns in pairs on the nodes. Common along dry riverbeds. Fruits edible, wood used for construction.

VITACEAE

- ***Cissus rotundifolia* (Forsk.) Vahl** - Lorodo (Turkana): Succulent climber with 4-5-angled stems and forked tendrils. The bark is used for rope; roasted leaves are used to reduce swellings (e.g. Bee stings) Common scrambler on dense thickets and woodland.

- ***Cissus quadrangularis* L.** - Egis (Turkana): Succulent climber with 4 angled-stems and the wings at the angles. Tendrils simple, leaves only rarely present. A root infusion is employed against chest pain and as a pesticide against termites by Turkana. Common in dwarf bushland.

RUTACEAE

- ***Vepris glomerata* (F. Hoffm.) Engl.** - Ekuri, Emalitenyit (Turkana): Short shrub or tree with 3-foliolate. Rare in rocky outcrops and dry riverbeds.

BALANITACEAE

- ***Balanites aegyptiaca* (L.) Del.** - Eroronyit (Turkana): Tree to 5m in height with smooth and green bark. Fruit edible, red and yield oil. The fruit is liked by goats. Common in deciduous woodland eastern project area.

BURSERACEAE

- ***Boswellia neglecta* S. Moore (*B. hildebrandtii* Engl.)**: Tree to 7m tall with horizontal branches. Branches break easily. Common in deciduous shrubland.
- ***Commiphora africana* (A. Rich.) Engl.** - Ekadeli (Turkana): Spiny shrub or tree to 4-8m tall. A cylindrical trunk. Leaves serrate, smooth. Bark peeling in shiny reddish brown or grey scrolls. Common all over the project area especially to the eastern side.
- ***Commiphora schimperi* (Berg) Engl.** - Spiny shrub with cylindrical trunk, outer bark peeling in dull yellow or grey curved flakes from the green under bark. Leaves hairy. Common on rocky shrubland in the eastern part of the project site.
- ***Commiphora campestris* Engl.** - Etopojo (Turkana): Spiny shrub or short tree to 10m in height with massive, irregular, angled trunks; outer bark yellowish, breaking away in rather small flakes from the greenish under bark. Common in *Acacia-Commiphora* mixed shrubland east of the project area.
- ***Commiphora edulis* Kl. Engl. Ssp *boiviniana* (Engl.) Gillett**: Shrub branching from the base; bark pale grey, smooth. Common in *Acacia-Commiphora* mixed bushland and on rocky areas.

MELIACEAE

- ***Turraea mombassana* C.DC.** - Enampapapa (Turkana): Shrub, rarely in rocky and riverbeds.

SAPINDACEAE

- ***Allophylus rubifolius* (A. Rich.) Engl.** - Ekarai (Turkana): Shrub in dense bushland and riverine habitat.
- ***Dodonaea angustifolia* L.f.** - Shrub 2m in height with glossy sticky leaves. Fruits pinkish or reddish, 2-3-winged. Occasional in bushland north-east of the project area. Plant with hard wood used for tool handles and walking sticks.

- ***Pappea capensis* Eckl. & Zeyh.** - Etolelk (Turkana): Shrub or tree to 7m in height. Common on rocky outcrops in the eastern part of project site.

ANACARDIACEAE

- ***Lannea triphylla* (A. Rich.) Engl. – Etopojo (Turkana):** Shrub with spreading crown. Bark grey, smooth. Fruit and root edible. Common in *Acacia-Commiphora* mixed bushland.
- ***Rhus natalensis* Krauss** - Shrub to 4m in height. Branchlets pale grey or whitish. Fruit edible. Common in bushland and riverbeds.
- ***Rhus vulgaris* Meikle:** Shrub to 5m in height with smooth, dark brown bark. Fruits edible. Common in bushland and on riverbeds.

EBENACEAE

- ***Diospyros scabra* (Chiov) Cuf.** - (Elim-Turkana; Lgotoi-Samburu): Shrub or tree to 10m tall; bark grey, corrugated-platy. Common along luggas and on rocky places.
- ***Euclea divinorum* Hiern:** Evergreen shrub or tree to 8m in height; bark dark-grey and fissured. Leaves smooth and shining above. Common in river channels on the slopes of Mt. Kulal.

MYRSINACEAE

- ***Marine africana* L.** - Easy (Turkana); Skeet (Samburu): Shrub, 2m tall with grey-brown branches. Rarely on rocky outcrops.

APOCYNACEAE

- ***Addendum obese* (Forsk.) Rome. & Schultz. (Desert Rose)** - Eagles (Turkana); Parental (Samburu): Shrub with bulbous stems and white, pink or reddish flowers. Common in *Acacia-Commiphora* mixed bushland. The whole plant is poisonous especially roots that are used for making fish and arrow poison.
- ***Carissa edulis* (Forssk.) Vahl** - Ekamura (Turkana); Lmuria/Lmuriel (Samburu): Shrub, occasionally scrambling to 5m tall. Bark grey and spines rarely forked. Flowers white inside and pink to red outside. Fruits edible, red when unripe and black when ripe. Common on rocky areas.

