EAST AFRICAN COMMUNITY
LAKE VICTORIA FISHERIES ORGANIZATION

Guidelines for Establishment and Operation of Cage Fish Farming in the East African Community

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FOREWORD

The potential of aquaculture to contribute significantly to regional food security, livelihoods and economic growth is recognised by the EAC. With a rapidly expanding human population, there is urgent need to develop new interventions that deliver on food security but at the same time do so in a manner that is sustainable and avoids damage to the environment and natural renewable wild fish resources.

The region is blessed with an abundance of high quality water resources that offer opportunities for expanding cage fish culture interventions. We see that such interventions have already taken off on Lake Victoria, especially in its Ugandan and Kenyan waters. This rapid uptake of a relatively new technology to the region needs to be both welcomed and guided. Several Partner States of the EAC have an interest in this technology for possible uptake on water bodies in their respective countries.

Recognising this interest and the potential benefits from cage fish culture, the 6th Special Session of the LVFO Council of Ministers noted the pressures from investors to cage fish farming on Lake Victoria and directed the development of Guidelines to steer the development and uptake of this technology.

The LVFO Secretariat and its national institutions operating through the LVFO Aquaculture Regional Working Group responded to the Council directive and led the production of the first Guidelines for Establishment and Operation of Cage Fish farming in the East African Community. We appeal to all EAC Partner States to use the regionally harmonised guidelines to develop their own national guidelines and supporting legislation to provide a clear enabling environment that facilitates cage farming business development and expansion in the region.

We look forward to future successful and sustainable development of an industry capable of delivering benefits to regional food security, livelihoods and economic growth and pray that these guidelines help this new industry emerge and grow.

Godfrey V. Monor
EXECUTIVE SECRETARY, LVFO

SUMMARY

Aquaculture is the fastest growing animal production sector in the world and is considered a major remedy to increase fish supply amidst dwindling wild fish stocks to meet the increasing demands for fish. In East Africa, aquaculture has been mainly practiced through land-based ponds but cage fish farming in natural waters has shown potential to be more productive than pond culture. It can therefore, if promoted and sustainably practiced, contribute to increased fish production to meet local, regional and international demands.

However, cage fish farming presents environmental and food safety challenges arising from feeds, chemicals, veterinary medicines, waste products, fish escapes, and diseases which are all potential contaminants to the natural environment. Cage fish farming can also result into conflicts among multiple water resource uses such as fishing, recreation, transport, water extraction, cultural practices and hydro power generation.

In almost all EAC Partner States, there have been interventions aiming to establish cage fish farming on lakes and reservoirs, many of these failed to take off either because of inadequate supplies of fish fry or feedstocks or due to poor management capacity. On Lake Victoria, however, there has been rapid development and expansion of cage culture by the private sector.

Consequently, the 6th Special Session of the Lake Victoria Fisheries Organization (LVFO) Council of Ministers of October 2014 directed the LVFO Secretariat to coordinate development of guidelines and standard operation procedures for cage fish farming in East Africa to ensure optimal benefit to farmers with minimal impacts on the environment and other lake users.

The overall aim of these guidelines is to streamline and guide the establishment and operation of cage fish farming in line with international codes of practice for aquaculture to ensure environmental sustainability and harmony among the resource users. The guidelines pay particular attention to the care needed to be taken during the initial establishment of cages on water bodies so as to avoid any negative and damaging environmental impacts. The potential social and economic impacts are also highlighted especially when many of the natural waters serve multiple purposes for different dependent resource users. The document guides operational aspects not only of growing fish but also in managing their security, waste disposal and the decommissioning of enterprises when they are no longer functional. The existing policy, regulatory and institutional frameworks guiding development, operation and licensing of cage aquaculture are set out for the riparian countries of Lake Victoria where cage fish farming is expanding rapidly. The guidelines also provide step by step processes for establishment of cage fish farms which include: obtaining establishment and operating license, site selection, basic fish farm management practices and requirements.

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We appreciate the Sectoral Council responsible for Fisheries and Aquaculture for consideration and approval of the guidelines.

LIST OF ABBREVIATIONS

ABW	Average Body Weight
BMU	Beach Management Unit
BOD	Biological Oxygen Demand
CA	Competent Authority
CBD	Convention of Biodiversity
DiFR	Directorate of Fisheries Resources
DO	Dissolved Oxygen
DWRM	Directorate of Water Resources Management
EAA	Ecosystem Approach to Aquaculture
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
FAO	Food Agricultural Organization of the United Nations
FCR	Feed Conversion Ratio
HACCP	Hazard Analysis and Critical Control Points
HVLD	High Volume Low Density
KEBS	Kenya Bureau of Standards
KenInvest	Kenya Investment Authority
KMFRI	Kenya Marine and Fisheries Research Institute
LVFO	Lake Victoria Fisheries Organization
LVHD	Low Volume High Density
NAADs	National Agricultural Advisory Services
NaFIRRI	National Fisheries Resources Research Institute
NDA	National Drug Authority
NEMA	National Environment Management Authority
NEMC	National Environment Management Council
NPA	National Planning Authority
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MPA	Marine Protected Areas
PCPB	Pest Control Products Board
POP	Persistent Organic Pollutants
PPB	Pharmacy and Poisons Board
SoN	Source of the Nile
TAFIRI	Tanzania Fisheries Research Institute
TBS	Tanzania Bureau of Standards
TFDA	Tanzania Food and Drugs Authority
TIC	Tanzania Investments Centre
UNBS	Uganda National Bureau of Standards
UIA	Uganda Investment Authority
UNRA	Uganda National Roads Authority
VHP	Veterinary Health Plan
ZMA	Zone of Maximum Accumulation

GLOSSARY OF TERMS

Aquaculture: Means rearing of fish and other aquatic organisms under a controlled environment. Aquaculture includes fish farming.

Biosecurity: Measures designed to protect a population or a system from transmissible infectious diseases.

Cage: A structure enclosed on all sides by mesh materials that permit free exchange with surrounding waters and used for rearing fish.

Cage fish farming: Is the growing of fish inside a cage. Also called cage fish culture.

Carrying capacity: The potential maximum fish production (total weight) that can be maintained in a production unit with defined dimensions in a given ecosystem for a given time without negative impacts to the environment.

Chemicals: Include any substances either natural or synthetic which can affect live fish, its pathogens, water and equipment used for production or the land within the proximity of the aquaculture establishment.

Conditioning of fish: Various handling practices and treatments subjected to the fish before, during and after transportation in order to minimize stress, injuries and mortalities while introducing fish into a new culture environment.

Competent Authority: Body mandated to manage and regulate aquaculture resources.

Diseased fish: Fish with pathological changes or other abnormalities that affect safety, acceptability and quality.

Disinfection: Treatment of equipment, surface or water of agents capable of causing or transmitting disease.

Ecosystem Approach to Aquaculture: Is a strategy for the integration of the activity within the wider ecosystem such that it promotes sustainable development, equity, and resilience of interlinked social-ecological systems.

Enterprise: An establishment owned by a person(s) consisting of a defined number of cages of a given volume and surface area**.**

Extensive aquaculture: Raising fish or other aquatic organisms under conditions of little or incomplete control over the growing process and production conditions where their growth is dependent upon endogenously supplied nutrient inputs.

Feed additives: Chemicals other than nutrients for fish which are approved for addition to their feed.

Fish: Term as used in this document shall refer to fin and shellfish

Fish welfare: Fish welfare concerns may occur when fish is exposed to stressful conditions.

Fish farm: Is an area where controlled fish production is done, consisting of holding facilities (tanks, ponds, cages, etc.), plant (buildings, storage, processing), service equipment and fish stock.

Good aquaculture practices (GAPs): A series of considerations procedures and protocols designed to foster efficient and responsible aquaculture production.

Harvesting: Operations involving removal of the targeted market size fish from the production units.

Intensive aquaculture: Refers to raising fish under controlled production conditions usually at high stocking densities with artificially formulated feeds being the sole source of the cultured fish nutritional requirement.

Low Volume High Density (LVHD) cages: Cages operated at minimum density of 120 fish/m^3

High Volume Low Density (HVLD) cages: cages operated at maximum density of 75 fish/m^3

Pathogen: An organism that is infectious and causes disease or illness to its host.

Pesticide/herbicides: Any substance intended for preventing, destroying, attracting, repelling or controlling any pests including unwanted species of plants or animals during the production, storage, transport, distribution and processing of food, agricultural commodities, or animal feeds or which may be administered to animals for the control of ecto-parasites. The term normally excludes fertilizers, plant and animal nutrients, food additives, and veterinary drugs.

Pesticide residue: Any remains of specified substance in food, agricultural commodities, or animal feed resulting from the use of a pesticide. The term includes any derivatives of a pesticide, such as conversion products, metabolites, reaction products, and impurities considered to be of toxicological significance.

Primary fish processing: Primary fish processing refers to the removal of internal organs and, as appropriate, the gills from slaughtered and bled fish; and the washing, cleaning and the packing of the fish in boxes.

Primary fish production: Operations including the production procedures, transport, storage, and handling of fish at the place of production which does not substantially alter their nature and the transport of fish from the place of production to a processing establishment

Quality assurance: Refers to planned and systematic activities implemented / put in place to ensure that fish and fish products are safe for human consumption and of the required / acceptable standard.

Risk: A probability or threat of damage, injury, liability, loss, or other negative occurrence that is caused by external or internal vulnerabilities, and that may be reduced or eliminated / neutralized through preventative action.

Stocking density: The number of fish reared per unit of space (area or volume).

Supplementary feed: An additional formulated feed given to fish to support the naturally existing food in a production system.

Traceability: The ability to trace and follow a food, feed, food-producing animal or substance through all the stages of production, processing and distribution.

Veterinary medicine: Any curative or preventive substance applied or administered to any food animal and / or food-producing animal, whether used for therapeutic, prophylactic or diagnostic purposes or for modification of physiological functions or behavior.

Withdrawal time: Is the period of time necessary between the last administration of a veterinary medicine to fish, or exposure of these animals to a veterinary medicine, and harvesting to ensure that the concentration of the veterinary medicine in their edible flesh intended for human consumption, complies with the maximum permitted residue limits.

Zone of Maximum Accumulation: Is the area affected by organic accumulation in the sediments within area occupied by a cage farm system and largely depends on the quantity and quality of organic matter input and current flow rate.

1. PURPOSE AND SCOPE OF THE GUIDELINES

These guidelines aim at ensuring cage aquaculture enterprises are established, operated and managed in a manner that is in line with the Ecosystems Approach to Aquaculture (EAA) which is a requirement for all aquaculture interventions worldwide. This approach requires that aquaculture operations are sustainable and consider all ecosystem users, taking into account their influence on the surrounding social and natural environment. The geographical scope of the guidelines extends to all water bodies in the East African Community. The guidelines provide for prohibited areas, prerequisites of candidate sites, operational plans, policy and institutional framework requirements to support enterprise development. They provide protocols for investors and regulators to follow so as to reduce negative impacts on the environment and other water resource uses. They also provide guidance in the preparation of a business plan for cage fish farming establishments and approval procedures.

