ENVIRONMENTAL IMPACT ASSESSMENT STUDY FOR THE PROPOSED 200 ACRE BAMBOO PLANTATION ON PLOT NUMBER KILIFI/WERU/23 SITUATED AT LANGOBAYA LOCATION IN KILIFI COUNTY

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CERTIFICATION

Certification by EIA/EA Experts

We hereby certify that this Environmental Impact Assessment (EIA) study report has been done under our supervision and that the assessment criteria, methodology and content reporting conforms to the requirements of the Environmental Management and Coordination Act, 1999 and Legal Notice No. 101 of 2003 (Environmental Impact Assessment and Audit Regulations).

Signature: _____ 26th July, 2016
EIA/EA Expert: Joseph Kyalo **NEMA Reg. No. 6830**

Signature: _____ 26th July, 2016
EIA/EA Expert: Salma Hadhidha **NEMA Reg. No. 6379**

Certification by Proponent

Africa Plantation Capital Management Limited hereby confirms that the contents of this EIA study report are true and shall implement the mitigation measures proposed and undertake to implement further instructions as NEMA may deem appropriate in relation to the findings and from time to time as inspections may inform.

Signature: _____Date_____

Director
Africa Plantation Capital Management Limited
P.O. Box 21840 - 00515
Nairobi, Kenya.

ACKNOWLEDGEMENTS

Many people have directly contributed to this EIA exercise. It would be impossible to thank each and every one of them individually. The EIA team hopes that its efforts in rendering the collective findings of this exercise will do justice to the many who assisted and facilitated this work.

The team must however acknowledge the logistical support provided by the proponent. We also recognize all project stakeholders and neighbours for agreeing to participate in the public consultative process. To all who helped and have not been mentioned individually, kindly accept our sincere thanks.

EXECUTIVE SUMMARY

This Environmental Impact Assessment study was conducted for and on behalf of the proponent in compliance with the Environmental Management and Coordination Act (EMCA, 1999) which requires that an Environmental Impact Assessment (EIA) be carried out for developments such as the proposed. Provisions of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003 also dictate the submission of such an assessment to the National Environment Management Authority (NEMA).

The assessment examined the potential impacts of the proposed project on the immediate surroundings with due regard to all the phases of establishment through to operation and decommissioning. It encompassed all aspects pertaining to the physical, economical, ecological, socio-cultural, health and safety conditions at the site and its environs. The assessment was based on laid down scientific qualitative procedures with the most recent methodologies and analysis required in EIA and strictly adheres to the relevant legislative framework governing the agriculture and production industry.

Project description

The proponent proposes to establish a 200 acre bamboo plantation on plot number Kilifi/Weru/23 situated at Bao Lala area in Langobaya Location, Kilifi County. Bamboo is a versatile, strong, renewable and environment-friendly material. It is a member of the grass family, Gramineae and the fastest growing woody plant on earth. Most bamboo species produce mature fibre in 3 years, sooner than any tree species. Some bamboos grow up to 1 metre a day, with many reaching culm lengths of 25 metres or more. Bamboo can be grown quickly and easily, and sustainably harvested in 3 to 5 years cycles. It grows on marginal and degraded land, elevated ground, along field bunds and river banks. It adapts to most climatic conditions and soil types, acting as a soil stabilizer, an effective carbon sink and helping to counter the greenhouse effect.

The proponent may blend (but not limited to) the following species which were introduced to Kenya as recommended by the Kenya Forest Research Institute (KEFRI) under Guidelines for Growing Bamboo (Guideline Series: No. 4 - April 2007):

- *Bambusa bambos;*
- *Bambusa nutans;*
- *Bambusa tulda;*
- *Bambusa vulgaris;*
- *Bambusa vulgaris Vitatta;*
- *Cephalosta chyumpe gracile;*
- *Dendroca lamusasper;*
- *Dendrocalamus asper*
- *Oxytenanthera abyssinica; and,*
- *Yushania alpina;*

The following utility facilities/infrastructure will be put in place:

- Drilling of boreholes;
- Installation of plumbing and water reticulation systems;
- Installation of a site office and a store for farm inputs. This will include improvised Twenty Feet Equivalent Units (TEUs);
- Installation of overhead tanks with a minimum capacity of $10m^3$ adequate enough to feed the plantation farm;
- Construction of 4 No. water reservoirs/dams for collection of rain water to supplement borehole water supply as per the project requirement; &,
- Construction of a toilet block with a septic tank-soak pit system for waste water management.

The project implementation cost is estimated at kshs. 225,000,000.00.The proponent will pay Kshs 225,000.00 to the NEMA Revenue Account: 1102298158 KCB, KICC Branch as EIA fees. The latter is usually 0.1% of the total cost but minimum kshs. 10,000.00.

Project site and neighborhood land use

The Bamboo Plantation will be established on plot number Kilifi/Weru/23 situated at Bao Lala area in Langobaya Location, Kilifi County. The site is about 38 km from the Mombasa – Malindi highway at Gede junction and about 1km southwards from Langobaya market centre. The site lies between Latitude 3.195190° S and Longitude: 39.785224° E at an elevation of about 91.5m above sea level. The basic land use within the locality is predominantly agricultural.

EIA objectives

The EIA process purposes to ensure that environmental concerns are integrated in all phases of the project cycle. In this regard therefore, the specific objectives of this EIA report included:

- To provide a description of the project cycle activities and the required legislative compliance;
- To predict and/or determine the potential impacts of the development in terms of the economic, social and environmental considerations;
- Propose appropriate mitigation measures to minimize or eliminate the environmental impacts associated with the development;
- Analyze project alternatives; and,
- To undertake a public consultative process aimed at obtaining the views of project stakeholders so as to mainstream their concerns and impact mitigation proposals into the Environmental Management Plan (EMP) developed for the project cycle.

Public participation

An extensive public consultation process was engaged in gauging the sentiments of a variety of stakeholders in the development of this project. Besides the fact that this is a regulatory requirement under the Environmental Management and Coordination (EIA/EA) Regulations (2003), it was an excellent opportunity to offer the public an opportunity to ventilate their fears and concerns. The public participation process engaged for this study demonstrates the project stakeholders' wish to see the actualization of the proposed EMP and their recognition of the enormous economic opportunities which this project represents. Public participation was implemented using semi-structured interview strategy, questionnaires and informal consultations.

Environmental impacts and mitigation

Both positive and negative impacts will result from the design, implementation, operation and possible decommissioning of the buildings and associated infrastructure. The environmental impacts arising from the project have both ecological and socio-economic dimensions. The overall aim of the project is ensuring an environmentally friendly development by planning around and utilizing the existing resources. The project activities that are likely to give rise to some environmental impacts of note are impact on the ecology of the area, farm management activities, the generation of domestic effluent, health and safety, solid waste as well as water and energy consumption. Appropriate mitigation measures have been discussed and an elaborate EMP outlined. All the negative impacts will be mitigated to the highest degree.

Positive impacts

Bamboo adapts to most climatic conditions and soil types, acting as a soil stabilizer, an effective carbon sink and helps to counter the greenhouse effect. Production benefits accrue from value-added products. Handicrafts (mats, baskets, tools, toys and utensils) and furniture are established possibilities, produced in finished form or supplied as components to small enterprises for further processing (for example, supply of mats for production of bamboo mat board). There are emerging industrial and large-scale applications too in the manufacture of wood substitutes and

composites, energy, fibre, charcoal and activated carbon. Building and structural components represent vast possibility for enterprise, value addition, income and employment.

Conclusion

There are very few negative impacts of low severity and spatial/temporal significance. On the basis of the evaluation of the development proposal, the project does not occasion environmentally significant negative impacts that could lead to environmental degradation on an appreciable throughout the project cycle. This EIA study report therefore presents a "Findings of No significant Impacts". The development of this project is considered economically viable, socially acceptable and environmentally sound.

Recommendations

This report recommends issuance of an EIA license on condition that the proposed EMP will be implemented in line with other conditions that NEMA may impose during the decision making process. The proponent should use the EMP as monitoring and evaluation tool to submit an Environmental Audit report to NEMA annually or as may be directed by the Authority without fail. The proponent is however obliged to undertake all the operations within the legal limits.

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ABBREVIATIONS AND ACRONYMS

CFCs	Chlorofluorocarbons
EA	Environmental Audit
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act (1999)
EMP	Environmental Management Plan
EMS	Environmental Management System
KEBS	Kenya Bureau of Standards
M & E	Monitoring and Evaluation
NEC	National Environmental Council
NEMA	National Environmental Management Authority
OHS	Occupational Health & Safety
PPE	Personal Protective Equipment
SERC	Standards and Enforcement Review Committee
KEPHIS	Kenya Plant Health Inspectorate
KEFRI	Kenya Forestry Research Institute

DEFINITION OF TERMS

Analysis means the testing or examination of any matter, substance or process for the purpose of determining its composition or qualities or its effect (whether physical, chemical or biological) on any segment of the environment or examination of emissions or recording of noise or sub-sonic vibrations to determine the level or other characteristics of the noise or sub-sonic vibration or its effect on any segments of the environment.

Clump refers to a cluster or group of stems of bamboo growing from a common underground rhizome system.

Culm means the stem of the bamboo plant.

Effluent means gaseous waste, water or liquid or other fluid of domestic, agricultural, trade or industrial origin treated or untreated and discharged directly or indirectly into the aquatic environment.

Environment includes the physical factors of the surroundings of human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants and the social factor of aesthetics and includes both the natural and the built environment.

Environmental Impact Assessment means a systematic examination conducted to determine whether or not a programme, activity or project will have any adverse impacts on the environment.

Hazardous substance means any chemical, waste, gas, medicine, drug, plant, animal or micro-organism which is likely to be injurious to human health or the environment.

Mulching refers to protective covering of leaves spread over the roots of nursery or planted seedlings to retain moisture or smother weeds.

Noise means any undesirable sound that is intrinsically objectionable or that may cause adverse effect on human health or the environment.

Offset means a dug out rhizome with a short portion of a culm (about 50 cm long) attached.

Plant tissue culture – A biotechnological method that enables the nurturing of a plant organ, tissue, cells or even cells without walls in a controlled nutrient medium. The technique is useful in mass propagation of plants.

Pollution means any direct or indirect alteration of the physical, thermal, chemical, biological, or radio-active properties of any part of the environment by discharging, emitting, or depositing wastes so as to affect any beneficial use adversely, to cause a condition which is hazardous or potentially hazardous to public health, safety or welfare, or to animals, birds, wildlife, fish or aquatic life, or to plants or to cause contravention of any condition, limitation, or restriction which is subject to a license under this the Environmental Management and Coordination Act (1999).

Project includes any project, programme or policy that leads to projects which may have an impact on the environment.

Proponent means a person/entity proposing or executing a project, programme or an undertaking.

Rhizome refers to thick, horizontal stem of bamboo just below the ground, from which new shoots and roots grow.

Soil includes earth, sand, rock, shale, minerals, vegetation, and the flora and fauna in the soil and derivatives thereof such as dust.

Waste includes any matter prescribed to be waste and any matter, whether liquid, solid, gaseous, or radioactive, which is discharged, emitted, or deposited in the environment in such volume composition or manner likely to cause an alteration of the environment.

Wildings refer to seedlings germinated in the wild under natural conditions.

CHAPTER ONE

1.1 Introduction and Background

For a long time, the world over, policy makers have been directing all their efforts in economic development without due regard to the nature of the resource base on which the economic development depend on. As a result, there has been unprecedented environmental degradation, during project implementation and operation stages, due to lack of integration of environmental concerns into the project design, planning and management, thereby resulting into unsustainable development. To ensure sustainability and revitalization of the degraded environment, all proposed development projects' activities and their subsequent operations are now required to be critically examined to evaluate the impacts (both positive and negative) they would have on the environment before they are implemented and to enhance Sustainable Environmental Management as well as controlling and revitalizing the much – degraded environment.

Some of the Environmental Management tools used to achieve this is the Environmental Impact Assessment (EIA) study, done before the implementation of a new project and an Environmental Audit (EA) done on existing projects. All these are emphasized in the Environmental Management and Coordination Act (EMCA) of 1999. An EIA identifies both negative and positive impacts of the proposed project, how it affects people, their property and the general environment. Environmental Experts registered by The National Environmental Management Authority (NEMA) should conduct the EIA study of new projects and Environmental Audits (EA) for the already existing projects pursuant to requirements of EMCA, Environmental Impact Assessment and Audit Regulations, 2003 and the World Bank Guidelines.

1.2 Scope and criteria

The study has been conducted to evaluate the environmental impacts of the proposed Bamboo Plantation in Kilifi County. Upon evaluation, recommendations are made on the accentuation of positive impacts and the mitigation of negative ones. The scope for the assessment dwelled on impacts the project will have on the following:

- Physical environment;
- Socio-cultural environment;
- Land use;
- Socio-economic aspects;
- Health and safety issue; and,
- Archaeological/historic/cultural sites.

The study was commissioned principally to comply with provisions of the Environmental Management and Coordination Act (1999) and the Environmental (Impact Assessment and Audit) Regulations 2003. However, due to the nature of the project and its eventual clientele, the experts have also taken into due consideration World Bank Guidelines and common international best practices in Environmental Impact Assessment Studies.

1.3 EIA objectives

The EIA process purposes to ensure that environmental concerns are integrated in all phases of the project cycle in order to contribute to sustainable development. In this regard therefore, the specific objectives of this EIA report are outlined as follows:

- To provide a description of the project cycle activities and the required legislative compliance;
- To predict and/or determine the potential impacts of the development in terms of the economic, social and environmental considerations;
- To propose appropriate mitigation measures to minimize or eliminate the environmental challenges associated with the development;
- To analyze project alternatives; and,
- To undertake a public consultative process aimed at obtaining the views of project stakeholders so as to mainstream their concerns and impact mitigation proposals into the Environmental Management Plan (EMP)

developed for the project cycle.

1.4 Assessment methodology

The following various tools and instruments were utilized during the initial survey to collect data and information on the site.

- Site visits whereby the consultants utilized a pre-determined checklist developed on the basis of the scoping and screening exercise.
- Observable details were recorded using a note book and a camera.
- Baseline information for the site was further obtained through literature review of site documentation.
- A semi-structured interview strategy, questionnaires and informal consultations were used to obtain comments from neighbours.
- Desktop reviews were conducted using the internet and other EIA reports of similar nature in the area by the EIA consultants.

The information gathered using the above strategies was evaluated and data analyzed to determine the required level of environmental performance and make recommended environmental action plans for the development proposal.

