Environmental and Social Impact Assessment(ESIA) Study Report for the Proposed Gas Exploratory Drilling in Blocks L4 and L13 in Lamu County






Prepared for

Zarara Oil & Gas Limited

Prepared by

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DECLARATION

The Environmental and Social Impact Assessment (ESIA) Study Report for Zarara Oil and Gas, for the proposed Gas Exploratory Drilling in Blocks L4 and L13 in Lamu County, is submitted by Environnementalistses Sans Frontieres (ESF) Consultants, a firm of Environmental Experts, NEMA Registration Number 0204. To our knowledge, all the information contained in this report is accurate and a true reflection of the planned activities in the proposed project.

ON BEHALF OF ZARARA OIL AND GAS

Signed:

ZARARA OIL & GAS LTD.

Dated: 21/11/2016

ON BEHALF OF ESF CONSULTANTS

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Dated: 25/11/2016

ABBREVIATION

2D	two-dimensional
3D	three-dimensional
BMU	Beach Management Units
BOP	Blow-out Preventer
CRS	Comments Registration Sheets
CSR	Corporate Social Responsibility
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
EP	Equator Principles
ESIA	Environmental and Social Impact Assessment
ESF	Environnementalistses Sans Frontieres
ESMP	Environmental and Social Management Plan
FGD	Focused Group Discussions
IFC	International Finance Corporation
MSDS	Material Safety Data Sheets
NADF	Non-Aqueous Drilling Fluids
NEMA	National Environment Management Authority
NGO	Non-Governmental Organization
NOCK	National Oil Corporation of Kenya
OBM	Oil Based Mud
OSH	Occupational safety and health
PPE	Personal protective equipment
PSC	Production Sharing Contract
SOHI	SwissOil Holdings International Ltd
SBM	Synthetic Based Mud

UNESCO	United Nations Educational, Scientific and Cultural Organization
WBM	Water Based Mud

UNITS

Km	Kilometres
m	Metres
m^3	cubic metres
ng/J	nanograms per joule
ppb	parts per billion
ppm	parts per million
µg	microgram

TRANSLATIONS

Baraza	Public Community Meeting
Boda Boda	Motobike used for Public Transportation
Kaskazi	Northern Monsoon
Kusi	Southeast Monsoon
Mashua	Dhows

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EXECUTIVE SUMMARY

Project: Hydrocarbon exploration drilling programme on Blocks L4 and L13 in Lamu County

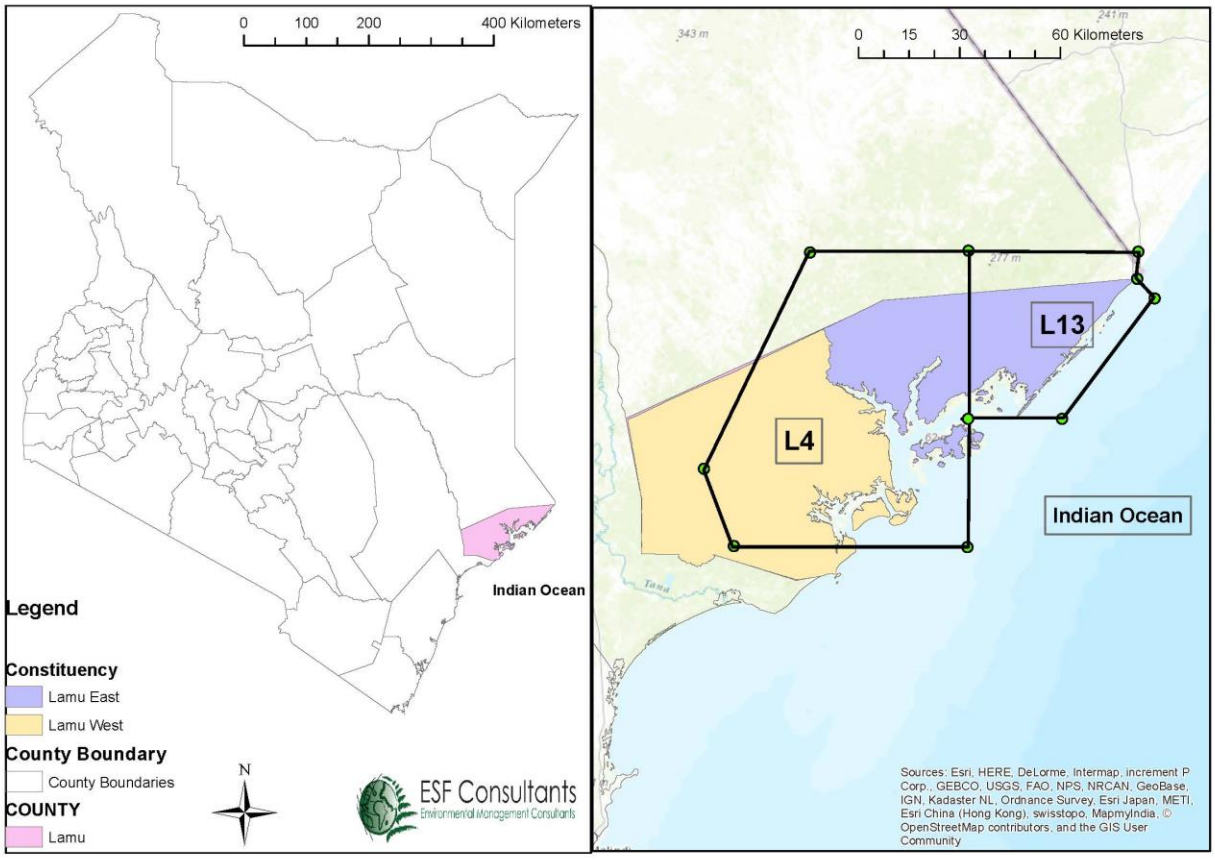
Proponent: Zarara Oil and Gas Limited

Location: Blocks L4 and L13 are in Lamu county, special focus on Pate Island

Project Background

The proposed project aims at carrying out a hydrocarbon exploration drilling programme on Blocks L4 and L13 in Lamu County, with specific focus on Pate Island (See Figure 0.1 below). Zarara Oil and Gas Limited (Zarara), a wholly owned subsidiary of Midway Resource International with a 75% working interest in Blocks L4 and L13 is the operator of the blocks and will be implementing the proposed project.

Figure 0.1: Location of Block L4 and L13 in Lamu County



Source: ESF Consultants

Environmental and Social Impact Assessment (ESIA)

The ESIA has been prepared by Environnementalistes Sans Frontieres (ESF) Consultants Limited of Kenya, working in cooperation with the proponent "Zarara". ESF Consultants has performed a number of ESIAs in the Oil and Gas sector in Kenya according to the requirements and procedures of the Environmental Impact Assessment and Audit Regulations and International Best Practise; and is registered with National Environment Management Authority (NEMA) as a firm of consultants (Registration Number 0204) to perform ESIA.

This ESIA has been structured such as to cover the requirements under the Environment Management and Coordination Act (EMCA, 1999) through the Environmental Impact Assessment (EIA) regulations as stipulated under the Gazette Notice No. 56 of 13th June 2003. Under Schedule II of the Act such projects are required to develop an ESIA to avert the potential adverse impacts of the proposed project and propose recommended mitigation measures.

The scope covered by this ESIA includes exploration drilling activities with specific focus on Pate Island in Lamu County. The ESIA relies on information already available concerning environmental and socio-economic conditions in the area through literature review; information learned through engagement of the public and relevant stakeholders; and primary sources of information such as socio-economic survey, ecological survey, noise assessment and hydrological survey undertaken by ESF.

ESIA Study Objectives

The aim of this ESIA Report is to examine both the positive and negative effects that the proposed exploratory drilling project is likely to have on both the physical and the socio economic environment. Early identification of possible impacts promotes environmental sustainability in that, anthropogenic factors do not interfere with natural environment but blends with it creating harmony.

ESIA Methodology

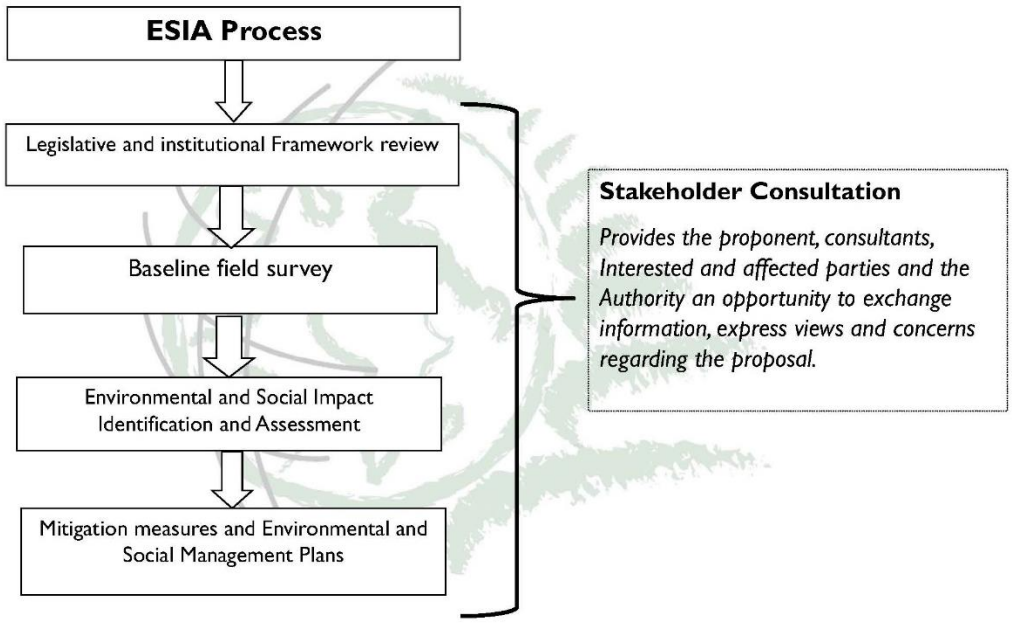
The ESIA Study covered the following aspects:

1. Establishing the existing environment (Environmental, socio-economic and health baseline) where the project falls
2. Defining the legal, institutional and policy framework of the proposed project
3. Analysing the potential impacts of the proposed project
4. Analysing the alternatives to the proposed project
5. Developing accurate and practical mitigation measures for the significant negative impacts
6. Developing an Environmental and Social Management Plan (ESMP) for the significant negative impact
7. Identifying, consulting and involving all stakeholders to facilitate all study objectives

To achieve these objectives, the study collected baseline data firstly through desktop studies on a: national level; regional, and then finally scoping down to the study area and its immediate environs. This is done using detailed study, information from previous similar studies, developed checklist, and professional knowledge. The checklist focused on information gained from the screening process and other cross-sectorial issues such as: health and safety, biodiversity, air pollution, noise, among others.

Several methods and processes were undertaken to enable the achievement of the study's objectives. The ESIA process used in this study is illustrated in Figure 0.2 below:

Figure 0.2: EISA Process



Public Consultation

As required by regulations, stakeholders were identified and engaged as part of this ESIA Study Report. The groups are those generally considered to be most likely to be potentially adversely impacted by the Project. Public consultation and participation ensures that the views of the affected and interested parties are incorporated as early as possible in the project development: at planning, implementation and operation phase and thereby minimize the potential for unexpected opposition of the proposed development and potential for adverse effects to the environment. It is also very beneficial in incorporating the views of the public into the design process for the adoption of the best workable models and systems.

Stakeholders identified were grouped into two categories:

- **Primary Stakeholders** - Those directly affected by the project such as members of the public and various surrounding institutions

- **Secondary Stakeholders** – Those indirectly affected by the project but who influence development as part of its project implementation. These include the responsible agencies of both the County and National Government and civil organisations.

Below are some of the key issues, concerns and comments raised during the stakeholder consultation exercise:

- Concerns on the project's impact on biodiversity through the drilling process.
- Concerns on waste generation and the methods that will be used to dispose of waste.
- Concern on how the project will benefit the community such as jobs, social investment projects and infrastructural development
- Concerns on sharing of resources such as water sources for the project.
- The issue of compensation was raised by the communities in all locations

Legal Framework

This ESIA has been prepared in accordance with the national and international laws applicable to oil and gas exploration and development. All activities will be undertaken in accordance with Kenyan legal and regulatory requirements, International Best Practices/Standards and Zarara's standards and policies. The legal framework review involved the following:

1. National legislations
2. National policies and plans
3. National institutional framework and permits
4. International agreements and conventions
5. IFC Performance Standards/ World Bank Group EHS Standards
6. Equator Principles

Project impacts and mitigation measures

The potential impacts (positive and negative) associated with the proposed development were identified from their sources that include: projects activities; equipment; processes; materials against their main receptors that includes the baseline environmental and social condition all with respect to the four phases of the project cycle which include the Design, Construction, Operation and Decommissioning phase. The evaluation approach implemented in this study is a Receptor-Specific Analysis approach addressing the various sources of impacts from the project's different implementation phases.

Assessment of the identified potential impact was done by developing a criterion that was used to determine the severity of the impact identified in terms of significance, duration, reversibility, likelihood of occurrence and geographical extent.

Some of the impacts identified and mitigation measures are summarized in Table 0.1 below

Table 0.1: Summary of Project Impacts

Environmental and Social Impact	Mitigation Measures
Biodiversity (Flora, Fauna, Soil Characteristics)	• Rapid regeneration of plant cover must be encouraged by setting aside topsoil during earthmoving and replacing onto areas where the reestablishment of plant cover is desirable to prevent erosion if it was necessary. • Implement a tree planting program within the well site boundary to offset loss of trees due to the construction phase • Work areas should be clearly defined and demarcated, where necessary to avoid unnecessary disturbance on areas outside the development footprint • Ensure protection of important resources by establishing protective buffers to exclude unintentional disturbance • Providing soil erosion control structures on the steeper areas of the site & controlling activities during the rainy season • Manage storm and flood flash water effectively to avoid movement of loss soils. • Vehicles coming into the site must use designated roads • Education on the importance of flora and fauna in the areas, including the appropriate regulatory requirements • Develop a plan for control of noxious weeds and invasive plants that could occur as a result of new surface disturbance activities at the site. The plan should address monitoring, weed identification, the manner in which weeds spread, and methods for treating infestations • If possible, schedule operations during least sensitive periods such as species migration periods, nesting and mating seasons. March to August is the peak turtle nesting season in Lamu. Throughout a nesting season females may come back to nest up to five to eight different clutches of eggs on the same beach with up to 150 eggs in each clutch, with 12-15 days apart. They then migrate back to their feeding grounds after this to come back for the same experience two to three years later. However, the proposed drilling programme will be carried out onshore.
Water	**Water Consumption** There are several options in sourcing freshwater to reduce impact of sourcing freshwater in the island: 1. Filling barges with water from water stations or rivers on the main land (e.g. Tana River), Malindi or Mombasa; and transporting to Pate Island. 2. Building a storage pit which can be filled with freshwater before commencement of the project, which can act as an available reserve to minimize possible over abstraction with the local supply 3. Drilling a bore hole to tap in to aquifer of Vumbe wells in the mainland 4. Locating a local source that is acceptable with the local community 5. Treating sea water through a reverse osmosis process

	Waste Water 6. Wastewater can be recycled and used in the drilling process, domestic effluent can also be treated and recycled and sludge from site for safe disposal at a designated disposal site. 7. In the management of black and grey water, the proponent can dispose of the waste using the three methods below: 1. Use of a septic tank of sufficient capacity to accommodate anticipated crew numbers 2. Kitchen waste water will be channelled through a grease trap before going into the septic tank 3. Kitchen sinks, wash basins and drains shall be permanently equipped with gratings to retain soils and avoid conduction line clogging 8. Where possible rain water can be used in the drilling process. If pit water is deemed uncontaminated it can be pumped offsite or reused as irrigation water for restoration of the site perimeters.
Waste Generation	• Establishing a waste management plan such as: o Terms on waste collection schedule and disposal by waste handler credited by NEMA o Training of site personnel in proper waste management and chemical handling procedures o Provision of suitable facilities for the collection, segregation and safe disposal of the wastes. Waste should be segregated in terms of recyclable, reusable, biodegradable, non- biodegradable and providing equipment for handling waste o Regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors
Air Quality	• Sprinkling water periodically when operations are under way to prevent raising of dusts • Impose and enforce speed limits and provide driving guidelines for vehicle operators • Sensitize truck drivers to avoid unnecessary racing of machinery engines at loading, offloading sites, and parking areas and encourage them to keep the vehicle engines off at these points. • Use of low sulphur fossil fuel. • Regular maintenance and services of machines and engines • Educate and raise awareness to construction workers on emission reduction and emissions that are likely to occur. • Provide workers with appropriate Personal Protective Equipment (PPE) such as dust masks.
Noise and Vibration	• Inform local residents beforehand, via notices and advisories, of pending noisy periods and solicit their tolerance well before the commencement of any activities

	• Machinery should be maintained regularly to reduce noise resulting from friction during operations • Using modern machinery equipment with noise suppressing technologies in order to reduce the noise-rating as much as possible • Locate all stationary construction equipment (i.e. compressors and generators) and exploratory wells as far as practicable from nearby residences and other sensitive receptors • Provision of warning signs should be made at the gate warning of construction activity and heavy machinery turning • A grievance procedure will be established whereby noise complaints by neighbours are recorded and responded to • Workers to be provided with PPE such as earmuffs and be trained on how to use them when operating in noisy environment.
Occupational, Health and Safety	• Provide workers with appropriate PPE such as goggles, gloves, hard hats, overalls, ear muffs, dust mask among others • Employing an Occupational safety and health (OSH) plan that will outline all OSH risks and provide a strategy for their management • Maintain on site a record of incidents and accidents • Placing signs around where there are risks. Signs should meet international standards and should be in English and Kiswahili for easy understanding • The well pad should be cordoned off and there be security in and around the site to control the movement of unauthorized personnel and thereby protect the general public from dangers associated with the operations • Provision of warning signs warning of construction activity and heavy machinery turning. • Providing firefighting equipment, in easily accessible areas and ensuring site personnel are well trained to use them as well as maintaining them regularly • Raising awareness, educating workers on risks and use of equipment; animal species and habitats found in the area and their risks; first aid training. • Have a malaria management plan in place • Providing safe and secure storage for equipment and materials in the site and maintaining Material Safety Data Sheets (MSDSs) • Establishing emergency procedures against hazards and ensuring the workers stay aware/educated on following them and commensurate to the magnitude and type of emergency, by conducting regular drills and involving the neighbours.
Social Impacts	• Grievance Mechanism will be in place to resolve any employment and local supplier-related grievances. • Where feasible look into vocational training programs for the local workforce to promote development of skills required by the oil and gas industry • Develop and implement a Health Risk Assessment and a workforce management plan for the local workforce.

Traffic	• Issue notices/advisories of pending traffic inconveniences and solicit tolerance by local residents before the commencement of construction works • Flagmen/road marshals should be employed to control traffic and assist mobilization vehicles as they enter and exit the project site • Ensuring that all drivers for the project comply to speed regulations • Ensure all vehicles and machinery used for the project are in good working conditions both legally and are commensurate to the intended use. • Prepare an access road siting study and management plan to guide road design, construction, and maintenance standards, and to allow for successful interim and final reclamation. (For example, require operators to coordinate closely with the local governments responsible for maintaining roadways providing access to the project area. Compare the number, size, and weight of loads to service projects to the existing road infrastructure to determine if roads and bridges are adequate to support intended loads. Consider routing project traffic to minimize impacts on local residents.)
Visual Impact	• During construction of the well pads, existing vegetation around the perimeter of the site should be maintained to minimize views into the site. Following construction, natural vegetation should be restored in none operational areas of the site and/or additional landscape planting with local indigenous species used to improve views into the site • Consider site-specific landscaping in selected area to provide screening for resident whose property abuts the project • Ensure good housekeeping of the site in order to create a positive image in the eyes of the public • External lighting shall be as unobtrusive as possible and shall be shielded and directed downwards to prevent side spill. The use of tall mast lights shall be carefully assessed before being used due to proximity of fauna and residential areas • Consider site-specific landscaping in selected area to provide screening for resident whose property abuts the project
Chemical, waste or oil spill	• Requirements of oil spill and emergency plans must be met before operations commence. • Apply spill prevention practices and response actions in refuelling and vehicle-use areas to minimize accidental contamination of habitats and soil. • Address spills immediately per the appropriate spill management plan, and initiate soil clean-up and soil removal if needed. • Containerize spent oils and lubes for appropriate disposal or recycling. • Containerize contaminated soils that cannot be treated in situ and remove off-site for treatment

Project alternatives

A “No Action” alternative was determined to be unwarranted because the proposed program, which is required by agreement between Zarara Oil and Gas Limited and the Government of Kenya and is consistent with national economic development objectives into attaining vision 2030, can clearly be executed with little measurable environmental impact. Other alternatives such as site location, layout, project inputs and design were also considered.

Environmental and Social Management Plan (ESMP) and Project Monitoring

An environmental and social management plan (ESMP) has been developed to manage the identified potential impacts and to keep the impacts at an acceptable level throughout the projects lifecycle.

Conclusion and recommendations

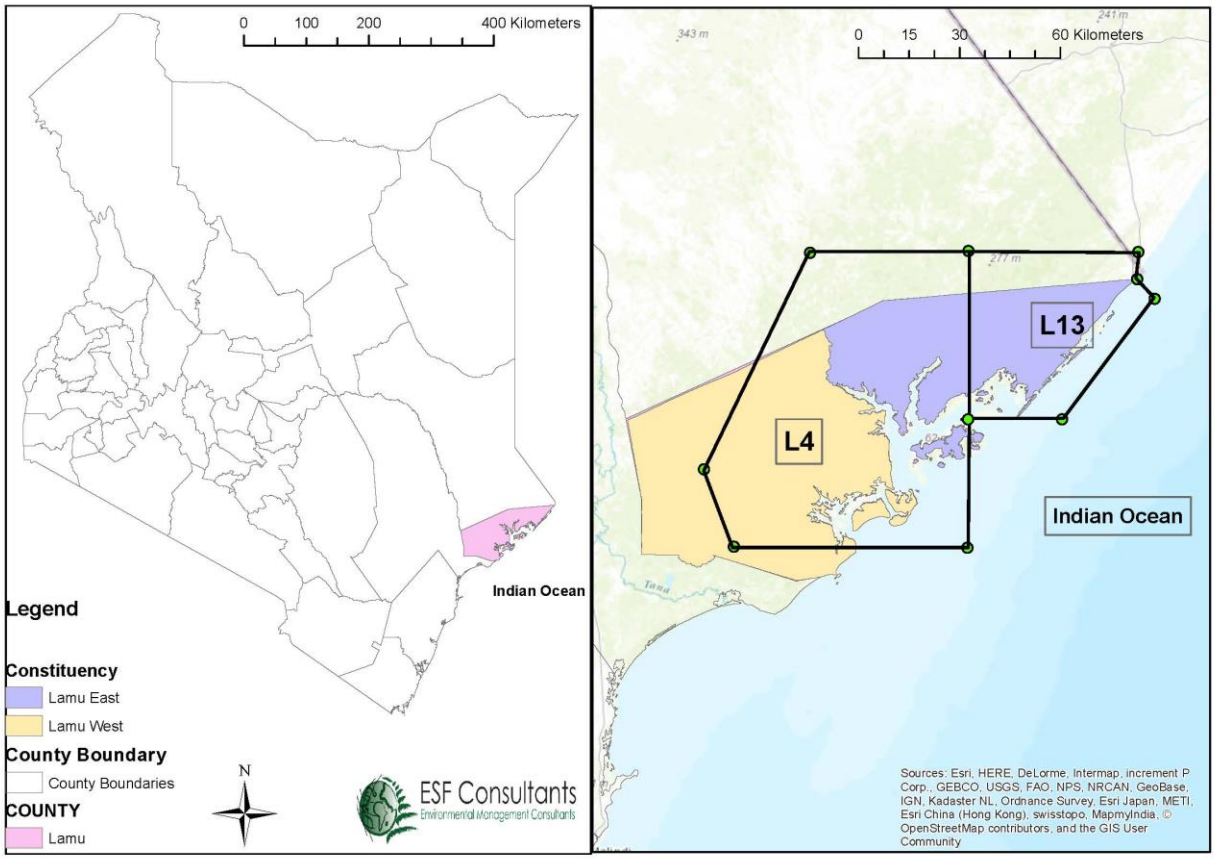
The study finds the project is acceptable if the identified and developed management plans and practises are implemented accordingly. It also recommends appropriate monitoring of the project development and operational activities to ensure that adverse impacts that were unforeseen are identified and addressed in a timely fashion. Subsequent projects that might arise as a result of this project should undergo environmental assessment and permitting with NEMA as a prerequisite for any development undertaking. NEMA is advised to license th e project since it is a viable project.

1.0. INTRODUCTION

1.1 Project Background

Zarara Oil and Gas Limited (Zarara) is wholly owned subsidiary of Midway Resource International and operator with a 75% working interest in Blocks L4 and L13 (as illustrated in Figure 1.1 below).

Figure 1.1: Location on Block L4 and L13 in Lamu County



Source: ESF Consultants

Zarara is the Operator of Blocks L4 and L13, with a shareholding with two other companies as represented in Table 1.1. Two Production Sharing Contracts (PSC) were signed on the 3rd December 2008 with SOHI-Gas Lamu Limited for a 90% interest in Block L4 and SOHI-Gas Dodori Limited for a 90% interest in Block L13, collectively SOHI with the balance of 10% being a carried interest for the Government of Kenya through to commerciality. The PSCs were for an initial three-year exploration period, which have been extended on two occasions through to 3rd June 2017. The PSCs contain minimum work programmes of two-dimensional (2D) and three-dimensional (3D) seismic, together with a high resolution ground magnetic and gravity survey over the Pate structure and the drilling of one exploratory well to a minimum vertical depth of 4,500 m. On 4th April 2011, SOHI farmed out its interests to Zarara Oil and Gas Limited

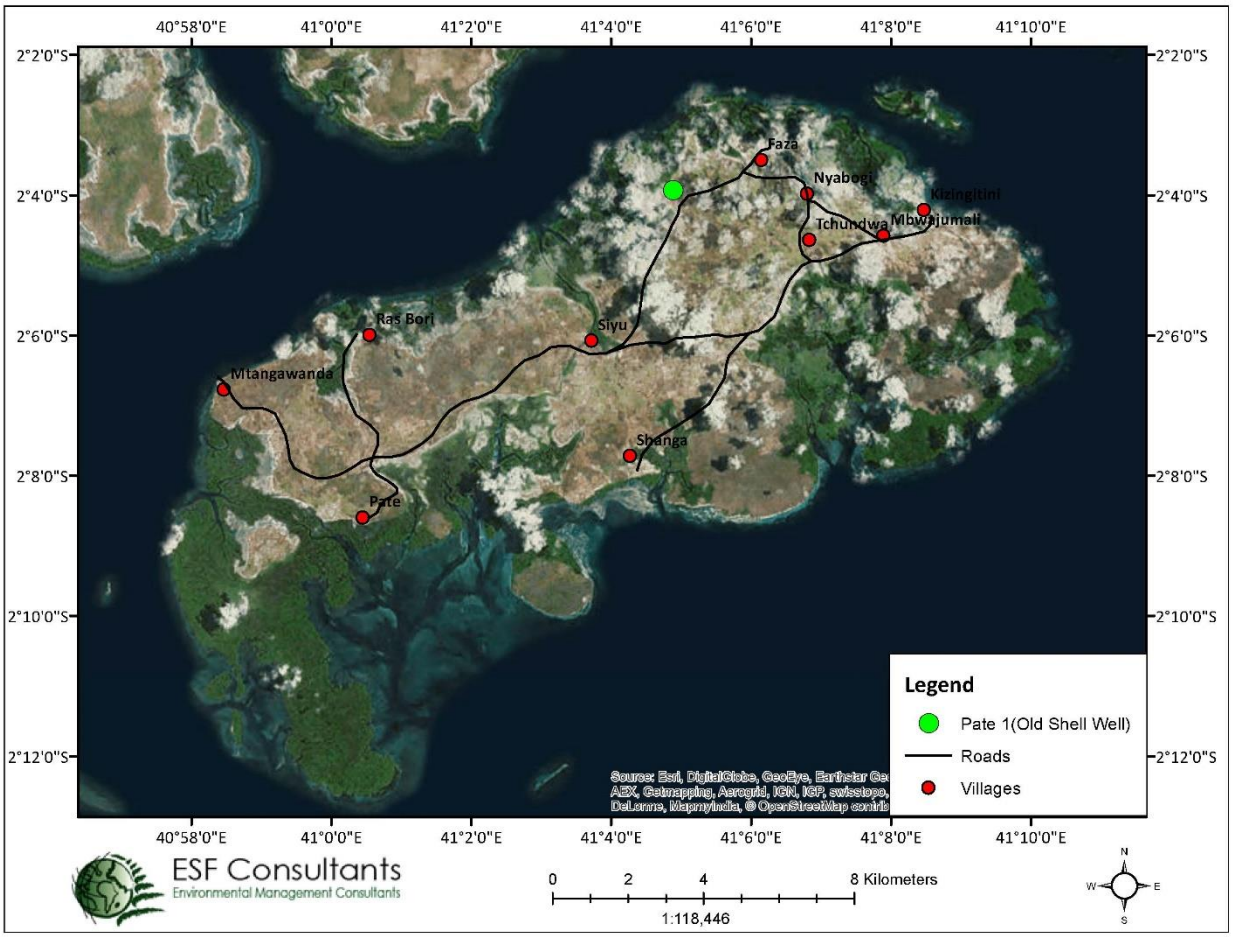
(Zarara), whereby Zarara, committed to fund the minimum work programme for a 75% interest in the blocks from SOHI.

Table 1.1: Current shareholding interest for oil blocks L4 and L13

Company	Equity (%)
Zarara (Operator)	75
SOHI	15
Government of Kenya	10

Zarara plans to undertake a hydrocarbon exploration drilling programme on Blocks L4 and L13 in Lamu County to further explore and appraise the gas discoveries made by Shell in the 1970s (see Figure 1.2), which encountered high-pressure gas, but in an unknown quantity and quality as the well did not fully penetrate the reservoir section and was neither logged nor tested due to technical problems whilst drilling.

Figure 1.2: Location of Pate 1 - Shell Well

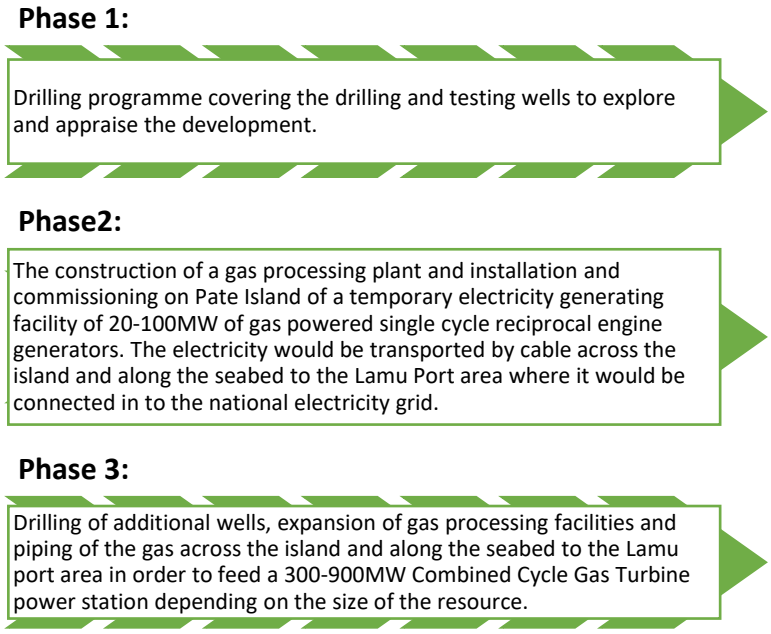


Source: ESF Consultants

In 2012, Zarara conducted a 6,200 kilometres (km) high resolution airborne magnetic and gravity survey in order to produce a regional map of the main depocentres where hydrocarbons may be generated thereby permitting a more optimised location and orientation of the 2D seismic lines over prospective structures in the blocks. In 2013, Zarara acquired 400 km of 2D seismic, interpretation of which enabled more detailed maps to be produced. These surveys together with past seismic, well log and past geological interpretations have been integrated by Zarara, as Operator, to estimate the potential resource and define the drilling targets for the drilling campaign.

Zarara plans to commercialize the prospect in a phased approach as illustrated in Figure 1.3. In this regard, Zarara has appointed Environnementalistses Sans Frontieres (ESF) Consultants Ltd, to conduct an Environmental and Social Impact Assessment (ESIA) to cover Phase 1 of the project; that is, Exploratory Drilling Programme.

Figure 1.3: Zarara proposed business plan in a phased approach



1.1. The ESIA Study

This ESIA study was undertaken under requirements of Environmental Management and Coordination Act (EMCA) of 1999 schedule II as stipulated by National Environment Management Authority (NEMA) through the Environmental Impact Assessment (EIA) regulations.

The ESIA was also conducted in accordance to international agreements and conventions; International Best Practices such as International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability 2012, Equator Principles III 2013; and World Bank Groups Environment, Health and Safety General Guidelines and on Onshore Oil and Gas Development.

The aim of this ESIA study is to examine both the positive and negative effects that the proposed project is likely to have on both the physical and the socio economic environment. Early identification of possible

impacts promotes environmental sustainability in that, anthropogenic factors do not interfere with natural environment but blend with it creating harmony. This study is important because it plays the following roles:

1. **Acts as a planning and management tool**: the ESIA is an important planning and management tool for the project proponent as it will state any significant project effects and clearly defined mitigation measures to avoid or curb adverse impacts.
2. **Acts as a reconciliatory tool**: the ESIA process helps to bring together various lead agencies, which can shed some light on a proposed activity and possible conflicts or conflict situations and give a forum for dealing with such situations in advance before a project is implemented.
3. **Acts as an advisory tool**: the ESIA process helps to advise any project proponent on whether or not a project is viable enough to be implemented while relying on the environmental base as the foundation for its existence.

1.3 ESIA Methodology

The ESIA Study will cover the following aspects:

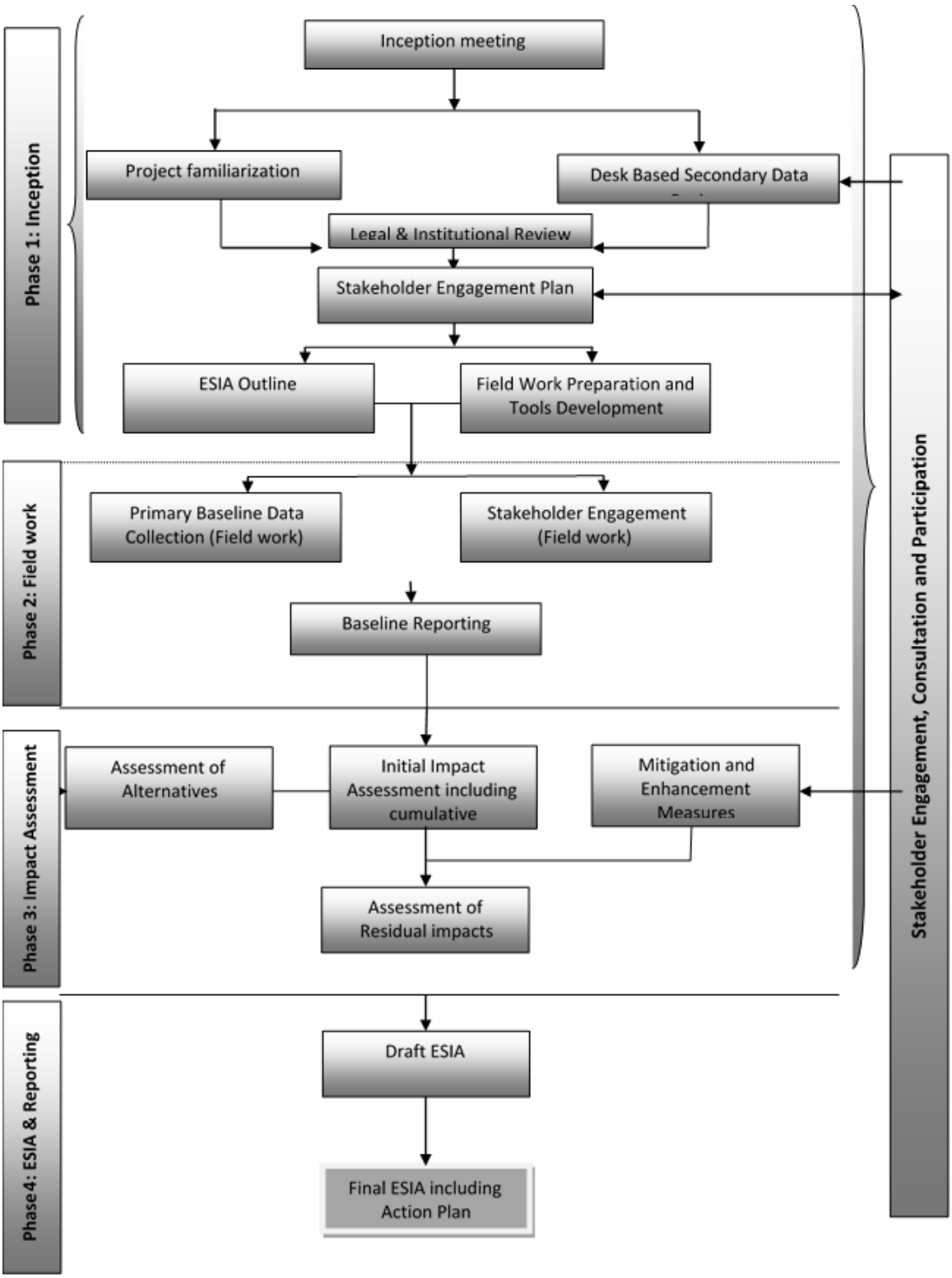
1. Establish the existing environment where the project falls
2. Define the legal, institutional and policy framework of the proposed project
3. Analyse the potential impacts of the proposed project
4. Analyse the alternatives to the proposed project
5. Develop accurate and practical mitigation measures for the significant negative impacts
6. Develop an Environmental and Social Management Plan (ESMP) for the significant negative impact
7. Identify, consult and involve all stakeholders to facilitate all study objectives

To achieve these objectives, the study collected baseline data firstly through desktop studies on a: national level; regional and then finally scoping down to the study area and its immediate environs. This is done using detailed study, information from previous similar studies, developed checklist and professional knowledge. The checklist focused on information gained from the screening process and other cross-sectorial issues such as: health and safety, biodiversity, pollution etc.

Several methods and processes were undertaken to enable the achievement of the study's objectives. The ESIA process that was employed is depicted in

Figure 1.4.

Figure 1.4: ESIA Process



Some of the specialist studies that were carried out during the field baseline survey include:

- Ecological Survey
- Socio-economic Survey
- Hydrogeological Survey
- Ambient Air Quality Assessment
- Traffic Survey
- Noise Assessment

1.4 ESIA Team

ESF Consultants is registered by NEMA (Registration Number 0204). The ESIA team members who took part in the study comprised of the following:

Table 1.2: ESIA Team Members

Name	Position	Qualification	NEMA Registration Number
James Kambo	Team Leader / Projects manager	MSc in Environmental Planning and Management	0713
Duncan Oyaro	ESIA Specialist	MSc in Environmental Planning and Management	0159
Dorothy Suleh	Environmental Consultant	MSc Environmental Assessment and Management	7066
Linet Mbova	Public Consultation and Participation Specialist	BSc Environmental Science	6374
Dan Odera	Hydrogeologist	Msc Hydrogeology	
Godfrey Wafula	Air Quality Assessment	Msc Environmental Chemist	
Anthony Kiovi	Environmental Consultant	BSc Environmental Science	7324
Lameck Okeyo	Environmental Consultant	BSc Environmental Planning and Management	6970
Michael Kiboi	GIS Specialist	BSc Environmental Science	7435

1.5 Report Structure

The structure of this ESIA Report is as follows:

- Executive Summary
- Introduction (Chapter 1)
- Project Description (Chapter 2)
- Analysis of Alternatives (Chapter 3)
- Policy, Institutional and Legal Framework (Chapter 4)
- Environmental and Socio-economic Baseline (Chapter 5)
- Public and Stakeholder Consultation (Chapter 6)
- Impact Assessment and Mitigation Measures (Chapter 7)
- Environmental and Social Management and Monitoring Plan (Chapter 8)
- Conclusion and Recommendations (Chapter 9)
- Reference
- Appendices

2.0. PROJECT DESCRIPTION

This Chapter provides a description of the key Project components and details regarding activities throughout the life of the Project.

2.1. Project Background

Zarara's business plan is to commercialise the prospect in a phased approach. Phase I is a drilling programme covering the drilling and testing of wells to explore and appraise the resource potential. Zarara plans to undertake a hydrocarbon exploration drilling programme on Blocks L4 and L13 in Lamu County to further explore and appraise the gas discoveries made by Shell in the 1970s which encountered high-pressure gas, but in an unknown quantity and quality as the well did not fully penetrate the reservoir section and was neither logged nor tested due to technical problems whilst drilling.

In 2012 Zarara conducted a 6,200 km high resolution airborne magnetic and gravity survey in order to produce a regional map of the main depocentres where hydrocarbons may be generated thereby permitting a more optimised location and orientation of the 2D seismic lines over prospective structures in the block. In 2013, Zarara acquired 400 km of 2D seismic, interpretation of which enabled more detailed maps to be produced. These surveys together with past seismic, well log and past geological interpretations have been integrated by Zarara, as Operator, to estimate the potential resource and define the drilling targets for the drilling campaign.

2.2. Project Location

Figure 2.1 and Table 2.1 show the coordinates for Blocks L4 and L13.

Figure 2.1: Oil Blocks Coordinates

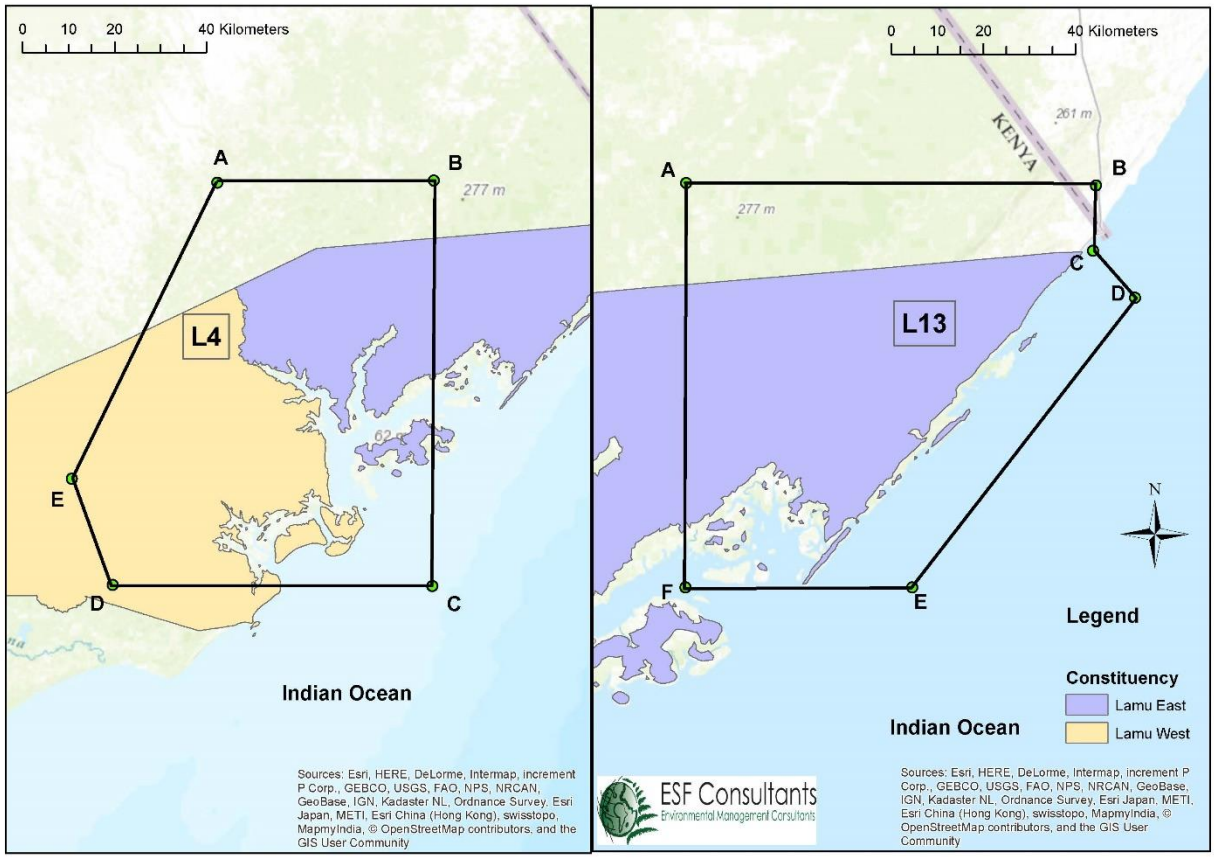


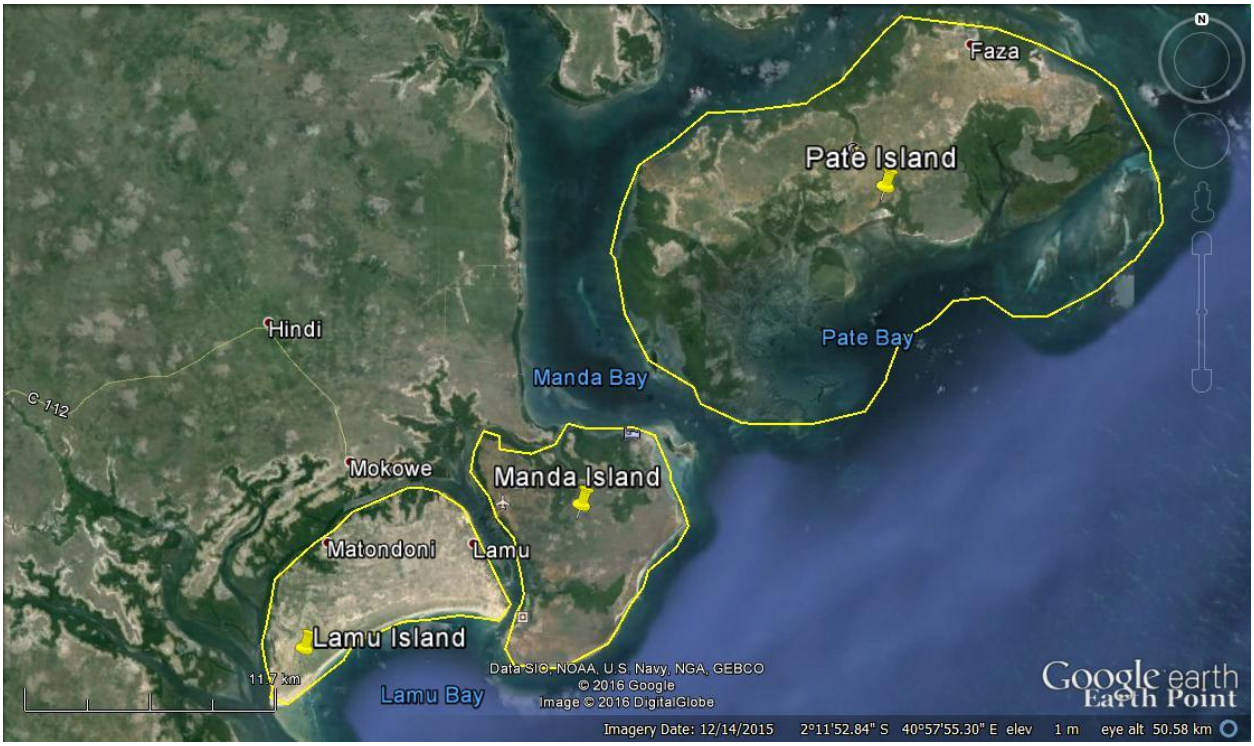
Table 2.1: Oil Blocks Coordinates

Oil Block	Point	Oil Blocks Coordinates
Block L4	A	1°35'14"S, 40°42'2"E
	B	1°34'57.30"S, 41° 7'22.62"E
	C	2°22'41.40"S, 41° 7'16.68"E
	D	2°22'36.97"S, 40°29'49.68"E
	E	2°10'7.7"S, 40°25'0.3"E
Block L13	A	1°34'57.30"S, 41° 7'22.62"E
	B	1°35'5.19"S, 41°34'38.33"E
	C	1°39'26.86"S, 41°34'27.79"E
	D	1°42'35.9"S, 41°37'15.9"E
	E	2°2'0"S, 41°22'26.6"E
	F	2° 2'1.02"S, 41° 7'21.22"E

The location of the exact drill site in the focus areas depends on the characteristics of the underlying geological formations as shown by seismic data. It is generally possible to balance environmental considerations with logistical needs and the need for efficient drilling. However, it is known that the hydrocarbon exploration drilling programme will concentrate in Pate Island as shown in Figure 2.2. The

scope of work will cover the drilling of two wells on Pate Island, with the option to drill up to two additional wells to further appraise the prospect.

Figure 2.2: Location of the three islands in Lamu County



2.3. Exploratory Drilling Components

Exploratory drilling is a temporary and short duration activity and includes site preparation, equipment assemblage, well site and drilling pad construction, erection of the rig, drilling, testing and restoration of the well site. In the event that potentially commercial volumes of hydrocarbons are discovered additional exploration wells and/or appraisal wells are likely to be drilled in the future to provide greater information on the likely nature and scale of the hydrocarbon resources.

Mobilization and establishment will involve transportation to the project site of the drilling rig, drill pipe, casing, camp and other supporting equipment, drilling materials and consumables including fuel, drilling mud, among others.

2.3.1. Accessibility and Transportation

During this phase the drilling rig and ancillary drilling equipment will be transport by ship or barge from the ports of Mombasa to Pate Island. Consumables and ancillary equipment will be sourced locally to the extent possible. These equipment and materials will be landed on Pate Island by barge using the Jetty at Mtangawanda or on the adjacent beach and transported to the drill site by road using truck. Figure 2.3 below shows the locations of Mtangawanda Jetty and the road systems in Pate Island.

Figure 2.3: Map showing location of Mtangawanda Jetty and Main roads in Pate Island

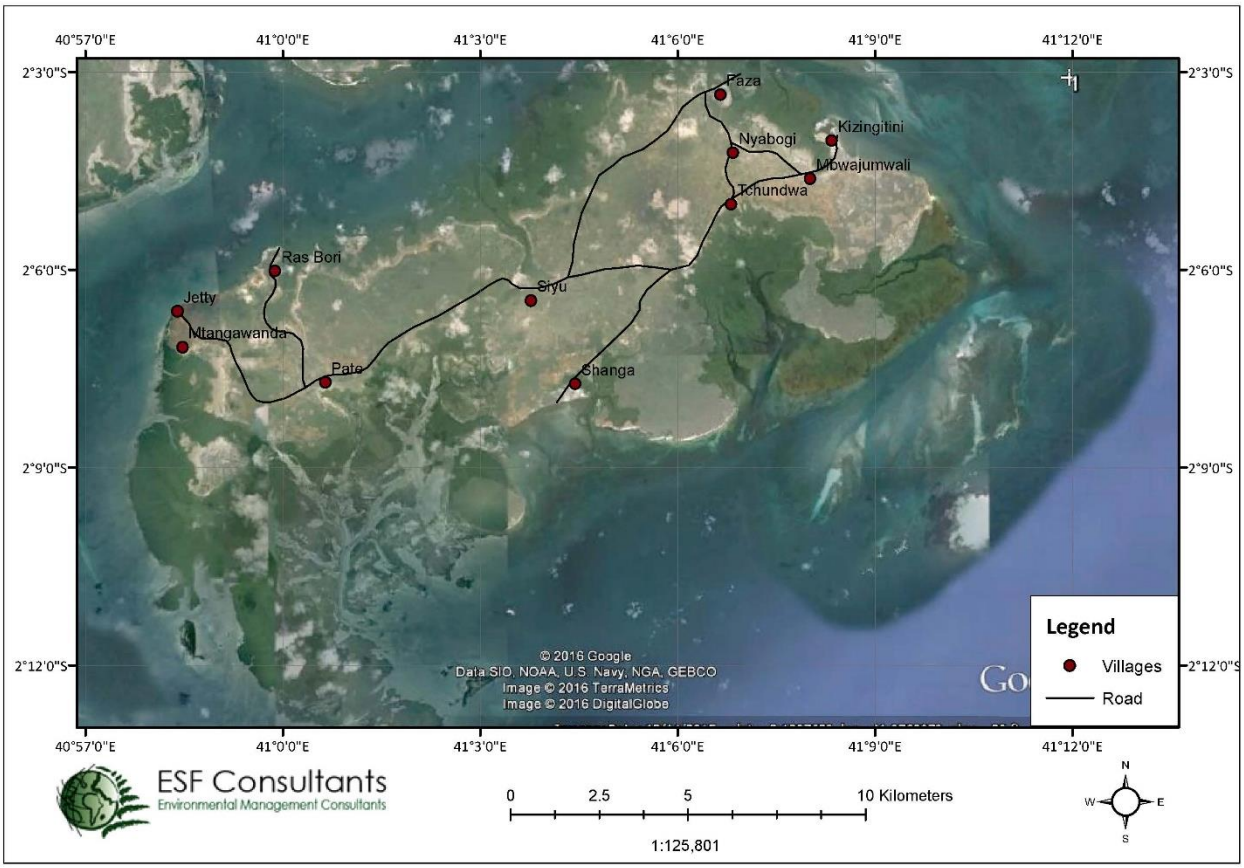

40°57'0"E
41°0'0"E
41°3'0"E
41°6'0"E
41°9'0"E
41°12'0"E
2°3'0"S
2°6'0"S
2°9'0"S
2°12'0"S
Paza
Kizingitini
Nyabogi
Mowajumwali
Tchundwa
Ras Bori
Siyu
Jetty
Mtangawanda
Pate
Shanga
© 2016 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2016 TerraMetrics
Image © 2016 DigitalGlobe
Legend
Villages
Road
ESF Consultants
Environmental Management Consultants
0
2.5
5
10 Kilometers
1:125,801
N
W
E
S

Figure 2.4 shows the current jetty in Mtangawanda. This jetty is small and can be used to offload the light loads at the right tide. The heavier cargoes will be offloaded at the adjacent beach (Figure 2.5).

Figure 2.4 Mtangawanda Jetty

Figure 2.5: Adjacent beach to Mtangawanda Jetty

There is one main road connecting Mtangawanda to Faza and Kizingitini. Some of the access roads in Pate Island were created during the seismic period, which the community members requested to be left. There will be approximately 5 – 10 trucks transporting material to and from Mtangawanda Jetty to the project

site. The trucks will carry approximately 150-200 truckloads of equipment: carrying loads weighing approximately 20-40 tonnes. Due to the heavy nature of the equipment, where necessary roads will be upgraded and jetties, bridges and drainage and culverts will be strengthened and reinstated. Figure 2.6 below shows the current status of the road from Mtangawanda Jetty, which is an earth road.

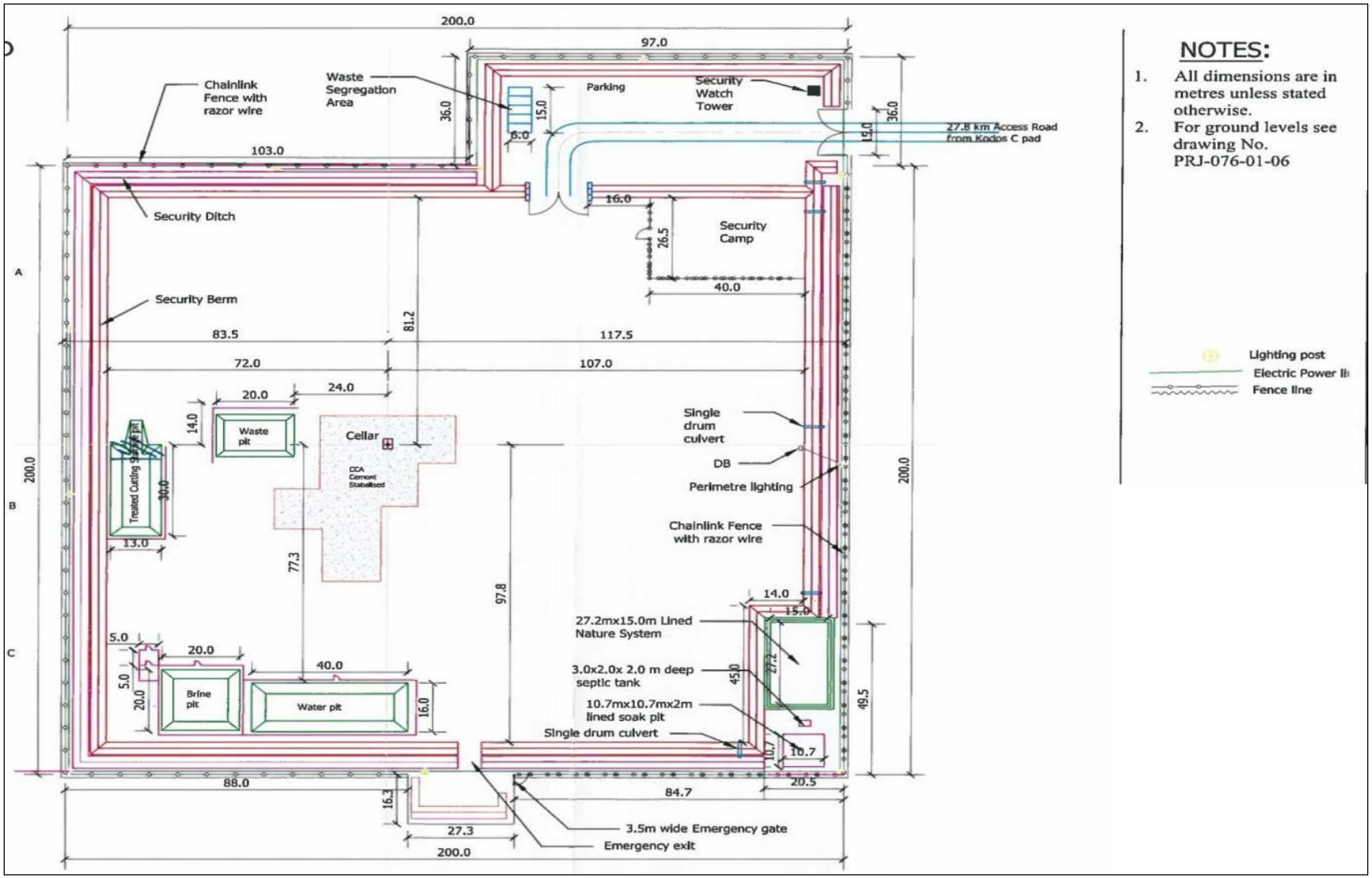
Figure 2.6:Road leading into Pate Island from Mtangawanda Jetty

2.3.2. Well Pad Layout

A well pad will be constructed at the drilling site to accommodate the following, but not limited to: the rig, ancillary drilling equipment, accommodation and offices, among others and it will cover an area of approximately 200 metres (m) by 200m. The camp will hold approximately 120 people, both workers and contractors. The mobilisation and establishment phase is expected to last up to 60 days.