2. BACKGROUND

2.1. Regional context

Globally, fish production from natural fish stocks has generally stagnated, with most fisheries already fully exploited or over-exploited. Aquaculture is the fastest growing food industry in the world[1] and provides a viable option for increasing fish supply. Whereas the current world's total aquaculture production is over 100 million tons, the sector is still at its infancy in Africa where less than 2 million tons are produced. The world aquaculture production assumed exponential growth from the mid-1970s but only took off in the late 1980s in Africa and only after the turn of the millennium in East Africa**.**

The Malabo Declaration of 2014 stresses the significance of enhancing conservation and sustainable use of all our natural resources including aquaculture through coherent policies as well as governance and institutional arrangement at national and regional level to realize the huge potential to generate wealth, social benefits and contribute to the development of the economies. Therefore with dwindling stocks, new opportunities for investment under "The Blue Economy" concept and the potential return promised by cage culture, the industry could help supplement lacustrine capture production in East African lakes such as Victoria, Tanganyika, Kivu etc.

African Union (AU) Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa calls for realizing full potential of the aquaculture sector to generate wealth, social benefits and contribute to the development of the African economy and food security by jump starting market-led sustainable development strategies. Thus, the East African Community (EAC) Partner States are making efforts to put in place mechanisms to increase aquaculture production and have developed the EAC Regional Strategy and Implementation Plan (2015-2020) for sustainable aquaculture. The Strategy provides for establishment and harmonization of legal frameworks; support for improved production systems for seed and feeds through Public Private Partnerships (PPP); focus on local species; institutional capacity building; and sustainable management of aquaculture value chain. The EAC has also developed the protocol on Sanitary and Phytosanitary measures to promote trade in food and agricultural commodities within the community and

[1] FAO 2014. The State of the World Fisheries and Aquaculture – Opportunities and Challenges. Rome, Italy.

between the community and other trading partners. In addition it provides for harmonizing the inspection, certification and approval of establishments, hatcheries, breeding centers and feed stuffs.

Results have indicated that cage culture in lacustrine environments is a promising viable economic venture. Considerations that have to be taken into account include regulatory and legal frameworks to guide investments in cage farming and in the delineation of the lake for other uses. The objectives of these regulatory frameworks and guidelines are to minimize resource use conflicts and protect the environment. They will also ensure safe and quality fish and fishery products.

2.2. Justification for cage culture in East Africa

Cage farming has many advantages over other methods of fish culture, including: very high production per unit volume of water; relatively low investment per unit of production; the anticipated high profitability levels; the use of existing water bodies thus reducing the pressure on land; the requirements of relatively low capital outlay; the ease of movement and relocation; the reduced effect of drought on production in relation to the availability of water; and the flexibility of management (De Silva and Phillips 2007[2]).

In most African countries, cage fish farming is still a relatively new technology (FAO 2004[3]). In East Africa, cage fish farming is an emerging industry in most of the Partner States of the EAC. It has been piloted periodically on many small lakes in the region with varying results and in the face of challenges such as inadequate seed and feed supply. The one exception is on the largest lake in the region, Lake Victoria, where cage culture has been spearheaded in recent years by the successful transfer of private sector expertise from Zimbabwe to Uganda from where the technology spread to Kenya. In 2017, there were estimated to be over 4,000 cages on the lake in these two countries with Tanzania also beginning to develop its own industry.

This lake and many others in East Africa support indispensable artisanal and commercial fisheries, important for employment, food and income for riparian communities. The lake also supports other economic sectors such as water transport, water for industrial, domestic and agriculture use, hydroelectric power generation important for more than 30 million people in the lake basin and beyond East Africa region (Aura et al. 2013[4])

There appear to be ecological changes in most East African lakes that are having a bearing on the dwindling fish stocks. A good example of such changes have been witnessed in Lake Victoria. The

[2] De Silva S.S. & Phillips M.J., 2007. A review of cage aquaculture: Asia (excluding China). In Halwart, M., Soto, D. and Arthur, J.R. (eds). Cage aquaculture – Regional reviews and global overview, pp. 18–48. FAO Fisheries Technical Paper. No. 498. Rome, FAO. 2007. 241 pp.

[3] FAO 2004. FAO Regional Technical Expert Workshop on Cage culture in Africa, Entebbe.

[4] Aura M.C., Musa S., Njiru J., Ogello E.O., Kundu R., 2013. Fish-Restocking of Lakes in Kenya: Should solemnly be an Environmental Issue, 39-60pp. *In*: Adoyo, W. A. & Wangai, C. I. African Political, Social and Economic Issues: Kenya Political, Social and Environmental Issues. NOVA Science Publishers, Inc. NewYork. ISBN: 978-1-62081-085-9.

lake being the main East African Lake shared by three countries, had originally supported at least 12 major commercial fish species. However, multiple stressors such as over exploitation, species introductions, eutrophication, pollution, and habitat change[5], have reduced the number of commercial fish species to only three comprising introduced Nile perch (*Lates niloticus*) and Nile tilapia (*Oreochromis niloticus*) as well as one native fish species the silver fish (*Rastrineobola argentea*). The catches and biomass of fish in the lake is currently dominated by four groups of fish comprising the less valuable species *R. argentea (dagaa/muken/omena),* the haplochromine species group, the more economically valuable Nile perch and the Nile tilapia.

This lake provides the bulk of national fish catches in Kenya, Tanzania and Uganda, and despite rises in catch especially of dagaa, this has failed to keep pace with population growth in the EAC and consequently there has been a corresponding reduction in *per capita* fish consumption to as low as 3.2 kg in Kenya, 7.7 kg in Tanzania and 8 kg in Uganda; levels that are much lower than the 19.2 kg recommended by the Food and Agriculture organization (FAO, 2016). While natural fish stocks in Lake Victoria appear to be declining from overfishing among other factors, demand for fish protein continues to rise as a result of rapid human population growth and increasing awareness of benefits of eating fish (FAO 2016[6]). Aquaculture is viewed as an alternative to reducing the widening gap between fish demand and its supply.

Consequently there is need to seek alternative avenues of fish production such as cage farming in the East African lakes to bridge the growing supply gap between production and domestic, regional and international supply requirements. Contribution from cage culture is anticipated to make inputs to the national and regional economies within the East Africa Community (EAC). Other benefits to be realized include industrial linkages involving sectors such as manufacturing, retail and wholesale trade, construction, transportation, and business services along the value chain. It is further envisaged that cage culture may reduce poverty, provide food and boost income of the fishers, while reducing pressure on capture fisheries. With the importance of cage culture, it therefore necessitates the need for an Ecosystem Approach to Aquaculture that provides the conceptual guideline for spatial planning and management through legal frameworks.

2.3. Potential for cage fish farming

East Africa is endowed with immense fresh water resources including Lake Victoria where potential for cage fish farming has already been demonstrated. The attributes include: suitable climate with conducive water temperatures 27-30^{o}C; availability of suitable native aquaculture fish species especially the Nile tilapia (*Oreochromis niloticus*); huge national, regional and international markets for fish; Existence of fish processing capacity; availability of local ingredients for fish feed formulation such as cereal brans, soya bean, oil seed cakes and fish meal (*Rastrineobola argentea*, *Neobola bredoi*, *Brycinus nurse*, Haplochromines and fresh water shrimps); favorable investment climate and increased interest in aquaculture by local and foreign

[5] Hecky. R.E., R. Mugide, P.S. Ramlal, M.R. Talbot, and G.W. Kling, 2010. Multiple stressors cause rapid ecosystem change in Lake Victoria. Freshwater Biology 55 (Suppl.1); 19-42

[6] FAO (2016) The State of World Fisheries and Aquaculture 2016. *Contributing to food security and nutrition for all*, Rome, Italy.

investors; increased population explosion in the region; and availability of some policy, legal and institutional frameworks for regulation, research, and extension to support cage fish farming.

The EAC is promoting aquaculture through the adoption of new production technologies. Pond culture has been the dominant production system in East Africa since the middle of the 20th century. Although there have been important advances in pond technologies, growing fish in cages has several fundamental advantages including increasing the production from the regions' significant water resources. Moreover, recent advances in cage design and operation have made cage culture a much more viable option for those wishing to enter the aquaculture subsector.

Interest in cage aquaculture in lakes and other water bodies by local and foreign investors has increased in recent years. The upsurge in cage fish farming is mainly a response to the dwindling stocks from capture fisheries and low productivity from pond culture in the region. Since its establishment more than 60 years ago, pond culture has achieved production of only 2 - 4 kg m^{-3}. On the other hand, cage fish farming has achieved up to 60 kg m^{-3} under good management practices in Uganda[7] where it started comprehensively in 2006 using Low Volume High Density (LVHD) cages of 4 - 9 m^3.

Cage fish farming has a number of advantages over other fish culture systems[8], which include:

a) Relatively high production per unit volume of water;

b) Relatively low investment per unit of production (the cost of construction of a LVHD cage is about 1/4 that of a pond producing the same yield of fish);

c) Land ownership is not required;

d) No water inlets required;

e) Easier handling, monitoring and harvesting of fish;

f) Little or no breeding in cages;

g) Fish predators are easily controlled;

h) Often higher survival rates of fish;

i) Frequently feeds are more efficiently utilized;

j) It allows total harvesting and re-investing of the resources;

k) Fish grown in cages can be sold fresh and in good quality; and

l) Requires relatively less labor per unit of production.

A basic enterprise budget using the Nile tilapia as the cultured fish species (stocked with 10-15g) over a culture period of six months in LVHD cages of 15.6 cubic meters **(Annex 1)**, indicates high returns on investments over a short period of time, demonstrating that cage fish farming has higher potential to increase fish production and benefits to fish farmers in the region if well planned and

[7] Experience from Uganda shows a stocking rate of 120-150 fish/m^3 and harvest ABW of 400g gives a harvest range of 40-60kg/m^3 in LVHD cages.

[8] Beveridge, M.C.M, 1984. Cage and Pen fish farming. Carrying capacity models and environmental impacts. FAO Fisheries Technical Paper (255): 131p.

managed. Fry of 0.2g should first be raised in nursing facilities for 2-3 months or 10-15g before transfer to the grow-out cage.

2.4. Socio-economic and environmental challenges

Cage fish farming takes place in water bodies that are both public and private property and are used for other social and economic activities such as fishing, recreation, transport, water extraction for domestic and industrial use, sewage disposal, and hydropower generation as well as cultural activities. In public water bodies, these uses have to be considered in the process of establishment of cage fish farms on the water bodies if conflicts are to be avoided.

Inputs in cage fish farming especially feeds, chemicals, cage materials and products such as dead fish, uneaten feeds, faeces and other wastes can adversely affect water quality. Cage fish farming poses a risk of disease and genetic distortion if not well managed. Cages set up in shallow areas which are nursery and breeding areas for fish, can disrupt natural recruitment thereby affecting natural fish populations. Escapees from the cages can result in interbreeding and adulteration of gene pool of the natural stocks. The materials, chemicals and drugs used to treat diseases, can negatively affect the environment. Cage fish farming if not well managed can change physical, chemical and biological conditions of the aquatic environment that can lead to increases in turbidity, BOD, Organic-N, total-P and organic content of sediments under cages. Anchors ploughing the lake bed can sometimes disturb the deposits releasing sediments and gases into the water column. Lack of availability of adequate protein supply for fish feed production is also poses a challenge especially as the cage fish farming industry expands. Current dependence on fish meal if continued unabated will place increasing pressure on wild fish stocks as the cage farming industry expands.

3. ESTABLISHMENT OF CAGE FISH FARMING

3.1. Site selection and description

Site selection is an important initial step in any cage farming operation because it influences enterprise viability. Within the site selection process, all possible interactions and their impacts on and by cage culture, including both environment and human related should be evaluated and assessed in order to minimize threats, hazards and over exploitation[9].

