ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY REPORT FOR

PROPOSED EXPANSION OF VICTORY FARM'S COMMERCIAL, SUSTAINABLE AND SOCIALLY RESPONSIBLE TILAPIA CAGE SYSTEM WITH AN ESTIMATED PRODUCTION CAPACITY OF 30,000 METRIC TONNES PER ANNUM IN NEW CONCESSION BLOCKS WITHIN LAKE VICTORIA, SUBA SOUTH SUB-COUNTY, HOMABAY COUNTY

Prepared by:	Prepared for:
Lakers Consultancy Ltd **P.O. Box 19276-40123 Kisumu**	**Victory Farms Ltd** **PO Box14730-00800-Nairobi** **+254-797-736-164**

This EIA Report is submitted to the National Environment Management Authority (NEMA) in accordance with the requirements of EMCA, CAP 387 and the Environmental (Impact Assessment and Audit) Regulations, 2003

JULY 2024

GPS Points: Attached in the Annexes

CERTIFICATION

Certification by Lead Expert

We hereby certify that this Environmental and Social Impact Assessment for the Victory Farms Ltd land and lake based sustainable aquaculture in Roo beach, Sindo area, Suba South Sub-County within Homabay County has been done under our supervision and that the EIA criteria, methodology and content reporting conform to the requirements of the Environmental Management and Coordination Act, 1999-Revised 2015 and legal notice No. 101 of June 2003 (Environmental Impact Assessment and Audit Regulations).

Signed: _____ **Date**_____

Kevin Musiega (NEMA 1682)

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Certification by Proponent

We, **Victory Farms Ltd** hereby confirm that the contents of this Environmental Impact Assessment (ESIA) report are true to the best of our knowledge, and we will implement the environmental management plan (EMP) proposed in this report and undertake to implement further mitigation measures as NEMA may direct in relation to the findings of this EIA and future inspections by the Authority.

Signed for and on behalf of**: Victory Farms Ltd**

Name: **……**Signature**: ……**

Position**: ……...**Date**: ……**

ACRONYMS AND ABBREVIATIONS

BMU	Beach Management Unit
EIA	Environmental Impact Assessment
CPP	Consultation and Public Participation
EA	Environmental Audit
EHS	Environment, Occupational Health and Safety
EIA/EA	Environmental Impact Assessment/Environmental Audit Regulations, 2003
EMCA	Environmental Management and Coordination Act, 1999
EMS	Environmental Management System
ERP	Emergency Response Plans
EMP	Environmental Management Plan
ISO	International Standards Organizations
IAP	Interested and Affected Parties
LR	Land Registration
LVFO	Lake Victoria Fisheries Organization
TOR	Terms of Reference
NEMA	National Environment Management Authority
NEAP	National Environmental Action Plan
NET	National Environmental Tribunal
NETF	National Environmental Trust Fund
NEC	National Environment Council
PSP	Private Sector Participation
KPLC	Kenya Power and Lighting Company
DITTO	Same as Above
SEM	Sustainable Environmental Management
PPE	Personnel Protective Equipment
HDPE	High Density Polyethylene

EXECUTIVE SUMMARY

Introduction

Cage aquaculture is the practice of growing fish in existing water resources while enclosed in a net cage that permits free passage of water. It is an established and profitable system in many countries and is considered one of the key interventions to increase fish supply in the face of declining wild fish stocks. Globally, cage aquaculture is hugely varied ranging from subsistence level holding of a few kilos of fish in small nets to salmon farms producing more than 5000 tonnes per year. In Asia, more than 50 species are reared in various forms of cage aquaculture. While the financial success of cage aquaculture has been demonstrated in Asia, Europe, North America and Latin America over the years, it is picking up in Africa and further growth is expected. This is despite cage aquaculture being introduced in several African countries in the 1970s[1].

The production of farmed fish in Sub-Saharan Africa has expanded more than sixteen-fold, mostly due to the expansion of tilapia cage aquaculture. Notable examples of rapid spread of cage aquaculture in Sub-Saharan Africa include Lake Victoria in Kenya, Lake Victoria in Uganda, Lake Volta in Ghana, Lake Kariba in Zimbabwe and Lake Malawi in Malawi. Despite the region's enormous fish market and the practice's proven potential, cage fish farming has not been widely practiced in East Africa though it has shown potential to be more productive than pond culture. Cage aquaculture was pioneered in Kenya by the Lake Basin Development Authority (LBDA) in 1988 with first trials around Dunga Beach. Dominion Group of Companies successfully harvested fish from cages at its Yala wetland farm in 2005. Between 2008 and 2013, "BOMOSA," an EU-sponsored project, conducted trials on cage aquaculture in small water bodies within the Lake Victoria Basin. Cage aquaculture techniques have grown in popularity on the beaches of Obenge and Dunga in Siaya and Kisumu counties respectively, through efforts of the Fisheries Cooperative Society and Beach Management Units (BMUs[2]).

Despite initial setbacks, the cage aquaculture strategy was eventually adopted in 2010 at Dunga Beach in Kisumu County through collaborative work between Kenya Marine and Fisheries Research Institute (KMFRI) and the Dunga BMU. Cage aquaculture has evolved in recent years as a new source of income and livelihoods in Lake Victoria, in addition to protecting endangered wild fish species. Since then, the practice has expanded across Lake Victoria's five riparian counties: Busia, Siaya, Kisumu, Homa Bay, and Migori. Notably, between 2016 and 2022, the total number of cages in the Kenyan section of Lake Victoria rose from 1663 to more than 5242[3]. This expansion has resulted in ecological concerns on cage aquaculture sustainability in Lake Victoria. It's against this background that, the proponent here in referred as **Victory Farms Limited** has proposed to expand commercial Sustainable Tilapia Cage System Farming in new acquired concession blocks within Lake Victoria waters in Suba South, Homa-bay County.

Project Objectives

[1] Lake Victoria Fisheries Organization (2016). Draft guidelines for establishment and operation of cage fish farming in East African Community.

2Aura, C. M., Musa, S., Yongo, E., Okechi, J. K., Njiru, J. M., Ogari, Z. & Oucho, J. A. (2018). Integration of mapping and socio-economic status of cage culture: Towards balancing lake- use and culture fisheries in Lake Victoria, Kenya. Aquaculture Research, 49(1), 532-545

[3] KMFRI-ABDP-CAGES (2022). Sustainable community-based cage aquaculture in Lake Victoria, Kenya. Kenya Marine and Fisheries Research Institute (KMFRI) Aquaculture Business Development Programme (ABDP), Kenya Fisheries Service (KeFS)

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[3] KMFRI-ABDP-CAGES (2022). Sustainable community-based cage aquaculture in Lake Victoria, Kenya. Kenya Marine and Fisheries Research Institute (KMFRI) Aquaculture Business Development Programme (ABDP), Kenya Fisheries Service (KeFS) and State Department for Fisheries, Aquaculture and the Blue Economy (SDFA & BE) for Cage Aquaculture technical report funded by the International Fund for Agricultural Development (IFAD).

Kenya has vast fish resources (in marine, inland capture and aquaculture) the exploitation of which is providing a wide variety of benefits to the country in terms of revenue, employment and general contribution to socio economic growth and development. However, the capture fisheries of the country have generally demonstrated oscillations in total catch with a general tendency of declining catches in recent years. Therefore, the proposed project is expected to boost fish production levels in a sustainable manner.

Requirement for EIA

This Environmental Assessment Project Report study was undertaken pursuant to the requirements stipulated by the National Environmental Management Authority (NEMA) under the Environmental Management and Coordination Act (2015) that requires all proposed development projects listed under Schedule II of the EMCA, to undergo an Environmental Impact Assessment Study to determine the potential adverse impacts of a project and thereby devising appropriate mitigation measures. The proposed expansion of Tilapia cage culture system project is among developments that require the critical and strategic assessment as stipulated in the Environmental Management and coordination (amendment) Act, 2015 and Environmental Impact Assessment and audit regulation (2003).

Project Location

The proposed project location in Sindo Lake Victoria's Litare, Jiudendi, Ngeri, Nyagwethe, Kamogo, Uterere, & Kisegi Beaches in Suba South Sub- County, Homabay County. The project site is georeferenced by GPS **as attached in the annexes.**

Relevant Policies and Regulatory Frameworks

Project related national policies and regulatory frameworks reviewed and analysed include: -

- Sessional Paper No. 10 of 2014 on National Environment Policy, 2014;
- Kenya Fisheries Policy 2023,
- National Aquaculture Policy, 2011,
- National Water Policy, 2021,
- National Aquaculture Strategy and Development Plan, 2010,
- Kenya Vision, 2030

Legislative and Regulatory Framework

- Environmental Management and Coordination Act Cap 387 and other subsidiary regulations,
- Fisheries Management and Development Act No 35, 2016,
- Water Act 2016,
- Physical and Land Planning Act, 2019,
- Public Health Act, Cap 242 Revised edition 2012,
- Occupational Health and Safety Act, 2007,
- Lake Basin Development Authority Act, cap 442

Methodology

A mixed methods approach was used in the study to address all pertinent environmental and safety aspects of the project on the biophysical and socio-economic aspects. The following data collection methods were used:

- **Remote Sensing and GIS Analysis** – Remote sensing was undertaken and ground-truthing done by the consultant at the time of the site visit. Remote sensing was based on available satellite imagery of the project area.
- **Desk Reviews**–A literature review was undertaken based on the findings of the reconnaissance process, which involved reviewing legislation, policies, the County Integrated Development Plan (CIDP), (Technical Design Documents), and previous EIAs studies carried out in the project area to determine the baseline conditions and establish the legal, institutional, and biophysical/socio-economic environmental setting of the project area. The desk-based study also included the development of fieldwork tools and fieldwork schedules as well as the approach to stakeholder engagement.
- **Site Visits** – A site investigation was undertaken during which detailed Environmental and Social Baseline data was gathered and collected.
    - **Stakeholder Engagement**–Various stakeholders were engaged (Proponent, Beach Management Units amongst other opinion leaders), and data was collected through: Focus group discussion and KIIs.
    - Questionnaires administration– people living within a radius of 4 kilometer of the proposed project area; and

Photography – was used to record the salient features and baseline conditions at the proposed project site and surroundings. These included checklists, matrices, and observations.

Impact Assessment Methodology

Overview

A detailed analysis of beneficial and adverse impacts of various components of the project on the physical, biological, and human (*social, cultural, and economic*) environments was conducted based on analysis of project interaction with the baseline conditions. **Appropriate mitigation measures** were then identified **to prevent, minimize, mitigate, or compensate for adverse environmental and social impacts**. Consequently, **enhancement measures for positive impacts were developed to improve project environmental and social performance**. In addition, the roles, and responsibilities in the implementation of the mitigation measures were clearly defined, costs of implementing such measures as well as the costs for environmental and social capacity building for effective implementation of mitigations measures by the respective agencies. The sources of such financial resources will be clearly outlined in the mitigation plan.

Stakeholder Engagement

Stakeholder engagement ensures that the views and concerns of diverse stakeholders (including the community) are incorporated as early as possible into the project development (i.e., at the planning, implementation, and operational phases), to minimize any potential or unexpected opposition to the proposed development. It also helps incorporate the views of key stakeholders into the design process.

The main objective of the stakeholder engagement process is to inform stakeholders and the public about the proposed project and its likely effects, while incorporating their inputs, views, and concerns into project planning.

Summary of the Project Impacts

Positive Impacts

Impact	Narrative
Employment, skills transfer and	Implementation of this project will involve the use of both skilled,

human resource capacity development	semi-skilled and unskilled labour. Different expertise will be required for the project. Provision of employment will contribute to raising the socioeconomic well-being of the people living and working around the project.
Impact on human nutrition on local and national level	The supply of fish will contribute to filling the country's need for proteins, a commodity which is not adequate now.
Diversifying community livelihoods	Beneficiary businessmen and middlemen will have an alternative livelihood thus offering cushion against shortcomings of the current agricultural activities in the area

Negative Impacts

Component/Activity	**Mitigation/Management**
Water quality impacts because of feed wastage.	• Only high-quality aquaculture feeds must be purchased from recognized feed producers; Information on the nutrient makeup, primary ingredients and production techniques, e.g. extrusion, should be available, • Feeding rates must be correlated to water quality sampling to allow detection and alteration of over-feeding. This will be done by the water quality monitoring programme to be implemented; • Correct feed pellet size must be used to ensure low levels of feed wastage.
Chemical spills and incorrect application of chemicals	• The handler must wear appropriate Personal Protective Equipment (PPE); • Dosages, application methods and resultant outcome must be known and recorded in a treatment register; • Expired chemicals must be disposed of at a suitable hazardous waste disposal site; • The advice of a recognized fish pathologists or aquaculturists must be sought where the application of chemicals is uncertain;
Fish mortalities	• All mortalities must be recorded and the associated behavior of the remainder of the organisms monitored, e.g. loss of appetite; • A database must be kept of the numbers of dead organisms and the behavioral patterns of the population.
Endangering predators	• No traps may be used to injure any predators of aquaculture organisms. Traps may only be set if these predators can be caught live (without injury) for translocation to alternative areas. This may only be done under the supervision of recognized organizations or authorities i.e. KWS; • Ensure no poisons is left out for aquaculture predators; • Ensure no animals that prey on the aquaculture species is shot • The main aquaculture predators and their control methods include cover netting for birds (Kingfishers, Fish Eagles, Herons, Storks and others) and fencing
Health and safety compliance at the cage	• All involved personnel need to have adequate floatation safety gear and need to be fully trained in health and safety codes related to water borne

Component/Activity	**Mitigation/Management**
site	activities; and • Skippers need to be licensed
Disease from processed fish waste	• The waste generated in the primary processing of the harvested fish (heads, gills and intestines) and the mortalities experienced from production must be ensiled to produce a stable and odor free high protein supplement for animal feeds or fertilizer. This waste must be milled and chopped and then stabilized by means of adding organic or mineral acids. The mineral or organic acids decrease the pH, which inhibits the growth of bacteria, and hence enables long term storage of the raw material.

Project Cost

The project cost is approximated at KES 750,077,009.00 (Kenya Shillings Seven Eighty Million, Seventy-Seven Thousand and Nine only. The Cost is summarized and **attached in the appendix.**

Conclusion:

The environmental impact assessment process has identified and assessed a range of potential impacts to the bio-physical and socio-economic environments. Where impacts have been identified, mitigation and enhancement measures for those impacts have been outlined in this EIA CPR. Most of the identified negative impacts are either of moderate or minor significance, even prior to the application of appropriate mitigation/management measures. With proper implementation of the proposed recommended mitigation/management measures, the significance of the potential or likely residual impacts looks set to be reduced to a minor or negligible level. The project will bring into productive use a high potential resource, the lake that has hitherto been underutilized. The project will boost fish production and improve incomes in the project area. The experts recommend to the authority that the project be approved.

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1 INTRODUCTION AND BACKGROUND

1.1 Background

Cage aquaculture is the practice of growing fish in existing water resources while enclosed in a net cage that permits free passage of water. It is an established and profitable system in many countries and is considered one of the key interventions to increase fish supply in the face of declining wild fish stocks. Globally, cage aquaculture is hugely varied ranging from subsistence level holding of a few kilos of fish in small nets to salmon farms producing more than 5000 tonnes per year. In Asia, more than 50 species are reared in various forms of cage aquaculture. While the financial success of cage aquaculture has been demonstrated in Asia, Europe, North America and Latin America over the years, it is picking up in Africa and further growth is expected. This is despite cage aquaculture being introduced in several African countries in the 1970s[4].