Figure 2.7 below shows a typical layout of a well pad. The type of well pad to be contracted will depend on terrain, soil conditions, and seasonal constraints.

Figure 2.7: Well pad Layout



2.3.3. Water Requirements

A land well is normally drilled with freshwater; however, this is dependent on the abundance of fresh water supply in the area. Maximum expected water usage for each well is 3,180,000 litres.

There are several options in sourcing freshwater:

1. Filling barges with water from water sources or rivers on the main land (e.g. Tana River, Malindi or Mombasa) and transporting to Pate Island.
2. Building a storage pit which can be filled with freshwater before commencement of the project, which can act as an available reserve to minimise possible over abstraction with the local supply.
3. Locating a local source that is acceptable with the local community.
4. Drilling a bore hole to tap in to aquifer of Vumbe wells in the mainland

The best options we would recommend to be used during this project would be sourcing water from Malindi or Mombasa and transported to Pate Island via barge.

2.3.4. Power and storage requirement

The drilling process requires rotation of a drill bit through the draw works which requires power. This power will be provided by generators (Caterpillar SR4 1500KVA x 4 or equivalent). A major part of the fuel will be consumed by the Rig and the rest by the base camp. A temporary fuel storage facility at the site will be constructed with a maximum storage capacity of $100m^3$.

Other chemicals and equipment used in the site such as cement and drilling mud will also require safe storage.

2.3.5. Labour Requirements

The camp will hold approximately 120 people. The drilling contractor and Zarara are expected to employ and train residents from the island or immediate areas. The locals will be contracted to undertake manual work throughout the project cycle. Initially, local personnel will be involved in the functions requiring little previous experience. However, as the drilling program progresses, locals will be trained to undertake more skilled activities.

2.4. Well Drilling and Operation

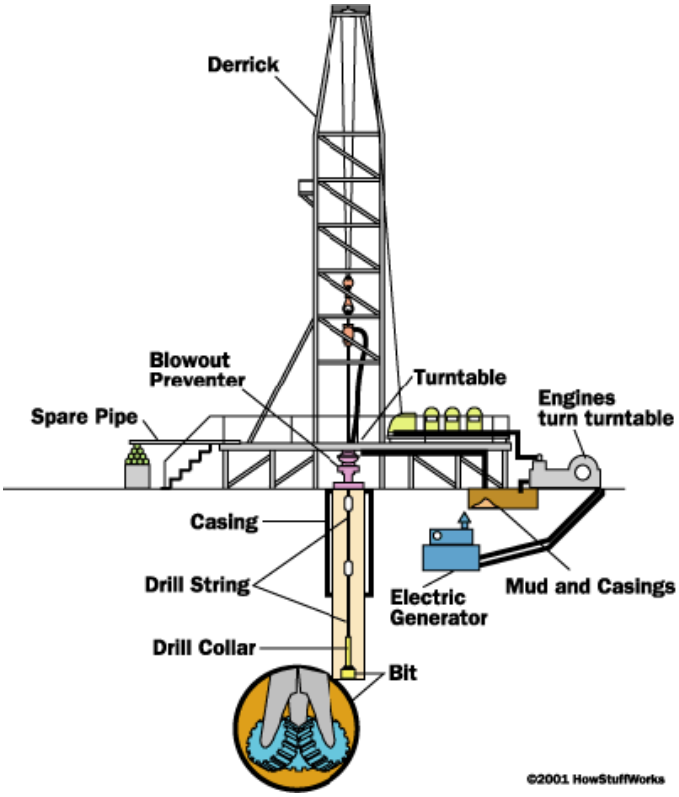
The initial well will be a vertical well to a target depth of 4,600 metres and broadly twin the exploration well Pate -1 drilled by Shell in 1971. Assuming identification of the expected levels of hydrocarbons, a further 1 to 4 appraisal wells will be drilled as part of this campaign. These will use deviated drilling to a vertical sub surface depth of between 4,000 and 4,500 metres or vertical wells from separate well pads. The drilling process of one well is expected to take 3 months.

2.4.1. Drilling Process

Once the land has been prepared, several holes are dug to make foundations for the rig and the main well hole. A rectangular pit, called a cellar, is dug around the location of the actual drilling hole, which provides a work space for the workers and drilling accessories. Drill bits, attached on a drill string, that vary in size

are used to drill the hole in the ground. When these holes are finished and the Derrick (rig mast) erected, the rig equipment can be brought in and set up**.** The first part of the hole is larger and shallower than the main portion, and is lined with a large-diameter conductor pipe. Figure 2.8 below shows a typical structure of a drilling rig.

Figure 2.8: Drilling rig



Once the hole extends to a reasonable depth the drill pipe is removed and replaced with steel pipe called, surface casing (Figure 2.9 shows an example of a casing used in the drilling process). Cement is then added around the sides of the well to permanently set the casing in place: this process has been illustrated in Figure 2.10 below. Casing will be used to provide structural support and isolate underground rock formations to prevent natural gas or other substances from leaking out into any surrounding freshwater aquifers, and to facilitate movement of equipment up and down the hole.

Figure 2.9: Example of casing used in the drilling process

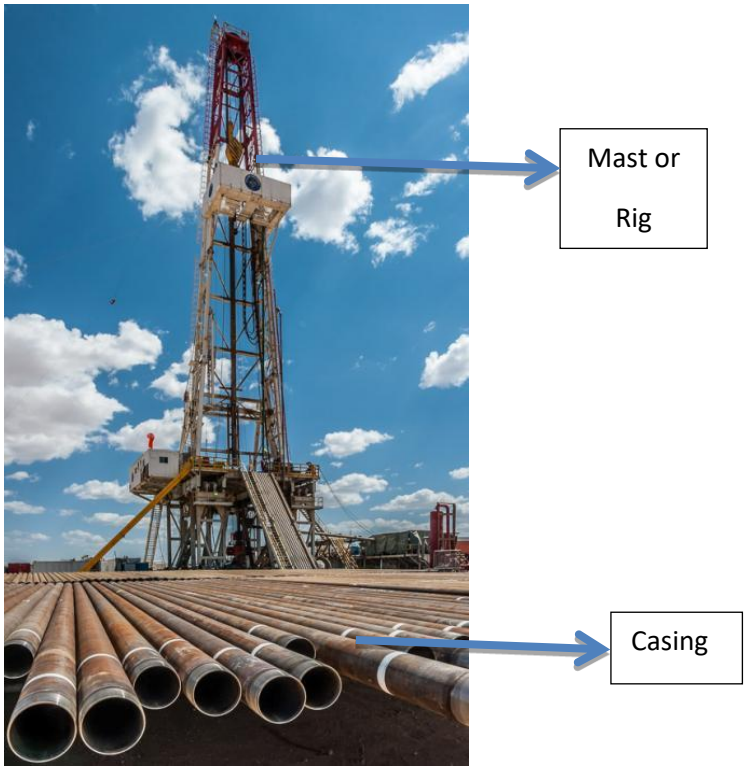
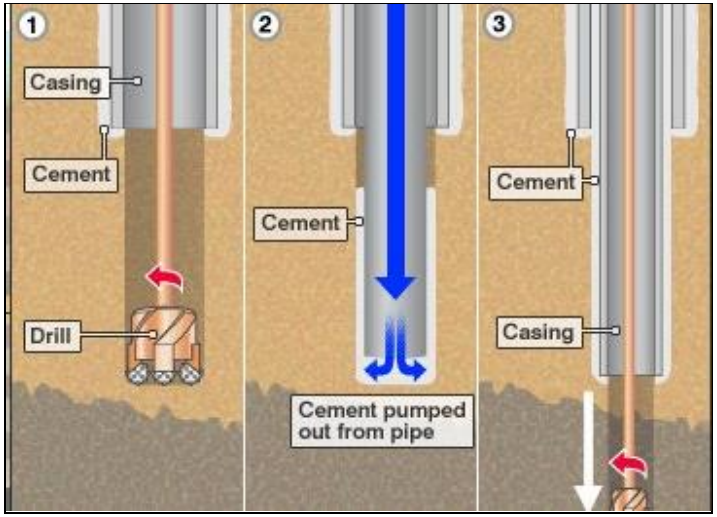


Figure 2.10:How cement and casing is placed in drilling well



2.4.2. Well Control

Primary Well Control: Drilling Mud

Primary well control is the control of pressure in the rock by using the weight of the drilling mud that is pumped into the well. The drilling mud prevents gas and fluids from the rocks from flowing into the well, it lubricates the drill bits and moves broken rock (cuttings) out of the way.

During drilling, drilling mud will be continuously circulated down the drill pipe and back to the surface to[1]:

a. Facilitate the drilling process by suspending cuttings
b. Balance underground hydrostatic pressure
c. Providing buoyancy
d. Cool the bit
e. Flush out cuttings

The drilling mud is mixed and stored in the mud tanks on the surface. Large, powerful mud pumps will suck the mud from the surface and pump it down in the drill string and out through the nozzles in the drill bit. The mud jetting out from the nozzles of the drill bit will then be pumped back to the surface through the annular space between the wellbore and the drill string. Back at surface, the mud flows from the well, via the flow line, to the shale shakers where the pieces of rock cut by the drill bit ("drilled cuttings") are separated from the mud, the mud is then further treated through other 'solids control equipment' to remove fine solids from the well and remove any gas. After this process the clean mud is then passed back into the mud storage tanks ready to be recirculated back into the well.

There are three different types of drilling mud used in the drilling process, which are:

1. **Water Based Mud (WBM)-** Most basic water-based mud systems begin with water, then clays and other chemicals are incorporated into the water to create a homogeneous blend resembling something between chocolate milk and a malt (depending on viscosity).
2. **Oil Based Muds (OBM)** - Oil-based mud is a mud where the base fluid is a petroleum product such as diesel fuel.
3. **Synthetic Based Muds (SBM)** - Environmentally-friendly organic-based muds using a base fluid produced from natural gas, or processed base oil or natural (non-petroleum) oils which are non-toxic and quickly biodegradable, such as the synthetic-based mud.

This proposed project will be using WBM which has:

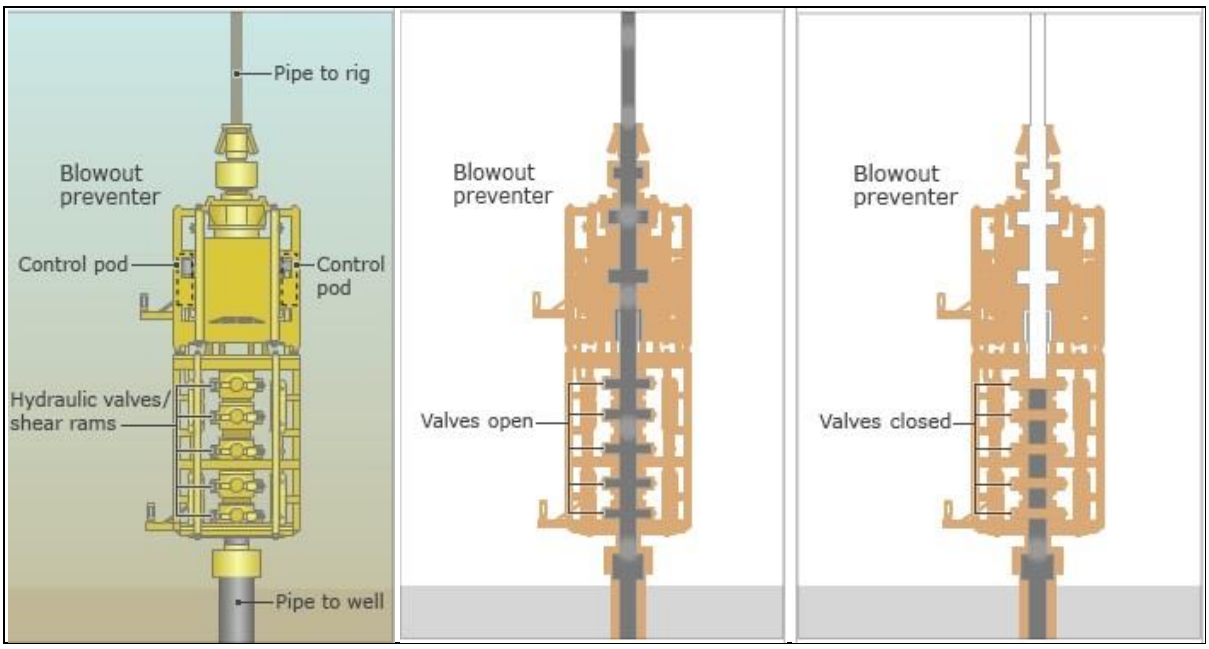
a. less environmental impacts
b. less costs associated with cuttings, contaminated fluid disposal and tank cleaning on rig
c. The kick detection is easier as gas does not readily dissolve in water
d. Easier to get good cement bonding to casing and formation

[1] International Union for Conservation of Nature (IUCN). 1993. *Oil and Gas Exploration and Production in Artic and Subartic Onshore Regions: Guidelines for Environmental Protection.* Oxford, UK: Words and Publications

Secondary Well Control: Blow-out Preventer (BOP)

This measure is used if pressure of the formation fluids exceeds the hydrostatic pressure of the drilling mud. To prevent the risk of uncontrolled flow from the reservoir, a BOP is used to reduce the risk by sealing the off the well. The BOP is normally installed on the well head on the top of the surface casing and other strings of the casing are suspended from the wellhead. When the pressure caused by the weight of the column of the drilling mud in the well is less than the pressure of the fluid in the pore space of the rock, then the drilling mud will be unable to hold back the pressure in the rock and the fluid will flow from the rocks into the well. When this happens the BOP will close to prevent the flow of the fluids from the well. The systems control panel keeps the valves open to allow flow from the well to rig. In case of an emergency the hydraulic valves close shut on the pipes, sealing it and preventing flow.

Figure 2.11: Blowout Preventer and how it works



2.5. Waste Generation

2.5.1. Solid waste

The main sources of waste generated during the drilling campaign will be the drilling mud and cuttings; drilling rig waste; and domestic waste from the people living at the well site. From previous oil and gas exploration projects well pad with a depth of 4,500 and 5000 metres will generate approximately 300 skip loads of cuttings and drilling fluid. However, quantities of waste generated will vary depending on depth, geology, and drilling duration.

A summary of waste types, sources, and disposal options is presented in Table 2.2 below

Table 2.2: Summary of waste type, source, and disposal options

Waste Stream	Source	Additional Segregation	Disposal Procedure
Domestic waste (food, paper)	Well Pad (Camp facilities)	Food, paper	Sorted and transported by licensed waste handlers
Recyclable Materials	Well Pad	Glass, wood, cardboard, plastics, paper	Sorted and transported by licensed waste handlers or sold to recycling agents
Burnable waste	Drill rig and well pad	Oil waste, paint cans	Recycle oil where possible. Collect until sufficient inventory to be transported by licensed waste handlers.
Hazardous waste	Drill rig and well pad	Fluorescent tubes, PCB, batteries and lab chemicals	Collect until sufficient inventory to be transported by licensed waste handlers.
Scrap metal and metal drums	Drill Rig and well pad	Sorted, drums crushed	Sorted and transported by licensed waste handlers or sold to recycling agents
Spillage (fuel, oils & lubricants)		None	Collected and transported to an appropriate site for disposal.
Excess cement	Drill Rig	None	Stored to be used in other applications
Drill cuttings, mud residues, and residue from tank cleaning	Drill Rig	Drill Cuttings, Drilling mud	Treatment of the drilling mud to remove fine solids and any gases. The mud will then be stored in the mud storage tanks to be recycled in the drilling process. At the end of the drilling programme the cuttings may be used for road surfacing or construction materials. Before reuse it is necessary to ensure that the hydrocarbon content, moisture content, salinity, and clay content of the cuttings are suitable for the intended use of the material. Some cuttings, may need washing to remove dissolved salts prior to beneficial use.
Sludge	Lagoons at the well pad after treatment of grey water	None	Stored and transported to the nearest treatment works to the project site by licensed waste handlers.

The disposal method of cuttings to be used will be Potassium Acetate mud system, which limits chloride content of the disposed waste which makes it much more environmentally acceptable. The cuttings can then be dried on location and land farmed. Best management practices are as follows:

- The initial chloride concentration in the receiving soil must be less than 500 parts per million (ppm).
- The maximum chloride concentration in land-spread drilling waste must be less than 10,000 ppm.
- The waste loading rate is calculated to ensure that the final chloride concentration in the top 12 inches of soil does not exceed 900 ppm.
- No land-spreading may occur if the area is being irrigated with water containing chlorides above 350 ppm.

During the drilling of the well all drilling waste will be contained on the location A reserve pit, which is used to dispose of rock cuttings and drilling mud during the drilling process, will be constructed and lined with plastic to protect against any possible contamination. The liner will be removed at the end of the project after the residual liquids have been evaporated. The cuttings will be dried and dispersed/spread on roads.

All other domestic waste will be removed from the location and disposed in an approved disposal site.

2.5.2. Wastewater

In the management of black and grey water, the proponent will then dispose the waste using either of the three methods below:

1. Use of a septic tank of sufficient capacity to accommodate anticipated crew numbers
2. Kitchen waste water will be channelled through a grease trap before going into the septic tank
3. Kitchen sinks, wash basins and drains shall be permanently equipped with gratings to retain soils and avoid conduction line clogging

2.5.3. Produced Water

Oil and gas reservoirs contain water (formation water) that is produced when brought to the surface during hydrocarbon production. The produced water will contain a complex mixture of inorganic (dissolved salts, trace metals, suspended particles) and organic (dispersed and dissolved hydrocarbons, organic acids) compounds, and residual chemical additives (e.g. scale and corrosion inhibitors) that are added into the hydrocarbon production process.

Any produced water will be treated then trucked / piped to approved disposal ponds. The water can be used to spray on unpaved roads for dust control and reused in the drilling process.

2.6. Appraisal Drilling and Well Evaluation/ Testing

During the drilling operations for different depths logging operations are undertaken to get information on the potential type and quantities of hydrocarbons present in the target formations.

If the results of logging indicate a potential for hydrocarbon/gas bearing formations, the well may be tested. The hydrocarbons will be flowed through a test package where the pressures, flow rates, and hydrocarbon types will be characterised and sampled, and excess hydrocarbons flared. The escaping gas will be flared or vented out in the open. The gas flaring or venting will create a flame and noise from the burning of the gas. Testing is important in order to determine the pressure, flow and composition of the gas in the well. Flaring is also done for safety during emergencies, maintenance, equipment repairs; where equipment or piping becomes over-pressured. This is done to avoid risk of fires and explosions. Flare gas systems are also used to manage waste gas that cannot be efficiently captured and returned to the system for processing.

Well testing is expected to last for between 1 and 2 months per well.

If the well is successful, Zarara will aim to evaluate the size and nature of the reservoir to determine the number of development wells that may be required and whether 3D seismic survey is necessary.

2.7. Decommissioning

In case Zarara drills a dry hole, (if the well is unsuccessful), the well will be plugged with cement and abandoned. The site will be deconstructed/demolished and the site will be restored to its original state through re-vegetation and continuous monitoring.

2.8. Project Schedule and Cost

Each well is expected to take 3- 4 months to drill and there may be a standby period between drilling of each well to analyse the data results from the previous well.

Table 2.3: Project Implementation schedule

Task	Period
Rig mobilisation and establishment phase	60 Days
Drilling Process period (for 1 well)	3-4 months

The estimated total project cost is estimated to be **United States Dollar** (**USD) Fifteen Million, Seven Hundred and Four Thousand, Four Hundred and Eleven ($15,704,411).** The project cost breakdown is as follows:

Table 2.4: Budget Cost Estimate Breakdown

Budget Cost Estimate		
Line Items	**Cost Estimate (USD)**	**Cost Estimate in Kenya Shillings (Ksh)**
Civils	1,064,000	107,464,000
Rig move	2,252,000	227,452,000
Drilling Unit	2,125,530	214,678,530
Drilling Tools and Services	1,402,200	141,622,200
Mud and Cement	2,219,600	224,179,600
Wireline and Mud Logging	945,720	95,517,720
Fuel, water and lubricants	596,500	60,246,500
Transportation	338,550	34,193,550
Logistics	1,112,800	112,392,800
Project Management	925,100	93,435,100
Operations Support	1,272,700	128,542,700
Tangibles - Casing and Wellhead	1,491,700	150,661,700
Budget Cost:	**$15,746,400**	**Ksh 1,590,386,400**

As per the updated NEMA levies and processes hydrocarbon projects are classed as high risk projects, hence the EIA license fee will be **0.1% of the total cost of the project subject to a minimum of Kenya Shillings Fifty Thousand (Ksh. 50,000) and a maximum of Kenya Shillings Forty Million (Ksh. 40, 000, 000)**

Hence, the 0.1% to be paid to NEMA is **USD Fifteen Thousand, Seven Hundred and Forty- Six** (**$15,746)**. Equivalent to **Kenya Shillings One Million, Five Hundred and Ninety Thousand, Three Hundred and Eighty- Six (Ksh. 1,590,386)** using the exchange rate of 1 US DOLLAR: Ksh.101 (Central Bank of Kenya Rate on the 13th September 2016). **This fee needs to be paid to NEMA in Kenyan Shillings using the days exchange rate.**

3.0. PROJECT ALTERNATIVES

With a view of shedding light of the proposed project's impacts on the existing environment and at the same time achieve its objectives; available alternatives were sought in line with the requirements under EIA regulations and EMCA of 1999. In this analysis, alternatives were considered on the following basis:

- Alternative well location
- Alternative drilling technology
- Alternative drilling input
- The 'No' Project Option
- Proceed with the proposed project with Mitigation Measures

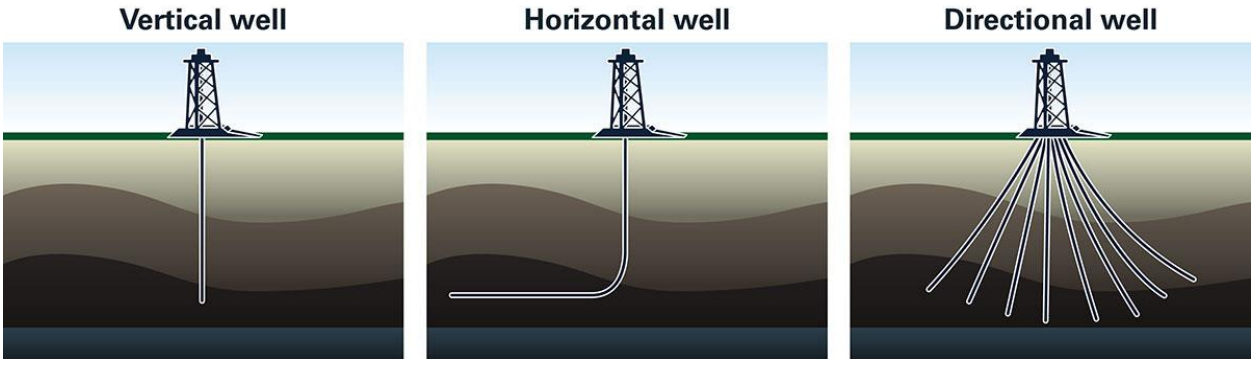
3.1 Alternative Well Location

The drilling area was determined by analysis of data obtained from the seismic survey. This data indicates areas where hydrocarbons are potentially trapped in geological structures. However, as in this case, without exploratory drilling, seismic data alone is not enough evidence of presence of oil or gas. Neither can it show whether the deposits are commercially viable nor the extent of the deposits. A number of potential well locations will be selected based on review and interpretation of geophysical data. The number of well targets is likely to be small and therefore the number of options for alternative surface well locations will be limited. In addition, the well's depth will depend on the location of the gas reservoir; which is approximately 4kms below ground and therefore, the location of the wells will not likely result in a significantly more negative or positive impact on the environment, no matter the location.

3.2 Alternative Drilling Technology

There are three types of onshore drilling technologies: vertical drilling, horizontal drilling and directional drilling as represented in Figure 3.1 below.

Figure 3.1: Types of drilling technologies



Horizontal wells begin with a vertical wellbore. But once the desired depth is reached, the well bore changes direction, arcing from a vertical trajectory to a horizontal one and extending for thousands of feet, allowing maximum exposure to the targeted reservoir rock.

Directional drilling techniques are applied for target well locations that lie in an environmentally sensitivities area and to potentially reduce duplication of surface infrastructure. This helps in avoiding sensitive surface areas, such as mangroves and to gain access to the reservoir from less sensitive surface areas.

3.3 Alternative project inputs

3.3.1. Drilling fluids

Drilling fluids is used to lubricate the drill bit and circulate drilled cuttings out of the well bore. There are three major types of drilling fluids:

1. ***Water Based Mud (WBM)***
   Most basic water-based mud systems begin with water, then clays and other chemicals are incorporated into the water to create a homogeneous blend resembling something between chocolate milk and a malt (depending on viscosity).
2. ***Oil Based Muds (OBM)***
   Oil-based mud is a mud where the base fluid is a petroleum product such as diesel fuel.
3. ***Synthetic Based Muds (SBM)***
   Environmentally-friendly organic-based muds using a base fluid produced from natural gas, or processed base oil or natural (non-petroleum) oils which are non-toxic and quickly biodegradable.

Table 3.1: Difference between the three drilling fluids

WBM	OBM	SBM
Less environmental impact and less cost associated with cuttings and contaminated fluid disposal and tank cleaning on rig Kick detection is easier as gas does not readily dissolve in water Easier to get good cement bonding to casing and formation	Advantages include: increased lubricity, enhanced shale inhibition, greater cleaning abilities with less viscosity and can withstand greater heat without breaking.	Non-toxic and quickly biodegrades Unlike most water-based muds, the SBM can be reused from well to well which is an environmental advantage

From the project description chapter, the project is supposed to use the water based mud. We recommend this would be the best alternative for this project.

3.3.2. Water requirements

A land well is normally drilled with freshwater; however, this is dependent on the abundance of fresh water supply in the area. Due to the scarcity of freshwater in and around the project area, the proponent

could opt to use seawater; however, this will have an impact on fluid and cuttings disposal due to the associated chlorides content. There are several options in sourcing freshwater:

1. Filling barges with water from a water source or rivers on the main land or transported from Malindi or Mombasa; and transporting to Pate Island.
2. Building a storage pit which can be filled with rain and other freshwater before commencement of the project, which can act as an available reserve to minimize possible over abstraction with the local supply.
3. Locating a local source that is acceptable with the local community
4. Drilling a bore hole to tap in to aquifer of Vumbe wells in the mainland

The best options we would recommend to be used during this project would be sourcing water from Malindi or Mombasa and transported to Pate Island via barge.

3.3.3. Power requirements

From the project description process, power will be provided by the generators. Other alternatives would be the use of renewable sources of energy such as solar and wind energy. However, these would require a substantial capital investment for the project.

3.4 The No-Project Option

This options means forfeiting the proposed exploratory drilling programme thus avoiding all 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 project area under consideration. The only benefit of this option would be negative impacts would be avoided such as loss in flora and fauna habitats, waste generation etc.

However, if the project does not take place, the potential abundant gas reserves in Blocks L4 and L13 will remain untapped. The Nation, Lamu County and communities in the project area will forego the benefits that will arise as a result of project implementation. The benefits will include; development (infrastructure); employment of the local community both direct and indirect; improvement in the livelihood of the community and revenue for the area that could result if the exploration drilling program reveals that the targeted hydrocarbon reservoirs are commercially viable.

The availability of abundant local supplies of natural gas in the country will provide an effective additional energy source for the Kenyan market. A secure supply of natural gas will provide the country with an environmentally friendly source of energy of, as opposed to environmentally friendly sources such as wind and solar which are intermittent. Based on the benefits that will arise as result of the proposed project and also the fact that the potentially adverse impacts are manageable, the “No-Action” alternative is not warranted.

3.5 Proceeding with the proposed project with mitigation measures

This option is the preferred option and it entails carrying out the proposed exploratory drilling programme with mitigation measures to prevent, offset, or avoid any negative impacts thereby maximizing it gains.

This option would therefore lead to achieving the proposed objectives through drilling wells and contribute to the achievement of other sectoral and policy goals and objectives.

4.0. POLICY, LEGAL AND INSTITUTONAL FRAMEWORK

This chapter outlines the applicable international standards and relevant Kenyan regulatory framework that set the context within which the Project will operate. It also identifies applicable licensing and permitting requirements that the project will require upon successful implementation of the project.

This ESIA will be conducted in accordance with:

- IFC Performance Standards for Social and Environmental Sustainability, April 2012
- IFC's General Environmental, Health and Safety (EHS) Guidelines, and the EHS Guideline for Onshore Oil and Gas Development
- The Equator Principles
- Kenyan laws, regulations and permits applicable to the Project

4.1 National Legal Framework[2]

Legislation	Legislative Scope	Relevance to Proposed Project
The Constitution of Kenya, 2010	• The constitution declares that the people of Kenya are respectful to the environment, which is their heritage and they are determined to sustain it for the benefit of future generations. • The constitution under article 42 states that every person has a right to a clean and healthy environment. Also every person has a duty to cooperate with state organs and other persons, to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources, according to section 2 of Chapter 5. • Article 70 deals with enforcement of environmental rights and everyone who feels their right to a clean and healthy environment has been denied has the obligation to go to court to seek redress.	Zarara must ensure that during operations they follow the ESMP provided ensuring operations are working in a clean sustainable way. This will ensure both workers and community members to operate in a

[2] Kenya Law. n.d. *Laws of Kenya.* [Date accessed 4th April 2016]. Available from: http://www.kenyalaw.org:8181/exist/kenyalex/index.xql

Legislation	Legislative Scope	Relevance to Proposed Project
	• Section 63 states that any unregistered community land shall be held in trust by county governments on behalf of the communities for which it is held	healthy and clean environment.
The Environmental Management and Co-ordination Act (EMCA), 1999 (Amendments 2015)	• This is the principal law governing environmental protection. It contains various legal notices with regulations on environmental conservation and Management, while Part II confers the right of every person to a clean environment and therefore makes it mandatory to work in a clean environment and protect people living close to the project. • Details mechanism and stipulation regarding environmental impact assessment. Sub-section (1) of section 58 • The act also prohibits anyone from discharging or applying poisonous, toxic, noxious or obstructing matter, radioactive or any other pollutants into aquatic environment. • Require that operators of projects which discharges effluent or other pollutants to submit to NEMA accurate information about the quantity and quality of the effluent. • Prohibits discharge or dispose of any wastes, whether generated within or outside Kenya, in such a manner as to cause pollution to the environment or ill health to any person, • Sections 90 through 100 outline more regulations on management of hazardous and toxic substances including oils, chemicals and pesticides.	The Act requires Zarara to acquire an EIA license from NEMA before commencing of any development. The Act also requires that no one should pollute the environment by discharging or dumping of waste unless it meets the required standards for effluent, solid waste to be disposed of on designated dumping sites. Hence, Zarara should contract a NEMA registered waste handler to dispose of the waste.
Environmental (Prevention of Pollution in Coastal Zone and other Segments of the Environment)	• No ship or any other person in Kenya shall be allowed to discharge any hazardous substance, chemical, oil or oily mixture into the territorial waters of Kenya or any segment of the environment contrary to the provisions of these Regulations • All ships in the territorial waters of Kenya shall off-load oil or oily mixture, sludge, bilge water, ballast water, waste and sewage to the certified Port Waste Reception Facility at the Port of Mombasa.	Though the drilling operation will be conducted onshore, a barge will be used to transport equipments from the port of Mombasa to

Legislation	Legislative Scope	Relevance to Proposed Project
Regulations, 2003	• Every ship shall be required to carry an Oil Record Book, which shall detail entries on machinery space operations, cargo and ballast operations in accordance with the provisions of the Merchant Shipping Act (Cap. 389) • All ships shall be required to obtain a certificate issued by a Certified Port Waste Reception Facility in accordance with MARPOL	Pate Island (Mtangawanda Jetty). The proponent should ensure that the barge contracted to carry out the operations should adhere to regulations.
Environmental (Impact Assessment and Audit) Regulations, 2003	• Stipulates the mechanisms for undertaking an EIA. Project Proponent, upon consultation with NEMA shall appoint at their own cost lead expert/firm of experts registered under NEMA to undertake an environmental impact assessment. • Provides ways in which environmental experts should conduct an EIA/EA. • Requires during public participation, licensing procedure, inspection and any possible offences and penalties as part of EIA process	The Act requires that project proponent to contract a licensed EIA expert to conduct an EIA. In this case Zarara has contracted ESF Consultants NEMA Registration No. 0204 to carry out the ESIA Study As per the regulation the public and stakeholders were consulted during the exercise.
EMCA (water quality) Regulations, 2006	• These regulations provide for the protection of lakes, rivers, streams, springs, wells and other water sources. Also address the challenges of pollution of water resources as well as their conservation. • Provides guidelines for water use, and conservation for the proposed project, as well as effluent standards for discharge.	The Regulation requires that water guidelines set to be adhered to and no water to be abstraction unless it meets standards required. Also it will be important to protect

Legislation	Legislative Scope	Relevance to Proposed Project
	• Prohibits abstraction of water from natural water body unless such water meets the standards set out in schedule nine of the regulation in this legislation.	ground water sources and meeting standards for discharge of effluent, both National and International. One of the options in sourcing freshwater for the project is abstracting from rivers on the mainland. The client will need to adhere to guidelines set. The Regulation also requires Zarara to meet the effluent discharge standards in section 4.1.1.1 in this report.
EMCA (Waste management) Regulations, 2006	• Focuses on management of solid wastes, industrial wastes, hazardous wastes, pesticides and toxic substances and radioactive substances. • Provides standards for handling, transportation, and disposal of different types of waste. Addresses concerns such as responsibility for waste generators and obligations for disposal. • Prohibits disposal of any waste on a public highway, street, road, recreational areas or in any public place except in a designated waste receptacle. • Requires that any persons whose activities generate waste will collect, segregate, and disposed by person who is licensed by NEMA.	The waste generated in this project will include: domestic waste, drill cuttings and mud residues. For waste management there should exists proper contractual agreement with NEMA licensed solid waste handlers and that solid wastes are disposed of in designated sites approved by County

Legislation	Legislative Scope	Relevance to Proposed Project
	• Requires that any person granted a license to transport waste to ensure that does not cause scattering, escaping and/or flowing out of the waste. • No owner or operator of a trade or industrial undertaking will discharge or dispose of any waste in any state into the environment, unless the waste has been treated in a treatment facility and in a manner prescribed by the Authority in consultation with the relevant lead agency.	Government of Lamu. It will be good to segregate waste from the source and managed in line with the provisions of this regulation, and adhere to all the National and International guidelines for waste management.
EMCA (Fossil Fuel Emission) Control) 2007	• Regulations gives direction on the emission limits expected from internal combustion engines of various engines include; Hydrocarbons (HCs), Volatile organic Compounds(VOC), Sulphur dioxide (SOx), Nitrogen oxides (NOx), Particulates (PM) and Carbon Monoxide (CO).	Zarara wishes to use approximately 5 – 10 trucks transporting material to and from Mtangawanda Jetty to the project site. The trucks will carry approximately 150-200 truckloads of equipments: carrying loads weighing approximately 20-40 tonnes Regulation requires that all emissions standards must observe as set out in on First schedule of this regulation. Also machines with internal combustion engines will be required to undergo annual

Legislation	Legislative Scope	Relevance to Proposed Project
		combustion inspection to ensure compliance to this regulation.
Environmental EMCA (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006	• This regulation sets that any activity that will lead to a. An adverse impact on any ecosystem b. Lead to the introduction of any exotic species c. Lead to unsustainable use of natural resources Will require an EIA license before commencement of any activity	The proposed project has the potential of having an impact on the biodiversity in the project area, hence it will require an EIA license before commencement of the project. Also as a requirement, the proponent will be required to monitor species count in the area, or to monitor if any exotic/ invasive species are introduced in the project site. This will be a requirement introduced in the ESMP.
EMCA (Controlled Substances) Regulations, 2007	• The regulation seeks to control the production; consumption; and exports and imports of controlled/toxic substances. Such substances include of halogenated flourochemicals, hydrobromoflourocarbons and bromochloromethane, all with ozone depleting substances	The regulation will be adhered to ensure substances used in the exploration activities are free of toxic substances, also equipment and machines used on site with chemicals containing such

Legislation	Legislative Scope	Relevance to Proposed Project
		components are not imported for project use. Zarara will use substances for exploration activities which are free of toxic substances, also no equipment or machines will be used on site will contain chemicals stated in this regulation.
EMCA (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulation, 2009	• This regulation sets standards for the conservation, protection and sustainable use of wetlands. • It also facilitates the sustainable utilization and conservation of resources on river banks, lake shores, and on the seashore by and for the benefit of the people and community living in the area;	Subject to provisions of the act the proponent cannot carry out operations on the beach shore without an EIA license and authorisations from relevant authorities. The proponent will need to build a ramp at the adjacent beach to the jetty at Mtangawanda, in order to facilitate offloading of cargo from the barges.
EMCA (Noise and Excessive Vibration Pollution) (Control)	• These regulations prohibit any person from making or causing to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. It also prohibits excessive vibration which annoys, disturb, injure or endanger the comfort, repose, health or safety of others and the environment or	The permissible noise levels set under this regulation and the IFC standards should be adhered to at all phases of

<table>
<tr><th>Legislation</th><th>Legislative Scope</th><th>Relevance to Proposed Project</th></tr>
<tr><td>Regulations, 2009</td><td>
excessive vibrations which exceed 0.5 centimetres per second beyond any source property boundary or 30 metres from any moving source.

Part III provision relating to Noise. No. 12 on noise from motor vehicles, (1) No person shall operate a motor vehicle exceeds 84 dB(A) when accelerating.
To follow NEMA and World Bank/IFC standards ambient noise levels shown below

<table>
<tr><th colspan="2" rowspan="3">Receptor</th><th colspan="4">Maximum allowable noise in decibels</th></tr>
<tr><th colspan="2">NEMA</th><th colspan="2">World Bank/ IFC standard</th></tr>
<tr><th>Day time</th><th>Night time</th><th>Day (0700-2200Hrs)</th><th>Night (2200-0700)</th></tr>
<tr><td>A</td><td>Silent Zone</td><td>40</td><td>35</td><td></td><td></td></tr>
<tr><td>B</td><td>Places of worship</td><td>40</td><td>35</td><td></td><td></td></tr>
<tr><td>C</td><td>Residential: Indoor
Outdoor</td><td>
45</td><td>
35</td><td>55</td><td>45</td></tr>
<tr><td>D</td><td>Mixed residential (with some commercial and places of entertainment)</td><td>55</td><td>35</td><td></td><td></td></tr>
<tr><td>E</td><td>Commercial</td><td>60</td><td>35</td><td>70</td><td>70</td></tr>
</table>
</td><td>
the project to avoid reprimanding from the NEMA officers. This could be done through technological advancements, i.e. use of noise mufflers in equipment and generators.

Expected noise levels to be generated from the drilling site are as follows[3]:

Typical compressor station 50dBA (375 feet from property boundary)
Pumping unit 50 dBA (325 feet from well pad)
Fuel and water trucks 68 dBA

</td></tr>
</table>

[3] Earth Works. *Oil and Gas Noise.* [Date accessed 20th May 2016] Available from: https://www.earthworksaction.org/issues/detail/oil_and_gas_noise#.V0Kuob6M64b

Legislation	Legislative Scope	Relevance to Proposed Project
		(500 feet from source) • Crane for hoisting rigs 68 dBA (500 feet from source) • Concrete pump used during drilling 62 dBA (500 feet from source) • Average well construction 65 dBA (500 feet from source)
Water Cap 372	• Provides for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water; and to provide for the regulation and management of water supply and sewerage services. • The proponent will require a licence for the following purpose: a) Any use of water from a water resource b) The drainage of any swamp or other land c) The discharge of a pollutant into any water resource d) Any purpose, to be carried out in or in relation to a water resource, whch is prescribed	According to the Act, there will be need to apply for water permit from WRMA, for water abstraction from any water source (underground and surface water bodies) for use during drilling operations and any other uses. One of the alternative sources for freshwater is in the abstraction of water

Legislation	Legislative Scope	Relevance to Proposed Project
	• Licensee is to construct and maintain drains, sewers and other works for intercepting, treating or disposing of any foul water arising or flowing upon land for preventing pollution of water sources within his/her jurisdiction. • Prohibits obstruction or pollution of watercourse or water resource. • Requires authority from Water Resources Management Authority obstruct, interfere with, divert, or abstract water from any water course or any water resource, or negligently all any obstruction, interference, diversion, or abstraction.	from rivers from the mainland and transported to Pate Island.
Energy Act Cap 314	• The Energy Act, amongst other issues, deals with all matters relating to all forms of energy including the generation, transmission, distribution, supply and use of electrical energy as well as the legal basis for establishing the systems associated with these purposes. • Stipulates that the Energy Regulatory Commission shall, before issuing a permit under section 90, take into account all relevant factors including the relevant government policies and compliance with Environment Management and Coordination Act, 1999 and in particular EIA report as per Impact Assessment and Audit Regulations 2003, the Physical Planning Act, 1996 and the Local Government Act. • ERC is mandated to protect the environment, conserve natural resources, and protect the health and safety of workers, service users and the public at large.	The Act requires that before connecting to or installation of electric power to any site one must liaise with the Kenya Power and Lighting Company (KPLC) to ascertain the requirements required ensuring that the power to the site is adequate and doesn't affect the other users in the area. Zarara will use energy from generators for drilling activities; Pate Island is not served with KPLC. Installation of the generators will have to

Legislation	Legislative Scope	Relevance to Proposed Project
		consider the safety of employees onsite.
Petroleum (Exploration and Production) Act, Chapter 308	• No person can engage in any petroleum operation in Kenya without having previously obtained the permission of the Cabinet Secretary • Section 4 (3) indicates the government may conduct petroleum operations either (a) through an oil company established by the government to conduct those operations or (b) through contractors in accordance with petroleum agreements;	This Act regulates the scope of project contractor on the obligations expected as per the agreement on explorations. This regards the effective and sincere release of information pertaining to the discovery of petroleum products; employment and training of Kenya national in the petroleum sector; and provisions of exploration within the confines of the provision this Act. Zarara has acquired permits from the Ministry of energy for conducting gas exploration on Block L4 and L13.

Legislation	Legislative Scope	Relevance to Proposed Project
Climate Change Act, 2016	• This Act provides for a regulatory framework for enhanced response to climate change; to provide for mechanism and measures to achieve low carbon climate development, and for connected purposes. • On behalf of the climate change council NEMA has been given the mandate to regulate, enforce and monitor compliance on levels of greenhouse gas emissions as set by the Council under this Act.	• The project proponent, its contractors and clients must strive to minimize the use of equipment, materials and technology that emit ozone depleting fumes throughout the project cycle. • The project designs must also take into account design and plans that embrace clean energy solutions to avoid emissions as much as possible
Standards Act Cap 496	• The Act provides specifications for standardization of commodities and the codes of practice in the use of those commodities and their raw materials. In establishing Kenya Bureau of Standards, the Act seeks to consolidate control powers of the agencies that quality standard in the country.	All materials to be used for the exploration activities should have a mark showing accreditation as of quality from Kenya Bureau of Standard (KEBS).
County Government Act 2012	• The law empowers the County Governments to control or prohibit all businesses, factories and other activities (including the proposed project which, by reason of smoke, fumes, gases, dust, noise or other cause may be or become a source of danger, discomfort or annoyance to the neighbourhood) and to prescribe conditions subject to which such activities shall be carried.	Zarara will observe all the regulations provided by Lamu County Government in respect to environment,

Legislation	Legislative Scope	Relevance to Proposed Project
	• The legislation emphasizes on the right of citizens to participate to any development projects to their implementation.	health and safety of the locals.
Penal code cap 63	• It's an offence to make or vitiate the atmosphere in any place to make it noxious to health of persons/institution in dwellings or business premises in the neighbourhood or those passing along public way, commit an offence. • It's the responsibility of every person who is in charge or has under control anything, that in the absence of care or precaution in its use or management, might endanger the life, safety or health of any person, to use reasonable care and take reasonable precautions to avoid the danger.	The Act addresses the welfare of workers, to work and operate in a safe and healthy environment. Zarara must ensure that their safety policy is in line with the Act on site at all time.
Occupation Health and Safety Act, 2007	• Provides for the safety, health and welfare of workers and all persons lawfully present at workplaces, in all phases of the project. • Prohibits any persons from engaging in improper activity or behaviour at work place which may create or constitute a hazard to that person or any other person. • Gives powers to occupational safety and health officer to enter, inspect, and examine, by day and by night, a workplace, and every part thereof, when he has reasonable cause to believe that any persons is employed therein, and enter, inspect, and examine, by day, any place which has reasonable cause to believe to be part of a workplace and any building of which a workplace forms part and in which have has reasonable cause to believe that explosive, highly inflammable, or any other hazardous materials are stored or used	The Act requires the employer to ensure a safe working environment for the workers, through provision of appropriate Personal protective equipment (PPE), adequately equipped first aid kits, fire safety apparatus, training on use of the above, emergency response mechanisms, and health schemes as required by the Act.
Occupation Health and	1. Factories (First-Aid) Order: Provides requirements of what needs to be included in a first aid box.	These regulations states that is the duty of the employer to provide the

Legislation	Legislative Scope	Relevance to Proposed Project
Safety Act, 2007 Subsidiary Legislations:	2. Factories (Docks) Rules: Provides rules of and process of loading, unloading, moving and handling goods in, on or at any dock, wharf or quay in any port or harbor. Equipment's used in lifting cargo must be inspected regularly to ensure maintenance of good quality materials. 3. Factories and Other Places of Work (Safety and Health Committees) Rules, 2004: Provides for health, safety and welfare of persons employed in factories and other places of work. Also it ensures measures to protect employees from dust, fumes or impurities originating from any process within the facility 4. Factories and Other Places of Work (Medical Examination) Rules, 2005: It shall be the duty of the employer to ensure that all persons employed in any of the occupations outlined in the Eighth Schedule to the Act undergo both pre-employment and periodic medical examinations by the designated health practitioner as outlined in the First Schedule. 5. Factories and Other Places of Work (Noise Prevention and Control) Rules, 2005: this provides regulations for activities that produce noise levels of the continuous equivalent of 90 dB(A) in 8 hours within any 24 hours' duration; and 140 dB(A) peak sound level at any given time. It states machinery should be well maintained, PPE provided such as ear muffs, placing o warning signs. 6. Factories and Other Places of Work (Fire Risk Reduction) Rules, 2007: This provides safety requirements for at risk areas. Safety requirements include: good ventilation systems, good housekeeping, fire safety training/drills, fire fighting equipment on site 7. Factories and Other Places of Work (Hazardous Substances) Rules, 2007: this provides measure to limit/ protect employees from hazards.	health, safety, and welfare of persons employed on site. Zarara will provide a safe working environment for all workers, through provision of appropriate PPE (safety boots, safety gloves, ear muffs, reflective clothes, helmet among other PPE). There will be no entry for unauthorised persons or livestock on the well pad. Zarara will have fully equipped First Aid Kit and trained first aider onsite at all times to attend on emergency cases. Also will have an emergency response mechanism, and health schemes as required by the Act.

Legislation	Legislative Scope	Relevance to Proposed Project
Work Injury Benefit Act, 2007	• Provides for compensation for work related injuries and diseases contracted in the course of their employment and for other purposes of protecting employees from occupational health and safety faults at work place. • Provides for insurance for the employer. • Provides for entitlement of benefits to an employee who is involved in an accident resulting in the employee's disablement or death • Employer is liable to pay compensation in accordance with the provisions of this Act to an employee injured at work.	The Act requires that Zarara should have a grievance policy to redress the social, security, health, and welfare grievances of the employees and local residence during the project implementation.
Public Health Act Cap 242	• This is an Act of Parliament to make provisions for securing and maintaining health. Sections include those dealing with notification of infectious diseases; inspection of infected premises and examination of persons suspected to be suffering from infectious diseases; rules for prevention of diseases; venereal diseases and infection by employees, among others. The proposed project will encourage the movement of people in search of jobs and opportunities, and with this, the risk associated with spread of diseases. • Part IX, section 115, of the Act states that no person/institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Section 116 requires that Local Authorities take all lawful, necessary and reasonably practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to be injurious or dangerous to human health. Such nuisance or conditions are defined under section 118 and include nuisances caused by accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbour rats or other vermin.	Zarara has the obligation to ensure adequate compliance to the health and sanitation provisions set out in this Act. Also the environmental management plan (EMP) advises on the safety and health aspects, potential impacts, personnel responsible for implementation and monitoring, frequency of monitoring.

Legislation	Legislative Scope	Relevance to Proposed Project
Employment Act, 2007	• Defines the fundamental rights of employees, to provide basic condition of employment of employees, to regulate employment of children.	Zarara should adhere to basic conditions of employees to be observed to avoid unnecessary conflicts in the future.
The Physical Planning Act, Cap 286	• Gives the county governments' physical planning department to develop regulations for development control in their areas of jurisdiction in terms of buildings to ensure orderly and sustainable development planning. • Any person who carries out development without permission will be required to restore the land to its original condition. • In case the local authority is of the opinion that the proposed development activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an EIA report.	This covers all development activities in preparation of the well pad that may result in adverse effects on the environment, particularly the generation of waste and the method of its discharge.
Land Act 2012	• According to section 31 of the Act Community land shall be managed in accordance with the law relating to community land enacted pursuant to Article 63 of the Constitution … - "*Section 63 of the Constitution states that any unregistered community land shall be held in trust by county governments on behalf of the communities for which it is held*" - *According to Section 3 of the constitution, Community land consists of—* *(a) land lawfully registered in the name of group representatives under the provisions of any law;* *(b) land lawfully transferred to a specific community by any process of law;* *(c) any other land declared to be community land by an Act of Parliament; and* *(d) land that is—* *(i) lawfully held, managed or used by specific communities as community forests, grazing areas or shrines;* *(ii) ancestral lands and lands traditionally occupied by hunter-gatherer communities; or* *(iii) lawfully held as trust land by the county governments,*	Community land shall not be disposed of or otherwise used except in terms of legislation specifying the nature and extent of the rights of members of each community individually and collectively.

Legislation	Legislative Scope	Relevance to Proposed Project
	but not including any public land held in trust by the county government under Article 62(2).	
Traffic Act Cap 403	• This Act consolidates the law relating to traffic on all public roads. Key sections include registration and licensing of vehicles; driving licenses; driving and other offences relating to the use of vehicles on roads; regulation of traffic; accidents; offences by drivers other than motor vehicles and other road users. Many types of equipment and fuel shall be transported through the roads to the proposed site. Their registration and licensing will be required to follow the stipulated road regulations. • The Act it prohibits obstruction of traffic, either by persons or facilities which are constructed in such a way as to interfere with the flow of traffic on roads or road reserves.	During transportation of the heavy machines such as the rig, heavy trucks should not interfere with traffic flow, also the speed limit should be should be observed All personnel operating the vehicles and machineries should be licensed by relevant authorities
Public Roads and Roads of Access Act Cap. 399	• The Act provides for the dedication, conversion or alignment of public travel lines including construction of access roads adjacent lands from the nearest part of a public road. • The law allows for notices to be served on the adjacent landowners seeking permission to construct the respective roads. The project design concept has left the required road reserves and relevant road widening surrenders. This Act consolidates the law relating to traffic on all public roads.	Zarara will use the existing road to transport equipment from jetty to the proposed site. Sectiond of the road will be upgraded. Zarara will have to seek permission from the appropriate authorities and land owners to create access roads to the site

Legislation	Legislative Scope	Relevance to Proposed Project
		during the construction phase.
Merchant Shipping Act, 2009	• The law provides for various maritime concerns regarding Kenyan and foreign ships in a port, or place in or within the territorial and other waters under the jurisdiction of Kenya. In relation to the proposed project, there will be transportation of rigs from ports of Mombasa or Lamu and this will focus on the prevention of collisions, the safety of navigation, the prevention of pollution, maritime security, the liability of ship owners and others, inquiries and investigations into marine causalities and to make provisions for the control, regulation, and orderly development of merchant shipping and related services. • The Act requires that all ships operating in Kenya waters to be registered in Kenya, the requirement for ship to be registered; the ship if it is of 24 metres or more, not exempted from registration. • The act also makes regulations for the protection and preservation of the marine environment from pollution by matter from ships. The regulations may give effect to any provision of the following international maritime conventions and agreements	There will be transportation of personnel and machineries (Drilling rig, Vehicles, and construction equipment and materials) for the proposed project from the ports of Mombasa and Lamu via barge. The vessel will be registered with KMA and clearly labelled (name written) on the sides. If the proponent wishes to dispose any waste into the sea, they would need to follow regulations set in international maritime conventions and agreements
National Museums and Heritage Act Cap 216	• The Act empower National Museums of Kenya to take lead role in research, development, protection, and management of cultural and heritage resources. • Part V on searches and discoveries stipulates the needs for exploration licenses.	This Act relates to the disturbance of, and interference with, sensitive cultural, natural heritage and archaeological sites in

Legislation	Legislative Scope	Relevance to Proposed Project
	• Prohibits the searching or excavation of cultural heritage without the consent of the Minister and without an exploration license. Section 30 obligates reporting chance finds to NMK or the District Commissioner in the jurisdiction, while section 31 prohibits the movement of cultural heritage items from their place of discovery contrary to provision of a heritage exploration license.	the project area, which may be affected as a result of gas exploration. In Pate Island there are archaeological sites at Siyu and Pate locations. Zarara will conduct its activities in a sensitive cultural, natural heritage and archaeological sites in the Island.
Forestry Services Act, 2005	• Provides that if mining, quarrying or any other activity carried out in the forest, where the activity concerned is likely to result in forest cover depletion, the person responsible shall undertake compulsory re-vegetation immediately upon the completion of the activity.	The Act requires one to apply for a special licence and involvement of applicable forest officers in public consultations as part of the EIA process. The well site for Pate 1 operated by Shell, is largely covered by shrub and bush. Vegetation will be lost or altered to pave way for construction activities for access roads and well pad (200 m by 200 m). There are no protected forest in

Legislation	Legislative Scope	Relevance to Proposed Project
		and around the proposed site
Wildlife Conservation and Management Act, 2013	• The Act prohibits activities that are likely to have adverse effects on the environment, which include seepage of toxic waste into rivers, streams, lakes and wetlands. • The Act also it prohibits any mining and quarrying activities in a National park without approval and consent of Kenya Wildlife Service. KWS will only approve quarrying and mining if only EIA has been conducted according to provisions of the EMCA 1999. • The Act in its sixth schedule list various animals and tree species that are nationally considered as critically endangered, vulnerable, nearly threatened and protected species.	The Act relates to the disturbance and interference with protected areas around the Project area, in this case Block L4 and Block 13 touches Dodori National Park. Block L4 touches Boni National Reserve and Kiunga Marine National Reserve. The well site for Pate 1 operated by Shell, is largely covered by shrub and bush. Vegetation will be lost or altered to pave way for construction activities for access roads and well pad (200 m by 200 m). There are no protected forest in and around the proposed site

4.1.1. Environmental Compliance Standards

National legislation has provided various safeguards/ limits for emissions. This study used these limits as benchmarks for assessing every impact of oil and gas drilling activity. Many of these standards such as Effluent Discharge Standards, Noise Emission Standards as stipulated in the NEMA and World Bank/IFC standards are as shown in subsections below:

Effluent Discharge Standards

Table 4.1: Effluent discharge standards criteria for NEMA and World Bank/IFC Standards[4]

Pollutant or Effluent parameter	Maximum allowable limits	
	NEMA discharge standard (mg/l)	World Bank/ IFC standard (mg/l)
Ammonia	100	10
Biological oxygen demand (BOD)	30	50
Chemical oxygen demand (COD)	50	250
Chromium (VI)	0.05	0.1
Chromium (Total)	2	0.5
Iron	1.0	0.5
pH	6.5-8.5	6-9
Oil & grease	Nil	10
Hydrogen sulphide		15 ppm
Total residual chlorine	0.10	0.2
Total suspended solids (TSS)	30	50
Total Dissolved Solids	1200	
Temperature	±30C above ambient temperature of receptor	±30C above ambient temperature of receptor
Zinc	0.5	2.0
Boron	1.0	
Sulphate	0.1	1.0
Fluoride	1.5	20
Arsenic	0.02	0.1
Cadmium	0.01	0.1

[4] NEMA Environmental Management and Coordination Act (Water Quality) Regulations, 2006 and World Bank Pollution Prevention and Abatement Handbook 1998

Ambient Air Quality Standards

NEMA Fossil Fuel Emission Control

Diesel powered vehicle are not to emit visible emissions in excess of 20% opacity for 5 consecutive seconds or more when under the applicable loading.