It consists of two main components: site capability and site suitability analyses. Approaches for site capability analysis are diverse and are integrated with considerations of site suitability, but typically include exclusion of no go areas, and a description of all bio-physico-chemical and social conditions affecting the ability of the site to support cage fish farming. Biophysical characteristics include factors such as bathymetry, climate, predator and micro and macro fauna[10]. Site suitability factors include extrinsic aspects of resource use such as potential conflicts, land use patterns,

[9] FAO, 2015: Fisheries and Aquaculture Technical Paper 593, Aquaculture Operations and Floating HDPE cages- a field handbook.

[10] Kapetsky, J.M. and Aguilar-Manjarrez, J. 2007. Geographich information systems, remote sensing and mapping for the development and management of marine Aquaculture. *FAO Fisheries Technical paper*, 458.

market conditions, infrastructure and technical support[11]. These in addition to bio-physico-chemical conditions represent the site capability analysis. Consultations should be undertaken with the community for their concurrence on the establishment of cages in the area. In this approach all areas deemed capable are evaluated with suitability and socio-economic factors weighted equally.

In examining a site for suitability, the type of cage system to be used must be indicated. The two commonly used types of cages for culturing finfish are the floating and stationary types. The floating cages are movable and can be adopted for use in deep waters. Stationary cages are normally used in relatively shallow waters. Before evaluating any site for cage fish farming, there are sites that should be excluded from the consideration for cage fish farming. These include "no go" or prohibited areas that have to be eliminated from the evaluation.

3.2. No go areas

Cages are required to be a specified distance away from prohibited areas and some establishments and these are considered as no go areas. The no-go areas include:

a) Areas of social and / or security interest or activities;

b) Established anchorages such as piers, marinas (where ships and boats anchor or seek shelter from stormy weather) and harbor approaches;

c) Established navigation routes for ships or ferries or any other form of water transport;

d) Entry to fish landing sites;

e) Marine/Lacustrine Protected Areas;

f) Cables, pipelines and drilling platforms;

g) Parks, conservation and heritage or tourist sites;

h) Gazetted fish breeding sites, spawning and nursery grounds;

i) Existing domestic and industrial water intake and extraction points;

j) Effluent discharging gates of industrial and urban effluents;

k) Fish migration routes such as river and stream mouths and sources;

l) Existing hydropower plants;

m) Core Zones of Ramsar sites;

n) Areas where water depth and quality fluctuation is high such as seasonal rivers; and

o) Known common and important fishing grounds.

Even though an area is identified as suitable for cage fish farming, a distance must be kept from the no-go area (Table 1). It is important to note that the list of these establishments as well as the distances indicated can change depending on circumstances and these shall be approved by the relevant authorities in consultation with stakeholders.

[11] Nath, S.S., Bolte, J. P., Ross, L. G. and Aguilar-Manjarrez, J. 2000. Applications of geographical information systems (GIS) for spatial decision support in aquaculture. *Aquacultural Engineering*, 23, 233 – 278.

Table 1: Distance of separation between cage aquaculture sites of operation/candidate sites and some establishments of public interest (no go areas)

Establishment	Distance with not go within
Shore line.	200m or a minimum depth of 5m
Existing large scale commercial cage fish farming entreprises.	2km
Areas of military or security interest or activities.	2km
Published anchorages (where ships and boats anchor) and their defined berths (sufficient space for a vessel to maneuver).	500m- 1km
Marked navigation channels for ships or ferries or any other form of water transport.	1km
Established harbors (where ships and boats seek shelter from stormy weather, or are stored for future use) and harbor approaches.	2km
Marinas or mooring areas with structures to which vessels may be secured such as piers.	500m
Marine/Lacustrine Protected Areas.	At least 200m
Cables, pipelines and drilling platforms.	500m
Parks, conservation and heritage or tourist sites.	500m
Gazetted fish breeding sites, fish spawning and nursery grounds.	500m
Existing domestic and industrial water intake and extraction points.	500m
Fish migration routes.	500m
Existing hydropower plants.	1km
Core Zones of Ramsar sites.	2km
Gazetted Lacustrine Areas.	1km
Areas where water depth and quality fluctuation is high such as seasonal rivers.	500m
Effluent discharging gates of industrial urban effluents and other waste disposal points.	1km
River and stream mouths and sources.	3km
Landing sites.	500m
Recreational facilities.	500m

NB: The distances provided here have been based on a wide range of literature but may change depending on the needs and agreement of stakeholders.

3.3. Description of the candidate site

After elimination of no go areas and consideration of no go within designated distances, a proposed site becomes a candidate site for cage fish farming. A candidate site should be described in detail based on attributes that demonstrate its suitability in relation to: location, adjacent uses, physical and chemical environment, pollutants and contamination, biological communities, economic and social factors.

Site description should be carried out by an authorized competent organization(s) who compiles a site suitability report. The information provided in the report will be required and shall be used by the Competent Authority (CA) in assessment and issuance of provisional operational license for 2 years and upon satisfactory compliance, 5 years renewable. It also provides baseline information for monitoring the effect of cage fish farming operations on the environment and compliance with the guidelines.

3.3.1. Location and adjacent uses

A description of the location of the candidate cage site should include:

a) Administrative boundaries (District/County, Sub-County/Division, Parish/Ward, Village) and nearest landing site or Beach Management Unit (BMU);

b) Location coordinates (longitude and latitude of exact cage site);

c) Category of water body where the site is located such as lake, river, dam, other reservoirs

d) Actual area covered by the farm and access road(s);

e) Shoreline description including the ground types, slope, aquatic vegetation;

f) Streams and rivers running into or out of the site;

g) Tenure and ownership of adjacent land;

h) Area of intensive use (where the cages will be placed) presented as a polygon; and

i) A demonstration of lay out and anchorage of cages in the site.

Information should also be provided on adjacent uses including those listed in Table 1 and other uses such as housing and settlements and any other shoreline structure; power lines, crop cultivation and livestock grazing, waste water treatment structures, and industrial activities. Places where adjacent uses are intensive should be avoided to reduce conflicts among different users.

3.3.2. Physical and chemical environment

Poor water quality affects the fish, promotes disease and parasite outbreaks and can cause fish kills. A non-stressful water environment inside the cage is fundamental to good fish health and production performance. Therefore, during site description, information should be given on levels of different physical and chemical characteristics of the site to demonstrate that they can support cage fish farming. In addition to water depth, currents and flushing rates, information should be generated on other physical characteristics such as temperature, transparency and suspended solids at the site. Information should be provided on chemical characteristics of the water including: nitrate, nitrite, ammonium, dissolved silicon, dissolved oxygen, dissolved solids, dissolved salts (salinity), carbon-dioxide, hydrogen sulphide, methane, Biological Oxygen Demand (BOD), oxidizable organic matter, pH, and conductivity. Also a test for radio-active materials should also

be undertaken. **Annex 2** presents ideal levels of key physical chemical conditions that should be considered. If these ideal levels are not met, the candidate site should be deemed unsuitable for cage fish farming and no license should be sought or offered for such sites.

3.3.3. Biological information

Biological data should be obtained on communities of phytoplankton, zooplankton, benthic invertebrates, fish and macrophytes (aquatic plants that grow in or near water and are emergent, submerged, or floating). Information should be synthesized to determine whether the sites are critical habitats for fish, spawning and nursery areas, fish migratory corridors and critical areas for fish food organisms and other sensitive or endangered species, presence in the area of species at risk and those that are threatened. The species that may be at risk due to the cage aquaculture activity should be identified and measures that will be taken to mitigate the risks indicated. This forms part of the environmental monitoring plan (**Annex.3**)

3.3.4. Pollutants and Contaminants

A site selected for cage fish farming should also be free of pollution and contamination by heavy metals and Persistent Organic Pollutants (POPs). Heavy metals and POPs are important as they persist and bio-accumulate through the food web, causing severe adverse effects to living organisms including humans. Consequently, the desired levels of selected heavy metals and POPs at sites selected for cage fish farming are provided in **Annexes 4 & 5** respectively and this will guide issuance of license.

3.3.5. Economic and Social considerations

It is essential that cage fish culture sustains and contributes to existing socioeconomic activities and overall development of communities in the vicinity of the cage establishments. If wild fish stocks become more scarce, there will be a need to train and divert fishermen into the aquaculture sector as alternative source of livelihoods. Fish farmers and prospective investors should present a business plan including how the farm or establishment will contribute to economic and social development of the communities around the farm. Consideration should also be taken of other water uses such as transport, irrigation, power generation, tourism and fishing.

3.3.6. Environmental and Social Impact Assessment (ESIA)

Inputs into cage culture such as feeds, seed/fry, chemicals and drugs, waste products such as dead fish, residues of uneaten feeds and fish faecal material and cage installation materials may have negative impacts on the water environment and other aquatic organisms including wild fish[12]. Establishment of the farm may also affect other environmental and socio-economic activities in its vicinity. ESIA shall be required for cage fish farming establishments as required by National Environmental Management Authorities to ensure minimal impact of the farm on the environment. An ESIA is to be undertaken by certified person(s) or organization and submitted to respective National Environment Management Authorities for approval, following existing ESIA guidelines. A detailed environmental management plan is a requirement and Annual environmental audits should be undertaken. The following should be considered:

[12] Beveridge, M.C.M. 1984. Cage and pen fish farming. Carrying capacity models and environmental impact. FAO Fish. Tech. Paper. (255): 131p.

a) Water rights and accessibility to water and other resources (fishers, navigation, industries, etc.);

b) Production carrying capacity;

c) The impact on the natural environment, water quality and biodiversity;

d) The impact on capture fisheries, harvesting of wild juveniles for stocking, transmission of diseases to wild populations, biodiversity and escapees of cultured species;

e) Human health issues such as waterborne diseases e.g. bilharzias;

f) Gender and Local participation;

g) Economic issues. e.g. whether cage fish farming will reduce or increase poverty by disturbing established local socio-economic activities;

h) Whether it displaces alternative activities and at what cost; and

i) Social corporate responsibility.

3.3.7 Site Suitability Report

The suitability report prepared by the mandated technically competent authorized organization or National Fisheries Resources Research Institute shall include the above considerations on description of proposed site. The suitability report together with a report of the ESIA approved by National Environmental Management Authorities shall be required for issuance of a provisional license for fish cage culture operations. For a practicing license to be issued, the investor must have abided with the stipulated operating procedures including a monitoring report which must have included seasonal variability.

Where Partner States have mapped and designated areas for cage culture, prospective farmers will not be required to produce suitability reports for such sites.

4. PROJECTION AND OPERATIONAL PLANS

A proposed cage fish farm should have projection and operational plans. The operational plan must include the following:

a) Cage design, layout and plans for future expansion;
b) Other inputs in the farms;
c) The plans for security of facility, health management, waste management, environmental monitoring, escapes management, and decommissioning.

While the projection plan must include;

a) Capital investment costs
b) Operational costs
c) Variable costs
d) Production practices outlining the species to be farmed, the source of fry (seeds) to be used, stocking density, feeds and feeding regimes;
e) Projected sales
f) Projected performance indicator

4.1 Basic guidelines on the requirements

4.1.1. Site plan of the farm and future expansion

The farm should have a site map which should include:

a) The boundary as determined by GPS coordinates;
b) The cage fish farming facility and expected Zone of Maximum Accumulation (ZMA);
c) Location of the cages, layout and any other containment structures;
d) Dimensions and number of cages;
e) Navigation markers and potential navigation pathways around the farm;
f) Buildings, offices and staff living quarters if available;
g) Access road, walkways, utilities, cables, catwalks;
h) Stores for fuel, chemicals, feeds etc.;
i) Water lines that supply clean piped water to the farm ;
j) Mortality storage and net cleaning points;
k) Depth contours from the low water mark;
l) Predominant current direction;
m) Anchor blocks, mooring lines, marker buoys and shore attachments

The farm is required to obtain an approval from the licensing authority before carrying out any expansion.