ASCLEPIADACEAE

- ***Caralluma acutangula* (Decne) N.E.Br.** - An erect, 4-angled stems succulent. Common on rocky areas especially eastern part of the project site.
- ***Sarcostemma viminale* (L.) R.Br.** - A twining shrub with cylindrical thin green stems. Flowers greenish. Common and forming dense clumps in rocky areas especially in the eastern project area.

RUBIACEAE (Coffee Family)

- ***Vangueria apiculata* K. Schum.** - Emaler (Turkana): Shrub or tree to 8m tall; bark smooth, grey-brown. A rare plant in project area though found along river channels and on rocky area. Fruit green when unripe and changing to purple-black when ripe.

COMPOSITAE

- ***Kleinia squarrosa* Cuf:** A fleshy, sprawling stem-succulent up to 2m in height. Leaves appearing on the very young shoots which are soon shed. Flower heads cylindrical, born 2-8 together in umbels at the end of branches. A very conspicuous species in dwarf bushland associated with *Duosperma eremophilum*, *Indigofera spinosa*, *Plectranthus igniarius*, *Euphorbia uhligiana*, *E. nubica* and *Sesamothamnus busmans*.
- ***Gutenbergia cordifolia* Olivo (*Erlangea cordifolia* (Oliv.) S. Moore):** A small erect herb with alternate simple leaves. Flower heads solitary with purple florets. Rarely under shrubs on the slopes of Mt. Kulal.
- ***Vernonia brachycalyx* O. Hoffm.:** Shrub to 3m tall. Common in dry bushland.
- ***Vernonia cinerascens* Sch.B~.R.** - Esirilipong/Ejulot (Turkana); Torau Magifi (Samburu): Woody herb under shade in *Acacia-Commiphora* mixed bushland.
- ***Vernonia lasiopus* O. Hoffm.** - Nkaputi (Samburu): Woody herb under shade on the edge of shrubs
- ***Conyza steudelii* Sch. Bip. :** A stiff, often big coarse herb. Common on the slopes of Mt. Kulal in a mixed bushland.
- ***Conyza stricta* Willd.:** An erect annual; rarely found on the western slope of Mt. Kulal in *Acacia-Commiphora* mixed bushland.
- ***Psiadia punctulata* (DC.) Vatke** - Laba, Labai (Samburu): Shrub, 2m tall with sticky shining leaves. Flowers yellow in many flowered heads. Fairly common on the slopes of Mt. Kulal in mixed bushland.
- ***Helichrysum glumaceum* DC.:** A slender low perennial, grey-hairy with linear, pointed leaves. Heads white or pink in tight clusters. Rarely found under mixed woody bushland.
- ***Aspilia mossambicensis* (Oliv.) Wild:** Woody herb or shrub, usually much branched with stalked rough-hairy. Heads yellow. Rarely found in mixed bushland and along river channels.
- ***Bidens pilosa* L.:** Annual herb on shade. Commonly found around abandoned settlements.
- ***Lactuca inermis* Forsk.:** An erect herb with few high branches. Common under shade and in abandoned settlements.
- ***Sonchus bipontini* Aschers.:** A robust erect or trailing herb, heads almost stalk less, in tight terminal clusters and with white wool below the orange-yellow heads. Common under thickets in *Acacia-Commiphora* bushland.

BLUMBAGINACEAE

- ***Ceratostigma abyssinica* Asch.** : A low rough-hairy shrub with stiff, elliptic-oblongate sharply pointed leaves. Rare in rocky areas.

BORAGINACEAE

- ***Cordia monoica* Roxb. (*Cordia ovalis* DC.)** - Etuntun, Elkaisekiseki (Turkana); Lmantume (Samburu): Evergreen shrub or small tree 6m tall. Bark smooth or rough, flaking-very sandpapery above, pubescent-sandpapery beneath. Common along water channels and on rocky areas.
- ***Cordia sinensis* Lam. (*C. gharaf* (Forsk.)** - Edome (Turkana), Ilgoita (Samburu): Shrub or small tree, bark smooth, leaves sub-opposite and elliptic; sandpapery. Common in the eastern portion of project site.
- ***Heliotropium longiflorum* (A.DC.) Jaub. & Spach. (*H. somalense* Vatke):** Erect, minutely hairy perennial herb with flat, linear to lanceolate leaves. Common along seasonally streams and under shades.