Table 4.2: A Petrol powered motor vehicle emission standards[5]

Vehicle Class and Model Year	Maximum Emission Concentration HP (ppm)	CO (percentage)
Class I:		
Gross vehicle weight of 6000 pounds or less		
1975-1977	500	5.0
1978-1979	400	4.0
1980	300	3.0
1981+	220	1.2
Class II		
Gross vehicle weight of 6001 pounds to 10000 pounds		
1975-1977	750	6.5
1978-1979	600	5.5
1980	400	4.5
1981-1984	300	3.0
1985+	200	1.2

NEMA Ambient Air Quality Tolerance Limits

The guidelines in the First Schedules prohibits any person from causing ambient air quality to exceed levels listed in the tables below and any other parameter as may be prescribed by the authority from time to time

[5] EMCA (Fossil Fuel Emission) Control Regulations, 2006. The regulation shows the standards for both petrol and diesel powered motor vehicle emission standards.

Legend

- µg- microgram
- m3 – cubic metres
- ppm – parts per million
- ppb – parts per billion
- the 24-hour limit may not be exceeded more than three times in one year
- ** 24-hour limit may not be exceeded more than three times in one year micrograms/m^3
- *** Note to be exceeded more than once per year average concentration

Table 4.3: Ambient Air Quality at Property Boundary for General Pollutants[6].

	Pollutant	Time weighted Average	Property Boundary
1	Particulate matter (PM)	Annual Average*	50 µg/m^3
		24 hours**	70 µg/m^3
2.	Oxides of Nitrogen (NO_X);	Annual Average*	80 µg/m^3
		24 hours**	150µg/m^3
3.	Sulphur oxides (SO_X);	Annual Average*	50 µg/m^3
		24 hours**	125 µg/m^3
4.	Hydrogen Suphide	24 hours**	50 µg/m^3
5.	Ammonia	24 hours**	100µg/m^3

Note

a) For residential premises in designated industrial areas, the above standards do not apply.

b) For industries in designated residential areas, standards for residential areas shall apply.

[6] EMCA (Air Quality) Regulations, 2014. The Act prohibits any person, operator or owner of any facility from causing or allowing fugitive emissions to cause the ambient air quality at its property boundary to exceed the limits prescribed under the First Schedule of this Act.

Table 4.4: Ambient Air Quality Tolerance Limits6

	Pollutant	Time weighted Average			
			Industrial area	Residential, Rural & Other area	Controlled areas***
1.	Sulphur oxides (SO_X);	Annual Average*	80 µg/m^3	60 µg/m^3	15µg/m^3
		24 hours**	125 µg/m^3	80 µg/m^3	30µg/m^3
		Annual Average		0.019 ppm/50 µg/m^3	
		Month Average			
		24 Hours		0.048ppm (125 µg/m^3	
		One Hour			
		Instant Peak		500µg/m^3	
		Instant Peak (10 min)		0.191 ppm	
2.	Oxides of Nitrogen (NO_X)	Annual Average*	80µg/m^3	60µg/m^3	15µg/m^3
		24 hours**	150µg/m^3	80µg/m^3	30µg/m^3
		8 hours			
		Annual Average		0.2 ppm	
		Month Average		0.3 ppm	
		24 Hours		0.4 ppm	
		One Hour		0.8 ppm	
		Instant Peak		1.4 ppm	

3.	Nitrogen Dioxide	Annual Average	150µg/m^3	0.05 ppm	
		Month Average		0.08 ppm	
		24 Hours	100µg/m^3	0.1 ppm	
		One Hour		0.2 ppm	
		Instant Peak		0.5 ppm	
4.	Suspended particulate matter (SPM)	Annual Average*	360µg/m^3	140 µg/m^3	70µg/m^3
		24 hours**	500 µg/m^3	200 µg/m^3	100µg/m^3
		mg/Kg			
		Annual Average****		100 µg/m^3	
		24 hours***		180 µg/m^3	
5.	Respirable particulate matter (<10m) (RPM)	Annual Average*	70 µg/m^3	50 µg/m^3	50 µg/m^3
		24 hours**	150 µg/Nm^3	100 µg/Nm^3	75 µg/Nm^3
6.	$PM_{2.5}$	Annual Average	35µg/m^3		
		24 hours	75 µg/m^3		
7.	Lead (Pb)	Annual Average*	1.0 µg/Nm^3	0.75 µg/Nm^3	0.50 µg/m^3
		24 hours**	1.5 µg/m^3	1.00s µg/m^3	0.75 µg/m^3
		Month Average		2.5	
8.	Carbon monoxide (CO)/ carbon dioxide (CO_2)	8 hours**	5.0 mg/m^3	2.0 mg/m^3	1.0 mg/m^3
		1 hour	10.0 mg/m^3	4.0 mg/m^3	2.0 mg/m^3
		mg/Kg			
		24 hours**			

9.	Hydrogen Sulphide	24 hours**	150 µg/m^3		
10.	Non-methane hydrocarbons	instant Peak	700ppb		
11.	Total VOC	24 hours**	600 µg/m^3		
12.	Ozone	1-Hour	200µg/m^3	0.12 ppm	
		8 hours (instant Peak)	120µg/m^3	1.25 ppm	

World Bank/ IFC standard

The World Bank/IFC guidelines with regard to the maximum ground level concentration of contaminants allowed in ambient air at the site boundary are as per **Table 4.5**.

Table 4.5: Emission from Onshore Oil and Gas Production (milligrams per normal cubic meter, unless otherwise specified)

Parameter	Maximum Value
VOCs, including benzene	20
Hydrogen sulphide	30
Sulphur oxides (for oil production)	1,000
Gas fired	320(86ng/J)
Oil fired	460(or 130ng/J)
Odour	Not offensive at the receptor end (Hydrogen sulphide at the property boundary should be less than 5 mg/m3)

Note: ng/J-nanograms per joule

Noise standards

EMCA Noise and excessive vibration pollution regulation 2009 and World Bank IFC Standards have provided recommended ambient noise levels for different land uses as represented in table XX Below

Receptor		Maximum allowable noise in decibels			
		NEMA		World Bank/ IFC standard	
		Day time	Night time	Day (0700-2200Hrs)	Night (2200-0700)
A	Silent Zone	40	35		
B	Places of worship	40	35		
C	Residential: Indoor Outdoor	45	35	55	45
D	Mixed residential (with some commercial and places of entertainment)	55	35		
E	Commercial	60	35	70	70

4.1.2. Institutional Framework and Permitting

The summary of the main environmental permitting and licensing requirement relevant to the project is provided in Table 4.6.

Table 4.6: Key Institutions relevant to the development, their roles and requirements

Institutions	Role in Project Cycle	Permits Required	Relevant Legislation	Time
Ministry of Energy and petroleum	Get permission from the Cabinet secretary before commencing any petroleum operations	Petroleum operation license	The Energy Act, 2006	30 working Days. Issued by the Ministry of Energy and Petroleum.
NEMA	Issuance of EIA License -Monitoring project compliance with approval conditions	Environmental Impact License	EMCA 1999	21 working days after submission of project report.

Institutions	Role in Project Cycle	Permits Required	Relevant Legislation	Time
	-Environmental Auditing			45-90 working Days after submission of study report.
Kenya Forest Service (KFS)	License to undertake prohibited activity in forest area	KFS gives input during the ESIA review. No Objection letter given within 90 working days of the submission of ESIA study report to NEMA.	Kenya Forest Act, 2005	Way Leave Permit takes 30 working days upon application. Permit issued by KFS
National Museum of Kenya (NMK)	Permit for movement of heritage items	NMK gives input during the ESIA review.	The National Museum and Heritage Act of 2006	No Objection letter given within 90 working days of the submission of ESIA study report to NEMA
Water Resource Management Authority (WRMA)	Permit for water abstraction from surface water and/or drilling a borehole	Application for a permit shall be the subject of public consultation and, where applicable, of environmental impact assessment in accordance with the requirements of the Environmental Management and Co-ordination Act, of 1999	The Kenya Water Act, 2002	Within 21 working days after inspection visit.
Traffic Department, Kenya Urban	Permit for the transporting wide load	Application for exemptions from the provisions of the	Traffic Act Cap 403 Part V and VI. Kenya Roads	

Institutions	Role in Project Cycle	Permits Required	Relevant Legislation	Time
Roads Authority,		traffic Act for bulk carriers and abnormal loads	Act Cap 2 of 2007	
Kenya Maritime Authorities (KMA)	Provision for the registration and licensing of Kenyan ships, to regulate proprietary interests in ships, the training and the terms of engagement of masters and seafarers and matters ancillary thereto; to provide for the prevention of collisions, the safety of navigation, the safety of cargoes, carriage of bulk and dangerous cargoes, the prevention of pollution, maritime security, the liability of ship-owners and others, inquiries and investigations into marine casualties; to make provision for the control, regulation and orderly development of merchant shipping and related services; generally to consolidate the law relating to shipping and for connected purposes.	Registration of vessels No	Merchant Shipping Act, 2009.	

4.2 National Policies and Plans

National policy	Applicability
Kenya Vision 2030	Kenya Vision 2030 is the country's new development blueprint covering the period 2008 to 2030. The vision has three pillars to achieving its goal and they are economic, social and political and their foundations are anchored by macroeconomic stability; continuity in governance reforms; enhanced equity and wealth creation opportunities for the poor; infrastructure; energy; science, technology and innovation (STI); land reform; human resources development; security; and public sector reforms. The energy sector in Kenya is identified as one of the sectors that contribute to the country's economic growth; it is highly dominated by imported petroleum for the urban/industrial sector and wood fuel for the rural and urban poor.
National Land Policy 2009	The Policy was formulated in August 2009, under Sessional Paper No.3 of 2009 on National Land Policy. This was the first time that Kenya adopted a comprehensive policy on land. The policy covers all aspects of land as regards to holding, classification, adjudication, registration, ownership and management. It also deals with historical injustices on land, and covers issues on natural resources and environment. The policy to achieve the goals of securing the National interests, where the is exploitation of natural, exploration should confer benefits to the local community, government is to compulsorily acquire land in areas where minerals are discovered with an aim of preventing environment degradation and securing mechanisms for restoring the land after exploitation.
Sessional Paper No.4 of 2004 on Energy	The policy that guides the energy industry including oil and gas. This policy on energy was formulated in October 2004 and is meant to guide the GoK in the energy sector for the period 2004 to 2023. The policy only seeks to put in place a legal and regulatory framework for mining, fossil fuel and the management of downstream oil and gas. Regarding hydrocarbons, the policy provides measures that are to be taken by the government in order to mitigate perceived risks by oil exploration companies.
National Energy Policy 2014	The main objective of the policy is to ensure affordable, sustainable, and reliable supply to meet National and county development needs, while protecting needs, while protecting and conserving the environment. According to the policy, petroleum exploration is being undertaken both onshore and offshore in the country's four major sedimentary namely Lamu, Mandera, Anza and Tertiary Rift. The policy outlines major policies that should be considered in petroleum exploration. In petroleum exploration, adoption of Extractive Industries Transparency Initiative (EITI). In addition, the government has the mandate to develop mechanisms for sharing and management of petroleum revenue as well as undertake measures to fast track commercial petroleum discovery.
National Marine Oil Spill Response	The policy aim at dealing with oil spill emergencies likely to occur within the territorial waters of Kenya. Section 1on strategy defines the range of the plan taking into account the geographical area covered; the apparent risks; responsibilities; assignment of roles; and anticipated response strategies. Section on plans and operations section set out the emergency measures necessary for rapid

National policy	Applicability
Contingency Plan (NMOSCRCP)	mobilization of resources for effective response to emergency oil spill. Data directory on the other hand contains lists of available oil spill response equipment and data sheets required to assess an oil spill situation.
Policy Paper on Environment and Development (Sessional Paper No. 6 of 1999)	The policy recommends the need for enhanced re-use/recycling of residues including wastewater, use of low or non-waste technologies, increased public awareness and appreciation of a clean environment. It also encourages participation of stakeholders in the management of wastes within their localities. Regarding human settlement, the paper encourages better planning in both rural and urban areas and provision of basic needs such as water, drainage and waste disposal facilities among others. The policy identifies energy sector as a source of important gaseous pollutants is carbon monoxide, hydrocarbons, hydrogen sulphide, nitrogen oxide and fluorides. These sources of include electric power generation, refuse burning, industrial and vehicle fuel consumption and emissions and industrial by-products. The policy is aims to: • Ensure that from the onset, all development policies, programmes, and projects take environmental considerations into account • Ensure that an independent EIA report is prepared for any industrial venture or other development before implementation • Effluent treatment standards that will conform to acceptable health guidelines.

4.3 International Agreements and Conventions

Kenya is a signatory to numerous multilateral agreements and international conventions. The agreements of interest to Kenya can be categorized as those for protecting natural resources, atmosphere and social wellbeing of man. The following list is a presentation of some of which are relevant to this project and study.

Conventions	Applicability
Montreal Protocol, September, 1987	Montreal Protocol On Substances that deplete the Ozone Layer: Adopted in September 1987 and intended to allow the revision of phase out schedules on the basis of periodic scientific and technological assessments, the Protocol was adjusted

Conventions	Applicability
	to accelerate the phase out schedules and has since been amended to Introduce other kinds of control measures and to add new controlled substances to the list.
The Basel Convention 1989	It is a global instrument for controlling trans-boundary movement of hazardous waste and their disposal. The convention aimed at reducing trans-boundary movement off hazardous wastes, minimizing creation of such wastes, and prohibiting shipment to countries that lack capacity to dispose of hazardous waste in an environmentally sound manner.
Vienna Convention for the Protection of the Ozone Layer March, 1985	Vienna Convention for the Protection of the Ozone Layer: Inter-governmental negotiations for an international agreement to phase out ozone depleting substances concluded in March 1985 with the adoption of this Convention to encourage Inter-governmental co-operation on research, systematic observation of the ozone layer, monitoring of CFC production and the exchange of Information.
Kyoto Protocol 1997	Pursuant to the objectives of the United Nations (UN) Framework Convention on Climate Change, in which the developed nations agreed to limit their greenhouse gas emissions, relative to the levels emitted in 1990.
Convention on Biological Diversity (CBD, 1994):	This Convention entered into force on 29 December 1993, and its objectives are to: conserve biological diversity; use biological diversity in a sustainable fashion and share the benefits of biological diversity fairly and equitably. This Convention governs Kenya's international obligations regarding biological diversity.
United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention	UNESCO Convention for the protection of the World Cultural and Natural Heritage (World Heritage Convention, 1972): This Convention aims to encourage the identification, protection, and preservation of Earth's cultural and natural heritage. It recognizes that nature and culture are complementary and that cultural identity is strongly related to the natural environment in which it develops;
Convention on the International Trade in Endangered Species (CITES) of Wild Fauna and Fauna, 1990	This is a 1990 treaty that regulates the wildlife trade and protects forests as habitat for endangered species. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival and it accords varying degrees of protection to many species of animals and plants.

Conventions	Applicability
Convention on the Ban of the Import into Africa and the Control of Trans boundary Movements and Management of Hazardous Wastes (Bamako Convention)	Convention on the Ban of the Import into Africa and the Control of Trans boundary Movements and Management of Hazardous Wastes (Bamako Convention) is a treaty of African nations prohibiting the import of any hazardous (including radioactive) waste. The Convention was negotiated by twelve nations of the Organization of African Unity at Bamako, Mali in January, 1991, and came into force in 1998.

4.4 IFC Performance Standards

IFC Sustainability Frameworks consist of IFC's Policy and Performance Standards on Environmental and Social Sustainability and IFC's Access to Information Policy. On environment and social sustainability, the framework, assess the commitments, roles, and responsibilities necessary from ensuring environmental sustainability.

Performance Standards	Applicability	Relevance to the Project
PS1: Assessment and Management of Environmental and Social Risk and Impacts	This PS relates to integrating and managing environmental and social performance throughout the life of a project with the aim of identifying and evaluating environmental and social risks and impacts of the project; adopting a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize; and where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment, promote improved environmental and social performance of clients through the effective use of management systems and to ensure that grievances from affected communities and external communications from other.	The standard requires the management of environmental and social performance throughout the life of a project. It requires the developer to identify the environmental and social risks, establish management programs that will mitigate the risks, establish, maintain, and strengthen organizational structure that defines roles, responsibilities, and authority to implement the ESMS, establish and maintain an emergency preparedness and response system, establish procedures to monitor and measure the effectiveness of the management program, as well as compliance with any related legal and/or contractual obligations and regulatory requirements and establish a stakeholder engagement plan that will be used to disclose and disseminate information, consult and involve stakeholders as well as grievance mechanism.
PS 2: Labour and Working Conditions	This standard seeks to ensure project proponents establish, maintain, and improves the worker-management relationship that promotes the fair treatment, non-discrimination and equal opportunity of workers, and compliance with national labour and employment laws. This PS aims to protect the workforce by applying this standard, which also addresses child labour and forced labour, and promoting safe and healthy	Requires the adoption and implementation of human resources policies and procedures appropriate to its size and workforce that set out its approach to managing workers consistent with the requirements of this Performance Standard and national law. Provide reasonable working conditions and terms of employment. Respect the rights to form and to join workers' organizations of their choosing without interference and to bargain collectively even if not recognised by national laws

Performance Standards	Applicability	Relevance to the Project
	working conditions, and to protect and promote the health of workers by recognizing the role of employees.	To base employment relationship on the principle of equal opportunity and fair treatment, and not to discriminate with respect to any aspects of the employment relationship. Prior to implementing any collective dismissals, to carry out an analysis of alternatives to retrenchment. If the analysis does not identify viable alternatives to retrenchment, a retrenchment plan will be developed and implemented to reduce the adverse impacts of retrenchment on workers. The retrenchment plan will be based on the principle of non-discrimination and will reflect the client's consultation with workers, their organizations, and, where appropriate, the government, and comply with collective bargaining agreements if they exist. To establish a grievance mechanism for workers (and their organizations, where they exist) to raise workplace concerns. Not to employ children in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. Not to employ forced labor, which consists of any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty. To provide a safe and healthy work environment, taking into account inherent risks in oil and gas sector and specific classes of hazards in the work areas, including physical, chemical, biological, and radiological hazards, and specific threats to women.
PS 3: Resource Efficiency and	The Performance Standard 3 aims at abetting pollution to air, water, and land that may threaten people and the	To implement technically and financially feasible and cost effective measures for improving efficiency in its consumption of energy, water, as well as other

Performance Standards	Applicability	Relevance to the Project
Pollution Prevention	environment at the local, regional, and global levels. The main objectives of this PS are; to avoid or minimize adverse impacts on human health and the environment by avoiding of minimizing pollution from project activities; to promote more sustainable use of resources, including energy and water and to reduce project-related GHG emissions.	resources and material inputs, with a focus on areas that are considered core business activities. To consider alternatives and implement technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of the project To adopt measures that avoids or reduces water usage so that the project's water consumption does not have significant adverse impacts on others. To avoid the release of pollutants or, when avoidance is not feasible, minimize and/or control the intensity and mass flow of their release. This applies to the release of pollutants to air, water, and land due to routine, non-routine, and accidental circumstances with the potential for local, regional, and transboundary impacts To avoid the generation of hazardous and non-hazardous waste materials. Where waste generation cannot be avoided, to reduce the generation of waste, and recover and reuse waste in a manner that is safe for human health and the environment.
PS4: Community Health, Safety, and Security	The role of this PS is to anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances and to safeguard personnel and property in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities. This study evaluates the risks and impacts to the health and safety of the Affected Communities during the project lifecycle and proposes mitigation measures consistent with good international	To identify risks and impacts and propose mitigation measures that are commensurate with their nature and magnitude. To design, construct, operate, and decommission the structural elements or components of the project in accordance with GIIP, taking into consideration safety risks to third parties or affected communities To avoid or minimize the potential for community exposure to hazardous materials and substances that may be released by the project.

Performance Standards	Applicability	Relevance to the Project
	industry practice (GIIP), such as in the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) or other internationally recognized sources	To identify those risks and potential impacts on priority ecosystem services that may be exacerbated by climate change To avoid or minimize the potential for community exposure to water-borne, water-based, water-related, and vector-borne diseases, and communicable diseases that could result from project activities, taking into consideration differentiated exposure to and higher sensitivity of vulnerable groups. To assist and collaborate with the affected communities, local government agencies, and other relevant parties, in their preparations to respond effectively to emergency situations, especially when their participation and collaboration are necessary to respond to such emergency situations To assess risks posed by its security arrangements to those within and outside the project site.
PS5: Land Acquisition and Involuntary Resettlement	The PS5 deals with land acquisition and resettlement of people on the land that they have been depending on. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood1) as a result of project-related land acquisition and/or restrictions on land use.	This standard relates to the temporary land acquisition process for the proposed exploratory drilling project. To consider feasible alternative project designs to avoid or minimize physical and/or economic displacement, while balancing environmental, social, and financial costs and benefits, paying particular attention to impacts on the poor and vulnerable. If displacement cannot be avoided, to offer displaced communities and persons compensation for loss of assets at full replacement cost and other assistance to help them improve or restore their standards of living or livelihoods. To engage with affected communities, including host communities, through the process of stakeholder engagement on decision-making processes related

Performance Standards	Applicability	Relevance to the Project
		to resettlement and livelihood restoration should include options and alternatives, where applicable. To establish a grievance mechanism consistent which will allow receiving and addressing specific concerns about compensation and relocation raised by displaced persons or members of host communities in a timely fashion, including a recourse mechanism designed to resolve disputes in an impartial manner. In case of involuntary resettlement, to establish a resettlement and livelihood restoration plan for the affected In the case of physical displacement, to develop a Resettlement Action Plan that covers, at a minimum, the applicable requirements of this Performance Standard regardless of the number of people affected. In the case of projects involving economic displacement only, to develop a Livelihood Restoration Plan to compensate affected persons and/or communities and offer other assistance that meet the objectives of this Performance Standard.
PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	This PS aims at protecting and conserving biodiversity based on Convention on Biological Diversity, which defines biodiversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems". This PS divides habitat into three categories, modified, natural, and critical. Critical habitats are a subset of modified or natural habitats. Modified habitats are areas that may	To consider direct and indirect project-related impacts on biodiversity and ecosystem services and identify any significant residual impacts especially focusing on habitat loss, degradation and fragmentation, invasive alien species, overexploitation, hydrological changes, nutrient loading, and pollution To establish appropriate actions that include avoiding impacts on biodiversity through the identification and protection of set-asides, implementing measures to minimize habitat fragmentation, such as biological corridors, restoring habitats during operations and/or after operations; and implementing biodiversity offsets.

Performance Standards	Applicability	Relevance to the Project
	contain a large proportion of plant and/ or animal species of non-native origin, and/ or where human activity has substantially. These may include areas managed for agriculture, forest plantations, reclaimed6 coastal zones, and reclaimed wetlands.	In event the project is located within a legally protected area or an internationally recognized area, Zarara will demonstrate that the project in such areas is legally permitted ,act in a manner consistent with any government recognized management plans for such areas , consult protected area sponsors and managers, affected communities, indigenous peoples and other stakeholders on the proposed project, as appropriate; and implement additional programs, as appropriate, to promote and enhance the conservation aims and effective management of the area Not to intentionally introduce any new alien species (not currently established in the country or region of the project) unless this is carried out in accordance with the existing regulatory framework for such introduction. To conduct a systematic review to identify priority ecosystem services. These area, those services on which project operations are most likely to have an impact and, therefore, which result in adverse impacts to affected communities and/or) those services on which the project is directly dependent for its operations (e.g., water).
PS 7: Indigenous Peoples	This standard deals in safeguarding Indigenous People which it defines as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population.	To identify, all communities of Indigenous Peoples within the project area of influence who may be affected by the project, as well as the nature and degree of the expected direct and indirect economic, social, cultural (including cultural heritage2), and environmental impacts on them. Undertake engagement process with the affected communities of Indigenous Peoples To consider feasible alternative project designs to avoid the relocation of Indigenous Peoples from communally held lands and natural resources subject to traditional ownership or under customary use.

Performance Standards	Applicability	Relevance to the Project
		Where a project may significantly impact on critical cultural heritage that is essential to the identity and/or cultural, ceremonial, or spiritual aspects of Indigenous Peoples lives, priority will be given to the avoidance of such impacts. The determination, delivery, and distribution of compensation and other benefit sharing measures to the Affected Communities of Indigenous Peoples will take account of the laws, institutions, and customs of these communities as well as their level of interaction with mainstream society.
PS 8: Cultural Heritage	This standard defines Cultural heritage as any tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values; unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes, and waterfalls; and certain instances of intangible forms of culture that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles. As a control measures, the standard requires the project proponents to identify and protect cultural heritage by ensuring that internationally recognized practices for the protection, field based study, and documentation of cultural heritage are implemented.	To protect cultural heritage in project design and execution. Take the responsibility of siting and designing a project to avoid significant adverse impacts to cultural heritage. The environmental and social risks and impacts identification process to determine whether the proposed location of a project is in areas where cultural heritage is expected to be found, either during construction or operations To consult with affected communities who use, or have used within living memory, the cultural heritage for long-standing cultural purposes. To allow continued access to the cultural site or will provide an alternative access route, subject to overriding health, safety, and security considerations.

4.5. The Equator Principles (EPs)

The Equator Principles (EPs) are a set of voluntary environmental and social guidelines that have been adopted by a significant number of financial institutions influential in the project finance market (collectively the Equator Principles Financial Institutions, EPFIs). The objective of the Equator Principles (EPs) is to provide the EPFIs with a mechanism to incorporate into their financing decisions a structured and rigorous consideration of environmental and social impacts associated with a particular investment initiative. Although project is not expected to require a loan, the Equator Principles have been considered as reference standards for the project due to their international recognition.

The EPs comprise a set of ten broad principles that are underpinned by the environmental and social policies, standards and guidelines of the IFC. Under the EPs, the EPFIs undertake publicly to only contribute financing to projects where the project sponsors are able to demonstrate to the EPFIs' satisfaction that they are both able and committed to comply with the provisions of the EPs. It should be noted that the third revision (EP III) is effective from the 4th June 2013.

The basic framework of the EPs remains intact since 2006; however, there are important expansions and additions in EP III. Key changes include the expansion of the scope of the EPs to apply to a broader range of financial product as project-related corporate loans and the inclusion of bridge loans. Changes also take into consideration the inclusion of new Language on Human Rights in due diligence and Stakeholder Engagement Requirements, with Free, Prior and Informed Consent required for projects with adverse impacts on indigenous people, as well as obligations to analyze and report on Greenhouse Gas emissions arising from high emitting Projects.

Table 4.7:The summary of Ten EPs:

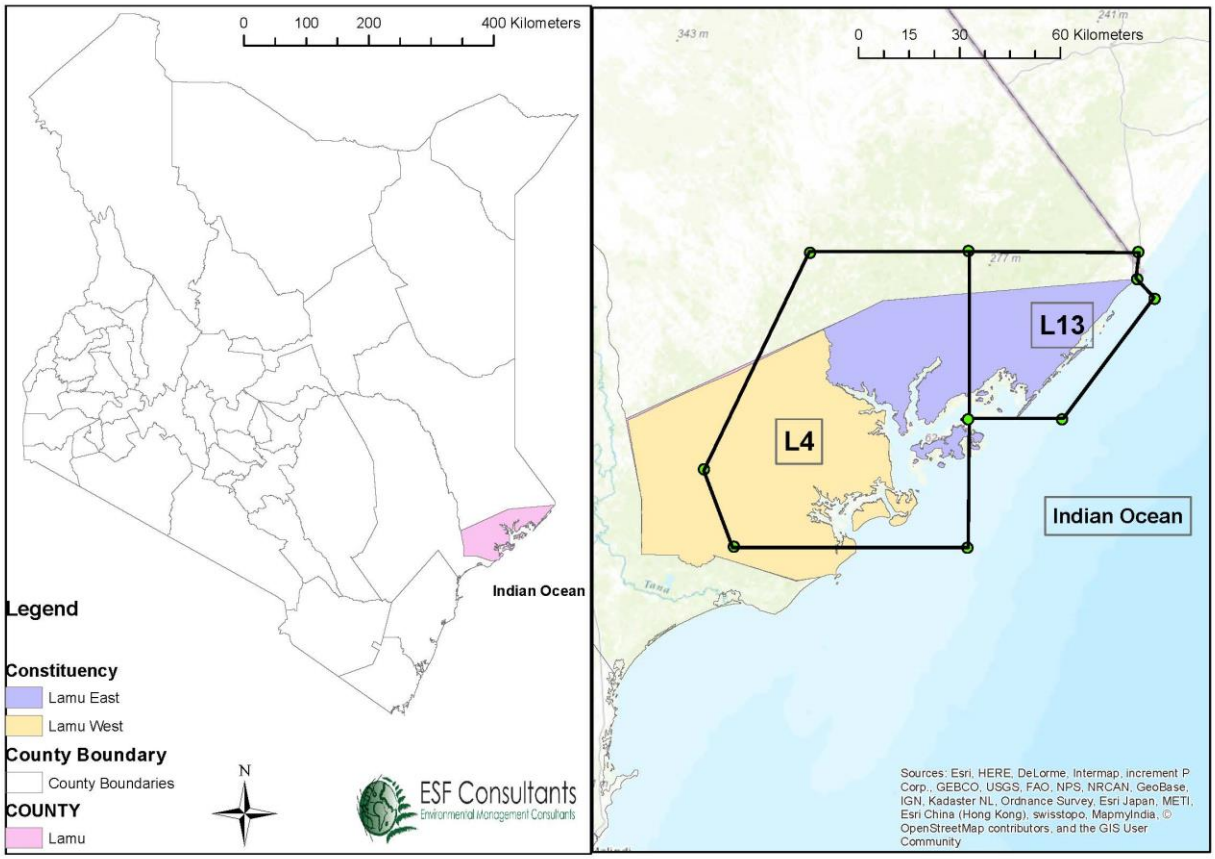
Performance Standards	Applicability
EP 1:	Requires all projects considered for financing to be categorized according to the degree of environmental and/or social risk and impacts they present. Projects with minimal environmental or social impacts require no further analysis under the EPs; those with attributable impacts are potentially subject to meeting the requirements of the remaining Principles
EP 2:	Mandates a project specific environmental and social impact assessment (ESIA) and provides an illustrative list of potential environmental and social issues to be addressed in the assessment.
EP 3:	This principle concerns the environmental and social standards that the project must adhere to during its construction, operation and decommissioning.

Performance Standards	Applicability
EP 4:	This principle addresses requirements for a comprehensive ESMP which needs to be implemented within a structured management system to ensure that the provisions of the remaining EPs are effectively implemented.
EP 5:	This covers the requirements for consultation as well as the public disclosure of key project documentation and information.
EP 6:	This principle takes into account concerns for structured grievance mechanism to be put in place to enable project-affected communities (including workers engaged on the project and workers at neighboring sites) to express any concerns or grievances they may have concerning the development.
EP 7:	This provides for the possible requirement for an independent review of EP compliance in order to assist the EPFI's due diligence.
EP 8:	This provides for the incorporation of covenants linked to EP compliance to be included in the project financing agreements.
EP 9:	This principle deals with the possible requirement for independent verification of monitoring carried out by the project sponsors.
EP 10:	This principle commits each EPFI to report publicly at least annually about its EP implementation processes (and hence is the only one of the ten Principles not to address specific project financing applications).

5.0. BASELINE CHARACTERISTICS

This chapter describes environmental, socio-economic and health characteristics of block L4 and L13 which falls within Lamu County as illustrated in Figure 5.1 below.

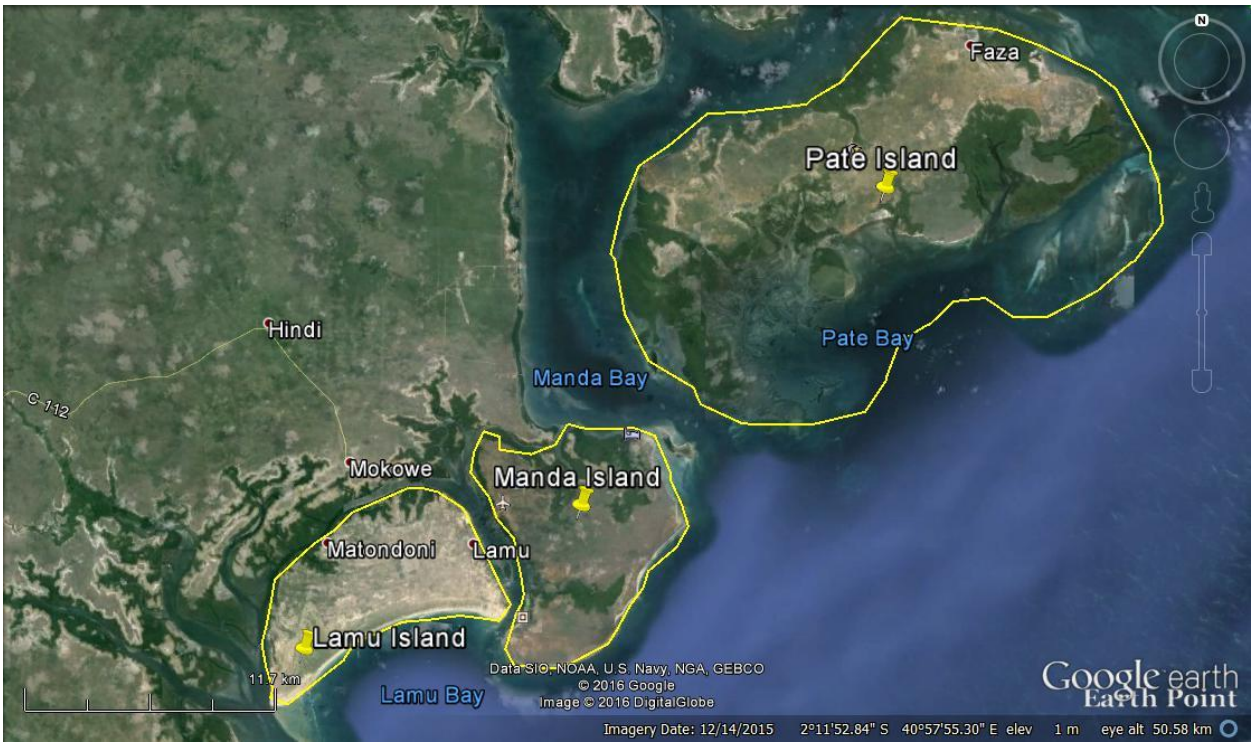
Figure 5.1: Location of Lamu County



Source: ESF Consultants

The location of the exact drill site in the focus areas depends on the characteristics of the underlying geological formations as shown by seismic data; however, the area of interest is in Pate Island as illustrated in **Figure** 5.2 below). Zarara wishes to further explore and appraise the gas discoveries made by Shell in the 1970s, which encountered high-pressure gas but in an unknown quantity as the well did not fully penetrate the reservoir section and was neither logged nor tested due to technical problems whilst drilling. The scope of work will cover the drilling of two wells on Pate Island, with the option to drill up to two additional wells to further appraise the prospect.

Figure 5.2: Islands in Lamu County



Source: ESF Consultants

Pate is the largest Island in the Lamu archipelago. Pate has a fascinating and colourful history largely defined by the influence of Arabic and Portuguese traders, starting as early as the 19th century. Shipping and trade, battles for power, intermarriage, periods of extreme wealth, creativity and elaborate architecture are just some of the patches in the island's quilt. Remnants from this elaborate history can still be found on the island today, making it one of Kenya's best kept north coast secrets.

5.1. Environmental Baseline

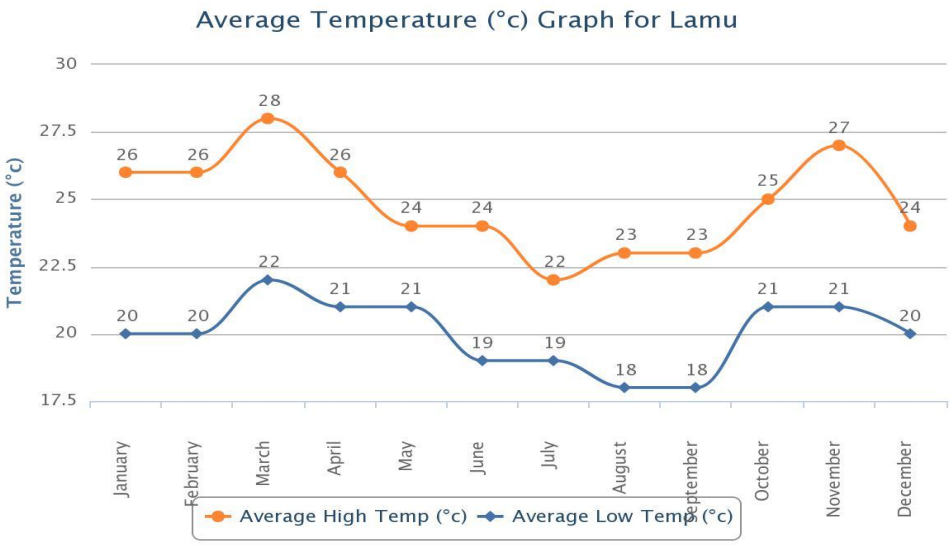
5.1.1. Climate and Meteorology

Temperature

The Lamu area in general has a hot and humid climate, but is further classified by the Kenya Agro climatic description as semi-humid on Lamu Island and along the coastal strip, but semi-arid further inland past Witu. The mean maximum temperature ranges between 28-31°C and the mean minimum temperatures 20-23°C. The hottest months are between December and April while coolest months are between May and July. This shows that total amount of evapotranspiration is high especially in the months of March and September and lowest in May.

Figure 5.3: Average Temperature (^{0}C) Graph for Lamu County[7]

[7] World Weather Online. 2015. *Manda Airport (LAU) Weather Lamu*



Based on the Koppen and Geiger climate classification, Pate Island lies in Tropical Monsoon and Arid Steppe Hot climate. Climate in Pate is characterized by hot temperatures throughout the year, with mean average temperatures of 27^{0}C, maximum temperatures of 29.3^{0}C and minimum temperatures of 24.3^{0}C. Lamu experiences an East-West temperature variation[8].

Climate in Pate Island is dominated by large scale pressure systems of the western Indian Ocean (El Nino, Indian Ocean Dipole and the Madden Julian Oscillation) and two distinct monsoon seasons leading to bimodal distribution throughout the year. Annual precipitation averages at 500-900 mm in Lamu. The rainfall pattern is greatly influenced by the Monsoon winds with the main rains coming between late March and early June and declines from August. Short rains come in November and December and rapidly decrease in January and February.[9]

Salinity

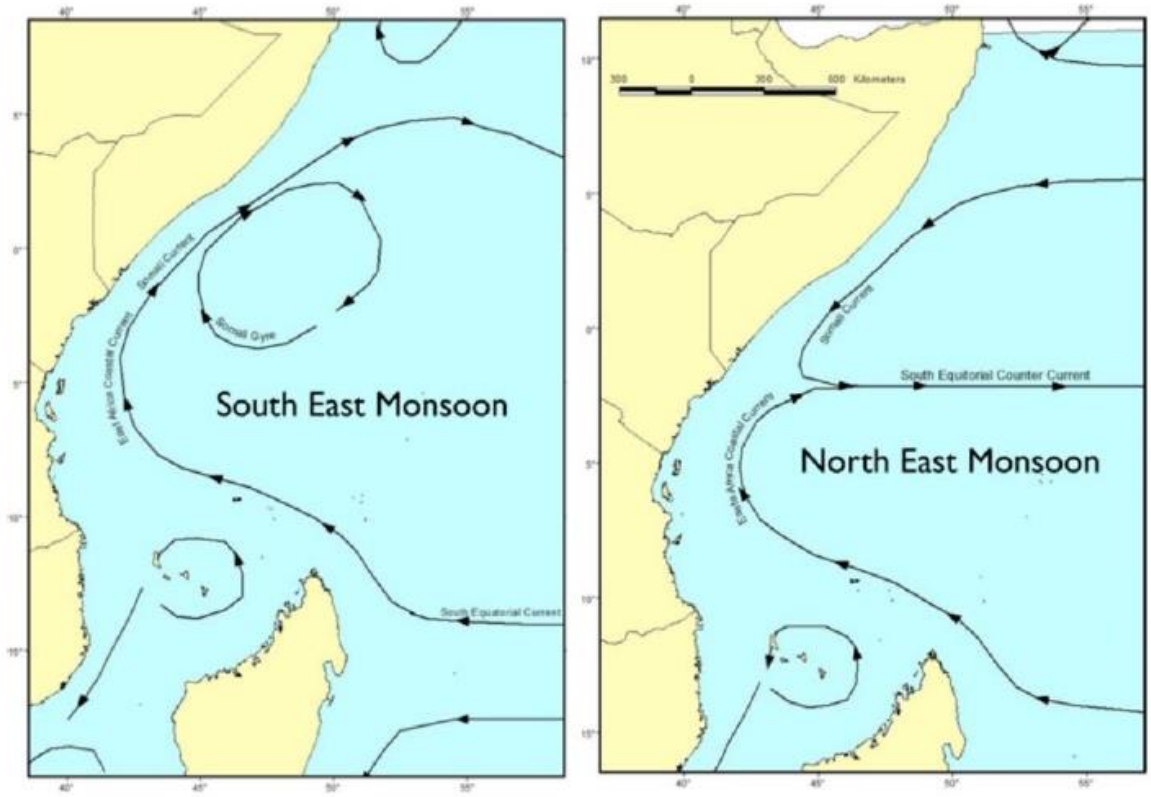
Monsoon winds along the coast of Kenya influence both the temperature and salinity of the ocean waters. As shown in **Figure 5.4** below, the highest temperature in this waters range between 28°C and 29°C and occur after the Northeast Monsoon in the months of March and April. During the Southeast Monsoon, the shifting of the ocean currents brings Pacific Ocean waters of high salinity into the South Equatorial Current.

The coldest months are between May to July whereas the hottest months are between December and April. Mean evaporation rates range from 1650 to 2300 mm per year in Lamu. Wind speeds, usually peak in *Kusi* and drop in *Kaskazi* and also show variability in direction. During the Northeast Monsoon, the South Equatorial Currents draws waters of low salinity from the Malay Archipelago. Such changes in salinity affect the salinity of the East African Coastal Current water. In the months of March, April, and May, there are heavy rains which influences salinity of the ocean waters at the Kenya Coastal line due to the

[8] (University of Nairobi, 2012)
[9] Benny, P. N., 2002: Variability of Western Indian Ocean currents, 1, 81-90. WIOMSA

discharges from the major river systems that drain into the ocean. Offshore temperature and salinity are however affected by ocean currents and surface water systems and conditions.

Figure 5.4: Monsoon winds and ocean currents[10]



Salinity in coastal seawater range from $34.5^0/_{00}$ to $35.4^0/_{00}$ (dissolved salts in 1 kilogram of seawater expressed as parts per thousands). **Table 5.1** below: Salinity levels in Lamu

Table 5.1: Salinity Levels in Lamu

Site	Salinity
Kiwayu	36.33
Ndau	37.2
Kizingitini	37

Rainfall

Annual rainfall on the Kenyan coast follows the strong seasonal monsoon pattern influenced by the south-easterly and the north-easterly monsoon winds. The main rains come between late March and early June with the rainfall decreasing from August; May remains the wettest month throughout the area. Some rain

[10] Obura, David O. 2001: Kenya, Marine Pollution Bulletin, 42 (12): 1264-1278, ISSN 0025-326X, Retrieved from: http://dx.doi.org/10.1016/S0025-326X(01)00241-7.

occurs between October and November but from December, rainfall decreases rapidly once again to a minimum during January and February

Lamu is characterized by bimodal rainfall distribution of approximately 540 mm annually and temperatures of 28^{0}C. The tides are semi-diurnal, with mean range of 2.5 to 3 meters and a maximum range of approximately 4 m[11]. The rainfall pattern in Lamu County is bimodal with the long rains falling throughout the county from mid-April to end of June with light showers in July. May is the wettest month. The short rains fall in November and December. January to March are usually dry months.

Table 5.2: Average Rainfall for Lamu County[12]

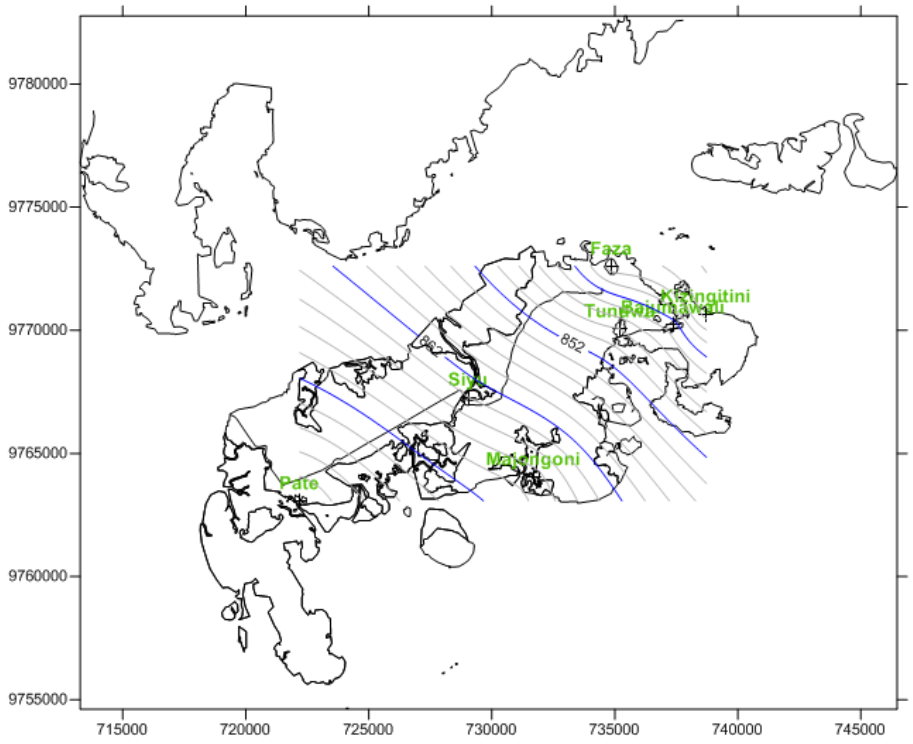
Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mm	7	3	32	135	299	145	82	41	47	37	42	25

Annual precipitation varies slightly across the Island from north to south, being approximately 835mm in the Kizingitini area, to 882mm p.a around Pate (Figure 6). Precipitation is heaviest in the months of April to July with a peak in May. December to March is the driest season on the island with a cumulative total average of between 10 and 20 mm.

On Pate Island, temperatures average at 26.9^{0}C per annum and rainfall at 882 mm per annum[13]. On Pate Island, the main rainy season lasts from April to July, when 75% of the long term total of mean monthly rainfall is observed with a peak in May. However, in the 10-year period between 1981 and 1991, the total mean was much higher, which shows that there are cyclic periods of high and low rainfall. Figure 5.5 shows that precipitation increases progressively from Kizingitini southwest to Pate. Rainfall is an important source of water for the Island either trapped directly as rainwater harvesting, in djabias as surface runoff or by recharging groundwater to keep a minimum freshwater lens above the saline groundwater layer.

[11] Church J. and Palin O. 2003. The Sea Turtle Conservation Initiative in Kiunga Marine National Reserve, Lamu Kenya, from February 1997 to June 2003. Report, WWF EARPO, Nairobi.
[12] Holiday Weather. 2016. *Lamu: Annual Weather Average*. [Date Accessed 17th May 2016] Available from: http://www.holiday-weather.com/lamu/averages/
[13] climate-data.org, 2015. *Climate Lamu.* [Date accessed 17th May 2016]. Available from: http://en.climate-data.org/location/47680/

Figure 5.5: Rainfall Distribution



Town	Rainfall
Pate	882
Tundwa	848
Bajumawal	843
Siyu	864
Faza	837
Majongoni	869
Kizingitini	835
Nyambogi	843

Air Quality

Pate Island is moderately populated, undeveloped with strong winds caused by tides and air pressure variations in the Indian Ocean and the island. Pate Island has bushlands, bushy grasslands, mangrove forests, and scattered coconut trees effective in filtering the air and blocking strong onshore winds.

The presence of Kenya Electricity Generating Company's (KenGen) diesel power plant in Lamu, agricultural activities and flights to and from Lamu, may affect the air quality in Pate Island. There is minimal atmospheric pollution, release of exhaust fumes and dust due to few vehicles traversing on the island. There are herds of grazing goats contributing to minimal dust production from their movements. Air pollution occurring in Pate Island is localized, transient and negligible.

The proposed project may have some impacts on air quality. Vehicular movements, for instance, and other man made events will definitely increase, which will therefore lead to higher levels of air pollutants. The baseline air quality was therefore assessed prior to the commencement of this project and was also in compliance with the Environmental Management and Co-ordination Act, 1999. Airborne concentrations of sulphur dioxide, nitrogen dioxide, carbon dioxide, suspended particulate matter (dust) and volatile organic compounds were determined in Siyu village and at the Shell Drilling Site in Pate Island 19th May 2016. Figure 5.6 shows the air sampling sites on Pate Island.

Figure 5.6: Air sampling collection sites

Siyu Vilage

Pate 1 -Shell Site

Sample Collection

Air samples were collected using an electric driven suction pump whose flow rate was 3.44 litres per minute. The air was scrubbed through appropriate trapping solutions for sulphur dioxide, nitrogen dioxide, carbon dioxide and carbon monoxide. Total suspended particulate matter (dust) was trapped in pre-weighed and pre-conditioned membrane filters. Total volatile organic compounds were collected in appropriate air bags and preserved for subsequent chemical analysis.

Quantitative Determination

1. Sulphur dioxide was determined quantitatively using the Pararosaniline method.
2. Nitrogen dioxide was determined using the Modified Griess-Saltzman method.
3. Carbon monoxide was determined spectrophotometrically using the silica ammonium molybdate method.
4. Carbon dioxide was determined titrimetrically.
5. The Filtration Technique was used to determine the airborne concentrations of suspended particulate matter (dust).
6. Total volatile organic compounds were determined using gas chromatography.

Results

Table 5.3 below provides the results of air quality measurements in Pate Island

Table 5.3: Air quality measurements in Pate Island.

Sampling Site, Date and GPS Coordinates	Parameter	Concentrations	WHO Guidelines	NEMA Ambient Quality tolerance limits for Residential, Rural and Other Areas
SIU VILLAGE (19-05-2016) GPS COORDINATES (UTM) LATITUDE 37° 0729359E 9767203N 3 Metres Elevation	Sulphur dioxide	34 µg/m^3	500 µg/m^3 10 minutes 350 µg/m^3 1 hour 125 µg/m^3 24 hours 60 µg/m^3 1 year	80 µg/m^3 -24 hours 60 µg/m^3-Annual Average
	Nitrogen dioxide	29 µg/m^3	120 µg/m^3 8 hours 40 µg/m^3 1 year	80 µg/m^3 -24 hours 60 µg/m^3- Annual Average
	Carbon monoxide	1.014 mg/m^3	30 mg/m^3 1 hour 10 mg/m^3 8 hours	2 mg/m^3-8 hours 4 mg/m^3-1 hour
	Carbon dioxide	702 mg/m^3	No published guidelines	No published guidelines
	Total Suspended Particulate Matter (dust).	46 µg/m^3	150-230 µg/m^3 24 hours 60-90 µg/m^3 1 year	180 µg/m^3 -24 hours 100 µg/m^3 -Annual Average
	Total Volatile Organic Compounds	Not Detected	No published guidelines	6.0 mg/m^3

Sampling Site, Date and GPS Coordinates	Parameter	Concentrations	WHO Guidelines	NEMA Ambient Quality tolerance limits for Residential, Rural and Other Areas
SHELL DRILLING SITE (19-05-2016) GPS COORDINATES (UTM) LATITUDE 37° 0731621E 9771226N 4 Metres Elevation	Sulphur dioxide	26 µg/m^3	500 µg/m^3 10 minutes 350 µg/m^3 1 hour 125 µg/m^3 24 hours 60 µg/m^3 1 year	80 µg/m^3 -24 hours 60 µg/m^3-Annual Average
	Nitrogen dioxide	15 µg/m^3	120 µg/m^3 8 hours 40 µg/m^3 1 year	80 µg/m^3 -24 hours 60 µg/m^3- Annual Average
	Carbon monoxide	0.760 mg/m^3	30 mg/m^3 1 hour 10 mg/m^3 8 hours	2 mg/m^3-8 hours 4 mg/m^3-1 hour
	Carbon dioxide	686 mg/m^3	No published guidelines	No published guidelines
	Total Suspended Particulate Matter (dust).	41 µg/m^3	150-230 µg/m^3 24 hours 60-90 µg/m^3 1 year	180 µg/m^3 -24 hours 100 µg/m^3 -Annual Average
	Total Volatile Organic Compounds	Not Detected	No published guidelines	6.0 mg/m^3

NOTE: $\mu g/m^3$ and mg/m^3 means micrograms per cubic metre of air and milligrams per cubic metre of air respectively (1 mg/m^3 =1000 $\mu g/m^3$).

Observations

- The pollution levels at the two sites were significantly low.
- The parameters that were analysed did not exceed both the NEMA and WHO guidelines for ambient air.
- The levels of carbon dioxide were close to the typical concentrations that are usually found in unpolluted air (about 677 $\mu g/m^3$ at the then prevailing weather conditions).

Projected Future climate

For most of East African region, the latest Global Climate Change Model projection largely agree on wetter conditions. However, the model can overlook critical regional climate dynamics which might change local level climate. The future projected climate change for Lamu and/ or seascape has been downscaled to the weather station in Lamu by the Climate Systems Analysis Group (CSAG) at the University of Cape Town, using two future economic scenarios:

- Scenario A1: "Business as usual" growth in greenhouse gas emissions
- Scenario B1: Rapid growth path but based on regional convergence and the introduction of more efficient technology (see

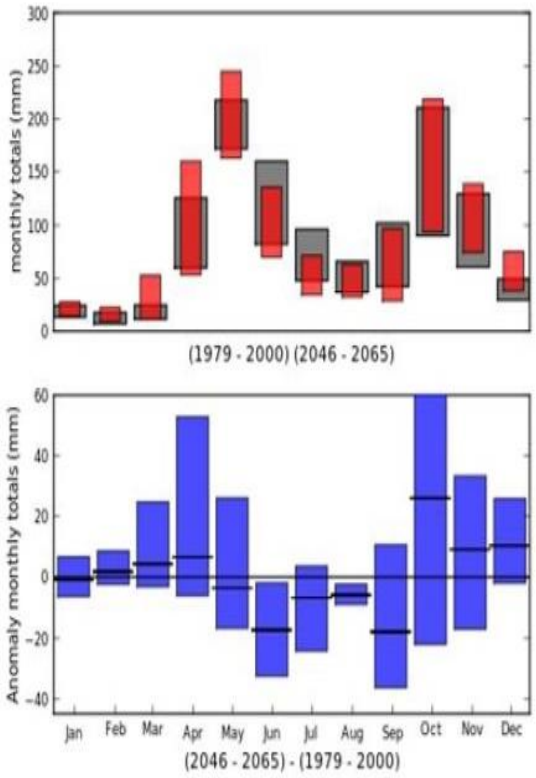
- Figure 5.7).

Models generally project increase in rain day frequency from November to April, with most positive change in extreme rainfall between October and November, with a decrease between June to September for all types of rainfall frequency. Decrease in dry spell might occur during the dry season of January to April suggesting a period of rain increase into the future (see

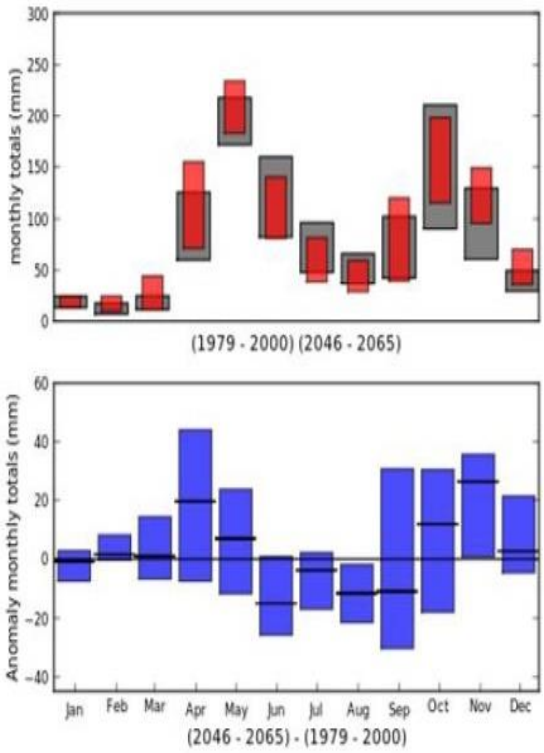
Figure 5.7). Although the same months may have greater dry spell lengths, this may not necessarily translate into the long duration of dry spells defined as droughts.