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1.2 Background and Rational of the EIA

There has been a remarkable and refreshing interest in environmental issues in the recent past with the publication of the 1987 Report of the World Commission on Environment and Development (the

[4] Lake Victoria Fisheries Organization (2016). Draft guidelines for establishment and operation of cage fish farming in East African Community.

5Aura, C. M., Musa, S., Yongo, E., Okechi, J. K., Njiru, J. M., Ogari, Z. & Oucho, J. A. (2018). Integration of mapping and socio-economic status of cage culture: Towards balancing lake- use and culture fisheries in Lake Victoria, Kenya. Aquaculture Research, 49(1), 532-545

[6] KMFRI-ABDP-CAGES (2022). Sustainable community-based cage aquaculture in Lake Victoria, Kenya. Kenya Marine and Fisheries Research Institute (KMFRI) Aquaculture Business Development Programme (ABDP), Kenya Fisheries Service (KeFS) and State Department for Fisheries, Aquaculture and the Blue Economy (SDFA & BE) for Cage Aquaculture technical report funded by the International Fund for Agricultural Development (IFAD).

Brundtland Report titled, "Our Common Future"). This is particularly so due to the increasing realization that man's unsustainable production and consumption patterns are largely responsible for the unprecedented rate of environmental degradation that is threatening mankind. Some of the negative consequences of mankind's irresponsible interaction with the environment include climate change, desertification, loss of biological diversity, pollution of air, water, and land/soil; diminishing indigenous forest cover and loss of natural habitats; among others. The concern for environment made evident the necessity for the planning authorities to count on sound information about possible environmental consequences of development actions[7].

Environmental Impact Assessment (EIA) can be broadly defined as the systematic identification and evaluation of the potential impacts (effects) of proposed projects, plans, programmes, or legislative actions relative to the physical-chemical, biological, cultural, and socioeconomic components of the total environment. EIA systematically examines both beneficial and adverse consequences of the project and ensures that these effects are considered during project design. EIA is both a decision-making process and a document that provides a systematic, reproducible, and interdisciplinary evaluation of the potential effects of a proposed action and its practical alternative on the physical, biological, cultural, and socioeconomic attributes of a particular locality[8]. An EIA aims to predict environmental, social, and economic impacts at an early stage in project planning and design, find ways to reduce adverse impacts, shape project to suit local environment and recommend suitable options to decision makers.

The purpose is to ensure that important environmental resources are recognized early in the planning process and protected through proper planning and decision-making. As a decision-making tool, EIA provides a means for all stakeholders in an action to be heard and to participate in the process of selection of alternatives and mitigation of adverse impacts. EIA gives decision makers more alternative courses of action that may better achieve several instead of just one set of goals.

1.3 Proposed Project Objectives

The proposed project will involve the expansion of the existing Victory Farms Sustainable Tilapia Cage Production to approximately 30,000 MT per annum through HDPE cage system in the new concession areas in Sindo, Suba South Sub- County. The proposed project was subjected to a comprehensive project assessment and the report prepared in accordance with the *Environmental Management and Coordination Act (EMCA) Cap 387 of 1999 (amended 2015) and Environmental (Impact Assessment) and Audit regulations of 2019* which categorizes the proposed project as medium risk and can be approved by National Environmental Management Authority (NEMA) though preparation of a comprehensive project report (CPR).

1.4 Terms of Reference for the EIA

- A critical look into project objectives.
- Assessment of the proposed location of the project.
- A concise description of the baseline information, national environmental policy, legislative and regulatory framework, and any other relevant information related to the project.
- Evaluation of the technology, procedures and processes to be used, procedures and processes to be used in the implementation of the project.
- Evaluation of the materials to be used in the construction and implementation of the proposed project and their extended sources.

[7] Singh et al., 2007. In: Environmental bioremediation technologies, Singh, S. N.; Tripahti, R. D. (Eds) Springer, 223-258

[8] Wamukoya, G. M, and Ludeki, J., 2003. Environmental Impact Assessment in Kenya. Understanding Environmental Impact Assessment Process. CREEL Publications No 3. Nairobi.

- Description, evaluation and analysis of the foreseeable potential environmental effects of the proposed project broadly classified into physical, ecological/biological and socio-economic aspects (direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated)
- Evaluation of waste management.
- Evaluation and analysis of alternatives including the proposed project, no project alternative, project site, design and technologies.
- An Environmental Management Plan (EMP), proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment.
- Propose measures to prevent health and safety hazards and to ensure security in the working environment for the employees and the management in case of emergencies. This encompasses prevention and management of foreseeable accidents and during both the construction and operational phases.
- Such other matters as NEMA may require.

1.5 Objectives and Scope of the Project Report.

The ESIA of the proposed developments was conducted to:

- Determine the Impacts the proposed project may have on the biophysical Environment.
- Assist decision makers arrive at a decision whether to grant or deny a license for the proposed project.
- Propose cost-effective mitigation measures for the significant negative impacts of the proposed project on the environment.
- Coming up with an Environmental Management Plan (EMP) to address environmental and social impacts of the proposed project to the affected population during construction, operational and decommissioning phases of the project.

1.5.1 Reporting

This report is an output of the whole EIA project report including public consultation. The proponent will have to submit ten copies of this report alongside a soft copy to the National Environment Management authority. All the materials and workmanship used in the execution of the work shall be of the best quality and description. Any material condemned by the planners shall be removed from the site at the contractor's cost. Environmental concerns need to be part of the planning and development process and not an afterthought. It is therefore advisable to avoid land use conflicts with the surrounding area through the implementation of the EMP.

1.5.2 Study Team

Table 1 Study Team

	Name	**Role**
1.	Kevin Musiega	Lead EIA Expert / Team leader
2.	Ruth Muhonja	Aquaculture expert and associate expert
3.	Edward Adino	Chemical Analyst and a lead expert
4.	Juliana Akinyi	Socio-Economist Expert
5.	Wycliff Oloo	GIS expert and a planner
6.	John Ambuya	Lead Expert and Green Business Enthusiast

2 ENVIRONMENTAL LEGISLATIVE AND REGULATORY FRAMWORK

2.1 Brief Overview

Applicable national statutes and regulations on environmental conservation and management suggest that the operation of the tilapia cage project must have a legal duty and social responsibilities to ensure that the operation of the sub-project does not compromise the status of the natural resources in the area, health and safety of the surrounding community. This position enhances the importance of this ESIA study to check on the compliance level of the sub-project. The key national laws that govern the management and conservation of environmental resources in the country have been discussed briefly below.

2.2 Policy Framework

2.2.1 The Constitution of Kenya, 2010

Article 42 of the Constitution states that every person has the right to a clean and healthy environment, which includes the right:

1. To have the environment protected for the benefit of present and future generations through legislative and other measures, particularly those contemplated in Article 69;
2. To have obligations relating to the environment fulfilled under Article 70. Article 69(2) states that 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. Article 70 (1) states that If a person alleges that a right to a clean and healthy environment recognized and protected under Article 42 has been, is being or is likely to be, denied, violated, infringed or threatened, the person may apply to a court for redress in addition to any other legal remedies that are available in respect to the same matter.

2.2.2 The Sessional Paper No. 10 of 2014 on National Environment Policy, 2014

Contained in Sessional Paper No. 10 of 2014, the Environment Policy aims at integrating environmental aspects into national development plans. Its broad objectives include, among others, optimal and sustainable use of natural resources and integrated environmental management. It's also meant to harmonize environmental management and development goals to ensure sustainability. It provides guidelines and strategies for government action regarding environment and development.

2.2.3 Kenya Fisheries Policy 2023

The policy aims to sustainably maximize utilization of the fisheries and aquaculture resources for socio-economic development. The Policy acknowledges the low adoption of aquaculture technologies including; Recirculating Aquaculture Systems, cage culture, aquaponics, aquaparks, breeding and feed formulation, particularly among the small-scale fish farmers and inadequate platforms for dissemination of research information and weak linkages between aquaculture research and management.

The proposed project is anticipated to contribute towards the policy objectives by promoting and upscaling sustainable aquaculture technologies.

2.2.4 National Aquaculture Policy, 2011

The Policy highlights the fact that the government recognizes the contribution aquaculture makes to food security and income generation to millions, poverty reduction and economic development in the country. It sets out the aquaculture sector's primary goal of ensuring for increased, sustainable and safe fish production and utilization in a sound environment.

The Policy's overall objective is to enhance the aquaculture sub-sector's contribution to wealth creation, increased employment for all especially for youth and women, food security and income generation through effective private, public and community partnerships. It aims at promoting the development of small scale, medium scale and large-scale aquaculture enterprises; achieving self-sufficiency in fish and ensuring that the domestic market is always adequately supplied; ensuring that gender issues, HIV/AIDs and other lifestyle diseases and cross cutting issues in aquaculture are addressed through establishment of social development programmes in aquaculture in collaboration with relevant stakeholders and partners.

It underlines in its strategies, the need to zone aquaculture resources by identifying, mapping and regulating zones of aquaculture practices in terms of species, systems, climatic and ecological diversities, and promoting the establishment of aquaculture parks (aquaparks) as well. It has strategies in place to promote marketing of aquaculture products through development of physical infrastructure and information systems; encouraging the maintenance of disease-free zones, biosecurity, fish safety and quality assurance management systems; promoting aquaculture produce value addition; and finally, promoting participation of the relevant stakeholders in aquaculture development.

2.2.5 The Kenya National Fisheries Policy, 2020

The policy is designed to improve the management and development of the fisheries sector in Kenya. The policy provides guidance on sustainable management of fisheries resources, enhancement of fish production, and promotion of socio-economic development in the fishing communities. The policy emphasizes the need for effective governance, stakeholder participation, and the use of modern technologies to improve the efficiency and profitability of the sector. It also aims to enhance the value chain of the fisheries sector, improve market access, and promote trade and export opportunities for Kenyan fish products. The policy also recognizes the role of women and youth in the fisheries sector and seeks to empower them through capacity building and access to financing.

The proposed project is aligned to the vision and mission of this policy.

2.2.6 National Water Policy, 2021

The overall goal of the policy is to guide the achievement of sustainable management, development, and use of water resources in the country. The overall objective of the policy is to provide a framework that is dynamic, innovative, and effective for re-engineering the water sector. It was developed to address missing gaps in water resources management. Finally, the policy geared towards and to builds on the successes, challenges, and lessons learnt from the previous policies of 1999, 2012, and the provisions of the Kenya Vision 2030 on water conservation and management.

The proponent will abide by the provisions of the Policy.

2.2.7 National Aquaculture Strategy and Development Plan, 2010 – 2015

Under the banner of filling the fish supply gap for food security, income and healthy living, the National Aquaculture Strategy proposes means and methods of addressing critical issues relating to aquaculture development vis-à-vis input supply (e.g., production and delivery of feeds and seeds as well as the availability of farm credit) and access to extension support and markets within the context of prevailing macro and micro-economic, social and cultural conditions involving a wide range of partners in the public and private sectors. These four critical issues entail the need for institutional reforms such as fostering public and private sector partnerships; strengthening the regulatory framework for aquaculture;) developing an enabling environment for expansion of the sector; and developing requisite human resource.

The strategy is in line with Vision 2030, the long-term national development blueprint that aims to transform the country into an industrialized middle-income economy providing high quality life for its

entire citizenry by the year 2030 as well as programmes already put forward by the Ministry of Fisheries Development. This, it attains through its primary objectives which, among others, is to increase fish production through expanded aquaculture resource base and ensure for the availability of quality and adequate feeds by facilitating feed distribution networks.

2.2.8 Sessional Paper No 4 of 1981 on National Food Policy

The rapid expansion of the population and a shortage of un-exploitable arable land in the main high potential areas are beginning to expose a potentially dangerous imbalance in the relationship between the national supply of and demand for food.

In these circumstances, there is a clear need for a national food policy which will set guidelines for decision-making on all major issues related to food production and distribution. The overall objective of this policy is to maintain a position of broad self-sufficiency in the main foodstuffs to enable the nation to be fed without using scarce foreign exchange on food imports; achieve a calculated degree of security of food supply for each area of the country; ensure that these foodstuffs are distributed in such a manner that every member of the population has a nutritionally adequate diet.

2.2.9 The Kenya Vision 2030

One of the aims of the vision is to raise incomes in agriculture, livestock and fisheries even as industrial production and the service sector expand. This will be done by processing and thereby adding value to her products before they reach the market. She will do so in a manner that enables her producers to compete with the best in other parts of the world. This will be accomplished through an innovative, commercially oriented and modern agriculture, livestock and fisheries sector. These interventions are expected to generate an additional KSh.80-90 billion increase in GDP, mainly through better yields in key crops, increased smallholder specialization in the cash crop sector (2-3crops per plot), utilization of a million hectares of currently uncultivated land, and new cultivation of up to 1.2 million hectares of newly opened lands. Specific strategies will involve the following:

1. transforming key institutions in agriculture and livestock to promote household and private sector agricultural growth; and
2. Increasing productivity of crops and livestock. Kenya will also introduce new land use policies through:
    a. Better utilization of high and medium potential lands by her farmers;
    b. Preparation of new land for cultivation by strategically developing more irrigable areas in arid and semi-arid lands for both crops and livestock; and
    c. By improving market access for small holders through better marketing.

The proposed fish cage culture project is in line with the country's aspirations of increasing agricultural productivity.

2.3 Legislative and Regulatory Framework

2.3.1 Environmental Management and Coordination Act (EMCA, Cap 387)

The Environmental Management and Coordination Act (EMCA), Cap 387, is the framework law on environmental management and conservation. The National Environment Management Authority (NEMA) was established as the principal instrument of government charged with the implementation of all policies relating to the environment, and to exercise general supervision and coordination over all matters relating to the environment. In consultation with the lead agencies, NEMA is empowered to develop regulations, prescribe measures and standards, and issue guidelines for the management and conservation of natural resources and the environment. The Act provides for environmental protection through:

- Environmental impact assessment;
- Environmental audit and monitoring; and
- Environmental restoration orders, conservation orders, and easements.

Part VI under Section 58 of the Act directs that any proponent for any project listed on the Second Schedule of the Act should undertake and submit to NEMA an Environment Impact Assessment (unless exempted by NEMA), who in turn issues a license as may be appropriate.

The proponent has contracted Lakers Consultancy Ltd to undertake the EIA and prepare the report for submission to NEMA. The proponent shall obtain an EIA license before the commencement of works.