1.5 EIA organization and structure

This EIA report is organized into 11 main chapters organized as follows:

- Introduction;
- Project description;
- Baseline information;
- Policy and legislative framework review;
- Public and stakeholder consultations;
- Impact identification and prediction;
- Environmental mitigation measures;
- Environmental management plans;
- Analysis of project alternatives;
- Environmental monitoring programme; &,
- Conclusions and recommendations.

The report conforms to the guidelines issued by NEMA following the gazettment of Legal Notice No. 101 of 2003.

CHAPTER TWO

2.0 Project Description

The proponent proposes to establish a 200 acre bamboo plantation on plot number Kilifi/Weru/23 situated at Bao Lala area in Langobaya Location, Kilifi County. The objective of the plantation is to grow bamboo for production of bamboo fibre.

2.1 Location of the Site

The Bamboo Plantation will be established on plot number Kilifi/Weru/23 situated at Bao Lala area in Langobaya Location, Kilifi County. The plot lies between Latitude 3.195190° S and Longitude: 39.785224° E at an elevation of about 91.5m above sea level. The site is located about 1km off the C103 road and about 43 km from Malindi town as shown on figure 2.1 below.

Figure 4.1: A Google Earth map image showing the location of the site in Bao Lala Village, Langobaya Location in Kilifi County (Credit: Google Earth Maps, 2016).

2.2 Project site

2.2.1 Neighborhood land use

The basic land use within the locality is predominantly agricultural. Livestock keeping is more dominant in the area than crop farming which is discouraged by erratic rainfalls. There is a squatter household within the site that is yet to be relocated.

2.2.2 Suitability of the project site

The choice of site is influenced by the following factors;

- Favorable weather conditions,
- Availability of land and capital to implement the proposal,
- The investment opportunity on the part of the proponent,
- Availability of technology and materials required to implement the development.

2.2.3 Flora and fauna

The vegetation at the proposed project site is characterised by shrubs with occasional emerging trees and grasses. Trees and shrubs observed on in area include *Cynometra lwebberi*, *Dalbergia melanoxylon*, *Adansonia digitata* and *Cacia siamea*. Some of the shrub species include *Maytenussenegalensis* (Confetti tree) and *Pulmeria lubra* (Frangipani). Human activities such as cultivation, grazing, quarrying, slash and burning have greatly altered the area's potential to support animal life. These activities have altered the natural ecological system that support biodiversity. Only a few reptiles such as green mamba and lizards can easily be seen on site.

2.3 The Bamboos

Bamboos are a subfamily (Bambusoideae) of floweringperennialevergreen plants in the grass family Poaceae. Giant bamboos are the largest members of the grass family. In bamboo, the internodal regions of the stem are usually hollow and the vascular bundles in the cross section are scattered throughout the stem instead of in a cylindrical arrangement. The dicotyledonouswoodyxylem is also absent. The absence of secondary growth wood causes the stems of monocots, including the palms and large bamboos, to be columnar rather than tapering.

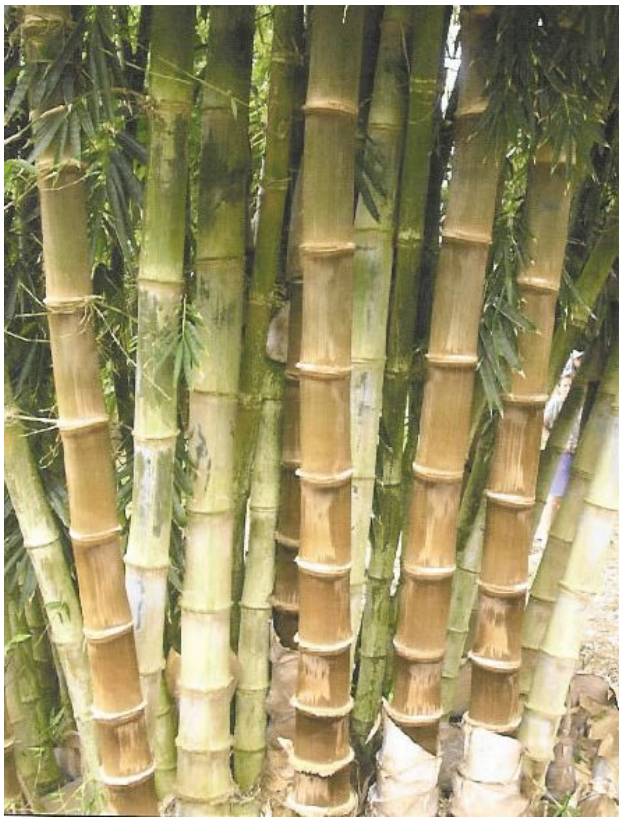

Figure 2.1: Bamboo clump.

Being a versatile, strong, renewable and environment-friendly material, it is a member of the grass family, Gramineae and the fastest growing woody plant on earth. Most bamboo species produce mature fibre in 3 years, sooner than any tree species. Some bamboos grow up to 1 metre a day, with many reaching culm lengths of 25 metres or more. Bamboo can be grown quickly and easily, and sustainably harvested in 3 to 5 years cycles. It grows on marginal and degraded land, elevated ground, along field bunds and river banks. It adapts to most climatic conditions and soil types, acting as a soil stabilizer, an effective carbon sink and helping to counter the greenhouse effect.

2.3.1 The growth habit of bamboo

The bamboo plant (Figure 4.1) is made up of an underground axis and above ground axis. The underground axis is comprised of rhizomes, roots, and buds. The above ground axis is comprised of stems, branches, and foliage. Buds on the rhizomes may develop into shoots that emerge from the ground. The new shoot elongates vertically into a main stem or *culm* until it attains its full height. The growth of a culm is completed in one growing season. In large bamboo species, new culms may grow to a height of more than 20 meters within 3 months.

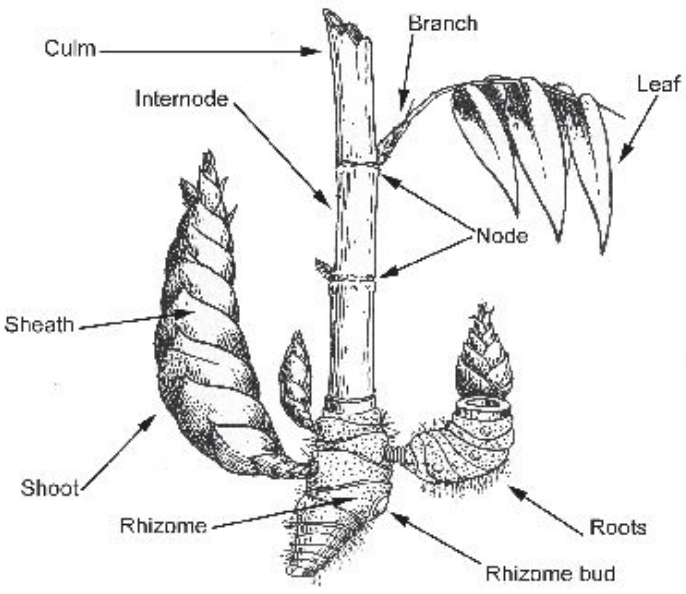

Figure 2.2: Parts of the Bamboo plant (Source: KEFRI, 2007).

The bamboo culm is cylindrical and is divided into sections by diaphragms or *nodes*. The section between two nodes is called an *internode*. Internodes are hollow in most bamboos, but solid in some species. The new culm is protected by sheaths that are attached to each node. The culm gradually develops branches and leaves. As the culm matures, it lignifies and becomes harder and stronger. The bamboo culm does not get thicker each year. Unlike trees, bamboos do not have any secondary growth. Rather, as the rhizome system develops and matures, new and larger shoots emerge annually until the maximum size of the species has been reached. The life of a culm varies from species to species. Usually a culm is fully mature after 3 or 4 years. As mature culms grow older, they deteriorate and eventually die and rot. The life of the bamboo plant is however sustained by the new shoots and culms.

2.4 Proposed species

The proponent may blend and not limited to the following species which were introduced to Kenya as recommended by the Kenya Forest Research Institute (KEFRI) under Guidelines for Growing Bamboo (Guideline Series: No. 4 - April 2007):

- *Bambusa bambos;*
- *Bambusa nutans;*
- *Bambusa tulda;*
- *Bambusa vulgaris;*
- *Bambusa vulgaris Vitatta;*
- *Cephalosta chyumpe gracile;*
- *Dendroca lamusasper;*
- *Dendrocalamus asper*
- *Oxytenanthera abyssinica; and,*
- *Yushania alpina;*

2.5 Project phases

The diagram below illustrates the project phases.

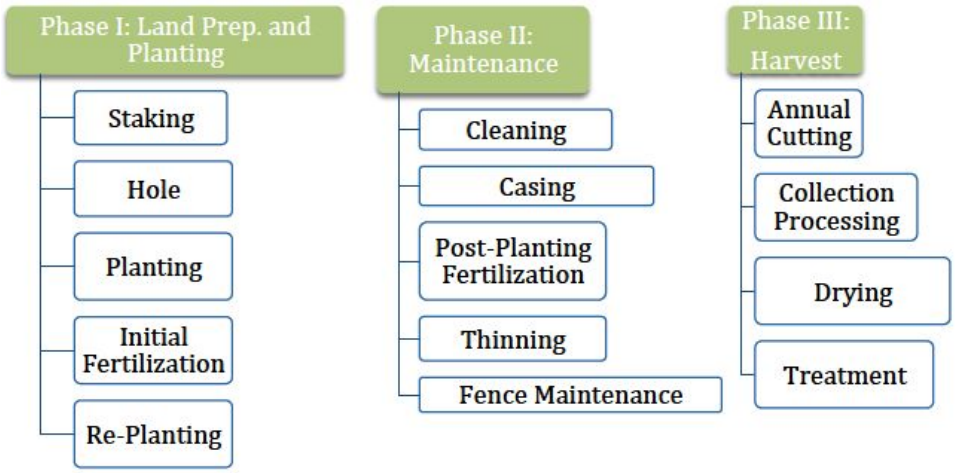

Figure 2.3: Project phases for plantation management.

2.6 Project farm preparation

2.6.1 Fencing

The 200 acre land parcel will be fenced using 3000mm high wooden poles and barbed wire. There will be 1 No. access gates fronting the main road. The number of access gates might change depending on necessity.

2.6.2 Vegetation clearance and ground preparation

This will be done by earth movers. The site is barely flat and well drained therefore will need minimum leveling considering that the bamboo crop cannot withstand water logging; sloping land is thus preferable.

2.6.3 Installations of utility infrastructure

The following utility facilities/infrastructure will be put in place:

- Drilling of boreholes;
- Installation of plumbing and water reticulation systems;
- Installation of a site office and a store for farm inputs. This will include improvised Twenty Feet Equivalent Units (TEUs);

- Installation of overhead tanks with a minimum capacity of $10m^3$ adequate enough to feed the plantation farm;
- Construction of 4 No. water reservoirs/dams for collection of rain water to supplement borehole water supply as per the project requirement; &,
- Construction of a toilet block with a septic tank-soak pit system for waste water management.

2.6.4 Raising of planting materials

Growing bamboo starts with obtaining the materials for planting. Such materials may come in the form of seeds, wildings, saplings, offsets or cuttings that may be gathered from forests. Tissue-Cultured (TC) plantlets provide other forms of planting materials. The plantation will source planting materials from the Kenya Forestry Research Institute (KEFRI), Gede.

2.6.5 Planting spots

After ground clearing, planting spots will be dug at spacing suitable for the species to be planted, in accordance with the plantation layout and design (4.3). Larger and deeper planting holes are always better and allow for easier establishment of newly planted bamboos. Holes of about 60 cm diameter and 60 cm depth will be dug around each stake. Well rooted seedlings or TC bamboos may be planted in small holes of about 30 cm diameter and 30 cm depth.

2.7 Plantation layout

The field layout may be in north-south rows so as to have an even distribution of sunlight in the plantation but this may be subject to change if necessary. Bamboo may be planted in lines and rows to make management of the plantation easier. The direction of rows and lines will however be planned with full consideration of the characteristics of the terrain. Any furrows will be done across the slope, following the contour of the land, and never in an uphill-downhill direction. Furrowing across the slope will prevent the water runoff and thereby control erosion.

The field layout will take into account the habit and size of the bamboos, such that small species are spaced more closely and large species are afforded wider spaces. A spacing of 4.5m x 4.5m to 5m x 5m may be sufficient for many bamboos but is inadequate for large species like *Dendrocalamusgiganteus*, *Dendrocalamusbrandisii*, or *Dendrocalamusasper*. For larger species, spacing will be widened and plants per hectare will be reduced. Spacing of up to 10 x 10m (100 clumps/ha) may be suitable for large bamboos; wider spacing will allow the clumps to reach their full potential. The following table shows spacing that may be considered for small, medium, to large bamboos.

Table 2.1: Recommended spacing for bamboo (source: KEFRI, 2007).

Plant Spacing (m) and Plants per Hectare		
In line	**Between lines**	**Plants per ha**
4	5	500
4	6	417
5	6	333
5	7	286
6	7	238
6	8	208
7	8	179
7	9	159
8	9	139
8	10	125
9	10	111
10	10	100

2.8 Plantation maintenance and harvesting

Proper maintenance and protection of the plantation is highly important. This involves replanting, plant protection, weeding, general tending and sustainable harvesting of culms (bamboo stems).

2.8.1 Weeding and mulching

Mulching around seedlings encourages growth through reduced evaporation of soil water. Spot weeding rids the

seedlings of competing weeds. This will be done at a radius of 60 cm around the seedlings after out planting. Weeding will be regular or as necessary to avoid competition from weeds. The soil will be loosened at least three times during the plantation establishment year to improve aeration.

2.8.2 Replanting

Not all transplanted seedlings and offsets will survive the new environments. The plantation will therefore be visited regularly to check on the survival of plants and replace dead seedlings and offsets. Replanting maybe done simultaneously with the first weeding schedule. This will be done in the subsequent rain seasons when there is enough moisture until the second year.

2.8.3 Plant protection

Bamboos are palatable to many animals, especially in the locality where goats are left loose. It is necessary to carry out protection against goats and antelopes using simple sticks. These are stuck in the ground around the seedlings and made to converge above the seedling, forming a conical shape of protection. Fencing will be done as outlined in 2.6.1.

Fire is a major hazard to a bamboo plantation especially during the dry season and in drier areas. To safeguard the area, firebreaks will be established. A 10 m wide fire-line is enough to stop fire from spreading into the plantation. In some species, the amount of bamboo litter on the ground is too thick. During the dry seasons, this will be reduced by collecting it and thus improving the degree of success in fire control.