Figure 5.7: Projected future climate model[14]

Scenario A1



Scenario B1



Key

Red colour: Monthly projected rainfall total

Blue colour: Rainfall anomaly (i.e. anything above the line is more rainfall expected than was experienced in 1979-2000 period; while anything below the line shows less rainfall than was experienced in the 1979-200 period)

Winds

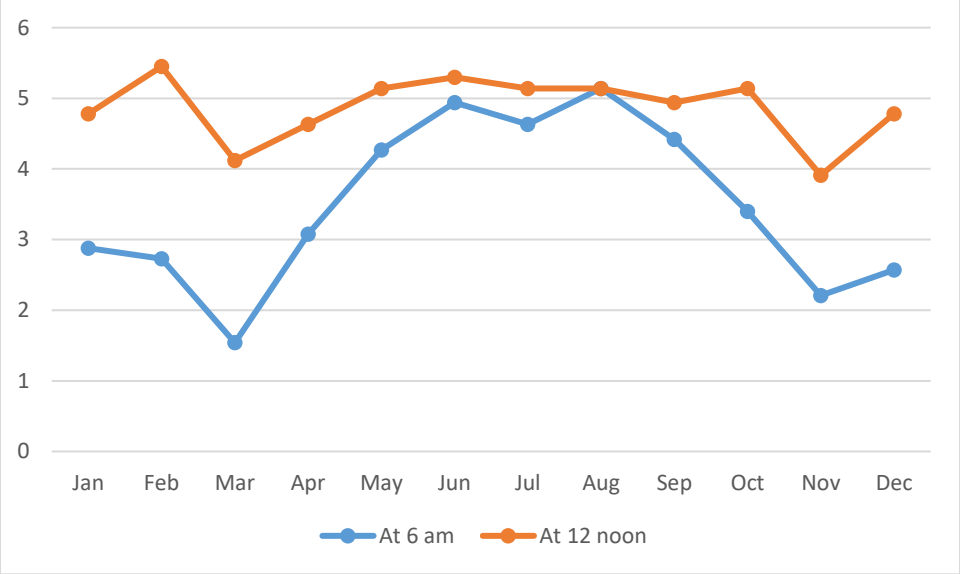
Block L4 is characterized by variable climatic conditions as it lies under agro climatic zones IV (semi-humid to semi-arid), V (semi-arid) and VI (arid). There is presence of strong winds due to pressure changes in the Indian Ocean but moderate due to thick vegetation cover serving as breakers for the strong winds. Void lands experience wind erosion and deposition. **Table 5.4** and **Figure 5.8** below show the wind speed in Lamu County.

[14] CSAG, 2012: Current state of knowledge on climate trends and variability, and downscaled climate change projections, for Eastern Africa, report prepared for WWF CEAI by the University of Cape Town Climate Systems Analysis Group (CSAG), 99p.

Table 5.4: Wind speed in Lamu [15]

Lamu Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
At 6 am	2.88	2.73	1.54	3.08	4.27	4.94	4.63	5.14	4.42	3.40	2.21	2.57
At 12 noon	4.78	5.45	4.12	4.63	5.14	5.30	5.14	5.14	4.94	5.14	3.91	4.78

Figure 5.8: Wind speed in Lamu County



The major ocean current in western Indian Ocean is the Equatorial currents and the Monsoon winds which influence in determining the oceanographic conditions[16]. The Kenyan coast experiences two distinct Monsoon seasons, the Northeast Monsoon (*Kaskazi*) and the Southeast Monsoon (*Kusi*). *Kusi* runs from May to September and *Kaskazi* runs from November to March. In between *Kaskazi* and *Kusi* is one or two-month transition period characterized by lower variable winds locally referred to as *Matlai*[17]. According to McClanahan in 1988, the start and the end of the two seasons vary with *Kusi* running from March to October and *Kaskazi* running from October to March.

East African Coastal Currents, Monsoon Winds and the Southwest Somali Current form an interplay creating a unique condition on the northern Kenyan coast, i.e. North of Lamu. Lamu Archipelago is characterized by mild upwelling and eutrophic conditions[18] . The Somali Current, being the only current that changes direction, is known for its high speeds of up to 3.5 m/s, on its top 200 meters, it reverses and

[15] World Weather Online. 2015. *Manda Airport (LAU) Weather Lamu*
16 Schott, F. 2001: The monsoon circulation of the Indian Ocean. Progress in Oceanography, 51(1): 1-123
[17] Church, J. E. and Obura, D. O., 2004: Management recommendations for the Kiunga Marine National Reserve, based on coral reef and fisheries catch surveys, 1998–2003. CORDIO/WWF KMNR, Lamu, Kenya, 1-57.
[18] Obura, David O. 2001: Kenya, Marine Pollution Bulletin, 42 (12): 1264-1278, ISSN 0025-326X, Retrieved from: http://dx.doi.org/10.1016/S0025-326X(01)00241-7.

change direction by 180^0 clockwise and emerges as a northward extension of East African Coastal Current during the Southeast Monsoon Winds, Southwest Monsoon winds or the Summer Monsoon Winds[19],[20].

5.1.2. Noise Environment

Extreme noise often results in sleep disturbance, annoyance, hearing disabilities and deafness.

The proposed gas drilling activities may enhance the noise levels in that area. Ambient noise level samples were collected from strategic points in Pate Island, to assess the existing noise levels in the island.

There are no industrial activities in Pate Island. The main activities are agricultural activities (livestock and crop farming), fishing, mangrove cuttings, small housing constructions. The potential noise sources in the island are from the vehicle, motorbike (boda boda), speed boats movement; and places of worship

EMCA Noise and excessive vibration pollution regulation 2009 has provided recommended ambient noise levels for different land uses as represented in Table 5.5below.

Table 5.5: EMCA Noise Regulation, 2009 levels[21]

Receptor		Maximum allowable noise in decibels	
		NEMA	
		Day time	Night time
A	Silent Zone	40	35
B	Places of worship	40	35
C	Residential: Indoor Outdoor	45 50	35 35
D	Mixed residential (with some commercial and places of entertainment)	55	35
E	Commercial	60	35

ESF consultants recorded ambient noise levels using the sound Level Meter, VA8080. Samples were collected at strategic points such as schools, Baraza (public community meeting) meeting points, public social halls in the study areas, among others as represented **Table 5.6** below. The noise level was measured at each location during daytime. It was noted that the noise levels, which were measured during the day, were mostly within the NEMA recommended standards

Table 5.6: Recorded Ambient Noise Levels from Pate Island

[19] Spencer, T., Laughton, A. S. and Flemming, N. C., 2005: Variability, interaction and change in the atmosphere ocean ecology system of the western Indian ocean. Philosophical Transactions of the Royal Society, 363(1826): 3-13

[20] Gert, J. T., 1989: A numerical study of the seasonal variability of the Somali current. PhD Thesis; Department of Geophysical Fluid Dynamics, The Florida State University. 1-141.

[21] EMCA Noise regulation, 2009

No.	Sampling location	Noise range in dBA (Day Time)
	Faza Location (Social Hall)	50.6
	Kizingitini Location (Social Hall)	57.2
	Mbwajumwali Location (Baraza Meeting point)	50.35
	Siyu Location (Primary School next to Siyu Port)	46
	Siyu residential village	57.4
	Shell drilling site	54.3
	Tchundwa Location (Tchundwa Primary school)	49.6
	Pate Location (Social Hall)	46.3
	Mtangawanda location (Baraza Meeting Point)	44.5

5.1.3. Geomorphology

To appreciate the geology of the Lamu Basin, a distinction has to be made between the near-surface geology and the thick sedimentary deposits and evaporates laid down in the long geological history of the area.

The geological map of Kenya shows this area as covered by Quaternary sediments, with inliers of Tertiary sediments appearing further inland near Galole. It thus simplifies the geology to the extent that a lot of the surface detail is lost, in terms of the characters of these sediments. On the other hand, geological data acquired through oil exploration activities provide a lot of information on deep-seated geological units.

Oil Block L4 lies in the Lamu Embayment geological feature which developed during the Carboniferous-Permian era during the onset of continental fragmentation. Lamu Embayment represents a failed arm of Palezoic tri-radial rift system which extends to Malawi and Mozambique. Block L4 falls within the Pate syncline separating Garissa High (Northwest-southeast striking structural basement in the northern part of the basin) and Walu-Kipini High (north-south trending basement uplift in the southern part of the basin separating Pate and Tana syclines).

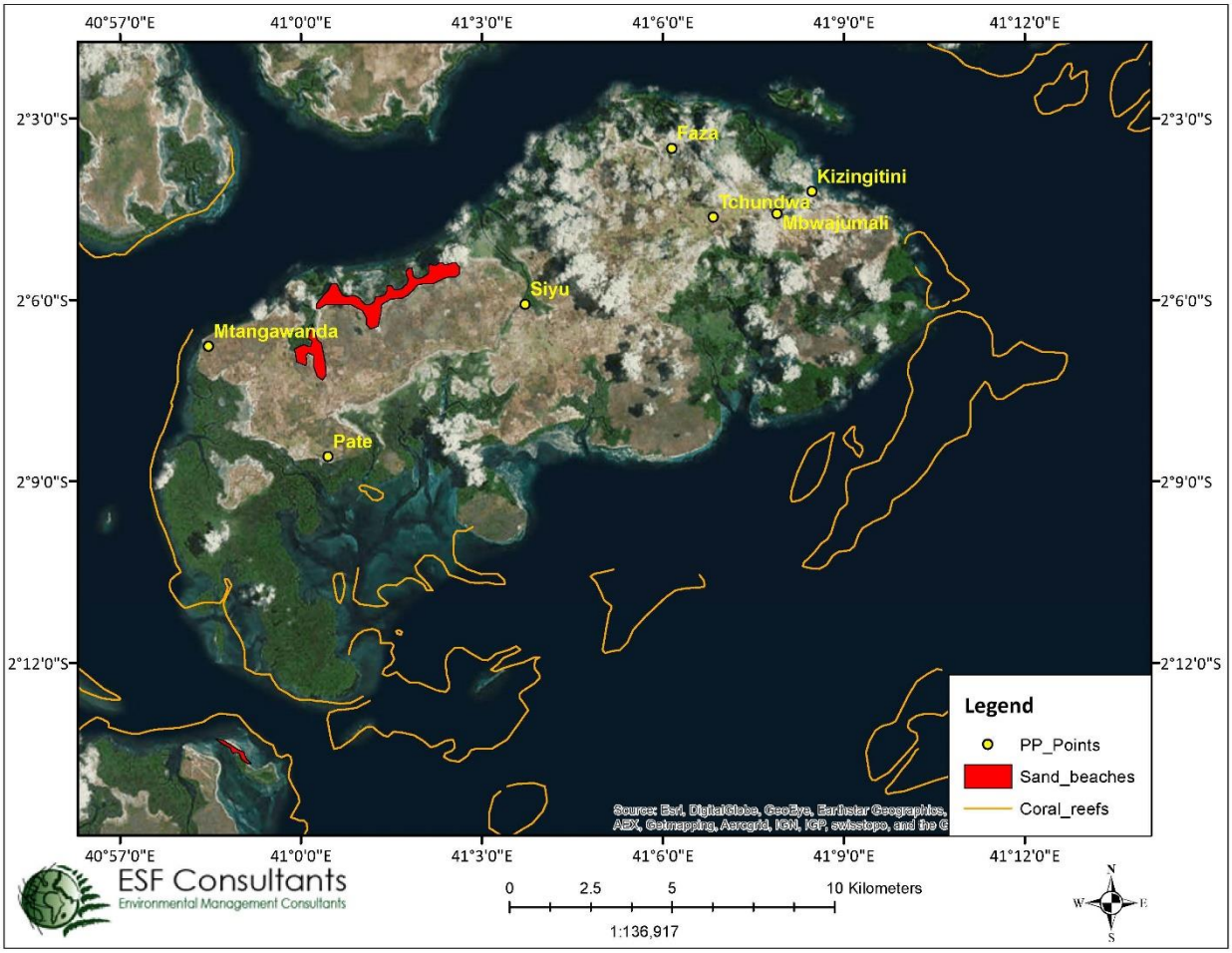
Oil Block L13 also lies in the Lamu Embayment but is comprised of the mainland; coastal; and marine environments constituting the Indian Ocean. The mainland is generally flat with elevations ranging between 16 and 63 meters above sea level. This elevation gradually decreases as you move towards the Indian Ocean. The coastline entails wide beaches sloping gently towards the ocean, and arrays of dune ridges caused by wind deposition. Marine environment with elevations of 0 to <5 meters above sea level is generally composed of life and dead corals as well as mangrove swamps.

The geology of Lamu is composed of residual coral limestone and columns of sand, as illustrated in

Figure 5.9 below. In the islands of Manda and Kiwayu there are rock outcrops; whereas Lamu Island and parts of Mkokoni in Kiunga division have sand dunes. Tectonic processes which resulted in opening up of the Indian Ocean, led to formation of sedimentary rocks along the coastline, into the ocean and offshore. Kenyan coast is predominated by low, approximately 4-6-meter-high limestone coral cliffs. Fossil coral reef deposits form the coastal plain, with reef flats or gently sloping beach formations, while beaches sheltered behind fringing reefs typically are backed by one or a series of windblown sand dunes up to 30 meters in height i.e. north of Kipini, Shela, Kiwayu and Mkokoni. River plumes, on the other hand, reduce, and sometimes prevent offshore coral growth, particularly in the south of the seascape from Kipini to Lamu. The reef is continuous from Lamu Island all the way to Ishakani and broken into islands and patch reefs.

Coral reefs have high biodiversity levels comprised of algae, molluscs, sponges, polychaetes, fish, crustaceans and reptiles. Coral reefs are highly sensitive to natural and anthropogenic disturbance due to their lengthy time they take to develop, and also because recovery of any disturbed or degraded coral reef takes a long to recover. Increased sedimentation clogs coral reefs thereby reducing their productivity.

Figure 5.9: Location of Coral Reefs in Pate Island



Source: ESF Consultants

Lamu-Galole area is covered by quaternary aged soils. Apart from Mesozoic and Miocene sedimentary rocks which are predominantly limestone, Block 13 overlays quaternary superficial unconsolidated thick sediments. Quaternary sediments comprising of Kilindini sands are rich in marine sands and clays, raised coastal reefs and windblown sands. Rising a few meters above marine sands and clays, are low ridges of sand usually red in colour in their higher better drained parts. Quaternary sediments are also found in Dodori and Boni, with underlain limestones of Paleocene (Eocene-Oligocene) They are believed to be of Recent Aeolian origin. Recent marine deposits form the present continuation of the Pleistocene sedimentation.

Quaternary Geology

Lamu archipelago is covered by Quaternary deposits which range from estuarine deposits to sands, clays and coral limestone. Seven different types of these Quaternary deposits can be differentiated: -

i. Sand dunes
ii. Undifferentiated Quaternary sands

iii. Near-surface coral limestone
iv. Beach deposits
v. Alluvial deposits
vi. Contemporary estuarine deposits
vii. Deltaic deposits

Sand dunes

Three different age groups of sand dunes occur in the area. Firstly, there is the Mundane Range type composed of Pleistocene sands. These are often reddish in colour due to staining by ferrous oxides. Secondly, there are the near coastal sand dunes which occur predominantly south of Lamu Island. These are composed mainly of yellow and off-white sands and are of Holocene age. Finally, the recent sand dunes that fringe the coastline on Lamu Island and Kiongwe area on the mainland.

Undifferentiated Quaternary sands

Quaternary sands cover a large portion of the area. These are mostly Pleistocene sands overlying Pliocene sands. The Pleistocene sands are grey or yellow in colour and have been referred to as the Kilindini Sands in comparative relationship with Mombasa area geology. They are variable in thickness and have inclusions of clay material and coral limestone in places.

Near-surface coral limestone

Surface outcrops of this coral reef are uncommon, being overlain by Quaternary sands, sand dunes or beach deposits throughout much of the area. They have a maximum thickness of about 100 metres, but are generally between 30 and 50 metres thick. The reef is not coral in the real sense; instead, it contains large proportions of coral breccia, calcite and quartz grains.

Beach deposits

These are essentially paleo-features overlying either Quaternary sands or corals. They have variable composition ranging from clays and sands to coral breccia. Both consolidated and unconsolidated forms of these deposits occur. They vary in depth up to 10 meters, and areas where they occur are characterized by low ridges.

Alluvial deposits

These deposits consist of fine grained materials, generally clay. Sand deposits also occur. Alluvial deposits are found in the non-estuarine areas of the Duldul and Dodori rivers.

Contemporary estuarine deposits

These are sand deposits with clay lenses and are very similar in composition to the Quaternary sands. Areas where these deposits occur are characterized by mangrove swamps.

5.1.4. Soils

Pate Island was formed as a result of fossilized coral reefs. Overall, the island has poor soils with relatively flat surface covered in white sand. These soils are of sedimentary parent material. The sand often forms dunes which can reach up to about 33 ft. in height.

The soils are broadly divided into three types:

- Soils of the coastal plain developed on lagoonal deposits (Kilindini sands) – consists of excessively drained to imperfectly drained, brown to very dark grey, loamy sand to sand in the top soil and sandy clay loam to sandy clay in the subsoil. The soils become coarser textured as you move northwards from the sea[22].
- Soils of the bottomlands and swamps developed on infill from lagoonal deposits (Kilindini sands) – They are light brownish grey to very dark brown sand in the top soil and sandy clay loam to sandy clay in the subsoil. Some parts of these areas are seasonally waterlogged after rains whereas others are permanently water logged, although the amount of water decreases during the dry season. Areas with permanent waterlogging have organic matter accumulated in the top soil.[22]
- Soils of the dunes and beach ridges developed on dune sands of Aeolian origin – Consists of excessively drained to well drained, dark red to yellowish brown, sandy to sandy clay loams. The colour and texture of these soils vary with topographic conditions. Higher areas have well drained, dark red sandy clay loams while relatively lower areas are excessively drained, yellowish brown sands to loamy sands[22].

The entire Lamu County is covered with quaternary deposits ranging from estuarine deposits to sand, clay and coral limestone. These deposits have been categorized into eight different types including[23]:

(i) Barrier Island complex – Are formed due to deposition of erosional material from coral reefs. They consist of modern time beach deposits.

(ii) Undifferentiated quaternary sands – They cover large portions of Lamu County. They are mostly Pleistocene sands, grey or yellow in colour, also known as Kilindini sands. They vary in thickness and have inclusions of clay material and coral limestone Pliocene sands are similar to Pleistocene type.

(iii) Near surface coral limestone – Surface outcrops of coral reefs are uncommon, and are overlain by quaternary sands, sand dunes or beach deposits. They have a maximum thickness of about 100 meters, but are generally between 30 and 50 meters thick. The reef is not coral in the real form, it contains large proportions of coral breccia, calcite and quartz grains.

(iv) Beach deposits – They are essentially paleo-features overlying either quaternary sands or corals. They have variable composition ranging from clays and sand to coral breccia. Both consolidated and unconsolidated forms of beach deposits occur. They vary in depth up to 10 meters, and a characteristic of low ridges.

(v) Deltaic deposits – They are contemporary deposits predominantly clay in texture.

(vi) Offshore corals – Are contemporary coral reefs growing laterally without any vertical growth. They are due to no changes in the sea level.

[22] Kenya Soil Survey, 1985, An Assessment of the Soil Conditions in the proposed extension of Lake Kenyatta settlement scheme (Lamu and Tana River Districts). Site evaluation report No. P62, June, 1985

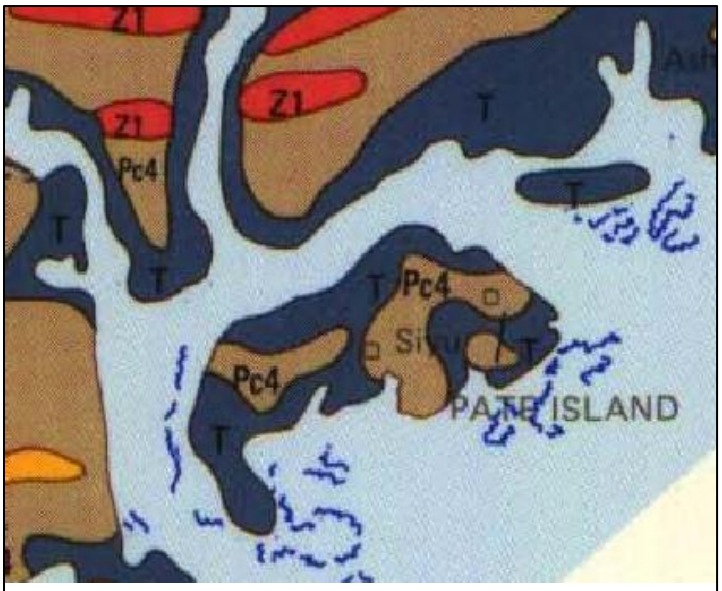
[23] Lamu District Environmental Assessment Report, 1985. National Environment Secretariat, Ministry of Environment and Natural Resources. Nairobi.

(vii) Alluvial deposits – Consists of fine grained material, generally clay. Alluvial deposits are found in non-estuarine areas of the Duldul and Dodori Rivers.

(viii) Contemporary estuarine deposits – They are deposits of clay lenses and very similar in composition to quaternary deposits. These deposits are characterized by mangrove swamps.

Soils are also influenced by the landform topography in which they are developed, hence their distribution provides clues for groundwater occurrence and its quality. For example, in Figure 5.10(below) the bottomlands soils are mainly black cotton clay soils and the coastal beach ridges represent denuded sand dunes and sandy soils on former beach platforms.

Figure 5.10: Soil map extract of the project area



Key

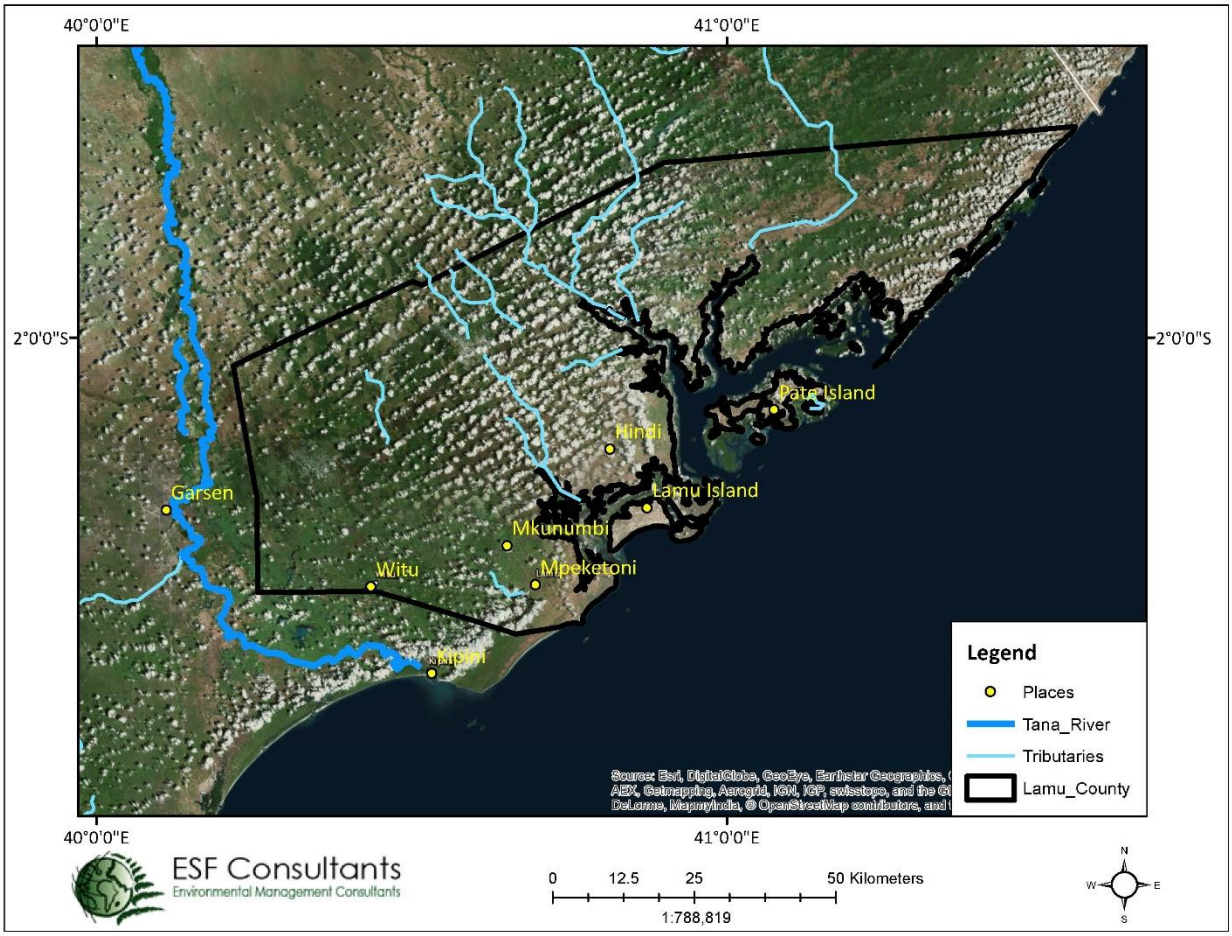
A – Soils	Floodplain soils
B – Soils	Bottomlands soils
D – Soils	Dunes or duneland
P – Soils	Coastal Plain soils
T – Soils	Mangrove swamps
Z – Soils	Coastal beach ridges

5.1.5. Hydrology

Hydrology in Lamu County

Water in Lamu County is very scarce, because there are no permanent rivers. Instead there are a number of drainage ways forming seasonal rivers, as illustrated in Figure 5.11 below. There are seasonal rivers in the Lamu County which include: Dodori, Arosen, Duldul, Mkondo wa Bargoni, Mkondo wa Kareni, Kitoko and Mkondo wa Mkuyuni near witu. Other important inland waters are Dodori creek, Mto wange creek, Ndau Bay, Mto wa Hidio, Mto wa Kipungani and Mto wa Mkunumbi. Kibokoni Lakes flow from northwest to the southeast, none reaching the Indian Ocean.

Figure 5.11: Rivers in Lamu



Most of these lakes are however quite small and shallow and are typical ox-bow lakes such as Lake Boa, Kenyatta and Dide Waride which are remnants of various meanders of the Tana River. Some of the lakes especially the smaller ones, have marsh characteristics, and are recharged by rain water and its reliability depends on the reliability of rainfall. The Tana River itself meets the Indian Ocean in an open estuarine delta.

Lagoons are found in Kiunga, Mikokoni and Kiwayu areas. A lagoon is a stretch of sea water partly separated from the sea by low, narrow, elongated strips of land, reef crests or sand bars[24]. Lagoons separate beaches and cliffs from fringing coral reefs. The depths of lagoons vary from a few centimeters to over 10 meters depending on the shore topography and presence of tidal channels. Lagoons are formed when fringing reefs are separated from the ocean by the reef flats and reef crests. Seagrass beds are commonly found in coastal lagoons with sandy bottoms, while coral heads and micro-atolls may be well developed on more consolidated substrates. Coastal lagoons are important source of food as they are

accessible when fishing on the outer reef is prevented by rough water[24]. They are also a valued tourist attraction and offer a range of natural services such as storm protection and fisheries protection.

The hydrogeology of Lamu Basin has been studied by various researchers, work which led to the development of the Lamu Water Supply wells, the Chomo wells, the Hindi-Magogoni wells and the Lake Kenyatta (Lake Mukunganya) wells. Pate Island within the basin has however been less researched and still remains undersupplied with fresh water. The hydrogeological concepts of groundwater occurrence developed through these studies include:

i. Sand dune aquifers on Recent dunes, e.g at Shela and Makafuni on Lamu Island and Kiongwe on the mainland;
ii. Karst aquifers developed in fossilised coral limestone on the mainland through percolation into sink-hole type depressions, e.g., at Belebele and Chomo.

In 1991, the IFAD-ASAL groundwater survey program placed the thickness of the freshwater lens below the Belebele aquifer at a maximum of 15 – 20m, similarly in and around Lake Kenyatta.

Conceptual model for groundwater occurrence

Most of the groundwater resources in the larger Lamu County are generally saline and therefore not suitable for human and animal consumption, except for dune and coral reef formations.

Previous researches note that groundwater recharge occurs seasonally assisted by a high recharge: rainfall ratio of 13.5% (by one estimate, COWI 1984) and the high porosity of the coral limestone and the fine dune sands.

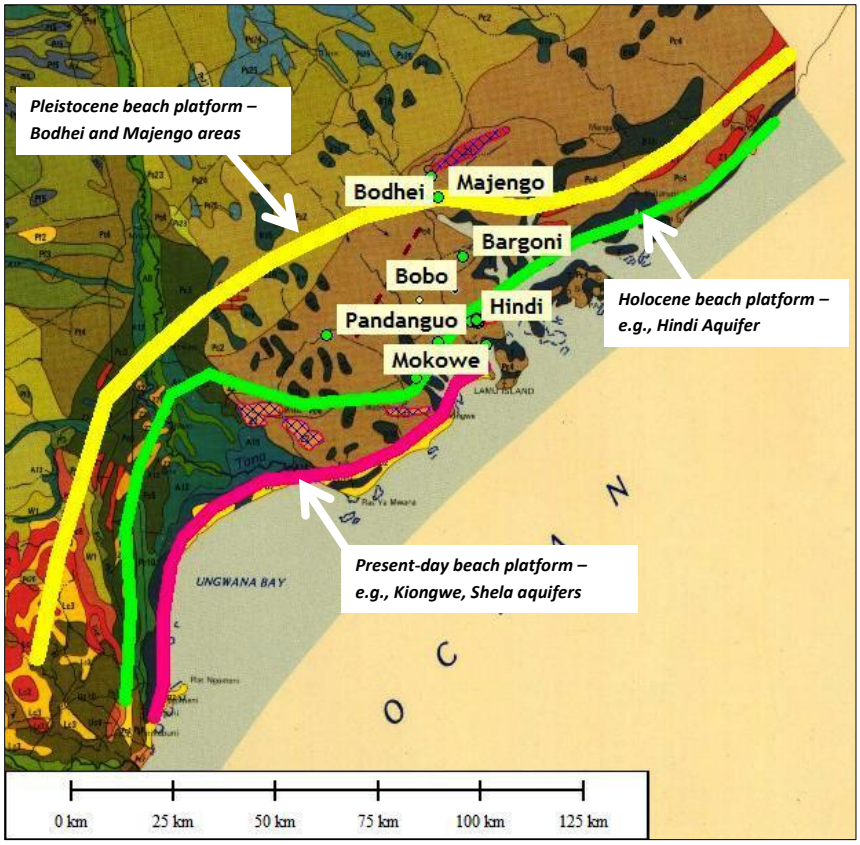
Dune ridges are a characteristic feature of the East African coastline and in effect each transgression or regression episode resulted to corresponding ridges. Three generations of dune ridges can be found in the Lamu Basin – Tana Delta area, the oldest probably being of Late Pleistocene age, the younger closer to the sea is Holocene (Ase, 1978, in Abuodha 2003). Figure 5 presents the approximate alignments of the three dune ridges, as interpreted from the soil map.

The youngest dunes are the active present day ridges that dot the coastline, e.g., Shela on Lamu Island and Kiongwe on the mainland. On Pate the dune sands are rare and are found in a few places south of Siyu, at Kizingitini, Mbajumwali and Nyambogi. Even then the dunes here have a very low elevation compared to the Shela dunes. While the Shela dunes reach a height of 35m amsl, Pate Island maximum elevation is just about 12m amsl. This means the freshwater lens is very thin on Pate which correspondingly has lower groundwater potential.

Groundwater recharge to the freshwater aquifer lens is assumed to occur in areas with elevation of 5 meters or higher. From DEM model this area is little more than 20 square kilometers. Where precipitation falls on lower ground the recharge is expected to get contaminated with saltwater hence does not count much for freshwater availability on the island.

[24] Richmond, M. D. (ed.), 2002. A Field Guide to the Seashores of Eastern Africa and Western Indian Ocean Islands. Sida/SAREC-UDSM.461 pp. ISBN 91-6586-8783-1.

Figure 5.12. Approximate alignment of the three beach ridges in the Lamu – Tana Delta area



Using the COWI estimate of 13.5% rainfall depth for recharge, the average 850mm annual precipitation will yield a recharge of 2,295,000L (2.295 MCM/ per year) for the island. Sand has specific yield as high as 30%, hence this recharge may yield up to 700,000 m^3/ year (1,900 m^3/day).

Water quality

The Island's population largely depends on groundwater and surface water trapped in underground tanks and shallow wells. Because the highest elevation is approximately only 13 meters above sea level, with most areas being less than 10 meters above mean sea level, the fresh water layer beneath the island is very thin. Furthermore, because of this low elevation the quality of groundwater is expected to vary widely with seasons and daily with the tidal movement.

Water quality distribution on the island broadly follows the pattern shown in Figure 13. It shows that Faza in the northwest and some areas south of Pate have the better groundwater quality that is less mineralized. The distribution is based on the wellhead chemistry (TDS) collected on site during the survey. The distribution is on a coarse scale since there is a wide scatter of the data points, hence it should only be used indicatively.

In terms of water pollution indicators of interest, volatile organic compounds are one of the most common groups of anthropogenic water pollutants. As they are not naturally occurring, the presence of them in

surface waters is a measure of their anthropogenic use. They enter the sea and rivers via discharges of municipal and industrial sewage.

Five samples were collected from settlements across the islands and tested for volatile organic compounds. The results are presented in Figure 5.13.

Figure 5.13. Total dissolved solids (TDS) distribution on the island

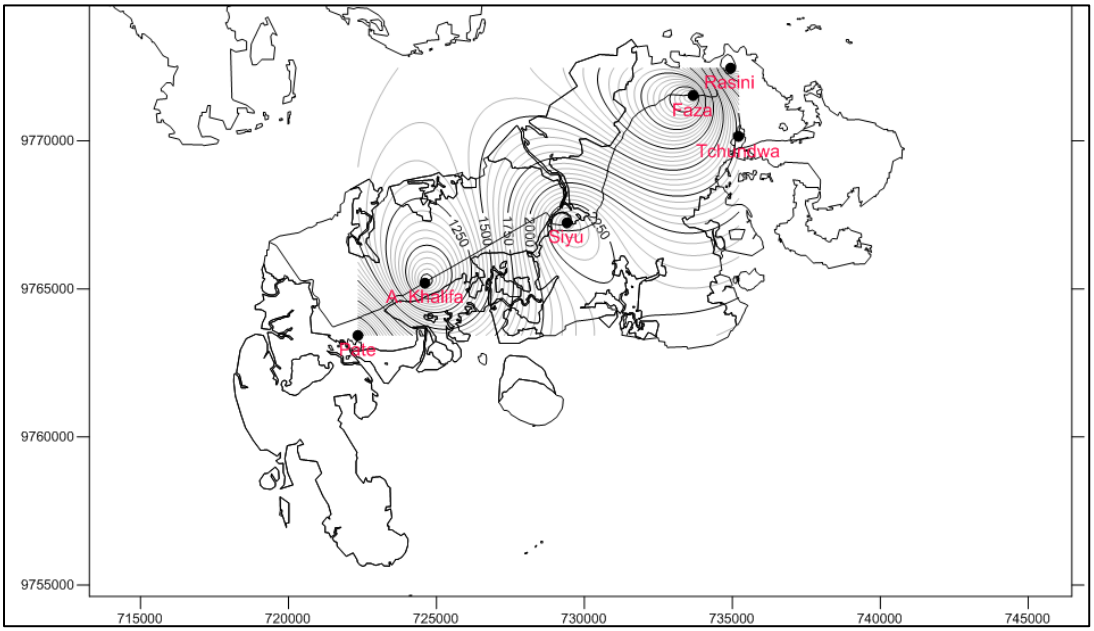


Table 5.7. Volatile hydrocarbon compounds analysis results

Analyte	Faza	Rasini	Pate	Siyu	Tchundwa	Abubakar Khalifa	Unit
TDS	500	>2000	>2000	>2000	1800	658	mg/l
pH	4.01	4.7	3.35	3.1	3.1	4.5	
T	29.1	27.9	30.1	31.1	30.1	30.7	C
n-Decane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
n-Docodane	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	mg/l
n-Dodecane	<0.01	**0.08**	<0.01	<0.01	<0.01	<0.01	mg/l
n-Dotetracontane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
n-Dotriacontane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
n-Eicosane	<0.01	<0.01	<0.01	**0.06**	<0.01	<0.01	mg/l
n-Hexacosane	<0.01	<0.01	<0.01	<0.01	**0.07**	**0.11**	
n-Hexadecane	<0.01	<0.01	**0.07**	**0.08**	<0.01	<0.01	mg/l
n-Hexane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l

Analyte	Faza	Rasini	Pate	Siyu	Tchundwa	Abubakar Khalifa	Unit
n-Hexatriacontane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
n-Octacosane	<0.01	**0.14**	<0.01	<0.01	<0.01	<0.01	mg/l
n-Octadecane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
n-Octane	<0.01	<0.01	<0.01	<0.01	**0.06**	<0.01	mg/l
n-Octatriacontane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
n-Tetracontane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
n-Tetracosane	**0.02**	<0.01	**0.02**	<0.01	<0.01	<0.01	mg/l
n-Tetradecane	**0.21**	**0.11**	<0.01	**0.03**	**0.11**	<0.01	mg/l
n-Tetratetracontane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
n-Tetratriacontane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
n-Triacontane	**0.05**	<0.01	<0.01	**0.05**	<0.01	<0.01	mg/l

The data shows that the volatile hydrocarbons are largely undetectable in water sources of Pate Island. Nonetheless, each of the sampled wells has at least one organic compound available in detectable limits. It is likely that these come from household sources and the open dumpsites.

The Pate well sampled returned Total Dissolved Solids in the field being over 2000 mg/litre. This is not a measure of chlorides; however, it shows a high concentrate of salts and salinity.

Similarly, total petroleum hydrocarbons (TPH) are undetectable (Table 2) which means there are no current cases of oil pollution in the environment.

Table 5.8. Total hydrocarbon analysis results

Analyte	Faza	Rasini	Pate	Siyu	Tchundwa	Abubakar Khalifa	Units
TPH (>C34)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
TPH (>C10 - C16)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
TPH (>C16 - C34)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
TPH (>C28 - C44)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
TPH (>C5 - C12)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
TPH (>C6 - C10)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
TPH C12 - C28	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
TPH C30 - C34	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
TPH C5 - C10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l
TPH C6 - C44	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l

With regards to toxic substances – metals in particular, the following were tested for:

- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Silver
- Vanadium, and
- Zinc

All six samples selected from across the island tested very low values below activation limits for all the metal. Boron was also tested for and was found at concentration above activation level in all sites except Faza. It is a naturally occurring element in groundwater hence the levels seen could be as a result of geology.

Sources of water source contamination

As an indication of the contamination of wells on Pate Island, a study that was done in Lamu gives insight (Giorgio, 2005). The concentration of nitrate measured varied from 5 mg/l to a maximum of 106 mg/l. For 145 wells tested in Stone town, only 19 showed levels of nitrate (NO_3^-) above 50 mg/l, which is the recommended guideline maximum value for by WHO drinking water standards. The spatial distribution of the data showed that the high concentrations of nitrate were found in wells equipped with motorized pumps, suggesting increased seepage from pit latrines due to the drawdown effect where latrines fall within the area of well influence (AWI).

In public wells water is fetched with buckets. Contamination is visible, with empty plastic bottles, plastic bags and “makuti” thatches floating on the surface of the water. It was observed that some of the wells in the villages are close to dwellings hence they are prone to pollution from household waste. The biggest problem expected is nitrate pollution, which is also observed on Lamu Island.

With very low altitude on the island, the water table is high and there is the real risk of cesspits and latrine leachate to mix with groundwater. The second and related problem is that of solid waste disposal. There is no sanitary way yet on the island to dispose of solid waste, hence leachate from open dumpsites is a quick way for contaminants to pollute shallow groundwater.

Figure 5.14. Open dumping of domestic solid waste

Recommendations from hydrogeological survey

The hydrogeological impact assessment study has established that the proposed project will have the challenge of accessing suitable water supply for their operations, based on the assessed available quantities and quality of water supply. Nonetheless, there are options for accessing water through construction of wells on the mainland, as has been done for the Faza Water Project, installation of a desalination plant or locating suitable relatively fresh aquifers in select areas on Pata and Siyu.

The proponent of the proposed project is committed to putting in place several measures to manage the effects of drilling on the water resources. These include transportation of the drill cuttings for safe disposal, using freshwater for drilling operations instead of seawater.

The client has the option of sourcing water from the mainland and transported by barge to the drilling site or drill water wells in the area on aquifer as the Vumbe wells. The Vumbe wells are about 7.5 kilometres from the Faza landing beach. Once the project comes to an end, these wells should be handed over to the county government to be part of the Faza Water Scheme. The same wells will also come in handy if the need to drill on the mainland becomes imperative.

Overall, it is established that the water sources have no toxic compounds or elements and there is no evidence of hydrocarbon contamination

5.1.6. Flora and Fauna

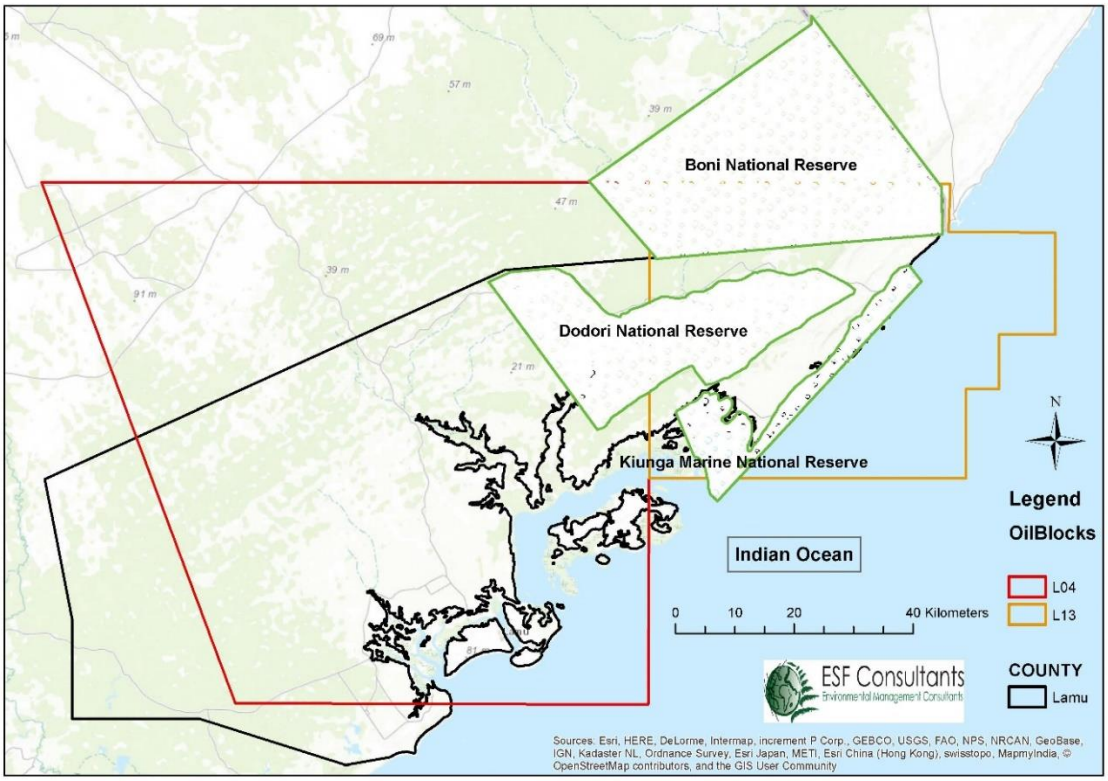
Protected areas

Lamu County has three protected national reserves as shown in **Figure 5.15** below, which are:

1. Boni National Reserve

2. Dodori Forest
3. Kiunga Marine National Reserve

Figure 5.15: Map of National reserves in the project Area



Source: ESF Consultants

Boni National Reserve was gazetted in 1976 as a dry season sanctuary for elephants from Garissa and Lamu Counties. Located in Garissa County and parts of Lamu Count, the general area of the forest lies between 40°83' E and 41°66' E and 1°76' S and 1°25' S and covers an area of 133 km². As an indigenous open canopy forest that boarders the North coast county of Lamu, Boni Forest is the home of Northern Zanzibar-Inhambane coastal forest mosaic that forms a quasi-continuous belt separating forests of the coastal region from the bushlands on the interior lands. Boni forest represents one of the most varied ecosystems and provides a refuge for endangered mammals like elephants, Hirola, and wild dogs as well as a number of rare species.

Gazetted in 1976, Dodori forest lies between 1° 50' S, 41° 8' E in Lamu County and covers an area of 877 KM². The forest forms the northern most extent of the one-time continuous stretch of the East African Coastal forests biome that today remain as fragments of varying sizes and structure and they are one of the Earth's 25 biologically richest places. The forest represents one of the most varied ecosystem and provide a refuge for endangered mammals like the elephant, Hirola and the wild dog, rare species found nowhere else in the world and hundreds of flora and fauna that are still yet to be described. This indigenous open canopy forests of the Northern Zanzibar-Inhambane coastal forest mosaic. Zanzibar-

Inhambane scrub forest forms a quasi-continuous belt that separates the forests of the coastal region from the bush-lands of the interior. Dodori reserve is named after the river ending in the Indian Ocean at Dodori Creek, a breeding place for dugongs. Dodori River and its delta, has some of the densest, most varied assemblage of mangrove forest species in Kenya

Kiunga Marine National Reserve is located in Lamu County, the northern most stretch of the Kenyan coastline ($40^0$07'E, $2^0$00'S). It was designated in 1979 under Wildlife conservation and Management Act of 1976, and it is currently, under the management of Kenya Wildlife Service (KWS). The reserve covers an area of 250 Km^2 (25,000 hectares) in the Northern part of Lamu Archipelago. It's over 50 Km in length and 5 Km in width. The reserve extends to the shoreline to a discontinuous outer rocky reef which is as shallow as 8 meters in some places, and has its southern end within the reserve. The bottom reaches a maximum depth of 40 meters mostly in sandy area between shoreline and the rocky reef. Beyond the rocky reef, the continental shelf slopes into deeper waters.[25]

Kiunga Marine National Reserve and Dodori National Reserve were granted "Man and Biosphere Reserve" status by UNESCO due to their biological sensitivity and dependence by the local community's for natural resources.[26],[27]

- Strengthening of management operations of Kiunga Marine National Reserve
- Collection, analysis and use of ecological and socio-economic information for management Improvement community and stakeholder understanding of and support for conservation needs Promotion of sustainable use of Kiunga Marine National Reserve's resources to improve their livelihoods.

Vegetation in Lamu

Due to varying soil types, the vegetation keeps changing. Silt and sand support scrub bushes, scatter palms and indigenous trees and scrubs. Grassy open swampy places dominate some parts that have drainage problems due to low altitude in the region. The coastline has sandy beaches, some with mangrove swamp and great variations of marine flora including bivalves, nails and other benthic invertebrates. Microscopic marine plants are absent from the upper part of the inter-tidal zone except for areas with *Bostrychia species*.

Inter-tidal sand and mud have finer sediments below water, which are subject to less wave action, and have become fixed by growth of green algae and *Zostera species*. Dwarf shallow-like shrub thickets of halophytes typical for this region littoral zone are common on the mainland, and species include *ipomea species*, *perus species*, *suaeda species* and *Tephnosia species*. The largest Mangrove forests strands in

[25] Weru S. M, Lubia I, Nikes N, Church J, Verheij E, Koyo A. O, Muthiga N, Kavu B. K, Kareko J. K, and Litoro K., 2001: Management plan: kiunga marine national reserve (Hof. T. Ed), Kenya Wildlife Service and World Wide Fund for Nature, Coast Region Headquarters, Mombasa.
[26] UNEP, 1998: Eastern Africa Atlas of coastal resources: UNEP Regional Reports and Studies, No. 1 Nairobi, Kenya
[27] Tychsen, J. 2006 (ed.): KenSea. Environmental Sensitivity Atlas for Coastal Area of Kenya, 76 pp. Copenhagen; Geological Survey of Denmark and Greenland (GEUS); ISBN 87-7871- 191-6

Kenya are found in Lamu (30,000 hactares from Lamu to Kiunga. Here, there are protective islands, gentle relief and slightly estuarine conditions predominated by sheltered waves.

In Block L4, wooden bushlands are a common terrestrial feature confined to the stabilized sand dunes, beach ridges, low and high level coastal plains and bottomland plains. Wooden bushland dominates the expansive black clay soils and include *Acacia tortilis, Acacia zanzibarica, Commiphora sp, Euphobia spp, Acacia melifera, Trichilla emetic* and *Teminalia spp*.

At Pate Island, Riverine forest occur and they are predominantly composed of woody vegetation found along waterways including *Acacia spp, Afzelia quanzensis, Indigofera Spinosa, Dalbergia melanoxylona* and *Termimalia spp* which dominate riverines of Dodori and Lugga Milimani.

Perhaps the most important type of natural vegetation in Lamu County is the mangrove forests and thickets. This type of vegetation is found in swamps and their adjacent saline areas. The mangrove forests extend from Hongwe in the south to a few kilometres south of Kiunga. Pate Island lies within Kenya's largest mangrove forest archipelago and the island is surrounded by mangroves. This system confers high productivity to the surrounding fisheries and also provides valuable mangrove products for local communities.

Mangroves are of two types: Creek mangrove (occurs in low gradient shores, creeks and bay); and Fringe mangrove (occurs solitarily or in cluster along high energy shores, in front of rocky and cliffs). Creek mangrove is the most common mangrove formation in the project area, and indeed the largest mangrove cover (304.75 km^2) found in Lamu archipelago[28].Areas with large extents of creek mangroves include Kiwayu, Kiunga, Kizingitini, Ndau and Mikokoni.

Mangroves are inter-tidal as they occur naturally between the mean of low water neap and extreme high water spring[28]. They grow along sheltered sedimentary shores, especially in bays and estuaries[24]. Mangrove species in the project area include: *Rhizophora mucronata, Brugueria gymnorhiza, Ceriops tagal, Sonneratia alba, Avicenia marina, Lumnitzera racemose* and *Xylocarpus granatum.*

A salt marsh is dominated by halophytic (salt tolerant) herbaceous plants as they thrive in intertidal transition between land and saline water. Flora composition is therefore low as the vegetation must be salt tolerant, complete or partial submersion, and anoxic mud substrate. Common salt marsh vegetation includes glassworts (*Salicomia spp. And Sarcocomia spp.)*, the cord grasses (*Spartina spp*) and several grasses and sedges. Salt marshes are found on the landward margins of Kiunga and Mikokoni areas.

5.1.7. Flora of Pate Island

During the baseline survey the ESF Consultants where able to spot different tree species within the island.

Mango (Mangifera indica)

[28] Ruwa, R. K., 1992. Mangrove wetlands in Kenya. *In. Crafter S.A; Njuguna S.G; and Howard G.W (Eds), 1992. Wetlands of Kenya. Proceeding of the KWWG Seminar on Wetlands of Kenya, National Museums of Kenya, Nairobi, Kenya 3-5 July 1991*. Vii+183 pp.

The mango trees were spotted mainly in areas of Pate and Siyu location. Mango trees are planted for their fruit, shade due to the large crown, charcoal, fuelwood, timber, herbal medicine, and fodder for livestock.

Mangroves Forest

Mangroves are among the most productive ecosystem. They provide a broad array of goods and services to the local community. They play an important role in on and offshore fishery, providing juvenile fish with nursery habitats and shelter. They are also a source of timber and fuel wood for the adjacent villages. They are rich in biodiversity, they can store and sequester significant amount of carbon, protect the shoreline from soil erosion.

Figure 5.16: Mangroves ecosystem as viewed from Pate social hall

Neem tree (Azadirachta indica)

The tree is drought resistant and does well in poor soils. Its highly used as medicinal from the bark and leaves. It also provides timber and fuel wood for the local community, as the shown in the

Figure 5.17

Figure 5.17: Neem tree (Azadirachta indica) spotted in areas of Mbwajumwali Location

Tamarind (Mkwaju) (*Tamarindus indica L*)

Is large evergreen tree, with dense crown, greyish-brown leaves alternative, compound with 10-18 pairs of opposite leaflets, the tree can tolerate a wide range of soils and climatic conditions.

Banana plantation

Pate location is one of villages they practice crop faming as shown in the

Figure 5.18. The island has good soils favourable for growing crops especially bananas. They are grown for subsistence and the excess products are sold in the local markets. The bananas grown in Pate Island are rain fed.

Figure 5.18: Banana Plantation spotted at Pate location

Coconut tree (*Cocos nucifera*)

The coconut tree (*Cocos nucifera*) is a tropical plant from the palm family. Uses of coconut tree are as follows:

a) used locally for its refreshing drink called “madafu” and white gelatinous flesh
b) Tree leaves used: for thatching houses, making brooms
c) Husks used to make rope
d) Flowers used for its medicinal value
e) Coconut oil: used for cooking; making skins and hair products

The *Cocos nucifera* is shown in

Figure 5.19 common found in areas of Faza, Tchundwa, Siyu and Mbwajumwali

Figure 5.19: Coconut trees spotted in Faza location

5.1.8. Fauna spotted in Pate Island

During the field visit the team was able see different species of animals especially livestock kept in the island such as cattle, donkey, cats, dogs and chicken. Keeping of livestock is done mostly by the Somali and Orma pastoralists who migrate frequently depending on the severity of drought in Lamu, Tana River and Garissa Counties. The common types of cattle found are the Boran, Semi-zebu shown in Figure 5.20. Donkeys are kept mainly for use of transport within the Island.