4.1.2. Cage design and size

Cages can be rectangular, square or cylindrical in shape (**Plate 1** and **2**) and can range in size from $1m^3$ to several hundreds of cubic meters based on location and carrying capacity. Small cages are easier to manage than large cages. Performance per unit volume of cage is higher and economically more efficient in small (LVHD) cages

Cage structures should be strong enough to withstand strong winds and currents and hold the fish securely. The materials for construction of cages should be durable, strong, light in weight, rot and weather resistant (not degradable in the water), rustproof, fouling resistant, easily worked and repairable, drag free, smooth in texture and non-abrasive to fish. The materials should allow complete exchange of water.

There should be auxiliary cage equipment including: completely or partially removable cover to control predators and prevent fish from jumping out; a floating feed box or ring cylinder with wire mesh cover can extend 40cm below and 20cm above the water surface to retain floating feeds; or solid or fine mesh tray (covering 20% of the cage bottom) with 5 to 15cm raised sides if sinking feeds are used; Steel bar or Polyvinyl Chloride (PVC) or High Density Plastic Ethylene (HDPE) pipes or other rigid materials used to support the cage walls; Floats; Anchors and Platforms/walkways.

The cages should be located in waters with good water exchange (10 – 100cm/sec), protected from strong currents and high waves (especially LVHD cages). Stagnant water of poor quality may stress or even kill the fish. It is preferred that cages are in rows, spaced at least 2m apart. The water should be deep enough to allow the cage bottom to be at least 2-3m above the bottom sediments and should be located in an accessible area to facilitate routine maintenance and feeding.

The cages should be placed where they can be monitored and security provided. A surveillance system can be installed on the cages for monitoring and security purposes. Hired guards and/or other forms of security such as guarding dogs can also be deployed.

Plate 1 Example of HVLD cage

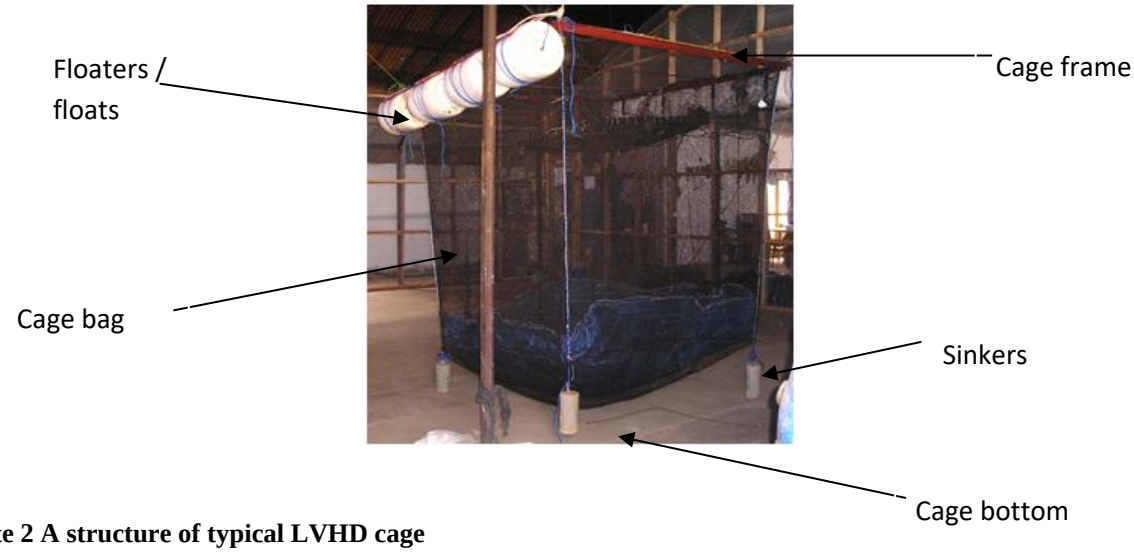

Plate 2 A structure of typical LVHD cage

A typical cage (**Plate 2**) has different parts with different functions including the following:

a) Cage frame and floaters: Cage frames are usually made of PVC, HDPE pipes or other rigid materials. Floatation may be provided by plastic drums/jerrycans, sealed PVC or HDPE pipes, Styrofoam or bamboo frames or specially designed floaters. Metal materials that rust should not be used.

b) Cage bag: Consists of a netting with a mesh size which allows water exchange between a cage and the surrounding water. Water exchange potential increases with increasing mesh size, but decreases with increasing amount of solid space between mesh openings (clogging). The mesh size is important in preventing fish from escaping to the surroundings as well as protecting fish from some predators. A double case netting should be used to reduce the risk of fish escaping and predation. A 5-8mm square mesh size are preferred for nursery cages, a 10-12 mm square mesh are preferred for the juveniles cages while 13 mm is the preferred minimum mesh size for grow-out cages. These mesh sizes can be adjusted accordingly to maximize water exchange while ensuring no fish escapes.

c) Floaters: these help the top of the cage to remain on the surface of the water.

d) Sinkers: heavy object attached to the bottom of the net to stretch it down, maintain the shape of the cage and balance the cage in position.

e) Cage shape: Cage shape influences water exchange as well as the stress experienced by the fish under culture. Most cages are either rectangular or square (especially for LVHD cages), but circular or cylindrical cages are sometimes used (especially for HVLD cages).

f) Feed enclosure: This is a structure installed in the cage to prevent loss of feed and optimize feeding in LVHD cages. It can extend 40 cm below and 20 cm above the water surface. Its purpose is to prevent loss of floating feeds while allowing the fish free access to the feeds. Water surface area inside the feed container should be 20 - 25% of the total cage surface area. Floating feed enclosures should be placed in the center of cages. Demand feeders may be used as trickle feeders.

g) Cage covers: There should be covers over the cages to protect fish from predators such as otters, birds and theft. The cage cover also prevents fish from jumping out of the cages. The cover material should be light in weight, be at least 10 – 15 cm above the water, cover the entire cage surface excluding the floating feed container at the center of the cage.

h) Cage anchors: Anchor is a concrete slab or other heavy object placed on the seabed and connected by a rope or chain to buoy or other floating object (cage) to keep it in a fixed area Since cages are placed in water to allow at least 2-3 m below the cage bottom and the bottom sediment, there should be anchorage to ensure that the cages do not drift away by wind (**Plate 2**).

4.1.3. Cage placement and positioning:

Placement and positioning of cages are primarily dictated by access to the cages for management purpose and water quality maintenance within the cages. Routine access to cages for feeding and other management activities is essential. Efforts to facilitate access must not adversely affect water quality in the cage.

Cages may be placed and positioned in several ways, including individual cages suspended at random or in lines in the open water accessible by boat or raft, or attached to floating or fixed piers or raft accessible by boat or a walkway to shore. Water current rates of 10 to 100 cm/sec are acceptable. Less frequent water exchange may cause physiological stress because of low water quality. More frequent water exchange may cause physical stress because of the force or turbulence of the water. Cages should be placed in open areas away from stagnant waters and areas subject to

strong currents and wind induced waves. Cages should be suspended from the water surface, and spaced at least 2 cage widths apart in lines (**Fig 3**) and never in "chess-board" grids as in **Fig 4**.

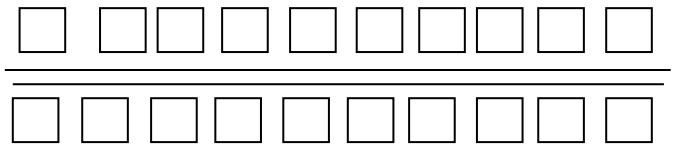

Figure 1. Sample layout of cages with spaces in between

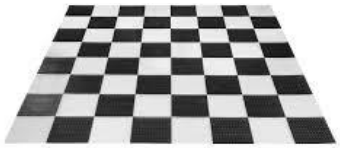

Figure 2. Chess board grid

The cage grids should be set in parallel at least 50 meters. Water currents should not directly carry water from one cage into another. A space of at least 4 m should separate the cage bottom from the lake bottom to facilitate water exchange, avoid oxygen depletion, accumulation of uneaten food, faeces and debris, disease infection and buildup of noxious gases such as hydrogen sulphide from decomposition of wastes.

4.1.4. Other inputs

A number of other inputs are required in management of a cage fish farm. These include items like: a canoe/boat; outboard engine; life jackets; fuel; and labor. These should be considered in the projection plan for the farm.

4.2. Production Practices

The farm should maintain production information including: the species cultured; seed; stocking density; feeds and feed management practices; sampling, growth performance, harvesting, handling and marketing.

4.2.1. Selection of Species for culture

The desired fish species for cage fish farming should have fast growth rate, be tolerant to crowded conditions, and of high market value. Nile tilapia is the recommended species for cage fish farming in East Africa. However, the African catfish can also perform well in cages. These species are native to the region although they require improvement of seed quality and growth performance through research. Introduction of new (not already in the lake) fish species or genetically modified species should not be allowed for cage fish farming in any EAC water bodies except with scientific clearance. Any illegally introduced species will be destroyed at the farmers own cost..

4.2.2. Broodstock, Seed production and acquisition

Seed should be obtained from authorized certified hatcheries in the EAC. Broodstock should be obtained from approved research centers National Fisheries Resources Research Institute (NaFIRRI), Tanzania Fisheries Research Institute (TAFIRI), Kenya Marine and Fisheries

Research Institute (KMFRI) or those approved by the Department responsible for Aquaculture Management and Development in collaboration with the national research institutes. Seed production centres will be certified and monitored by the Departments responsible for Aquaculture Management and Development (Competent Authorities)[13].

All broodstock and seed must be accompanied by a Live Fish Transfer/Movement Permit. Broodstock and seed should be handled, transported and stocked in a manner that does not affect the fish welfare. "Fish welfare concerns may occur when fish is exposed to stressful conditions. such as chemical ions, pH and dissolved oxygen outside the normal ranges resulting into stressful conditions in fish. Other fish stress factors are inadequate water, high stocking density, grading, mixing of species, presence of predators, removal of fish from and exposure to light. The fish's response to stressors is hormonal imbalance, osmoregulation disruption, suppression of inflammatory response (immune suppression) which lead to fish being more susceptible to disease and possibly more to bacteria carriage which may have effect on the safety of fish products". Stocking more fish than the carrying capacity will result in increased stress, disease, and mortality, and reduce feed conversion efficiency, growth rate, and ultimately profits.

4.2.3. Stocking density

Generally, a recommended stocking rate for LVHD cages is 120-150 fish per m^3 and for HVLD cages 70 – 100 fish per m^3. Stocking density depends on the quantity and quality of the feed to be used, water quality, water temperature, the species to be cultured, expected yield and average size desired at harvest. The carrying capacity of a water body determines the standard crop and shall be based on the water quality. Sites with good water exchange can have higher stocking densities, while those with poor water exchange should use lower stocking densities. Fingerlings for stocking should be graded to ensure uniformity in size at harvest. Water temperature affects fish mortality after stocking. Nile tilapia survival is best when stocked at 26^{o}C to 29°C.