2.8.4 General tending

Depending on the intensity of weed growth, weeding and hoeing may have to be repeated in the second and third year. Soil will be heaped around the developing clump to allow and ease shoot production, which takes place mainly in the periphery of the clump. The very small and thin culms, broken and over-hanging culms, will be regularly removed to leave only clean culms standing within a clump.

2.8.5 Harvesting

The proposed bamboo species are the clumping types. The clumping habit enables the plant to regenerate naturally after harvesting. Harvesting of bamboo is through selection of culms for cutting rather than clear felling. The plantation will be ready for first harvesting in about five years. Thereafter, cutting of mature stems can be done annually. The cutting cycles and methods of extraction of stems from a bamboo clump entail an important management system of the entire bamboo plantation. Success or failure of sustainability of crop production will therefore depend on how best stem extractions are carried out.

2.8.5.1 Cutting cycles and methods of cutting

- After the first cutting, subsequent selective extraction of bamboo stems will be done annually. This cycle of cutting is considered suitable for a number of clumping bamboo species.
- In a clump, new culms are normally produced outwards, towards the periphery of the clump and the older stems are left in the centre. Harvesting of bamboo therefore should be from the centre and not at the sides of the clumps.

2.8.5.2 Cutting rules

The following bamboo cutting rules according to KEFRI Guideline Series: No. 4 - April 2007, are to be followed for a well-established bamboo area:

- Culms growing on the periphery of the clump should not be cut. Cutting should be restricted to the oldest culms in the centre of the clump.
- All dead and dry culms should be cut and removed.
- All broken, live stems, less than 2.5 m in length, should be removed except in clumps containing less than 10 culms. In the latter case, even shorter broken culms may be retained for support of new culms.
- Heavily congested clumps may not be salvaged to productive state and should be clear-felled.

- Current year's and one-year old culms should never be cut unless in cases where they are curved and twining around other culms or are infested by disease or insects.
- The number of older culms retained should not be less than the number of current year's culms.
- Rhizomes should not be dug out.
- In order to avoid future congestion, all clumps should be worked, even though they may not produce usable or saleable material.
- Culms should be cut between 15 and 45 cm from the ground, but not below the first prominent node above the ground.
- Cutting should be made with a sharp tool-bill-hook, a sharp *panga* or saw so that the stump is not split.
- All cutting debris should be collected and removed away from the clump.
- Lopping of bamboos should be prohibited.
- No cutting of culms should be done during the growing season, i.e. during the rains. Culm cutting should be done only during the dry seasons.
- In case of sporadic or gregarious flowering, all flowered clumps which have shed their seeds should be clear-felled.
- The areas under bamboo should be strictly fire-protected.

The above cutting rules are important management controls and may be used as a guideline. The rules may be suitably modified for formulating the cutting rules for other introduced species where experiences in their management may not have been locally gained.

2.8.5.3 Cutting tools and extraction

It is necessary that sharp implements are used in order to avoid splitting of stumps and the cut culms. A sharp *panga* (long sharp knife), power saws or preferably a curved saw may be used.

2.8.5.4 Hauling from stump site

Extraction roads will be planned during plantation establishment. Firebreaks may also be used for extraction but must be planned in advance. Hauling of culms will be carefully planned before any harvesting takes place. Failure to have a clear plan for the hauling of culms can result in excessive damage of other vegetation and may result in excessive soil compaction. The stems will be bundled together, so that these can be pulled easily to the roadside or collection area. Hauling of cut stems and loading onto lorries maybe done easily using human labour.

2.8.6 Post-harvest treatments

2.8.6.1 Methods for protecting bamboo

Bamboo poles are susceptible to decay and attack by fungi or insects especially powder post beetles. Such attacks give bamboo low natural durability. One way to extend the life of bamboo under use is through preservation treatments. Processing methods may also minimize attack by fungi and insect.

When bamboo culms have been preserved, and particularly when they will be used for construction or for value added products, it is strongly advisable to store them in an elevated and covered area to protect them so that their quality can be maintained.Techniques used to increase the durability of bamboo include nonchemical and chemical methods. The most useful and economical methods are listed below.

2.8.6.1.1 Non-chemical methods

Clump curing: culms are cut at the bottom, but are left standing on the clump for some time with branches and leaves still on. Because the assimilation of the leaves still goes on, the starch content in the culm is reduced and as a result, the durability against infestation by borers is increased. This treatment does not influence attack by termites or fungi.

Smoking: culms are stored above fireplaces inside houses for some time so that the smoke blackens the culm. Due to heating, the starch within the stem cells may be destroyed. The treatment is effective against insect attacks.

White-washing: bamboo culms and bamboo mats for housing construction are often painted with slaked lime (white wash). This delays water absorption, leading to a higher resistance against fungi.

Plastering: cow dung is mixed either with lime or with mortar and plastered onto the surface of bamboo. This is a common method used in the construction of bamboo houses.

Soaking in water: freshly cut, green, culms are put into stagnant or running water or mud for several weeks. Subsequently, the bamboo is dried in shade. During the soaking period, starch is reduced and the method therefore improves the resistance against borers which are usually attracted by the high amount of starch in bamboo culms.

Simple construction method: In constructions using bamboo, the upright culms that provide structural support should be elevated on stones, cement, or concrete blocks, and never directly on the bare ground or soil. This will reduce the risk of rotting and insect attack. Painting the culms with water repellent formulations helps to reduce mould.

2.8.6.1.2 chemical preservation methods

Chemical preservation methods of bamboo generally provide more effective protection than non-chemical methods, but are not always economical. The following treatments may be used.

Fumigation: application of methyl bromide or some other chemical to bamboo for insect control.

Steeping or sap displacement: green bamboo culms are allowed to stand vertically in a container of preservative solution till adequate chemical is picked up. At times, the culm may be freshly cut with branches and leaves on.

The open-tank treatment: culms prepared to size are soaked in a solution of a water soluble preservative for several days. The solution gets into the culm by diffusion through the ends and partly through the sides.

Butt treatment: the bottom part of green bamboo or dried bamboo is immersed in a container of preservative, for example, an old oil drum. The culms are left for about one week. The open-tank and the butt methods are effective, economical and more popular. Using these methods, 10% Copper sulphate solution extends the service life in the ground extensively. For out-of-ground contact poles or strips, treatment with 10% boric acid will give extended service life.

2.9 Project Decommissioning

All establishments determined to be removed from the plantation shall be removed and disposed of using the following procedures:

- All on site machinery and shall be assessed to determine the presence of hazardous conditions, materials, or waste and a report prepared for the Management teams;
- All machinery components shall be surveyed to determine if they have potential for local re use or recycling.Quantities of all machinery components to be removed, relocated, sold, recycled or donated shall be estimated by site assessment;
- All utility connections, power, water, sanitary connections, etc., shall be identified, disconnected, capped and properly closed prior to or at the time of building demolition;
- All loads for transport shall be covered and secured;
- All materials to be disposed of shall be taken to a licensed disposal facility, scrap yard or recycling centre. Manifests of all loads, including detailed material descriptions shall be maintained;
- A final Decommissioning Report shall be completed for upon completion of the decommissioning activities; and, on site security shall be maintained throughout the decommissioning phase of the project.

CHAPTER THREE

3.0 Environmental Baseline

The environmental baseline of the project area offers both the present and future states of the environment which assumes the project does NOT take off. It takes into account changes which might be occasioned by natural and anthropogenic activities.

3.1. Administrative location and size

The project site is in Bao Lala area situated at Langobaya location, Kilifi County. The County borders Voi County to the north and the Indian Ocean to the east, Mombasa county to the south, Kwale County to the southwest and Taita-Taveta County to the west. The County covers an approximate area of 12,464 sq km inclusive of about 109 sq km of water.

3.2 Climate

The project site is located along the inland coastal belt of Kenya. The area is characterized by a tropical and monsoon climate with temperatures high throughout the year. The rainfall pattern is bimodal with rainfall averaging at between 900- 1000mm annually. The long rains come between March and July with a peak in May while the short rains are experienced between October and December. Apart from the monsoon rains, the other dominant feature of the weather at the site is the heat and humidity. Maximum and minimum temperatures range between 26.5-34 and 22.5-24.5 respectively. The coastline experience more than 6 hours of sunshine daily exceeding 8 hours between October and March. The relative humidity (RH) varies from a minimum of 74% in October to 81% in January and May.

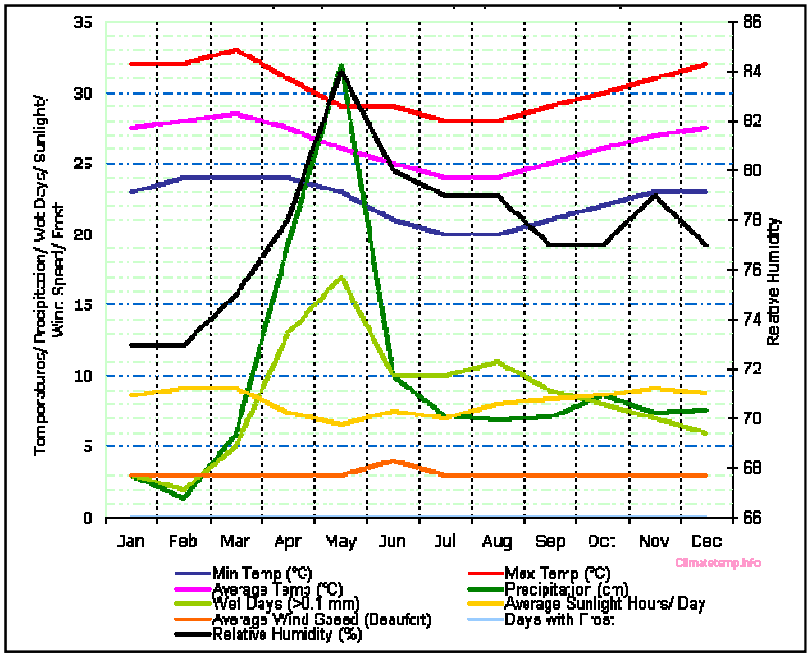

Table 3.1: Climatic characteristics in Kilifi County

3.3 Topography and geology

The project site lies in Kilifi County which has four major topographical features. These are;

- The Coastal plain,
- The Foot Plateau,
- The Coastal Range and
- The Nyika Plateau.

The proposed project site is located on the coastal range. The range is a narrow belt, varying in width between 10 km and 30 km. It lies below 200m above sea level except for occasional prominent peaks on the western boundary. Because of its evolutionary history, the principal rocks observed along the coastal area are sedimentary in origin, and range in age from Triassic to Recent (UNEP, 1998). The Duruma sandstone series, the oldest formation, is represented by the Mariakani and the Mazeras sandstones, which were deposited under sub-aqueous, deltaic, lacustrine or possibly neritic conditions that prevailed before the opening of the Indian Ocean. The upper Mesozoic is represented by marine limestone and shales, with occasional horizons of sandstones and early limestone. Recent rocks comprise mostly marls and limestone, and are represented by sandstones, clays, conglomerates and gravels, such as those found in the Marafa beds. This well-developed reef complex, consisting of coral reefs, coral rubble and sandstone, is extensively exploited by the building industry.

3.4 Socio-economic setting

3.4.1 Infrastructure facilities

The area is well served with various infrastructure facilities. The site is served by, electricity, piped water and telephone services, mobile providers and landline in addition to a good road network.

3.4.2. Human and economic development

The economy of Kilifi County is driven largely by the commercial activities that take place in neighboring Mombasa County. Although there are companies involved in the manufacturing of steel products for example Mabati Rolling Mills, Corrugated Sheets and Kalu Works, there is a recent upsurge in the establishment of truck marshaling yards for most of the major transport companies, container depots and Container Freight Stations (CFSs). The existence of the Kilindini port in Mombasa County and the attractions that Mombasa offers to tourists contributes significantly to the overall business activity in Kilifi.

3.4.3. Water resources

Kilifi County is generally water scarce both in terms surface and ground water and largely depend on piped water from the Mzima springs and Baricho water. The only permanent river is the Sabaki River which feeds the Baricho water works and crosses the northern part of Kilifi County. The others are temporary due to few catchment areas, sandy soils which have high infiltration rates and high evapo-transpiration rates. Ground water resources are exploited along the coastline through shallow wells and bore holes but diminish as one moves inland.

3.4.4. Energy supply.

The main source of energy supply in the area is electricity from the Kenya Power and Lighting Company. However, this is mostly supplemented with diesel powered generators in times of power blackouts. A number of facilities have also ventured into harnessing solar energy by use of solar panels and accumulators. Wind energy has also been sparsely used especially in pumping water from boreholes in the remote parts of the County. In the rural areas, main energy sources are fuel wood, charcoal and paraffin. The proposed development will majorly rely on electricity.

3.4.5. Sewage Management Infrastructure

The entire Kilifi County has no sewerage infrastructure. Hence the common methods for disposal of human wastes is through pit latrines and septic tank and soak pit systems. The problem is compounded by the fact that the local authority has not developed by-laws guiding generation and disposal of liquid waste. It relies on the Public Health Act Cap 242, which is inadequate in seeking lasting solutions to the problem of liquid waste. There is little evidence of adherence to the Water Act 2002 that stipulates the requirements for boreholes and pit latrines are located at far distances to protect ground water sources from contamination.

3.5 Soil Characteristics

The lithology of Kilifi County is composed of sedimentary rocks of the Mesozoic and Cenozoic eras. The sedimentary rocks consist of a variety of sandstones, siltstones, shales and limestone. The project site is underlain by the Mariakani sandstone.

3.6 Land Use Systems

Agriculture, mostly of subsistence nature, is the main land use in the County. However, the land use is gradually changing due to the outcropping of commercial and industrial establishments abutting the Mombasa-Nairobi Highway. A major challenge to the management of land use patterns in Kilifi County is the lack of a zoning plan to guide development activities and dictate land use activities. Development and land use activities have largely been uncontrolled leading to the proliferation of informal land use patterns. Within the entire county, it's only Mtwapa area that has prepared a zoning plan through the office of the Deputy Prime Minister and Minister for Local Government.

3.7. Solid Waste

The main waste generation sources are domestic, commercial ventures, hotels, markets, industries and institutions

including health facilities. The types of waste that are generated can be classified as follows.