Table 2: EMCA Subsidiary Legislations Requirements

Relevant Regulations	Narratives
The Environmental (Impact Assessment and Audit) Regulations, 2003	These regulations outline the procedures and guidelines for carrying out environmental impact assessments and audits. The regulation requires that the EIA/EA be conducted by a registered lead or firm of experts in accordance with the terms of reference developed during the scoping exercise. These regulations have been amended by the Environmental (Impact Assessment and Audit) (Amendment) Regulations, 2019. The amendment list projects into Low, Medium, and High Risk. For the low -risk projects, an environmental impact assessment Summary Project Report (SPR) is prepared while for medium-risk projects Comprehensive Project Report (CPR) must be prepared. For the high-risk projects, a full study report (FSR) is prepared and submitted to NEMA. ***The environmental consultant shall undertake an EIA study in accordance with the general environmental impact assessment guidelines provided for in Part III of the regulations***.
EMCA (Water Quality) Regulations, 2006	Described in Legal Notice No. 120 of the Kenya Gazette Supplement No. 68 of September 2006, these regulations apply to drinking water, water used for industrial purposes, agricultural purposes, recreational purposes fisheries and wildlife and any other purposes. The Regulations outline various water quality standards in relation to use and discharge. Regulation 24 of these regulations prohibit discharge or apply any poison, toxic, noxious or obstructing matter, radioactive wastes, or other pollutants or permit any person to dump or discharge any such matter into water meant for fisheries, wildlife, recreational purposes or any other uses unless such discharge, poison, toxic, noxious or obstructing matter, radioactive waste or pollutant complies with the standards set out in the Third Schedule to these Regulations.
EMCA (Air Quality)	The objective of the Regulations is to provide for prevention, control, and abatement of air pollution to ensure clean and healthy

Relevant Regulations	Narratives
Regulations, 2014	ambient air. It provides for the establishment of emission standards for various sources such as mobile sources (e.g., motor vehicles) and stationary sources (e.g., industries) as outlined in the Environmental Management and Coordination Act, 1999. It also covers any other air pollution source as may be determined by the Cabinet Secretary in consultation with the Authority. Emission limits for various areas and facilities have been set. The regulations provide the procedure for designating controlled areas, and the objectives of air quality management plans for these areas. ***Fish processing is prone to foul smell and therefore, the proponent will ensure no foul smell emanates from the proposed activities.***
Environmental Management and Coordination (Wetlands, Riverbanks, Lake Shores and Sea Shore Management) Regulations (2009)	These Regulations make provision for the management, conservation and sustainable use of wetlands and wetland resources and the sustainable utilization and conservation of (resources on) riverbanks, lake shores, and the seashore. ***Permit to be obtained for activities set out in section 42 of EMCA;*** No person shall carry out any of the activities stipulated in that section without a permit issued by the relevant lead agency and an EIA license issued by NEMA; and Projects having a significant impact on a wetland, riverbank, lake shore or the seashore also require an EIA.
The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations (2006)	The Act states that no person shall engage in any activity that may have an adverse impact on any ecosystem, lead to the introduction of any exotic species, or lead to unsustainable use of natural resources, without an EIA License. Relevance: the proponent shall abide by the provision of this regulation.

2.3.2 The Fisheries Management and Development Act No. 35 of 2016

The main aim of the Act is to promote conservation, management and development of fisheries and other aquatic resources to enhance the livelihood of the communities dependent on fishing. This is to be achieved through establishment of Kenya Fisheries Service. The act also highlights the functions of the two levels of governance of significance to this sub-project component is the function of National government to develop mariculture related infrastructure and resource mobilization for conservation management of the fisheries development. And the function of the county government is to spearhead the development of mariculture at county level.

The proponent has obtained approvals from the County Government of Homa Bay County.

Regulations under Fisheries Management and Development Act

Table 3 Regulations under Fisheries Management and Development Act

Regulation	Narrative

Regulation	Narrative
Fisheries (Beach Management Units) Regulations, Legal Notice no. 55 of 2024.	These Regulations, made under section 37 of the Fisheries Management and Development Act, provide for establishing beach management units for a designated fish landing station, in order to: strengthen the management of fish landing stations, fishery resources and the aquatic environment; support the sustainable development of the fisheries sector; improve planning and resource management, good governance, democratic participation and self-reliance; ensure production of safe and quality fish and fishery products; build capacity of the members for the effective co-management of fisheries; reduce or resolve conflicts in the fisheries sector.
Fisheries Management and Development (Aquaculture) Regulations, Legal Notice no. 62 of 2024.	These Regulations, made under provisions of section 74 (1) and (2) of the Fisheries Management and Development Act, apply to any person engaged in any aquaculture activity, the sustainable-use, protection, conservation and management and development of inland, coastal and marine, lake and river basin aquaculture operations, occurring on private, public or community land. The objectives of these Regulations are: promoting the integration of wise-use of aquaculture resources and operations in the local, county, and national management; strengthening participatory conservation of aquaculture resources in Kenya; ensuring the protection of the diversity of aquaculture habitats, flora and fauna; promoting awareness creation, education, research, indigenous knowledge and partnerships with other relevant institutions in the management of aquaculture systems; maintaining an up-to-date inventory and database of aquaculture operations; protecting aquaculture operations on land, in river basins, lakes and coastal zones from pollution including siltation, agricultural and infrastructural developments, overexploitation, alien and invasive species, and other activities likely to degrade such ecosystems.

2.3.3 Occupational Safety and Health Act (OSHA), 2007

The Acts aim to ensure the safety, health, and welfare of persons at work and non-workers as well as cushion workers against loss of income or livelihood due to occupational accidents or diseases. The Act shall be applied for the safety of workers and the public to be ensured during project implementation, operation, and decommissioning phases. The site shall be registered under the Act as a workplace at all phases of the project before commencement of any activities.

2.3.4 Public Health Act, Cap 242 (Revised edition 2012)

The Act addresses matter of sanitation, hygiene, pollution, and general environmental health and safety, which are directly related to cases of pollution and contamination of water sources, be it ground or surface. The management of wastewater or any effluent that shall be generated should be managed in a way that shall not cause any public nuisance.

2.3.5 The Water Act (2016)

The new Water Act (2016) of the Laws of Kenya seeks to make better provision for the conservation, control of pollution; apportionment and use of the water resources in Kenya, and for purposes they are incidental thereto and connected therewith. The Act vests ownership and control of water in government

subject to any rights of user. Under this provision the responsibility to regulate access, use and control of water resources is vested in the Water Resources Authority (WRA).

Part 2, Section 18 provides for national monitoring and information systems on water resources. The Water Act protects water bodies and sources from pollution and controls their use by the project. It ensures that the projected required amount of water that can be provided by the existing water system and that the project designer will work to conserve the available water both during construction and operation phases.

2.3.6 The Physical and Land Planning Act, 2019

The Act provides for planning and controlling for physical development in the country in general. The Act read together with the county government Act 2012 will assist in synchronizing the national, local, and project physical planning, controlling for any possible conflicts.

The project shall be approved by the relevant County departments after meeting the requirements of the Act.

2.3.7 Land Titles Act Cap 282

Section 10(1) of the Act states that there shall be appointed and attached to the Land Registration Court, a qualified surveyor who, with such assistants as may be necessary, shall survey land, make a plan or plans thereof and define and mark the boundaries of any areas therein, as when and where directed by the Recorder of Titles, either before, during or after the termination of any question concerning land or any interest connected therewith, and every area so defined and marked shall be further marked with a number of other distinctive symbol to be shown upon the plan or plans for the purposes of complete identification and registration thereof, as is herein-after prescribed.

Section 27 further provides that every certificate of title shall set out a description of the immovable property therein referred to, with figures and references necessary to identify it on the plan or map of the area, in which it is situated, and a correct statement of the right, title or interest of the person to whom it is issued. Sub section 4 requires that there shall be attached to every certificate of ownership, a plan of the land, the subject of the certificate, and the plan shall be signed by the Recorder of Titles and the Director of Surveys or such officer as the Director of Surveys may appoint.

2.3.8 County Governments Act, 2012

The Act empowers county governments to protect the environment and natural resources with a view to establishing a durable and sustainable system of development. In addition, the county governments are responsible for development planning and control including the county spatial plans. The proponent will work in liaison with Homa/Bay County Government to ensure compliance with land use requirements within the county.

2.3.9 The Agriculture Act, Cap 318

The Agriculture Act Cap 318 of the Laws of Kenya seeks to promote and maintain a stable and sustainable agriculture, to provide for the conservation of the soil and its fertility and to stimulate the development of agricultural land in accordance with the accepted practices of good land management and good husbandry. This Act primarily guides and regulates farming practices especially in relation to the proximity of farming within the riparian section. The Act specifies that no agricultural activity is allowed and or permitted within the riparian area of a wetland, river or Lake. The Agriculture Act is the principal land use statute covering, inter- alia, soil conservation, and agricultural land use in general.

2.3.10 The Penal Code, Cap. 63

Section 191 of the Penal Code makes it an offence for any person or institution that voluntarily corrupts, or foils water for public springs or reservoirs rendering it less fit for its ordinary use. Similarly, section 192 of the same act prohibits making or vitiating the atmosphere in any place to make it noxious to health of persons/institution in dwellings or business premises in the neighborhood or those passing along a public way.

2.3.11 Lake Basin Development Authority (LBDA) Act, Cap 442

The LBDA Act that established the Authority stipulates among others, that the Authority shall coordinate the abstraction and use of natural resources and set up an effective monitoring system; effect the protection and utilization of water and soils; ensure water and soil conservation measures are undertaken; identify and collect all data related to water uses and other resources for efficient forward planning; examine the hydro-geological and ecological effects of development and evaluate how they affect economic activities of the persons dependent on river and lake water development; Consider all aspects of development of the area and their effects on lake inflows and outflows; and monitor the operation and provide technical reports on the operations of any agreement or other arrangements between Kenya and other states on the use of the waters of the Nile and Lake Victoria.

2.3.12 HIV/AIDS Prevention and Control Act, 2006

This is an Act of Parliament providing measures for the prevention, management, and control of HIV and AIDS, to provide for the protection and promotion of public health, and for the appropriate treatment, counseling, support, and care of persons infected or at risk of HIV and AIDS infection, and for connected purposes**.**

Requirements of the Act will ensure that the proponent together with Homa Bay County public health department provide VCT services for employees and locals where appropriate and promote public awareness. This will go a long way in ensuring stigmatization of HIV and AIDS is reduced as well as managed during the operation period.

2.4 International Conventions

The United Nations and other international institutions have drafted several international treaties and conventions aimed at enhancing social economic development, environmental sustainability and promoting fundamental human rights. Due to their ecological and economic significance to the Kenyan Nation, the Government of Kenya has found it befitting to be signatory to various global conventions on conservation of wetlands and biodiversity. These conventions include:

- The Convention on Conservation of Wetlands, or the Ramsar Convention (1971);
- The Convention on Conservation of Biological Diversity (Nairobi, 1992);
- The Convention on the Conservation of Migratory Species and Wildlife (Bonn 1979); and
- The Conservation of Important Bird Areas, (IBAs) of these, the following are the most relevant for the project under review.

2.4.1 Convention of Biological Diversity

The convention was made in Nairobi in 1992, of which Kenya is a signatory. The approach of conservation of biodiversity is basically broad. Parties to the convention are required to adopt, national strategies, plans and programmes for the conservation and sustainable use of biological diversity into their relevant sectoral and cross-sectoral plans, programmes and policies. The Flood Control and Afforestation project should ensure the rare and endangered species in the project area and its environs are conserved.

2.4.2 The Protocol on Environment and Natural Resources (EAC, 2010)

Specific to the management of floods and flood-related disasters such as sedimentation, the protocol in article 112 (c) of the management of the environment take necessary disaster preparedness, management, protection and mitigation measures especially for the control of natural and manmade disasters. These include oil spills, biohazards, floods, earthquakes, marine accidents, and drought and bush fires. For purposes of paragraph 1 of this Article, the Partner States undertake to: (e) adopt environmentally sound management techniques for the control of land degradation, such as soil erosion, desertification and forest encroachment. These directly relate to sound management of land practices that reduce incidents of soil erosion that leads to flooding and sedimentation.

2.4.3 Convention on the Conservation of Migratory Species

The convention on migratory species (CMS) was adopted to conserve migratory species of wild animals given that migratory species are seen as international resources. Such species may be terrestrial or marine. The conventions agreement on the conservation of African-Eurasian Migratory water birds is specific on the need to protect the feeding, breeding and wintering habitats, the main ones being wetlands and open water bodies. Kenya observes the convention.

2.4.4 Important Bird Areas (IBAs)

The Lake Victoria region has five out of the sixty sites that have been identified as an IBA of Kenya. Nature Kenya, Birdlife international and Global Environment Facility (GEF) have identified the sites. The Important Bird Areas Program is a worldwide initiative working for the conservation of biological diversity and sustainability of human use of natural resources. The project is expected to recognize these sites and protect them where they occur in the project area or its environs.

2.4.5 ILO Convention No. 184 on Safety & Health in Agriculture

This is the first time that waged agricultural workers – whether permanent, temporary or seasonal – are guaranteed in international law the same rights and levels of protection as other categories of workers, even though the agricultural industry is one of the three most dangerous in the world and has the largest workforce of any.

2.5 Institutional Framework

2.5.1 NEMA

NEMA is the National body charged with coordinating matters of implementation of policy issues relating to the environment. This body was established under the EMCA, Cap 387. Other departments that deal with environmental issues in Nyanza Province include the Kenya Forests Service (KFS), Kenya Wildlife Services (KWS), County Government of Homa Bay, among others.

2.5.2 National Environmental Council (NEC)

The NEC was set up under the EMCA 1999 and is responsible for policy formulation and directions; sets national goals and objectives and determines policies and priorities for the protection of the environment; promotes cooperation among public departments, local authorities, private sector, NGOs and such other organizations engaged in environmental protection programmes among other functions assigned under EMCA 1999. This Council is appointed by the Minister.

2.5.3 National Environment Complaints Committee (NECC)

The NECC[9] investigates allegations and complaints of suspected cases of environmental degradation. The Committee also prepares and submits to the NEC periodic reports of its activities.

Members of the public can register or appeal to this committee regarding any aspects of the project that violates the law and its licenses.

2.5.4 National Environmental Action Plan (NEAP) Committee

The NEAP is responsible for the development of a 5-year Environmental Action Plan among other things.

2.5.5 Standards and Enforcement Review Committee (SERC)

The SERC is a technical committee that is responsible for the environmental standards formulation, methods of analysis, inspection, monitoring and technical advice on necessary mitigation measures.

2.5.6 National Environmental Tribunal (NET)

NET[10] reviews administrative decisions made by NEMA relating to issuance, revocation or denial of license and conditions of license. It also provides legal opinion to NEMA on complex matters where the Authority seeks such advice. In addition, the Tribunal has powers to change or give an order and direction regarding environmental issues in dispute.

2.5.7 The East African Community (EAC)

The EAC is a regional forum that brings together Kenya, Tanzania, Uganda, Rwanda, Burundi, Democratic Republic of Congo (DRC), Somalia and South Sudan into an economic block. There are also plans to turn EAC into a regional political body. The EAC together with the donors are in the forefront of promoting sustainable development of the Lake Victoria Basin.

2.5.8 Lake Victoria Fisheries Organization (LVFO)

This is one of the projects of the EAC that is specifically responsible for promoting proper management and optimum utilization of the fishery resources of the Lake Victoria. Its establishment was achieved through the funding of the LVEMP courtesy of the three East African countries, the FAO, the European Union (EU), World Bank/GEF. It has the responsibility of enhancing partnership and collaboration with institutions and stakeholders for the betterment of Lake Victoria's ecosystem for sustainable fisheries resource utilization and socioeconomic development of the riparian communities.

2.5.9 Lake Victoria Environment Management Project (LVEMP)

This is a Global Environmental Facility (GEF) funded project whose second phase is currently underway. The first phase was completed in 2004 with a total funding to the tune of USD 75,636,000, of which the three East African states contributed 10%. Specific objectives of LVEMP Phase I were to maximize the sustainable benefits to the riparian communities from using resources within the basin to generate food, employment and income; to supply safe water and sustain a disease free environment; to conserve biodiversity and genetic resources for the benefit of the riparian communities; to harmonize national and regional management programs in order to achieve to the maximum extent possible the reversal of environmental degradation; and to promote regional co-operation.