4.2.4. Feeds and feeding

Feeds play a major role in cage fish farming. Farmers should use floating feeds evaluated by a mandated competent institution for feed quality as per National Bureau of standards. The feeds must be free of bacteria and other contaminants likely to affect the environment, health of fish and consumers. The feed should be nutritionally complete with all essential nutrients including proteins, lipids, vitamins, minerals and carbohydrates. The ideal constituent of the different nutrients for different developmental stages are summarized in **Annex 6** while the feeding ratios are provided in **Annex 7**.

Feed Conversion Ratio (FCR): Feed Conversion Ratios (FCR) should be calculated as:

$$FCR = \frac{Weight\ of\ \ feed\ used\ (kg)}{Final\ weight\ of\ \ fish\ (kg) - Initial\ weight\ of\ \ fish\ (kg)}\ .$$

It should normally vary between 1.2-2.0 depending on feed quality, growing conditions and management.

A correct amount of feed should be weighed and provided to the fish daily. Feeding rate tables are used to adjust daily ration. The fish should be sampled every four weeks to determine their

[13] National seed production and hatchery certification guidelines should be developed, harmonized and standardized at regional level.

average body weight and to facilitate calculation and adjustments of the daily ration. The amount of feed per day per cage depends on: the average body weight of the fish (ABW); the number of fish (N); the percentage body weight (%BW) of feed obtained from standard feeding charts (**Annex 7)**.

4.2.5. Performance, yield and marketing

Fish in the cages should be sampled every four to six weeks to monitor growth performance to guide adjustment of the feeds. Fish should be starved for about 24 hours before sampling in order to reduce stress. Sampling should be done by lifting one side of the lid and a sample of the fish collected using a scoop net and placed in a bucket containing water. The fish should then be weighed as a batch or individually and returned to the cage. At least 30 fish should be sampled. Average weight of the fish is then obtained. Fish should be handled carefully to reduce stress and injury. Fish should be weighed regularly to monitor growth rates, FCR and facilitate adjustments of the amount of feed.

Survival rates: Survival rates of the fish in cages should be monitored. This is expressed as a percentage of the number of fish stocked to the number harvested. This is obtained from the record of mortalities throughout the production cycle and at harvest. Survival rate can be 80% to 95% depending on cage management.

Harvesting: Harvesting of fish in cages should be done depending on the size preferred in the market. The following should be taken in account when harvesting:-

a) Fish for processing preferably be taken live to the processing factory without allowing any of the farmed fish into the wild or vice versa.

b) Farmers and owners of cage culture facilities must keep and provide on an annual basis records for all their production at harvest to the relevant authorities.

c) All handling and transportation of fish or fish products out of cage fish facilities must be according to established national, regional and international Hazard Analysis and Critical Control Points (HACCP) procedures.

Marketing: The price at which the fish is sold per kg and the market should be recorded and submitted to the Competent Authority annually. The following should be taken for consideration:-

a) Fish should not be sold at the cage facility but at the onshore handing facility with clear production records per cage and information for the traders and processors.

b) Traders should obtain a Fish Movement Permit/Fish Transfer Permit from the Competent Authority

c) Processors should clearly mark or label production from cage culture facilities and should separate processing of farmed aquaculture products from that of capture fisheries.

d) Joint marketing and/or competitive auctioning with reserves prices set by fishing industry for unprocessed fish should be encouraged to protect the small volume cage culture producers. Farmers are encouraged to form cooperatives.

e) Anyone dealing with processing or marketing of farmed fish from cage facilities should have an established and certified fish handling and processing facility, be it for local, regional on premium markets following the respective specifications and requirements for each market.

f) All aquaculture products marketed nationally, regionally or international should be certified by the authorized authorities as per harmonized EAC SPS measures.

g) Farmers and investors should be encouraged to produce fish according to market specifications and available markets with clearly established market linkages.

h) National authorities in collaboration with fish processors and marketers should carry out regular market surveys and sensitize farmers on the market requirements and availability.

4.3. Facility Security Plan

Commercial fish farms should have a well presented facility security plan to ensure that farmed fish do not escape in the wild as well as ensuring that fish are not stolen from cages. This should include constructing cages with double netting and taking precautions to minimize escapes while transferring, harvesting and grading fish. The specifications for cage construction and the nets to be used should be provided including net strengths, and farmers should use cages with the highest strength available.

There should also be a plan to monitor predators such as otters and birds, theft and wind, which can also lead to fish escape. Theft can be controlled by involving the community in cage culture operations and hiring guards or using dogs. Cages should be properly anchored to avoid being carried away by wind.

All workers in the fish farming established must be provided with protective clothing and those going on the lake must have life jackets.

4.4. Requirements for an internal system to control safety hazards in cage farmed fish

Every fish cage farm shall have an effective bio-security program incorporating:

a) Disease monitoring, prevention, and management of disease out breaks;
b) Cleaning and disinfection between production cycles; and
c) General security precautions.

A Bio Security Plan should be adaptable, be reviewed at the end of each production cycle and should include:

a) Checking weak fish and bathing them in fresh water to check for parasites. If there are parasites, all fish should be bathed and the cage changed;
b) Separating infected fish and moving them to a special quarantine tanks on land;
c) All equipment used to handle infected sick fish should be disinfected before further use;
d) Treating sick fish properly according to the infection and changing the net at the same time;
e) Taking dead fish away and bury or burn them on land;
f) Not selling sick fish or using them in feed;
g) Aerating the cages to increase Dissolved oxygen (DO) in water and bottom;
h) Acting quickly to stop spreading disease;
i) Consulting and informing other farmers about a disease outbreak and treatment;
j) Consulting and informing extension workers and research institutes;
k) Collecting the infected fish or their parts such as gills and injured parts as samples, preserved in alcohol, formalin or ice boxes and sending them to a laboratory for disease pathogen detection.

Farmers should only use internationally accepted chemicals and veterinary medicines as much as possible. In case of disease, should seek guidance from competent authorities.

All records of disease outbreaks and treatment should be kept and submitted to the competent authority.

4.5. Waste management plan

There should be a waste management plan including disposal of dead fish, processing products and solid waste in accordance with national laws. Waste water should not be discharged directly into natural water without dilution or neutralization. Waste water should be kept in drum/tanks for few days to allow oxygenation to neutralize the chemical and drug before discharge. The CA should carry out inspections to ensure compliance with the set requirements

4.6. Environmental Monitoring Plan

Every enterprise should have an environmental monitoring plan which involves activities to evaluate the influence of the activities of the enterprise on the sites, considering potential effects of the siting and operation of farms on sensitive aquatic organisms and habitats. Data should be collected prior to establishment of the farm and periodically (quarterly, biannual, and annual) after establishment of the farm on environmental variables and biological communities as indicated in **Annex 3**. This data should be maintained and submitted to the Competent Authority annually.

The environmental management plans should take the form of a recognized and independently audited environmental management system.

The CA will also undertake independent monitoring of the environmental factors as per **Annex 2**.

Existing cage fish farming enterprises requiring expansion or renewal of operating license will have to provide a report detailing monitoring interventions during operations. This report should highlight interventions undertaken to mitigate any negative impacts by recommendation of the monitoring process and any others aimed at preventing undesired consequences. It should also highlight any noticeable changes that have occurred since the beginning of the operations.

4.7. Decommissioning plan

There should be a plan for removing of materials and equipment and all structural and support features at the close of the farm. The decommissioning plan should be included in the business plan at the time of application for operational license.

The plan should include steps that will be made to restore the site to its natural conditions. The investor should inform the Competent Authority 3 months before closure of the facility and the proposed new site if any.

4.8. Enterprise Data and Budget

Fish farmers must record data from their cage fish farming operations. This data is required on different variables indicated in enterprise budget (**Annex 1**) and others indicated in **Annex 8**. The data requirements may change with time. This data shall be used in evaluating performance of the cage fish farming thus providing a basis for evaluating and justifying the of cage fish farming on the water bodies. Farmers are expected to provide this data to sector relevant agencies such as Department responsible for fisheries management annually. The data should also be availed to fisheries research on request. These institutions will be expected to keep the data from specific farms confidential and only use it to inform management.

5. POLICY, LEGAL AND INSTITUTIONAL REQUIREMENTS

Aquaculture developments worldwide are regulated to ensure adherence to the Ecosystem Approach to Aquaculture.

5.1. International and Regional Frameworks

Aquaculture sustainability is of a global concern. There are international and regional policies, legal instruments and institutions that shall be applied or improved to support aquaculture establishments and practices in East Africa. Key international and regional policies shall be applicable include those of the United Nations especially the Food and Agricultural organization of the United Nations (FAO), the African Union, and the East African Community. The international and regional policies shall be adopted where applicable by national governments to support aquaculture. Some of these policies, their key provisions and responsible institutions are summarized in **Annex 9**.

5.2. National Frameworks

5.2.1. Uganda

There are existing policies, regulations and institutions that can be applied to support cage fish farming in Uganda. The main policies, regulations and institutions of direct relevance to cage fish farming are those responsible for fisheries management, research and management of the fish habitat. A number of institutions that have a stake in the development of cage aquaculture in Uganda include the following.

a) Directorate of Fisheries Resources (DiFR);
b) National Environmental Management Authority (NEMA);
c) Directorate of Water Resources Management (DWRM);
d) Department of Wetland Inspection Division;
e) National Fisheries Resource Research Institute (NaFIRRI);
f) Local Governments;
g) Academic institutions such as universities and other tertiary institutions such as the Fisheries Training Institute (FTI);
h) Uganda Investment Authority (UIA);
i) National Drug Authority (NDA);
j) Ministry of Water and Environment (MWE)
k) Ministry Works and Transport;
l) Uganda National Roads Authority (UNRA)
m) Uganda National Bureau of Standards (UNBS);
n) National Planning Authority (NPA);
o) National Agricultural Advisory Services (NAADs); and
p) Fisheries CBOs – BMUs and Fish Farmers Associations/Organizations.

The institutions above, including those that are not directly responsible for fisheries have policies with relevant provisions or regulations that can address issues or support cage fish farming in Uganda as summarized in **Annex 10**. Farmers, investors, and managers are expected to familiarize themselves with these policies, utilize them and ensure compliance.

5.2.2. Kenya

Like in Uganda, there are existing policies, regulations and institutions (**Annex 11**) that can be applied to support cage fish farming in Kenya including those of direct relevance to cage fish farming. Institutions include:

i. The State Department of Fisheries and Blue Economy (SFD & BE);
ii. The Kenya Marine and Fisheries Research Institute (KMFRI);
iii. County Governments;
iv. Public and private training institutions including Universities;
v. Community Based Organizations (CBOs) such as BMUs and fish farmers' associations/organizations;
vi. Kenya Bureau of Standards;
vii. National Environmental Management Authority (NEMA);
viii. Ministry of Water and Irrigation;
ix. Kenya Private Sector Alliance (KPSA);
x. Kenya Maritime Authority;
xi. Ministry of lands and Housing / National Lands Commission;
xii. Ministry of Environment and Natural Resources; and
xiii. Ministry of Transport, Infrastructure, Housing and Urban Development; State Department for Maritime and shipping Affairs.