- Mixed heavy plastics -Soft drink bottles, detergent bottles, cooking oil/fat bottles, household plastics etc.
- Mixed light plastics - Shopping bags, wrapping films, waste collection bags
- Rubber - Old tires, shoe soles etc.
- Mixed paper - Books, office paper, newspapers carton pieces etc.
- Metals -Pieces and sheets of aluminum, steel and other metals
- Mixed glass - Colored and non-colored, broken or whole glass bottles, panes, household glass items etc.
- Organics - Food remnants, wooden debris, yard waste etc.
- Biomedical waste- waste from hospitals, dispensaries and medical clinics.

All types of waste are transported to disposal sites including hazardous types containing pesticides, heavy metals, oils, batteries, acids, domestic and hospital wastes. The private sector has initiated ways to address the problem of waste management through construction of compost pits in areas where collection is limited and providing waste disposal services to complement those provided by the County Government.

3.8 Poverty index

Poverty in Kilifi County manifests itself, in the inability by the majority of the population to access basic needs due to geographical, economic and social-cultural barriers. The poverty index on the area is estimated at 50% and is slightly above the national average. Out of the 719,000 people in Kilifi District (2009), 65.35% are food poor and 43.02% hardcore poor meaning that they cannot meet the minimum food requirements even after spending all their income on food alone. Within the adult population, 66.8% people cannot meet the minimum cost of food and non-food items essential for human life and hence are absolutely poor. In terms of gender, 45% of the poor are male and 55 percent are female. Factors that contribute to the poverty incidence in Kilifi include climatic conditions, low levels of education and land ownership. Effects of the high poverty levels in Kilifi include high rate of school drop outs, deteriorating health conditions, worsening literacy levels etc. The immediate cause of poverty within the proposed project area has been attributed to landlessness, high and increasing cost of living, inaccessibility to credit facilities, lack of entrepreneurial skills, unemployment, low incomes and HIV/AIDS and discrimination at places of work.

In general, poverty has led to over-use and destruction of natural resources where short-term development goals are pursued at the expense of long-term environmental sustainability. There is need to ensure that environmental concerns are integrated into development planning and that development plans lead to empowerment of local communities to engage in sustainable livelihood activities. Hence the development proposal will contribute significantly to reducing the poverty index at a local level through employment creation and the trickledown effect of the development on other business establishments.

3.9 Demography

3.9.1 Population

The 2009 population census figures show that Kilifi District had a population of over 700,000 persons and a density of 144 persons per km² with a population growth rate of 3.05% against the national population growth rate of 2.49% (CBS 2009 estimate) compared to approximately 500,000 people in 1999.The population of Kilifi especially in its urban centers has been on the rise mainly due to rural urban migration, tourism and the influx of foreigners. The local population is culturally heterogeneous. The largest indigenous ethnic group being the Mijikenda which is comprised of nine sub-tribes namely: Giriama, Digo, Rabai, Duruma, Kauma, Chonyi, Kambe, Ribe, and Jibana. Other indigenous Coastal ethnic groups are: Taita, Pokomo, Bajuni, Orma, Sagala, and Swahili. Due to its socio-economic dynamics which offer great opportunities for livelihoods and leisure, Kilifi and the project site in particular has over the years attracted a multiplicity of ethnic and racial groups.

3.9.2 Settlement patterns

Settlement patterns in Kilifi County are influenced by infrastructure network (roads, water, and electricity) and high agricultural potential zones. High population densities are found in Kilifi Town, Kikambala and Kaloleni divisions

along the tarmac road of Mombasa-Malindi and Mombasa-Nairobi up to Mariakani area (proposed project locality). These areas are also well supplied with piped water and electricity. High population clusters are also found in Chonyi division and some parts of Kaloleni division where there are high potentials for agricultural production. Sparsely populated divisions in the district are Ganze, Vitengeni, Bamba and some parts of Kaloleni division. These areas are rangelands and are less productive agriculturally. The three larger towns in the district (Kilifi, Mariakani&Mtwapa) have a total population of 100,000 (2009), which represents approximately 13% of the total district population. The resident population of Mariakani Town is estimated at 10,000 people.

3.10 Protected areas

Gazetted forests, kayas and marine parks constitute the protected areas in Kilifi County. The gazetted forests include a section of the ArabukoSokoke forest and mangrove forests mainly found at Takaungu, Kilifi creek, Mtwapa creek and part of the Mida creek in Uyombo, with an area of approximately 880Ha. The kayas (sacred forests) include Chonyi, Kambe, Ribe, Jibana, Kauma and Kaya fungo. The marine parks and reserves include, part of the Mombasa marine and National Reserve, Watamu-Voi Marine National park and Reserve (coral gardens) and part of the Voi Marine and National Reserve. The part of ArabukoSokoke forest which falls in Kilifi County constitutes 19,000 Ha out of the 37,000 Ha .The forest is situated between Kilifi creek and The Sabaki River. The forest has a very high biological diversity. It is one of the important sites for bird conservation in Kenya (Kesley and Langton). Six of the bird species listed as rare in the ICBP/IUCN Bird red data book occurs in this forest. Two of these bird species, the Sokoke Owl (Otus arena) and the clerk's weaver (Ploceusgolandi) are found nowhere else in the world except in this forest. In addition to the endemic bird species, ArabukoSokoke is also home to other terrestrial fauna. For instance it is the only known home for the endangered Cephalophusadersi, the frog Leptopelisflavomacculatus, and two butterfly species, the Charaxesprotocles and the Charaxeslasti. None of these protected areas are close to the project site.

3.11 Flora and fauna

Human activities such as cultivation, grazing, quarrying, slash and burning have greatly altered the area's potential to support animal life. These activities have altered the natural ecological system that support biodiversity. Only a few reptiles such as green mamba and lizards can easily be seen on site. Livestock keeping is more dominant in the area than crop farming which is also discouraged by erratic rainfalls.

3.12 Socio-economic profile

The socio-economic profile of Kilifi County is mainly defined by subsistence farming, artisanal fisheries, Tourism, mining and trade. However agriculture and tourism are the two primary forms of economic activity in the County. In Kilifi County tourism is concentrated around Malindi and to a lesser extent Kilifi. The revenue earned effects only a small proportion of the population. Under Vision 2030, the county is set to transform into a tourist destination featuring world class golf courses and a Resort City.

3.13 Employment

Agriculture, employing 85% of the population remains the backbone of the local economy and since the population density is high in relation to the agricultural potential, the County is one of the poorest in Kenya in terms of per capita income. Waged employment only absorbs 4% of the population.

CHAPTER FOUR

4.0 Policy, Institutional and Legal Framework

4.1 Introduction

The relevant legislation which the project must comply with is intended to ensure project's sensitivity to environmental concerns, public safety, public health, physical planning regulations, County Government of Mombasa bylaws and construction standards. In response to environmental degradation, the Kenya parliament enacted the EMCA No. 8 of 1999 to comprehensively address the challenges of environmental management in Kenya. Later Legal Notice No. 101 was gazetted in 2003 as an attendant regulation to EMCA, 1999. Under this legal framework major changes in land use are required to undergo an EIA study which is later submitted to a statutory body i.e. NEMA for approval and granting of an EIA license. Similarly existing projects with a potential to impact on the environment, health and safety of the environment are required to undergo an initial environmental audit to determine compliance with environmental legislation and integrate environmental concerns into the operational stages of the project life cycle.

Environmental degradation is a major global challenge especially in terms of how to maintain sustainable development without degrading the natural environment on which people are dependent (UNEP & ACTS, 2002). It is now accepted that development projects must be economically viable, socially acceptable and environmentally sound (Okidi and Mbote, 2001). Among the major environmental problems being experienced in Kenya today include land and habitat degradation, loss of biodiversity, environmental pollution and water management. The broad objectives of the national environmental policy include the following;

- Integrate environmental conservation and economic activities into the process of sustainable development,
- Optimal use of natural land and water resources in improving the quality of human environment,
- Undertake appropriate reviews and evaluations of developmental plans and operations to measure their progress and to ensure compliance with this policy.
- Sustainable use of natural resources to meet the needs of the present generations while preserving their ability to meet the needs of the future generations,
- Encourage concern and respect for the environment, emphasize on every Kenyan's responsibility in environmental performance and ensure appropriate operating practices and training of generations,
- Communicate with the public on environmental matters to facilitate improvements in environmental performance, and,
- Meet national goals and international obligations by conserving biodiversity, arresting desertification, mitigating effects of disasters, protecting ozone layer and maintaining ecological balance on the earth.

Under EMCA 1999, regulations have been established to facilitate the process of EIA and EA studies. These are contained in the Kenya Gazette Supplement No. 56 legislatives Supplement No. 31, Legal Notice No. 101 of 13th June 2003 and are known as the Environmental (Impact Assessment and Audit) Regulations 2003. Several other statutes and national policies to enhance environmental conservation and sustainable development are in place in Kenya. Several of these policies and legal provisions are briefly described in the following subsections.

4.2 Policies

4.2.1 National Environmental Action Plan (NEAP, 1994)

According to the Kenya National Environmental Action Plan (NEAP, 1994) the government recognized the negative impacts on ecosystems emanating from industrial, economic and social development programs that disregard environmental sustainability. Following on this, establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished and/or are in the process of development. Under the NEAP, Environmental Impact Assessments and Environmental Audits were introduced targeting the industrialists, business community and local authorities.

4.2.2 National Policy on Water Resources Management and Development

While the National Policy on Water resources Management and Development (1999) enhances systematic development of facilities in all sectors for promotion of the country's socio-economic progress, it also recognizes the by-products of this process as waste water. It therefore calls for development of appropriate sanitation systems to protect people's health and water resources from institutional pollution. Industrial and business development activities therefore should be accompanied by corresponding waste management systems to handle the waste water and other waste emanating from their activities. The same section requires that such projects should also undergo comprehensive Environmental Impact Assessment (EIA) that will provide suitable measures to be taken to ensure environmental resources and people's health in the immediate neighborhood and further downstream are not negatively impacted by their emissions. As a follow-up to this, EMCA 1999 requires annual environmental audits to be conducted in order to ensure that mitigation measures and other improvements identified during EIA studies are implemented. In addition, the policy provides for charging levies on waste on the basis of quantity and quality. The "polluter-pays-principle" applies in which case parties contaminating water are required to meet the appropriate cost of treatment. The policy provides for establishment of standards to protect water bodies receiving waste water, a process that has been accomplished through the gazettment of Legal Notice No. 120 of 2006 (Water Quality Regulations).

4.2.3 Policy Paper on Environment and Development

The key objectives of the Policy on Environment and Development include:

- To comply with and make provisions for effluent treatment standards that will conform to acceptable NEMA guidelines.
- To ensure that an independent environmental impact assessment (EIA) report is prepared for any industrial venture or other development before implementation; &,
- To ensure that from the onset, all development policies, programs and projects take environmental considerations into account.

4.2.4 The Land Policy (2007)

Environmental management principles: To restore the environmental integrity the government shall introduce incentives and encourage use of technology and scientific methods for soil conservation and maintain beaches at high and low water mars and put in place measures to control beach erosion. Fragile ecosystems shall be managed and protected by developing a comprehensive land use policy bearing in mind the needs of the surrounding communities. Zoning of catchment areas to protect them from further degradation and establishing participatory mechanisms for sustainable management of fragile ecosystems will also be done. It will also develop procedures for co-management and rehabilitation of forest resources while recognizing traditional management systems and sharing of benefits with contiguous communities and individuals. Lastly all the national parks, game reserves, islands, front row beaches and all areas hosting fragile biodiversity are declared fragile ecosystems. Conservation and sustainable management of land based natural resources: The sustainable management of land based natural resources depends largely on the governance system that defines the relationships between people, and between people and resources. To achieve an integrated approach to management of land based natural resources, all policies, regulations and laws dealing with these resources shall be harmonized with the framework established by the Environmental Management and Coordination Act (EMCA),1999. The new land policy has a vision of 'efficient, sustainable and equitable use of land'. It designates all land in Kenya as Public, Community or Private; 'Community land' replaces the Trust Land category. It also recognizes and protects customary land rights.

Some key relevant issues:

- The exercise of (these) powers (compulsory acquisition and development control) should be based on rationalized land use plans and agreed upon public needs established through democratic processes (Section 43);
- Ensure that the exercise of development control takes into account local practices and community values on land use and environmental management (Section 51(f));
- Ensure effective public participation in the exercise of development control (Section 51(g)); and,

- Strategies for sharing benefits should be developed taking into account the nature of the resources involved and the contribution that diverse actors make to the management of the resources (Section 98).

The policy also addresses land management. Key issues include Section 3.4.3.2 – ecosystem protection (including wetlands). Measures for protection are required with sub-section 135 addressing fragile ecosystems to be managed and protected. Sub-section 137 focuses on Protection of watersheds, lakes, drainage basins & wetlands shall be guided by among other principles prohibition of settlement and agricultural activities in the water catchment areas, identification, delineation and gazettement of all water courses and wetlands as well as integrated resource management based on ecosystem structure. Section 3.4.3.3 addresses urban environment management on the face of the rapid urban development in the country. The section calls for control of waste dumping, regulation quarrying activities and rehabilitation of material dumping sites and land.

4.2.5 The National Biodiversity Strategy, 2007

The overall objective of the National Biodiversity Strategy and Action Plan (NBSAP) is to address the national and international undertakings elaborated in Article 6 of the Convention on Biological Diversity (CBD). It is a national framework of action to ensure that the present rate of biodiversity loss is reversed and the present levels of biological resources are maintained at sustainable levels for posterity. The general objectives of the strategy are to conserve Kenya's biodiversity to sustainably use its components; to fairly and equitably share the benefits arising from the utilization of biological resources among the stakeholders; and to enhance technical and scientific cooperation nationally and internationally, including the exchange of information in support of biological conservation.

4.2.6 National Policy on Water Resources Management and Development

The National Policy on Water Resources Management and Development (Sessional Paper No. 1 of 1999) was established with an objective to preserve, conserve and protect available water resources and allocate it in a sustainable rational and economic way. It also desires to supply water of good quality and in sufficient quantities to meet the various water needs while ensuring safe disposal of waste water and environmental protection. The policy focuses on streamlining provision of water for domestic use, agriculture, livestock development and industrial utilization with a view to realizing the goals of the Millennium Development Goals (MDGs) as well as Kenya Vision 2030. To achieve these goals, water supply (through increased household connections and developing other sources) and improved sanitation is required in addition to interventions in capacity building and institutional reforms. While the National Policy on Water Resources Management and Development (1999) enhances a systematic development of water facilities in all sectors for promotion of the country's socio-economic progress, it also recognizes the by-products of this process as waste water. It, therefore, calls for development of appropriate sanitation systems to protect people's health and water resources from institutional pollution. Development projects, therefore, should be accompanied by corresponding waste management systems to handle the waste water and other waste emanating there from. The same policy requires that such projects should also undergo comprehensive EIAs that will provide suitable measures to be taken to ensure environmental resources and people's health in the immediate neighbourhood and further downstream are not negatively impacted by the emissions.