[9] https://www.necc.go.ke
[10] https://www.judiciary.go.ke/the-national-environment-tribunal/

2.5.10 The Lake Victoria Fisheries Research Project (LVFRP)

This was established in 1997 courtesy of the funding from the European Union. The principal aim of the Project was to assist the LVFO in establishing a framework for the rational management of Lake Victoria's fisheries. The specific objectives of the project were to carry out stock assessment, to train fisheries researchers, to rehabilitate and construct research vessels, to equip the research institutes and to investigate socio-economic issues related to the Lake and its fisheries.

2.5.11 The Nile Basin Initiative (NBI)

This initiative, funded by donors (e.g., World Bank, Norway and Sweden) comprises ten countries which make up the Nile River Basin, namely, Burundi, Democratic Republic of Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda. Its aim is to promote the exploitation of the development potential of the Nile River in a way that focuses on gaining mutual benefits from developments rather than on defending rights.

3 PROJECT DESCRIPTION AND IMPLEMENTATION

The proposed proposed commercial sustainable tilapia cage farming expansion with an approximate production of 30,000 Metric Tonnes per year in new concession blocks in Lake Victoria's Litare, Jiudendi, Ngeri, Nyagwethe, Kamogo, Uterere, & Kisegi Beaches in Suba South Sub- County, Homabay County. The entire proposed farming project will incorporate environmental guidelines as well as health and safety measures.

3.1 Construction Inputs and Activities

Table 4 Construction Inputs and Activities

The project inputs	• **Construction raw materials –** The construction of HDPE cages will include round HDPE pipes, nets, strings and fasteners. All these will be to the approved standards and shall be obtained from licensed dealers and especially those that have complied with the environmental management guidelines and policies; and • **Labour** – Construction labor force of both skilled and non-skilled workers who will require services such as water supply, washing and sanitation facilities
Construction activities	Construction activities will entail: • Procurement of construction materials from approved dealers; • Appropriate storage of the construction materials; • Site preparation i.e. demarcation; • Construction of the HDPE fish cages; and • Disposal of the resulting waste materials.

3.2 Project Description

The proposed project will be implemented in offshore waters of Litare, Jiudendi, Ngeri, Nyagwethe, Kamogo, Uterere, & Kisegi Beaches. The proponent has an existing and largest sustainable tilapia cage farm in East and Central Africa. The expansion of the tilapia fish cage system will help in meeting the current national tilapia fish demand and generate income both to the proponent and residents of Homabay. The proposed new concession blocks are targeted to produce approximately 30,000 Metric Tonnes per year.

3.2.1 Cage Design (High Density Polyethylene- HDPE Cages)

The design of fish cages is determined by several factors. In designing a cage, it is important to ensure that the fish and the people who use the cage are safe as mentioned above. The parts of a floating cage unit should be designed and constructed in a manner that provides suitable anchorage, buoyancy, strength and stability. When deciding on the adequacy of these features it is necessary to consider the likely loads imposed by vehicles, equipment, fish food, etc., and the effect of waves and wind. Continued safety of the installation will depend on regular routine inspection combined with maintenance inspection, normally at least once a year and immediately after storms (HSE, 1997). Lack of proper maintenance can lead to serious losses of fish, property or human life.

The proponent will use floating surface cages in the project. The proponent will make use of modern HDPE cages that are plastic in nature and more durable. They will be 30m diameter and 10m depth given the lake bottom depth of over 30 m. Thus, the difference between cage bottom and lakebed is 20m, making oxygen circulation optimum for juvenile tilapia fingerlings.

Figure 1 Project location

Plate 1 Sample HDPE Cage Design

4 BASELINE INFORMATION

4.1 Position and Size

Kenya has faced a steady decline in capture fish production in the recent years. The government of Kenya has realized this trend and implemented economic stimulus program (ESP) for small scale farmers in the country which increased fish production by around 22,000 Tones and created a good business climate for aquaculture. There have been progressive policy milestones to support aquaculture production since the implementation of the ESP program. Given that Lake Victoria's Fishery accounted for 86,394 MT in 2022, which was a 8% decrease in catch compared to 94,349 MT recorded in the year 2021, it is obvious that the decrease was attributed to increasing overfishing and illegal fishing practices and even declining wild stocks. Thus, the proponent, Victory Farms Ltd, proposes to invest in tilapia juvenile/nursery cage system production in Roo, Sindo, Suba South sub-county, Homabay County.

4.1.1 County Overview

The study area is in Nyagwethe Sub-location Suba North Sub-County, Homa-Bay County. Homa Bay County lies between latitude 0^0 15' South and 0^0 52' South, and between longitudes 34^0 East and 35^0 East. The county covers an area of 4,267.1 Km^2 inclusive of the water surface which on its own covers an area of 1,227 km^2. The county is in Southwestern Kenya along Lake Victoria where its boarders Kisumu and Siaya counties to the North, Kisii and Nyamira counties to the East, Migori County to the South and Lake Victoria and the Republic of Uganda to the West.

4.2 Administrative and Political Units

Table 5 Area of the Sub-County by Division and Respective Population (Source: KNBS)

SUB COUNTY	NO. OF DIVISIONS	NO. OF LOCATIONS	NO. OF SUB LOCATIONS	AREA IN KM2
Rachuonyo South	3	13	25	256.1
Rachuonyo East	2	15	35	250.9
Rachuonyo North	4	23	59	435.4
Homa Bay	2	23	59	182.0
Rangwe	2	7	19	274.1
Ndhiwa	6	29	49	711.4
Suba North	3	11	27	406.3
Suba South	2	9	24	634.1
Total	**24**	**130**	**297**	**3,150.3**

Table 6 Ward Population

Ward	Population	Urban population	Population density
Gwassi Central	27,574	1,653	90
Gwassi South	47,221	0	142

Source: KNIBS census 2019

4.3 Population and Settlement

According to the 2019 Kenya Population and Housing Census, the county population was 1,131,950 persons consisting of 539,560 males, 592,367 females, and 23 intersexes. This population was domiciled in 262,036 households, with 260,290 categorized as conventional households and 1,746 being group quarters. The county had a population density of 3150.3 people/ Km2 and an annual population change of 1.6 % in ten years (2009-2019). The county's annual growth rate stands at 1.6% against the national average of 1.9%. The growth is currently a result of a high fertility rate that stands at 3.6% against the national average of 3.4%. This is attributed to low use of modern contraception methods by married women, which stands at 48.5%.

4.3.1 Population Distribution by Sub-County

Table 7 Population Distribution by Sub-County

	Area(KM²)	Population	Density	Area(KM²)	Population	Density	Population	Density	Population	Density
Homabay	182.0	117,439	645	182.0	125,370	688.85	132,611	728.6	137,729	756.8
Ndhiwa	713.5	218,136	306	713.5	232,868	326.4	246,316	345.2	255,823	358.5
Rachuonyo North	435.4	178,686	410	435.4	190,754	438.1	201,770	463.4	209,557	481.3
Rachuonyo East	250.9	121,822	486	250.9	130,049	518.3	137,560	548.3	142,869	571.2
Rachuonyo South	256.1	130,814	511	256.1	139,649	545.3	147,713	576.8	153,414	599.0
Rangwe	274.1	117,732	429	274.1	125,683	458.5	132,941	485.0	138,072	503.7
Suba North	406.3	124,938	307	406.3	133,376	328.2	141,078	347.2	146,523	360.6
Suba South	634.1	122,383	193	634.1	130,648	206.0	138,193	217.9	143,527	226.3

Source: KNIBS Census, 2019

4.4 Physiographic and Natural Conditions

4.4.1 Physical and Topographic Features

Homa-Bay County is divided into two main relief regions namely: -

a) The lakeshore lowlands and the upland plateau. (The lakeshore lowlands lie between 1163-1219m above the sea level and comprise a narrow stretch bordering the Lake Victoria especially in the northern parts of the County).
b) The upland plateau starts at 1219m above the sea level and has an undulating surface which has resulted from erosion of an ancient plain. It is characterized by residual highlands such as Gwassi and Ngorome hills in Suba, Gembe and Ruri Hills in Mbita, Wire Hills in Kasipul as well as Homa hills in Rachuonyo. Kodera forest in Kasipul and the Kanyamwa escarpment that runs along the borders of Ndhiwa and Mbita also form part of the upland plateau.
c) To the west of the County lies the Lambwe Valley where Ruma National Park is located.

The outer part of the Gwasi massif is composed of a steep, deeply gullied outer ridge of volcanic rocks called Kisingiri with high points at Gembe (6,230 feet), Sumba (6,034 feet), Gwasi (6,384 feet) and Usengere, alternatively known as Kwirathia (7,454 feet). To the north of the Gwasi massif, four large islands rise from Lake Victoria, which is 3,726 feet above sea-level. The proposed project site is bound by both rugged and undulated terrain (15% elevation) at an altitude of 1744 metres a.s.l.

Plate 2 Gwasi or (Usengere) Hills

4.5 Geological and Soil Characteristics

4.5.1 Geological Formation of Suba North

The Gwasi hills, rising to seven thousand feet above sea-level, are part of an old, dissected volcano. The slopes are steep, traversed by numerous gullies, and in part forested. The valley is of tectonic origin and its flat floor reflects an earlier extension of the lake, comparable with the extension that gave rise to the Kano plains. The rocks of the Gwasi area comprise Precambrian lavas and sediments belonging to two systems, an extensive series of volcanic and intrusive rocks as well as sediments of Tertiary age, and various sediments of Pleistocene and Recent age. During the Palaeozoic and Mesozoic eras stable continental conditions prevailed, and there is no evidence of sedimentation, volcanic activity, or of igneous intrusions.

The oldest rocks exposed in the area are the weakly metamorphosed members of the Nyanzian System which, in contrast to the rocks of the Basement System long considered as the oldest rocks in Kenya, have undergone only low-grade "phyllite" metamorphism. In the southern part of the area, they consist of meta basalts with banded ironstones, and well-defined pillow lavas.

4.5.2 Area Soil

The Lambwe valley including Malongo, Sindo and Nyagwethe areas are largely covered by completely flat alluvium lying between the Kanyamwa escarpment and the Gwasi massif. The valley is of tectonic origin and its flat floor reflects an earlier extension of the lake, comparable with the extension that gave rise to the Kano plains near Kisumu. The Lambwe valley is mantled by black cotton soil. Dark reddish-brown soils occur in the better drained areas of volcanic rocks especially the proposed project site.

4.6 Drainage (Surface Water)

The county is dissected by several rivers namely Awach Kibuon, Awach Tende, Maugo, Kuja, Rangwe and Riana rivers, most of which originates from Kisii and Nyamira counties. The deeply gullied watercourses of the Gwasi massif flow only as storm torrents for a few hours after heavy rain. To the north and east of the massif the streams sink underground immediately their courses strike the deep

alluvium of the Lambwe valley. River Misare, Olambwe Nyagwethe, Kisaku, and Taronegi that drain into trans-boundary Lake Victoria are supported by Gwasi Massif.

Plate 3 Lake Victoria

4.7 Climate

Homa Bay County has an inland equatorial type of climate. The climate is however modified by the effects of altitude and nearness to the lake which makes temperatures lower than in equatorial climate. There are two rainy seasons namely the long rainy season from March to June and the short rainy season from August to November. The project area experiences bi-modal rainfall annually with peaks between March and May, and between October and December. Average annual rainfall is between 1200-1600mm.

The future projections spanning from of 2021-2065, the temperature is anticipated to increase by 0.4ºC, with the first wet season projected to experience even greater changes. And by this time, precipitation is projected to increase by 0.7% in the first wet season, and 3% in the second wet season11. The proposed project site covering Gwasi hills and part of Gembe hills both have hinterland equatorial climate modified by altitude and proximity to Lake Victoria, with short rains occurring between September-December and long rains March-May. Gwassi Hills experience relief rainfall with an annual average of between 700-1200 mm with approximately 60% reliability

4.7.1 Winds

Generalized wind speeds average about 4m/sec and have certain regularity due to the convection effect of the large water body of the lake that borders the often-hot dry land.

4.7.2 Temperatures

Temperature typically varies with altitude and proximity to the lake and tends to increase towards the lowland with an average of 18.3^{0}C to 29.4^{0}C and it rarely goes below 16.6^0 or above 32.2^{0}C. Temperatures are highest between December and March with the hottest weather being experienced in February and the lowest in April and November. (*Homa Bay CIDP, 2019).*

[11] Kenya County Climate Risk Profile Series

4.8 Biological Resources (Fauna and Flora)

The vegetation is largely of acacia woodland and bush land growing over expansive black cotton soils that cover most of the Homabay County apart from the hilly areas which have rock outcrops. The vegetation of acacia woodland is characteristic of the kind of vegetation cover found in areas of dominate black cotton soils. There is also an assortment of species of indigenous species of trees. A lot of trees are grown within the urban and peri-urban areas for the conservation of the environment. However, since agriculture is still exercised in most parts of the Homabay county, crops also form part of vegetation cover as do grass in open fields and homesteads and compounds or courtyards, as well as trees planted for landscaping like the jacaranda dot the landscape of the Homabay county. It is to be noted that the water hyacinth in the lake can also be considered available vegetation, but this is subject to winds as sometimes it is blown further into the lake, but mostly it covers a large tract of the shoreline.

4.8.1 Habitat (Flora)

Homa-Bay County has two gazetted forests covering 29.6 km². These forests are Gwassi and Wire hills. The county also has eight non-gazetted forests covering about 128 km². They are Ngorome hills, Ruri hill, and Gembe hills, Mfangano, Homa Hills, Asego Hill and Kodera Forest. Nyagwethe/Malongo borders the gazetted Gwasi hills.

4.8.2 Wildlife (Fauna)

The main wildlife found in the county of Homa Bay includes Topi antelope, hyenas, Roan antelopes, giraffes, buffaloes, hippopotamus, crocodiles, and various species of snakes. Lately, zebra and rhinoceros have been introduced to Ruma National Park. Sindo/Nyagwethe habitable areas are currently experiencing surge in anthropogenic activities which has driven away wildlife population uphill into dense forest of Gwasi hill. Gwasi hill is a habitat for various fauna such Roan antelope, warthogs, porcupines, wild pigs, dik dik, hare, and baboons amongst other reptiles. There were no wild animals spotted during EIA study at the proposed site except for Hippos and other aquatic animal species.

4.9 Economic Activities and Household Income

Homa-Bay County is predominantly lower midland (LM1-LM5) agro ecologically, with pockets of upper midland (UM1-UM4) agro-ecological zones on the eastern edges of the county and on hilltops/slopes. The agro-ecological zones range from dry ones with only one cropping season near Lake Victoria, to wet ones with permanent cultivation possibilities in the eastern parts of the County.

The County has the potential to produce a wide variety of crops. Some of these include sugarcane, maize, and beans in the wetter LM1 and LM2 belt. The drier LM3 and LM4 belts have the potential for cotton, finger millet, sorghum, and ground nuts. The climate is suitable for upland rice and oil palm. Sweet potato, a major food security crop, is produced in the entire county. Major economic activities taking place within Homa-Bay include trading and wholesale, retail, hawking, microenterprise, touting, non-motorized transport business. The local communities living around Gwassi hills practice subsistence farming, livestock rearing and fishing. Approximately 89% of the population practice agriculture for consumption and income generation. The main crops grown in the area include cassava, and maize. Livestock rearing is also practiced where cattle, goats, donkeys, and chicken are kept.