Figure 5.20: Cattle Roaming on roads in Pate Island

Figure 5.21: Donkey Spotted in Pate

5.2. Socio Economic Baseline

The socio-economic baseline will look into the following parameter but not limited to:

a) Demography characteristics such as population structures and trends, in and around the area of interest

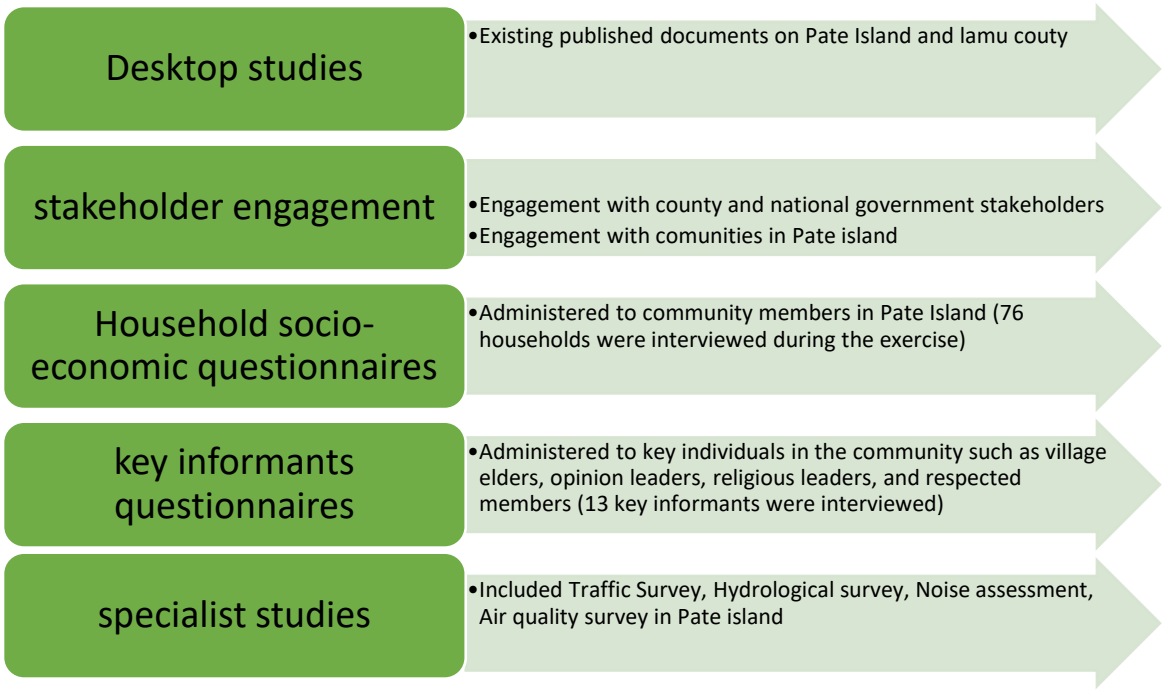
b) Both direct and indirect economic baseline such as employment, labour supply and demand, among others

c) Supply and demand of local services such as health, education, housing, transportation, among others

d) Socio-cultural aspects such as quality of life, social problems, among others

In the development of the socio-economic section of the baseline, the following methodologies were used:

Figure 5.22: Socio-economic Methodology

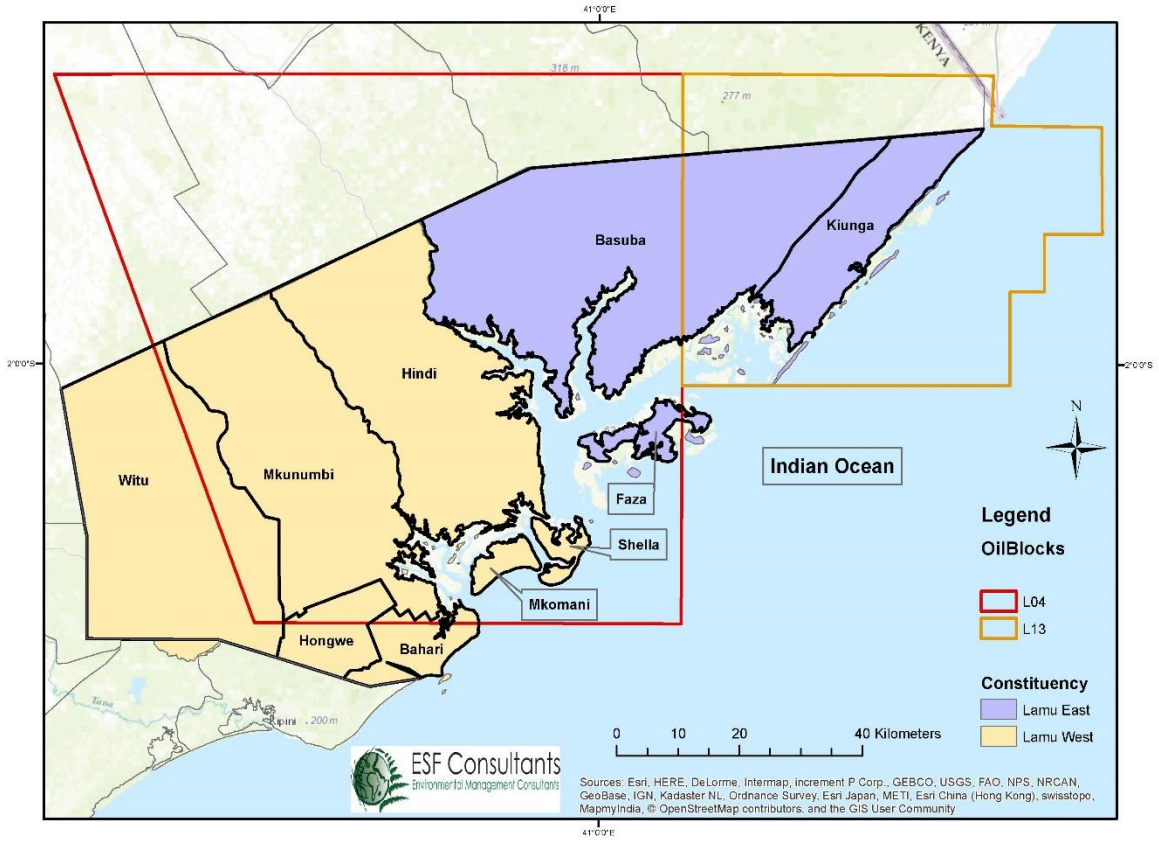


5.2.1. Administrative Units

Lamu has two sub counties namely Lamu East and Lamu West. In the political mapping the county has two constituencies namely Lamu East composed of Basuba, Faza, and Kiunga wards and Lamu West composed of Bahari, Hindi, Hongwe, Mkomani, Mkunumbi, Shella, and Witu wards. This has been represented in

Figure 5.23 below. The county has 23 locations and 38 sub locations.

Figure 5.23: Wards Located in Lamu County



Source: ESF Consultants

Below is the ministry structure of Lamu County.

1. Ministry of Land, Planning, Development & Natural Resources
2. Ministry of Trade and Culture
3. Ministry of Fisheries & Livestock
4. Ministry of Information, e-Governance and Citizen Participation
5. Ministry of Education, Gender, Youth Affairs, Sports & Social Services
6. Ministry of Finance, Strategy & Economic Planning
7. Ministry of Agriculture
8. Ministry of Health Services, Sanitation and Environment

5.2.2. History and Culture

History of Pate Island

The history of Pate begins with the foundation of the kingdom in 1204, when a member of the Nabahani royal house of Oman married the daughter and heiress of the previous dynasty of Pate, the al-Batawoya. The Nabahani established a ruling dynasty for six centuries to about 1812 under 34 kings. The ruling was monarchical[29].

According to Mr. Khalifa Bwanamaka, caretaker of Pate ruins, in 14th century, Pate town was the most powerful in the East African Coast as it had conquered all of Lamu Archipelago and had spread its rule as far North as Somali and South to Sofala, (Tanzania and Mozambique border). At this time Mvita was the name of Pate and Mogadishu (which was named by the Europeans) was earlier known as ''Mui wa mwisho'' which meant the last town. Both towns were under the rule of Nabahani Family. Portuguese later arrived and wanted to dominate as fights ensued.

By mid-16th century the influence by the Portuguese brought about a chapel, prison, custom house (ushuru), grave yards and plantations of cassava, bananas and tobacco started. The plantations before they arrived were cashew nuts, coconuts and mangrove. By the end of 16th century the Portuguese rule was starting to diminish and the Arabs started to flourish as trade was doing well. Wars between Pate and Lamu followed.

There were four wars in total, Pate won the first three but lost the last one which was in Shela. The weapons that were being used included swords, guns and cannons. The battle of Shela was in 1812. After the battle, the royal family and many of the people of Pate moved to Witu and because of the deaths and migration, the population decreased from 48,000 to 7,000 people. About 1892, there was a disaster of cholera and diarrhoea outbreak. There was a further decrease of population from about 7,000 to 3,000 people.

Pate is today a small fishing village but extensive ruins of the former town still exist, and include several mosques, a palace and large surrounding defensive walls[30]. According to traditional sources the first settlement was made during the 7th Century, by Syrian Arab traders who settled down and intermarried with the local people. Clearly Pate is one of the most important sites of East Africa.

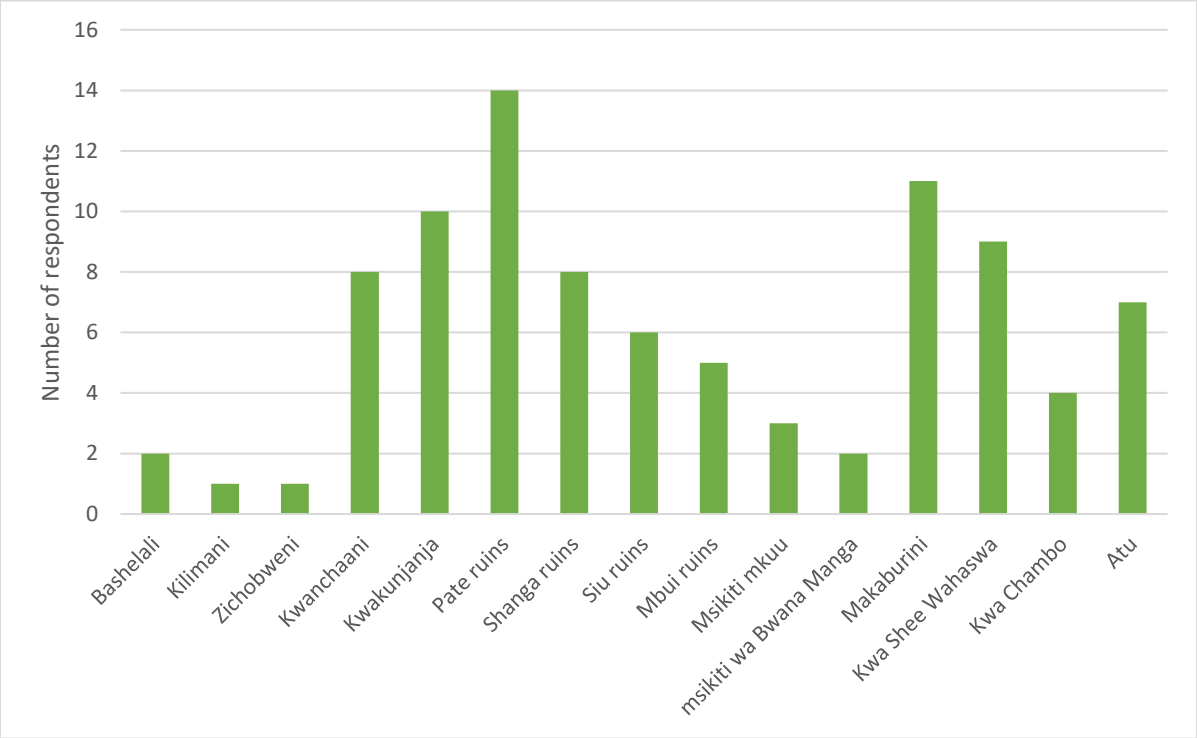
From the key informant's survey, 69% of the respondents were aware of existing historical/archaeological sites. 23% were not aware of any while 8% didn't know[31].

According to the household socio-economic survey conducted, the communities identified the important historical/ archaeological sites in Pate Island. Pate ruins were identified as the most known historical site

[29] Allen J, V. (1993). Swahili Origins; Swahili culture and the Shungwaya Phenomenon. London: James Currey Ltd.
[30] Spear, T. (2000). Early Swahili History Reconsidered. Boston: Boston University African Studies Centre.
[31] ESF Consultants key informants survey data collected from Pate Island

while Makaburini was identified as a burial site within the Island[32]. This is represented in Figure 5.24 below.

Figure 5.24: Important historical, cultural, and burial sites in Pate as identified by the communities



Cultural Heritage

Lamu Stone Town is recognized as a UNESCO World Heritage Site. Other key monuments and cultural heritage places in Lamu County include

- Boni Dodori National reserve
- Lamu Museum
- Lamu Fort
- Siyu Fort
- Takwa Ruins
- Swahili House
- Kunjanja Mosque
- German Post Office
- Lamu Stone Town
- Kiunga National Reserve

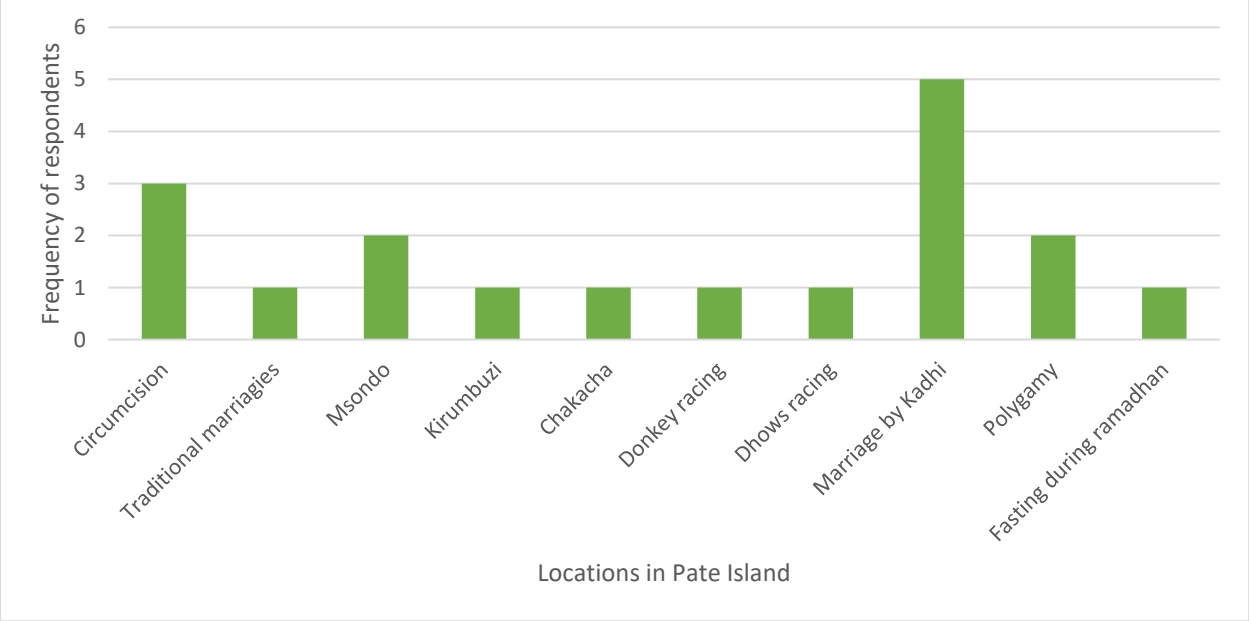
[32] ESF Consultants Household Socio-economic data collected from Pate Island

Lamu County is known for its rich Swahili Culture dating back to 14th Century. During these times traders arrived in Lamu and other areas along the East African coastline from different parts of the world including Asia, Arabia, and Europe. Some of the goods and commodities bought by such traders include mangrove poles, animal products, grains, and slaves. In exchanges for these valuable Lamu products, the foreign traders brought in goods like cloths and spices from other parts of the world. As trading continued, some traders settled in Lamu Town and intermarried with the local communities such as the Pokomos and other natives of the area. The resultant blend between the foreigners and the locals led to the formation of the Swahili Culture which is widespread along the Kenya Coast.

Lamu Cultural festival is an annual event dedicated to celebrating and preserving the cultures and heritage of the archipelago. Each year, the event is timed to coincide with the high tides that create ideal conditions for the large Jahazi and Mashua Dhows that engage in the races. Other competitions in this festival include swimming, canoe races, and donkey races. Similarly, the tradition of this festival stipulates that each of the Islands show case their dances. Other activities like henna painting, iron smelting, wood carving, dhow making, mat making, and palm weaving are also show cased in this festival[33].

From the survey, 54% of the respondents from Pate Island were aware of existing cultural sites while 46% were not aware of any[31]. According to the socio-economic survey, customary practices are still practiced in Pate Island. Marriage by Kadhi and circumcision are the most practiced[32]. These are represented in Figure 5.25 below

Figure 5.25: Customary practices among communities in Pate Island



Religion

[33] Magical Kenya. n.d. *Lamu: Where history lives.* [Date accessed 5th May 2016] Available from: *www.kenyabrussels.com/ckfinder/userfiles/files/.../**Lamu**.pdf*

According to archaeological evidence, the earliest mosque to be excavated, dates back to the 8th century was actually in Shanga, which is in Pate Island. Large Percentage of the people in Pate Island are Muslims[34].

Islam is the most conspicuous religion in Lamu County with over 68% coverage while Protestant mainstream follow with 13%. Table 5.9 below shows the distribution of religious groups in Lamu County.

Table 5.9: Religious Affiliation in Lamu Couty[29]

Affiliation	Catholics	Protestant-Mainstream	Protestant-Evangelical	Islam	None
Percentage	11%	13%	8%	68%	0%

From the survey, 69% of the respondents were aware of existing religious sites while 31% were not aware of any[31]. No cultural differences were noted by the people occupying Pate Island. From the household socio-economic survey conducted, there are two main religions in Pate Island i.e. Islam and Christianity[32]. 97% of the respondents practice Islam as a religion in the project area.

5.2.3. Demography and Social determinants

Population and demography

Lamu County population has registered an upward trend in growth since first censure was held in 1969. Table 5.10 below shows the statistics on the number of persons registered in each of the household census carried out in Kenya. As per the 2012 population projection, it was estimated that Lamu County has a population of 112,551 people out of which 58,641 were males and the rest were females.

Table 5.10: Population Census Results[35]

	1979	1989	1999	2009
Population	42,299	56,783	72,686	101,539

Based on numerous projects on going in Lamu such as the LAPSSET project and the Lamu Port, the population project continues to increase with migrant population expected to push the county's number to more than one million between by 2020. According to the Lamu County Integrated Development Plan 2014-2019, the following trends shown in Table 5.11 are expected in 2015 and 2017 in terms of population distribution.

[34] Maiteri, C. (2012). Form and Symbolism of Swahili Architecture in Pate Island.
[35] Kenya National Bureau of Statistics (KNBS). 2009. Economic survey 2009. Nairobi: KNBS. Kiamba, M., 1994. The Dynamics of Urbanization and Urban Development in Kenya.

Table 5.11: Population Projections for Lamu County [37]

	2009 CENSUS)			2012 (PROJECTIONS)			2015 (PROJECTIONS)			2017 PROJECTIONS		
Age Group	MALE	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**
0-4	8038	7681	15719	8886	8491	17377	9823	9387	19210	10503	10503	21005
5-9	7375	7184	14559	8153	7942	16095	9013	8780	17793	9636	9636	19272
10-14	6148	5904	12052	6797	6527	13323	7514	7215	14729	8033	8033	16066
15-19	5722	5095	10817	6326	5632	11958	6993	6227	13220	7476	7476	14953
20-24	5020	4577	9597	5550	50560	10609	6135	5594	11729	6559	6559	13118
25-29	4155	3905	8060	4595	4317	8910	5078	4772	9850	5429	5429	10858
30-34	3713	3125	6838	4105	3455	7559	4538	3819	8357	4851	4851	9703
35-39	3070	2579	5649	3394	2851	6245	3752	3152	6904	4011	4011	8023
40-44	2363	1918	4281	2612	2120	4733	2888	2344	5232	3088	3088	6175
45-49	1890	1644	3534	2089	1817	3907	2310	2009	4319	2469	2469	4939
50-54	1522	1384	2906	1683	1530	3213	1860	1691	3551	1989	1989	3977
55-59	1113	927	2040	1230	1025	2255	1360	1133	2493	1454	1454	2909
60-64	1051	890	1941	1162	984	2146	1284	1088	2372	1373	1373	2746
65-69	583	468	1051	645	517	1162	712	572	1284	762	762	1524
70-74	533	476	1009	589	526	1115	651	582	1233	696	696	1393
75-79	228	197	425	252	218	470	279	241	519	298	298	596

	2009 CENSUS)			2012 (PROJECTIONS)			2015 (PROJECTIONS)			2017 PROJECTIONS		
Age Group	MALE	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**
80+	478	527	1005	528	583	1111	584	644	1228	625	625	1249
85+	43	13	56	48	14	62	53	16	68	56	56	112
TOTAL	**53045**	**48494**	**101539**	**58641**	**53610**	**112251**	**64827**	**59265**	**124092**	**71664**	**65515**	**137180**

Data collected from the key-informants indicated that Kizingitini and Faza had the highest population of people. This is due to the fact that Faza is the administrative headquarters of Pate Island and Kizingitini is the main fishing town in Pate[31]. Figure 5.26and Figure 5.27 below represents number of people per location and number of households per location in Pate Island. According to the socio-economic survey conducted, most households have between 4-9 persons[32]

Figure 5.26: Population demographics (number of people) per location in Pate Island

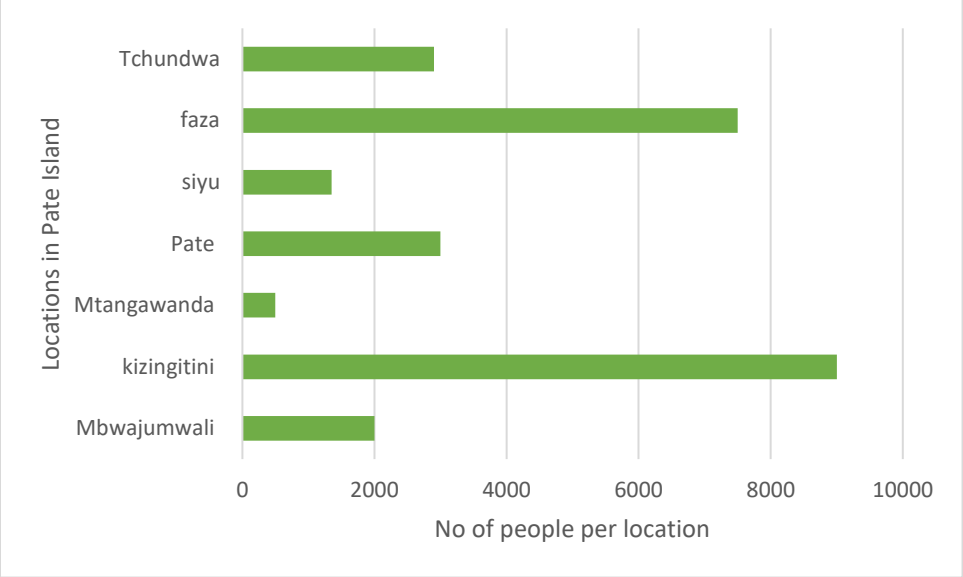
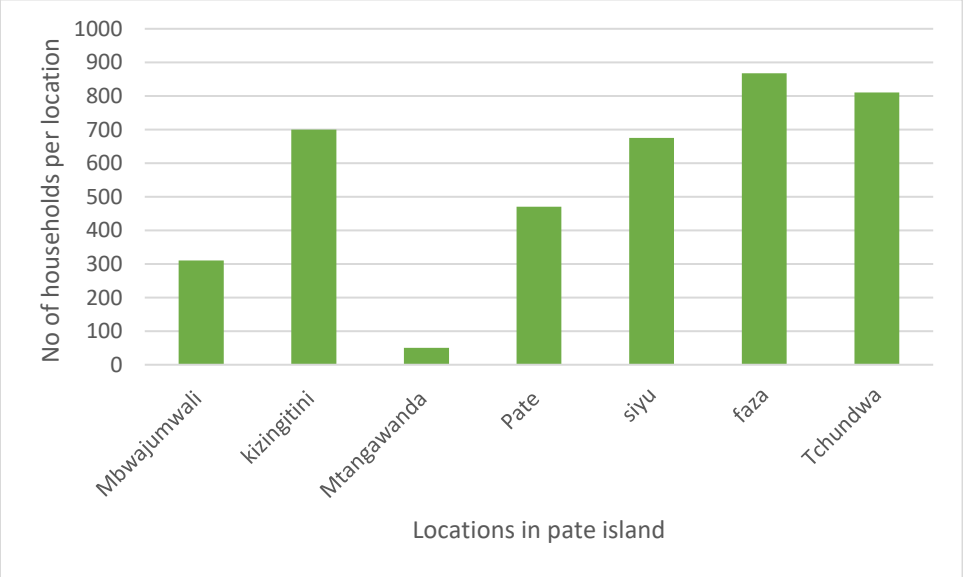


Figure 5.27: population demographics (number of households)



Gender

Out of the 76 participants in the socio-economic survey, 82% were male and 18% female[32] Most of the participants were between ages 31-40 years and no minor was interviewed (see Figure 5.28). The survey

targeted household heads and out of the 76 participants, 76% were household heads (see Figure 5.29 below)

Figure 5.28: Age distribution of the 76 households interviewed

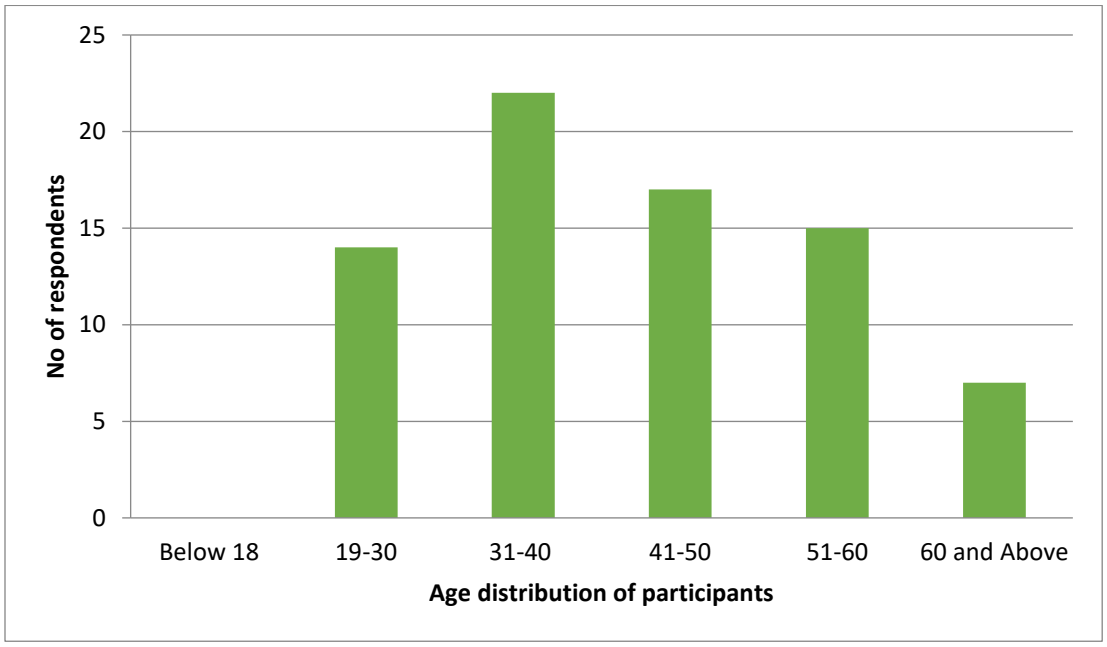
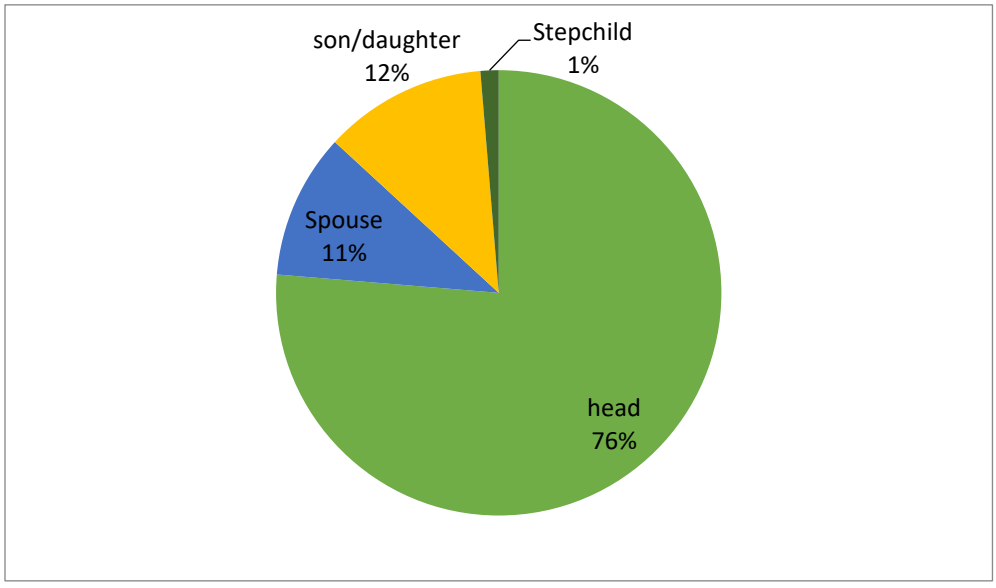


Figure 5.29: Nature of participants interviewed

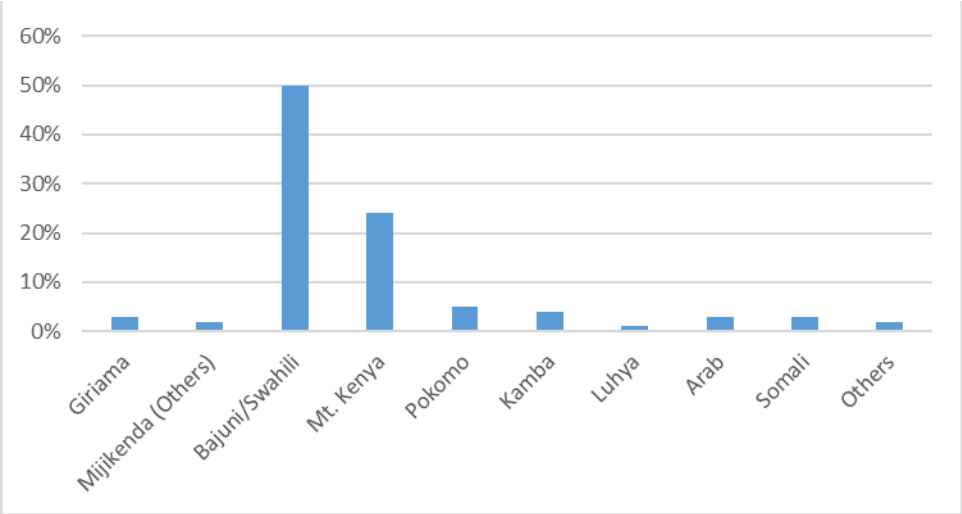


Ethic Groups and Language

The County is made up of Cosmopolitan population composed of indigenous communities made up of Swahili's, Arabs, Korei, Boni, and Ormas as well as migrant communities from the rest of the country.

According to a survey by Ipsos in 2014, the coast region and Lamu in particular has different numbers of community/ethnic groups. In Lamu County, several communities/ethnic groups exist, including immigrants in both the mainland and Islands (as illustrated in Figure 5.30 below). Kiunga Division is inhabited by the Boni community and Bajunis. The Bonis are preoccupied with traditional bee keeping while the Bajunis are fishermen[36]. Among the Mijikenda community subtribes only Digo lacks representation in Lamu County[37].

Figure 5.30: Distribution of Ethnic Groups in Lamu County[29]



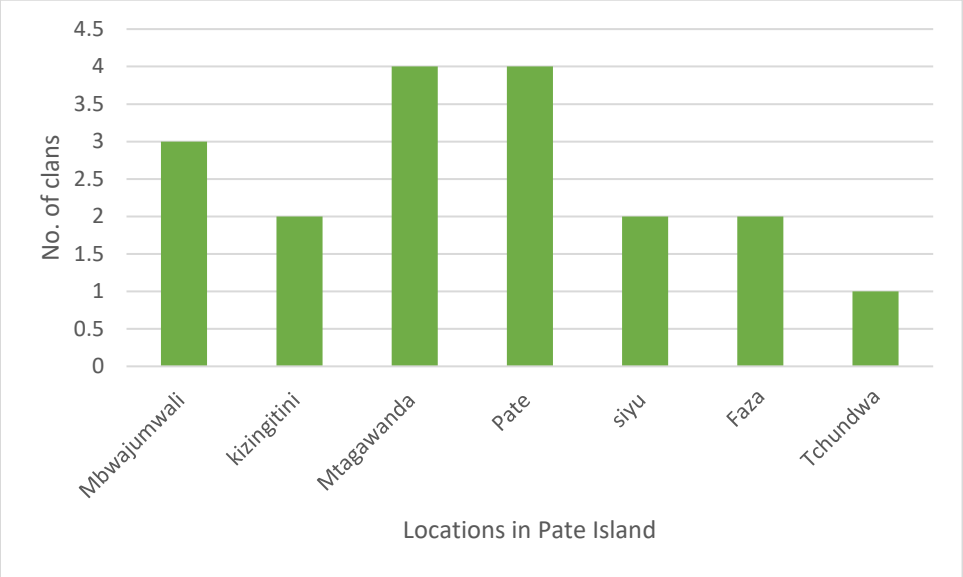
According to the key informants survey conducted, Pate Island is predominantly dominated by the Banjunis and just a small percentage of Swahili people. The main language spoken is the banjuni and Swahili language. There are several clans within the locations namely: banjuni, vatandaa, masharifu, lausy, khazrad, Nabahany, Al-kindiey, Bawry, nabahany, Al-mafazii and Wanzalia. The distribution of these clans is represented in

[36] Environmental & Social Impact Assessment Project Report for The Proposed Hindi MJ Road – Mokowe Old Jetty – Lamu Island's Mnazi Moja– Manda Island 33kv & 11kv Electrical Transmission Line and Associated Substation in Lamu Island, Lamu County

[37] Ipsos Survey, 2014: Household Development, Marginalization, Security, and Public Participation.

Figure 5.31 below.

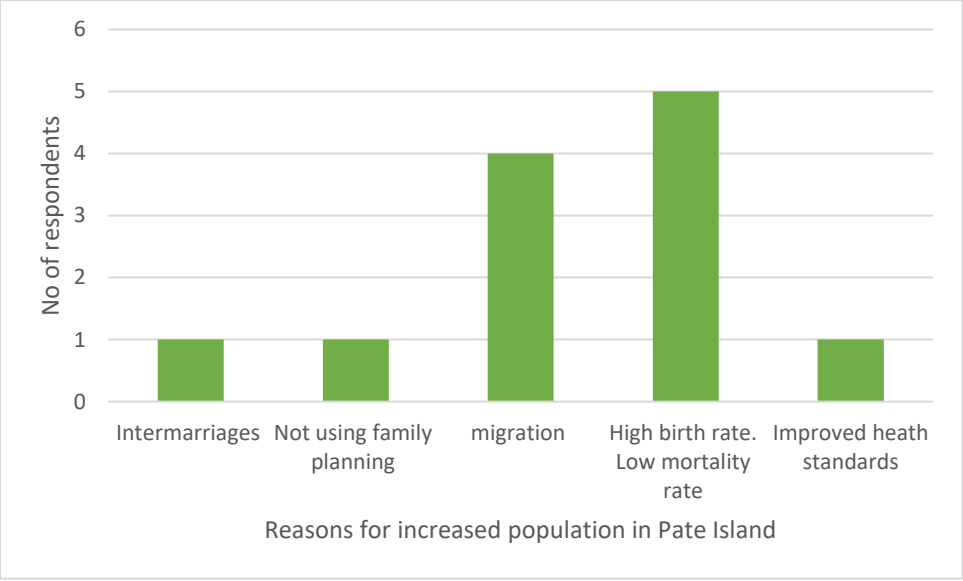
Figure 5.31: Number of clans within the locations in Pate Island



Population influx and migration of people in Pate Island

According to the key informants survey carried out, all key informants observed that there has been an increase in human population in the recent past. Some of the suggested main reasons for the increase in population are high birth rate vs low mortality rate and migration as shown in Figure 5.32 below.

Figure 5.32: Reasons for increased population in the last 10 years in Pate Island



50% of key personnel interviewed expressed that there has been migration into the area. According to the household socio-economic data collected, 96% of the respondents were permanent residents of Pate Island since birth and 4 % migrated to the Island due to issues such as insecurity, Escape from drought/Famine and seeking job opportunities[32]

5.2.4. Welfare

Education and literacy levels

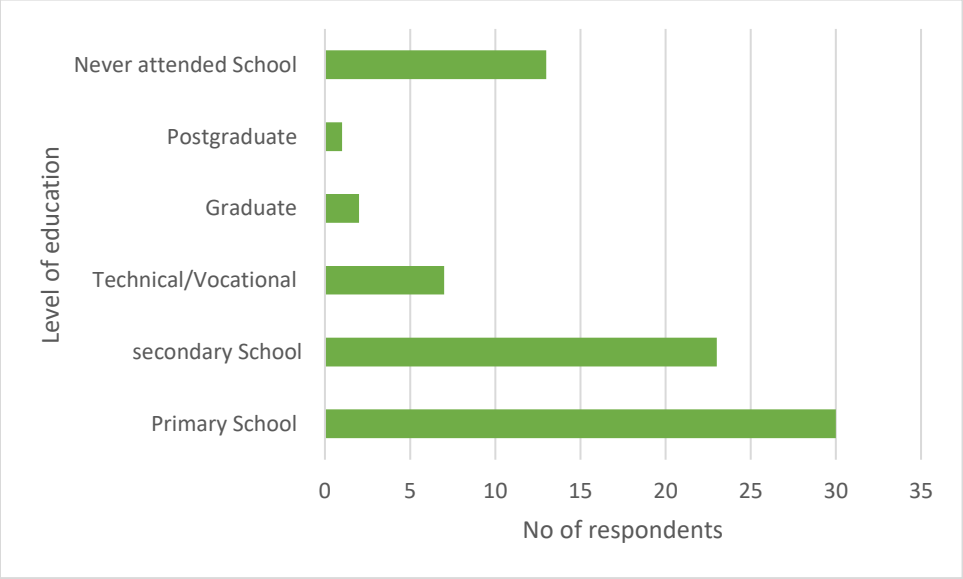
Education levels in Lamu County are generally low. Literacy levels are low which is most likely to be attributed to inadequate number of schools and vocational training colleges in the area. A glance at the county' literacy level is presented in Table 5.12

Table 5.12: Literacy Levels[37]

Education level	Percentage of Population
Illiterate	11%
Functional Literate	9%
Primary Incomplete	19%
Primary Complete	27%
Post-Primary Training	1%
Secondary Incomplete	7%
Secondary Complete	16%
Post-Secondary Training	6%
University	3%

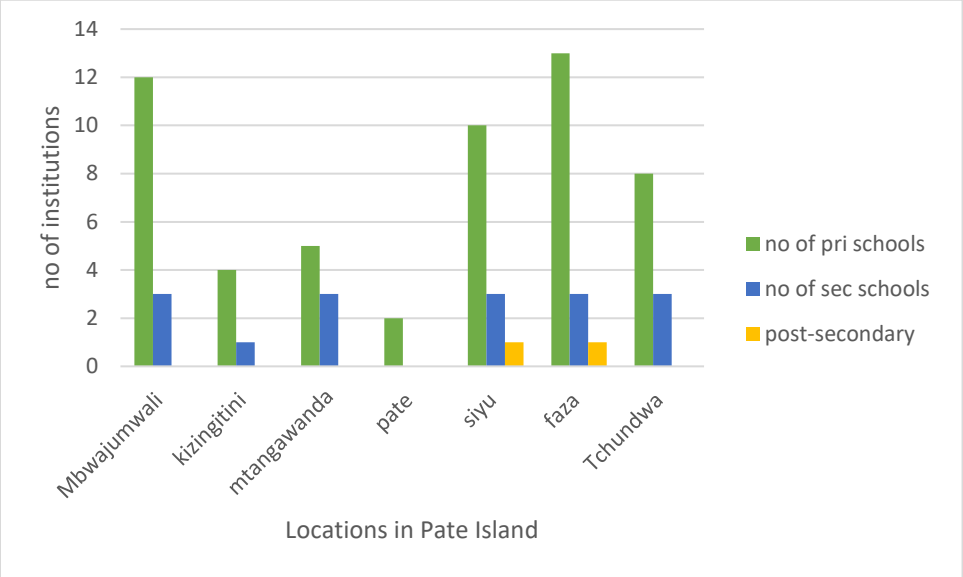
Out of the 76 participants in the survey, only 13% have attained post-secondary education. Majority of the participants have attained primary school education only as depicted in Figure 5.33 below.

Figure 5.33: Level of Education of the 76 participants in the socio-economic survey



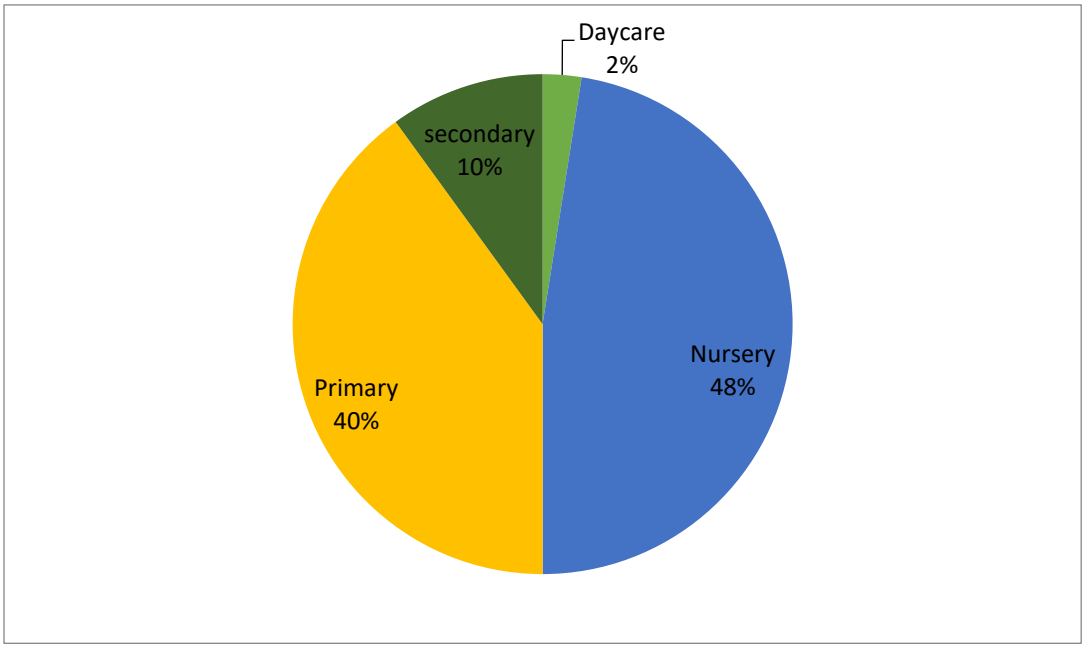
According to the Key-informants survey conducted in Pate Island, illiteracy is as a result of low education standards in the area. This is attributed to poverty, early marriages, drug abuse and mental diseases. It was noted that most communities prefer engaging their children in fishing activities when young to attending schools. Figure 5.34 below describes the distribution of learning institutions in Pate Island in regards to data collected from key informants.

Figure 5.34: Distribution of learning institutions per locations in Pate Island



The average percentage of learning institutions is represented in Figure 5.35 below. This is according to the socio-economic survey conducted.

Figure 5.35: Average percentage of learning institutions in the project area.



According to socio-economic survey, 85% of the respondents were not satisfied by the education status in Pate Island while 15% were satisfied. The main reasons given for not being satisfied with education status in Pate include: School fees problem; lack of quality education; limited qualified or professional teachers; shortage of books and poor education performance by schools and students.

The major problems associated with access to education include school fees, teacher availability and poverty. Poverty has the greatest impact on education access (47%) in Pate Island, followed by school fees (33%) and the availability of teachers (20%)[32]

Wealth Distribution

The distribution of wealth is a comparison of the assets and incomes of various members or groups in a society. It differs from the distribution of income in that it looks at the distribution of ownership of the assets in a society, rather than the current income of members of that society.

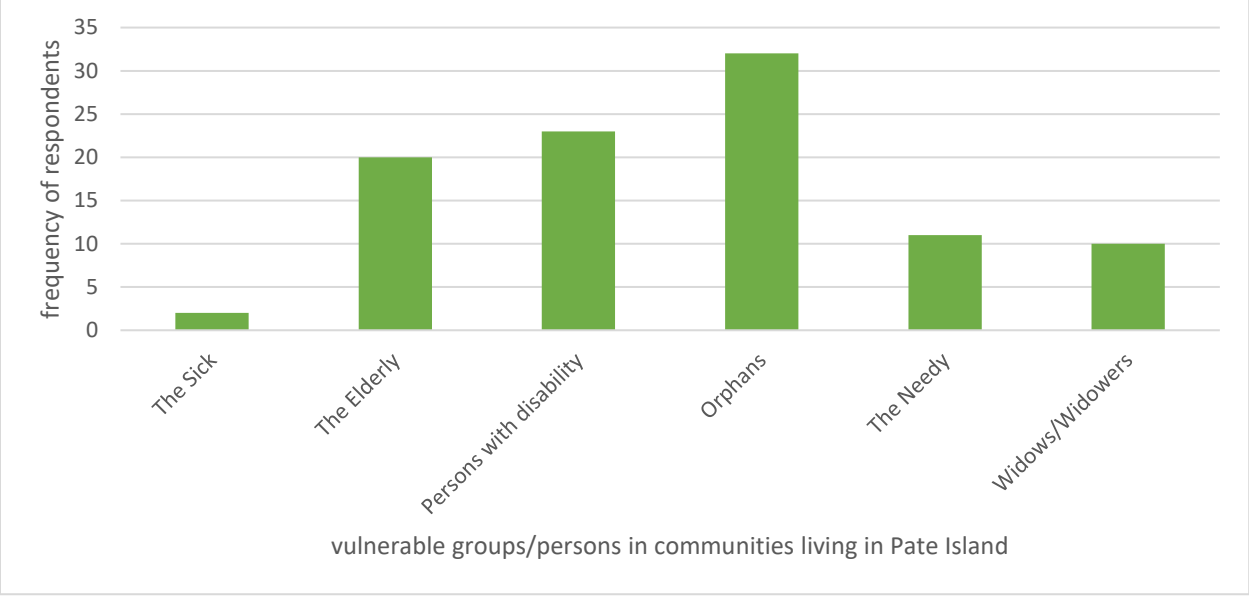
From the survey conducted, it was established that people in the project area acquire wealth through: inheritance, businesses, farming, and fishing. Money is spent in acquiring basic needs such as food, clothes, shelter, education and health services. The community perception of a wealthy person is one who has a lot of money and properties

Vulnerable Groups

Pate Island has been marginalized in many aspects of development. From land ownership and inadequate infrastructure development, people in the Island remain relatively poor and survive on natural resource dependent activities fishing, honey collection, pastoralism, farming, and mangrove harvesting for survival.

Community members listed the poor, women-headed households, disabled, orphans and the elderly as the vulnerable groups among the communities. Persons considered as most vulnerable in the society are the orphans and people with disability. This is represented in Figure 5.36 below.

Figure 5.36: Vulnerable groups in the society



5.2.5. Economic Activities

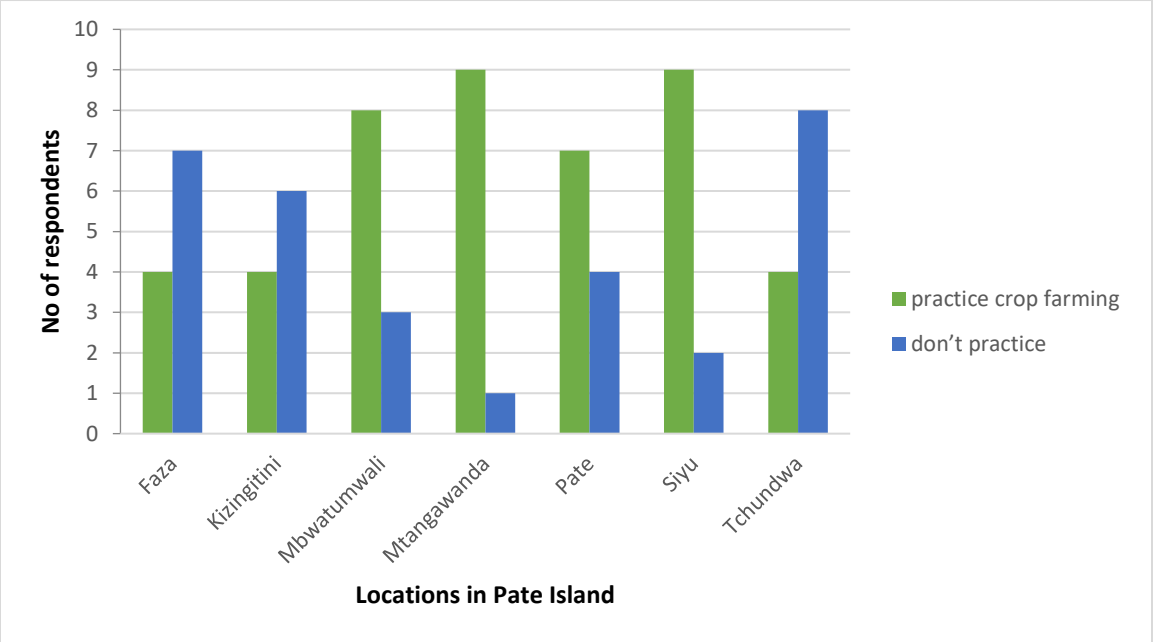
Crop production

Crop production is mainly practiced on the mainland. Major crops grown in the county include maize, cassava, peas and green grams. Others include cotton, coconut, mangoes, bananas and bixa. Horticultural farming has currently been introduced. National Cereals and Produce Board (NCPB) depots provide storage facilities for cereal crops produced.

In Pate Island some of the crops grown include cashew nuts and coconuts[32]. Based on the data collected from the field, 59% of the sampled population carried out crop farming while 41% did not engage in any crop farming.

A comparison among the seven locations in the project area indicated that Mtangawanda and Siyu had the highest number of respondents engaged in crop farming. On the other hand, Tchundwa and Faza had the highest number of respondents that did not engage in crop farming as show in Figure 5.37 below.

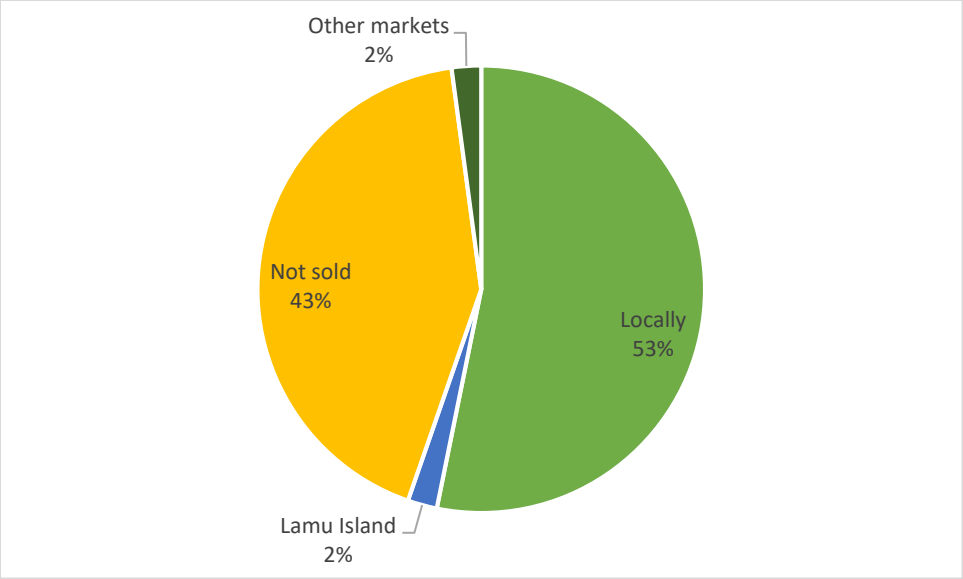
Figure 5.37: Crop Farming Response per Location



The most common crop in the project area is cereals with 82% of the respondents having indicated their engagement in the farming of cereals. Vegetables and fruits each have an 8% of coverage of the crops farmed in the area. All the crop farming done in the project area depends on rains for success.

According to the results of data analysis from the socio economic survey, 53% of the crop produce are sold within the local markets, 43% is consumed, while an equal share of the remaining percentage is shared between sales in the markets of Lamu Island and other areas as shown in Figure 5.38 below.

Figure 5.38: Main markets for crops



Livestock Farming

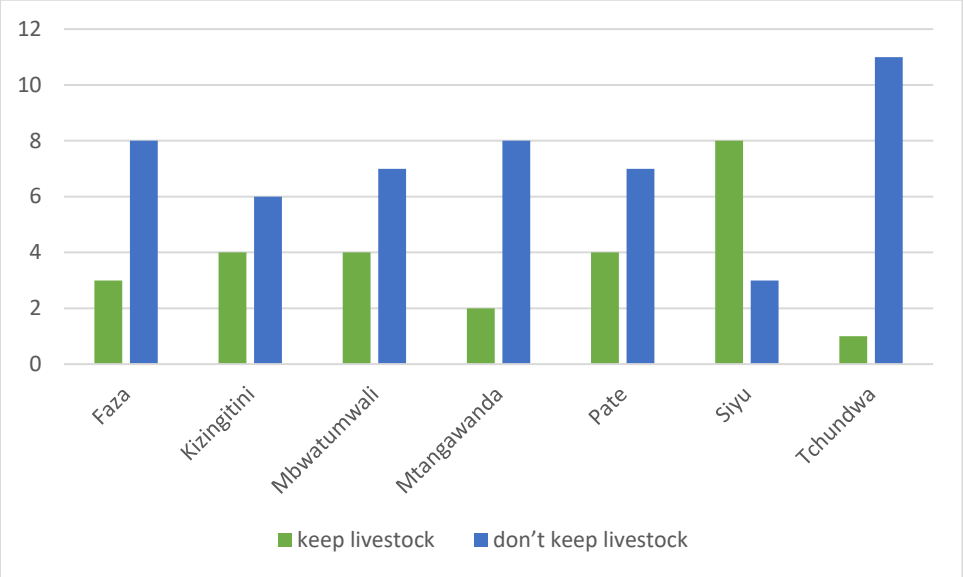
Livestock farming in Pate Island a source of livelihood for approximately 30% of the population, both directly and indirectly. Some of the common livestock in the area include; cattle, goats and sheep. Poultry farming and bee keeping are also practiced in the area.

Livestock farming plays a role in poverty reduction since pastoralists are among the vulnerable groups and depend on livestock farming for survival

Based in the socio-economic survey and data collected from the field on 34% of the sampled population carried out livestock farming. 66% did not engage in livestock keeping as an economic/agricultural activity as shown in Figure 5.39. Out of the 34% of the livestock keepers among the respondents, Siyu location registered the highest number of livestock keepers followed by Pate. Kizingitini and Mbwatumwali had equal number of livestock keepers. Tchundwa location on the other hand had registered the highest number of population which did not engage in livestock keeping followed by Faza and Mtangawanda. This is described in

Figure 5.39.

Figure 5.39: Livestock keeping trends per location



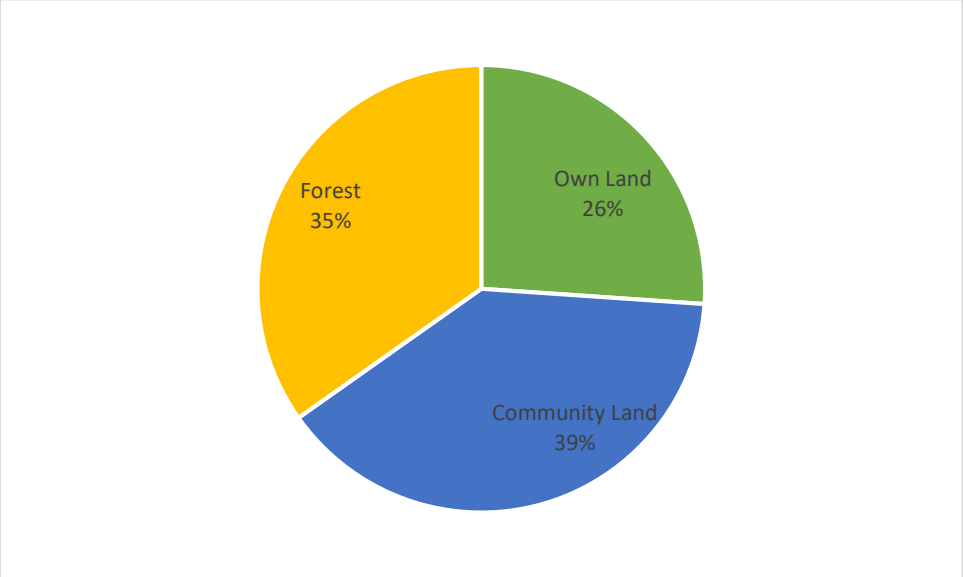
Among the 34% of the sample population dealing in livestock keeping, the lead animal in stock area cattle with a 25% coverage followed by goats with 15%. Donkeys are third at 13% while sheep covers only 2% of the animal kept in the project area. Other animals such as chicken, rabbits, pigs, dogs cover 45% of the animals kept in the project area[32]

In terms of mode of grazing for the animals kept in the project area, 91% of the respondents use free range mode of grazing while 5% of the respondents use paddocking as a mode of grazing. The rest used other means tethering[32]

On the sources of pasture for the livestock, 39% of the respondents got their pasture from community land, 35% from forest while 26% from their own land as shown in the

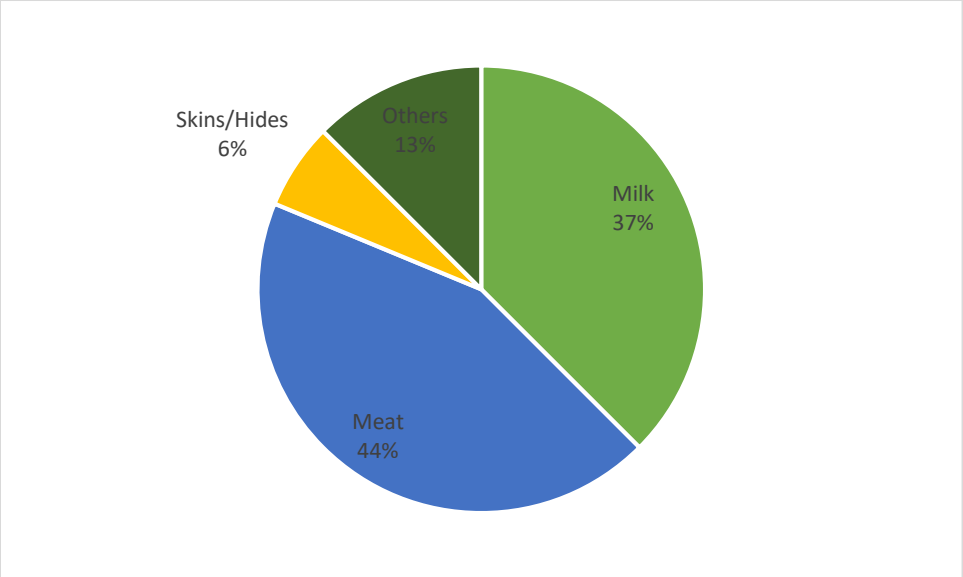
Figure 5.40 below.