SOLANACEAE

- ***Lycium europaeum* L.** - Lokei (Samburu), Ekake-bekeke (Turkana): Shrub with spines to 3m in height. Flowers white fading to cream or lilac. Fruits orange or red. Common on rocky outcrops and along dry riverbeds.
- ***Solanum incanum* L.** - Ltulerlei (Samburu), Etulelo (Turkana): Short shrub to 2m in height. Common in abandoned manyattas and on the slopes of Mt. Kulal in evergreen & semi-deciduous bushland
- ***Withania somnifera* (L.) Dunal** - Lesayet (Samburu), Emotoe (Turkana): Woody herb or shrub to 3m in height. Young leaf densely hairy but later glabrous. Flowers yellow-green, fruits orange or red. Common on abandoned manyattas and under shade.

CONVOLVULACEAE

- ***Convolvulus sagittatus* Thunb.** - Perennial herb with white petals. Rarely under shade and on rocky crevices.
- ***Hildebrandtia obcordata* S. Moore** - Egong (Turkana): A very conspicuous shrub when blossoming, 2-3m in height. Flowers white cream. Common in bushed dwarf shrub among *Acacia-Commiphora* mixed community.
- ***Ipomoea cicatricosa* Baker** - Ekuyenit (Turkana): Shrub growing to 3m in height. Very attractive when in flower. Flowers pink, mauve or purple. Common in eastern side of project area on rocky outcrops.
- ***Ipomoea kituiensis* Vatke** - Eneket (Turkana): Climbing shrub to 6m in height. Flowers cream to pale yellow, with mauve or purple centre. Common in *Acacia tortilis* wooded shrubland, occasionally in open grassland.

SCROPHULARIACEAE

- ***Cycnium tenuisectum* (Standl.) O. J. Hansen (*Rhamphicarpa tenuisecta* Standl.):** Annual herb. Common on wet grounds and along river channels.

PEDALIACEAE

- ***Sesamonthamnus rivae* Engl.** - Loborea (Turkana): Shrub or small tree to 4m in height. Bark smooth, grey, branches arching, sparsely spiny. Flowers scented, white. Fruits brown, slightly obovate, splinting easily when dry. Rarely found in deciduous shrubland among *Acacia* and *Commiphora* mixed bushland.

ACANTHACEAE

- ***Asystasia gangetica* (L.) T. Anders** - Perennial herb to 1m in height. Flowers blue. Common under shade in *Commiphora-Acacia* mixed bushland.
- ***Blepharis maderaspatensis* (L.) Roth** - Perennial creeping herb under bushes. Rare in semi-deciduous bushland
- ***Duosperma eremophilum* (Milne-Redh.) Brummitt** - Sapani (Samburu), Emerkwi (Turkana): Dwarf shrub 1m in height. Very common dwarf shrub in the whole of project area. One of the most important browse for all species of livestock in the region.
- ***Dyschoriste radicans* Nees:** A trailing herb, common in dwarf shrubland.
- ***Barleria acanthoides* Vahl:** Short shrub with almost stalk less. Locally common wooded dwarf shrubland
- ***Justicia flava* Vahl:** A trailing or erect hairy woody perennial. Flowers small, bright yellow. Common under shade and along water channels.
- ***Justicia odora* (Forsk.) Vahl:** Lodto (Samburu): Woody shrub to 1m in height. Leaves narrow, elliptic to slightly obovate. Flowers yellow. Common on rocky outcrops and under bushes.
- ***Ruttya fruticosa* Lindau** - Shrub, 4m in height. Leaves ovate or elliptic. Flowers red, rarely yellow with black throat. Rarely in rocky outcrops and along dry riverbeds.

VERBENACEAE

- ***Clerodendrum myricoides* (Hochst.) Vatke** - Makutikuti (Samburu), Gobetie (Turkana): Shrub 4m in height. Leaves opposite or in three/fours, ovate or slightly obovate. Flowers blue or purple, occasionally greenish with one lobe blue, or blue with two lobes white. Common in semi-deciduous bushland
- ***Leucas glabrata* (Vahl) R.Br** - Short-or long hairy annual or perennial herb or weak shrub with elliptic to ovate leaves and clusters of flowers. Common in dwarf shrubland.

- ***Leucas tomentosa* Guerke** - A white woolly erect or ascending shrub. Leaves narrow at base, flowers white. Common among the *Duosperma eremophilum* dwarf shrubland.
- ***Lantana trifolia* L.** - Sekechewo (Turkana): Woody herb. Leaves opposite and occasionally sandpapery. Flowers mauve or purple. Common under shade on the slopes of Mt. Kulal.
- ***Lantana viburnoides* (Forsk.) Vahl** - Woody herb. Leaves opposite, ovate, base cuneate or attenuate. Flowers white (rarely pale pink). Common under shade in semi-deciduous bushland and wooded dwarf shrub land.
- ***Lippia kituiensis* Vatke (*L.ukambensis* Vatke sensu Baker et al** - (Sinoni (Samburu): Shrub, 3m in height. Leaves opposite (rarely in three), aromatic. Flowers white with yellow throat. Rarely under shade and along dry riverbeds in evergreen & semi-deciduous bushland.
- ***Premna resinosa* (Hochst.) Schauer** - Ikorderedet (Turkana): Shrub 3-5m in height. Leaves opposite, aromatic, ovate or (broadly) elliptic. Flowers (greenish) cream or white. Fruits purple to black. Common in *Acacia/Commiphora* bushland.