5.2.3. Tanzania

The main policies guiding the development of aquaculture in Tanzania are the Fisheries Policy, Water Resource Policy, Lands Policy and policies that address the youth and employment issues. Regulations drawn from these main policies and the implementing institutions facilitate the development of this subsector. The following are some of the key institutions that have a stake in the development of cage aquaculture in Tanzania:

a) Directorate of Aquaculture Development;
b) Directorate of Fisheries Development;
c) Local governments (LGAs);
d) National Environmental Management Council (NEMC);
e) Ministry of Water - Directorate of Water Resources Management (DWRM);
f) Department of Wetlands Management;
g) Tanzania Fisheries Research Institute (TAFIRI)
h) Tanzania Fisheries Training and Education (FETA);
i) Economic and Social Research Foundation (ESRF);
j) Academic institutions such as universities (UDSM, SUA and others);
k) Tanzania Investment Centre (TIC);
l) Tanzania Food and Drugs Authority (TFDA);
m) Ministry of Transport;
n) Surface and Marine Transport Regulatory Authority (SUMATRA);
o) Tanzania Bureau of Standards (TBS);
p) Fisheries CBOs – BMUs, Fish Farmers/Associations.

Annex 12 summarizes policies, institutions and regulations of relevance to cage fish farming in Tanzania.

6. STEP BY STEP PROCEDURE OF ESTABLISHING A CAGE FISH FARM

The following steps are proposed to obtain a license to establish a cage fish farm:

a) The prospective farmer or investor will start by visiting responsible fisheries agencies (Devolved/Local Government Authorities) where the proposed cage culture investment is to be established to obtain information on the requirements and expectations.

   i. At this stage, the farmer and investor are expected to either prove that they are citizens of the respective countries by presenting authentic and valid national identity cards or in case of a foreign investor, documents to prove that they are legally living in the countries.

   ii. In addition, foreign investors are expected to present an investment license issued by respective investment authorities.

b) Evidence of community consultation and disclosure near the site:

   i. Visit the village and hold discussions on proposed investment;

   ii. Obtain consent letter on acceptance of the cage establishment in their area.

c) Site suitability report done by the relevant authorized organizations (see section 4.3.7.)

d) The prospective investors or farmers will in addition to the site suitability report present a business proposal (**Annexes 13**)

e) Obtain a clearance/permit for water abstraction in case of use in excess of 400m^3 of water a day and discharge plan including measures for treatment of farm effluents into the surroundings from institution responsible water resources management;

f) Where necessary, obtain land title/lease land from the relevant authorities;

g) Certificate of incorporation and registration of business;

h) Registration with devolved/local government and obtain trading license;

i) Source of seed and feeds.

If these requirements are met, the Department responsible for aquaculture will issue the farmer a two-year provisional license to establish and operate a cage fish farming enterprise. At this stage, the farmer can establish a cage fish farm on the approved site. The respective Aquaculture Agency will monitor farm operations and upon satisfactory compliance issue 5 years operating license renewable. Approved applicants are given approval numbers, and are added to the list of certified aquaculture establishments authorized to produce and sell particular aquaculture products locally and/or externally if they meet the export market requirements. Any major changes made to the originally approved plan will require approval from the Competent Authority. During operation and establishment, farmers or investors are expected to comply with all policies related with cage fish farming (**Annexes 9-12**). Lack of compliance will lead to cancellation of the license

7. ADOPTION AND REVIEW OF THE GUIDELINES

The Guidelines for Establishment and Operation of Cage Fish Farming in the East African Community were approved by the Fisheries and Aquaculture Sectoral Council on 2nd March 2018.

The guidelines will initially be reviewed after two years and thereafter every four years, when any modifications necessitated or allowed by changes in national legislation and national guidelines can be incorporated.

8. ANNEXES

Annex 1 - Enterprise budget for 10 units of Low Volume High Density (LVHD) cages

Gross Receipts	Unit	Quantity	Unit Cost	Total cost (USD)
Gross Receipts of tilapia at harvest	Kg	16,875	8,500	54,747
Variable Costs:				-
Nile tilapia fingerlings	No	18,750	250	1,789
Feeds	Kg	25,313	2,850	27,535
Labor	months	6	1,200,000	2,748
Food/Fish Baskets	No	10	20,000	76
Feeding accessories	Assorted	10	10,000	38
Total Variable Costs (TVC)				32,186
Net Returns Above TVC				22,561
Fixed Costs (FC):				
Cage (2.5X2.5X2.5) m	No	10	2,200,000	8,397
Mooring and technical services		1	500,000	191
Boat	No	1	2,500,000	954
Life jackets	No	4	70,000	107
Multi parameter meter	No.	1	4,000,000	1,527
Weighing Scales	No	2	1,000,000	763
Placement of the cages in lake		10	250,000	954
Total Fixed Costs (TFC)	UGX			12,893
TFC Amortarised over 10 year	UGX			1,289
Total Costs (TC)	UGX			45,079
Insurance - per annum	UGX			1,150
Professional Management	UGX			2,254
Net Returns Above TC - Run 1	UGX			6,264
Net Returns above TC per cage - Run 1	UGX/Cage			626
Net Returns less TFC Run 1				19,157
Net Returns less TFC Run 1/cage				1,916
Net Returns (Amortarised FC)	UGX			17,868
Net Returns per cage Amortaritsed	UGX/Cage			1,787
Cost of installing, running 1 cage for 6months				4,848
Cost of installing, running 1 cage for 6months				3,688
% profit (Run 3) / cage				
% profit (Run 3) / cage				

Notes: The projections are for operating ten cages (15.6 m^3 each), stocked with Nile tilapia fingerlings of 20 g at a stocking density of 280 fish m^{-3} with a survival rate of 90%, fed with pelleted diet of 30% crude protein, with a food conversion ratio of 1.5, harvested twice a year at 0.5 kg, producing 120 kg m^{-3} i.e. a production period of six months, assuming cage frames last for ten years and the nets last 5 years. 1$ = 2620 Uganda shillings).

Annex 2 - Ideal levels of physico-chemical conditions required in sites suitable for cage fish farming.

Variable	Description/Notes	Ideal levels
Depth	There should be at least 4m depth under the cage i.e. 7-8m for a cage that is 3m deep to facilitate water exchange; avoid oxygen depletion, accumulation of uneaten food, faecal material and debris, disease infection and buildup of noxious gases such as hydrogen sulphide and methane from decomposition of wastes. Depths greater than 20 m should be avoided for small cages as they tend to have high waves that can stress the fish.	5- 20 m
Water transparency	Depth of visibility in water is a measure of suspended and dissolved solids, sunlight and salinity. The greater the depth the lower the nutrient level, but the greater the potential for cage fish yield. The recommended water transparency for cage culture is ≥40 cm.	>70 cm
Bottom type	Bottom should not have or accumulate large amounts of organic debris.	Gently sloping gradient.
Sediment color	Sediment at the site should not show signs of contamination by possessing a black layer	Clear sediment with no black layer
Sediments type	The ideal site should have a firm substrate with fine gravel and sand. The cage site should slope from the shore leading to flat bottoms to reduce buildup of waste at the bottom of cages	Firm substrate with fine gravel and sand, sloping from the shore to flat bottoms
Wind velocity	This determined the height of waves at a specific site on a water body. The higher the velocity , the higher the wave height and current speed	≤10 knots
Wave height	Wave height of a surface wave is the difference between the elevations of a crest and a neighboring trough. High waves deform and destroy cages leading to losses and escapes of fish	<1m
Current speed	Currents bring fresh oxygenated water and remove waste from the cages. A minimum current of 10 cm $sec.^{-1}$ and a maximum of 100 cm $sec.^{-1}$ are recommended for high stocking densities. Stronger currents exert strain on the cage anchoring system and distort the cage structure. The rectangular raft of the cage should be in a direction parallel to the current to minimize strain on the anchoring system. In weak current areas, the raft can be positioned against the current for better water flow. Currents also influence temperature by facilitating mixing, bringing cooler water from the bottom to the surface and reducing the heating of the surface waters.	10 to 100 cm/sec
Temperature	Water temperatures of 27-30^{0}C are ideal for tropical fish growth in the tropics. Changes in water temperature affect fish metabolism, oxygen consumption, and ammonia and carbon dioxide production rates, Feed Conversion Ratio (FCR) as well as fish growth.	27-30^{o}C
pH	The desirable range of pH is between 6.5 and 9.0. pH outside this range slows fish growth and increases susceptibility to disease. Most fish species grow slowly at pH levels < 6.5 and >11	6.5-9
Dissolved Oxygen (DO)	DO influences growth, survival, behavior and physiology of fish	≥5 mgL^{-1}
Biochemical oxygen demand (BOD)	BOD measures the total DO consumed by microorganisms for biodegradation of organic matter. High BOD levels above 6 mgL^{-1} indicates pollution from organic material such as sewage and can suffocate fish	<6 mgL^{-1}
Carbon-dioxide (CO_2)	Produced from respiration of animals and exists in water as bicarbonate or carbonates. It forms carbonic acid when dissolved in water leading to low pH which can be harmful to fish	≥5 mgL^{-1}.

Variable	Description/Notes	Ideal levels
Total Ammonia Nitrogen	Ammonia is caused by deposition of uneaten food and debris, excretion wastes, sewage discharge and industrial pollution. The recommended level of ammonia in fish culture should be <0.01mgL^{-1}. The suitable time to measure ammonia is when water current is slow. Sewage discharge and industrial pollution are the main sources of high ammonia content. Sites of effluent deposition to the lake should be avoided.	Not more 0.3–2 mg L^{-1}
Nitrate	The optimal level is 2mgl^{-1}. Accumulation of organic matter in the sediment provides an environment for nitrite generation where it is converted to ammonia. This can bind with hemoglobin to form methemoglobin which interferes with transportation of oxygen in the blood. Toxicity increases with low DO and decreases with increasing chloride concentration.	0.1-4.0 mg L^{-1} (2 mg L^{-1} is optimal)
Nitrite	Nitrite affects fish by oxidizing haemoglobin to methemoglobin in the blood, hindering respiration and causing damage to the nervous system, liver, gills, spleen and kidneys of the fish.	< 0.2 mgl $^{-1}$
Total phosphorous	Total Phosphorus is the sum of reactive, condensed and organic phosphorous and is an important nutrient in fresh water bodies which can cause adverse environmental impacts when present in large concentrations	<100 µg/L
Chlorophyll-*a*	This is an indicator of primary production	<75 µg/L
Total suspended solids	Suspended solids are pieces of particulate matter larger than 0.45µm. They make water turbid preventing good water exchange due to accumulation of suspended solids in the cage. Suspended solids act as substrate for growth of fouling organisms which affects water circulation. Suspended solids can also clog the gills of fish leading to mortality. Visibility of fish will also be reduced leading to feed losses and impaired growth.	<10mgL^{-1}
Total dissolved solids	These are pieces of particulate matter smaller than 0.45µm.	<40 mg L^{-1}
Conductivity	Conductivity is determined by presence of ions such as Ca^{2+}, Mg^{2+}, HCO, CO_3^-, NO_3^- and PO_4^- in water	30-5,000 mSiemens/cm
Salinity	Salinity is defined as the total concentration of electrically charged ions (cations – Ca++, Mg++, K+, Na+ ; anions – CO3-, HCO3-, SO4-, Cl- and other components such as NO3-, NH4+ and PO4-). Salinity is a major driving factor that affects the density and growth of aquatic organism's population	2-3 ppt
Alkalinity	This is the capacity of water to resist changes in pH, and is based on total concentration of bases such as carbonates, bicarbonates, hydroxides, phosphates.	120-400 ppm
Hardness	This is the measure of elements such as calcium, magnesium, aluminium, iron, manganese, strontium, zinc, and hydrogen ions. These are essential for metabolic reactions	30-180 mgL^{-1}
Chloride	Chloride is a common component of most waters and is useful to fish in maintaining their osmotic balance	60-100 mg L^{1-}
Faecal coliform	Coliform are bacteria belonging to Family Enterobacteriaceae. Presence of these is indicative of contamination of feacal material of human and other warm blooded animals High levels of these may cause typhoid fever, hepatitis, gastroenteritis, dysentery and eat infection	≤100 count per 100 ml

(Adopted from: Bhatnagar, A. and Devi, P. 2013; OECD 1982)

Annex 3 - List of variables on which data should be obtained for monitoring purposes

Water quality Parameters	Monitoring frequency by farmer	Monitoring frequency by CA
PH	Monthly	Quarterly
Dissolved oxygen.	Monthly	Quarterly
Temperature	Quarterly	Quarterly
Suspended solids	Quarterly	Quarterly
Nutrients	Quarterly	Quarterly
Turbidity	Quarterly	Quarterly
Total nitrogen	Biannually	Biannually
Trace metals		Annually
Organic matter		Biannually
Total carbon		Biannually
Sulfide		Annually
Macro invertebrates		Biannually
Plankton		Biannually
Fish communities around the cage		Biannually

Annex 4 - Maximum concentrations of selected heavy metal contaminants in water(mg m^{-3}) and sediments (µg/g) at sites selected for cage fish farming.