Plate 4 Fishing Boats at Sindo Market

4.10 Environment Issues

4.10.1 Water Pollution

The pollution of Lake Victoria is a critical issue. The lake, being a huge system fed by rivers that originate from far-off areas, has elements of both on-site and off-site pollution:

- Agro chemicals/ fertilizer (non-point sources of pollution of the lake)
- Water hyacinth menace
- Direct draining of sewers into the lake
- Car washing in town (run-off to main sewer)
- Clothes washing and bathing in the lake
- Agro-based industrial water release on rivers

Proposed Mitigation Measures

- Proper management of sewage
- Ensure riparian reserves are protected
- Efforts to rid the lake of hyacinth urgently

4.10.2 Air Pollution

Air pollution within the area is minimal; however, there are notable problems and challenges which include;

- Dust during constructions
- Stench from fish mortality
- Burning of wastes such as polythene bags, tyres
- Smoking in public places
- Exhaust fumes from un-roadworthy automobiles

Opportunity for improvement

- Enforcement of laws for hoarding construction sites
- Watering during construction to reduce the dust levels
- Provision of incinerators
- Improve public awareness, especially on the advantages of environmental conservation
- Designating smoking zones within the Homabay County.

4.11 Cross Cutting Socio-Economic Issues

4.11.1 Water

There's a lack of water storage facilities to keep water during after treatment. The residents consume water directly from the lake hence contributing to water borne diseases.

4.11.2 Sanitation

- Lack of toilets is a big problem in beach areas.
- Pit latrines collapse due to lose soils in the beach.

4.11.3 Solid waste

There is lack of waste management system in the beach.

4.11.4 Poverty

Poverty in the Homabay County is exemplified through the following factors:

- Lack of food security
- Poor housing conditions
- Mushrooming of slums and squatter settlements
- Increased insecurity
- Dwindling health standards, high under-5 mortality rates, low life expectancy and high prevalence of HIV-AIDS
- Inequitable resource distribution

5 METHODOLOGY OF THE STUDY

The EIA experts used site surveys and perused documents relevant to the EIA to come up with data and information regarding the proposed development and expected effects on the water and land resources and socio-cultural environment.

5.1 Methodology Outline

The general steps followed during the assessment were as follows: -

- Environment screening, in which the project was identified as among those requiring environmental impact assessment under schedule 2 of EMCA, Cap 387
- Environmental scoping that provided the key environmental issues
- Desktop studies and interviews
- Stakeholders' engagement and distribution of questionnaires
- Physical inspection of the site and surrounding areas
- Reporting

5.2 Site Surveys

It was important that the Environment Experts carry out a detailed study of the proposed site. Observation enabled the expert to determine what environment factors were most likely to be impacted.

5.2.1 Interviews and Focused Group Discussion

To determine the part of the extent of the proposed project, the expert consulted in depth with the proponent, to determine, size, and objectives of the proposed project. Proponent elucidated his vision for the project and dialogued with the environment expert who advised concerning application of all relevant laws and by-laws related to the project.

For the proposed project to see light at the end of the tunnel, the team of EIA expert sought the views of the professionals and government agencies as well as those of the individuals from different social classes in the community; using structured interviews and focused group discussion to further in depth understanding of the perception to the locals regarding the proposed project.

5.2.2 Perusal of Documents

The environment expert explained to the proponent the importance in acquiring the proper documents associated with the proposed projects. The environment expert perused the following documents:

- County Approvals
- Project layout designs
- State department of fisheries aquaculture guidelines
- The proponent development concept
- Biosafety and biosecurity plan.

5.2.3 Secondary Data

Various literatures were used in aiding the successful completion of the report. They include EMCA-Cap 387, The Physical Planning Act (Cap 286) Laws of Kenya, The Factories and Other places of Work Act, The Public Health Act, Cap 242 and Environmental Management and Co-ordination (Waste

Management) Regulations, 2006 Legal Notice No. 12. And Fisheries Development Management Act, 2016.

5.3 Actual EIA Public Consultation

Public participation is enshrined in Kenyan constitution. It has also demonstrated that projects that go through this process will acquire high level of public acceptance and accrue benefits for a wider section of the society. Public consultation forms a useful component of gathering, understanding and establishing impacts of projects; determine community and individual preferences and selecting mitigations. Furthermore, it makes it possible to enhance project designs and ensure sustainability of projects.

5.3.1 Process of Public Consultation

The Consultant developed questionnaires for the proposed juvenile tilapia fish cage culture project to gather concerns from the community living in the project area and the entire community. Comments from the Beach Managements (BMU) Committee were sought and incorporated in the report. The study team also sought comments from key informants in the fisheries sector.

5.3.2 Objective of Public Consultation

The consultations with the relevant and affected persons were conducted with a view to: -

- Inform the community, stakeholders and relevant parties of the proposed fish cage culture project.
- Seek the views of the residents of Beach Management Units on the proposed project;
- To seek their opinions on any positive or negative impacts from the establishment of such a project;
- To find out if there are any issues that the project could negatively or positively impact on the lives of the residents and the public.
- Explain to the community and stakeholders the nature of the proposed project, its objectives and scope;
- Obtain suggestions from the public on possible ways that they feel potential negative impacts can be effectively mitigated.

There was a positive reaction over the proposed project with the residents giving no objection to its establishment. The residents could clearly see the benefits of the existing project and thus supported the establishment of a juvenile tilapia cage system.

5.3.3 Salient Issues

The respondents expressed several positive impacts they expect from the proposed project. There were also negative impacts that the respondents expected, and these have been adequately addressed in the Environmental Management Plan. The major issues raised include:

- Will interfere with water quality
- Will hamper free navigation
- May cause disease outbreak
- Pollution of the lake waters
- Injuries and accidents
- Involvement of the BMU in the project implementation
- Proper construction of the cages
- The proponent to limit the project to Tilapia species only

- Use certified fingerlings and feeds.
- Create a buffer zone for biosecurity
- Adopt advanced feeder technology
- Site project clear of navigation route
- Minimizing feed waste
- Keep proper sanitation at the cages
- Control use of chemical drugs
- Proper despoil of human wastes

5.3.4 Consultation & Public Participation (CPP)-analysis

The public interviewed welcomed the development and were optimistic that the project will create employment opportunities, boost food security at the beach as well as improving the incomes from sale of fish, stimulate the growth of national economy by boosting other sectors of business and lead to better standards of living. There was no major negative issue raised as far as the flood control project is concerned. The participation from the stakeholders, the public and neighbors were very successful, and the participants were very cooperative. Therefore, the project is commendable for approval by NEMA

5.3.5 Reporting and Documentation

A comprehensive EIA Study Report containing the findings has been compiled by the consultant in accordance with NEMA guidelines for consideration and approval by the authority.

5.3.6 Key Stakeholders Consulted

Table 8 Key Stakeholders Consulted

Name of Stake Holder	Organization
County Fisheries Department	Homa Bay County Government
Lands Office	Suba South-Land Office
Water Analyst	Water Resources Authority Lab
State Department of Fisheries	Kisumu Regional Office
Aquaculture Specialist	Part of the experts
Immediate Neighbors	Neighboring residents
Ministry of Interior and National Government Coordination	Chief, Sub-Chief and Nyumba kumi
Local Community	Local Fishing Community
Media Houses	Newspaper, Radio and Kenya Gazette outlets

5.3.7 Summarized Methods, Tools and Techniques for Stakeholder Engagement

Stakeholder Category	Engagement				
	Communication strategist	**Information Disclosure**	**Consultation**	**Participation**	**Negotiation and Partnership**
Beach management Units Leadership	General meeting, FGD and KIIs (Shared Minutes)		Informed and in-depth individually	BMU	Memorandum of understanding and agreements
All residents of the project area	General meeting, FGD and KIIs (Shared Minutes)	-	General meeting with questions and answers	Beach management units (BMU)	Group
Fishermen in the project area	Key informants' interviews (KIIs)		General meeting with questions and answers	Group	Group
Government Stakeholders	NEMA public consultation	Newspaper adverts	Meeting and letters	Lead agencies	Lead agencies
The general fishing community	Posters, general meetings, minutes, reports and flyers distributed through BMU offices, shops, and chief's baraza and office, websites and documents and reports at county information		Meeting	Representatives	County government

5.4 Feedback and Outcome of Public Consultation

Detailed analysis of administered questionnaires and outcome of public meetings and Barazas are annexed in the report.

6 PROJECT ALTERNATIVES

This Chapter analyses the proposed project alternatives in terms of culture sites, species, and culture systems, with and without floating cages, technology scale and waste management options.

6.1 Project Alternatives Considered

This section analyses the project alternatives in terms of site, technology scale and waste management options.

6.1.1 Relocation Option

Relocation option to a different site is an option available for the project implementation. At present the proponent has alternative sites but the current site is the best according to the surveys done. However, this means that he must look for another site and this will take more time and resources. The proponent already secured concession from relevant authorities.

6.1.2 No Project Option

The No Project option in respect to the proposed project implies that the status quo is maintained. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. This option will, however, involve several losses both to the proponent and the community. The No Project Option is the least preferred from the socio-economic and partly environmental perspective due to the following factors:

- The proponent will not benefit from the revenue expected from the project.
- The economic status of the Kenyans and the local people would remain unchanged.
- The local skills would remain underutilized.
- No recreational center and job opportunities will be created for thousands of Kenyans who will work and live in the proposed project.
- Increased urban and rural poverty and crime in Kenya.
- Discouragement for investors to produce this level of affordable facility to the public.

From the analysis above, it becomes apparent that the No Project Option is no alternative to the proponent, Local people, Kenyans, and the government of Kenya.

6.1.3 Analysis of Alternative Construction Materials and Technology

Cages for fish culture can be constructed from a variety of materials and in practically every shape and size. Cages can also be purchased from companies that sell aquaculture supplies, but it will be more economical if construction of cages can be done by oneself. The two most important things to remember are: Cages should be made of sturdy materials. The cage materials should be strong, durable, and nontoxic. The cage (mesh size) must be able to retain the fish yet allow maximum circulation of water through the cage. It is best to select the largest mesh possible that will retain your fish. Adequate water circulation brings oxygen into the cage while washing wastes away. The proponent will use HDPE cages.

6.1.4 Materials

Cage components consist of frame, nets, floats, weights and ropes.

Frame: The frame of the cage can be made from wood, plastic, fiberglass, PVC or metal. Frames made from metals and wood should be coated with a water-resistant paint.

Net materials: Net materials can be plastic coated, welded wire, solid plastic mesh or nylon netting. Mesh size of the net depends on the culture species, initial size of the seed, and the culture method. If we use 6 - 8-inch fingerlings as seed to culture most suitable mesh size is ½ inch and nets with 1/8, ¼ or 3/8-inch (0.5 – 1.0 mm) mesh sizes can be used for fry to fingerling rearing cages.

Floats: For the floating cages, flotation can be provided by waterproof foam rubber, Styrofoam, sealed PVC pipes, plastic bottles or barrels, sealed metallic barrels or any other suitable floating material. For small cages Styrofoam or foam rubber floats are commonly used and plastic or metal barrels are used for large cages.

Anchors: On the other hand, it should be anchored using stones or cement or metallic anchors. For fixed cages the cage should be fixed to the bottom using bamboo, PVC pipes or metallic pipes and nylon ropes to avoid drift. Materials used for cage construction should have following qualities:

- Be durable and strong, but lightweight
- Allow complete exchange of water volume every 30 to 60 seconds
- Allow free passage of fish wastes
- Not stress or injure fish
- Be resistant to fouling
- Be inexpensive and readily available

6.1.5 Wastewater management alternatives

The project is not expected to generate wastewater.

6.1.6 Cage culture site location

There is no water body in region with more suitable conditions for cage culture than Lake Victoria. Other sites along Lake Victoria exist, but do not have better water quality conditions than the zone selected for developing the fish farm. The site that proponent has earmarked is in most suitable location for cage culture and ponds in the area. Other zones are acceptable but with limitations on depth due to higher average turbidity. It is therefore recommended to develop the aquaculture farm by proponent in its current location

6.1.7 Cage Culture without Tilapia Species

Tilapia is the fish species of choice as it is the only proven fish species suitable for economical cage culture in Kenya. There is no alternative water body for culture of Tilapia in cages in the project area. Tilapia fish are widespread in the wild within the lake. Other fish species can also be reared in cages, but this alternative system has not been proven in the area and its economic viability is still questionable. Using an alternative species on Lake Victoria has no environmental benefit.

6.1.8 The Proposed Development Option

Under the Proposed Development Option, the developer of the proposed project would be issued with an EIA License. In issuing the license, NEMA would approve the proponent's proposed development of the project, provided all environmental measures are complied with during the construction period and operational phases. This alternative consists of the applicant's final proposal with the inclusion of the NEMA regulations and procedures as stipulated in the environmental impacts to the maximum extent practicable.

7 PROJECT POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

7.1 Introduction

This Chapter provides the potential ecological effects associated with cage fish farming in Lake Victoria Sindo, Nyagwethe, Homa Bay County. The potential impacts were based on existing commercially farmed Tilapia.

7.2 Positive Impacts

Table 9 Positive Impacts

Impact	Narrative
Employment, skills transfer and human resource capacity development	Implementation of this project will involve the use of both skilled, semi-skilled and unskilled labour. Different expertise will be required for the project. Provision of employment will contribute to raising the socioeconomic well-being of the people living and working around the project.
Impact on human nutrition on local and national level	The supply of fish will contribute to filling the country's need for proteins, a commodity which is not adequate now.
Diversifying community livelihoods	Beneficiary businessmen and middlemen will have an alternative livelihood thus offering cushion against shortcomings of the current agricultural activities in the area

7.3 Negative Impacts – Farm Design and Construction Phase

7.3.1 Disturbance of Benthic Habitat

Installation of the proposed development offshore cluster cages (quays) may result in some localized disturbance of the lakebed, including the movement and suspension of sediment and substrate materials within the water column. The destruction of habitats for the establishment of aquaculture farms will be negative if the habitat is considered ecologically or economically important. Such areas would include breeding, nesting, nursery and foraging areas for a range of species with emphasis on rare and endangered species and species of conservation importance. The establishment of cages will smother existing habitats.

Mitigation Measures

- Sensitive habitats such as bird nesting or fish breeding areas, must be identified prior to cage establishment and avoided,
- During the installation phase, due diligence should be observed including use of underwater cameras to avoid potentially sensitive benthic habitats and species, and
- The proponent will use floating surface cages in the project. The proponent will make use of modern HDPE cages that are plastic in nature and more durable. They will be 30m diameter and 10m depth given the lake bottom depth of over 30 m. Thus, the difference between cage bottom and lakebed is 20m, making oxygen circulation optimum for juvenile tilapia fingerlings

7.3.2 Deployment of Cage

During the process of cage deployment, the process could possibly impact on the benthic substrate as follows. Disturbance of fauna and flora (turbidity in the water column)

7.4 Negative Impacts – Farm Operation and Management Phase (Impacts)

7.4.1 Water Quality Deterioration

The concentration of fish in the cage's sites are likely to contribute to deteriorating physical parameters including turbidity, conductivity and pH. Effluent discharges are also likely to cause water pollution. At the cage localized high nutrient load is likely to take place due to un-utilized feed, fish excreta and build-up of organic material. The major pollutants are nitrates and phosphates whose quantities at certain thresholds become a threat to the water body as well as the fish.