Figure 5.40: Source of pasture for livestock



Different people keep livestock for different reasons. In the project area based on the data collected , Consultants in the socio economic survey, 44% of those who kept livestock drew meat from the livestock. 37% kept livestock for milk while 6% kept livestock for skins and hides. 13% on the other hand kept livestock for other products such as eggs as show in the Figure 5.41 below.

Figure 5.41: Livestock products in the project area



On the market for the animal products, 62% of the population engaged in animal keeping do not sell their animal products. The 38% that sell their products do so in the locally available markets

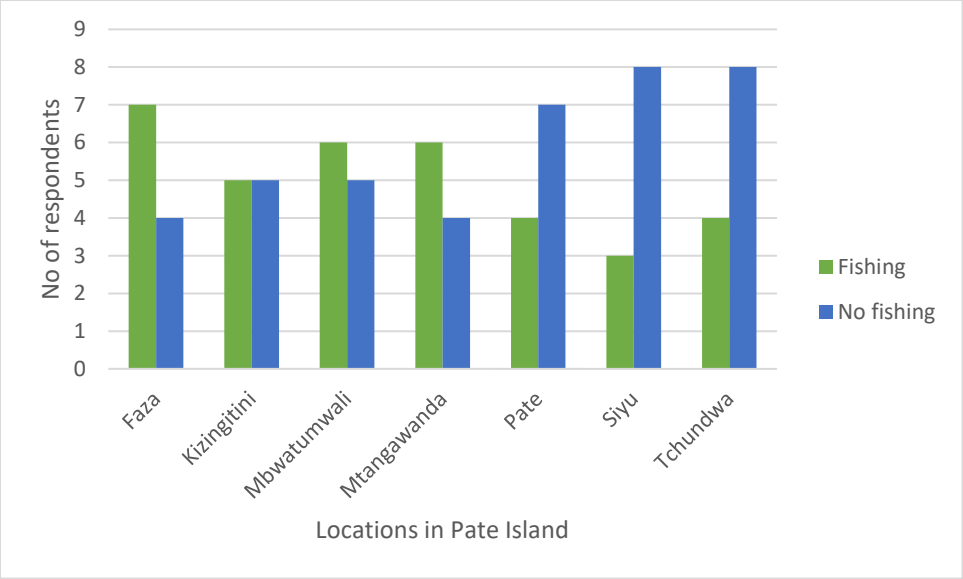
Fishing

Another major economic activity in the county is fishing especially for the residents of the Island areas. The fishing ground cover 3100 km² of territorial market water surface extending from Kiunga to Ras Teweni. In the mainland, fishing is carried out in fish pond programmes and ox-bow lakes and water masses along the Tana River delta.

In Pate Island, there is no major disparity between the number of persons engaged in fishing and those not engaged in fishing in the area. According to the data from the socio-economic survey 54% of the sampled population did not engage in fishing while 46% engaged in fishing activity[32]

A comparison between fishing activities among the location indicate that Faza location had the highest number of respondents engaged in fishing followed by Mbwatumwali and Mtangawanda. Tchundwa and Siyu were the lead location in respondents without engagement in fishing activities. They were closely followed by Pate location as shown in Figure 5.42 below. It is vital to note the main type of fishing in the project area is generally shallow water fishing which requires no form of specialization like in sport fishing and lobster diving.

Figure 5.42: Distribution of Fishing Activities per Location



In terms of the ownership of fishing vessels among the population engaged in fishing activities 59% of the respondents did not own the vessels they use for fishing. Only 41% of the respondents owned such vessels. Most of the fishing vessels belonged to the various Beach Management Units (BMUs) which act as societies and group set ups for most fishermen in the project area.

The most common fishing vessel in the area is Mashua with 64% coverage among the fishermen in the project area. This is followed by Flat bottom boats at 29% while the rest of the fishermen use dau as their main fishing vessel as indicated in Figure 5.43 below. In terms of vessel propulsion mode, sail boats are commonly used as illustrated in Figure 5.44 below

Figure 5.43: Common types of fishing vessels

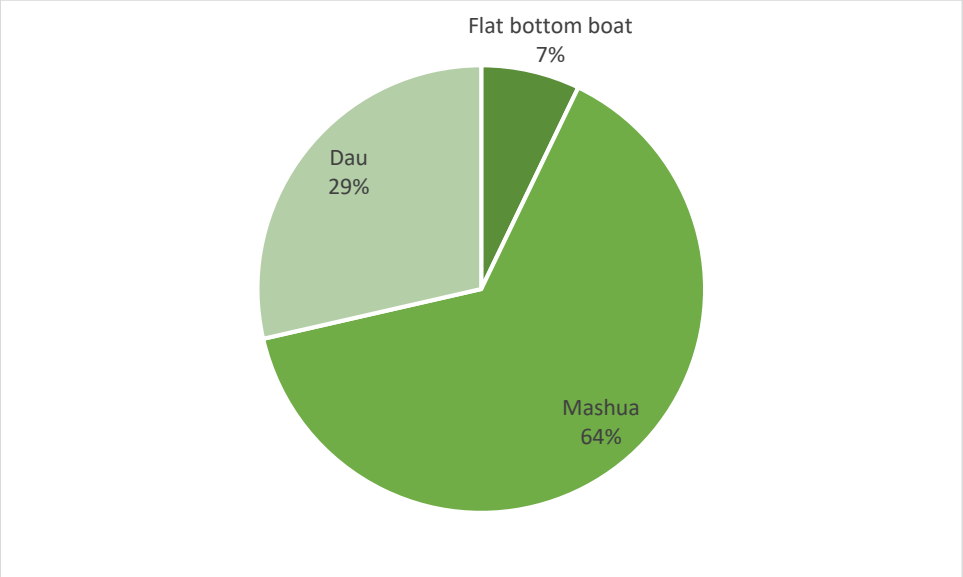
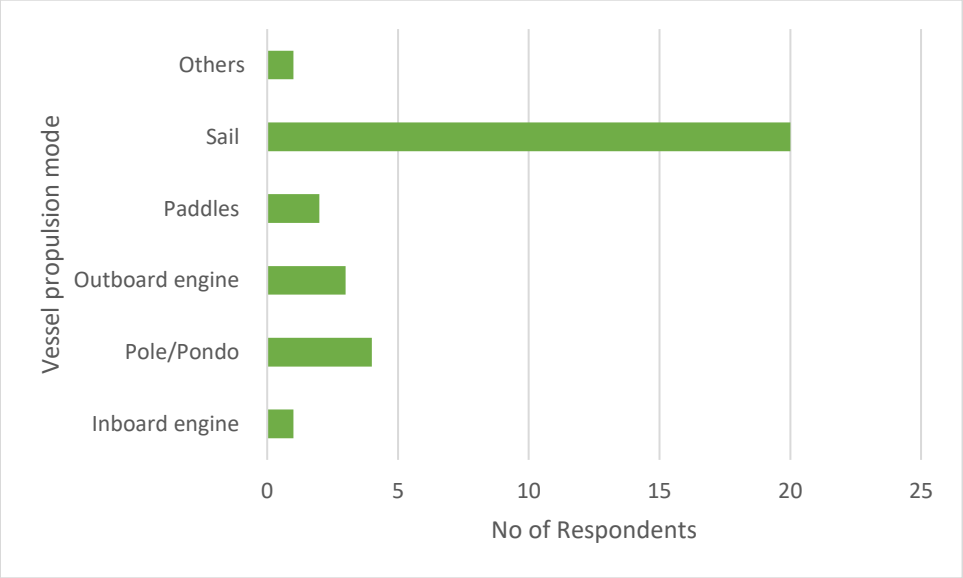


Figure 5.44: Vessel propulsion mode among fishermen in Pate Island



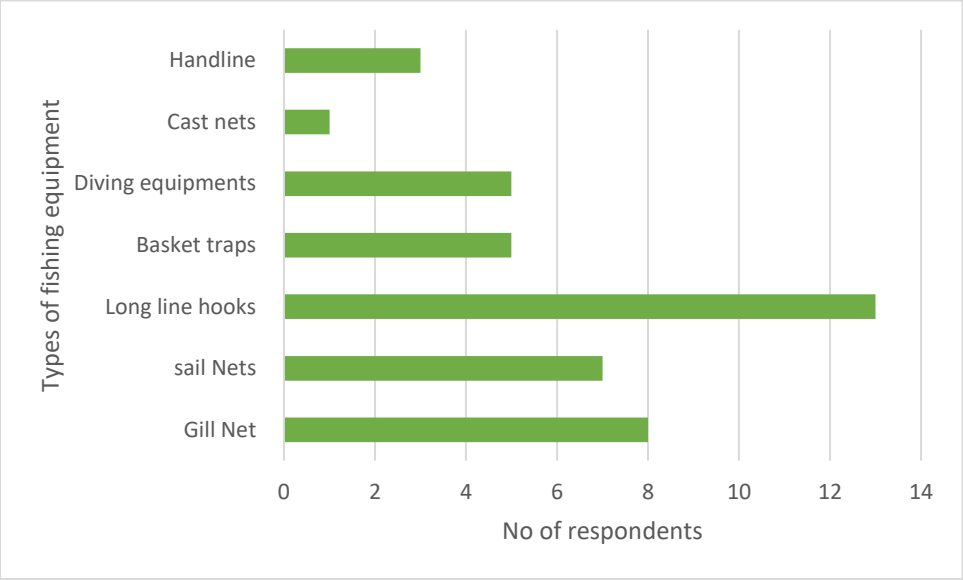
In terms of registration of vessels for fishing in the project area, 89% of the vessels are registered with the fisheries/maritime department while only 11% are not registered.

According to the socio-economic survey data, 78% of the respondents engaged in the fishing activities are members of local societies. Only 22% of those engaged in fishing have not joined any form of society. Most of these societies are groupings such as the local BMUs and the local self-help SACCOs.

The fishermen in Pate use different fishing gears in their activities. The leading equipment in use are the Long line hooks which take up 31% of the equipment in use followed by gills and sail nets at 19% and 17%

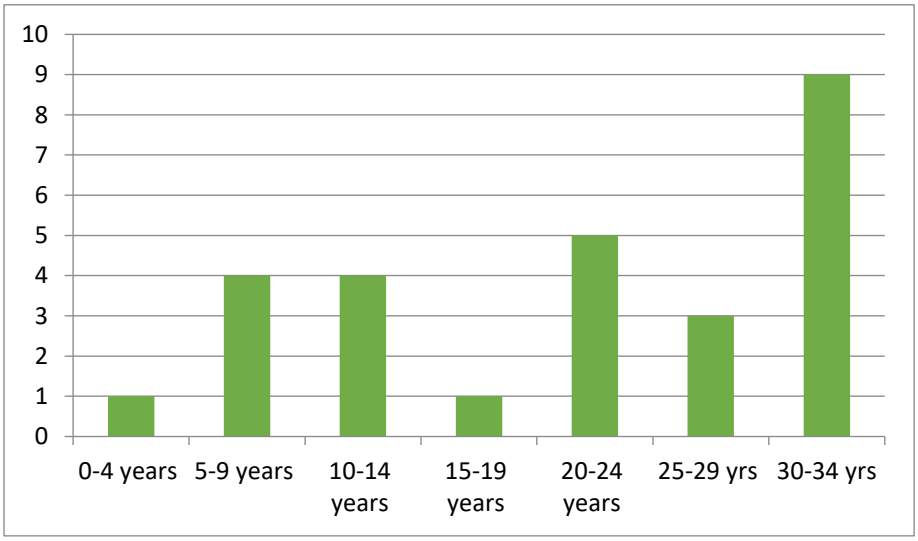
respectively. The least used equipment in this area is cast nets which only has 2% use in the area. The distributions of equipment used for fishing are shown in Figure 5.45 below.

Figure 5.45: Equipment for Fishing among fishermen in Pate



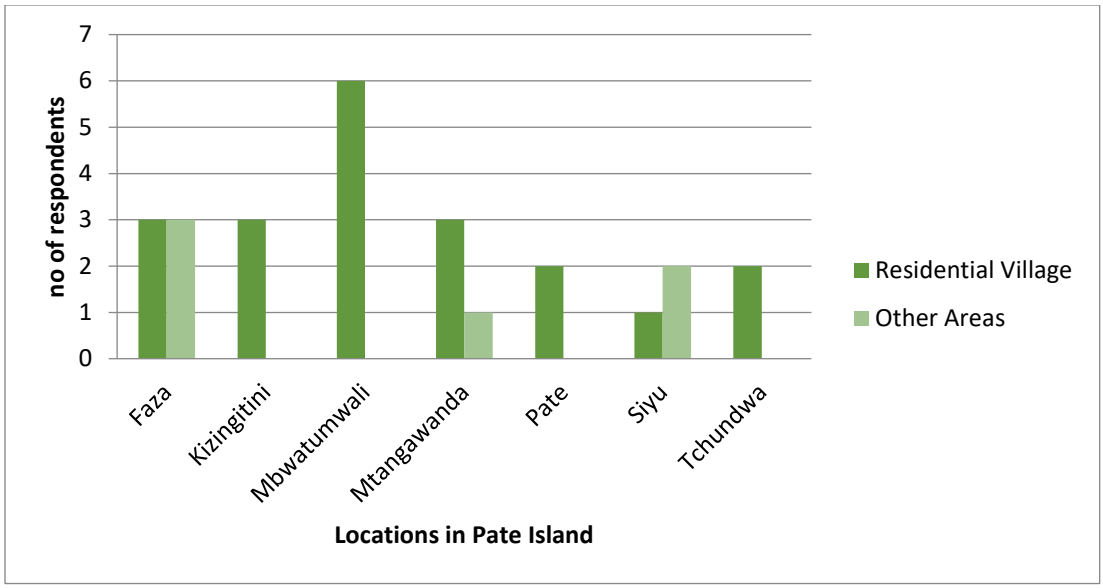
The highest number of fishermen has an experience of between 30-34years in the industry. Those with experiences ranging from between 1-4 years and 15-19years are the lowest in the project area. Figure 5.46 below shows the distribution of experience levels among the fishermen in the project area.

Figure 5.46: Distribution of Experiences among the Fishermen



According to the socio economic survey data, 77% of the respondents engaged in fishing covered their local residential areas. Only 23% of the respondents engaged in fishing went further than their residential areas in times of fishing. Distribution of areas of coverage per location is as shown in Figure 5.47 below

Figure 5.47: Areas of Fishing



Fish harvest depends on the weather conditions of the area. During the winter, the catches are higher with daily harvest ranging from 100kg to 1000kgs in per BMU. During the summer however, the fish harvest is general low with some beach management units like Rasini in Faza location registering only 25kgs per day. The average time taken in the winter season in a fishing season ranges from 4-6hours while in the summer the time taken in the sea for fishing is longer running to at least 8hours. During the low fishing season (summer), the earnings from the fish resources range from 5,000-10,000 Kenya shillings per month while in the high season (winter), the earnings range from between 25,000-35,000 Kenya shillings per month.

Tourism

Tourism is a major economic activity in the county given its rich endowment in diversity of cultural identity, home to several world heritage sites, fauna and flora. There are three national reserves, two national parks and three private ranches which are home to several species of dolphins and sharks (need a map).

Tourists are accommodated at 2 classified hotels and 181 unclassified hotels with a total bed capacity of 1881.The classified hotels attract high market clientele.

With its 130 km of sandy beach coastline and diverse tourist attractions, this sector has huge potential for growth, if effective marketing is done.

Pate Island has many valuable marine resources, such as mangroves, coral reefs and seagrasses, which provide an important source of livelihood and food security for local communities.

There are also ancient ruins, a rich cultural heritage and charismatic species (such as turtles, dugongs, dolphins, sharks, rare corals and fishes) that provide good marketing opportunities for eco-tourism.

5.2.6. Financial services

Lamu County has five commercial banks including Kenya Commercial Bank (KCB), GULF, ABC, EQUITY & Diamond Trust Bank (DTB) all in Amu. KCB and Equity have a branch also in Mpeketoni with several Automatic Teller Machines have been installed at Shella and Witu.

Pate Island has no physical presence of banking services. In such areas, mobile banking structures and internet banking facilities can be used by customers who have access to such services. Except Lamu Teachers Savings and Credit Co-operative Societies that provides Front Office Services (FOSA) in five main trading centres, the rest of the 15 micro finance institutions are concentrated in Mpeketoni.

5.2.7. Employment and Livelihoods

The leading employer in Lamu County is self-employment with 29%. Casual and Part time employment follows at 10% while private sector takes slot three with only 7%. It is important to note that the unemployment rate is high in the county with a total of 29% active and employable part of the population jobless and unemployed. Table 5.13shows the distribution of employment across different sectors.

Table 5.13: Employment Distribution[37]

Employment Status	Percentage
Self Employed (Small businesses and market stalls)	29%
Unemployed	29%
Casual/Part Time	10%
Employed in the Private Sector	7%
Family Subsistence	6%
Employed in the Public Sector	6%
Students population	3%
Employed in a family Business/Farm	3%
Retired	1%
Others	5%

Distribution of the income source percentages across the county is shown Table 1.6 below.

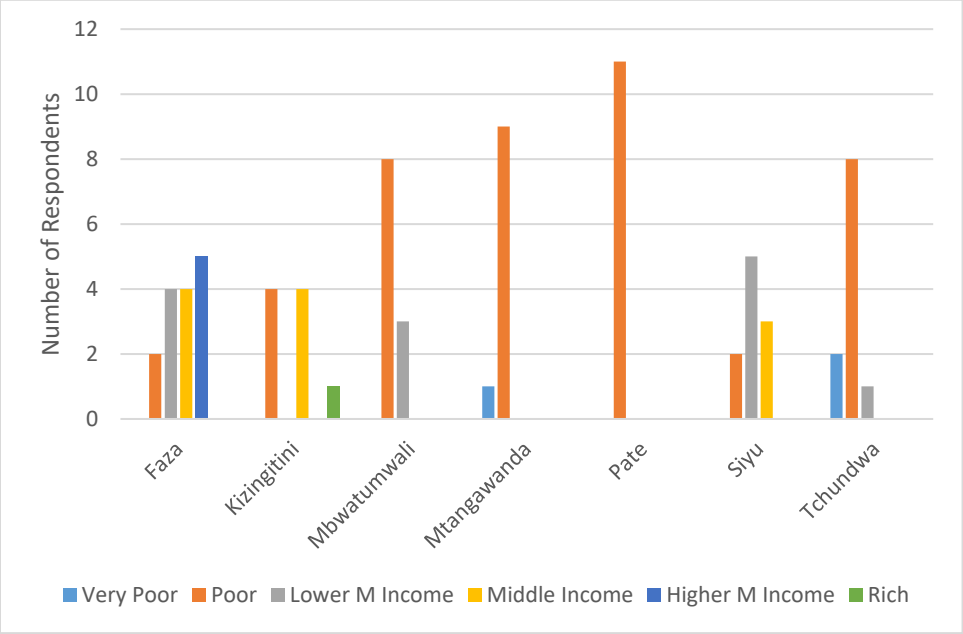
Table 5.14: Income Source Percentages[37]

Main source of income	Percentage
Public Sector	10%
Private Sector	25%
Self-Employment (Business owners/Traders)	45%
Agriculture (Own/Household)	8%
Livestock	0%
Relatives	8%
Others	1%

According to the data collected by the ESF Consultants in the field, the project area has relatively high number of poor citizens. No respondent indicated falling in the category of the rich. Pate, Kizingitini, Siyu,

and Tchundwa locations registered the highest number of very poor and poor residents while Faza, Kizingitini, and Siyu registered the highest number of middle income earners in the project area. Pate location had the highest number of poor resident in the entire project area. Figure 5.48 below shows the distribution of income status of the sampled populations in the project area.

Figure 5.48: Income Status



According to the data collected in the field 42% of the respondents registered zero changes in the income status in the last five years. 27% of the respondents indicated an improvement in their income levels while 31% indicated deterioration in the income levels[32]

Based on location levels, Tchundwa location registered the highest number of respondents with a decrease in income levels in the last five years. Siyu location on the other hand registered the highest number of respondents with an increase in the income levels compared to five years ago. Kizingitini on the other hand had an equal distribution respondent in the same status as five years ago and decrease in status level. In this location, only one respondent registered increase in the level of income[32].

5.2.8. Transport

Lamu County has a total road network of 688.6km out of which only 6Km is tarmacked[38]. Mokowe - Garsen road which connects the county to the rest of the coast counties and the county and Mokowe – Kiunga road which connects the county to Somalia border are the major two roads that are conspicuous in the county[38].

[38] Lamu County Integrated Development Plan (2013-2017).

Lamu County has seven jetties which inter link the main land to Islands and between Islands. These include Amu, Mokowe, Manda, Matondoni, Hospital Jetty, Custom fisheries Jetty and Mtangawanda jetty (Pate Island)

Major modes of transport in the Lamu - Faza Sea way are semi-Motorized dhows and speedboats. Mtangawanda jetty is the main access to Pate Island. This jetty is depicted inFigure 5.49 below

Figure 5.49: Mtangawanda jetty in Pate Island

The county has 13 airstrips out of which 11 are public while two are private. Manda is the main airstrip with three airline companies providing daily passenger flights. Manda point 11, Manda Bay Naval, Mokowe, Kiunga, Kiwayu Island and Kiwayu mainland (Mkokoni) which are fairly maintained; while, Witu, Mkunumbi, Faza, Kizingitini are under bad condition. Tenewi and Mangai are closed due to the LAPSSET project[39].

In undertaking the traffic survey in Pate Island, it was noted that the available means of transport are: Public boats, private boats, Motor vehicles, Motor cycles and donkeys. A summary of key findings is represented in Table 5.15 below.

[39] Lamu Holiday Solutions. (2016). County Information. Retreived on 22nd March 2016 from http://www.lamuholidaysolutions.com/aboutlamu/general-information-about-county

Table 5.15: Summary of key findings for the traffic survey

Means of transport	Number	Description	Timings
Public boats	2- work alternating, one per day	Transport passengers from Lamu Island to Mtangawanda Jetty in Pate	5 am in the morning 4:30 pm in the evening
	1	Transport passengers form Amu jetty in Lamu to Faza	4 am in the morning
Private boats	Frequency is very low.	Mostly used in transporting tourists or visitors to Pate. These are hired boats.	Anytime.
Motor Vehicles	3 Matatus	Mostly used in the morning and evening when taking passengers to take the boats to and from Mtagawanda and Lamu.	4 am in the morning 4:30 pm in the evening
	1 bus stationed at kizingitini	Used during special occasions	
	Others	Police van, ambulance and power contractor's vehicles found stationed at certain areas	
Motor cycle (boda boda)	Average of 2 per hour	Transport passengers from one village to another	Average of two per hour
Donkeys	Anytime	Transport passengers within the villages Transport goods for villagers	Anytime

From the socio-economic survey conducted, the use of donkeys, boats and motor vehicles were the common means of transport in Pate Island (see

Figure 5.50 below). Poor road network/ structure and high cost of transport were cited as the major transport challenges in Pate Island as depicted in Figure 5.51 below.

Figure 5.50: Common means of transport

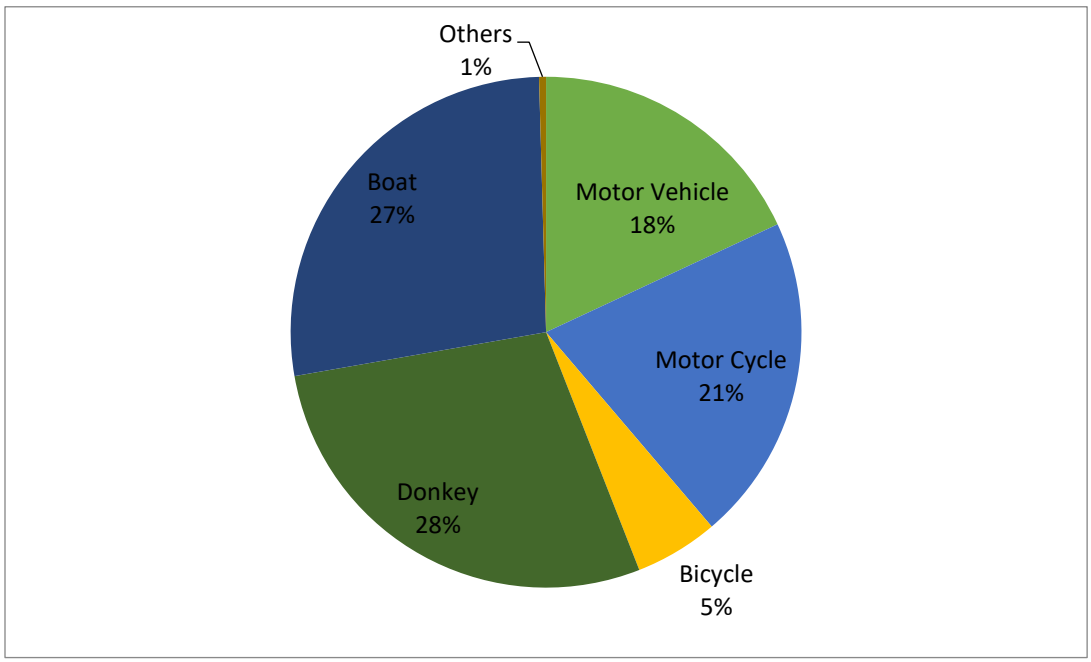
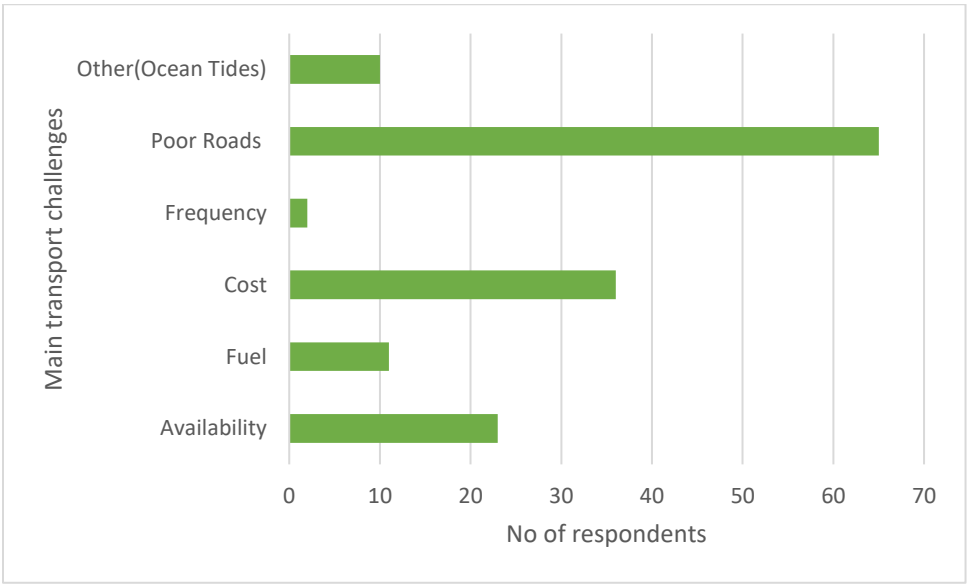


Figure 5.51: Major transport challenges in Pate Island



5.2.9. Communication

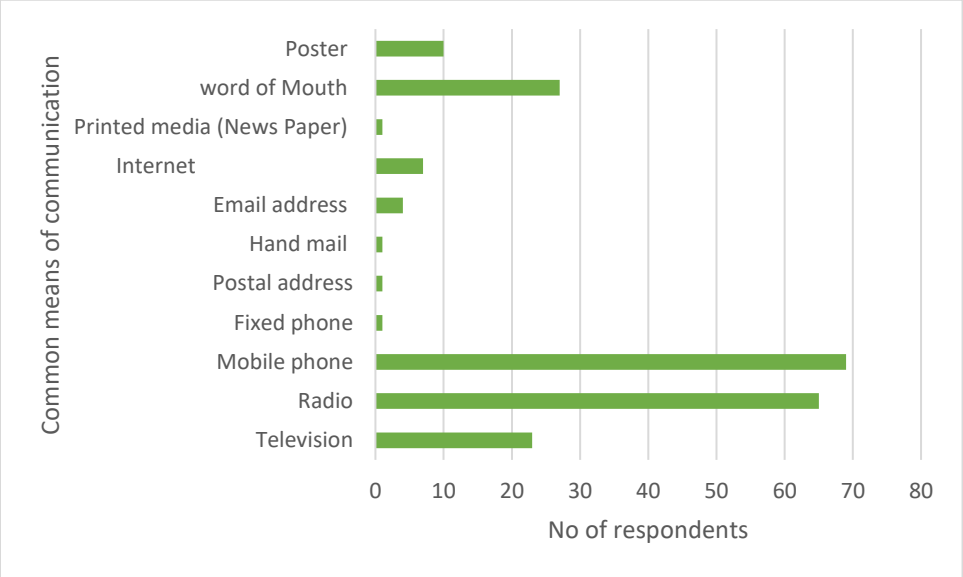
Communication infrastructure in Pate Island is underdeveloped. Mobile phone connectivity is at 60% while its use is at 50%. Internet access is at 20% and TV and radio coverage is very low. Safaricom mobile network and orange are strongest in Pate Island while Airtel has no signal. Boosters for orange network were observed in Faza town; the administrative headquarters of Pate Island, during the field survey (see Figure 5.52 below)

Figure 5.52: Orange mobile boosters observed in Faza

Common means of communication in Pate is mobile phone, radio, television and word of mouth as depicted in

Figure 5.53 below

Figure 5.53: common means of communication in Pate Island



5.2.10. Energy

In Lamu County, Kenya Electricity Generating Company (KenGen) supplies the electricity generated through diesel generators located in the main market centres in Lamu West Sub County. Connectivity to the National grid is almost complete: the National Grid power has been extended to the island. The diesel generators are being transferred to Pate.

Private investors have also shown interest in developing renewable sources of energy such as solar and wind energy. However, firewood and charcoal are the main sources of cooking fuel, with use of LPG limited to the affluent in the urban centres.

According to the survey, the most common means of lighting among communities in Pate was solar, paraffin and fuel wood as depicted in

Figure 5.54 below. The main source of heating/cooking energy is fuel wood and charcoal (see Figure 5.55 below). This poses a health risk to most women in the community.

Figure 5.54: Source of lighting among communities in Pate Island

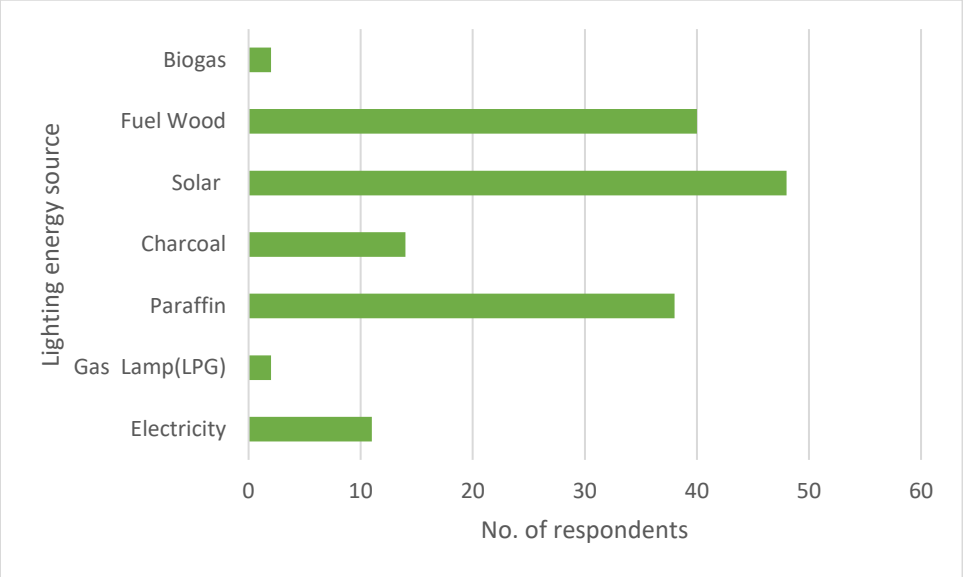
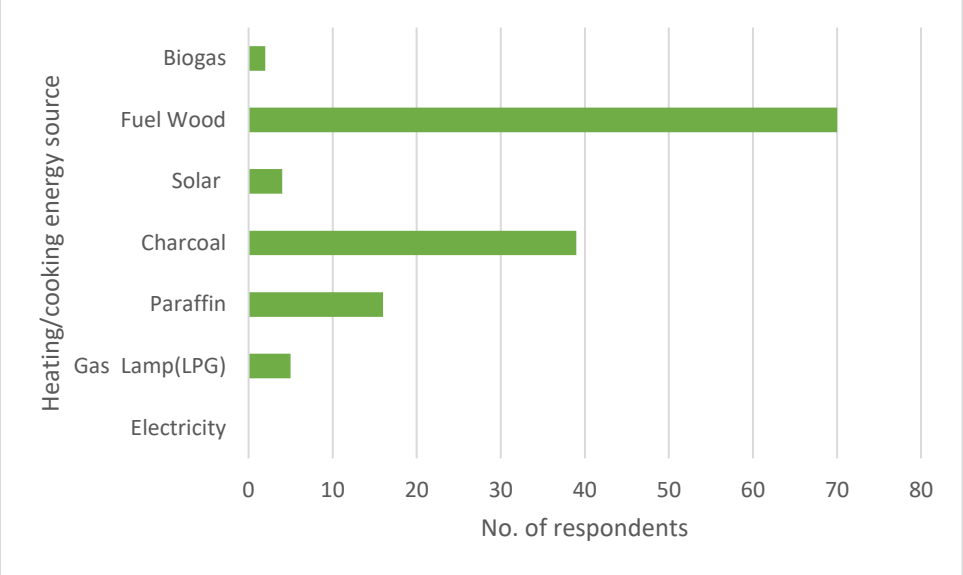


Figure 5.55: source of heating/cooking energy among communities in Pate Island



5.2.11. Water

Existing water sources include wells and djabias (underground tanks filled with rainwater); whenever there is a water shortage it is imported from Lamu. According to estimates from interviews on the ground, there are some 330 wells and 350 djabias on the larger Pate.

Stabilized sand dunes provide water around Pate village which is accessed from open shallow wells. Unfortunately, no water bearing formation has been found north of Pate village and the inhabitants of Siyu, Faza, Tchundwa, Kisingitini, Mtawabanga, Mybogi and Mbwajumwali depend on rainwater collection

into djabias for their drinking water needs. The shallow wells tapping relatively salty water are mainly used for cleaning and other domestic purposes.

Djabias are mainly privately owned, but also communal, run by a committee, or the property of the county government/ CDF. More recently, in several locations, some new ones were built by women users associations, financed by different donors. The communal and those owned by the county as well as those run by the women water committees are in generally good condition.

Figure 5.56:Djabias spotted in areas of Mbwajumwali location

Most recently the Faza Water Project was completed. It consists of a 14 kilometer HDPE pipeline, 10 km of which is subsea and 4 kilometres on land. The source is 3 large diameter wells constructed on the mainland south of Dodori Forest. The pipeline delivers 75 cubic meters fresh water per day to Faza. It is expected to supply water to the entire Pate Island that incorporates the villages of Siyu, Shanga, Pate, Tchundwa, Banjumwali, Kisingitini and Faza. Along with these is the Siyu Water Project under which borehole water is proposed to serve parts of Siyu.

Figure 5.57. Water well drilling at Siyu

Traditional wells are dug into the limestone formation and lined with coral stones or blocks. Some of them are lined with concrete rings from the bottom up to the surface. The majority are lined only in the upper part. A wall is built to prevent contamination and for security and in some cases an apron is built (Figure 5.58 to Figure 5.62).

Figure 5.58: Siyu village well

Figure 5.59: Abubakar Khalifa well

Figure 5.60:Tchundwa village well

Figure 5.61: A well at Pate

Figure 5.62: Well at Rasini, note proximity to house

Desalination is another process that is used to remove minerals from sea water to make it suitable for human consumption, there is one machine in Kizigitini Location as shown in Figure 5.63 below.

Figure 5.63: Desalination Machines at Kizingitini location

According to the communities in Kizingitini, the desalinization plant is fully functional and is usually managed by the County government of Lamu; and maintained and repaired by Davis & Shirtliff Company. Often, there are a minor pump breakdown issues (smaller pumps) which are repaired immediately after the county government is alerted. Repair period does not last more than a day.

Depending on the tide, and amount of water pumped, the plant can supply between 12,000 to 20,000 litres per day or more. There are two storage tanks each with a capacity of 10,000 litres. The water is pumped during the night and supplied from 6.00 AM to 8.00 PM with a two hour break in between to allow for the pumps to "rest" thereafter the pumping and supply of water resumes.

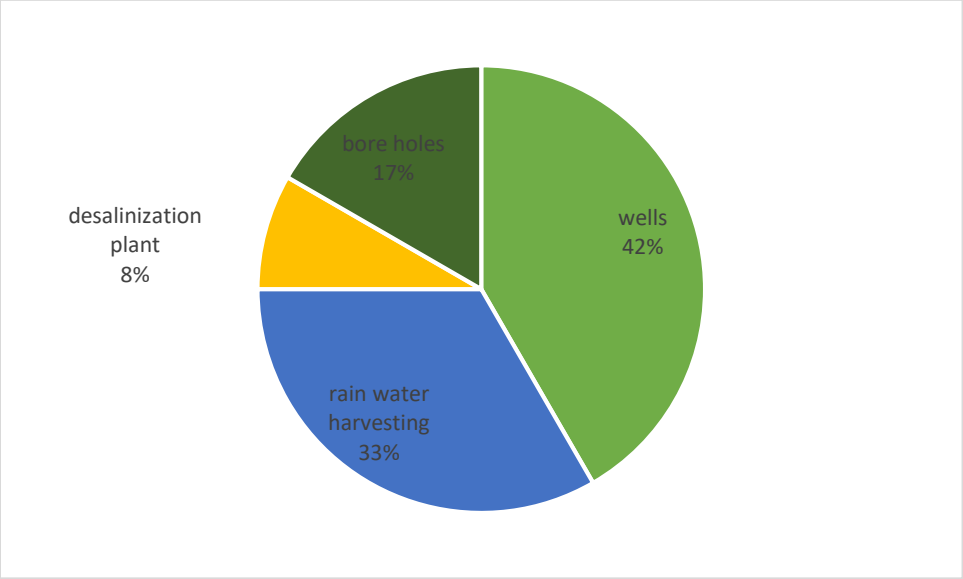
The pumped water is enough for Kizingitini residents. Everyone has ample supply of water. No one goes home with empty vessel. Initially, there was another supply tank (transfer station) in the middle of Kizinigitini town, this used to sort out long queues currently witnessed. However, the tank burst some time ago and has yet to be repaired. The other main challenge that can cause inadequate water to be pumped is that the transfer pump is small. It takes up to 6 hours to fill up one tank. If the pump was bigger, it would take approximately 2-3 hours.

Importing fresh water from Lamu Island is an added expense which many cannot afford in Pate Island. During the dry season which often lasts up to 4 months, wells are the only source of water and water shortage in Pate Island. It is vital to note that rainwater is the main source of fresh/soft water for the

county residents. From previous studies, the average distance of households to access clean water is approximately 5km. Organizations involved in the supply of water and sanitation services include Lamu Water and Sewerage Company (LWSCO), Lake Kenyatta Water Association, Hindu Water Association, and Witu Water Users' Association.

According to the key informant's questionnaire, it was noted that majority of the population in Pate Island rely on wells and rain water as their main source of water (see Figure 5.64 below). In Kizingitini, there is a desalinization plant that is used by the locals as a source of water. Water scarcity during dry seasons, wells having saline water and poor quality water were cited as the common water problems in Pate Island.

Figure 5.64: Distribution of water sources in Pate Island

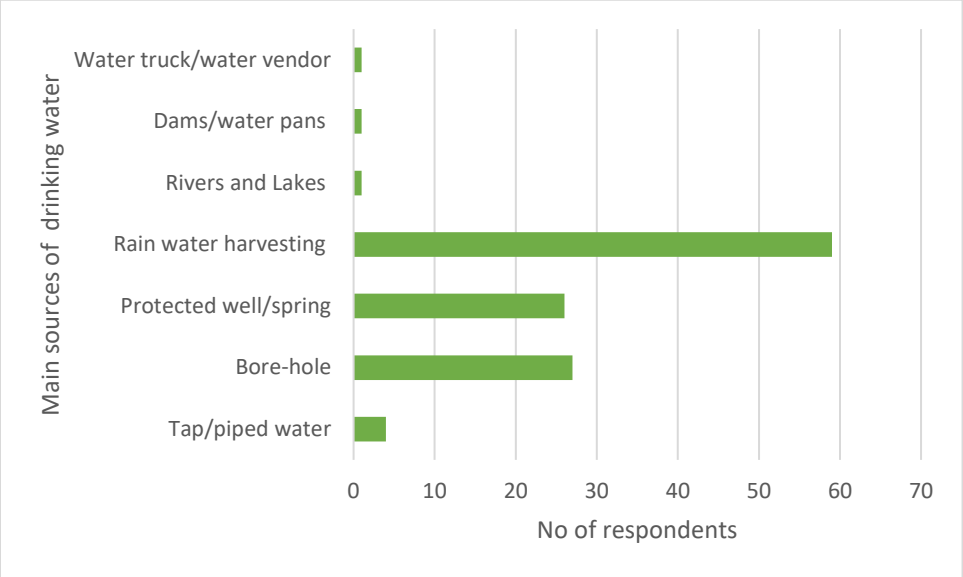


Source: ESF Consultants

From the socio-economic survey carried out, community's main sources of drinking water in Pate Island are rain water, wells and boreholes (see

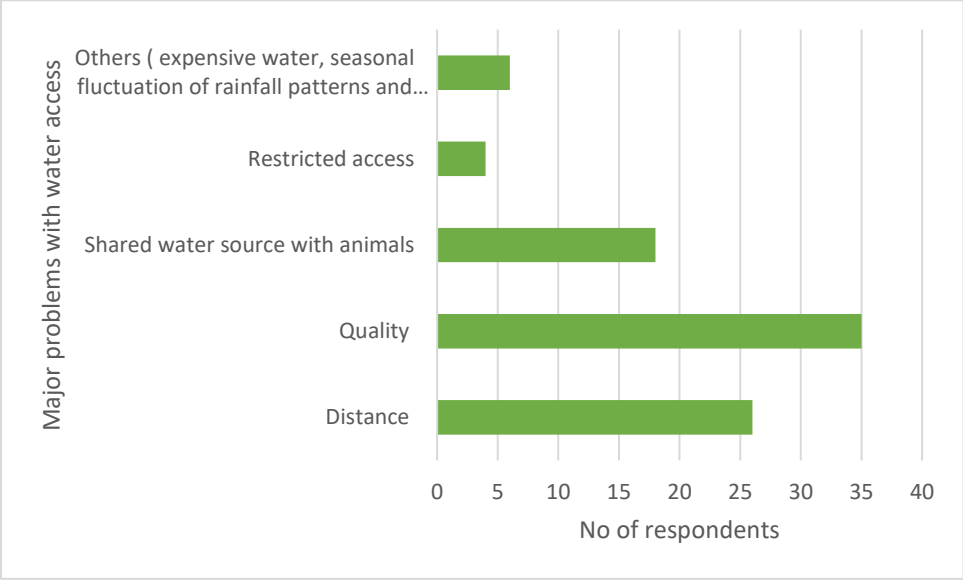
Figure 5.65 below). Rain water is most preferred due to the fact that its soft water compared to other water sources. Most water sources are saline and the overall average distance to the nearest water source for all communities in Pate Island is 1 km, from the results from the socio-economic survey conducted by ESF Consultants.

Figure 5.65: Main sources of drinking water in Pate Island



Water quality, travelling long distances to find water and having commonly shared water sources with animals are the major problems in water access in Pate Island as shown in Figure 5.66 below. However, in some locations like Pate and Mtangawanda, water quality was not a major challenge since there are fresh water wells. All other locations cited poor water quality as a major challenge

Figure 5.66: Major problems in water access in Pate Island



5.2.12. Sanitation

Toilet facilities

In Pate, it was noted that 95% of the communities use pit latrines and 5% use bush as their main toilet facilities. 96% of these toilets are privately owned within the homestead, while 4% of the respondents use public toilets[32]

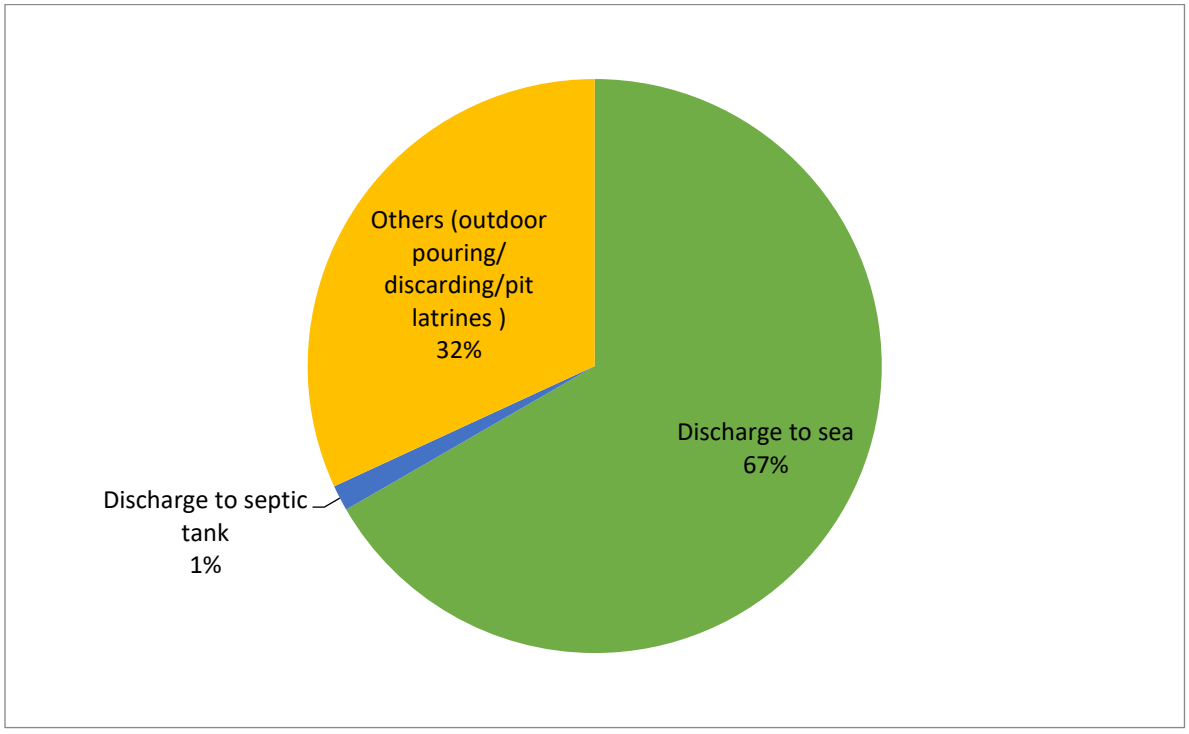
Foul sewer (grey water) drainage

It was also noted that Pate Island lacks connection to sewer system. 64% of the grey water is discharges into pits especially pit latrines which are commonly used in the area. Only 34% of it is discharges in septic tanks[32]

Waste water

According to the survey conducted, it was noted that 67% of waste water is directed to sea. This poses a risk of spread of water borne diseases in the area. Other methods used for discharge of waste water include directing into septic tank, outdoor pouring, and using pit latrines. This is represented in Figure 5.67 below.

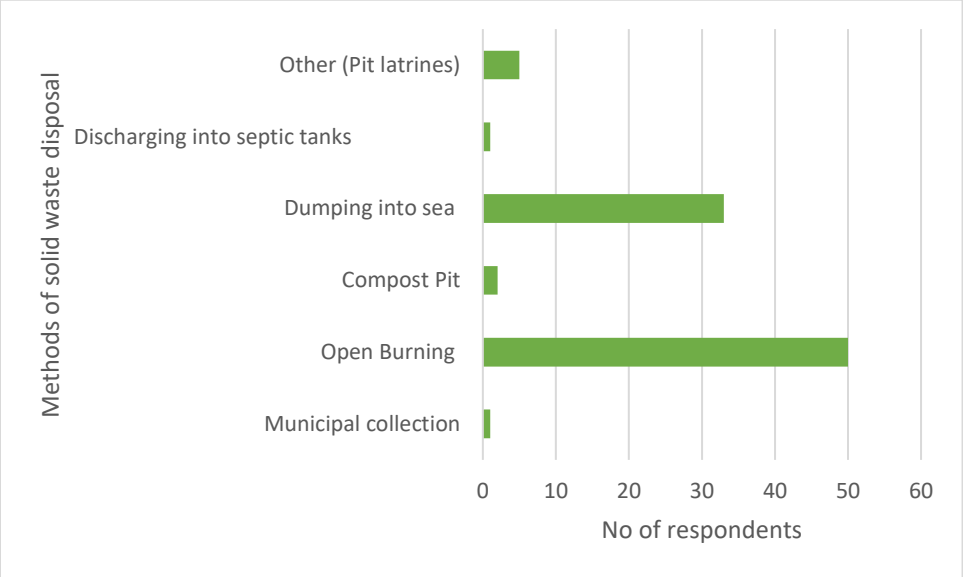
Figure 5.67: Waste water discharge method in Pate Island



Solid waste

Solid waste is handled through open burning and dumping into pits. Organic waste is sometimes taken to *shambas* as a form of manure (see Figure 5.68 below)

Figure 5.68: Methods of solid waste disposal



5.2.13. Housing and dwelling

The most common housing type in Lamu County is the Swahili housing type of setup. The architecture is traditional with coral rag walls and thatched roofing made from palm tree leaves (makuti). In some areas, some of the unique stone townhouses dates back to early 18th century.

The Swahili houses were designed as an inward looking self-contained complex with a plan organized around a central courtyard (Prof. Abdul Sheriff, 1998) and the houses vary in form and sizes, from relatively modest, single storey houses to magnificent mansions but share the same uniformity in design, construction and decoration. Thick walls, high ceilings and small windows are deliberately designed to protect the inhabitants from the equatorial sun and ensures that the interiors are cool, private and secluded.

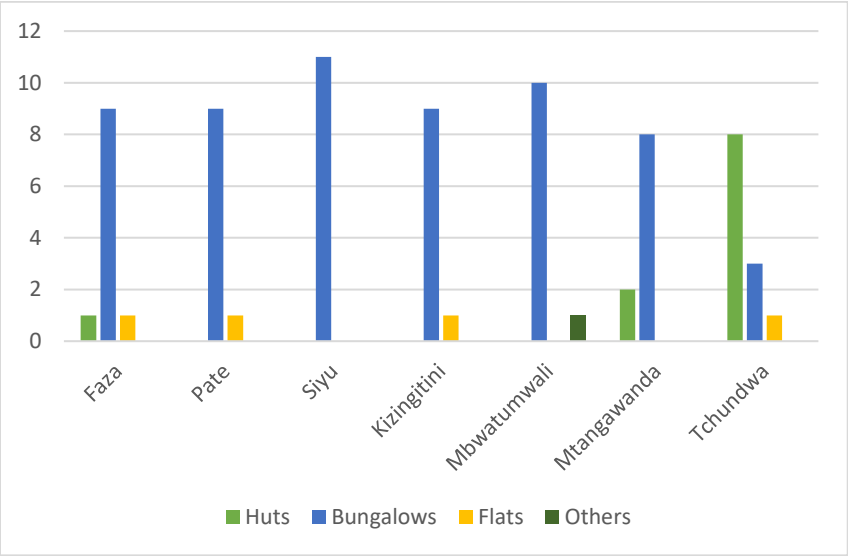
Pate Island is an early and important site and covers an area about 30 hectares. It has no proper harbor and the houses in Pate are clustered together illustrating cooperation during construction thus the houses have common party walls and interlocking plan forms. Sanitation is through a stoned-lined pit toilet and bath-like water container for washing (Garlake, 1966).

However, modern upcoming houses are bungalows and are not designed in the traditional Swahili architecture. This is due to the increasing population on the Island allowing for modern influence.

Types of Houses

According to the data collected, bungalows are the leading type of houses in the areas having registered more than fifty percent responses from all the location except Tchundwa. In Siyu location all the respondents lived in Bungalows. Figure below shows the distribution of housing types across all the seven location in the project area.

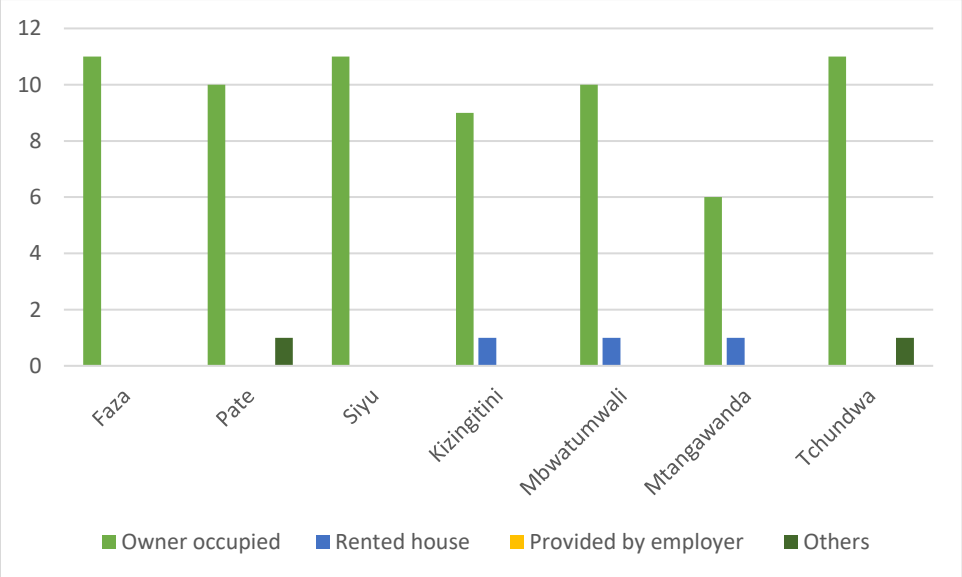
Figure 5.69: Distribution of housing types in the project area



Occupancy Tenure

In Faza, Siyu, and Tchundwa all the respondents owned the houses they lived in. As per the data collected in the field, it is only in Kizingitini, Mbwatumwali, and Mtanagwanda that registered 1 respondent as staying in rental houses as shown in Figure 5.70 below.

Figure 5.70: Occupancy tenure in Pate Island

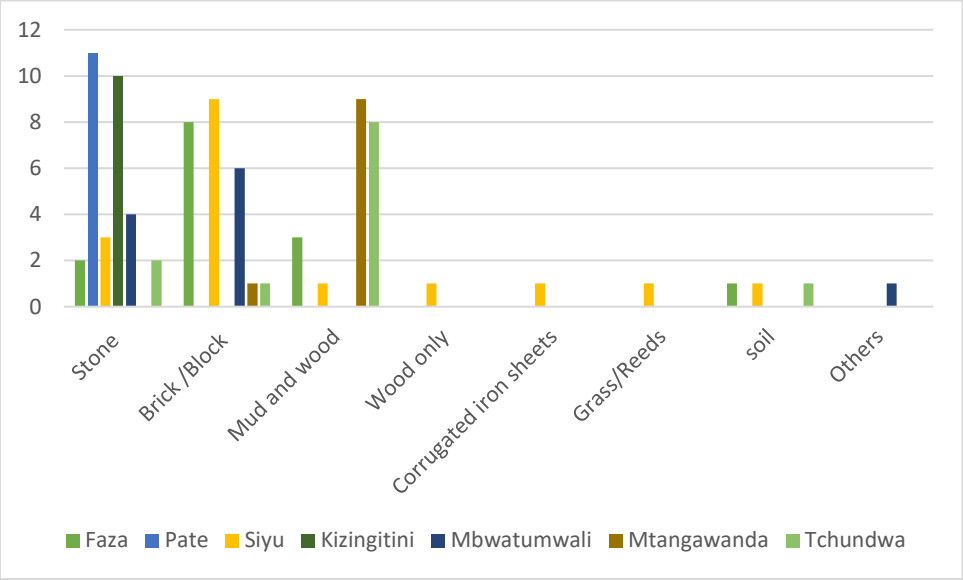


Wall materials

Stones are the most used materials for building walls for houses. Mud/Wood and Bricks/Blocks are the second highest used materials in building walls for most house in the project area. Figure 5.71 below

shows the distribution of materials used for building walls across all the seven locations in the project area.