LABIATAE

- ***Tinnea aethiopica* Hook. f.** - Shrub to 4m in height, sometimes weakly scandent. Leaves ovate to obovate, base cuneate or attenuate. Flowers blackish purple. Fruiting calyx membranous. Common in evergreen & semi-deciduous bushland and on rocky places.
- ***Becium obovatum* (E. Mey.) N.E.Br.** - An erect or trailing herb or wiry shrub from a woody rootstock. Leaves oblong, flowers white and pink. Common in woodland and open shrubland.
- ***Hoslundia opposita* Vahl** - Labai (Samburu): Spreading shrub with white or yellowish flowers. Fruit with yellow to red fleshy calyx. Occasional in mixed bushland and along dry riverbeds.
- ***Ocimum suave* Willd.** - Lemurran (Samburu), Loguru or Ichoke (Turkana): Woody herb or shrub to 3m in height. Leaves ovate or elliptic, base cuneate, apex acute. Flowers whitish or pale purple. Common in mixed bushland.
- ***Plectranthus igniarius* (Schweinf.) Agnew** - Akurau or Nakhwara (Turkana): Shrub slightly fleshy, often with arching branches, often flowers when leafless, 2-3m in height. Leaves broadly elliptic. Flowers blue or violet. Common on rocky outcrops in eastern part of the project site.

COMMELINACEAE

- ***Commelina africana* L.** - Fleshy prostrate perennial herb. Leaves narrow and small yellow to orange flowers. Rarely in bushland
- ***Commelina benghalensis* L.** - Freshy herb with ascending or erect branches. Leaves usually short stalked and oblique-based. Flowers blue. Rarely under bushes on the slopes of Mt. Kulal.

LILIACEAE (Aloeceae)

- ***Aloe secundiflora* Engl.** - A large stem less rosette, usually solitary, of green unspotted, more or less glossy leaves. Flowers red with minute translucent spots. Common in bushland and on rocky shrubland.
- ***Aloe turkanensis* Christian** - A clump of rosettes on short stems which lean or falls. Leaves spotted, very smooth. Common under shade in dense bushland.

ASPARAGACEA

- ***Asparagus falcatus* L. (*inc aethiopicus* L.)** - Straggling or climbing herb from rhizomes bearing edible tubers. Flowers minute, cream to white. Rarely in dense bushland
- ***Asparagus africanus* Lam.** - Scrambling woody shrub with brown spines from a fibrous rootstock, stems smooth or grooved, grey-brown. Flowers white. Common in dense bushland.

CYPERACEAE

- ***Bulbostylis boecklerana* (Schweinf.) Beetle** - Evergreen bush land.
- ***Cyperus alternifolius* L.** - Bushland community.
- ***Cyperus blysmoides* Hochst.** - Evergreen bushland.
- ***Cyperus giolii* Chiov.** - Deciduous woodland.
- ***Cypera kilimandscharicus* Kuek.** - Evergreen bushland and deciduous woodland.
- ***Cyperus obtusiflorus* Vahl** - Evergreen bushland
- ***Cyperus teneriffae* Poir.** - Evergreen bushland and wooded dwarf shrubland.
- ***Kyllinga alba* Nees (incl. var. *alata* (Nees) C.B.Cl.)** - Deciduous woodland.
- ***Mariscus amauropus* (Steud.) Cuf. (incl. *M. leptophyllus*** - Semi-deciduous bushland and deciduous woodland.
- ***Mariscus macropus* (Boeck.) C.B.Cl.** - Deciduous woodland.

GRAMINEAE (POACEAE) ;TRIBE ANDROPOGONEAE

- ***Andropogon schirensis* A. Rich.** - Deciduous woodland.
- ***Bothriochloa insculpta* (A. Rich.) A. Camus (*Dichanthium insculptum* (A. Rich.) W.D. Clayton)** - Evergreen & semi-deciduous bushland.
- ***Chrysopogon plumulosus* Hochst.** - Deciduous woodland and wooded dwarf shrubland.

- ***Heteropogon contortus* (L.) Roem. & Schult.** - Evergreen bushland.
- ***Hyparrhenia gazensis* (Rendille) Stapf** - Evergreen bushland.
- ***Hyparrhenia hirta* (L.) Stapf** - Evergreen bushland.
- ***Hyparrhenia papillipes* (A. Rich.) Stapf** - Evergreen bushland (3) composite bushland.
- ***Ischaemum afrum* (J.F. Gmel.)** - Dandy Perennial grassland.
- ***Sehima nervosum* (Rottl.) Stapf** - Evergreen & semi-deciduous bushland.
- ***Sorghum arundinaceum* (Desv.) Stapf** - Deciduous shrubland.