Mitigation Measures

- Reducing any over-supply of nutrients in the diet.
- Improving the efficiency of feed utilization.
- Feed on response to avoid overfeeding.
- Increase feed use efficiency by using high-quality feed that contains desired nitrogen and phosphorus minerals and by assuring that fish consume most of the feed offered.
- Include periodic water quality assessments to ensure mitigation measures are effective.

7.4.2 Ecological Effects

Fish farming sometimes requires the addition of artificial diets in the form of fish feed pallets. Therefore, most ecological effects on the water column are related to the Tilapia farming waste products such as uneaten feed and excreted ammonia entering the Lake system and changing the concentrations of nutrients. Particulate wastes expelled into the water column are also expected to settle onto the seabed in proximity to the farm. The buildup of organic matter on the Lakebed primarily may cause physico-chemical and ecological impacts. The deposition of faeces and uneaten feed can lead to localized over-enrichment of the Lakebed below the cages due to its high organic content.

Mitigation Measures

- Ensure feeds selection are of high utilization rates to reduce the nutrient pollution from uneaten feed and excreta,
- Feed shall include balanced levels of amino-acids and other nutrients appropriate for age of the fish, high palatability to stimulate consumption and high stability to prevent rapid nutrient release,
- Medicated feeds shall be used only when necessary for the control of specific diseases,
- Feeding management shall be in conformity with carrying capacity, stocking density and size of the fish, and
- Good feeding practices shall be employed to ensure minimal feed wastage.

7.4.3 Habitat Modification or Exclusion

The presence of the proposed farm structures and their associated aquaculture activities can potentially exclude or modify how particular species of the Lake mammals use critical and sensitive habitats, including foraging or feeding areas, resting or nursery areas, and migration routes. Habitat modification may also lead to aggregations of scavenging or predatory organisms. These faunas tend to be displaced under highly enriched conditions and instead they often aggregate around the perimeter of the farm. However, the excess food and waste released from fish cages may be food for wild fish.

7.4.4 Fish Mortalities

Bacterial action and autolysis of dead fish results in the excretion of ammonia in lake waters. Live fish preying on dead fish could result in the spread of diseases if the dead body died of a disease. Mortality attracts fish predators e.g. birds at the cage. Another possible cause of diseases is the risk of people using water near the cage for domestic purposes and swimming.

Mitigation Measures

Conduct a daily routine of collecting mortalities and the cages will be placed away from water use points.

7.4.5 Attraction to Artificial Lighting

The use of submerged lighting to aid in caged fish maturation may attract marine mammals to the associated aggregations of wild fish.

7.4.6 Waste from fish feeds

The company has its own feeds factory. However, not all feeds will be consumed by the juvenile tilapia. Thus, some feeds may enrich the lake water by promoting algae bloom. The following practices shall be adopted to maintain water quality, improve efficiency of feeds and feed management and at the same time reduce the number of wastes discharged into the environment.

Mitigation

- Feeds shall be selected for their high utilization rates to reduce the nutrient pollution from uneaten feed and excreta.
- The proponent will employ a qualified expert to deal with issues of feed formulation that will ensure feed efficiency, low feed conversion ratios, maximum feed floatability
- Feed shall include balanced levels of amino-acids and other nutrients appropriate for age of the fish, high palatability to stimulate consumption and high stability to prevent rapid nutrient release.
- Feed shall be stored in cool and dry areas to prevent contamination.
- Feeding management shall be in conformity with carrying capacity, stocking density and size of the fish.
- Use species and system-specific feeds to maximize food conversion ratios (and minimize waste)
- Monitor fish feeding behavior and particulate matter deposition, adapt the feeding strategy to maximize feeding efficiency and minimize particulate matter fallout.
- Rotation of cages within a site (fallowing) to allow recovery of benthos.
- Undertake ongoing, detailed water quality and benthic monitoring, including baseline surveys at control and impact sites.

7.5 Impacts on Biodiversity

Most farmed species are genetically different from native species and there is always concern about genetic contamination from the release of farmed species into the wild. Domestic fish are bred for traits that may not be optimal for survival in the wild. If some escape into the wild, for example, if a storm or predator attack damages a cage, the viability of wild populations may be threatened by inter-breeding.

7.5.1 Impacts on Wild Fish

The impact of fish cage farming on wild fish populations can lead to an increase in biomass as a result of increased natural and waste feed. Wild fish may be attracted to the floating structures and escaped fish may impact wild fish biodiversity and result in the transmission of pathogens from farmed stocks to wild fish populations. Wild fish can become trapped inside the cage when small and grown with the cultured

fish. Framed fish may escape from cages which may also lead to interbreeding with potential impacts on wild fish genetics (especially from genetically selected strains of cultured fish).

Mitigation Measures

- To avoid escape of farmed fish into the wild, the cages swill has series of net meshes and/or grills and screens and barriers on inlets and outlets of culture facility,
- Cages will be double netted with strong and appropriate nets. The nets will be appropriately sized to retain the stocked fish.
- Maintain genetic compatibility (similar levels of variation) between wild and cultured stock and ensure adequate genetic monitoring,
- Proponent will use Oreochromis niloticus, which is a species already present in the lake
- Reduce the number of escapees by maintain cage integrity through regular maintenance and replacement and training of staff.
- Develop and implement recovery procedures should escapes occur.
- The proponent shall collaborate local research institutions to stay updated on emerging diseases and best practices.

7.5.2 Disease and parasites

Potential disease and parasite transmission to wild stocks could have negative impacts throughout the natural distributional range of the species, the magnitude of the potential impact will be high as it could alter wider natural (ecosystem impacts) and social functions (fisheries), and the impact will be ongoing.

Mitigation

- Maintain strict bio-security measures within hatchery, holding tanks and fish cages.
- Ensure all fry undergoes a health examination prior to stocking in fish cages.
- Regularly inspect stock for disease and/parasites as part of a formalized stock health monitoring programme and take necessary action to eliminate pathogens using therapeutic chemicals or improved farm management. This will require focused research effort into the identification, pathology and treatment of diseases and parasites infecting farmed species, both within culture and wild stocks.
- Maintain comprehensive records of all pathogens and parasites detected as well as logs detailing the efficacy of treatments applied. These records should be made publicly available to facilitate rapid responses by other operators to future outbreaks.
- Locate cages stocked with different cohorts of the same species as far apart as possible.
- Treat adjacent cages simultaneously even if infections have not yet been detected.

7.5.3 Entanglement of other lake species

Physical interactions between Tilapia farms and Lake mammals can lead to an increased risk of entanglement in structures, nets, or non-biological wastes from farm production. The risk of entanglement also increases as some Lake mammals tend to be attracted to the farmed fish themselves or the associated aggregations of wild fish.

Mitigation

- Ensure all lines and nets are highly visible (use thick lines).
- Keep all lines and nets tight through regular inspections and maintenance.
- Ensure that mesh size nets do not exceed 16 cm stretched mesh, use square mesh.

- Establish a rapid response unit to deal with other species entanglements.

7.6 Social Risks

7.6.1 User Conflict

The main social issues relating to aquaculture and the intensification thereof are due to the conflicts over use of land, water and other natural resources (Boyd et al., 2008). Land rights and land ownership vary within Counties and communities, and within the case of Western Kenya many people are dependent on Lake Victoria for their livelihoods. Any intensification that takes place without formal permission (land ownership) or blocked the pathway to popular fishing sites would likely cause tension within the communities.

Farmers involved in the intensification must comply with regulated environmental standards and implement the recommended monitoring and management measures to ensure that their practices do not negatively impact on their neighbours' resources, and ultimately livelihoods. For example, the discharge of water and/or contamination of the domestic water supply would prove an issue to all users reliant on the resource especially if the quality of drinking water deteriorated. It is important that Victory Farm Limited (Proponent) establishes a communication channel for complaints (a grievance mechanism), so that should a member of the public, fishermen, have a concern are promptly addressed.

Mitigation

- Install navigational markers and lights.
- Include position of fish cages on navigational charts.
- Ongoing consultation with user groups, especially fishermen in Roo beach to keep them informed of the cage developments.
- The proponent shall hold regular stakeholder engagement sessions to proactively address concerns.

7.6.2 Occupational Health and Safety

As a general approach, health and safety management planning should include the adoption of a systematic and structured approach for prevention and control of physical, chemical, biological, and radiological health and safety hazards. Occupational health and safety hazards related to the daily operations of the aquaculture sector are physical hazards like drowning, effects from use of chemicals.

Mitigation

- Provide lifejackets and harnesses with safety clips that lock on to lines or fixed points;
- Ensure that workers/personnel are experienced swimmers;
- Train personnel in safety at the cages, including procedures for supervision of personnel;
- Always require that personnel wear lifejackets on exposed sites.
- Appropriate signage and warnings in potential risk areas shall be provided;
- Appropriate Personnel Protective Equipment (PPE) shall be provided to the workers where applicable;
- The Proponent shall develop and implement detailed and site-specific emergency response plans; and
- The Proponent shall endeavor to create health and safety awareness among residents.

7.6.3 Air Emissions

It is difficult to predict air emission impacts at this stage of the Victory farm planning stage. Fish feed mills are, however, known to generate dust. Auxiliary equipment such as diesel generators or boilers

would also require investigation. A detailed Baseline Air Quality Measurement was conducted in the preliminary stages of the EIA phase of the programme. The objective was to assess and document the existing levels of key air pollutants in the area surrounding the proposed fish farm expansion.

The results of the baseline air quality assessment conducted for Victoria Farm Kenya's proposed expansion of fish farming operations in Lake Victoria indicate that all monitored pollutants are within the permissible limits set by the Environmental Management and Co-ordination (Air Quality) Regulations, 2014 (EMCA, 2014) as outlined in the table below. The fact that these pollutants are within regulated thresholds suggests that the current air quality poses no significant risk to the environment or public health in the vicinity of the proposed expansion site.

Table 10 Air quality test results

VICTORIA FARMS

	Average Pollutant	Average in Standard units	TWA OEL -RL	Remarks
Carbon Monoxide (CO)	0.16 ppm	0.181 mg/m^3	4 mg/m^{3**}	Within Limit
Carbon Dioxide (CO_2)	288.69 ppm	288.694 ppm	9000 ppm**	Within Limit
Hydrocarbons (C_xH_y)	0.00 ppm	0.000 ppb	700 ppb****	Within Limit
Nitrogen Monoxide (NO)	11.28 ppb	11.285 ppm	NP	Not Provided
Nitrogen Oxides (NO_2)	15.04 ppb	0.015 ppm	0.1 ppm*	Within Limit
Nitrogen Oxides (NO_x)	26.32 ppb	49.178 $\mu g/m^3$	80 $\mu g/m^3$	Within Limit
Oxygen (O_2)	20.85 %	20.846 %	NP	Not Provided
Ozone (O_3)	0.84 ppb	0.001 ppm	0.12 ppm	Within Limit
Particulate Matter (PM_{10})	1.97 $\mu g/m^3$	1.975 $\mu g/m^3$	100 $\mu g/m^3$	Within Limit
Particulate Matter ($PM_{2.5}$)	1.14 $\mu g/m^3$	1.144 $\mu g/m^3$	75 $\mu g/m^{3****}$	Within Limit
Sulphur Dioxide (SO_2)	0.59 ppb	1.539 $\mu g/m^3$	80 $\mu g/m^3$	Within Limit
Relative humidity (RH)	85.46 %			
Temperature	27.05 °C			
Wind direction	85.55 °			
Wind speed	7.31 kph			

KEY: $\mu g/m^3$ - microgram per cubic metre, mg/m^3 - milligram per cubic metre, ppm - parts per million, ppb - parts per billion. Values at Standard Temperature and Pressure (STP). * the 24-hour limit may not be exceeded more than three times in one year; ** 24-hour limit may not be exceeded Emission limits are as stipulated under EMCA 2014; CO_2 limits are obtained from Occupational Safety and Health Act, of 2007

Mitigation Measures

- The proponent is advised to stick to the provisions of EMCA (Air Quality) 2014 by conducting annual air quality assessment and filing the same with NEMA as part of the annual Environmental Audit.
- Monitor dust levels while conducting land based aquaculture activities.
- If operating feed mill, ensure all emission controls are in place and maintained (dust collectors, exhaust fans, scrubbers etc.

8 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

8.1 Significance of an EMP

An Environmental Management and Monitoring Plan (EMP) provides a mechanism to address any negative environmental impacts of a proposed project and aims to promote benefits. The EMP provides a document that assists in detecting the development of any negative environmental issues through the monitoring of environmental parameters. The document defines the responsibilities and evaluates performance. As with the Victory farm, an EMP document needs to be designed for a specific project (in this case farm), as the monitoring requirements need to be tailored to the activities, the size of the farm and the location. All of these will in turn determine the frequency of sampling, methods and the details thereof (parameters and positions).

8.2 The objectives of the EMP:

- To militate against the possible degradation of the Lake Victoria ecosystem during the operation of the proposed cage aquaculture project by reducing negative impacts and enhancing positive effects.
- To ensure that the proposed project does not result in excessive enrichment of Lake Victoria thereby modifying the ecosystem integrity
- To outline mitigation measures, to manage environmental impacts associated with the project
- To ensure that the aquaculture project will comply with relevant environmental legislation of the country and other requirements throughout its operational phase
- To identify roles and responsibilities and the cost involved and
- To propose mechanisms for monitoring compliance

8.3 Water Quality Monitoring and Management

Best practice guidelines must be used for monitoring water bodies potentially impacted by the proposed cage farming. It is especially important to take samples of the fish farm sites to ensure that any impacts relating to feed and return effluents are identified. The water quality variables of concern (to be monitored) are as follows.