4.2.7 Kenya Vision 2030

Kenya Vision 2030 is the current national development blueprint for period 2008 to 2030 and was developed following on the successful implementation of the Economic Recovery Strategy for Wealth and Employment Creation which saw the country's economy back on the path to rapid growth since 2002. GDP growth rose from 0.6% to 7% in 2007, but dropped to between 1.7% and 1.8% in 2008 and 2009 respectively. The objective of the Kenya Vision 2030 is to transform Kenya into a middle income country with a consistent annual growth of 10 % by the year 2030". The 2030 goal for urban areas is to achieve "a well-housed population living in an environmentally-secure urban environment." This will be achieved by bringing basic infrastructure and services namely roads, street lights, water and sanitation facilities, storm water drains, footpaths, and others. One of the aims of the vision is to make Kenya to be a nation that has a clean, secure and sustainable environment by 2030. This will be achieved through promoting environmental conservation to better support the economic pillar. Improving pollution and waste management through

the application of the right economic incentives in development initiatives is critical. The current land use practices in the country are incongruent with the ecological zones. For instance, large portions of land in high potential areas have been subdivided into uneconomic parcels, while some parts of land in the medium and low potential areas are rapidly being converted into agriculture, despite the fragile environment they are located in.

4.3 Institutional Framework

4.3.1 Background and Administrative Structures

The Environmental Management and Co-ordination Act of 1999 received Presidential assent on January 6, 2000 and was gazetted on January 14, 2000. The main objectives of the Act are to:

- Provide guidelines for the establishment of a legal and institutional framework for the management of the environment in Kenya;
- Provide a framework of legislation for over 77 statutes in Kenya that contain environmental provisions; &,
- Provide guidelines for environmental impact assessment, environmental audit and monitoring, environmental quality standards and environmental protection orders.

In 2001, the Government established the administrative structure to implement the Act. The two main administrative structures are:

4.3.2 The National Environmental Council (NEC)

The National Environmental Council (The Council) is responsible for policy formulation and directions for the purposes of the Act. The Council also sets national goals and objectives and determines policies and priorities for the protection of the environment.

4.3.3 The National Environment Management Authority (NEMA)

The responsibility of the National Environmental Management Authority (NEMA) is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of government in the implementation of all policies relating to the environment. In addition to NEMA, the Act provides for the establishment and enforcement of environmental quality standards to be set by a technical committee of NEMA known as the Standards and Enforcement Review Committee (SERC).

4.4 Legal Framework

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

4.4.1 The Constitution of Kenya (2010)

The Constitution of Kenya 2010 is the supreme law of the land. Any other law that is inconsistent with the Constitution is null and void to the extent of its inconsistency. Under Chapter IV, article 42 provides for the right to a clean and healthy environment for all. Further, Chapter V of the Constitution deals with Land and Environment. Specifically Part 2 elaborates on the following components regarding the protection of the environment.

- Enforcement of environmental rights
- Obligations in respect of the environment
- Agreements relating to natural resources
- Legislation relating to the environment

Under the Constitution the proponent is entitled to carry out the project within legal limits and a fair administrative decision making process from NEMA and other State organs. On the other hand, he is required to ensure:

- *That the project is carried out in an ecologically, economically and socially sustainable manner;*
- *That the right to a clean and healthy environment for all is upheld in all phases of the development; &,*
- *That all the applicable provisions of the Constitution are observed at all times.*

4.4.2 The Environmental Management and Co-ordination Act (EMCA), 1999

The purpose of this Act aims at improving the legal and administrative co-ordination of the diverse sectored initiatives in the field of environment so as to enhance the national capacity for its effective management. It has several Regulations that are discussed in the proceeding sections.

4.4.2.1 The Environmental Management and Co-ordination (EIA/EA) Regulations, 2003. (Legal Notice No. 101 of 2003)

The EIA/EA Regulations are meant to ensure the implementation of Sec. 58 of EMCA. It makes it illegal for anyone to undertake developments without an EIA license and stipulates the ways in which environmental experts should conduct the Environment Impact Assessment and Audits reports in conformity to the requirement stated. It is concise in its report content requirements, processes of public participation, licensing procedures, inspections and any possible offences and penalties under the Act.

Relevance to the proposed project

Acquisition of EIA license prior commencement of the project. The operations of the project are similarly licensed since the EIA report contains an Environmental Management Plan which forms the basis for approval of the project by NEMA and imposition of conditions to safeguard the environment. Environmental Auditing should be done annually.

4.4.2.2 Environmental Management and Co-ordination (Water Quality) Regulations, 2006. (Legal Notice No. 120 of 2006)

Water quality regulations were gazetted as a legislative supplement to mainly address the challenges of pollution of water sources and conservation. It consists of VI parts and eleven schedules dealing with protection of water sources for domestic use to miscellaneous provision. Effluent discharge and water for industrial use are dealt with under part III which sets out the following:

- Standards for discharge into the environment,
- Standards for discharge monitoring, and
- Application for effluent discharge license.

Generally the act addresses the challenges of pollution of water resources as well as their conservation. The regulation provides guides for water use and conservation as well as effluent standards for discharge.

Relevance to the proposed project

Important in protection of ground water sources. Since there is a potential of work force effluent to be discharged into the environment, the proponent will ensure that such effluent is managed accordingly.

4.4.2.3 The Environmental Management and Co-ordination (Waste Management) Regulations, 2006. (Legal Notice No. 121 of 2006)

In pursuit of the provisions of the Environmental Management and Coordination Act, 1999, the Minister for Environment in 2006 gazetted the waste management regulations focusing on management of solid wastes, industrial wastes, hazardous wastes, pesticides and toxic substances and radioactive substances The regulations are aimed at addressing the following concerns;

- Licensing of waste disposal sites and transport,
- Reduction of waste through adoption of cleaner methods of production,
- Responsibilities for waste generators and obligations for disposal,
- Proper transportation and disposal of wastes,
- Management of waste disposal sites,
- Waste treatment requirements,
- Application of existing regulations in relation to waste management,
- Licensing of waste handlers and disposal sites, and,
- Licensing fees and procedures for waste handlers and pollution penalties

Relevance to the proposed project

Ensure there is proper contractual agreement with licensed solid waste handlers and that solid wastes are disposed on the manner prescribed. Ensure proper disposal of any materials used for the purposes of the activities of excavations. This could include PPE, packaging, plastic wrappings, lunch containers, cartons etc. All solid wastes generated by the operations of the facility shall be disposed of by a contracted NEMA licensed solid waste handler.

4.4.2.4 The Environmental Management and Co-ordination (Excessive Noise and Vibrations Pollution Control) Regulations, 2009. (Legal Notice No. 61 of 2009)

These Regulations were gazetted to manage noise levels to levels that do not cause a disturbance to the public. The proposed activities will however have a potential for the production of noise above the acceptable limits.

Relevance to the proposed project

Ensure compliance with the set noise level limits for the site especially during farm preparation activities. The contractor should ensure that employees are not exposed to noise levels above 85 dB (A) and in such cases provide suitable personnel protection equipment (ear protective devices).

4.4.3 The Water Act No. 8 of 2002

While developing the National Water Policy, the Government also established a National Task Force to review the Water Act, Chapter 372 and draft a Bill to replace the Water Act, Chapter 372. The Water Bill 2002 was published on 15th March 2002 and passed by Parliament on 18th July 2002. It was gazetted in October 2002 as the Water Act, 2002 and went into effect in 2003 when effective implementation of its provisions commenced. The legal framework under the Water Act 2002 provides the guidelines in line with the existing policy changes, four key institutions with separate functions and decentralized decision making systems.

Relevance to the proposed project

The proponent should ensure that water usage in all phases of the project cycle is in line with the provisions of this Act and obtain a water abstraction permit from WARMA before the borehole is to be sunk.

4.4.4 The Occupational Safety and Health Act 2007, OSHA

The OSHA 2007 repealed the Factories Act, Cap 514 Laws of Kenya which had been originally adopted in 1962 and revised in 1972, underwent further and extensive amendments in 1990. The provisions of OSHA have far reaching implications on safety and health at the work place. The OSHA sets out to make provisions that aim to eradicate or minimize accidents at the work place. Throughout the world, work related accidents are a major concern for Governments and industry, the hospitality industry included. The ILO estimates that there are over 250 million work related accidents per year; 160 million work related ill health every year and that 3000 people are killed at work per day. Many of the accidents could be avoided if appropriate safety practices and information were used. Work related accidents affect not only the injured employee, but others as well – employers, family, co-workers, clients, suppliers, community etc.

The OSHA 2007 commenced on 26th October 2007. It is an Act to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces. Although the OSHA 2007 repealed the Factories and Other Places of Work Act, Cap 514 Laws of Kenya, it inherited all the subsidiary legislation issued under Cap 514. Examples of subsidiary legislation inherited include:

- Electric Power Special Rules L.N 340 of 1979
- First Aid Rules L.N 87 0f 1964
- Docks Rules L.N 306 of 1962
- Eyes Protection Rules L.N 44 of 1978
- Building Operations and Works of Engineering Construction Rules L.N 40 of 1984
- Cellulose Solutions Rule L.N 87 of 1964
- Health and Safety Committee Rules L.N 31 of 2004

- Medical Examination Rules L.N 24 of 2005
- Noise Prevention and Control Rules L.N 25 0f 2005
- Fire Risk Reduction Rules L.N 59 0f 2007
- Hazardous Substances Rules L.N 60 of 2007

Of particular importance to the project site is the requirement that all work places must be registered with the Department of Occupational Safety and Health Services. Further, there is a requirement that a Safety and Health Committee must be put in place and that employee and members of this committee must be inducted and trained on the provisions of the Act accordingly. The Act imposes various obligations on both employers and employees. These are all necessary for the health and safety of persons accessing and using the premises of the proposed site. Strict provisions are made for in respect of equipment containing self-acting machines, hoists and lifts and the requirement for supervision and training of inexperienced workers. There must be put in place an SHC and proper training to be done.

Relevance to the proposed project

The proponent will ensure that the facility is registered with the DOSH as a work place. Further an abstract of the facility's safety and health policy should be exhibited at a conspicuous place within the property.

4.4.5 HIV/AIDS Prevention and Control Act (Act No.14 of 2006).

Part 11, Section 7 requires HIV and AIDs education in the work place. The government is expected to ensure provision of basic information and instruction on HIV and AIDs prevention and control to; Employees of all Government ministries, Departments, authorities, and other agencies; and, Employees of private and informal sectors. The information on HIV/AIDs is expected to be treated with confidentiality at the work place and positive attitudes shown towards infected employees and workers. *During the project implementation the contractor is expected to create awareness to the employees and the local communities on the issues related to HIV/AIDS.*

4.4.6 Traffic Act (Cap. 403)

Section 42 Part 1 forbids any driver to drive a vehicle at a speed exceeding fifty kilometers per hour on any road within the boundaries of any trading centre, township, municipality or city: The highway authority is expected to erect and maintain traffic signs as prescribed so as plainly to indicate to drivers entering or leaving such roads or areas where the fifty kilometer per hour speed limit restriction begins and ends.

Section 47 of the act states that any person who drives a motor vehicle on a road recklessly, or at a speed or in a manner which is dangerous to the public, shall be guilty of an offence and liable to a fine. Part VIII of cancelling any driving license or provisional driving license held by the offender and declaring the offender disqualified for holding or obtaining a driving license for such period as it thinks fit.

Section 52 Part 1, The driver of the vehicles are expected at all times to obey directions given by the police officer whether verbally or in signal, conform to the indications given by any traffic sign, and when any person in charge of any cattle raises his hand or in any manner signaling to stop, and keep it stationary for as long as it is reasonably necessary.

Section 53 Part 1, No vehicle shall be allowed to remain in any position on any road so as to obstruct or to be likely to obstruct or cause inconvenience or danger to other traffic using the road, and, save where the contrary is expressly provided in this Act, every vehicle on a road, when not in motion, shall be drawn up as close to the side of the road as possible.

Relevance to the proposed development

Drivers or machine operators should cause no obstruction but observe the recommended speed limits.

4.4.7 Occupier's Liability Act Cap. 34

The act regulates the duty that an occupier of premises owes to his visitors in respect of dangers due to the state of the premises or to things done or omitted to be done on them. It requires that the occupier warn the visitors of the likelihood of dangers within his premises to enable the visitor to be reasonably safe. *Proponent should ensure safety of workers in all project phases.*

4.4.8 Electricity Power Act No. 11 of 1997

The Electric Power Act No. 11 enacted in 1997 deals with generation, transmission, distribution, supply and use of electrical energy as well as the legal basis for establishing the systems associated with these purposes. In this respect, the following environmental issues will be considered before approval is granted:

1. The need to protect and manage the environment, and conserve natural resources;
2. The ability to operate in a manner designated to protect the health and safety of the project employees; the local and other potentially affected communities

Relevance to the proposed project

Electricity power installation and usage should be done in a manner that seeks to protect the health and safety of the project employees, the local and other potentially affected communities as well as the environment.

4.4.9 Pest Control Products Act (Cap. 346)

The Pest Control Products Board (PCPB) is a statutory organization of the Kenya Government established under the Pest Control Products Act Cap 346, Laws of Kenya with a broad mandate of regulating the trade and use of pesticides (pest control products) in the country. It specifies the license requirements for the marketing, use and disposal.

Relevance to the operations of the facility:

Proponent should ensure that pest control methods used in the farm do not result to residual chemicals being drained into the environment. Proponent should seek services of qualified and licensed pest control service provider.

CHAPTER FIVE

5.0 Public and Stakeholder Consultations

An extensive public consultation process was engaged in gauging the sentiments of a variety of stakeholders in the development of this project. Besides the fact that this is a regulatory requirement under the Environmental Management and Coordination (EIA/EA) Regulations (2003), it was an excellent opportunity to offer the public an opportunity to ventilate their joys as well as concerns. The exercise was carried in May - August, 2016.

5.1 Methodology

A semi-structured interview strategy, questionnaires and informal consultations were used to obtain comments from neighbours and stakeholders. Sample questionnaires have been appended in this report.