TRIBE PANICEAE

- ***Brachiaria deflexa* (Schumach.) C.E. Hubbard** - Evergreen bushland.
- ***Brachiazia leersioides* (Hochst.) Stapf** - Evergreen bushland.
- ***Brachiaria semiundulata* (A. Rich.) Stapf** - Deciduous bushland.
- ***Brachiaria serrata* (Spreng.) Stapf. (incl. *var.gossypina* (A.Rich.) Stapf)** - Evergreen bushland and deciduous woodland.
- ***Cenchrus ciliaris* L.** - Evergreen bushland and deciduous woodland.
- ***Digitaria abyssinica* (A.Rich.) Stapf** - Evergreen bushland and deciduous woodland.
- ***Digitaria macroblephara* (Hack.) Stapf** - Semi-deciduous bushland and Deciduous woodland.
- ***Digitaria rivae* (Chiov.) Stapf** - Evergreen bushland and deciduous woodland.
- ***Digitaria velutina* (Forsk.) P. Beauv.** - Evergreen & semi-deciduous bushland.
- ***Panicum coloratum* L.** - Deciduous bushland.
- ***Panicum deustum* Thunbo** - Evergreen & semi-deciduous bushland.
- ***Panicum maximum* Jacq.** - Evergreen bush.
- ***Pennisetum mezianum* Leeke** - Semi-deciduous bushland and Deciduous woodland.
- ***Pennisetum stramineum* Peter** - Evergreen & semi-deciduous bushland.
- ***Setaria sphacelata* (Schumach.) M. B. Moss (*S. trinervia* Stapf)** - Evergreen bushland and deciduous bushland

OTHER TRIBES:

- ***Aristida adscensionis* L.** - Annual grass in open grassland areas.

- ***Aristida mutabilis* Trin. & Rupr.** - Annual grass. Open grassland.
- ***Aristida adoensis* A. Rich.** - Evergreen bushland.
- ***Chloris pycnothrix* Trin.** - Semi-deciduous bushland.
- ***Cynodon dactylon* (L.) Pers.** - Evergreen bushland.
- ***Dactyloctenium aegyptium* (L.) Willd.** - Semi-deciduous bushland and wooded dwarf shrubland.
- ***Eleusine multiflora* A. Rich.** - Evergreen bushland.
- ***Enneapogon cenchroides* (Roem. & Schult.) Hubbard** - Deciduous shrubland.
- ***Enneapogon desvauxii* P. Beauv.** - Deciduous woodland and Wooded dwarf shrubland.
- ***Enneapogon schimperanus* (A. Rich.) Renv.** - Deciduous shrubland.
- ***Eragrostis braunii* Schweinf.** - Evergreen bushland and deciduous woodland.
- ***Eragrostis cilianensis* (All.) F.T. Hubb.** - Evergreen bushland.
- ***Eragrostis macilenta* (A.Rich.) Steud.** - Evergreen bushland.
- ***Eragrostis minor* Host** - Evergreen bushland.
- ***Eragrostis papposa* (Roem. & Schult.) Steud.** - Evergreen & semi-deciduous bushland and Deciduous woodland.
- ***Eragrostis superba* Peyr.** - Evergreen bushland.
- ***Eragrostis tenuifolia* (A. Rich.) Steud.** - Evergreen bushland and along roadsides.
- ***Eustachys paspaloides* (Vahl) Lanza & Mattei** - Semi-deciduous bushland.
- ***Harpachne schimperi* A. Rich.** - Evergreen & semi-deciduous bushland.
- ***Leptothrium senegalense* (Kunth) W. D. Clayton (*Latipes senegalensis* Kunth)** - Deciduous shrub land and Wooded dwarf shrubland.
- ***Oropetium minimum* (Hochst.) Pilger** - Wooded dwarf shrubland.
- ***Sporobolus agrostoides* Chiov.** - Evergreen & semi-deciduous bushland.
- ***Sporobolus pyramidalis* P. Beauv.** - Evergreen bushland.
- ***Sporobolus stapfianus* Gand.** - Deciduous woodland.
- ***Tragus berteronianus* Schult.** - Deciduous woodland.
- ***Tricholaena teneriffae* (L.f.)** - Wooded dwarf shrub land.