Heavy metal	Sediments (µg/g)	Water (mg m^{-3})
Mercury	0.2	0.144
Lead	31	5
Nickel	16	13.4
Cadmium	0.6	10
Zinc	120	20
Iron	2	300
Copper	16	3
Chromium	26	50
Arsenic	6	5
Manganese	460	50
Selenium	-	10
Barium	60	1000
Silver	0.5	50
Thallium	-	13

For each heavy metal, the concentrations is at the level it causes lowest influence to the environment (Adopted from: TNO, 2008a; TNO, 2008b; Swedish Environmental Protection Agency, 2000; FAO 1999; David Batts, D. and Cubbage, J. 1995)

Annex 5 - Maximum concentrations of selected Persistent Organic Pollutants (POPs) and Pesticides at selected sites for cage fish farming.

Persistent organic pollutant/pesticides	Sediments (µg/g)	Water (µg/l)
Aldrin	0.002	0.01
Chlordane	0.007	
DDT (total)	0.007	
Dieldrin	0.002	0.005
Endrin	0.003	0.005
Heptachlor	0.0003	
Toxaphene	-	0.002
Polychlorinated Biphenyls (total)	0.07	
Mirex	0.007	
Hexachlorobenzene	0.02	0.01
Endosulfan	-	0.1
Tributyltin	-	0.014
Pentachlorobenzene	-	1
Lindane	0.005	0.02
α-Hexachlorocyclohexane	-	10

Included in the table are some of the dirty dozen provided in the Stockholm convention on POPs in sediments (µg/g) and water (µg/l) at sites selected for establishment of cage fish farming. For each, the concentrations is at the level it causes lowest influence to the environment (Adopted from: TNO, 2008a; TNO, 2008b; Swedish Environmental Protection Agency, 2000; FAO 1999; David Batts, D. and Cubbage, J. 1995).

Annex 6 - Summary of nutrient level requirements for Nile tilapia at different culture stages

Nutrient	Fish Size Class and nutrient levels				
	Fry (0-0.5 g)	Fingerling (0.5-10 g)	Juvenile (10-50 g)	Grower (50g+)	Brood stock (500 g+)
Crude protein (% min)	45	35-39	30-37	30-35	35-37
Amino acids (% min)					
Arginine	1.6	1.2	1.1	1.1	1.2
Histidine	0.6	0.5	0.4	0.4	0.5
Isoleucine	1.2	0.9	0.8	0.8	0.9
Leucine	1.5	1.2	1	1	1.2
Lysine	2	1.6	1.4	1.4	1.6
Methionine	0.9	0.7	0.6	0.6	0.7
Cystine	0.29	0.27	0.26	0.24	0.26
Phenylalanine	1.4	1.1	1	1	1.1
Tyrosine	0.97	0.9	0.85	0.81	0.85
Threonine	1.5	1.2	1	1	1.2
Tryptophan	0.3	0.2	0.2	0.2	0.2
Valine	1.1	0.9	0.8	0.8	0.8
Crude lipid (% min)	8	7	7	6	5
Carbohydrate (% max)[1]	30	35	40	40	40
Crude fibre (% max)	1.5	2	3	4	4
Major minerals					
Calcium (% max)	2.5	2.5	2	2	2
Phosphorus (% min)[2]	1	0.8	0.8	0.7	0.8
Magnesium (% min)	0.08	0.07	0.07	0.06	0.07
Vitamins (IU/kg min)[3]					
Vitamin A	3000(6000)	2500(5000)	2000(4000)	1500(3000)	3000(6000)
Vitamin D_3	1500(3000)	1250(2500)	1000(2000)	750(1500)	1500(3000)
Vitamins (mg/kg min)					
Vitamin E	120(240)	100(200)	80(160)	60(120)	120(240)
Vitamin K	10(12)	8(10)	6(9)	5(6)	10(12)
Vitamin B12	0.015(0.03)	0.0125(0.025)	0.01(0.02)	0.0075(0.015)	0.015(0.03)
Vitamin C)[4]	300(900)	250(750)	200(600)	150(450)	300(900)

Source: Jauncey, 1998; NRC, 1983; and Millikin, 1982: [1]Digestible carbohydrate, [2]Available phosphorus, [3]Suggested minimum dietary vitamin levels required to prevent deficiency. Values in parentheses indicate suggested dietary vitamin levels taking into account processing, storage and leaching losses. [4]These vitamins should be added separately to the diet and not included in the form of a multivitamin premix; vitamin C should be added in fat coated form so as to minimize losses through diet processing and leaching

Annex 7 - A feeding chart showing recommended daily feeding rates for Nile tilapia of different weight.

Fish weight (g)	Feeding rate (%BW)	Quantity of feed /fish/day (g)
1	11.0	0.11
2	9.0	0.18
5	6.5	0.33
10	5.2	0.52
15	4.6	0.69
20	4.2	0.84
30	3.6	1.08
60	3.0	1.8
100	2.5	2.5
175	2.5	4.38
300	2.1	6.3
400	1.5	6
500	1.5	7.5

Source: SRAC No. 281

N.B: This feeding chart should only be used to guide the development of a local farm specific feeding chart.

Feeding frequency and time are also important. Fish should be fed two or three times a day by dividing the daily ration into two or three portions and each portion given at a different time such as 9:00 am, 1:00 pm and 4:00 pm. Fish less than 25 g should be fed at least three times a day. It is advisable to feed fish by response. Preferred feeding time is between 8:00 am to 4:00 pm. Adequate supplies of good quality feed must be available. Non-filter feeding fish confined in cages have limited access to natural foods and need a nutritionally complete diet on a daily basis using proper feeding considerations. Simple feeding equipment may be obtained to make feeding in cages easier. Floating rings are used to retain floating feeds inside cages. Feeding trays may be built inside cages or placed on the cage floor to retain sinking pellets. Other important considerations and recommendations for feeding fish in cages are as follows:

a) Time to feed should be between 9:00 am to 4:00 pm the late afternoon.
b) Feeding should be in the centre of cage or in many places at the same time.
c) Feeding should be based on the demand by the fish.
d) Feeding should be by observation of the fish and should be stopped once the fish stop feeding to prevent the residue of food waste that can lead to contamination and diseases.
e) The health of fish should be checked regularly to find out disease outbreak.
f) There should be adjustments in the amount of feed given to fish depending on the average body weight of the fish obtained from regular sampling.
g) Under special cases such as diseases problems, net tear or broken and too much fouling, the net should be changed.

Regular grading (at least once a month) is suggested to reduce competition and ensure uniform growth.

Annex 8 - Required enterprise data that should be obtained by farmers

Item/variable	Unit	Qty	Unit Cost	Total cost
Office space				
Canoe (wooden or fibre glass)	Number (N)			
Outboard engine	N			
Life jackets	N			
Cage size (m^{-3})	N			
Fish stocking density	fingerlings m^{-3}			
Number of fingerlings stocked	N			
Initial weight of fingerlings at stocking	g			
Initial total weight stocked	kg			
Feeds (35% protein)	kg			
Feeds (30% protein)	kg			
Other feeds	kg			
Fish survival rate	(%)			
Final weight of fish at harvested average	g			
Fish yield	Kgm^{-3}			
Selling price of fish	Ugshs/KShs/Tshs/ kg^{-1}			
Operation and maintenance – Fuel per day	Litres (L)			
Operation and maintenance – Oil per day	L			
Operation and maintenance – Labor (list key personnel and their monthly salary)				

Annex 9 - Key international and regional policies and institutions important for cage fish farming in East Africa

Issue to be addressed	Policy/Legislation	Provision of the policy and regulation	Implementing institution (s)	Role in cage fish farming
Ensuring that aquaculture practices and operations are sustainable	FAO - Code of Conduct for Responsible Fisheries (CCRF)	Provides for responsible aquaculture practices in trans boundary water bodies; cooperation in the promotion of sustainable aquaculture practices; ensure responsible choice of species, siting and management of aquaculture; requires consultation with their neighboring states before introducing non-indigenous species; establish appropriate mechanisms to collect, share and disseminate data; Cooperate in monitoring the impacts of aquaculture.	State Department for Fisheries and Aquaculture	Monitoring, regulating, capacity building, awareness creation, data management and reporting
Ecosystem integrity and biodiversity conservation	CBD	Calls for incorporation of the Ecosystem Approach into Planning and Policy Processes.	Member States	Ensuring that aquaculture activities do not negatively affect biodiversity
Sustainable use of aquatic resources	UN SDG No. 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.	Member States	Harmonize regional measures
Management of trans boundary waters	Regional (joint communiqué Oct. 2014 and previous, regional Aquaculture strategic plan	Practice responsible aquaculture in the lake.	LVFO/EAC	Harmonize regional measures
Certification of broodstock, seed and feeds	EAC Regional Aquaculture Strategy and Implementation Plan	Promote a standardized quality of fish feeds, brood stock, seed, across the region and establish the means to monitor standards; Harmonize the management and the access to the shared water resources; Promote responsible aquaculture, application of good environmental practises and reducing conflict between users; Promote land mapping for aquaculture at the national level; Promote appropriate international codes; ensure that EIAs are properly conducted	State Departments of Fisheries and Aquaculture	
Regional harmonisation of cage fish farming on Lake Victoria (LV)	The convention for the establishment of the LVFO, 2001	Provides forum for developing and adopting measures for conservation and management of LV resources	Lake Victoria Fisheries Organisation (LVFO)	Harmonise regional measures for cage fish farming on LV.