5.2 Conclusion on Findings

The overwhelming majority of the respondents could see enormous benefits accruing to them and to the enhancement of the environment by the coming into being of the project. The potential negative impacts will be mitigated to the highest degree as recommended in this EIA study report.

CHAPTER SIX

6.1 Potential Environmental Impacts

This Chapter identifies both positive and negative environmental impacts likely to be occasioned by the project implementation phases. It discusses the nature of impacts, their magnitude, spatial and time extent and significance. The impacts identified are discussed below:

6.1 Ground Preparation Impacts

6.1.1 Positive impacts during ground preparation

6.1.1.1 Employment

During the project planning and design, the project proponent has already employed consultants including Engineers, Hydro-geologists, and EIA consultants among others. At ground preparation stage the contractor will deploy some workers. This will include both skilled and unskilled personnel especially from the local population. Vendors of various items and food are likely to enjoy additional market from the demand created by those who will be working at the site. The income obtained from the employment will help be better the lives of the persons affected.

6.1.1.2 Attracting more investors to the area

Large scale investments and projects like the one the proponent is implementing usually makes an area more attractive to more investors as all the relevant services like infrastructure, electricity etc. are put in place. This will increase the economic activities in the area giving more employment to the locals and more revenue to the government. The socio-economic status of the area will improve greatly.

6.1.1.3 Income to the government in terms of taxes and statutory fees

The government intends to get income/revenue in terms of taxes generated during the acquisition of licenses. Through the revenues generated, the government will be capable of financing its obligations to the country. The proponent is obliged to pay 0.1% of the total project cost to the NEMA Revenue Account prior submission of the EIA report.

6.1.2 Negative impacts during ground preparation

6.1.2.1 Air quality

In general, the operation of machinery and emission of fumes will have a negative impact on air quality. This impact however, is at a small scale as operation of machinery is for small period of time, in open spaces, and impacts those within close proximity for example bulldozer operators. The intensity of the operations is considered to be low.

6.1.2.2 Safety hazards

There will be use of earth moving machines during ground breaking. Such machinery may cause accidents if precaution is not taken.

6.1.2.3 Destruction of the physical environment

The impacts on soil will be localized and will be caused by:

- **Excavation**

Excavation creates loose soil that is easily carried away by water or wind. This causes soil erosion and disturbance in soil quality. Soil and wind erosion will lead to pollution of air and water sources. Air pollution results to breathing infections and thereby need for money for medication.

- **Soil Compaction**

Vehicular movement will cause compaction of soil. This may lead to formation of hard pans and soil capping. The latter seals the soil on the surface hence hindering the penetration of air or water beneath the surface. This limits the aerobic activities of the organisms underneath the soil, hence affecting soil productivity. Compaction also hinders the infiltration of water into the surface hence increasing the surface run-off increasing the possibility of flooding downstream of the site.

- **Loss of bio-diversity**

The destruction to the physical environment will lead to loss of bio-diversity and thereby degrading the aesthetic value of the area affected.

6.1.2.4 Workforce sanitation

Sanitation provisions for the work force will be an issue of concern during farm preparation operations.

6.1.2.5 Noise pollution

Noise is expected from movement of earth movers, vehicles and ground preparation equipment. Noise may lead to hearing impairments which will reduce the workmanship of the employees and also affect their finances due to treatment and medication. The workforce at the site will also be an important source of noise in the neighborhood.

6.1.2.6 Oil spills

Machines and vehicles on the site will consume appreciable amounts of oils. There is always the likelihood of oil spills contaminating soils and surface water.

6.2 Plantation Operation Impacts

6.2.1 Positive impacts during operation phase

6.2.1.1 Income to the proponent

The proponent will accrue income from operations of the plantation i.e. during harvesting. This is his key objective.

6.2.1.2 Employment creation

It is estimated that at least 20 permanent people will be employed during the operational phase of the plantation as well as over 100 casual labourers as the project proceeds. The employment will consist of an Agricultural engineer, farm managers, plumbers and general farm workers among others.

6.2.1.3 Benefits to other business establishments

There will be direct benefits to other businesses in the area especially those dealing in transport and shipment.

6.2.2 Negative impacts during operation phase

6.2.2.1 Water quality

Water quality impacts are perceived to be those that arise from chemical contamination including the use of fertilizers, pesticides, and liquids for machine use. All of these activities vary in their geographic extent and intensity but in general should have mitigation activities in place when applied near waterways such as rivers or inundated areas. Additionally, erosion can contribute to water quality issue as increased sediment loads are connected with increased carrying capacity of water borne pathogens. In general, these impacts are seen to occur in areas where earthworks are being put in place as well as areas where chemical treatment is used. Mitigation strategies will focus on these activities.

6.2.2.2 Soil contamination

Contamination of soil is expected to occur through either accidental spills of chemicals and liquids used for the

operation of machinery or farm maintenance. Additionally, the use of pesticides is warranted during a pest outbreak and could pose a threat to soil health.

6.2.2.3 Run off impacts

Increases in runoff can occur in areas that allow water to directly flow into streams and rivers without first being buffered by natural vegetation or wetlands. Typically road surfaces, drainages, and firebreaks are thought to increase runoff from properties but mitigation strategies can be used to prevent this occurrence.

6.2.2.4 Air quality and noise pollution

The anticipated air pollutant from project activities includes nitrous oxides (NOx), sulphurous oxides (SOx), volatile organic compounds (VOCs), carbon black, and noise pollution.

6.2.2.5 Fire hazards

Fire is a major hazard to a bamboo plantation especially during the dry season and in drier areas. This can cause considerable losses in terms of injury to persons and damage to property. This has a negative financial impact to the proponent and workers.

6.2.2.6 Disaster and emergency situations

The term 'disaster' is used in this report to refer to any incident, accident, or natural occurrence that could affect the operation of the project in whatever way. Disasters and emergency situations for the development may result from any or a combination of the following;

- Fire hazards
- Medical.

All potential types are both anthropogenic as well as natural in origin. Besides fire hazards, emergency situations may occur such as accidents during production activities. The management of the development will therefore need to put in place measures to address such eventualities.

6.2.2.7 Effluent discharge

The plantation will be managed by several employees and will use sanitary facilities within the premises. Wastewater comprises an important source of pollution and its improper disposal can have far reaching implications on underground water resources. This wastewater typically constitutes a combination of flows from the development. Table 6-1 below summarizes the main characteristics of the projected domestic sewage from the development.

Table 6.1: Typical composition of untreated domestic sewage *

Constituent	Weak	Medium	Strong(all mg/l)
Alkalinity (as CaCo3)	50	100	200
Biological Oxygen Demand (BOD)	100	200	300
Chemical Oxygen Demand (COD)	250	500	1000
Total Suspended Solids (TSS)	100	200	350
Total Dissolved Solids (TDS)	200	500	1000
Total Nitrogen**	20	40	80
Total Phosphorous**	5	10	20

*adapted from Davis-Cromwell: Introduction to Environmental Engineering, pp 353

** Total Nitrogen is a measure of the total organic and ammonia nitrogen in the wastewater.

Phosphorus may appear in many forms in wastewater. Among the forms found are the orthophosphate, polyphosphates, and organic phosphates, all these are grouped as total phosphorus.

6.2.2.8 Increased water demand

The operational phase of the development will exert an extra demand on water. The water will be required for

irrigation, sanitation purposes and drinking among other uses. This causes strain on the water resources.

6.2.2.9 Increase in electricity consumption

Plantation operations will require use of electric energy in plumbing, lighting and probably powering some machines. Since electric energy in Kenya is generated mainly through natural resources, namely water and geothermal resources, increased use of electricity have adverse impacts on these natural resources base due to accelerated depletion.

6.3 Decommissioning Phase Impacts

This is the end of life of the plantation. A number of factors may contribute to the need for decommissioning including;

- End of project life,
- An order by a court of law due to noncompliance with existing Regulations,
- Change of user, and,
- Natural calamities.

6.3.1 Decommissioning negative impacts

6.3.1.1 Economic decline

The national economic gain got from the investment activities will be lost in the event of decommissioning of the development. The proponent will also suffer huge losses and the workers will be jobless.

CHAPTER SEVEN

7.0 Impact Mitigation

This chapter deals with the plan for the mitigation of anticipated adverse environmental impacts while enhancing beneficial impacts of the proposed project. The project's environmental mitigation plan has been drawn in accordance with legislative and regulatory frameworks on environmental and socio-economic aspects. In addition possible treatment and prevention measures have been discussed in this chapter.

7.1 Farm Preparation Phase Impact Mitigation

7.1.1 Occupational Health and Safety

To ensure the health and safety of workers at the site, the contractor and the proponent must if needed establish an Occupational Health and Safety Management System (OHSMS) which will be managed and operated for the proposed farm operation activities.

The system will basically contain the following features;

a. Occupational Health and Safety Policy,
b. Organizational Framework of the OHSMS. This includes:
   - Staffing of OHSMS,
   - Competence requirements,
   - Operating procedures,
   - Training programmes,
   - System documentation,
   - Communication.
c. OHSMS objective,
d. Hazard prevention. This involves:
   - Risk assessment
   - Prevention and control
   - Management of changes
   - Emergency preparedness and response
   - Procurement (tools, equipment, services, contractors)
e. Performance monitoring and measurements. This includes:
   - Hazard prevention measures
   - Ambient working environment
   - Occurrence of work related injuries, ill health, disease and injuries
   - Record keeping with regard to occurrence of incidents and actions taken.
f. Evaluation
   - Formative and summative evaluation
   - Feedback
   - Remedial actions
   - Incident re-occurrence prevention plan (IRPP)
   - Performance improvement

7.1.1.1 Safety of workers at the site

The levels of implementation of occupational health and safety considerations at the workplace should begin with the deliberate effort by the contractor and the proponent to protect the employees at the site. In this regard this proposal makes the following recommendations;

- Registration of the farm site as a workplace with the Directorate of Occupational Health and Safety (DOHS)
- Provision of appropriate and adequate Personal Protective Equipment (PPE) to employees,
- Enforcement and proper use of PPE by all workers,
- Provision of appropriate tools, equipment and machinery in sound working conditions to employees to avoid accidents,
- Develop clear policies on treatment of injured personnel,
- Provide insurance cover to workers on site,
- Reduce employees' exposure to dust and noise at the workplace.

7.1.1.2 Safety of visitors, neighbours and general public

The proponent and the contractor will have an obligation to put in place measures that will protect the visitors to the farm site, neighbors, and the general public in the following ways;

- Visitors to the project site must be provided with protective clothing at all times,
- Inform all neighbors in writing on the commencement of the project at least two weeks in advance,
- Restrict access to the site by the public by fencing off the farm site,
- Limit farm works to daytime only,
- All vehicles accessing the site to deliver materials must observe speed limits,
- Placing notices and safety slogans at strategic points to inform and educate neighbors and the general public displayed at the entry of the farm site and around the perimeter fence informing general public of ongoing activity and safety requirements,
- Provide for security services at the site.

7.1.1.3 Tools, Equipment, Machinery Use and Electrical Safety

It is expected that different machines, tools and equipment such as bulldozers and tractors will be used. Most of this equipment will be powered internally by use of diesel. In regard to electrical safety, the following will have to be undertaken:

- When not in use all machines should be put off,
- Qualified and well-experienced personnel should be hired to carry out operations,
- Safety slogans should be strategically posted as a reminder to employees,
- All machine operating manuals should be clearly archived and availed for use when needed,
- Each machine operator should be conversant with the use of machine operating manuals.

7.1.1.4 First aid

The following should be adhered to;

- It will be the responsibility of the contractor to ensure that first-aid services are provided to employees at all times,
- An appropriately equipped first aid station to be easily accessible at the site,
- There shall be a well-trained first aider on site at all times,
- An eye-wash station and/or emergency shower shall be provided where the recommended first aid response is immediate flushing with water,
- The first aid station shall be equipped with gloves, gowns and masks for protection against direct contact with blood and other body fluids,
- A written emergency response plan will be in place and drills conducted to familiarize employees.

7.1.2 Ambient factors at the site

7.1.2.1 Noise levels

- Employees not to be exposed to noise levels greater than 85 dB (A) for a duration of 8 hours per day,
- No unprotected ear to be exposed to peak sound pressure level (instantaneously) of more than 140 dB (A), and
- The use of ear protectors must be actively enforced.

7.1.2.2 Respiratory hazards

- Exposure to dust to be controlled by ensuring dust accumulation at workplace is contained,
- Equipment to be selected for use, priority should be given to those with in-built dust extraction systems,
- Employees exposed to dust should be given disposable dust masks.

7.1.2.3 Dust management strategy

In the management of dust at the site, the contractor will ensure that the following mitigation measures are

implemented.

- Access road and dust surfaces at the farm site should be sprinkled with water,
- Employees will be provided with appropriate dust masks.

7.1.2.4 Noise abatement

Moderate noise levels are expected in the area during the farm preparation phase. In line with the Legal Notice No. 61 (Noise and Excessive vibration pollution control) Regulations, the following mitigation measures are proposed to deal with noise emanating from the site.

- Restricting farm preparation activities to day time only,
- Ensuring that noisy equipment are fitted with silencers where possible,
- Providing workers with PPE for noise impact reduction.

7.1.3 Workforce sanitation

The proponent will procure portable toilets for use by the workforce. These will be emptied regularly and appropriately as required. The emptying entity should be licensed by the relevant authorities.

7.2 Operational Phase Impact Mitigation

7.2.1 Chemical and Pesticide Management

Effective chemical and pesticide management will mitigate potential impacts on water quality, potential soil contamination and air quality.

- A chemical and pesticide store will be put in place and security to restrict and monitor access of products put in place.
- An integrated Pest Management Plan (PMP) that will dictate the use of pesticides in the case of an outbreak will be developed. The plan will be able to train employees in the application of pests and procedures of application. This will ensure that pests will be identified quickly limiting the extent of which pesticides need to be applied.
- The pesticides to be used will be meeting the World Health Organization (WHO) standards.

7.2.2 Fire hazards

- Firebreaks will be established. A 10 m wide fire-line is enough to stop fire from spreading into the plantation.
- No fires will be lit within the farm.
- Security fence will be maintained and security put in place to avert arsonists.
- Employees will be trained in fire-fighting techniques.
- The proposed overhead tanks will have adequate water to contain fires.

7.2.3 Run off impacts

Mulching will be done to cover bare land during planting. However within a year after planting the bamboo system of rhizomes and roots creates a woven mesh, which allows them to act as efficient biological containment walls that control lateral scour and tie tightly to the ground, preventing erosion.