Annex 7. Common Water Birds of Lake Turkana

1. African Fish Eagle
2. African Jacana
3. Africa Skimmer
4. African Spoonbill
5. Black – crowned Night Heron
6. Black – headed Gull
7. Black Heron
8. Black – tailed Godwit
9. Caspian Plover
10. Caspian Tern
11. Cattle Egret
12. Common Planticole
13. Common Sandpiper
14. Common Stilt
15. Curlew Sandpiper
16. Egyptian Goose
17. Eurasion Avocet
18. Eurasion Wigeon
19. Fulvous Whistling Duck
20. Glossy Ibis
21. Goliath Heron
22. Great Cormorant
23. Great White Egret
24. Greater Flamingo
25. Green Shank
26. Grey – headed Gull
27. Grey Heron
28. Grey Plover
29. Gull-billed Tern
30. Hammercop
31. Herring Gull
32. Hottentot Teal
33. Kittlitz Plover
34. Lesser Black – headed Gull
35. Lesser Flamingo
36. Little Egret
37. Little Grebe
38. Little Stint
39. Little Tern
40. Long – tailed Cormorant
41. Marsh Sandpiper
42. Northern Pintail
43. Northern Shoveller
44. Osprey
45. Pied Kingfisher
46. Pink – backed Pelican
47. Pink – headed Pelican
48. Red – knobbed Coot
49. Redshank

50. Ringed Plover
51. Ruddy Turnstone
52. Ruff
53. Sacred Ibis
54. Sandering
55. Saunder's Tern
56. Senegal Thicknee
57. Spur Winged Lapwing
58. Squacco Heron
59. Yellow – billed Stork
60. Whiskered Tern
61. White – faced Whistling Duck
62. White-winged Black Tern

Annex 8a. Fisheries of Loiyangalani (2006)

Month	Fish Caught (Sun dried)	Dry Weight (Kg)	Value (KSh)	Comments
January	Tilapia	3,474.80	138,992.00	Boats – 14 Foot Fishermen - 23
	Labeo	1,219.20	39,014.40	
	Barbus	738.75	14,775.00	
	Nile Perch Fillet	642	51,360.00	
	Total	6,264.75	245,091.40	
February	Tilapia	7,201.8	288,072.00	Boats – 22 Foot Fishermen - 32
	Labeo	2,914.25	93,256.00	
	Barbus	1,096.25	21,925.00	
	Nile Perch Fillet	613.00	49,040.00	
	Total	12,138.80	458,563.00	
March	Tilapia	5,612.80	224,512.00	Boats – 18 Foot Fishermen - 24
	Labeo	2,013.25	64,424.00	
	Barbus	232.50	4,650.00	
	Nile Perch Fillet	496.00	39,680.00	
	Total	8,410.80	334,176.00	
April	Tilapia	6,215.40	248,616.00	Boats – 20 Foot Fishermen - 19
	Labeo	1,843.50	58,992.00	
	Barbus	-	-	
	Nile Perch Fillet	602	48,160.00	
	Total	8,660.9	355,758.00	
May	Tilapia	8,418	336,720.00	Boats – 24 Foot Fishermen - 32
	Labeo	3,000.75	96,240.00	
	Barbus	-	-	
	Nile Perch Fillet	908	72,640	
	Total	12,326.75	505,600.00	
June	Tilapia	15,292.00	611,680.00	
	Labeo	3,540.5	113,296.00	
	Barbus			
	Nile Perch Fillet	325	42,000.00	
	Total	19,357.5	766,976.00	
July	Tilapia	9,118.2	364,456.00	
	Labeo	3,118.5	99,792.00	
	Barbus			
	Nile Perch Fillet	428	34,240.00	
	Total	12,664.50	498,488	
August	Tilapia	13,949.20	557,968	Boats – 36 Foot Fishermen – 43
	Labeo	3,310.50	105,936	
	Barbus			
	Nile Perch Fillet	150	15,000	
	Total	17,409.70	678,904	
September	Tilapia	5133	328,528	Boats – 27 Foot Fishermen - 39
	Labeo	1509	48,288	
	Barbus			
	Nile Perch Fillet	120	12,000	

	Total	6,762	388,816	
October	Tilapia	13,706.60	548,264.00	Boat – 36 Foot Fishermen - 21
	Labeo	5020	160,640	
	Barbus			
	Nile Perch Fillet	435	4350.00	
	Total	19,161.60	713,254.00	
November	Tilapia	10,322.2	412,888	Boats – 36 Foot Fishermen - 21
	Labeo	6,360.75	160,640	
	Barbus			
	Nile Perch Fillet	620	62,000	
	Others			
	Total	17,302.95	635,528	
December	Tilapia	12,070.6	482,824	
	Labeo	3,660.75	117,144	
	Barbus			
	Nile Perch Fillet	805	80,500	
	Others	-	-	
	Total	16,536.35	599,968.00	

Annex 8b. Fisheries of Loiyangalani (2007)