Table 11 Water quality variables to be monitored

Variables	**Methods**
Temperature (°C)	In situ using a temperature meter
Dissolved oxygen (mg/ℓ)	In situ using a dissolved oxygen meter
pH	In situ PH using a water pH tester
Turbidity (NTU)	Standard Methods in laboratory
Secchi (m) – Visibility	In situ using Secchi Disk
Nutrients (mg/ℓ, ortho-phosphates, total phosphates, nitrate, nitrite, ammonia)	Standard Methods in laboratory
Algal identification	Standard Methods in laboratory

Table 12: EMP for Construction Phase and operation of the proposed cage culture

Component/Activity	Component/Activity	Mitigation/Management	Responsibility	Monitoring Mechanism	Indicator/ Performance Criteria
Fish feeding	Water quality impacts because of feed wastage.	• Only high-quality aquaculture feeds must be purchased from recognized feed producers; Information on the nutrient makeup, primary ingredients and production techniques, e.g. extrusion, should be available, • Feeding rates must be correlated to water quality sampling to allow detection and alteration of over-feeding. This will be done by the water quality monitoring programme to be implemented; • Correct feed pellet size must be used to ensure low levels of feed wastage.		Water quality monitoring programme.	Water quality results which fall within the predetermined parameters
Chemical and Drug treatments	Chemical spills and incorrect application of chemicals	• The handler must wear appropriate Personal Protective Equipment (PPE); • Dosages, application methods and resultant outcome must be known and recorded in a treatment register;	Proponent/Accredited aquaculture pathologist	Specific inspection of the suitability of chemical stores (expiry dates, etc.) must be done once in three months and according to the relevant MSDSs	Chemical spills

Component/Activity	Component/Activity	Mitigation/Management	Responsibility	Monitoring Mechanism	Indicator/ Performance Criteria
		• Expired chemicals must be disposed of at a suitable hazardous waste disposal site; • The advice of a recognised fish pathologists or aquaculturists must be sought where the application of chemicals is uncertain;			
	Fish mortalities	• All mortalities must be recorded and the associated behavior of the remainder of the organisms monitored, e.g. loss of appetite; • A database must be kept of the numbers of dead organisms and the behavioral patterns of the population.	Proponent	• Conduct a daily routine of collecting mortalities on the farm. • All mortalities be transported to the the company's licensed organic waste site for composting. • Establish a Black Soldier Fly (BSF) Breeding facility at the waste licensed site to produce animal	Outbreak of disease Accumulation of predators

Component/Activity	Component/Activity	Mitigation/Management	Responsibility	Monitoring Mechanism	Indicator/ Performance Criteria
				feeds.	
	Endangering predators	• No traps may be used to injure any predators of aquaculture organisms. Traps may only be set if these predators can be caught live (without injury) for translocation to alternative areas. This may only be done under the supervision of recognized organizations or authorities i.e. KWS; • Ensure no poisons is left out for aquaculture predators; • Ensure no animals that prey on the aquaculture species is shot • The main aquaculture predators and their control methods include cover netting for birds (Kingfishers, Fish Eagles, Herons, Storks and others) and fencing	Proponent	Specific consideration and inspection of all fences, predator netting	Predator injury or death
	Health and safety compliance at the cage site	• All involved personnel need to have adequate floatation safety gear and need to be fully trained in health and	Proponent		Health and safety incidents

Component/Activity	Component/Activity	Mitigation/Management	Responsibility	Monitoring Mechanism	Indicator/ Performance Criteria
		safety codes related to water borne activities; and • Skippers need to be licensed			
	Disease from processed fish waste	• The waste generated in the primary processing of the harvested fish (heads, gills and intestines) and the mortalities experienced from production must be ensiled to produce a stable and odour free high protein supplement for animal feeds through breeding of Black Soldier Flies. • Excess waste should also be composted at the Company's licensed organic waste facility located at Kinyasaga.	Proponent	Audit	Disease free processing facilities which have been audited.

Table 13 Environmental Management Plan for Decommissioning

Expected Negative Impacts	**Mitigation Measures**	**Responsible**	**Cost**
Scrap materials	Waste generated will be characterized in compliance with standard waste management procedures Disposal locations will be selected by the licensed contractor	Site supervisor and Licensed Waste Disposal Contractor	100,000
Scrap materials and other debris	Equipment and structures that will not be used for other purposes should be removed and reused or sold to scrap material dealers	Project Manager and site supervisor	
Rehabilitation of Project Site			
Site water quality disturbed	Remove project materials and debris from the lake to restore the site to its original condition	Project Manager and site supervisor	400,000

9 CLIMATE RISK VULNERABILITY ASSESSMENT

This chapter details the climate profile of the Project area. Specifically, it looks at the impact of climate stressors on the Project and beyond. A climate stressor is a climate factor that can affect the functioning of a system. For example, rising temperatures and greater rainfall variability may affect agricultural productivity, with implications for food security. Climate stressors can also limit the potential success of development interventions.

9.1 Climate Change

Climate change has resulted in alterations in temperature and rainfall patterns worldwide. Although it is still very difficult to assess the consequences of these changes at a local level, it is evident that whatever the magnitude of the phenomenon, aquatic fauna will be affected.

9.2 Key Climate Policies

- Constitution of Kenya (2010)
- National Climate Change Response Strategy, NCCRS (2010)
- 2nd National Communication to the UNFCCC (2015)
- National Adaptation Plan, NAP (2015- 2030)
- Nationally Determined Contributions, NDC (2016)
- Green Economy Strategy and Implementation Plan, GESIP (2016-2030)
- National Climate Change Framework Policy (2016)
- Climate Change Act (2019)
- Homa Bay County Climate Change Policy 2021
- Homa Bay County Climate Change Action Plan (CCCAP) 2021-2026
- National Policy on Climate Finance (2016)
- Low Carbon Development Strategy espoused in Kenya's Second National Communication (2015).

9.2.1 General Circulation Model Projections for Kenya

According to a climate change study conducted for the United Nations Development Programme (UNDP) in 2010, an increase in mean annual temperature and an increase in annual rainfall is projected for Kenya as outlined in the sub sections below:

a) Temperature

The mean annual temperature is predicted to increase by 1.0 to 2.8°C by the end of 2060s, and by 1.3 to 4.5°C by the 2090s; All projections indicate increases in the frequency of days and nights that are considered 'hot' in current climate; and All projections indicate decreases in the frequency of days and nights that are considered 'cold' in current climate (McSweeney *et al.*, 2010).

b) Precipitation

The projections indicate an increase in annual rainfall in Kenya. The range spans changes of -1 to +48% by the 2090s; Projected increases in total rainfall are largest in the short rainfall season (-3 to +49 mm per month), but the proportional changes are largest in January-February (-7 to +89%); The models consistently project increases in the proportion of annual rainfall that falls in heavy events. The increases range from 1 to 13% in annual rainfall by the 2090s; and the models consistently project increases in 1- and 5-day rainfall annual maxima by the 2090s of up to 25 mm in 1-day events, and 3 to 32 mm in 5-day events.

9.3 Homa Bay County Climate Change Profile

9.3.1 Climate change and variability: historic and future trends

There is some variation in precipitation throughout Homa Bay County, with the southern areas further from Lake Victoria receiving the most precipitation around 1750 mm, and the northern areas closer to Lake Victoria receiving 1000-1250 mm of precipitation per year. The temperature is consistently warm throughout the year. Precipitation also consistent throughout the year, although the first wet season (January-June) receives a slightly greater amount. Intense precipitation and heat stress are both hazards that contribute to agricultural risk in the County throughout the year, whereas dry spells are more an issue in the second wet season.

Historic analysis of weather in Homa Bay County shows that both dry spells and extreme precipitation are hazards in the County. Dry spells are on average longer during the second wet season and consistently close to 60 consecutive days of moisture stress, whereas moisture stress is consistently less than 30 days during the first wet season. Extreme precipitation and flood risks10 are moderate to low in both seasons, with most years receiving between 10 and 25 mm of precipitation on the wettest day.

Climate has already been observed to change slightly in the County. Since 1981, the first wet season—the predominant rains of the year—have experienced a moderate (1ºC) increase in mean temperature and associated reduction in crop cycle, and a small (~10%) decrease in precipitation on average. The combination of increased temperatures and decreased precipitation make for an increase in drought risk. The second wet season experienced a mild (~0.5ºC) increase in temperature, and a significant (20–30%) increase in precipitation. This has resulted in increased risk of flooding.

Looking to the future in the years of 2021-2065 (by the early 2040's), temperature is projected to increase by 0.4ºC, with the first wet season projected to experience even greater changes. And by this time, precipitation is projected to increase by 0.7% in the first wet season, and 3% in the second wet season[12].

Prolonged moisture stress is projected to occur in the first season of the year, whereas intense precipitation looks to change little in either season. Consecutive days of moisture stress is projected to almost double in the first wet season from approximately 25 days to around 45-50. In contrast, moisture stress in the second wet season is projected to decrease from 60 consecutive days of moisture stress to approximately 50 days. These projections of future climate change under the two climate scenarios—RCP 2.6 and RCP 8.512—show some small differences, but generally show the same future projections, suggesting climate change impacts will be similar during this time frame irrespective of greenhouse gas emissions.

9.3.2 Climate and Environmental Risks of Homa Bay County

The County's strategic plan identifies population dynamics, environmental degradation, and climate change (amongst others) as key development challenges. Like all the communities around the Lake Victoria Basin (LVB), a large proportion of the County's residents depend on the Lake to support agriculture, fisheries, livestock and other livelihoods. The adverse effects of climate change disproportionately affect marginalized and rural communities, especially women and youth, by reducing

[12] 1 Note that this is 20 mm on average over the entire County, so specific parts of the County will have experienced greater than this (possibly much greater), whereas other parts will have experienced less.
12 The two RCPs, RCP2.6 and RCP8.5, are named after a possible range of radiative forcing values in the year 2100 relative to pre-industrial values (+2.6 and +8.5 W/m2, respectively). The pathways are used for climate modelling and research. They describe two possible climate futures, considered possible depending on how much greenhouse gases are emitted in the years to come. RCP 2.6 assumes that global annual GHG emissions (measured in CO2-equivalents) peak between 2010 and 2020, with emissions declining substantially thereafter. In RCP 8.5, emissions continue to rise throughout the 21st century

the productivity of agriculture and wetlands, the abundance of fish in Lake Victoria and its tributaries, and loss of other ecosystem functions.

Effects of climate change includes;

- Threat to freshwater ecosystems, due to pollution and proliferation of invasive species
- Deteriorating water quality and quantity, declining fish stocks and loss of biodiversity, and
- Increased climate change-induced migration

9.3.3 Effect of Climate Change on Aquaculture

Most fish are poikilothermic, meaning that their body temperatures vary with the ambient temperature. Any changes in habitat temperatures will therefore significantly affect their metabolism and, consequently, growth rate, total production, reproduction seasonality and possibly reproductive efficacy, and susceptibility to diseases and toxins (FAO, 2008).

Impacts on aquaculture could be positive or negative, arising from direct and indirect impacts on the natural resource's aquaculture requires, namely water, land, seed, feed and energy. As fisheries provide significant feed and fingerling inputs, the impacts of climate change on them will also, in turn, affect the productivity and profitability of aquaculture systems (FAO, 2008). Vulnerability of aquaculture-based communities will stem from their resource dependency and exposure to extreme weather events.

The predicted increase in heavy rainfall events may result in flooding which can cause physical damage to farm structures, and consequential loss of fish. In addition, floods can cause great changes to water quality such as siltation or the transportation of pesticide residues from nearby agricultural practices. Flood waters may introduce predators into a farm, or new pathogens, and may also provide an opportunity for fish to escape confinement. Severe storms over Lake Victoria could damage cages resulting in the release of fish stock into the natural environment. Depending on the species and genetics of the fish farmed, this could have negative impacts on the wild fish stock.

Inland aquatic environments are critically dependent upon rainfall. Thus, any change in climate will have major consequences for the water balance that can cause an increase or reduction in aquatic habitats. In the case of drought, a decline in water resources will limit the carrying capacity of the ponds. Cages located in shallow waters could also be at risk. This could possibly drop the functioning of fish farm operations below profitable levels. The extraction of water for aquaculture during drought will exacerbate water shortages and could result in user conflict. Changes in temperature can also have significant impacts on the reproductive cycles of fish, including the speed at which they reach sexual maturity, the timing of spawning and the size of the eggs they lay. Ultimately, the success of a fish farm operation is highly dependent on temperature, water quality and quantity. It is therefore imperative that the fish farmers are well informed of the climate characteristics specific to their regions and associated risks, such as 100-year flood levels and drought (FAO, 1989).

9.3.4 Climate Change Management Measures

For most climate change-related impacts, improved management and better aquaculture practices would be the best and most immediate form of adaptation, such as the ecosystem approach to aquaculture (EAA) management (FAO, 2008). Genetic knowledge and management in aquaculture are not as developed as in other husbandries and provide both a major challenge and an opportunity. Genetics can be improved resulting in more efficient feeding and diet specificity, and for increasing species resistance to higher temperature, lower oxygen and pathogens. Climate change may increase pathogen risks and so biosecurity and prevention measures need to change accordingly. Early identification and detection mechanisms may need to be improved, and suitable treatment strategies and products developed (FAO, 2008).

Table 14 Climate change-related impacts and potential adaptation measures in aquaculture

Climatic change element	Impacts on aquaculture or related function	Adaptive measures
Warming	Raise temperature above optimal tolerance range of farmed species	• Selective breeding and genetic improvements for higher temperature tolerance.
	Increase in eutrophication- mortality of farmed stock	• Improve planning and siting to conform to climate change predictions; and • Establish regular monitoring and emergency procedures
	Increased virulence of dormant pathogens and expansion of new diseases	• Set up biosecurity measures; • Monitor to reduce health risks; • Improve treatments and management strategies; and • Make genetic improvements for higher resistance
Extreme weather events	Destruction of facilities; loss of stock; loss of business; mass scale escape with the potential to impact on biodiversity	• Improve siting and design to minimize damage, loss and mass escapes; • Encourage use of indigenous species to minimize impacts on biodiversity; and • Use non-reproducing stock in farming systems

10 LIMNOLOGY, LAKE SEDIMENT ANALYSIS AND BIOSECURITY/BIOSAFETY PLAN

This chapter details the limnology of the Project area, analysis of the laboratory analysis of the sampled lake sediment and biosafety/biosecurity plan of the proponent. The term Limnology is derived from Greek word; Limne means lake and logos means knowledge. Limnology is often regarded as a division of ecology or environmental science. It is however, defined as "the study of inland waters" (running and standing waters fresh and some times saline; natural or man made). This includes the study of lakes, ponds, rivers, reservoirs, swamps, streams, wet lands, bogs, marshes etc. Hence, it is commonly defined as that branch of science which deals with biological productivity of inland waters and with all the causal influences which determine it (Welch, 1963). Biological productivity, as used in this definition, includes its qualitative and quantitative features and its actual and potential aspects.

10.1 Baseline Parameters of the project area

The proponent's sustainable and socially responsible expansion project is to be located in the waters of Lake Victoria in off shore concessions in Suba South Subcounty, Homabay County. Lake Victoria is the largest lake in Africa (68,000 KM^2) with an average depth of 40M (130 Ft). The lake's shoreline is long (about 3,500 km) and convoluted, enclosing innumerable small, shallow bays and inlets, many of which include swamps and wetlands, which differ a great deal from each other and from the lake itself. The lake has a wide land catchment area, which is almost three times the size of the lake, and extends over the three East African countries together with Rwanda and Burundi. This is the area from which rivers carry water, nutrients, sediments and pollutants into the lake and is about 193000 km2 ; of which the catchment area in Kenya covers 42460 km2.

Lake Victoria has numerous wetlands on the edges of its shore as well as open beaches and islands. The coastline ranges from papyrus swamps to rocky and sandy beaches. The wetlands are important for fish breeding and growth; for filtering river waters; the wetlands plants are harvested for building materials by the riparian communities and are food for wildlife. The lake serves as an important reservoir for the region and for the larger Nile Basin. Because the lake is shallow (Fig. 2), its volume is substantially less than that ofother African Great Lakes, which have much smaller surface areas. Its total volume is about 2,760 km3 , only 15% of the volume of Lake Tanganyika, even though the latter has less than half its surface area. In the Winam Gulf of Lake Victoria, 8.1 billion m3 of water comes from rainfall over its surface and in-flowing rivers contribute 9.2 billion m3 . The rivers, which originate from and enter the Lake in the Kenyan catchment contribute 38% of the total river discharge entering Lake Victoria from land catchment, however River Mara, which enters the lake in Tanzania and contributes about 5% is mainly from the Kenyan catchment, therefore total contriution of Kenyan catchment is estimated at about 42% of land catchment input. Consequently activities in Kenya catchments potentially affect a substantial portion of the river discharge to the lake and especially in Winam Gulf. The table below indicates the discharges of several rivers that feed into Lake Victoria.

River discharges and their % contribution to Lake Victoria land catchment input.