7.2.4 Workforce waste water management.

- A septic tank – soak pit system will be installed to manage water emanating from washrooms.
- Exhaustion of the soak pit septic tank should be done by a NEMA licensed handler.
- Undertake effluent quality analysis quarterly to check conformity with standards specified in the third, fifth and sixth schedules of legal notice 120 of 2006.

7.2.5 Solid waste management plan

The solid waste management plan for the proposed development will focus on the storing, collection, and disposal of all the solid waste that is produced during operations. This program will implement and develop waste minimization strategies designed to maximize the use of recyclable and reusable materials as well as to report the generated volumes

and its reduction schemes. All solid waste from the development will be treated according to the Waste Management Regulations (Legal Notice No. 121 of 2006).

With this in mind, the solid waste produced by the proposed project will be separated into: hazardous and non-hazardous; organic and inorganic with the inorganic being further separated into combustible and non-combustible. The following sections briefly describe the waste management plan.

7.2.5.1 Waste minimization strategies

Waste management by whatever means is an expensive proposition especially given the nature of the project and is location. The project proponent will bear this cost and therefore will aggressively pursue other less expensive options as long as they are compatible with maintaining sound environmental practices. With this in mind, the development solid waste management plan will resort to the ***three R***s referring to Recycling, Reusing and Reduction. If incorporated, these practices will greatly reduce the solid waste volume produced by the project and overhead expenditures that accompany the solid waste management programs.

7.2.5.2 Solid waste collection

The solid waste generated on site will be divided into two i.e. organic and inorganic forms. Garbage receptacles will be placed at strategic locations for the collection and storage of garbage. Noncombustible wastes such as glass, iron, aluminum, some plastics and others will be further separated and recycled as much as possible. The waste will be collected on a regular basis but much more with new arrivals and when requested. The proposed project will implement a collection scheme that will be made available to all visitors and staff members. The collection schedule may vary from time to time depending on the volume and available human resources, nevertheless the endeavor will still remain a weekly operation. The precise collection days will be finalized after discussion with management and staff, and will be determined on the demand needs.

7.2.5.3 Educational and sensitization program

The Solid Waste Management Program for the proposed project will also include an educational and sensitization component to inform occupants and staff on the importance of solid waste management and its impact to the receiving environment. In addition, collection schedules, receptacle locations and other component will also be made known. It is anticipated that this component will be a dynamic and continuous effort in achieving the program's goal. The project will also be utilizing signs and notices to convey the message of solid waste management. These signs and notices will be placed at strategic locations around the property and will be aimed at conservation of the receiving environment.

7.2.5.4 Final waste disposal

For the wastes that could not be re-used, composted or recycled, a NEMA licensed waste contractor will be engaged to facilitate a final disposal of such waste within sites that are licensed by NEMA.

7.2.2.5 E-waste management

NEMA published guidelines for E-waste management in Kenya. A key strategy for the proponent and the occupants of the development will be the collection and conveyance of the e-waste to licensed recycling centers. For the proposed development, the most appropriate place would be the East Africa Computer Recycling Limited located in Kisauni area of Mombasa County.

7.2.6 Disaster and emergency situations

The project proponent plans to develop and implement a project responsive Disaster Management Plan for the project aimed at identifying the different potential disasters that could impact the development. Once in operation, a more comprehensive and detailed plan will be developed and implemented for the project focusing on dealing with the potential disaster types identified above. Table 7-3 below provides a summary that can be used in preparing a comprehensive disaster management plan which is dynamic and responsive on a need to need basis. Depending on the

scale of the disaster the disaster management policy of 2009 will take effect and will be coordinated by either the County/National governments.

Table 7.1: Summary guidelines in the preparation of a disaster management plan

Disaster	Description	Response plan	Stages
Fire	Fire outbreaks can vary in size and location and can cause irreparable damage to the project's infrastructure and are a serious threat to human life	Fire Prevention and Response Plan	Response
Medical	Medical emergencies can occur at any moment without giving notice and therefore requires a quick and coordinated effort to respond to this need.	Medical Emergency Plan (Transportation &Evacuation)	Response, Recovery

The proposed development will take into consideration these most likely potential disasters and plan accordingly in order to mitigate and remediate any negative effects these types of disasters could have on the infrastructure, operation and management of the development.

7.2.6.1 Disaster management plan

- The occupants and staff of the development to formulate an Emergency Committee to address the aforementioned Disaster Management Plan.
- The committee will be charged with the task of electing an Emergency Coordinator and his/her subordinate, who shall direct and execute all the activities outlined by the response plans.
- The emergency committee must conduct periodic meetings to address important issues concerning the disaster management plans.
- Such important issues should be the objectives of the committee, their roles and responsibilities, updates, training, drills as well as their terms of reference (TOR) which they will abide by.

7.2.6.1.1 Fire prevention and response plan

Fire outbreaks whether small or large can be detrimental to the project and in some instances be life threatening. It is therefore important to consider its likelihood and the circumstances surrounding its propagation. The development will therefore develop a Fire Prevention Response Plan aimed at addressing the awareness and the mechanism necessary for its response.

7.2.6.1.1.1 Purpose of plan

The basic responsibilities of the Emergency Committee is to ensure that the coordinating mechanism that will ensure maximum safety of property or lives during a blaze, is put in place, and to make sure the employees are familiar with the mechanism. The purpose of the Fire Prevention and Response plan for the proposed project is to:

- Increase awareness among employees, management and others of the need for a fire prevention and response plan,
- To establish the coordinating mechanisms necessary for management to prepare and implement measures to safeguard property and lives of all concerned should a fire occur in the premises.
- Indicate all possible evacuation routes.

7.2.6.1.1.2 Fire prevention

Fire prevention will be achieved by:

- Use of retardant material;
- Only qualified personnel to install electrical systems for the development;
- Engineering standards to meet provisions for adequate and safe wiring;&,
- Plumbing, heating, and cooling systems will also be in conformity with acceptable building codes.

7.2.6.1.1.3 Fire response

Fire outbreaks are unpredictable but can be prevented. It is difficult to portray a response plan for the project site

considering the different scenarios that might arise from a fire. It is important though, to have in mind certain tips and guidelines as to the advent of a fire. These guidelines may come in the form of a fire combating plan whereby trained staff may utilize the different fire controls to extinguish the fire. Fire outbreaks often require an evacuation plan and for this reason, a comprehensive evacuation plan will be required to be developed.

7.2.6.1.2 Medical Response Plan

The proposed development will implement a medical response plan in the event of a medical emergency. In general, the proposed response plan will cater to basic first aid health care and will only include emergency transportation to a recognized health institution capable of treating the patient.

7.2.6.2.2.1 Components of the plan

The medical plan should include;

- Basic first aid personnel and first aid kit (Most first aid kits contain bandages for controlling bleeding, personal protective equipment such as gloves and a breathing barrier for performing rescue breathing and CPR (cardiopulmonary resuscitation), and sometimes instructions on how to perform first aid.
- Transportation of patients – when conventional First Aid requires additional medical attention, the patient must be transported to a recognized health institution for further treatment. A standby ambulance should be provided.
- Contact information – Contact information is an important factor in considering emergency situations. It can be used in cases of fire, medical and other emergencies

7.2.6.2 Training and development

The proponent will acknowledge the importance of having well qualified personnel to deal with disaster preparedness at the development. This implies making investments in quality training through recognized institution for the emergency response committee of the development.

CHAPTER EIGHT

8.0 Environmental Management Plan

8.1 Introduction

The objectives of the Environmental Management Plan are:

- To guide the project implementers in project planning,
- To guide the Project implementers on the likely impacts of the project and when they are likely to occur.
- To give an assessment of the capacity requirements for the implementation of the EMP,
- To guide the project implementers to allocate adequate resources for the implementation of the mitigating measures.

8.2 Plan Period

The EMP provided here is to cover the first year of the project's operations. It is then expected that an Environmental Audit will be undertaken at the end of the year to evaluate conformity to the EMP as well as identify any gaps and recommend corrective adjustments to the plan. This will then be addressed through a loop mechanism from farm preparation phase to operational phase to identify the success of the project versus the failures. This should be analyzed through the environmental management criteria of impact and mitigation.

8.3 EMP Outline

The tables below outline the environmental management plans for the proposed development cycle. The plan considers the following;

- Predicted environmental impact
- Proposed mitigation measures
- Responsible party / parties
- Time frame
- Costs

8.4 EMP for Project Farm Preparation

Anticipated Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh.)
Noise pollution	– Preparation work and delivery of raw materials will be limited to day time hours only. – Delivery of raw materials will be done so as to exclude weekends. – Inform neighbours in writing prior to commencement of the development so that they are prepared psychologically at least two weeks in advance. – Employees using equipment that produce peak sounds shall be provided with earmuffs. – Comply with the provisions of Noise Regulations (Legal Notice No. 61 of 2009) – Register the site as a workplace with the Directorate of Occupational Health and Safety (DOHS).	Plantation manager & Proponent DOHS	Throughout preparation period	50,000.00
Destruction of physical environment	– Initial cultivation to be undertaken during dry season to limit soil erosion by rain water runoff. – Ensure that any compacted areas are ripped to reduce run-off. – Practice contour farming.	Project Contractor & Proponent.	Throughout construction period	400,000.00
Dust and fumes	– Ensure strict enforcement of on-site speed limit regulations – Ensure all equipment is serviced regularly to avoid excessive fumes; – Insist on use of low sulphur diesel & other environmentally friendly fuels – Provide dust masks to all employees and ensure their proper utilization – Access road and dust surfaces at the farm site should be sprinkled with water twice a day – Employees will be provided with appropriate Personal Protective Equipment (PPE)	Plantation manager	Throughout preparation period	600,000.00
Health and safety of employees at the workplace	– Provision of adequate and appropriate PPE including safety shoes, helmets, gloves and overalls – Train them in the use of all equipment that they will be required to operate. – Observe rest times and breaks as necessary. – Given employees the correct tools and equipment for the jobs assigned	Plantation manager	Throughout preparation period	150,000.00
	– Hire the right number of workers to avoid overworking them – First aid services and an emergency vehicle to be readily available at site – Securely protect moving parts of machines and sharp surfaces with guards to avoid unnecessary contacts and injuries during farm preparation phase – There must be adequate provision for artificial or natural lighting in all parts the working areas. – Ensure that all chemicals used in are appropriately labeled or marked. – The contractor to implement the provisions of the Occupational Safety and Health Act, No. 15 of 2007. – The farm site to be registered as a workplace with the Directorate of Occupational Health and Safety	Plantation manager	Throughout preparation period	150,000.00 for acquisition of PPE for workers
Solid waste management	– Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3. Reuse 4. Disposal – Through estimation of the sizes and quantities of materials required, order materials in the sizes and quantities they will be needed, rather than cutting them to size, or having large quantities of residual materials.	Plantation manager	Throughout preparation period	125,000.00

	– Dispose -off waste at the designated dump sites. – Transportation of wastes from the site to be done by a NEMA registered solid waste handler who will use appropriate vehicles for conveyance of wastes from site to designated sites. – Comply with the Waste Management Regulations, 2006			
Effluent from workforce	Procure a portable toilet facility to be emptied at appropriate intervals by licensed contractors.	Plantation manager	Throughout preparation period	120,000.00
Traffic management	– Heavy commercial vehicles delivering raw materials shall observe designated speed limits for the area. – Personnel shall be deployed at site entry and exit to direct traffic in and out of the site. Security personnel could double in this role – Proper signage and warnings to be placed on the access route to forewarn other motorists on the use of the road by heavy commercial vehicles	Plantation manager	Throughout preparation period	50,000.00
Possible fire outbreak	– Display warning signs e.g. "No Smoking', 'Highly Flammable', etc. to mitigate lighting fire on or near flammable substances. – Create awareness among workers on safety (Train in fire safety).	Plantation manager	Throughout preparation period	3,000.00
	Designate a storage area for fuel/highly flammable substances that will be guarded to limit access.	Plantation manager	Throughout preparation period	No cost
Increased water demand	– Ensure sources of water for use meets the standards specified under schedule I of Legal Notice No. 120 of 2006 (standards for domestic supply) – Create awareness among workers on the importance of conservation of water (resources). – All water for use shall be metered or consumption records kept determining consumption levels and yields of the underground water sources. – Seek water extraction permits from WARMA before the proposed boreholesare sunk to supplement the reticulated supply.	Plantation manager	Throughout preparation period	100,000.00
Increased energy demand	– Create awareness among workers on the importance of conservation of energy resources. – Switch off engines when not in use. – Employ technologies that demand less energy consumption. – Use energy saving lighting systems.	Plantation manager	Throughout preparation period	200,000.00
Oil spills	Build capacity of staff to manage spills	Plantation manager	Throughout preparation period	Contractor's time.