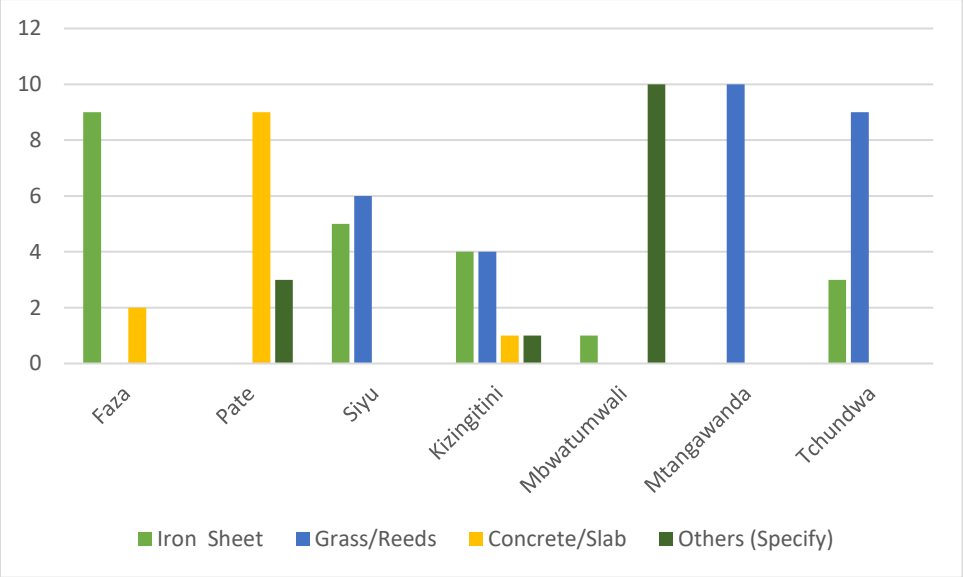
Figure 5.71: Wall material for houses in Pate Island



Roofing materials

In Faza, nine out of the 11 respondents lived in houses whose roofs were made of iron sheet with only two respondents having roofs made of slab. In Mtangawanda, all the respondents had their roofs made of Grass/reeds while in Mbwatumwali all the responds expect one had their roofs made of makuti. The distribution of roofing materials in the project area as depicted by the data collected, Consultants in the field are as presented in Figure 5.72 below.

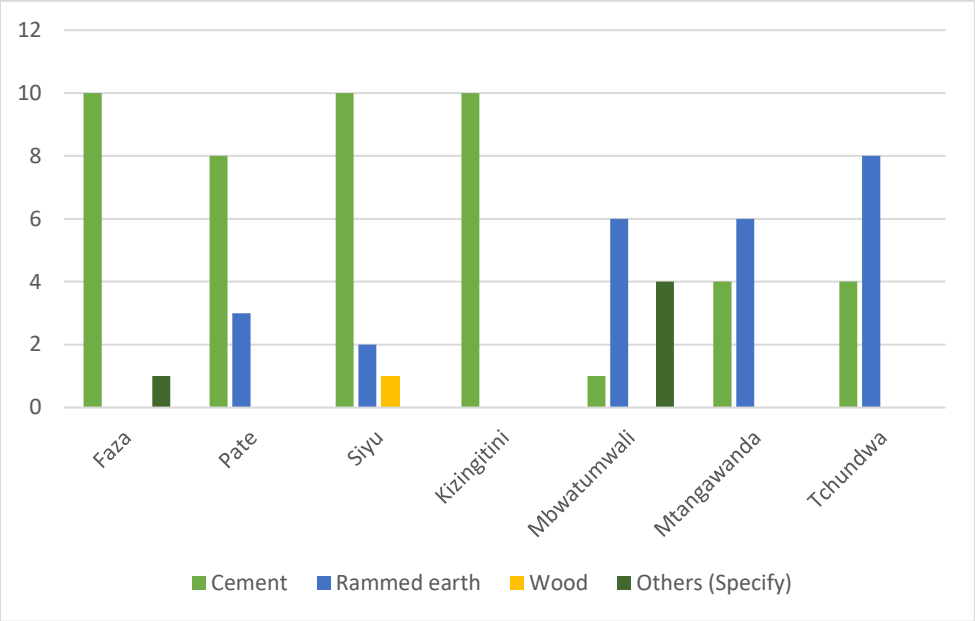
Figure 5.72: Roofing materials for houses in the project area



Floor Materials

According to the data collected, it's only in Kizingitini location that all the respondents have cement floors in their houses. Faza, Pate, and Siyu all had cement as the leading floor material. Mbwatumwali, Mtangawanda, and Tchundwa on the other hand have rammed earth as the leading material for floors. Other materials used for making housing floors in the project are including wood and cow dung.

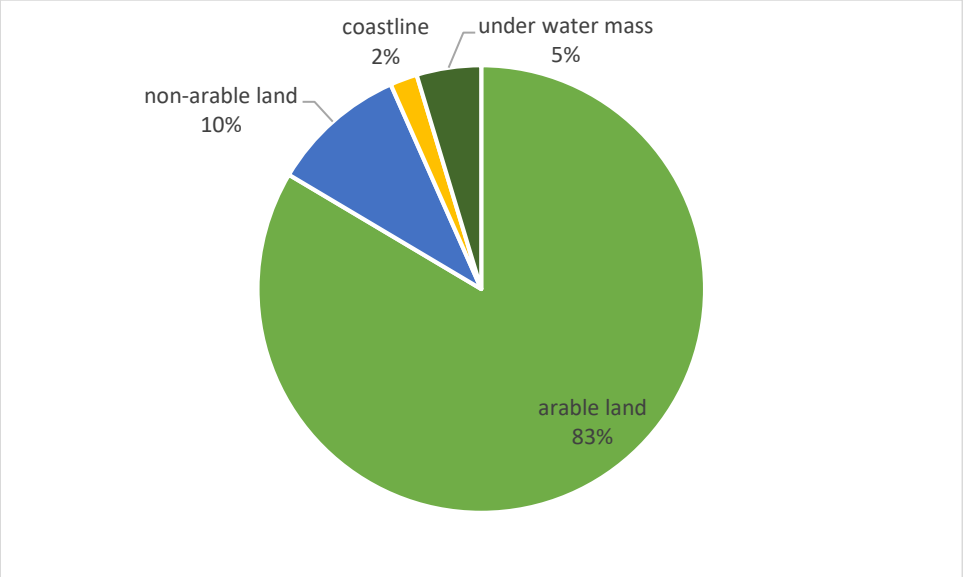
Figure 5.73: Floor materials for houses in the project area



5.2.14. Land and Land Use

Lamu County has a land surface area of 6273.1km² composed of 5517 km² of arable land 649.7 km² of non-arable land, 130km² of coastline and 308 km² under water mass.

Figure 5.74: Land use distribution in Lamu County



Lamu West sits on land surface area of 3971.3km² hence taking 63.3% of total land, leaving Lamu East with 36.7%[37]. The bulk of arable land is in Lamu West while Lamu East takes the bulk of water mass. Based on the physiographic and climatic conditions, the county is classified into the following Agro-Ecological zones.

- Coastal lowlands
- Coconut Cassava zone
- Cashew nut-Cassava zone
- Livestock millet zone
- Lowland ranching zone

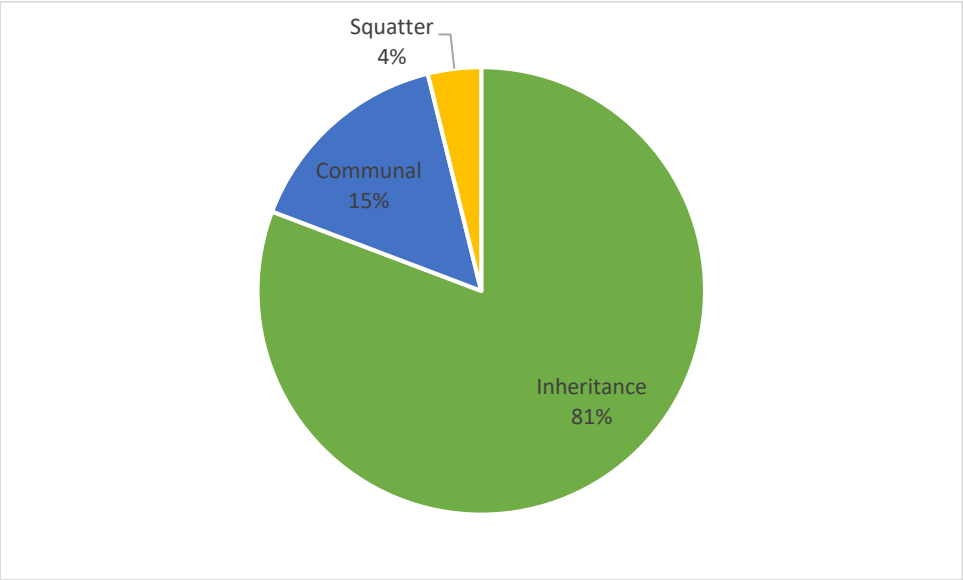
Landlessness and land ownership and squatter occupation is the biggest concern for the indigenous communities such as the Swahili, Arabs, Korei, Boni and Orma and the perennial source of conflict between farmers and livestock herders. There are 13,000 households who have title deeds, making 42% of the county households who have land ownership.

According to socio-economic survey conducted, it was noted that Land in Pate Island is mainly owned through purchasing and inheritance. 82% of the respondents owned land while 18% did not own land. 80% of the people who own land in Pate have a valid title deed or an allotment letter of the parcel of land[32].

97% of the respondents agreed that women are allowed to own land while 3% of the respondents disagreed to the same. However, all respondents agreed that when women own land, they are agreed to sell or decide how to use land independently[32]

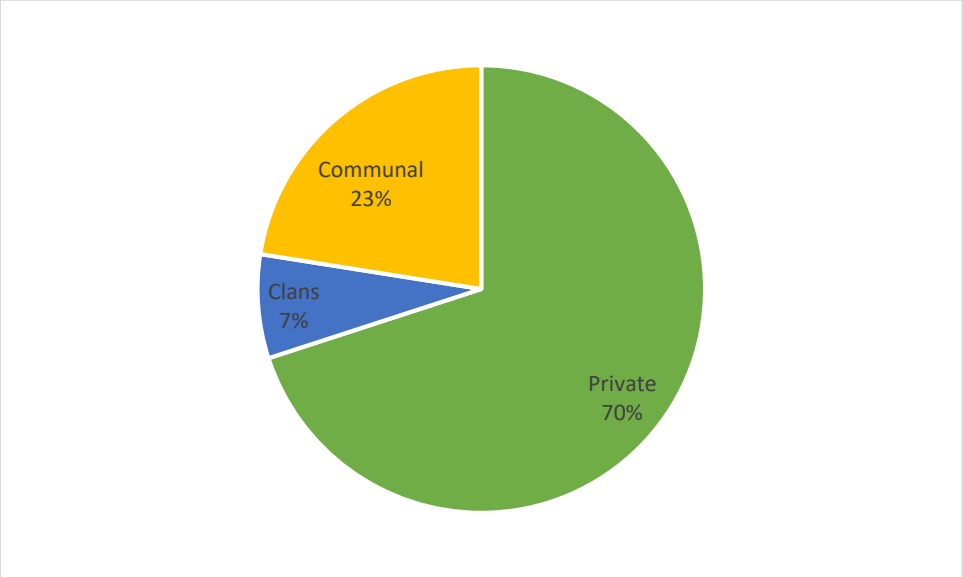
Land acquisition is mainly through inheritance in Pate Island. Other forms of land acquisition include communal lands while other are squatters inhabiting the said land. This is represented in Figure 5.75 Below.

Figure 5.75: Modes of land acquisition in Pate Island



Land ownership structure is 70% privately owned, 23% communally owned and 7% clan owned, according to the survey.

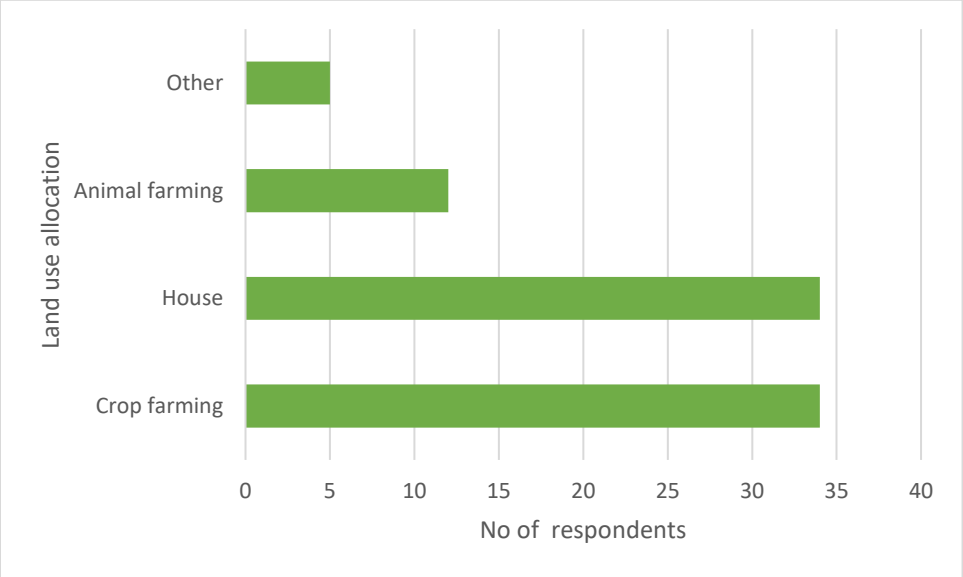
Figure 5.76: Land ownership structure in Pate Island



Predominant land uses include crop and animal farming; Quarrying for block harvesting. Traditionally, land use is determined by the community especially the elders.

According to the survey conducted, it was noted that crop farming and house are allocated the major proportion of the land by most communities in Pate Island each at 40% of the total land. Animal farming is allocated 14% while 6% of the land is allocated for other purposes such as being left bare to fallow. This is represented in Figure 5.77 below.

Figure 5.77: Land allocation structure among communities in Pate Island



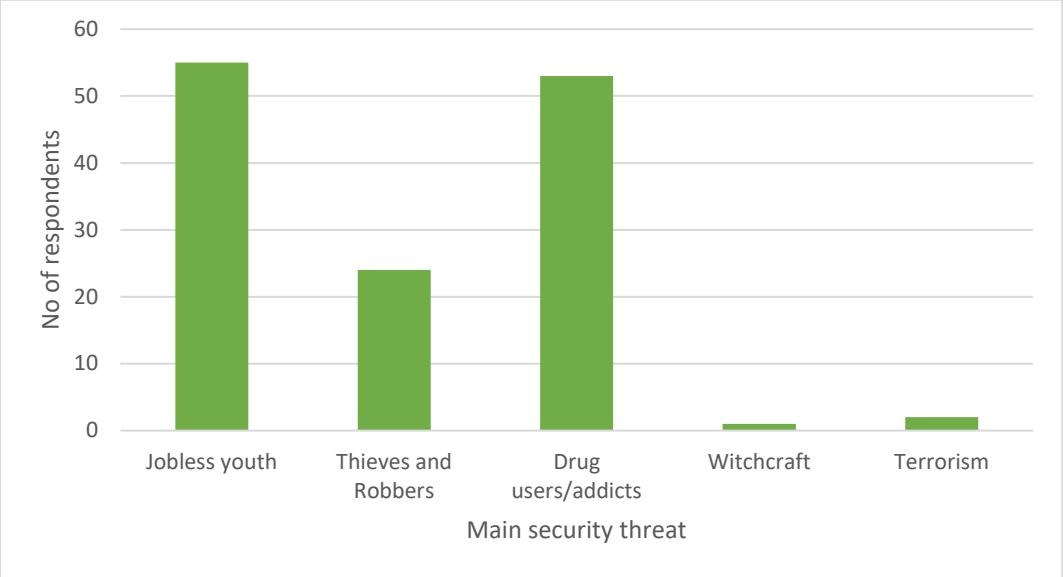
5.2.15. Security

The security situation in Lamu County is on a high alert due to the proximity to the volatile Somalia and the constant threats of terrorism, kidnapping and cross-border attacks. In the recent past, several foreign countries had issues travel advisories to its citizens against travelling to Lamu County due to attacks which occurred on the Island. However, the security situation in the Island has significantly improved lately, with the State together with the County Government collaborating in establishing police posts thus increasing the security presence in the area.

In Pate area, increased numbers of youths are abusing drugs thus becoming addicts. This has led to incidences of theft and robbery in the area, however their severity is quite minimal.

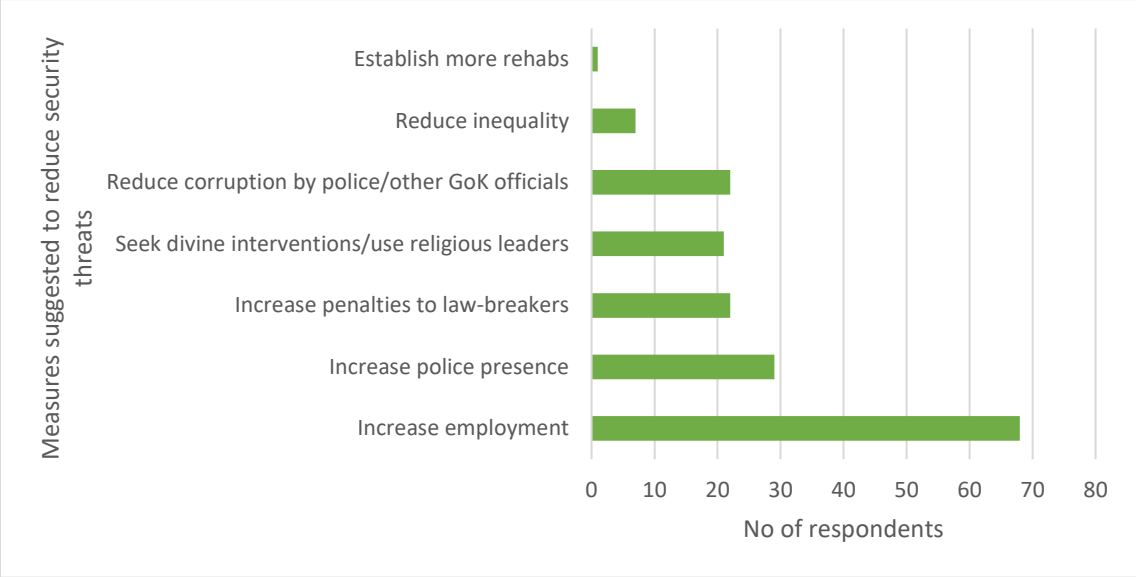
According to the survey conducted, in Pate, joblessness and drug abuse were cited as the main security threats in the Island as shown in Figure 5.78 below.

Figure 5.78: Main security threats in Pate Island



The participants gave suggestions on measures to reduce security threats and the most mentioned one was creating employment opportunities especially for the local youths. This is represented in Figure 5.79 below.

Figure 5.79: Suggested measures to reduce security threats in Pate



55% of participants also noted that security situation in the area has improved, while 36% felt that it was still same in the last three years.

5.2.16. Health Access

In the County, access to health care is a major issue. The number of health services providers in the county is far much lower than the population of the citizens of Lamu. In total, there are 42 health facilities, 24

County Government owned, 3 owned by faith-based organizations, 1 NGO owned and 14 private institutions composed of 3 level five facilities, 5 health centres, 1 nursing home and 33 dispensaries with a total bed capacity of 172 beds[37].

The County has only 4 medical doctors, 24 clinical officers, 94 nurses, 17 public health officers, 5 pharmacists and 30 technical personnel. On average a patient cover approximately 5Km to the nearest health facility[38].

Malaria is the leading diseases in the area with over 63.3% health care records attributed to it. HIV/AIDs prevalence rate stand at 3.2 percent with male prevalence at 3.7% while female prevalence is 2.7%. The prevalence is higher in urban settlements as compared to rural areas. In addition to all the county health facilities, there are 13 VCT centres that provide voluntary testing and counselling services[37].

Table 5.16: Health Services in Lamu County

Facility Name	Type	Owner	Constituency	Division	Location	Sub Location	Beds	Cots	Operational Status
Faza Hospital	Sub-District Hospital	County Government	Lamu East	Faza	Faza	Faza	15	0	Operational
Patte Dispensary	Dispensary	County Government	Lamu East	Faza	Patte	Patte			Operational
Siu Dispensary	Dispensary	County Government	Lamu East	Faza	Siu	Siu			Operational
Tchundwa Dispensary	Dispensary	County Government	Lamu East	Faza	Tchundwa	Tchundwa			Operational
Kiunga Health Centre	Health Centre	County Government	Lamu East	Kiunga	Kiunga	Kiunga	4	0	Operational
Mangai Dispensary	Dispensary	County Government	Lamu East	Kiunga	Mangai	Mangai	0	0	Operational
Mkokoni Dispensary	Dispensary	County Government	Lamu East	Kiunga	Mkokoni	Mkokoni	0	0	Operational
Kiwayuu Dispensary	Dispensary	County Government	Lamu East	Kizingitini	Kiwayuu	Kiwayuu	0	0	Operational
Kizingitini Dispensary	Dispensary	County Government	Lamu East	Kizingitini	Kizingitini	Kizingitini			Operational
Mbwajumwali Dispensary	Dispensary	County Government	Lamu East	Kizingitini	Kizingitini	Mbwajumwali	0	0	Operational
Ndau Dispensary	Dispensary	County Government	Lamu East	Kizingitini	Ndau	Ndau	0	0	Operational
Baraka Medical Clinic (Lamu)	Medical Clinic	Private Practice - Clinical Officer	Lamu East	Mpeketoni	Central	Mpeketoni	0	0	Operational
Ibnusina Clinic	Medical Clinic	Private Practice - Clinical Officer	Lamu West	Amu	Langoni	Langoni	0	0	Operational

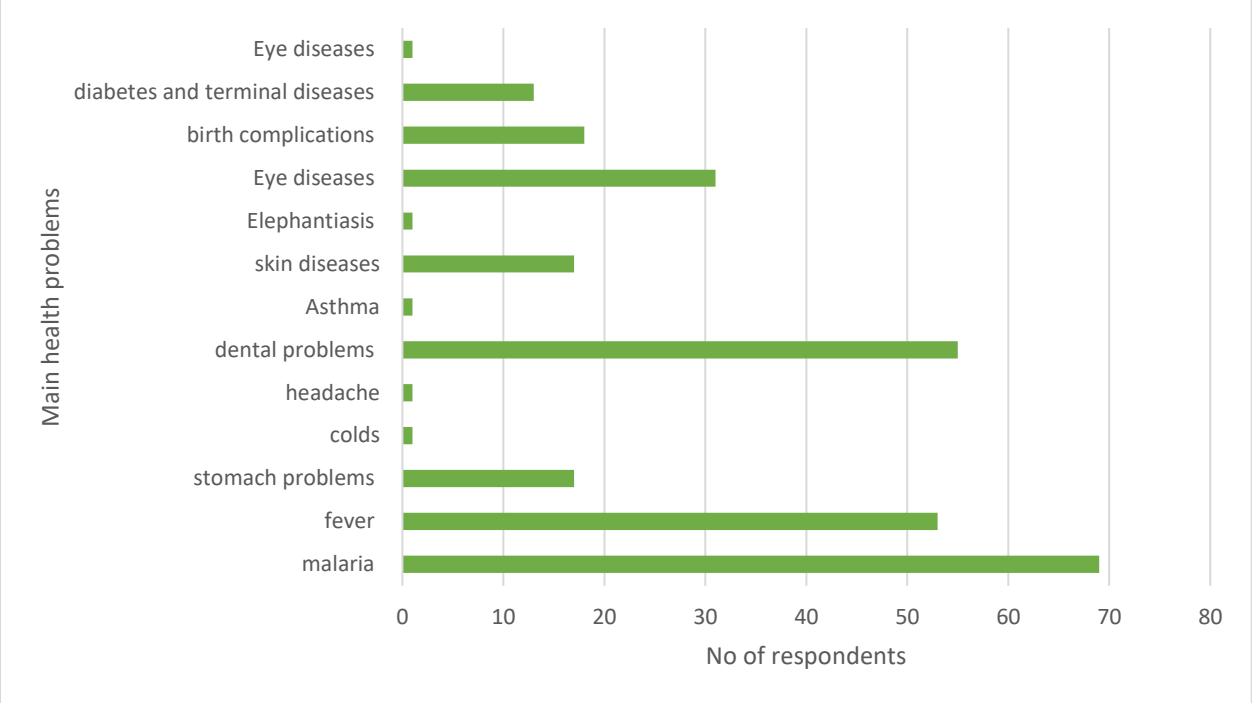
Facility Name	Type	Owner	Constituency	Division	Location	Sub Location	Beds	Cots	Operational Status
Kipungani Dispensary	Dispensary	County Government	Lamu West	Amu	Matondoni	Kipungani	0	0	Not-Operational
Lamu Clinic	Medical Clinic	Private Practice - Nurse / Midwife	Lamu West	Amu	Mkomani	Mkomani	0	0	Not-Operational
Lamu District Hospital	District Hospital	County Government	Lamu West	Amu	Langoni	Langoni	60	20	Operational
Lamu Fort VCT	VCT Centre (Stand-Alone)	Private Enterprise (Institution)	Lamu West	Amu	Langoni	Langoni	0	0	Not-Operational
Langoni Nursing Home	Nursing Home	Private Enterprise (Institution)	Lamu West	Amu	Langoni	Langoni	0	0	Operational
Matondoni Dispensary	Dispensary	County Government	Lamu West	Amu	Matondoni	Matondoni			Operational
Pablo Hortsman Health Centre	Health Centre	Non-Governmental Organizations	Lamu West	Amu	Mkomani	Mkomani	4	0	Operational
Shella Dispensary	Dispensary	County Government	Lamu West	Amu	Shella	Shella	0	0	Operational
Bargoni Nys Dispensary	Dispensary	County Government	Lamu West	Hindi	Hindi	Bargoni	0	0	Operational
Hindi Magogoni Dispensary	Dispensary	County Government	Lamu West	Hindi	Hindi	Hindi	6	0	Operational
Hindi Prison Dispensary	Dispensary	Other Public Institution	Lamu West	Hindi	Hindi	Hindi	0	0	Operational
Mokowe Health Centre	Health Centre	County Government	Lamu West	Hindi	Mokowe	Mokowe	4		Operational

Facility Name	Type	Owner	Constituency	Division	Location	Sub Location	Beds	Cots	Operational Status
Rafiki Miracle Clinic (Hindi)	Medical Clinic	Private Practice - Nurse / Midwife	Lamu West	Hindi	Hindi	Hindi	0	0	Operational
Sowa Medcal Clinic	Medical Clinic	Private Practice - Clinical Officer	Lamu West	Hindi	Hindi	Hindi	0	0	Operational
Hongwe Catholic Dispensary	Dispensary	Kenya Episcopal Conference-Catholic Secretariat	Lamu West	Mpeketoni	Hongwe	Hongwe	0	0	Operational
Hongwe Clinic	Medical Clinic	Private Practice - Nurse / Midwife	Lamu West	Mpeketoni	Hongwe	Hongwe	0	0	Operational
Jamii Clinic (Lamu)	Medical Clinic	Private Practice - Clinical Officer	Lamu West	Mpeketoni	Central	Mpeketoni	0	0	Operational
Mapenya Dispensary	Dispensary	County Government	Lamu West	Mpeketoni	Mapenya	Mapenya	0	0	Operational
Maria Teressa Nuzzo Health Centre	Health Centre	Kenya Episcopal Conference-Catholic Secretariat	Lamu West	Mpeketoni	Baharini	Baharini	6	0	Operational
Mission K Clinic	Medical Clinic	Private Practice - Nurse / Midwife	Lamu West	Mpeketoni	Central	Mpeketoni	0	0	Operational
Mkunumbi Dispensary	Dispensary	County Government	Lamu West	Mpeketoni	Mkunumbi	Mkunumbi	0	0	Operational
Mpeketoni Health Services Clinic	Medical Clinic	Private Practice - Clinical Officer	Lamu West	Mpeketoni	Central	Mpeketoni	0	0	Operational

Facility Name	Type	Owner	Constituency	Division	Location	Sub Location	Beds	Cots	Operational Status
Mpeketoni Sub-District Hospital	Sub-District Hospital	County Government	Lamu West	Mpeketoni	Central	Mpeketoni	50	0	Operational
Mugos Clinic	Medical Clinic	Private Practice - Clinical Officer	Lamu West	Mpeketoni	Central	Mpeketoni	0	0	Operational
Muhamarani Dispensary	Dispensary	County Government	Lamu West	Mpeketoni	Mkunumbi	Kibaoni	0	0	Operational
Sloam Medical Clinic	Medical Clinic	Private Practice - Nurse / Midwife	Lamu West	Mpeketoni	Central	Mpeketoni	0	0	Operational
Uzima Medical Clinic (Lamu)	Medical Clinic	Private Practice - Clinical Officer	Lamu West	Mpeketoni	Central	Mpeketoni	0	0	Operational
Didewaride Dispensary	Dispensary	County Government	Lamu West	Witu	Didewaride	Didewaride	0	0	Operational
Moa Dispensary	Dispensary	County Government	Lamu West	Witu	Moa	Moa	0	0	Operational
Mpeketoni Health Sevices (Witu)	Medical Clinic	Private Practice - Clinical Officer	Lamu West	Witu	Witu	Witu	0	0	Operational
Pandanguo Dispensary	Dispensary	Community	Lamu West	Witu	Pandanguo	Pandanguo	0	0	Operational
Witu Health Centre	Health Centre	County Government	Lamu West	Witu	Witu	Witu	10	0	Operational

According to the key informants survey, Malaria and fever were the most common diseases among the people. Other common diseases and their frequencies are represented in Figure 5.80 below. Shortage of medical staff, equipment and medicine was cited as the biggest challenge in access to medical care.

Figure 5.80: Common diseases in Pate Island



It was noted that most population goes to district hospital in faza. Most of the health centers in the area are dispensaries and some community members seek medication from traditional healers. This is represented in

Figure 5.81 below. The average distance that communities travel for medical services is 1.27 km as representeed in Table 5.17 below.

Figure 5.81: Hospitals where community's in Pate seek medication

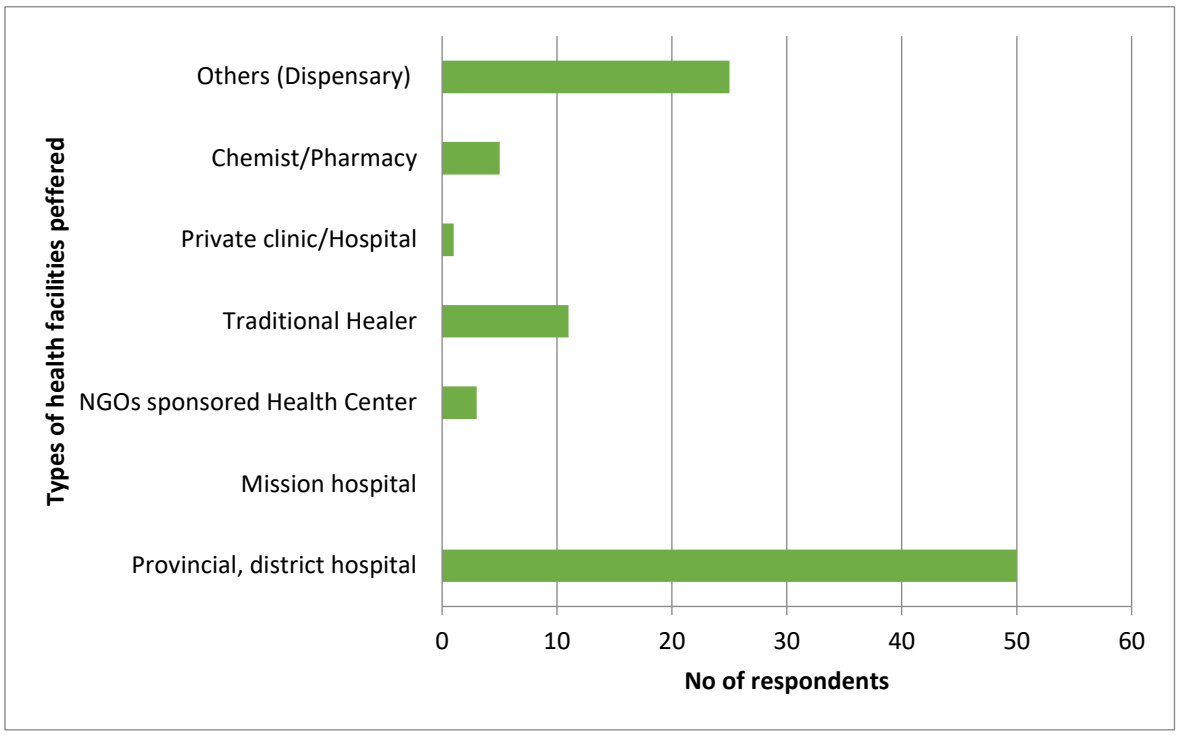


Table 5.17: Average distances that locations seek medical services

Location	average distance to nearest health facility in Km
FAZA	1.52
KIZINGITINI	0.47
MBWAJUMWALI	0.79
MTANGAWANDA	3.5
PATTE	0.87
TCHUNDWA	0.5
SIYU	
overall average distance	**1.275**

87% of the responses given portrayed that most of the respondents were not satisfied by the current health facilities and services, while 13% showed a level of contentment with the health facilities. Issues raised that led to the non-satisfactory state include: lack of skilled and professional doctors; lack of or limited supply of medicines; lack of medical facilities such as hospital beds; and poor health services from doctors and nurses.

6.0. PUBLIC AND STAKEHOLDER CONSULTATION

EMCA amendment Act 2015 and The EMCA 1999 and IFC Performance Standards call for effective stakeholder participation and public in the EIA process, this case an ESIA. This chapter describes the Stakeholder Engagement Exercise that was carried out for the proposed drilling programme on Blocks L4 and L13.

Stakeholder engagement is a key part of this ESIA process. One of the key aims of the stakeholder engagement exercise is to ensure all relevant stakeholders are provided with the opportunity to express their concerns and opinions and in turn have them reflected in the ESIA and ESMP. The stakeholder engagement exercise also provides NEMA with the necessary information to assist it in making an informed decision about the Project.

6.1. Objectives of Public Consultation

The main objective of the exercise was to inform stakeholders about the project and its likely effects, which in turn would incorporate their inputs, views and concerns, and thus enable their views to be taken into account during the decision-making. The specific objectives of the consultations were to:

- Obtain local and traditional knowledge that may be useful in decision-making including any Indigenous Knowledge Systems (IKS) (if any);
- Facilitating consideration of alternatives, mitigation measures and trade-offs (if any);
- Ensuring that important impacts are not overlooked and benefits are maximized;
- Reducing chances of conflict through early identification of contentious issues;
- Provide an opportunity for the public to influence the project design and operational plan in a positive manner;
- Improving transparency and accountability of decision-making; and
- Increasing public confidence in the ESIA

6.2. National and International Regulations and Requirements for Stakeholder Engagement

6.2.1. National Requirements for Stakeholder Engagement

The Environmental Impact Assessment (EIA) and Audit Regulations (2003) provide for the stakeholder engagement within EIA and were relied upon while engaging the Stakeholders within the Project Area.

6.2.2. International Best Practices for Stakeholder Engagement

There are Standards for International Best Practice on Stakeholder Engagement that was relied upon during the consultation exercise. These include:

- IFC Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts, 2012
- IFC's Access to Information Policy (AIP), 2012
- AFDB Handbook on Stakeholder Consultation and Participation

6.3. Stakeholders Identification

The first step in the process of public participation process was stakeholder identification. Stakeholder identification was to determine all organizations and individuals who may be directly or indirectly (positively or negatively) affected by the proposed project. In the end, the stakeholders were grouped into two main categories depending on their various needs, interest, and potential influence to the project: which are:

1. **Primary Stakeholders:** These are stakeholders directly affected by the project such as the local residences/ communities.
2. **Secondary Stakeholders:** These are stakeholders indirectly by the project but influence development through project implementation. These include but not limited to: National Government, Lamu County Government, Local Government, non-governmental organization (NGOs).

6.4. Tools and Methods of Engagement

6.4.1. Tools

The following documents were developed to support the Stakeholder Engagement Exercise:

1. Background Information Documents (BID) in both English and Swahili (Appendix 1). The BID included the following information:
    - Identification of the project proponent
    - A brief summary of the ESIA process, including the public consultation process and opportunities for stakeholder participation
    - A description of the proposed Project (the nature of the exploration drilling activities, methods, equipment and activities schedule)
    - A brief description of the project location as a map
2. Meeting Presentation (Appendix 2)
3. Stakeholder Meeting Register (Appendix 3)
4. Email and follow up telephone conversations. Respondents had the option to return Comments Registration Sheets (CRS) (Appendix 4)

6.4.2. Methods of Stakeholder Engagement

Interview

Enumerators were employed during the stakeholder consultation period to undertake socio-economic questionnaires with key community members and stakeholders. The interviews were expected to yield the following information:

1. Socio-economic characteristics of the area. This information was used to corroborate and verify data obtained from other sources, such as the literature review and the quantitative household survey
2. Impact of the project on the social, cultural and community settings

Focused Group Discussions (FGD) and Community Baraza's

Focused grouped discussions involved meetings with representatives from different sectors from the National Government, County Government, Local Government, NGOs, Community Based Organisations (CBOs).

The main aim of the community baraza's was to target local residents from the location in Pate Island.

The FGD and Community Baraza's were held in order to obtain:

- Information on community expectations and social risk associated with the project
- Insight on the challenges faced in the County
- Environmental and Socio-economic baseline characteristics of the project area
- To assess impact of the project on the environment and communities, both positive and negative impacts
- To establish mitigation measures for the negative for the negative impacts

6.5. Stakeholders Consulted

The stakeholder consultation process was conducted from 18th April 2016 – 6th May 2016, meetings held in both Lamu County and Nairobi County.

The study team that took part in the stakeholder consultation exercise are as shown in the Table 6.0.1 below.

Table 6.0.1: Public and Stakeholder Consultation Team

ESF Consultants	Zarara
1. Duncan Oyaro 2. Dorothy Suleh 3. Linet Mbova 4. Anthony Kiovi **5.** Michael Kiboi	1. Peter Nduru 2. Alawy Abzein 3. Abdulswamad Basheikh

6.5.1. Primary Stakeholders Consulted

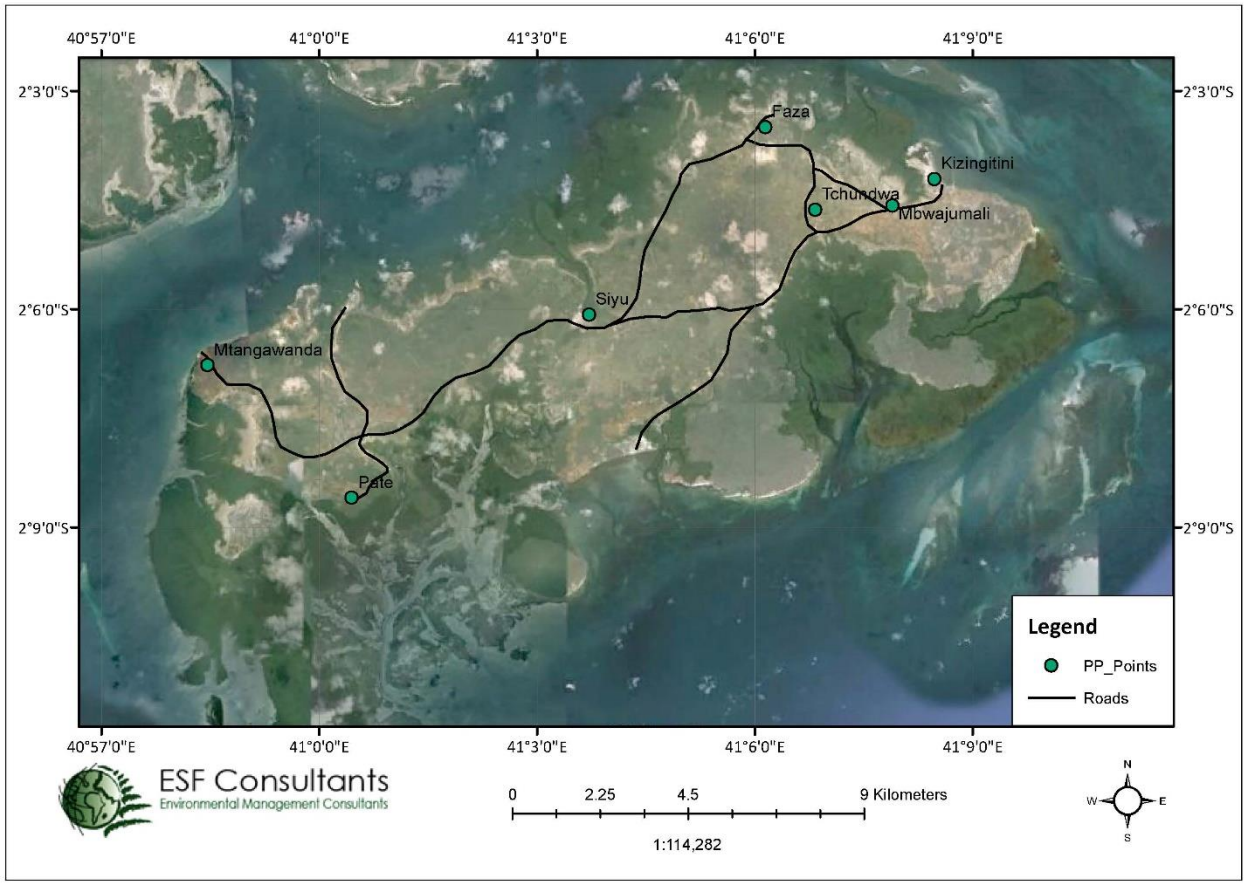
This comprised of communities in Pate Island. The Community stakeholder consultation concentrated in Pate Island because this is the area of interest where the proposed drilling programme is likely to take place.

Table 6.0.2: List of Communities Consulted

Date	Community
18th April 2016	Faza
19th April 2016	Kizingitini
	Mbwajumwali which included some community members from Nyabogi
20th April 2016	Tchundwa
	Siyu which included some community members from Shanga
21st April 2016	Pate
	Mtangawanda

*See appendix 5 Public and Stakeholder Meeting Pictures

Figure 6.0.1: Locations of Communities Consulted



6.5.2. Secondary Stakeholders Consulted

Date	Contact Person	Institution	Position Role
18th April 2016	Ann Komen	WWF Kenya	Project Officer, Boni-Dodori SFM Project
	Jonathan Chebesa	County Commissioners Office	Assistant County Commissioner
	Kamal Sharif	Department of Fisheries, Livestock and Co-operative	Director
19th April 2016	Edward Wanekhwe Mulongo	Kenya Maritime Authorities (KMA)	Branch Vessel Inspector
	Mahmoud H. Ali	Kenya Ports Authority (KPA)	Senior Superintendent
	Ali S. Bwana	Kenya Wildlife Services (KWS)	County Wildlife Conservation and Compensation Committee (CWCCC)
	Ali Osman Ferul	Kenya Forest Services (KFS)	Corporal
	Representatives from the Public Health Department (Please see register in Appendix 3)	Public Health Department	
20th April 2016	Save Lamu Members (Please see Appendix 3 Stakeholder Meeting Register and appendix 5 Public and Stakeholder Meeting Pictures)	Save Lamu NGO	
	Haji Mohamed	Lamu Museum	Conservation Officer
	Eric Muteti Njeru	National Museums of Kenya	Archaeologist
	Khalifa Bwanamara Khalifa	Lamu County Government	Faza Ward Administrator
	Mr. Salim	Ministry of Water	Hydrologist
	Executive Members	Tafakur Livestock Keepers Self Help Group – Tchundwa Location	

Date	Contact Person	Institution	Position Role
		(Please see Appendix 3 Stakeholder Meeting Register and appendix 5 Public and Stakeholder Meeting Pictures)	
21st April 2016	Philip Oloo Molo	Ministry of Interior and Coordination	Assistant County Commissioner Kiingitini Division
	Luqman Aboud		Chief Kizingitini
	Mohamed S. Mohamed		Assistant Chief Mbwajumwali
22 April 2016	Florence Ndungu	Ministry of Trade and Tourism	Chief officer Trade, Tourism, Culture, Wildlife and Forestry
18th May 2016	Shakila Abdalla		Lamu County Women Representative
	Athman Shariff		Lamu East Member of Parliament
	Mr. Abubakar		

Secondary Stakeholders who responded to comments via phone call and email

Date	Communication means	Contact Person	Institution	Position Role
25th April 2016	Phone Call	Shalom 0704864853	Individual interested in the project	
3rd May 2016	Email	Mohamed Hashim	County Assembly of Lamu	Speaker
4th May 2016	Email	Barkatch Mukholi cliff	NEMA Lamu	Environmental Officer
5th July 2016	Phone Call	Tom Bwana	Individual Interested in the project	

*Comments can be found in Appendix 4 CRS and Appendix 6 Issues and Response

6.6. Summary of the Key Issues, Concerns and Comments raised during the Stakeholder Engagement Exercise

Communities raised concerns that the project might have both environmental and socio-economic effects to the surrounding communities. Below are some of the issues raised:

6.6.1. Environmental

Impact on Biodiversity

The communities fear the proposed drilling process might lead to excessive gas been directed into the mangrove ecosystem. The community members claimed that this happened in the 1970s, during the oil drilling done by Shell. Zarara assured the communities that the current technologies are more advanced compared to the 70s, measures have been put in place such as blowout preventers have been fitted to the drilling rig to manage any accident that may arise from drilling.

Due to the unknown location of the drilling site, community members are speculating that the proposed project will be conducted offshore, hence will affect the breeding grounds for fish, crabs, and mangrove ecosystems. The community members were reassured by the both Zarara and ESF Consultants that the operations will be conducted onshore, and no waste from the well pad will be directed into the ocean.

Gas drilling being a new process in Lamu county, community feared that the project will impact on the biodiversity such as destruction of vegetation and soil disturbance in the area. Community proposed that measures should be put in place to ensure that all biodiversity in the area are conserved and not impacted on by the proposed gas drilling activities by undertaking a detailed ecological baseline that will be used in the development of the ESIA report. The vegetation to be impacted will be only on the 200mx200m, we as environmental consultants recommend that the company to plant indigenous trees along the perimeter wall.

It was also noted with the development of access roads in the area will improve accessibility in the area, hence other environmental challenges such logging and poaching will reduce.

Waste Generation

Waste generation and methods of waste disposal was another concern raised by the community members. ESF Consultants assured community members that a waste management system will be put in place; for example, the drilling fluid will be treated and reused in the drilling process. Waste will also be handled and transported by a NEMA certified waste handler.

Water Quality

The community from Pate location raised issues on water quality, their water wells turned salty rendering it unfit for human consumption after over abstraction by BGP during the seismic process. They feared the process of gas drilling which uses a lot of water, the company will not rely on their water wells for water use. Zarara assured the community that they had received complaints from the community members, hence sourced water from Hindi and Lamu Island instead. ESF Consultants would also recommend Zarara to use sea water in their drilling process, if possible.

Air Pollution

During the stakeholder consultation process, some of the community members feared that the process of gas exploration will generate emissions and generate dust leading to air pollution. Zarara and ESF Consultants informed the members that the project will be using up to date technologies to improve efficiencies to reduce emissions and mitigation measures will be put in place to reduce emissions.

Noise and Vibration

Community members are aware that the mobilisation and operation phase of the project will generate noise in and around the projects area; however, they wanted to enquire what mitigation measures will be put in place to reduce the impacts. ESF Consultants informed the community members that mitigation measures will be put in place and this will be included in the report.

6.6.2. Socio-Economic

Employment

Community members appreciated the employment opportunities created during the seismic period, this helped reduce cases of insecurity caused by the unemployed youths. Hence, enquired if there will be employment opportunities during the drilling phase, and what would be the criteria for employment. If employment opportunities will be there first consideration should be given to the local residence. ESF Consultants informed the community that during the ESIA period enumerators were used to collect socio-economic data to inform the report. Zarara went on to explain that there will be employment opportunities at the drilling stage, though less compared to the seismic phase. This is due to the specialist skills required for the project and confined area space-200m by 200m, less compared to the area coverage during the seismic stage.

The stakeholder also noted that other than created employment opportunities, the proposed development could also create improved retail business in the area for good and services such as food.

Land use

The land in some part of the Island is still in dispute and some still have unresolved land issues. It was also noted that most of the people in Pate Island do not have land Title deeds. Community membered feared that people from other areas will come and reposes or purchase their lands due to the project. There are fears that land speculations might increase the value of land in the area. Therefore, the community demanded that before any commencement of the proposed gas drilling program, community to be issued with land title deeds to avoid conflicts in the future. Zarara assured the community that it will only work on the lands which has no dispute and will deal with land owners.

Compensation

The issue of compensation was raised by the communities in all locations where community stakeholder meetings took place. They suggest that the compensation plan be mutually and legally agreed by all parties involved, it should be done through the actual land owners and not through the chiefs. Zarara assured community the process of gas exploration will only take place after agreement between the

Zarara Oil and affected individuals or community on the land the drilling will take place. They also assured the communities that gas drilling will be site specific; that is, 200m by 200m: smaller in comparison to the size/extent of land the seismic lines passed.

Community leaders consulted during the stakeholder consultation exercise raised concern that compensation should be done to the whole communities and not only to the land owners, it is the community that will be affected by the proposed project.

Community benefits and Corporate Social Responsibility (CSR)

The communities were more concerned on the benefits they would receive once gas has been discovered in Pate Island; and if whether the communities or individuals would benefit from the project. Zarara informed the community members that there will be both direct and indirect benefits to the community members such as employment, CSR proposed by the community members, improved roads since they will need to be upgraded to facilitate transportation of project equipment's. Zarara also gave the example of The Natural Resources (County Royalties) Bill 2013 which has been tabled in parliament for discussion, the Bill seeks to make provisions for sustainable exploitation and equitable apportionment of royalties with other accruing benefits by allocating 20 per cent of the proceeds to county government, 75 per cent to the national government and 5 per cent to the local community where activities are carried out.

Some of the community members claimed that in the past they had been promised CSR project by Zarara, but this is yet to be seen. It was noted the key concern in the area is poor road network; and inadequate health and education facilities. Community members have requested for more CSR projects to be done to improve the economic standards of the area. Some of the suggested CSR projects include: a girls boarding secondary school; rehabilitation and expanding of the only existing roads in Pate Island; equipping of health centers; and providing cheap energy to the communities.

Health and Safety Issues

Communities wanted confirmation from Zarara that their safety will be considered at all times during project operation. Zarara and ESF Consultants confirmed to the community members that the project will be confined within the well pad. Measures will be put in place to ensure health and safety measures are observed at all times.

Social impacts

The proposed project will increase the number of people in the project area and its surroundings which could lead to socio-cultural diversification.

There are also fears that with the increase in population into the project areas, there will be an increase in the spread of HIV and AIDS.

Interference of Mtangawanda Jetty

Community raised concern on the use of Mtangawanda Jetty during the transportation of drilling equipment's. Zarara responded that logistical issues have not yet been finalized, but it will be

recommended to the infrastructure engineers to consider contracting a temporary jetty/platform adjacent to the existing jetty or to expand the existing jetty.

Infrastructural Development

The proposed project will improve accessibility to the area, hence the local residence will be able to access social services provided by the government and other NGOs.

6.6.3. Other Concerns

Issues related to the ESIA

Community members wanted to know the start date for the drilling process. ESF Consultants informed the communities that the start date has not yet been determined, and EIA license needs to be acquired first. To acquire the license this would take 45-90 working days as stipulated in The Environmental (Impact Assessment and Audit) Regulations, 2003: after submission of reports. Zarara went further to explain that the Government of Kenya has extended their exploration license which is to expire in 2017, hence they need to have commenced with the drilling exercise during this time period.

Majority of the stakeholders wanted to know the exact location where the drilling will be undertaken. Zarara informed the community members that the exact locations are not yet known since results from the seismic data has not been finalised.

Key stakeholder also noted that with the new studies to be conducted such as hydrological survey, ambient air quality, and ecological survey will provide much needed data of the area.

All those consulted requested that there should be additional and continuous stakeholder consultations with opinion leaders and community members.

Majority of the stakeholder consulted are for the project because it will promote green energy in the area, and it has potential to create employment and improve accessibility in the area.

Issues not related to ESIA

Community members, particularly from Tchundwa Location raised concerns that holes created during the seismic period were not properly rehabilitated. Zarara confirmed that during the decommissioning phase of the seismic activates all the seismic lines where rehabilitated to its original state. The holes in question might have resulted from the heavy rainfall experienced after the process.

7.0. IMPACT IDENTIFICATION AND ASSESSMENT

This chapter outlines the potential negative and positive impacts that will be associated with the project. The impacts will be related to activities to be carried during the life cycle of the project: that is, design construction, operation and decommissioning phase.

The proposed development has the potential to create a range of impacts on the environment. These potential impacts can be both positive and negative. The objective of this chapter is to assess the likelihood of impacts which will be incorporated in the project design, construction, operation and decommissioning phase. If the negative impacts cannot be eliminated at least to be mitigated to as low as reasonably practicable and meets county, national and international laws.

The purpose of impact assessment and mitigation is to identify and evaluate the significance of potential impacts on identified receptors and resources according to defined assessment criteria and to develop and describe measures that will be taken to avoid or minimise any potential adverse effects and to enhance potential benefits.

7.1. Methodology

Potential Impacts associated with the proposed development were identified from their sources that include project's activities; equipment; processes; materials against their main receptors that include the baseline environmental and social condition. Information collected from public consultation, literature review, and professional knowledge were used to inform the baseline characteristics of the project site. The evaluation of baseline data provides crucial information for the process of evaluating and describing how the project could affect the biophysical and socio-economic environment.

The impacts were then classified as either positive or negative and the project phase whence which they will occur. The evaluation approach implemented in this study is a Receptor-Specific Analysis approach addressing the various sources of impacts from the project's different implementation phases decommissioning of existing structures, project design, construction, operation, and decommissioning phase.

The next step of the impact identification process is in the assessing the impacts in terms of their significance, duration, reversibility, likelihood of occurrence and geographical extent. The list of criteria used to assess significance is shown in Table 7.0.1 and the rating of likelihood of occurrence criteria is shown in Table 7.0.2. Based on the two lists of criteria the impacts of severities are determined.

Table 7.0.1: List of criteria used to assess significance

Criteria	Consequences
Massive impact over a large area resulting in extensive, potentially irreparable damage to a VEC*. Has a measurable effect on the livelihood of those using a resource over a period of years.	5: Catastrophic

Massive impact over a large area resulting in extensive, potentially irreparable damage to a site of social and/or cultural importance.	
Long term or continuous impact resulting in substantial adverse changes in a VEC, well outside the range of natural variation. Unassisted recovery could be protracted. Area of effect is extensive and/or encompasses an area that supports a statistically significant proportion of a VEC population or ecosystem. Has a measurable effect on the livelihood of those using a resource over a period of months. Significant damage / impact to a site of social and/or cultural importance.	4: Significant
Moderate adverse changes in a VEC or area that supports a VEC population. Changes may exceed the range of natural variation though potential for recovery within a few years without intervention is good. Area of effect encompasses an area that supports either a moderate or minor proportion of a VEC population or ecosystem. Long term (> 5 yrs) changes over an area which is not considered to be a VEC. Has a measurable effect on the livelihood of those using a resource over a period of weeks. Moderate damage to a site of social and/or cultural importance.	3: Moderate
Minor adverse changes in a VEC. Changes will be noticeable but fall within the range of normal variation and be typically short-lived, with unassisted recovery possible in the near term. However, it is recognized that a low level of impact may remain. Medium term impact (1-5 yrs) in an area that does not encompass a VEC or whose impact is highly localized within a VEC. Long term impact over a discrete, small area which does not support a VEC. May be noticed but does not affect the livelihood of those utilizing a resource. Minor impact to a site of social and/or cultural importance.	2: Minor
Short term changes in an ecosystem that are unlikely to be noticeable (i.e. fall within the scope of natural variation). Area of effect is restricted to the immediate vicinity of the source. Has no discernible effect on the environmental resource as a whole and is likely to go unnoticed by those who already use it. Negligible impact to a site of social and/or cultural importance.	1: Negligible
Changes that result in a net positive impact to an ecosystem, environment or population.	Beneficial

* VEC means Valuable Ecosystem Component, used to refer to components of the environment that are considered to be of commercial and/or ecological importance.

Table 7.0.2: Likelihood of occurrence criteria

Likelihood to occur	Category	Score
Impact is highly likely or certain to occur under normal operating/ construction conditions	High	C
Impact may possibly occur under normal operating/construction conditions.	Medium	B
Impact is unlikely to occur under normal operating/construction conditions but may occur in exceptional circumstances.	Low	A

Having identified and characterized the potential significant impacts during each phase using the screening procedure identified above, a matrix was developed to summarize all identified impacts during each phase of the project, please refer to Table 7.0.3.

Table 7.0.3: Impact Assessment Matrix

		Likelihood Rating		
CONSEQUENCE RATING		A	B	C
	1	1A	1B	1C
	2	2A	2B	2C
	3	3A	3B	3C
	4	4A	4B	4C
	5	5A	5B	5C
	6	6A	6B	6C
KEY				
Consequence		Likelihood	Acceptability	
1-Negligible	4-Significant	A-Low	Negligible with minor mitigation	
2-Minor	5-Catastropic	B-Medium	Minimize Impacts	
3-Moderate	6-Beneficial	C-High	Unacceptable	

7.2. Positive Impacts

7.2.1. Design Phase

This is one of the beginning stages of a project where the management process of planning and controlling the performance and execution of a project.

It is also at this stage where the ESIA process is undertaken, and preparing the proponent to get the necessary documentations for the execution of the project.