River	Discharge, m^3s^{-1}	% Kenya basin	% Whole basin
Sio	11.4	3.5	1.5
Nzoia	115.3	35.0	14.8
Yala	37.6	11.4	4.8
Nyando	18.0	5.5	2.3
North Awach	3.7	1.1	0.5
Sondu-Miriu	5.9	1.8	0.8
South Awach	42.2	12.8	5.4
Kuja-Migori	58.0	17.6	7.5
Mara	37.5	11.4	4.8
Total, whole basin	778.3	100	42.4

Source: J .O. Okungu, et al

Studies on the water exchange between the Winam Gulf and the open lake have been undertaken under the water quality component. Measurements and modelling of the hydraulic conditions at the Rusinga channel has been a major objective to understand water fluxes and movements of water borned materials between the littoral and pelagic areas of the lake. The largest loss of Lake Victoria water (76%) is through evaporation from the lake surface the rest leaves the lake through the outflow into Victoria Nile at Jinja. The greatest input of water into the lake is from direct rainfall onto the lake surface (82%). Therefore only about 18% of combined rainfall and river inflow water exits the lake at the Nile. The Nile provides critical water supplies for nations beyond the basin and so there is continuous interest internationally, as well as in the basin, in the quantity and quality of water leaving Lake Victoria (***Khisa, et al.,***)

The literature on limnology of the Kenyan waters of Lake Victoria is rather scanty. However, xtensive measurements of water currents, temperature dissolved oxygen and winds on the Kenyan waters of the lake were done by Ochumba (1996). Hypolimnion temperatures as low as 23.5ºC observed in 1928 by Worthington (1930) in the 1950s (Fish 1957) and in 1960-61 (Talling, 1966) were not seen, suggesting a response of Lake Victoria to a possible warning trend in the climate of East Africa. Ochumba (1996) also reported that oxygen conditions have deteriorated since 1950. Hecky et al. (1994) concluded that low oxygen conditions are now more extensive and persistent than previous investigators had found. Aware of these immense benefits of lake Victoria, the proponent has taken every measure to conduct baseline studies to determine physio-chemical conditions of the project site before implementing the project. Regular water quality assessment have been carried out. Zooplankton dynamics in Lake Victoria was outline by Bransrator et al (1996), who suggested that the composition of cladocerans, calanoid copepods and cyclopoid capepods in the modern community were largely unchanged from historical conditions although the proportions may have changed

The project site is located in the off shore areas of seven beaches (earlier mentioned) in Suba South, Homabay County. The shoreline is hilly, with rocky bays and well curved coast line. The water depth at the project site is approximately 30m.

10.2 Fisheries Resources in the project area

Since the 1970s total fish catches have increased by between four and five times after the introduction of exotic species such as the Nile Perch (Mbuta). However, catch per fishing effort has been dropping while effort has continued increasing, indicating that the maximum sustainable yield is below the present level of exploitation. Furthermore, introduction of exotic species of fish has altered the food web structure of

Lake Victoria, which has led to a dramatic decline in diversity of indigenous fish species. A number of original 300 species of fish are now extinct or facing depletion. Other factors which have affected the status of lake and riverine fisheries in the project area are: overfishing by use of small mesh nets and harvesting of brood stocks; destruction of fish habitats through river engineering; siltation due to deforestation, algal blooms due to nutrient enrichment, pollution, wetland conversion and development, fish pathogens and water hyacinth infestation. It is important to note that the project area is over 30 meters deep, thus the main fish species that can be found in the area is Nile perch. However, the proponent will culture Tilapia species within the HDPE cages while taking deliberate actions to avoid any escape of fingerlings to the lake.

10.3 Project Site Sediment Analysis

As mentioned previously, Lake Victoria receives waters of varying quality from several rivers, precipitation, recharge from groundwater; industrial and domestic waste treatment and disposal systems, urban and agricultural run-offs. These waters, rich in nutrients encourage biological activities within the lake that are a source of biogenic sediments. To a small extent, shoreline erosion is also responsible for the sediments found in the lake. The need to carry out sedimentation and sediment characteristics at the project site was to generate baseline information on bio-physical parameters of the project area sediments. This was important because of future monitoring of project/s impact on the lake sediment. The table below shows the results analysis of the sampled sediment in the project area:

Sediment Analysis Results

Date Received: 02/08/2024 **Date Analysis Started:** 05/08/2024 **Date Completed:** 12/08/2024

Date of Release: 12/08/2024

PARAMETER	Method	Results	[1]Standard (Max Limits)
Chemical			
pH	CSITP 002	7.53	np
Electrical Conductivity, µS/cm	CSITP 004	1260	np
Total Dissolved Solids (TDS), mg/Kg	CSITP 012	819	np
Sodium as Na^{+}, mg/Kg	CSITP 003	24.20	np
Potassium as K^{+}, mg/Kg	CSITP 003	2.98	np
Iron as Fe^{2+}, mg/Kg	CSITP 003	0.98	np
Zinc as Zn^{2+}, mg/Kg	CSITP 003	0.08	np
Calcium as Ca^{2+}, mg/Kg	CSITP 003	2.35	np
Magnesium as Mg^{2+}, mg/Kg	CSITP 003	1.65	np
Lead as Pb^{2+}, mg/Kg	CSITP 003	<0.01	np
Copper as Cu^{2+}, mg/Kg	CSITP 003	<0.01	np
Manganese as Mn^{2+}, mg/Kg	CSITP 003	<0.01	np
Sulphates as SO_4^{2-}, mg/Kg	CSITP 014	16.00	np
Nitrate as NO_3^{-}, mg/Kg	CSITP 011	5.70	np
Phosphates as PO_4^{3-}, mg/Kg	CSITP 018	3.28	np

<0.01- Below Detection Level (<0.001).
Sampling Method: CSISP 44 - Test Item Receipt, Sampling, and Handling Procedure
To maintain the correct history ensure that the next sample sent from this Water Source is labelled: Soil

10.1 Biosafety/Biosecurity Plan

The proponent's biosecurity plan aims to prevent disease, improve fish welfare, and increase productivity and profitability. The biosecurity measures are designed to improving fish welfare and productivity to increase the efficiency of inputs and the sustainability of the system.

The objectives of the plan are to:

- better fish health and improved performance;
- mitigate the transmission and amplification of diseases between cages and concessions;
- allow for early disease detection so that impacts can be reduced;
- support claims of freedom from diseases that impact marketability and market access;

- facilitate translocation within and between production sites;
- reduce the risk of diseases from being introduced to the farm, spreading within the farm, or escaping from the farm;
- have emergency response protocols in place for serious disease outbreaks.

The biosecurity plan fulfills the legal requirement mandated by the Kenya Fisheries Service (KFS) and ensures that during project implementation, off-shore concessions are chosen and designed in line with the surrounding topography, assuring optimum water quality conditions for animal welfare. Cages are spaced in order to assure water quality within each cage, reduce the risk of disease transmission, and minimize environmental impacts. Biosecurity and Biosafety plan covers both lake based and land based aquaculture of the proponent. All broodstock shall be produced on the farm and maintained off-shore in cages. Upon maturation, broodstock will be moved to breeding ponds, allowing the tilapia to practice their natural breeding behaviours, including burrowing and mouth-breeding. Eggs shall be collected from the females' mouths and incubated in a hatchery building, where optimum water quality shall be assured through a recirculating aquaculture system (RAS).

10.1.1 Traceability

The proponent shall record for traceability at the cage level, such that each cage can be traced back to the broodstock group that produced those eggs. Groups of broodstock shall be kept kept separately in ponds, and eggs from that pond will be labelled and identified by the pond of origin and date of collection. This identifying information shall be retained with the fry and fingerlings upon transfer to the pond nursery, the cage nursery, and eventually the grow-out cage. Fish shall be delivered to each retail outlet and should be traced back to the cage using the harvest date and the cage number recorded in during processing. These records shall be retained for at least 10 years.

10.1.2 Disease checkpoints

Staff shall record observations for indications of disease at all lifecycle stages. Broodstock and fish at nursery and grow-out stages shall be observed for lesions, physical abnormalities, and irregular swimming and eating behaviours. Eggs and fry shall be observed for physical or other developmental abnormalities. Observations shall be reported to management and recorded. At all stages, mortalities shall be promptly removed from the environment and disposed of using biosecure disposal protocols. The daily number of mortalities shall be recorded for each cage and pond.

10.1.3 Annual Biosecurity Risk Assessment

The proponent shall conducts an annual biosecurity risk assessment. The resulting report shall be stored in the main office and is used to inform annual revisions to the biosecurity plan. Audit reports shall also be stored in the main office.

10.1.4 Location of Cage Farms

This cage farm proposes to exceed Kenya Fisheries Guidelines of 500 meters between cage farms to 5 Kilometers between cage farms to enhance biosecurity of its operation.

11 CONCLUSION AND RECOMMENDATIONS

11.1 Recommendations

From this EIA process, cage fish culture in Lake Victoria basin has the potential to be beneficial and has attracted the attention of fishers and other members of the community. The proposed fish cage culture project will provide employment and additional income to local fishers and increase the supply of fish protein. Its main effect will be to reduce pressure on native fish by diverting fishers from fishing of wild stocks to aquaculture and thus provide alternative livelihoods. However, like in other culture systems, there are several constraints which limit the practice of cage culture system. Lack of inexpensive and suitable fish feeds is a problem in cage culture especially because special diets that do not pollute the environment are necessary. Several measures are needed to expand and intensify cage culture in the Lake Victoria basin. Fish hatcheries should be established in or near the Lake Victoria basin to meet the increased demand for fingerlings from cage farms.

Although caged fish can grow to larger sizes than pond raised fish, they are likely to face stiffer competition from capture fisheries at the local market because they are still far smaller than many of the wild caught stocks. Therefore, it is necessary that market

strategies for caged fish are put in place, which include marketing caged fish distances away from the lake and value addition and processing leading to larger profits, covering all the fixed and variable costs, thus making cage culture a sustainable venture. As more fishers turn into farmers, it will be necessary for provision of more cage material, construction of cages and fish feed production. These could be motivating factors for industries to form to provide these services. Because fish feeds are still unavailable in most Kenyan markets, farmers could start production of their own feeds. The results of lake-based cage culture trials indicate a relatively high growth of fish on natural lake productivity. Thus, cage culture as is practiced in Kenya can be economically and environmentally sustainable with proper cage culture production and marketing

11.1.1 Specific Recommendations

From the detailed environmental and socio-economic analysis of this project, the experts are of the opinion that this is a viable project, hence we recommend that NEMA approves it and issues an EIA license; since the EIA process reveals that this project does not have serious negative environmental impacts, and for the impacts identified, adequate mitigation measures have been spelt out in the EMP.

We further recommend that the proponent and contractors implement the recommendations in the environmental management plan and those in the health, safety and accident prevention action plan. This is to ensure that the potentially affected environment is well managed and that accidents are prevented during project implementation.

The proponent needs to continue complying with the relevant legal and policy requirements about project implementation. NEMA and other relevant authorities need to continue raising public awareness of EIA requirements.

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    b) The Environmental (Impact Assessment and Audits) Regulations, 2003 – Legislative Supplement No. 31 of 13th June 2003
    c) Legal Notice No. 120, Water Quality Regulations, 2006
    d) Legal Notice No. 121, Waste Management Regulations, 2006
    e) The Water Act (Cap. 372)
    f) The Water Act 2002
    g) The Public Health Act (Cap. 242)
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18. Material data sheets, information, facility details and licenses provided by the Emrald Beach Resort & SPA Limited management.

APPENDICES

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY

Mobile Lines: 0724-253 398, 0723-363 010, 0735-013 046
Telkom Wireless: 020-2101370, 020-2183718
Incident Lines: 0786-101100, 0741-101100

P.O. Box 67839, 00200
Popo Road, Nairobi, Kenya
E-mail: dgnema@nema.go.ke
Website: www.nema.go.ke

REF: NEMA/TOR/5/2/735 **DATE: 6th June, 2024**

The Director
Victory Farms Limited
P.O Box. 14730-00800
NAIROBI

RE: TERMS OF REFERENCE (TOR) FOR ENVIROMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED EXPANSION OF VICTORY FARMS CAGE SYSTEM WITH ESTIMATED PRODUCTION CAPACITY OF 30 METRIC TONNES PER ANNUM IN NEW CONCESSION BLOCKS ON L.R. NO. SUBA/KAKSINGIRI/WEST A WITHIN LAKE VICTORIA, HOMA BAY COUNTY.

We acknowledge the receipt of TOR for the above subject.

Pursuant to the Environmental Management and Coordination Act, 1999 the second schedule and the Environmental (Impact Assessment and Audit) Regulations 2003 and Legal notice 31 & 32 of 2019, your terms of reference for the Environmental Impact Assessment (EIA) for the **PROPOSED EXPANSION OF VICTORY FARMS CAGE SYSTEM WITH ESTIMATED PRODUCTION CAPACITY OF 30 METRIC TONNES PER ANNUM IN NEW CONCESSION BLOCKS ON PLOT L.R. NO. SUBA/KAKSINGIRI/WEST A WITHIN LAKE VICTORIA, HOMA BAY COUNTY**, has been approved with the following conditions:

1. Undertake detailed baseline environmental and social conditions with focus on the limnological characteristics of the lake.
2. Undertake climate change risks and vulnerability assessments for project footprint and value chains and provide a comprehensive climate change adaptation & mitigation measures.

You shall submit ten (10) copies of the study report, upon payment of the applicable EIA processing and monitoring fees being 0.1% of the total project cost, a soft copy of the summarised ESMP in **WORD** format for preparation of public notice and one electronic copy of the report prepared by the team of experts to the Authority.

You are advised to comply accordingly.

JOSEPH MAIKU
FOR: DIRECTOR GENERAL

OFFICE OF THE COUNTY EXECUTIVE COMMITTEE MEMBER

BLUE ECONOMY, FISHERIES, MINING AND DIGITAL ECONOMY

REPUBLIC OF KENYA

HOMA BAY COUNTY

When replying quote
Ref.HBC/BEFM&DE/CEC/BMU/Vol.1/48
All correspondences should be addressed to The CECM.

P.O. BOX 469- 40300
HOMA BAY
DATE: 12th Aug, 2024

The Chief Executive Officer,
Victory Farms,
Roo Bay, Homa Bay County
P.o Box 14730-00800
Westlands – Nairobi

Dear Sir,

RE: LETTER OF NO OBJECTION FOR COMMECIAL CAGE FISH PRODUCTION AT KISEGI, KOMOGO, NGERI, NYAGWETHE AND LITARE BEACHES

The above subject matter refers;

In response to your letter dated 2nd July, 2024 requesting for letter of No Objection to establish commercial fish cage production at Kisegi, Komogo, Ngeri and Litare beaches in Homa Bay County, Lake Victoria waters, I am pleased to inform you that your request has been considered and accepted. This office therefore provides you with this letter as proof of **No Objection** to your intended operation at the said Kisegi, Komogo, Ngeri, Nyagwethe and Litare beaches.

Please note that this does not constitute a license but is to enable you undertake the due process leading to licensing. Further take note that the validity of this **No Objection** is subject to the farm meeting all the other laid down requirements by both the County and National Government.

Thank you.

CECM, BLUE ECONOMY, FISHERIES, MINING & DIGITAL ECONOMY, HOMA BAY
12 AUG 2024

Dr. John Agili Nyangueso, PhD, CS (K), FKIM
CECM, BLUE ECONOMY, FISHERIES, MINING & DIGITAL ECONOMY

cc. Chief Officer- Blue Economy and Fisheries
Director – Fisheries