Month	Fish Caught (Sun dried)	Dry Weight (Kg)	Value (KSh)	Comments
January	Tilapia	8,391.6	335,664.00	Boat trips – 20 Foot Fishermen - 31
	Labeo	1,760.5	56,336.00	
	Barbus			
	Nile Perch Fillet	504.00	75,600.00	
	Others			
	Total	10,656.10	467,600	
February	Tilapia	13,130	525,200.00	Boat trips – 45 Foot Fishermen - 84
	Labeo	2,189	70,048.00	
	Barbus			
	Nile Perch Fillet	618	92,700.00	
	Others			
	Total	16,507	687,948.00	
March	Tilapia	15,019	600,760.00	Boat trips – 51 Foot Fishermen - 30
	Labeo	2,475	79,200.00	
	Barbus			
	Nile Perch Fillet	575	86,250.00	
	Others			
	Total	18,069	766,210.00	
April	Tilapia	16,757.4	670,296.00	Boat trips – 50 Foot Fishermen - 102
	Labeo	53,398.75	172,760.00	
	Barbus			
	Nile Perch Fillet	768	115,200	
	Others			
	Total	22924.15	958,256	
May	Tilapia	22,523	900,920.00	Boats – Foot Fishermen - 127
	Labeo	3,313	106,016	
	Barbus			
	Nile Perch Fillet	473	70950.00	
	Others			
	Total	26,309	1,077,886	
June	Tilapia	14,457.40	578,296.00	Boat trips – 38 Foot Fishermen - 102
	Labeo	6,038.75	193,240.00	
	Barbus			
	Nile Perch Fillet	608	91,200.00	
	Others			
	Total	21,104.15	862,736	
July	Tilapia	12,736	509,440.00	Boats – 46 Foot Fishermen – 107
	Labeo	7,035.75	225,144.00	
	Barbus			
	Nile Perch Fillet	502	75,300.00	
	Others			
	Total	20,273.75	809,884.00	
August	Tilapia	18,899	755,960.00	Boats – 50 Foot Fishermen –153
	Labeo	10,795	345,440.00	
	Barbus			

	Nile Perch Fillet	709	106,350.00	
	Others			
	Total	30403	1,207,750	
September	Tilapia	22,036	881,440.00	Boat trips - 51 Foot Fishermen - 123
	Labeo	5,604.75	179,352.00	
	Barbus			
	Nile Perch Fillet	550	82500.00	
	Others			
	Total	28,190.75	1,143,292.00	
October	Tilapia	17,944.8	717,792.00	Boat trips – 52 Foot Fishermen - 103
	Labeo	4,916.5	157,328.00	
	Barbus			
	Nile Perch Fillet	615	92,250.00	
	Others			
	Total	23,476.3	967,370.00	

Annex 9. NEMA's Conditions of Approval of the EIA Study Report for the Wind Project



NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY

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Website: www.nema.go.ke

Ref: NEMA/PR/5/2/5964

19th May, 2009

Lake Turkana Wind Power Limited
P.O. Box 63716 - 00619
NAIROBI

**RE: CONDITIONS FOR APPROVAL OF ENVIRONMENTAL IMPACT ASSESSMENT
PROJECT REPORT FOR THE PROPOSED LAKE TURKANA WIND POWER
PROJECT IN LAISAMIS DISTRICT**


The National Environment Management Authority (NEMA) has reviewed the Environmental Impact Assessment (EIA) Project Report of the above-mentioned proposed project and in light of the provisions of Environmental Management and Coordination Act, 1999; the Authority has approved the proposed project **subject to the following mandatory conditions:**

1. The proponent shall ensure that turbines are operated at frequencies that result in minimal interference with neighbouring activities
2. The proponent shall ensure that approval is obtained from the Kenya Civil Aviation Authority (KCAA) for the height of the turbine tower.
3. The proponent shall ensure that the turbines are lighted and are not made of reflectors material that may dazzle pilots
4. The proponent shall ensure that the siting of the wind park is not on bird breeding and migratory paths.
5. The proponent shall ensure that all labour camps are provided with adequate sanitary facilities and waste management structures
6. The proponent shall ensure strict adherence to the Environmental Management Plan developed throughout the project cycle.
7. The proponent shall collaborate with the EIA Expert(s) and the contractor(s) to ensure that proposed mitigation measures are adhered to during the construction phase and where necessary appropriate remedial measures undertaken and a report of the same submitted to NEMA. Emphasis must be given to control of dust, noise, vibrations, traffic, occupational hazards and provision of sanitary accommodation to construction workforce.
8. The proponent shall comply with the relevant principal laws, by-laws and guidelines issued for development of such a project within the jurisdiction of Ministry of Energy, Energy Regulatory Commission, Ministry of Regional Development, Kenya Civil Aviation Authority and other relevant Authorities.

9. The proponent shall ensure that the development adheres to zoning specifications issued for development of such a project within the jurisdiction of Marsabit County Council (with emphasis on compliance with the Energy Act No. 12 of 2006 and approved) land-use for the area.
10. The proponent shall ensure that during the construction phase, the operations adhere to provisions of Occupational Safety and Health Act, No. 15 of 2007.
11. The proponent shall ensure that environmental protection facilities or measures to prevent pollution and ecological deterioration such as birds scare from turbines are designed, solid waste management structures, sanitary facilities, dust control, noise control facilities are constructed and employed simultaneously with the proposed project.
12. The proponent shall ensure that records on conditions of licences/approval and project monitoring and evaluation shall be kept on the project site for inspection by NEMA's Environmental Inspectors.
13. The proponent shall submit an Environmental Audit Report in the first year of occupation/operation to confirm the efficacy and adequacy of the Environmental Management Plan.
14. The proponent shall comply with NEMA's improvement orders throughout the project cycle.