8.5 EMP for Project Farm Operations

Anticipated Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh.)
Solid waste	– Provide trash bins that promote separation at source. – Contract a private waste handler who is registered with both NEMA and the County Government of Kilifi and proper records kept for collection and disposal. – Manage waste through the hierarchy of options that including reduction at source, separation of wastes to make it easier to undertake recycling / reusing. – Create awareness among workforce and visitors on the importance of proper disposal of solid wastes – Generally solid wastes will be managed in line with Legal Notice No. 121 of 2006	Plantation manager and staff	Throughout operational phase	8,000 per month for the contractors managing solid wastes
Effluent generation	– Sewage/waste water will be managed by septic tank soak pit system – Kitchen sinks to be fitted with oil and grease traps. – Conduct regular inspections for sewage pipe blockages or damages and fix appropriately – Exhaustion of the soak pit septic tank should be done by a NEMA licensed handler. – Undertake effluent quality analysis quarterly to check conformity with standards specified in the third, fifth and sixth schedules of legal notice 120 of 2006	Plantation manager	Throughout operational phase	50,000.00 p.a. for maintenance of the sewage system
Increased water demand	– Water harvesting will be done through construction of 4 No. dams for irrigation. – Boreholes will be sunk. – Install self-regulating water taps for sinks and basins – Create awareness among workers on the importance of conservation of water resources. – All water for use shall be metered to determine consumption levels and yields of the underground water sources. – Implement cultural water conservation methods e.g. mulching and minimum tillage.	Plantation manager	Throughout operational phase	50,000.00 p.a.
Soil erosion	– Mulching will be done to cover bare land during planting. – Implement reduced tillage strategies. – Practice contour farming. – Practice no till farming. – Reduce impervious surfaces.	Plantation manager	Throughout operational phase	Variable
Possible fire hazards	– Establish firebreaks; a 10 m wide fire-line is enough to stop fire from spreading into the plantation. – Prepare and implement a Fire Hazard Response Plan. – Only qualified personnel (electrical engineers) to install electrical systems. – Engineering standards to meet provisions for adequate and safe wiring; plumbing,	Plantation manager Employees	During operational phase	250,000.00 p.a

	heating, and cooling systems will also be in conformity with acceptable building codes – Install fire alarm detection and notification systems i.e. install smoke and heat detectors or manually activated pull station. – Use fire Suppression Systems such as hydrants and fire extinguishers – Prominently display guidelines on what visitors and staff should do in the event of a fire. – Designate a fire assembly point. – Put warning (against fire) signs. – Develop and display visitor/occupier rules that will guarantee safety. – County Government of Kilifi to issue a fire safety certificate	County government of Kilifi		
Medical emergencies	– Have well trained first aid personnel on site at all times – Have an adequately equipped first aid kits on site at all times ensure there is always a standby ambulance for transportation in case of emergencies. – Have contact numbers of reliable health facilities and professional health practitioners	Plantation manager and medical practitioners	Operational phase	To be determined on a need by need basis
Chemical and pesticide management	– A chemical and pesticide store will be put in place and security to restrict and monitor access of products put in place. – An integrated Pest Management Plan (PMP) that will dictate the use of pesticides in the case of an outbreak will be developed. The plan will be able to train employees in the application of pests and procedures of application. This will ensure that pests will be identified quickly limiting the extent of which pesticides need to be applied. – The pesticides to be used will be meeting the World Health Organization (WHO) standards.	Plantation manager		
Accidents and incidents	The proponent will implement a health and safety program to address internal accidents and incidents.	Plantation manager and employees	Operational phase	Contingency fund to be established

8.6 EMP for Decommissioning Phase

Anticipated Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh.)
Legislative compliance	– Give adequate notice to the development's staff. – Engage the services of legal experts. – Undertake due diligence environmental audit for the decommissioning and submit to NEMA at least 3 months prior to decommissioning for approval	Proponent and management	At least 3 months to decommissioning	To be calculated at the time
Demolition waste	– Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary Land filling. – All machinery, equipment and structures that will not be used for other purposes must be removed and recycled/reused as far as possible. – Where recycling/reuse of the machinery, equipment and implements, is not possible, the materials should be taken to a licensed waste disposal site by a NEMA licensed transporter. – Donate reusable waste to charitable organizations, individuals and institutions.	Proponent & contractor	Throughout decommissioning phase	To be calculated at the time

CHAPTER NINE

9.0 Environmental Monitoring Programme

A monitoring plan is essential to assess the impact of the development on the environmental setting of the area. The principles underlying an environmental monitoring plan as it relates to any given development is to document, track and report any changes in environmental parameters over time that would be associated with the project. These changes would in principle vary over time in both magnitude and direction. In the case of the latter it is important to bear in mind that changes in environmental parameters may be positive or negative.

Thus in principle a monitoring program for the project would not necessarily focus only on the perceived or anticipated negative changes precipitated by a given development activity, but also on the positive or beneficial changes. The parameter chosen are those that have been identified in the analytical process as being affected in the most significant way by the proposed development.

9.1 Specific monitoring issues

The proposed monitoring plan for the project will entail those parameters and ecosystem components that have been identified through the mitigation matrix and other mitigation components. A number of these issues have also been highlighted in the mitigation plans and matrices associated with the previous section. These issues include:

- Water Quality monitoring (Effluent);
- Waste Management;
- Soil contamination (spills);
- Biodiversity;
- Environmental health and safety;
- Socio economic influence; &,
- Others.

The proposed monitoring program has been developed not only in relation to satisfying the statutory requirements of the EIA process, but also as a proactive tool for the proper implementation of the proposed development, within the context of its relationship to the integrity of the environment as well as the stakeholders in the area.

9.2 Water quality monitoring

As with so many of the EIA's, the water quality component plays an important role in the overall scheme of the proposed development. With this in mind, it is critical to conserve the environment and its resources in order to promote healthy and stable ecosystems around the proposed project.

Pollution from all the different sources can pose a serious threat to wear resources and therefore considering the negative impacts, the proposed development will have to incorporate a complete water quality monitoring program. This program, which will further be developed by the proponent, government departments (NEMA, KEBS & WARMA) in collaboration with accredited laboratories.Water samples will be collected and analyzed on a monthly basis for the following parameters using the recommended protocol required by Water Quality Regulations.

9.2.1 Laboratory Analysis

This will include the determination of the following effluent characteristics;

- BOD
- COD
- Total Suspended Solids
- Total Nitrate
- E. Coli
- Total Phosphate

- Total and Fecal Coliform

9.3 Wastewater Monitoring Program

Just as with the water resources monitoring program the proposed development intends to develop a wastewater monitoring program that will be tied into the surface water monitoring program. This program among others will monitor the quantity and quality of treated effluent (wastewater) generated by the septic tank –soak pit system.In addition, the program will also develop a maintenance plan encompassing structural failures, inspections, monitoring of equipment (sewer conveyance pipes, treatment plant, grease traps, oil/water separators, etc.) short and long term repairs as well as training for new employees in charge of supervising the plant.

Samples of the treated wastewater will be collected and sent to a NEMA accredited laboratory for testing. In any event, the proponent will comply with all applicable laws relating to this matter. The parameters (BOD, COD, TSS, Nitrates, and E. Coli etc.) to be incorporated in the monitoring programme are those included under Schedule III of Legal Notice No. 120 of 2006. The only addition to the monitoring template will be the date that the sample was taken.

9.4 Solid waste monitoring plan

As part of the overall management structure, the proposed development plans to undertake an intensive solid waste monitoring plan in order to address all the relevant issues that can arise from the collection, storage and disposal of garbage. Table 10-1 describes the outline for which the activity will be monitored.Indicators will be developed to keep track of this activity and report any incident/accident to the local authorities. Such examples include inadvertent spillage during barging, flying or 'blowing' away of uncontained garbage etc.

Table 10-1: Outline for solid waste monitoring plan

Parameter	Frequency
Collection	Daily
Disposal	Weekly
Storage	Daily
Management	Daily

The plan can become more dynamic if columns on critical levels and targets as well as responsible persons are added. This can be done once the development becomes operational.Generally the proposed development will carefully evaluate its options and implement a waste minimization strategy to cope with the anticipated generated volume. Options however, are limited, especially considering that the local infrastructure for the handling and disposal of solid waste.

9.5 Social Monitoring Plan

Due to the increase in the demand for permanent employment in the country, this project will result in positive benefits for Kilifi County. It expected that over 80% of the labour force will be from the local community. The social monitoring plan will consider the following parameters.

Table 9-3: Social Monitoring issues

Parameter	Frequency	Critical levels
Income from occupants	Annually	– Assess income dynamics that may be related to the establishment of the farm within the area. – Evaluate reduction in fishing pressure as a result of employment.
Employment	Annually	Ratio of locals to migrant workers.
Services	Annually	Acceptable and Non-acceptable.

9.6 Environmental auditing

The proponent shall undertake an initial environmental audit one year immediately following the operational phase of the project cycle in compliance with Legal Notice No. 101 of 2003. Thereafter annual audits shall be undertaken.

CHAPTER TEN

10.0 Analysis of Alternatives

10.1 Introduction

Investigating the available alternatives to the development proposal is an important aspect of the EIA process that could invariably help in mitigating the impacts predicted in the preceding chapters of this report. In this analysis, the consultants considered alternatives on the following basis.

- The arguments for or against the implementation of the project i.e. the "No" versus the "Yes" project alternatives.
- Siting of the project.
- Technological alternatives.
- Scale and extent.

10.2 The 'No Project' alternative

This alternative is the best in terms of mitigating the anticipated environmental challenges of the project since it maintains the status quo of the environmental conditions of the project area. However it does not add value to the status of the piece of the land under consideration. This alternative will in addition to denying the proponent, contractors and other workers a reliable income, deny the government revenue from the tax obtained on materials and licenses. This alternative will also deny the residents of Langobaya and their neighbor's additional business opportunities.

10.3 The "Yes Project" alternative

This option was considered as the most viable because of the following reasons;

- There will be employment creation,
- The proponent will accrue profits from the investment,
- The proposal is consistent with the existing land use character of the area,
- It will provide income to the government and other business ventures,
- It will improve the development ranking of the area.

10.4 Siting alternatives

Siting alternatives would be considered under the following assumptions;

- That the land proposed for the project is insufficient for the scale and extent of the project,
- The project is incompatible with the existing land use systems of the area,
- The site hosts sensitive ecosystems and the anticipated impacts cannot be reasonably mitigated.

Since the above concerns are not applicable to the proposed project site, it is deemed suitable for the proposed project site. The proponent further has adequate land to undertake the project. Choosing another site is negated by the requirement for additional capital and the availability of suitable land for the development in the event that the capital is available.

10.5 Technological alternatives

Technological alternatives are driven by the need for conservation of raw materials, implementation labour, energy and water resources.

10.5.1 Alternatives for raising of planting materials

10.5.1.1 Propagation by seed

Bamboos generate seeds when they flower. For many tropical bamboos, flowering intervals range from 40 to 80 years. There are two types of flowering in bamboos, gregarious flowering and sporadic flowering. When gregarious flowering occurs, the clumps of an entire species flower, produce seed, and then die. Although large quantities of

seed are produced during gregarious flowering, they are viable only for a short period, sometimes only for a few days or months. Sporadic flowering occurs in many species, including *Yushania alpina*, *Dendrocalamus giganteus*, *Dendrocalamus strictus*, *Dendrocalamus hamiltonii*, *Bambusa tulda*, and *Guadua angustifolia*, among many others. In this type of flowering, seeds are produced but the clumps generally survive. Because of the long flowering intervals of bamboo, seeds are very seldom available and not always a viable method for large scale propagation.

10.5.1.2 Use of wildings

Apart from raised seedlings, wildings of bamboo from indigenous forest stands can be collected and used for raising a bamboo plantation. There are a few places in the cold areas of Mt. Elgon, Mau and Aberdare ranges where wildings of *Yushania alpina* have been found.Direct planting of large bamboo wildings has not been practised in Kenya. Most likely establishment would be poor due to disturbance of the rooting system during the uprooting from the forest.

10.5.1.3 Vegetative propagation

When seeds or wildings are not available, bamboos can be propagated vegetatively. This offers a better source of planting material. Offsets (rhizome with attached section of stem) are commonly used but their extraction is laborious and time consuming, and it is difficult to collect large quantities of planting materials. During extraction, damage may also occur to the roots, buds and rhizomes of mother clumps. Offsets are bulky and also difficult to transport. Only small annual planting programmes may therefore be possible when using offset materials.

Use of culm cuttings is a viable alternative and has several advantages. Multiplication of several clumping species is possible by this method. When out planted, vegetative materials raised from cuttings develop to clumps much faster than offsets and even seedlings. The local species of bamboo, *Yushania alpina* and *Oxytenanthera abyssinica*, have however proved difficult to propagate in this manner. Bamboos with ectomorph rhizomes cannot be propagated by means of culm cuttings. Success rate is however very high by means of offsets.

10.5.1.4 Using Tissue Cultured plantlets

For the proposed project, we recommend using Tissue Cultured (TC) plantlets. The plantation will source planting materials from the Kenya Forestry Research Institute (KEFRI), Gede.

TC bamboo plantlets are small and generally more vigorous than bamboos propagated by more traditional methods. They can be grown to a size of up to 50 cm and planted into the field. Alternatively, they can be further subdivided by means of rhizome division. Mass propagation of small tissue culture plants is easily achieved and much less labour intensive than propagating large cuttings. Each TC plant can be multiplied into 4 to 6 plants within a year. This allows for a rapid development of nursery stocks. When effective nursery management techniques are applied, an investment of, for example, 10,000 young TC plants supplied in the form of rooted plugs can be easily multiplied by division of small plants to produce 40,000 to 60,000 planting materials in one year.

Bamboo produced by TC may be widely used to develop large scale industrial plantations for timber, biomass, or pulp and paper. Cloning bamboo plants with superior traits opens opportunities for achieving a better quality crop, either in culms or in high quality edible shoots. It is important that farmers be on the lookout for the development of this technique locally.

10.6 Project scale and extent

The scale and extent of the project is considered adequate given the availability of sufficient land resource upon which the project will be implemented.

CHAPTER ELEVEN

11.0 Conclusions and Recommendations

11.1 Conclusion

There are very few negative impacts of low severity and spatial/temporal significance. On the basis of the evaluation of the development proposal, the project does not occasion environmentally significant negative impacts that could lead to environmental degradation on an appreciable throughout the project cycle. This EIA study report therefore presents a “Findings of No significant Impacts”. The development of this project is considered economically viable, socially acceptable and environmentally sound.

11.2 Recommendations

This report recommends issuance of an EIA license on condition that the proposed EMP will be implemented in line with other conditions that NEMA may impose during the decision making process. The proponent should use the EMP as monitoring and evaluation tool to submit an Environmental Audit report to NEMA annually or as may be directed by the Authority without fail.

12.0. REFERENCES

The Constitution of the republic of Kenya, 2010;

Occupational Safety and Health Safety (OSHA) Act No. 15 of 2007

Legal Notice No. 120: EMCA (Water Quality) Regulations, 2006

Legal Notice No. 61 EMCA (Noise and Excessive Vibration Pollution Control) Regulations, 2009

Legal Notice No. 121: EMCA (Waste Management) Regulations, 2006

The Water Act No. 8 of 2002 (Effective implementation of provisions in 2003)

Environmental Impact Assessment & Audit Regulations, 2003

The County Government Act (2012)

The Public Health Act – Laws of Kenya, Chapter 242

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13.0 APPENDICES

The following documents (in photo copies) have been appended.

1. EIA /EA experts practising licenses
2. Proponent's certificate of incorporation
3. Proponent's PIN certificate
4. Land ownership documents
5. Hydrogeological survey report
6. Public participation questionnaires

FORM 7 (r.15(2))

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NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

License No : NEMA/EIA/ERPL/2796

Application Reference No: NEMA/EIA/EL/4430

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Issued Date: **1/25/2016**

Expiry Date: **12/31/2016**

Signature.....

(Seal)
Director General
The National Environment Management Authority

P. T. O.

ISO 9001 : 2008 Certified

FORM 7 (r.15(2))

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NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

License No : NEMA/EIA/ERPL/2961

Application Reference No: NEMA/EIA/EL/4649

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