Receptor	Construction Phase Impacts	Impact Significance Rating
Socio-economic	**Planning for Corporate Social Responsibility (CSR) in the area** Expectations from stakeholders are that social investment from the project will directly benefit the communities. From the public and the stakeholder consultation exercise, the key focus areas for the CSR strategy are likely to be health, education, employment, and water. These programmes should be undertaken in full consultation with local communities, the county government, and national government; and should be designed to provide positive benefits to individuals and communities.	6C
	Creation of employment and business opportunities The design phase of the project will create employment and business opportunities for various professionals/consultants involved in the planning stage of the project. They include project managers, engineers, surveyors, environmentalists, among others. They may be employed directly in the project or be consultants whose services will be procured.	6C
	Environmental Opportunities The design phase of the project will present opportunities for green/sustainable designing of the project, which support the minimization of the environmental impacts whilst fortifying the project to achieve its intended objectives.	6C

7.2.2. Construction Phase

This phase involves mobilization and establishment of the camp, which includes preparing the drilling equipment and ancillary drilling materials and setting up the drilling pad which will accommodate approximately 180 workers.

Receptor	Construction Phase Impacts	Impact Significance Rating
Socio-economic	**Employment** There will be several employment opportunities during the project construction phase. The employment opportunities will be either directly in the project or indirectly through associated businesses (supply food stuffs in the camp). These	6C

Receptor	Construction Phase Impacts	Impact Significance Rating
	include the generation of employment for skilled and unskilled labour in the short to medium term. Setting up the drilling pad will require extra hands; therefore, employment opportunities will be available for the locals to carry out manual work. The contractor will be expected to recruit, train and employ approximately 50 Lamu residents from the island or immediate due to the complexity of the work at hand.	
	Infrastructural development The roads leading to the site will be modified to ease access of transportation of civil engineering staffs, drilling rig and other construction materials to the site. The roads to the site will also serve other residents who are set to benefit from this infrastructure development brought by the project. This will enhance the ease of access to the project site especially to people neighbouring the project.	6B
	Improved economic growth The resources and raw materials needed for the success of the project such as fuel/oil, food, water, among other; will attract taxes including VAT which will be payable to the government hence increasing government revenue while the cost of these raw materials will be payable directly to the producers. The locals may also indirectly benefit by providing goods and services through associated businesses to the camp	6C

7.2.3. Operational Phase

This phase will involve the actual drilling activities and any other supporting activities.

Receptor	Construction Phase Impacts	Impact Significance Rating
Socio-economic	**Employment** The hydrocarbon exploration drilling project will provide employment opportunities to the people of Pate Island. During the drilling phase the contractor and the company will be expected to recruit, train and employ approximately 50 Lamu residents from the island or immediate due to the complexity of the work at hand. The employed residents will constitute about one quarter of the workforce during the drilling program.	6C
	Improved living Standards	6B

Receptor	Construction Phase Impacts	Impact Significance Rating
	Employment opportunities as a result of the project will be a platform for the employed local community members to improve their living standards. The income generated can serve the employed personnel to meet their basic needs.	
	Growth of the local economy Business investments owned by locals may benefit from the project by providing goods and services to the working crew on tender basis. The use of local providers for goods and services for the development will generate revenue which will be able to flow into the local economy.	6C

7.2.4. Decommissioning Phase

This phase will involve dismantling the drilling pad and rehabilitation of the drilling site into its previous or better state.

Receptor	Construction Phase Impacts	Impact Significance Rating
Socio-economic	**Employment Opportunities** The decommissioning phase and its activities will create business for the contracting company that will be charged with pulling down the structure and transporting the resultant materials/debris. This will create employment opportunities for transport services and staff involved in the dismantling of structures and equipment's.	6C
	Growth of Local Economy All the income generated will be taxed and the central government will benefit from the income tax.	6B
	Provision of cheaper building materials Recyclable building materials such as stones, metals, glass, wiring, electronics, and plumbing etc, maybe used for future projects strategically to increase the productivity of the purposes the establishments in which they are used. The materials may also be donated and used for development projects (schools, hospitals etc.) in much needed areas. This will assist in promoting development where it's mostly needed and generally improve the quality of life in those areas and cumulatively in the country.	6B
	Improved aesthetic value/ rehabilitation	6B

Receptor	Construction Phase Impacts	Impact Significance Rating
	Upon decommissioning the project, rehabilitation of the project site and access roads will be carried out to restore the area back to its original or better state. This will include backfilling of the topsoil and re-vegetation which will improve the visual quality of the area.	
Environment	**Environmental Conservation and Restoration** Waste material/debris can be reused or recycled as raw materials in other construction process, which reduces the demand for raw materials hence reducing the potential impact to the environment that would have been felt if the demand of the raw materials hadn't reduced. The disturbed areas (well pad site and access roads) should be rehabilitated to its original state if not better, this should be done to prevent soil erosion.	6B

7.3. Negative Impacts

7.3.1. Design Phase

Impact	Receptor	Design Phase Impacts	Impact Significance Rating	Mitigation Measures	Residual Impacts
Community perception	**Socio-economic**	**Locals against the project** There is a potential that there may be stakeholders/ local residents who may be against the project. However, from the public consultation exercise and the socio-economic survey that was undertaken many of the respondents support the project. Though, majority want to see direct benefits from the project in terms of CSR and employment.	1A	▪ There should be continuous stakeholder engagement throughout the project life cycle. ▪ Develop a grievance mechanism to record any complaint from the public/stakeholders ▪ Employ locals	1A
Conflict on land issues	**Socio-economic**	**Land acquisition** In Pate Island, some areas the owners have title deeds and some the land is communal. In the case of private land, the proponent could negotiate with the land owner to lease the land off them. In the case of communal land, the client will have to negotiate with the communities and leaders on what benefits the communities will want. This may create conflict due to different expectation levels	1B	▪ Constant communication with the land owners and community members ▪ Communicate with local administration, national and county government	1A

7.3.2. Construction Phase

Impact	Receptor	Construction Phase Impacts	Impact Significance Rating	Mitigation Measures	Residual Impacts
Vegetation Loss/ Soil Disturbance	**Biodiversity**	**Flora** Due to varying soil types, Pate Island is largely populated with scrub bushes, scatter palms and indigenous trees, and scrubs. Grassy open swampy places dominate some parts that have drainage problems due to low altitude in the region. The well site for Pate 1 operated by Shell, is largely covered by shrub and bush. Vegetation will be lost or altered to pave way for construction activities for access roads and well pad (200 m by 200 m)	3C	▪ Clearing vegetation only in construction areas and demarcating areas where no clearing will happen ▪ Education on the importance of flora and fauna in the areas, including the appropriate regulatory requirements ▪ Rapid regeneration of plant cover must be encouraged by setting aside topsoil during earthmoving and replacing onto areas where the reestablishment of plant cover is desirable to prevent erosion if it was necessary. ▪ Implement a tree planting program within the well pad to offset loss of trees due to the construction phase	2B
	Soil	Activities such as movement of truck transporting drilling materials to site and the construction of the well pad will lead to disturbance of the topsoil which will cause soil erosion. Due to the heavy nature of drilling equipment's (approximately 24-80 tonnes) to be transported by road the roads will be upgraded; and where necessary jetties, bridges and drainage and culverts will be strengthened and reinstated. These activities will lead to the disturbance of top soils leading to an increase in dust levels.	3C	▪ Work areas should be clearly defined and demarcated, where necessary to avoid unnecessary disturbance on areas outside the development footprint ▪ Providing soil erosion control structures on the steeper areas of the site & controlling activities during the rainy season ▪ Manage storm and flood flash water effectively to avoid movement of loss soils. ▪ Vehicles coming into the site must use designated roads	2B

Impact	Receptor	Construction Phase Impacts	Impact Significance Rating	Mitigation Measures	Residual Impacts
				▪ Sprinkling water periodically when operations are under way to prevent raising of dusts ▪ Impose and enforce speed limits and provide driving guidelines for vehicle operators; for example, 40 Km/hr	
Introduction of Invasive species	**Biodiversity**	During movement/transportation of drilling equipment and materials to the project site will create the risk of introducing invasive species from one area to another. For example, invasive species are introduced into new areas through: foods, stowaway's that attach themselves to shipping ballast tanks, shipping crates, passengers.	2B	▪ Develop a plan for control of noxious weeds and invasive plants that could occur as a result of new surface disturbance activities at the site. The plan should address monitoring, weed identification, the manner in which weeds spread, and methods for treating infestations.	1B
Air Pollution	**Air Quality**	Air pollution as a result of fumes and gases from vehicles and machinery such as generators or fossil fuel using-machines, will generate emission such as oxides of Carbon, Sulphur, and Nitrogen, which will pose risks to environmental and human health. Such emissions will contribute to both regulated pollutants and greenhouse gases in the project site. Raised dust as a result of anthropogenic movements such vehicle movements, throughout the drilling program will also contribute to air pollution.	3C	▪ Use of low Sulphur fossil fuel. ▪ Regular maintenance and services of machines and engines ▪ Educate and raise awareness to construction workers on emission reduction and emissions that are likely to occur. ▪ Sensitize truck drivers to avoid unnecessary racing of machinery engines at loading, offloading sites, and parking areas and encourage them to keep the vehicle engines off at these points.	2C
	Occupational Health and Safety	The health effects of exposure to fumes and dust generated from construction activities of the well pad, vehicle movement transporting drill rig to site can include irritation of the upper respiratory tract (nose	3B	▪ Provide workers with appropriate PPE such as dust masks.	2B

Impact	Receptor	Construction Phase Impacts	Impact Significance Rating	Mitigation Measures	Residual Impacts
		and throat), tightness in the chest, wheezing, lung damage, bronchitis, sight problems.			
Noise Pollution		During the construction phase of the proposed project, there will be an increase in the noise levels within the area due to machinery/ equipment including generators, vehicular traffic, and other construction activities. Elevated noise levels within the site will affect project workers and the residents, passers-by and other persons within the vicinity of the project site. The estimated average level of noise generated during the construction phase is about 65 dBA covering 500 feet from the source.[40]	3C	▪ Machinery should be maintained regularly to reduce noise resulting from friction during operations. ▪ Using modern machinery equipment with noise suppressing technologies in order to reduce the noise-rating as much as possible. Natural gas or diesel engines can be replaced with electric motors. These motors, if properly installed, tend to be much less noisy than their engine counterparts. The use of electrical motors depends on the availability of electricity ▪ Locate all stationary construction equipment (i.e., compressors and generators and exploratory wells) as far as practicable from nearby residences and other sensitive receptors. ▪ Vehicle movement should be limited to daytime hours, except in emergency cases, to reduce generation of noise	3B
Traffic Impacts	**Traffic**	**Traffic Congestion** Activities related to construction works will undoubtedly induce uncharacteristic levels of additional vehicular traffic along access roads.	3B	▪ Issue notices/advisories of pending traffic inconveniences and solicit tolerance by local residents before	2B

[40] Earthworks. *Oil and Gas Noise.* [Date Accessed 20th May 2016] Available from: https://www.earthworksaction.org/issues/detail/oil_and_gas_noise

Impact	Receptor	Construction Phase Impacts	Impact Significance Rating	Mitigation Measures	Residual Impacts
		There will be approximately 5 – 10 trucks transporting material to and from Mtangawanda Jetty to the project site. The trucks will carry approximately 150-210 truckloads of equipment's: carrying loads weighing approximately 24-80 tonnes. This is significantly more compared to the current modes of transport - 3 *matatus* which operate in the morning and evening transporting passengers to take boats to and from Mtangawanda and Lamu - 1 bus stationed at Kizingitini used during special occasions - Others such as: police van, ambulance and power contractor's vehicles found stationed at certain areas - *Boda Boda* transporting passengers from one village to another - Donkeys transporting passengers and goods within villages Though the vehicle movements are not that frequent. Most common transport means in the area are *boda bodas* and donkeys. The drilling rig and ancillary drilling equipment will be transported by ship or barge from the ports of Mombasa to Lamu. These materials will be landed on Pate Island by barge using the Jetty at Mtangawanda or on the adjacent beach and transported to the drill site by road using truck. Fear from community members is that this will interfere with regular vessel movements at the jetty.		the commencement of construction works ▪ Flagmen/ road marshals should be employed to control traffic and assist mobilization vehicles as they enter and exit the project site. ▪ Ensuring that all drivers for the project comply to speed regulations, i.e 40 kmph ▪ Ensure all vehicles and machinery used for the project are in good working conditions both legally and are commensurate to the intended use. ▪ Prepare an access road siting study and management plan to guide road design, construction, and maintenance standards, and to allow for successful interim and final reclamation. (For example, require operators to coordinate closely with the local governments responsible for maintaining roadways providing access to the project area. Compare the number, size, and weight of loads to service projects to the existing road infrastructure to determine if roads	

Impact	Receptor	Construction Phase Impacts	Impact Significance Rating	Mitigation Measures	Residual Impacts
		Occupational Health and Safety In addition, increased traffic will result in noise creation, dust generation, and safety impacts for other road users and the local residents living and working within a close proximity to the access roads of the site.		and bridges are adequate to support intended loads. Consider routing project traffic to minimize impacts on local residents.)	
Health and Safety Risks	**Occupational Health and Safety**	Below are some of the hazards that will lead to health and safety risk if proper HSE procedures are not followed: 1. Working in confined spaces 2. Injuries caused by moving objects 3. Working at heights 4. Fire risks Workers will also be exposed to biota in the area that can pose health and safety risks such as snakes, scorpions, mosquitos, among others.	3B	▪ Provide workers with appropriate PPE such as goggles, gloves, hard hats, overalls, ear muffs, among others ▪ Employing an Occupational safety and health (OSH) plan that will outline all OSH risks and provide a strategy for their management; ▪ Maintain on site a record of incidents and accidents ▪ Provision of warning signs warning of construction activity and heavy machinery turning. ▪ Providing firefighting equipment and in easily accessible areas as well as ensuring site personnel are well trained to use them as well as maintaining them regularly ▪ Raising awareness, educating workers on risks and use of equipment; animal species and habitats found in the area and their risks; first aid training. ▪ Have a malaria management plan in place	2B
Visual impact		**Tourism**	2B	▪ The design should take advantage of the existing topography and	1B

Impact	Receptor	Construction Phase Impacts	Impact Significance Rating	Mitigation Measures	Residual Impacts
		Construction activities such as clearing of vegetation, transportation of drilling materials to site, construction of the well pad will affect aesthetic values of the area. Pate Island is known to get tourist to view its historical and cultural sites. This will affect tourism in the area due to the sudden movements of equipment's and people in the area.		vegetation, and should use low profile facilities and storage tanks if technically feasible and if the overall facility ▪ During construction of the well pads, existing vegetation around the perimeter of the site should be maintained to minimize views into the site. Following construction, natural vegetation should be restored in none operational areas of the site and/or additional landscape planting with local indigenous species used to improve views into the site. ▪ Consider site-specific landscaping in selected area to provide screening for resident whose property abuts the project. ▪ Consider suitable paint colour for large structures that can blend with the background. ▪ Consider the use of existing utility and transport corridors for access roads to the extent possible; ▪ Ensure good housekeeping of the site in order to create a positive image in the eyes of the public.	

7.3.3. Operation Phase

Impact	Receptor	Operational Phase Impacts	Impact Significance Rating	Mitigation Measures	Residual Impacts
Fauna Disturbance	**Fauna Disturbance**	Short-term disturbance of local habitats from base camp lights, drilling noise, vehicular traffic and other activities will lead to changes in – animal habitat, food supplies, migration routes of birds or changes in herbivore grazing patterns (livestock) etc. Pate 1 drill is located near Siyu location. From the socio-economic survey conducted, Consultant majority of the respondents practice livestock keeping. Livestock grazing is practiced in and around the area. Depending on the location of the proposed project site this will affect grazing patterns but at a minor level since the proposed development will take up 200m by 200m area coverage. Other wild speices such as dik dk, wild dogs will be affected by the light and noise pollution from the proposed projects.	2A	▪ Educate workforce on environmental concerns and implement policies to protect biodiversity. ▪ Schedule operations during least sensitive periods such as species migration periods, nesting and mating seasons. For example, there are nesting sites for sea turtles in Pate ▪ Keep the workforce within defined boundary and to the agreed access routes for vehicles. ▪ Implement a tree planting program within the well pad to offset loss of trees due to the construction phase ▪ Ensure protection of important resources by establishing protective buffers to exclude unintentional disturbance.	1A
Noise and Vibration	**Biodiversity and Human settlement around the proposed project area**	The project involves a 24 hour drilling program. Noise and vibration from the drilling operations are limited to the surrounding environment. Vibrations are localized and limited to the point of drilling. Noise and vibration pollution will emanate from flaring and rotating equipment-rigs. Noise sources will include flares and vents, pumps, compressors, generators, and heaters. However, the operational	3C	▪ Machineries should be maintained regularly to reduce noise resulting from friction during operations. ▪ Using modern machinery equipment with noise suppressing technologies in order to reduce the noise-rating as much as possible	2C

		crew will be the most exposed to the noise and vibration, and can be negatively affected. Expected noise levels to be generated from the drilling site are as follows[41]: • Typical compressor station 50dBA (375 feet from property boundary) • Pumping unit 50 dBA (325 feet from well pad) • Fuel and water trucks 68 dBA (500 feet from source) • Crane for hoisting rigs 68 dBA (500 feet from source) • Concrete pump used during drilling 62 dBA (500 feet from source) • Average well construction 65 dBA (500 feet from source)		▪ Provision of warning signs should be made at the gate warning of construction activity and heavy machinery turning. ▪ A grievance procedure will be established whereby noise complaints by neighbours are recorded and responded to ▪ Workers to be provided with PPE such as earmuffs and be trained on how to use them when operating in noisy environment. ▪ Housing engines and pump jacks in sound insulated building to reduce noise ▪ Operating engines at their recommended constant number of revolutions per minute (RPM) to reduce the annoying fluctuating noise caused by engines slowing down or speeding down	
Soil disturbance		Activities such as vehicle movement and drilling activities will lead to soil disturbance such as removal of vegetation, mixing of soil horizons, soil compaction, increased susceptibility of soils to wind and water erosion, soil contamination, loss of top soil productivity, disturbance of biological soil crust.	3C	▪ Work areas should be clearly defined and demarcated, where necessary to avoid unnecessary disturbance on areas outside the development footprint ▪ Providing soil erosion control structures on the steeper areas of the site & controlling activities during the rainy season	3B

[41] Earth Works. *Oil and Gas Noise.* [Date accessed 20th May 2016] Available from: https://www.earthworksaction.org/issues/detail/oil_and_gas_noise#.V0Kuob6M64b

				▪ Manage storm and flood flash water effectively to avoid movement of loss soils. ▪ Rapid regeneration of plant cover must be encouraged by setting aside topsoil during earthmoving and replacing onto areas where the reestablishment of plant cover is desirable to prevent erosion if it was necessary.	
Waste generation		The main sources of waste generated during the drilling campaign will be the drilling mud and cuttings; drilling rig waste; and domestic waste from the people living in the well pad. Domestic waste: containers, packaging, drinking water bottles, and miscellaneous waste form equipment.	3C	Storage in dedicated storage tanks or lined pits prior to treatment, recycling, and / or final treatment and disposal ▪ On-site or off-site biological or physical treatment to render the fluid and cuttings non-hazardous prior to final disposal using thermal desorption in an internal thermal desorption unit to remove NADF for reuse, bioremediation, landfarming, or solidification with cement and / or concrete. ▪ Final disposal routes for the nonhazardous cuttings solid material should be established, and may include use in road construction material, construction fill, or disposal through landfill including landfill cover and capping material where appropriate. ▪ In the case of landfarming it should be demonstrated that subsoil chemical, biological, and physical properties are preserved and water resources are protected;	2C
		Drilling waste: drilling mud, drilling cuttings, plastics and scrap metal. Typically, the solid medium used in most drilling fluids is barite (barium sulphate) for weight, with bentonite clays as a thickener. Drilling fluids also contain a number of chemicals that are added depending on the downhole formation conditions. These cuttings contain a proportion of residual drilling fluid. These spent fluids are then contained for reuse or disposal (NADFs are typically reused).	3C		

				▪ Recycling of spent fluids back to the vendors for treatment and re-use.	
		Produced water:-the produced water will contain a complex mixture of inorganic (dissolved salts, trace metals, suspended particles) and organic (dispersed and dissolved hydrocarbons, organic acids) compounds, and in many cases, residual chemical additives (e.g. scale and corrosion inhibitors) that are added into the hydrocarbon production process.	3C	Sprayed on the unpaved roads for dust control, Produced water discharges to surface waters or to land should be the last option considered and only if there is no other option available To reduce the volume of produced water for disposal the following should be considered: Adequate well management during well completion activities to minimize water production; Recompletion of high water producing wells to minimize water production; Use of downhole fluid separation techniques, where possible, and water shutoff techniques, when technically and economically feasible; Shutting in high water producing wells. To minimize environmental hazards related to residual chemical additives in the produced water stream where surface disposal methods is adopted, production chemicals will be selected carefully by taking into account their volume, toxicity, bioavailability, and bioaccumulation potential.	

				Before disposal of the water on surface water or land, the produced water will be treated to achieve the standards below • Total hydrocarbon content: 10 mg/L • pH: 6 - 9 • BOD: 25 mg/L • COD: 125 mg/L • TSS: 35 mg/L • Phenols: 0.5 mg/L • Sulfides: 1 mg/L • Heavy metals (total)a: 5 mg/L • Chlorides: 600 mg/l (average), 1200 mg/L (maximum)	
Water Sources	**Water**	**Water Consumption** Maximum expected water usage for the well is 3.18 million litres. Approximately 40,000 litres of water per day will be used in the civil engineering process such as the construction of the well pad and associated infrastructure. Water will also be used in field camps which will depend on several factors such as the number of people in the camps, number of facilities such as accommodation, among others. Approximately 200 litres will be used per person per day. However, Pate Island has a problem in the accessibility of freshwater. There are minimal boreholes in the area that provide freshwater, hence the proponent needs find alternative sources of water.	3B	▪ There several options in sourcing freshwater: 1. Drilling a bore hole to tap in to aquifer of Vumbe wells in the mainland 2. Filling barges with water from rivers in the main land (e.g. Tana River) or from Malindi or Mombasa; and transporting to Pate Island. 3. Building a storage pit which can be filled with freshwater before commencement of the project, which can act as an available reserve to minimise possible over abstraction with the local supply. The proponent could also consider the use of seawater in the drilling process. However, this is dependent on the type of drill mud to be used. The proponent	2B

				wishes to use WBM. However, if seawater is used together with WBM it will have an impact on fluid and cutting disposal due to the associated chloride content. The chloride content could be too high for disposal on site, the maximum permissible level is 600 parts per million (ppm). The best options we would recommend to be used during this project would be sourcing water from Malindi or Mombasa and transported to Pate Island via barge.	
Waste water		**Waste Water** Liquid effluent will be from the drilling process, accommodation, kitchen, rain water etc. Storm water from heavy rainfall can introduce sediment and toxic chemicals into nearby rivers and streams and other water sources. These have the potential of contaminating water sources if not properly handled.	3C	▪ Wastewater can be recycled and used in the drilling process, domestic effluent can also be treated and recycled and sludge from site for safe disposal at a designated disposal site. ▪ In the management of black and grey water, the proponent can dispose the waste in the three methods below: 1. Use of a septic tank of sufficient capacity to accommodate anticipated crew numbers 2. Kitchen waste water will be channelled through a grease trap before going into the septic tank 3. Kitchen sinks, wash basins and drains shall be permanently equipped with gratings to retain	2B

				soils and avoid conduction line clogging ▪ Where possible rain water can be used in the drilling process. If pit water is deemed uncontaminated it can be pumped offsite or reused as irrigation water for restoration of the site perimeters.	
Air Pollution	**Air quality**	Air pollution as a result of: ▪ exhaust fumes and gases from vehicles and machinery such as compressors, generators or fossil fuel using-engines, gas flaring will generate emission such as oxides of Carbon, Sulphur, Nitrogen, and particulates ▪ raised dust levels by disturbing and moving soils from activities such as clearing vegetation, excavating, truck and equipment movement, drilling This can pose risks to environmental and human health. Such emissions will contribute to both regulated pollutants and greenhouse gases in the project site.	3C	▪ Sprinkling water periodically when operations are under way to prevent raising of dusts; ▪ Impose and enforce speed limits and provide driving guidelines for vehicle operators e.g. speed limit of 30kph in the site area ▪ Use of low Sulphur fossil fuel. ▪ Regular maintenance and services of machines and engines ▪ Educate and raise awareness to construction workers on emission reduction and emissions that are likely to occur. ▪ Sensitize truck drivers to avoid unnecessary racing of machinery engines at loading, offloading sites, and parking areas and encourage them to keep the vehicle engines off at these points. ▪ Provide workers with appropriate PPE such as dust masks. ▪ Use of cost effective technologies and practices to minimize emissions	2C

				of greenhouse gases and other pollutants	
Oil and Chemical spill	**Physical Environment**	This include spills from domestic products used in cleaning; fuel stored on site use din vehicle, machinery used on site such as the drilling rig, generator. This will pose risk of soil pollution.	2B	▪ Requirements of oil spill and emergency plans must be met before operations commence. ▪ Apply spill prevention practices and response actions in refueling and vehicle-use areas to minimize accidental contamination of habitats and soil. ▪ Address spills immediately per the appropriate spill management plan, and initiate soil clean-up and soil removal if needed. ▪ Containerize spent oils and lubes for appropriate disposal or recycling. ▪ Containerize contaminated soils that cannot be treated in situ and remove off-site for treatment ▪ Conducting maintenance and repair activities in well-established zones having paved surfaces to collect the oil and prevent soil pollution	1B
Health and Safety Risks	**Occupational Health and Safety**	Risks and hazards that will lead to serious injury associated with the exploration drilling process, include: ▪ Falls from elevated platforms (drilling platforms, well pads, etc.) ▪ Working in confined spaces which has several hazards such as reduced oxygen ▪ Ergonomic Hazards such as lifting heavy items, bending, reaching overhead, pushing and pulling	4C	▪ Placing signs around where there are risks. Signs should meet international standards and should be in English and Kiswahili for easy understanding ▪ Placing visible and readable signs to control the movement of vehicles and notify motorists and pedestrians around the, and workers in the site	2C

		heavy loads, posture: all these may lead to strains and sprains ▪ High pressure lines and equipment hazards ▪ Electrical hazards (electric faults, electrocution) which might cause fires ▪ Fatigue ▪ Insecurity		▪ The well pad should be cordoned off to protect the general public from dangers associated with operations work ▪ Ensuring there is security in and around the site to control the movement of unauthorized personnel ▪ Ensuring all potential hazards such as movable machine parts are labeled ▪ Providing safe and secure storage for equipment and materials in the site and maintaining Material Safety Data Sheets (MSDSs) ▪ All workers should be provided with PPE and trained on how to use them. These include safety boots, overalls, helmets, goggles, earmuffs, dust masks, gloves among others ▪ Raising awareness, educating workers on risks from equipment, and ensuring they receive adequate training on the use of the equipment ▪ Employing an OSH plan that will outline all OSH risks and provide a strategy for their management ▪ Establishing emergency procedures against hazards and ensuring the	

				workers stay aware/educated on following them and commensurate to the magnitude and type of emergency, by conducting regular drills and involving the neighbors. ▪ Providing firefighting equipment and in easily accessible areas as well as ensuring site personnel are well trained to use them as well as maintaining them regularly ▪ Creating safe and adequate fire and emergency assembly points and making sure they are well labeled	
Socio-economic	**Local Community**	**Cultural and regional interaction with the local community** Inter and intra communal conflicts and human rights issues may occur as a result of labour supply which could attract third party agitation. The workers and other migrants could include those who are from diverse cultural traditions and religious backgrounds.	2B	▪ Grievance Mechanism will be in place to resolve any employment and local supplier-related grievances. ▪ Where feasible look into vocational training programs for the local workforce to promote development of skills required by the oil and gas industry ▪ Develop and implement a Health Risk Assessment; and a workforce management plan for the local workforce. ▪ Preference should be given to locals as source of labour force for skilled, semi-skilled and unskilled laborers. ▪ Observing the cultural setup of the local community in terms of	1A

				interaction between men and women	
Visual Impacts		The erection of the rig and associated infrastructure will have a short term visual impact on the character of an area. Pate Island is known to get tourist to view its historical and cultural sites. Due to the sudden movement of activities in Pate, this will impact tourism in the area depending on individual perception. Due to the location of Pate 1 the proposed project will not be visible from the main road. The height of a rig is approximately 50 m high.	2B	• Adopt suitable paint colour for large structures (rig) to blend with the background. ▪ External lighting shall be as unobtrusive as possible and shall be shielded and directed downwards to prevent side spill. The use of tall mast lights shall be carefully assessed before being used due to proximity of fauna and residential areas. ▪ Ensure good housekeeping of the site in order to create a positive image in the eyes of the public. ▪ Landscaping can help reduce the visual impacts of the wells e.g. forming the soils around the well pads into ridges or gentle berms and planting vegetation on ridges and berms ▪ The wellpad design should take advantage of the existing topography and vegetation, and adopt the use low profile facilities and storage tanks ze land requirements for aboveground ent facilities; ze well pad size for drilling activities and /cluster, directional, extended reach techniques to be adopted existing utility and transport corridors for oads	1A

7.3.4. Decommissioning Phase

Decommissioning aims at restoring the project site back to its original state or to a stable environmental conditions for future use. However, some of the decommissioning activities to be carried out onsite may result in negative impacts to the bio and socio-economic environment.

Decommissioning activities may include but not limited to: dismantling of the drilling rigs, ancillary equipment and the camp; transportation of equipment out of site; re-grading of the roads; and revegetation.

Impact	Receptor	Operational Phase Impacts	Impact Significance Rating	Mitigation Measures	Residual Impacts
Waste Generation	**Environment**	**Waste generation** During the decommissioning phase and demolition of the well pad the waste generated will contain materials that were used in construction of the well pad. These include concrete, metal, wood and waste in form of debris and pieces of steel.	2B	▪ The contractor should prepare a site waste management plan prior to commencement of demolition activities. ▪ Some of the solid waste produced can be recycled for use in future projects or sold off as scrap. ▪ Identifying all sources of wastes, and ensuring wastes are handled by licensed NEMA waste handler ▪ Combustible waste material should not be burned on site	1B
Noise and Vibration	**Local residence**	The sources of noise during the decommissioning phase will be generated from bringing down the drilling rig, auxiliary equipment and camp; vehicle movement transporting the rig and auxiliary equipment from the site to the jetty.	3C	▪ Inform local residents beforehand, via notices and advisories, of pending noisy periods and solicit their tolerance well before the commencement of demolition works. ▪ Limit pick-up trucks and other small equipment to an idling time, observe a common-sense approach to vehicle use, and encourage	2C

Impact	Receptor	Operational Phase Impacts	Impact Significance Rating	Mitigation Measures	Residual Impacts
				workers to shut off vehicle engines whenever possible. ▪ Providing workers with appropriate PPE's such as earmuffs when operating noisy machinery and when in a noisy environment.	
Air pollution	**Air quality**	Major sources of emissions are dust from increased heavy vehicular traffic; exhaust emissions and particulates from generators; vehicles and heavy machinery; and dust due to restoration of disturbed areas (for example; re-grading of the road surfaces).	3C	▪ Sprinkling water on the loose road surfaces to reduce dust emission. ▪ Imposing speed limits to limit the heavy vehicles from racing through the unpaved road surfaces. ▪ Scheduling track movement to reduce the vehicular traffic ▪ Use of efficient new technologies having low particulate emissions. ▪ Regular maintenance of vehicles and machines ensuring low emissions. ▪ Provision and Use of Personal Protective Equipment (PPE) e.g. dust masks, safety glasses	2C
Health and Safety Risk	**Occupational Health and Safety**	The potential health and safety risks during the decommissioning phase are related to the presence of heavy machinery and increased vehicular traffic which increases the likelihood of accidents occurring.	3C	▪ Provision and Use of Personal Protective Equipment (PPE) e.g. dust masks, overalls, gloves, ▪ Raising awareness among the workers on the likely risk and hazards and ensure they have adequate training on the use of machines and equipment.	3B

Impact	Receptor	Operational Phase Impacts	Impact Significance Rating	Mitigation Measures	Residual Impacts
				▪ Employing a proper OHS plan that will outline all the potential OHS risks as well as propose a management strategy. ▪ Proving proper firefighting equipment and establishing fire assembly zones.	
Socio-economic	**Employees**	**Loss of employment** After decommissioning of the project, there will be loss of jobs to locals employed on contract basis to work on site. This will affect both skilled and unskilled personnel	4C	▪ Zarara will ensure all the local employees are well informed on the project decommissioning and its likely impacts before the project final closure. ▪ Zarara will also consider providing training to build the local skills	1C
Traffic Impacts	**Traffic congestion to the local residence**	During the decommissioning and reclamation phase, there will be an increased in heavy vehicle traffic to and from the project site. Such vehicles will be carrying heavy machinery and hauling wastes from the site. Due to the scarcity of vehicle in the project site this will be a minimal impact to the local residents. The Mtangawanda jetty on Pate Island will also witness increased sea traffic; however, the jetty is mostly used in the early morning and late evening by local residents.	3B	▪ Issue notices/advisories of pending traffic inconveniences and solicit tolerance by local residents before the commencement of works ▪ Flagmen/ road marshals should be employed to control traffic and assist mobilization vehicles as they enter and exit the project site. ▪ Ensuring that all drivers for the project comply to speed regulations ▪ Ensure all vehicles and machinery used for the project are in good working conditions both legally and are commensurate to the intended use.	2B

8.0. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

In this part of the report, environmental and social management control measures are articulated. The control measures seek to avoid, minimize, and manage all the environmental, social, health, and community related risks and negative impacts identified in the study. The chapter also covers monitoring indicators that Zarara and its contractors will use in evaluating the performance of the control systems. All these measures lie within the Kenyan legislations and international best practices as well as the Zarara Oil Internal Environmental, Social and Health (ESH) management systems.

This ESMP set a benchmark for successful implementation of the project as well as respect and conservation of both the social and environmental set up within which the project will operate. Some aspects of the ESMP recommend training and re-training of the responsible persons to ensure that they have the capacity to implement the recommendations on the control mechanisms. This implies that training and capacity building forms a key pillar in the implementation of the ESMP.

8.1. Design Phase

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
Community perception	**Socio-economic**	1A	▪ There should be continuous stakeholder engagement throughout the project life cycle. ▪ Develop a grievance mechanism to record any complaint from the public/stakeholders ▪ Employ locals	1A	Complaints raised by public and stakeholders	CLO Zarara Relevant external consultants Local, County and National Government	Grievance Mechanism	Weekly
Conflict on land issues	**Socio-economic**	1B	▪ Constant communication with the land owners and community members	1A	Complaints raised by public and stakeholders	CLO Zarara	Grievance Mechanism	Weekly

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
			▪ Communicate with local administration, national and county government o			Relevant external consultants Local, County and National Government		

8.2. Construction Phase

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
Vegetation Loss/ Soil Disturbance	**Biodiversity**	3C	▪ Clearing vegetation only in construction areas and demarcating areas where no clearing will happen ▪ Education on the importance of flora and fauna in the areas, including the appropriate regulatory requirements ▪ Rapid regeneration of plant cover must be encouraged by setting aside topsoil during earthmoving and	2B	No harm to Species and Habitat Amount of landscaped areas or vegetated areas	Contractor EHS Officer	Follow management plan and procedures to minimize: • Selective clearing of vegetation • Biodiversity management to try to control personnel and project to	Weekly

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
			replacing onto areas where the reestablishment of plant cover is desirable to prevent erosion if it was necessary. ▪ Implement a tree planting program within the well pad to offset loss of trees due to the construction phase				prevent causing harm to habitats or species	
	Soil	3C	▪ Work areas should be clearly defined and demarcated, where necessary to avoid unnecessary disturbance on areas outside the development footprint ▪ Providing soil erosion control structures on the steeper areas of the site & controlling activities during the rainy season ▪ Manage storm and flood flash water effectively to avoid movement of loss soils. ▪ Vehicles coming into the site must use designated roads	2B	Size of landscaped areas Number of erosion control structures Number of designated access roads for the vehicles			

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
			▪ Sprinkling water periodically when operations are under way to prevent raising of dusts ▪ Impose and enforce speed limits and provide driving guidelines for vehicle operators; for example, 40 kmph					
Introduction of Invasive species	**Biodiversity**	2B	▪ Develop a plan for control of noxious weeds and invasive plants that could occur as a result of new surface disturbance activities at the site. The plan should address monitoring, weed identification, the manner in which weeds spread, and methods for treating infestations.	1B	Record of invasive species found in the area	EHS Officer		Weekly
Air Pollution	**Air Quality**	3C	▪ Use of low Sulphur fossil fuel. ▪ Regular maintenance and services of machines and engines ▪ Educate and raise awareness to construction workers	2C	Availability of speed limit signs Number of engines switched off during loading /offloading	Contractor Supervisors EHS Officer	Vehicle maximum speed limit of 40 kmph Use of in-vehicle	Daily

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
			on emission reduction and emissions that are likely to occur. ▪ Sensitize truck drivers to avoid unnecessary racing of machinery engines at loading, offloading sites, and parking areas and encourage them to keep the vehicle engines off at these points.				monitoring system (IVMS) Safety observation card system	
	Occupational Health and Safety	3B	▪ Provide workers with appropriate PPE such as dust masks.	2B	Incidence record of ill employees PPE to be worn during operations	Contractor Supervisors EHS Officer	PPE worn during operations and at relevant sections Safety observation card system	Daily
Noise Pollution		3C	▪ Machinery should be maintained regularly to reduce noise resulting from friction during operations. ▪ Using modern machinery equipment with noise suppressing technologies in order to reduce the noise-rating as much as	3B	Number of noise warning signs on site (i.e. areas that generate more than 80 db of noise) Availability of PPE such as ear muffs	Contractor Supervisor EHS Officer	Incident report PPE to be worn during operations Safety observation card system	Daily

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
			possible. Natural gas or diesel engines can be replaced with electric motors. These motors, if properly installed, tend to be much less noisy than their engine counterparts. The use of electrical motors depends on the availability of electricity ▪ Locate all stationary construction equipment (i.e., compressors and generators and exploratory wells) as far as practicable from nearby residences and other sensitive receptors. ▪ Vehicle movement should be limited to daytime hours, except in emergency cases, to reduce generation of noise					

Traffic Impacts	**Traffic**	3B	▪ Issue notices/advisories of pending traffic inconveniences and solicit tolerance by local residents before the commencement of construction works ▪ Flagmen/ road marshals should be employed to control traffic and assist mobilization vehicles as they enter and exit the project site. ▪ Ensuring that all drivers for the project comply to speed regulations, i.e 40 kmph ▪ Ensure all vehicles and machinery used for the project are in good working conditions both legally and are commensurate to the intended use. ▪ Prepare an access road siting study and management plan to guide road design, construction, and maintenance	2B	No accident/incident reported Availability of warning signs for heavy traffic and trucks on site Availability of speed limit signage on site Frequency of engine maintenances and servicing	Contractor Supervisors EHS Officer	Vehicle speed limit of 40 kmph Follow Zarara management policies and guidelines Safety observation card system	Daily

			standards, and to allow for successful interim and final reclamation. (For example, require operators to coordinate closely with the local governments responsible for maintaining roadways providing access to the project area. Compare the number, size, and weight of loads to service projects to the existing road infrastructure to determine if roads and bridges are adequate to support intended loads. Consider routing project traffic to minimize impacts on local residents.)					

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
Health and Safety Risks	**Occupational Health and Safety**	3B	▪ Provide workers with appropriate PPE such as goggles, gloves, hard hats, overalls, ear muffs, among others ▪ Employing an OSH plan that will outline all OSH risks and provide a strategy for their management; ▪ Maintain on site a record of incidents and accidents ▪ Provision of warning signs warning of construction activity and heavy machinery turning. ▪ Providing firefighting equipment and in easily accessible areas as well as ensuring site personnel are well trained to use them as well as maintaining them regularly ▪ Raising awareness, educating workers on risks and use of equipment; animal species and habitats found in the area and their risks; first aid training.	2B	Records of training, induction, tool box meetings, Incident report Availability of PPE Availability of warning signs in areas with occupational, safety and health risks on site	Contractor EHS Officer Medic	Safety observation card system Incident report	Daily

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
			▪ Have a malaria management plan in place					
Visual impact		2B	▪ Issue notices/advisories of pending traffic inconveniences and solicit tolerance by local residents before the commencement of construction works ▪ During construction of the well pads, existing vegetation around the perimeter of the site should be maintained to minimize views into the site. Following construction, natural vegetation should be restored in none operational areas of the site and/or additional landscape planting with local indigenous species used to improve views into the site. ▪ Consider site-specific landscaping in selected area to provide screening for resident	1B	Number of complaints and reports Amount of vegetated/ landscaped areas	Contractor CLO EHS Officer	Grievance mechanism	Daily

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
			whose property abuts the project. ▪ Ensure good housekeeping of the site in order to create a positive image in the eyes of the public.					

8.3. Operation Phase

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing// Frequency
Fauna Disturbance		2A	▪ Educate workforce on environmental concerns and implement policies to protect biodiversity. ▪ Schedule operations during least sensitive periods such as species migration periods, nesting and mating seasons. For example, there are nesting sites for sea turtles in Pate ▪ Keep the workforce within defined	1A	Complaints from community members Record of species found within 500 m of the project site Timing of the activities	Contractor EHS Officer CLO	Follow management plan and procedures to minimize: • Selective clearing of vegetation • Biodiversity management to try to control personnel and project, to prevent causing	Daily

			boundary and to the agreed access routes for vehicles. ▪ Implement a tree planting program within the well pad to offset loss of trees due to the construction phase ▪ Ensure protection of important resources by establishing protective buffers to exclude unintentional disturbance.				harm to habitats or species	
Noise and Vibration		3C	▪ Machineries should be maintained regularly to reduce noise resulting from friction during operations. ▪ Using modern machinery equipment with noise suppressing technologies in order to reduce the noise-rating as much as possible ▪ Provision of warning signs should be made at the gate warning of construction activity	2C	Noise level warning signs on site Incidence report Availability of appropriate PPE on site e.g. ear muffs	Contractor Supervisors EHS Officer	Grievance Mechanism Incidence report	Daily

			and heavy machinery turning. ▪ A grievance procedure will be established whereby noise complaints by neighbours are recorded and responded to ▪ Workers to be provided with PPE such as earmuffs and be trained on how to use them when operating in noisy environment. ▪ Housing engines and pump jacks in sound insulated building to reduce noise ▪ Operating engines at their recommended constant number of revolutions per minute (RPM) to reduce the annoying fluctuating noise caused by engines slowing down or speeding down					
Soil disturbance		3C	▪ Work areas should be clearly defined and demarcated, where	3B	Number of soil erosion structures	Contractor EHS Officer	Cases of soil erosion or water logging	Weekly

			necessary to avoid unnecessary disturbance on areas outside the development footprint ▪ Providing soil erosion control structures on the steeper areas of the site & controlling activities during the rainy season ▪ Manage storm and flood flash water effectively to avoid movement of loss soils. ▪ Rapid regeneration of plant cover must be encouraged by setting aside topsoil during earthmoving and replacing onto areas where the reestablishment of plant cover is desirable to prevent erosion if it was necessary.		Amount of vegetated/ landscaped areas Demarcation of land for operation activities			
Waste generation		3C	▪ Establishing a waste management plan such as:	2C	Amount of waste generated	Supervisor EHS Officer	Waste Management Log Book indicting	Weekly

			○ terms on waste collection schedule and disposal by waste handler credited by NEMA ○ Training of site personnel in proper waste management and chemical handling procedures ○ Provision of suitable facilities for the collection, segregation, and safe disposal of the wastes. Waste should be segregated in terms of recyclable, reusable, biodegradable, non-biodegradable and providing equipment for handling waste. ○ Regular cleaning and maintenance programme for drainage systems,		Frequency of waste collection, segregation, transportation, and disposal Availability of waste management and sensitization sigs on site	NEMA County Department of OHS	- Type of waste - Weight - Mode of disposal and frequency	

			sumps and oil interceptors.					
Water Sources		3B	▪ There several options in sourcing freshwater: 1. Locating a local source that is acceptable with the local community 2. Drilling a bore hole to tap in to aquifer of Vumbe wells in the mainland 3. Filling barges with water from rivers in the main land (e.g. Tana River), Malindi or Mombasa, and transporting to Pate Island. 4. Building a storage pit which can be filled with freshwater before commencement of the project, which can act as an available reserve to minimise possible over abstraction	2B	Availability of water storage facilities Availability of local freshwater sources Availability of rain water harvesting structures	Contractor CLO EHS Officer	Grievance Mechanism	Weekly

			with the local supply. The proponent could also consider the use of seawater in the drilling process. However, this is dependent on the type of drill mud to be used. The proponent wishes to use WBM. However, if seawater is used together with WBM it will have an impact on fluid and cutting disposal due to the associated chloride content. The chloride content could be too high for disposal on site, the maximum permissible level is 600 parts per million (ppm) The best options we would recommend to be used during this project would be sourcing water from Malindi or Mombasa and transported to Pate Island via barge.					
Waste Water		3C	▪ Wastewater can be recycled and used in the drilling process,	2B	Amount of water recycled/re-used	Contractor CLO	Grievance Mechanism	Weekly

			domestic effluent can also be treated and recycled and sludge from site for safe disposal at a designated disposal site. ▪ In the management of black and grey water, the proponent can dispose the waste in the three methods below: 4. Use of a septic tank of sufficient capacity to accommodate anticipated crew numbers 5. Kitchen waste water will be channelled through a grease trap before going into the septic tank 6. Kitchen sinks, wash basins and drains shall be permanently equipped with gratings to retain soils and avoid conduction line clogging ▪ Where possible rain water can be used in the drilling process. If		Clear lines of collection of waste water. Separation of black and grey water at the points of generation Availability of rain water harvesting structures	EHS Officer		

			pit water is deemed uncontaminated it can be pumped offsite or reused as irrigation water for restoration of the site perimeters.					
Air Pollution		3C	▪ Sprinkling water periodically when operations are under way to prevent raising of dusts; ▪ Impose and enforce speed limits and provide driving guidelines for vehicle operators e.g. speed limit of 30kph in the site area ▪ Use of low Sulphur fossil fuel. ▪ Regular maintenance and services of machines and engines ▪ Educate and raise awareness to construction workers on emission reduction and emissions that are likely to occur. ▪ Sensitize truck drivers to avoid unnecessary racing of machinery engines at loading,	2C	Frequency of sprinkling water in times of high dust generation such as during continuous movement of trucks and high speed blowing winds Frequency of maintenance of engines to ensure effective burning of fossil fuels All engines of trucks switched off during loading/unloading on site Availability of dust masks among the employees involved in dusty operation	Contractor EHS Officer	Vehicle maximum speed limit of 40 km/hr on murram roads Use of in-vehicle-monitoring-system (IVMS)	Daily

			offloading sites, and parking areas and encourage them to keep the vehicle engines off at these points. ▪ Provide workers with appropriate PPE such as dust masks. ▪ Use of cost effective technologies and practices to minimize emissions of greenhouse gases and other pollutants					
Oil and Chemical spill		2B	▪ Requirements of oil spill and emergency plans must be met before operations commence. ▪ Apply spill prevention practices and response actions in refueling and vehicle-use areas to minimize accidental contamination of habitats and soil. ▪ Address spills immediately per the appropriate spill management plan, and initiate soil clean-	1B	Availability of a response plan Availability of reserve containers for collecting emergency spills	Contractor Supervisor EHS Officer	incidence report	Daily

			up and soil removal if needed. ▪ Containerize spent oils and lubes for appropriate disposal or recycling. ▪ Containerize contaminated soils that cannot be treated in situ and remove off-site for treatment ▪ Conducting maintenance and repair activities in well-established zones having paved surfaces to collect the oil and prevent soil pollution					
Health and Safety Risks		4C	▪ Placing signs around where there are risks. Signs should meet international standards and should be in English and Kiswahili for easy understanding ▪ Placing visible and readable signs to control the movement of vehicles and notify motorists and	2C	Records of training, induction, tool box meetings, Incident report Availability of PPE Availability of warning signs in areas with occupational, safety and health risks on site	Contractor EHS Officer Medic	Safety observation card system Incident report	Daily

			pedestrians around the, and workers in the site ▪ The well pad should be cordoned off to protect the general public from dangers associated with operations work ▪ Ensuring there is security in and around the site to control the movement of unauthorized personnel ▪ Ensuring all potential hazards such as movable machine parts are labeled ▪ Providing safe and secure storage for equipment and materials in the site and maintaining MSDSs ▪ All workers should be provided with PPE and trained on how to use them. These include safety boots, overalls, helmets,					

			goggles, earmuffs, dust masks, gloves among others ▪ Raising awareness, educating workers on risks from equipment, and ensuring they receive adequate training on the use of the equipment ▪ Employing an OSH plan that will outline all OSH risks and provide a strategy for their management ▪ Establishing emergency procedures against hazards and ensuring the workers stay aware/educated on following them and commensurate to the magnitude and type of emergency, by conducting regular drills and involving the neighbors. ▪ Providing firefighting equipment and in easily accessible areas					

			as well as ensuring site personnel are well trained to use them as well as maintaining them regularly ▪ Creating safe and adequate fire and emergency assembly points and making sure they are well labeled					
Socio-economic		2B	▪ Grievance Mechanism will be in place to resolve any employment and local supplier-related grievances. ▪ Where feasible look into vocational training programs for the local workforce to promote development of skills required by the oil and gas industry ▪ Develop and implement a Health Risk Assessment; and a workforce management plan for the local workforce.	1A	Number of incidences reported by the community members Frequency of conflicts between the community members and project implementers Availability of risk management plan and work force management plan	CLO EHS Officer Contractors	Grievance mechanism	Daily

			▪ Preference should be given to locals as source of labour force for both skilled, semi-skilled and unskilled laborers. ▪ Observing the cultural setup of the local community in terms of interaction between men and women					
Visual Impacts		2B	▪ External lighting shall be as unobtrusive as possible and shall be shielded and directed downwards to prevent side spill. The use of tall mast lights shall be carefully assessed before being used due to proximity of fauna and residential areas. ▪ Consider site-specific landscaping in selected area to provide screening for resident whose property abuts the project. ▪ Ensure good housekeeping of the	1A	Number of complaints and reports Amount of vegetated land	Contractor CLO EHS Officer	Grievance mechanism	Daily

			site in order to create a positive image in the eyes of the public. ▪ Landscaping can help reduce the visual impacts of the wells e.g. forming the soils around the well pads into ridges or gentle berms and planting vegetation on ridges and berms					

8.4. Decommissioning Phase

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
Waste Generation	**Environment**	2B	▪ The contractor should prepare a site waste management plan prior to commencement of demolition activities. ▪ Some of the solid waste produced can be recycled for use in future projects or sold off as scrap.	1B	Amount of waste generated Frequency of waste collection, segregation, transportation, and disposal Availability of waste management and sensitization sigs on site	Supervisor EHS Officer NEMA County Department of OHS	Waste Management Log Book indicting - Type of waste - Weight - Mode of disposal and frequency	Weekly

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
			▪ Identifying all sources of wastes, and ensuring wastes are handled by licensed NEMA waste handler ▪ Combustible waste material should not be burned on site					
Noise and Vibration	**Local residence**	3C	▪ Inform local residents beforehand, via notices and advisories, of pending noisy periods and solicit their tolerance well before the commencement of demolition works. ▪ Limit pick-up trucks and other small equipment to an idling time, observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle	2C	Noise level warning signs on site Incidence report / Grievance from community members Availability of appropriate PPE on site e.g. ear muffs	Contractor Supervisors EHS Officer	Grievance Mechanism Incidence report	Daily

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
			engines whenever possible. ▪ Providing workers with appropriate PPE's such as earmuffs when operating noisy machinery and when in a noisy environment.					
Air pollution	**Air quality**	3C	▪ Sprinkling water on the loose road surfaces to reduce dust emission. ▪ Imposing speed limits to limit the heavy vehicles from racing through the unpaved road surfaces. ▪ Scheduling track movement to reduce the vehicular traffic ▪ Use of efficient new technologies having low particulate emissions.	2C	Frequency of sprinkling water in times of high dust generation such as during continuous movement of trucks and high speed blowing winds Frequency of maintenance of engines to ensure effective burning of fossil fuels All engines of trucks switched off during loading/unloading on site	Contractor EHS Officer	Vehicle maximum speed limit of 40 km/hr on murram roads Use of in-vehicle-monitoring-system (IVMS)	Daily

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
			▪ Regular maintenance of vehicles and machines ensuring low emissions. ▪ Provision and Use of Personal Protective Equipment (PPE) e.g. dust masks, safety glasses		Availability of dust masks among the employees involved in dusty operation			
Health and Safety Risk	**Occupational Health and Safety**	3C	▪ Provision and Use of Personal Protective Equipment (PPE) e.g. dust masks, overalls, gloves, ▪ Raising awareness among the workers on the likely risk and hazards and ensure they have adequate training on the use of machines and equipment. ▪ Employing a proper OHS plan that will outline all the potential OHS risks	3B	Records of training, induction, tool box meetings, Incident report Availability of PPE Availability of warning signs in areas with occupational, safety and health risks on site	Contractor EHS Officer Medic	Safety observation card system Incident report	Daily

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
			as well as propose a management strategy. ▪ Proving proper firefighting equipment and establishing fire assembly zones.					
Socio-economic	**Employees**	4C	▪ Zarara will ensure all the local employees are well informed on the project decommissioning and its likely impacts before the project final closure. ▪ Zarara will also consider providing training to build the local skills	1C	Number of grievance from community members/employees	Contractor CLO EHS Officer	Grievance mechanism	Daily
Traffic Impacts	**Traffic congestion to the local residence**	3B	▪ Issue notices/advisories of pending traffic inconveniences and solicit tolerance by local residents before the	2B	No accident/incident reported Availability of warning signs for heavy traffic and trucks on site	Contractor Supervisors EHS Officer	Vehicle speed limit of 40 kmph Follow Zarara management policies and guidelines	Daily

Impact	Receptor	Impact Significance Rating	Mitigation Measures	Residual Impacts	Indicator	Responsible Person/ Function	Performance and Monitoring	Timing/ Frequency
			commencement of works ▪ Flagmen/ road marshals should be employed to control traffic and assist mobilization vehicles as they enter and exit the project site. ▪ Ensuring that all drivers for the project comply to speed regulations ▪ Ensure all vehicles and machinery used for the project are in good working conditions both legally and are commensurate to the intended use.		Availability of speed limit signage on site Frequency of engine maintenances and servicing		Safety observation card system	

CONCLUSION AND RECOMMENDATIONS

Zarara is wholly owned subsidiary of Midway Resource International and operator with a 75% working interest in Blocks L4 and L13. Zarara plans to undertake a hydrocarbon exploration drilling programme on Block L4 and L13 in Lamu County to further explore and appraise the gas discoveries made by Shell in the 1970s, which encountered high-pressure gas, but in an unknown quantity as the well did not fully penetrate the reservoir section and was neither logged nor tested due to technical problems whilst drilling.

EMCA 1999 requires that all new developments that are likely to affect the environment in any way must undertake an environmental impact assessment. The objective of an ESIA process is to aid decision-making and environmental accountability as part of safeguarding sustainable development.

The study finds the project is acceptable if the identified and developed management plans and practises are implemented accordingly. It also recommends appropriate monitoring of the project development and operational activities to ensure that adverse impacts that were unforeseen are identified and addressed in a timely fashion.

Specifically, the following recommendations are made

1. As stated earlier, the sands here have a high rate of infiltration, leading to annual precipitation recharge of up to 13.5% rainfall depth. It is therefore important to control runoff from operation areas. Therefore, the following measures should be in place:
    - Any produced water should be trucked / piped to approved disposal ponds;
    - Storage and disposal of drilling cuttings and waste shall be done in such manner that they do not spill onto the local environment. They shall be transported to sites of safe disposal.
    - Mud circulation hoppers/ lined mud-pits shall be used;
    - The pad area shall be protected from entry of surface runoff and from any runoff leaving the area
2. Work areas should be clearly defined and demarcated, where necessary to avoid unnecessary disturbance on areas outside the development footprint
3. Wastewater can be recycled and used in the drilling process, domestic effluent can also be treated and recycled and sludge from site for safe disposal at a designated disposal site.
4. Provision of suitable facilities for the collection, segregation and safe disposal of the wastes. Waste should be segregated in terms of recyclable, reusable, biodegradable, non- biodegradable and providing equipment for handling waste
5. Impose and enforce speed limits and provide driving guidelines for vehicle operators
6. Inform local residents beforehand, via notices and advisories, of pending noisy periods and solicit their tolerance well before the commencement of any activities
7. Employing an Occupational safety and health (OSH) plan that will outline all OSH risks and provide a strategy for their management
8. Employ a Grievance Redress Mechanism to record any complaints made by surrounding community members, and procedures to respond on the same.

9. It was established that the water sources have no toxic compounds or elements and there is no evidence of hydrocarbon contamination. Zarara should be committed in putting in place several measures to manage the effects of drilling on the water resources and the surrounding environments. These include transportation of the drill cuttings for safe disposal, using freshwater for drilling operations instead of seawater. It is our recommendation that the project water supply for the project be sourced on the mainland and transported by barge to the drilling site. The water wells can be drilled in the same area and aquifer as the Vumbe wells. Once the project comes to an end, these wells should be handed over to the community to be part of the Faza Water Scheme. The same wells will also be of value if the need to drill on the mainland becomes imperative.

Subsequent projects that might arise as a result of this project should undergo environmental assessment and permitting with NEMA as a prerequisite for any development undertaking. NEMA is advised to license the project since it is a viable project.

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APPENDICES