The above conditions will ensure environmentally sustainable development and must be complied with.

Kindly confirm in writing (within **30 days** from the date of receipt of this letter), that the conditions shall be complied with prior to commencement of the project to enable the Authority process the Environmental Impact Assessment Licence.


B.M. LANGWEN
For: DIRECTOR GENERAL

c.c.

Provincial Director of Environment
EASTERN PROVINCE

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 Ministry of Environment &
 Mineral Resources
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District Lands and Resettlement
 Officer
 c/o District Environment Officer
MARSABIT

The Clerk
 County council of Marsabit
 c/o District Environment Officer
MARSABIT

District Environment Committee
 c/o District Environment Officer
MARSABIT DISTRICT

Director
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Annex 10. NEMA's Conditions of Approval of the EIA Study Report for Transmission Line



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19th May, 2009

Lake Turkana Wind Power Limited
P.O. Box 63716 - 00619

NAIROBI

**RE: CONDITIONS FOR APPROVAL OF ENVIRONMENTAL IMPACT ASSESSMENT
PROJECT REPORT FOR THE PROPOSED 400 KV POWER TRANSMISSION LINE
FROM LOIYANGALANI TO SUSWA**

The National Environment Management Authority (NEMA) has reviewed the Environmental Impact Assessment (EIA) Project Report of the above-mentioned proposed project and in light of the provisions of Environmental Management and Coordination Act, 1999; the Authority has approved the proposed project **subject to the following mandatory conditions:**

1. The proponent shall adhere to the provisions of the Energy Regulatory commission and obtain the necessary permits before commencement of works.
2. The proponent shall ensure that the necessary wayleaves are obtained for the transmission lines and adequate earthing is provided
3. The proponent shall ensure that the transmission lines are realigned away from airstrips, dwelling areas and other sensitive areas.
4. The proponent shall ensure that adequate measures are in place to prevent and mitigate for oil spills from the transformers and substations.
5. The proponent shall ensure that transportation of construction materials to site and construction wastes from the site is undertaken during weekdays (and NOT weekends), off peak hours.
6. The proponent shall ensure that construction activities are carried out between 08.00 hours and 17.00 hours daytime. No construction works shall be undertaken at night.
7. The proponent shall ensure strict adherence to the Environmental Management Plan developed throughout the project cycle.
8. The proponent shall collaborate with the EIA Expert(s) and the contractor(s) to ensure that proposed mitigation measures are adhered to during the construction phase and where necessary appropriate mending-up activities undertaken and a report of the same submitted to NEMA. Emphasis must be given to control of dust, noise, vibrations, traffic, occupational hazards and provision of sanitary accommodation to construction workforce.
9. The proponent shall comply with the relevant principal laws, by-laws and guidelines issued for development of such a project within the jurisdiction of Kenya Power and

- Light Company, Energy Regulatory Commission, Ministry of Lands, Ministry of Labour, Ministry of energy, Nakuru county council and other relevant Authorities.
10. The proponent shall ensure that the development adheres to zoning specifications issued for development of such a project within the jurisdiction of Nakuru, Nyandarua and Samburu County Councils with emphasis on density requirement and approved land-use for the area.
 11. The proponent shall ensure that during the construction phase, the operations adhere to provisions of Occupational Safety and Health Act, No. 15 of 2007.
 12. The proponent shall ensure that environmental protection facilities or measures to prevent pollution and ecological deterioration such as control of vegetation along the power lines, occupational Health and safety equipments, wayleaves and earthing are designed, constructed and employed simultaneously with the proposed project.
 13. The proponent shall ensure that records on conditions of licences/approval and project monitoring and evaluation shall be kept on the project site for inspection by NEMA's Environmental Inspectors.
 14. The proponent shall submit an Environmental Audit Report in the first year of occupation/operation to confirm the efficacy and adequacy of the Environmental Management Plan.
 15. The proponent shall comply with NEMA's improvement orders throughout the project cycle.

The above conditions will ensure environmentally sustainable development and must be complied with.

Kindly confirm in writing (within **30 days** from the date of receipt of this letter), that the conditions shall be complied with prior to commencement of the project to enable the Authority process the Environmental Impact Assessment Licence.


B.M. LANGWEN

For: DIRECTOR GENERAL

c.c.

Provincial Director of Environment
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 Officer
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NAKURU

The Clerk
 County council of Nakuru
 c/o District Environment Officer
NAKURU

District Environment Committee
 c/o District Environment Officer
NAKURU

WM/smk