Issue to be addressed	Policy/Legislation	Provision of the policy and regulation	Implementing institution (s)	Role in cage fish farming
Regional cooperation in development, conservation, and sustainable and use of LVB resources	Protocol for sustainable development of the LVBC, 2004	Provides a guidelines for development, conservation, and sustainable use of LVB resources	Lake Victoria Basin Commission (LVBC)	Provides guidelines that can be applied for cage fish farming in Lake Victoria
Regional cooperation in management of the environment of trans-boundary ecosystems	Protocol on environment and natural resources management,	Provides requirements for management of the environment and natural resources	East African Community (EAC)	Provides environmental guidelines that can be applied in cage fish farming on LV
Intra-regional trade	EAC Common Market Protocol 2010	Provides for free movement of goods and services.	EAC, MEACA, Ministry in charge of trade, Ministry of Finance and Revenue Authorities	Awareness creation, issues of Tarrifs, reporting

Annex 10 - A summary of some national policy, legal and institutional frameworks relevant to aquaculture in Uganda

Issue to be addressed	Policy/Legislation	Provision of the policy and regulation	Implementing institution (s)	Role in cage fish farming
Incorporating cage aquaculture in the NDP and DSIP	National Planning Authority (NPA) Act 15 of 2002	Establish a framework in the national development plan	National Planning Authority (NPA)	Provide for cage fish farming in NDP and DSIP
Incorporating cage aquaculture in the National fisheries Policy and Fish Act	National Fisheries Policy 2004; Fish Act CAP 197	Establish a framework for development of cage culture	Ministry of Agriculture, Animal Industry and Fisheries	Development Policy and guidelines for aquaculture
Promoting and facilitating investments	Investment Code 2000	Promote and facilitate private sector investments	Uganda Investment Authority (UIA)	Promote and facilitate private sector participation in cage fish farming
Guidelines for cage aquaculture	Fish (Aquaculture) Rules, 2003	General rules to guide aquaculture in Uganda.	Directorate of Fisheries Resources (DiFR)	Issuance of license, and monitoring cage fish farming
Research information	National Agricultural Research Act, 2005	Undertake research in fisheries and aquaculture	National Fisheries Resources Research institute (NaFIRRI) and other Public Agricultural Research Institutions (PARIs) and academic institutions	Undertake research on cultured species, seed and feeds; and monitor impacts of cage fish farming
Technical information and human resources capacity	Academic and training institutions	Train personnel and conduct research	National universities; and Fisheries Training Institute (FTI)	Train personnel; and conduct research in cage fish culture
Reduce environmental impacts	National Environment Management Statute of 1995 EIA Regulation 1998 (U)	Sustainable management of the environment. Procedure for conduction an EIA	National Environment Management Authority (NEMA) NEMA	Approve EIA for cage fish farming Provides guidelines for conducting the EIA
Reduce impact of cage fish farming establishments on wetlands, lake shores and river banks	The National Environment (Wetlands, River Banks and Lake Shores) Management	Management of Wetlands, River Banks and Lake Shores	NEMA	Provides guideline for locating cage culture support services along the shore.
Protection and management of water resources	Water Act 1997	Provides for use, control, supply, protection and management of water.	Directorate of Water Development (DWD)	Provides for approval to put cages in water
Information on sewerage disposal areas	National Water and Sewerage Corporation Statute	Water and sewerage services including treatment of sewerage	National Water and Sewerage	Information on areas of sewerage disposal into

Issue to be addressed	Policy/Legislation	Provision of the policy and regulation	Implementing institution (s)	Role in cage fish farming
			Corporation (NWSC)	the lake to guide location of cages
Control of use of chemicals	Agricultural Chemical (Registration and Control) Regulation, 1993	Control of use of chemical in agricultural production	Ministry of Agriculture, Animal Industry and Fisheries (MAAIF)	Regulates use of chemicals in cage fish farming
Control of improper use of drugs	National Drug Policy and Authority Act Cap 206, Laws of Uganda (2000)	control the quality of drugs	National Drug Authority (NDA)	Controls use of prohibited drugs s are used in cages
Extension services	National Agricultural Advisory Services Act,. 2001	Extending advisory services to the people to engage in profitable agricultural production	National Agricultural Advisory Services (NAADs)	Provide extension agents and cage fish farmers
Information on Lake transport routes and anchoring sites	Uganda National Roads Authority (UNRA) Act, 2006	Addresses national transport planning	Uganda National Roads Authority (UNRA)	Provide guidance on lake transport routes
Management of cage fish farming under local governments	Local government Act, 1997	Decentralizes functions including management environment and production systems to local government	Districts authorities	Oversee implementation of cafe fish farming in under local government

Annex 11 - A summary of some national policy, legal and institutional frameworks relevant to aquaculture in Kenya

Issue to be addressed	Policy/Legislation	Provision of the policy and regulation	Implementing institution (s)	Role in cage fish farming
Review to be tandem with the devolved system (Constitution 2010)	National Oceans and Fisheries Policy	General Policy to guide aquaculture development in Kenya	Ministry of Agriculture Livestock and Fisheries (MOALF)– State Department of Fisheries and Blue Economy (SDF&BE) Kenya Fisheries Service (KeFS)	Promote aquaculture development
Revision to be in tandem with the devolved system (Constitution 2010)	National Aquaculture Policy (2011)	Promote and facilitate sustainable development of aquaculture;	MOALF –SDF&BE KeFS	Provide for Cage Fish Culture in NAP
Revision to be in tandem with the devolved system (Constitution 2010)	National Aquaculture Strategy and Development Plan (2010-2015)	Promote and facilitate sustainable development of aquaculture;	MOALF –SDF&BE KeFS	Provide for Cage Fish Culture in NASDP
Promoting and facilitating Investments	Investment Promotion Act No 6 revised 2012	Promote and facilitate investors to obtain the necessary licenses to invest	Kenya Investment Promotion Authority (KIPA)	Promote and facilitate Private Sector investment in Cage fish farming
Guidelines for Cage Culture	The Fisheries Act CAP 378, revised 2012	Sustainable development of aquaculture	MOALF –SDF&BE KeFS	Promote and facilitate Private Sector investment in Cage fish farming
Research information	The Science Technology &Innovation Act No. 28 of 2013	Facilitate the promotion, coordination and regulation of innovation in fisheries and aquaculture	KMFRI; Academic Institutions;	Undertake research on current cultured species; new culture species; fish seed, feeds; monitor impacts of cage fish farming
Reduce Environmental Impacts	The Environmental Management and Co-ordination Act, No. 8 of 1999	Sustainable Management of the environment; Procedures for conducting ESIA;	NEMA	Provides guidelines for conducting ESIA, and approves the ESIA for cage fish farming
Protection and management of water resources	Water Act, 2002 (CAP 372)	To promote sustainable availability of water for production purposes for attainment of national cultural and socio-economic development aspirations' (promote efficient use)	Ministry of Water	Provides guidelines for the use of the water

Issue to be addressed	Policy/Legislation	Provision of the policy and regulation	Implementing institution (s)	Role in cage fish farming
Prevention and Control of fish diseases	Animal diseases Act CAP 364, revised 2012	Provides for prevention, management and control of animal diseases	MOALF State Department of Livestock (SDL) – Directorate of Veterinary Services (DVS)	Provides guidelines for the management of fish disease outbreaks
Transport routes and anchoring sites on water bodies (Lake)	Kenya Maritime Authority Act, CAP 370, revised 2012	Monitoring, regulation and coordination of activities in the maritime industry	KMA	Provides for guidelines in undertaking investigation and surveys in the maritime field
Control of use of chemicals in fish farms	Pest Control Products Act, Cap 346 of 1982	Management of use of pest control products (chemicals)	Pest Control Products Board (PCPB)	Provides guidelines on use of chemicals in cage fish farming
Control of use of veterinary drugs/medicines in aquaculture	Pharmacy and Poisons Act, Cap 244, revised 2009	Management of the use of veterinary supplements/medical medicines in aquaculture	Pharmacy and Poisons Board (PPB)	Provides guidelines for the use of veterinary supplements/medical medicines in cage fish farming
Management and development of Aquaculture in the County	The County Governments Act, 2012	Provides the county governments power, functions and responsibilities to deliver services	County Governments	Monitor cage fish farming in County
Training/ Human resource Capacity building	Academic and Training Institutions	Training of personnel	Universities, Technical Training Institutions	Training in cage fish culture

Annex 12 - A summary of some national policy, legal and institutional frameworks relevant to aquaculture in Tanzania

Issue to be addressed	Policy/Legislation	Provision of the policy and regulation	Implementing institution (s)	Role in cage fish farming
Permission to carry out cage culture	The Fisheries Regulations, 2009 (G.N. No. 308 OF 2009)	Part IV, Section 37 (a),(b)	MALF	Describe permitting procedures to carry out cage culture
Overall aquaculture development policy	The Fisheries and Aquaculture Policy 2015.	Policy Statement2.4.2(v) *inter alia* 3.6, 3.7,3.14; 3.16.1	MALF	Promote sustainable aquaculture development in Tanzania including cage culture.
Environmental conservation	The National Environmental Management Act, 2004	Various provisions	NEMC	Conducting EIA
Ecosystem Approach to Aquaculture Development;	National Aquaculture Development Strategy, 2009	Chapter 2-3	MALF	Promote establishment of cage culture in Tanzania
Aquaculture Technology development	National Aquaculture Development Strategy, 2009	Matrix	MALF	Roles of central Government, LGAs, NGOs, CBOs, FBOs, the Civil society and institutions in aquaculture development
Research Development	Tanzania Commission for Science and Technology Act 1986	Facilitate the promotion, coordination, and regulation of innovation in fisheries and aquaculture	TAFRI, Academic Institutions	Undertake research on current and new cultured species, fish seed, feeds, diseases and monitoring impacts of cage fish farming.
Land for aquaculture development	National Land Policy	The Land Act, No. 4 of 1999 for public land; The village land Act of 1999.	Ministry responsible for Lands	Procedures for acquiring (public or village) land for aquaculture development; Designate areas for potential investors in commercial aquaculture
Aquaculture inputs, industrialisation, trade and standards	National policy on industrial development	Various provisions;	Ministry responsible for industries	Regulate manufacture and importation of aquaculture inputs and accessories;
Aquaculture processing industries	Rural Industrialization Strategy	Various sections	Ministry responsible for industries	Promote aquaculture processing to add value
Water for aquaculture development	National Water Policy 2009	Water Resource Management Ac t (No.11 of 2009)	Ministry responsible for water resource management	Provide procedures for granting water use permit;
Transport routes and anchoring sites on water bodies	National Transport Policy 2003	Surface and Marine transport regulatory authority act of 2001	SUMATRA	Guiding and regulating marine transport

Annex 13 - STRUCTURE OF A BUSINESS PLAN

Typical structure for a business plan for a start-up venture will include but not limited to the following:

EXECUTIVE SUMMARY

ENTERPRISE PROFILE

Introduction, Situation Analysis
Vision, Mission, Objectives, Core Values

PRODUCTS, SERVICES AND PRODUCTION PROCESS

Products and Services
Enterprise Siting
Production Process
Harvesting and Harvest Weight
Risks and Mitigation Measures

MARKETING PLAN

Market and Trade Analysis
Market Segments and Sales Forecasts
Competitive Edge

ENTERPRISE OPERATING ENVIRONMENT

Institutional Framework
Environmental Impact Assessment
Regulatory Framework
Competition
Collaborations and Partnerships
Aquaculture Extension Services

MANAGEMENT PLAN

Training Needs Assessment (TNA) Findings
Training, Research and Development
Enterprise Operational Policies and Procedures
Management Issues
Human Resource Management

STRATEGY

Production Strategy
Marketing Strategy
Advertising and Promotion Strategy
Products Pricing and Costing Strategy
Customer Care Strategy

Financing Strategy
Expansion Strategy
Management and Enterprise Development Strategy

FINANCIAL PLAN

Financing Plan
Financial Administration
Design, Reporting, Monitoring and Evaluation

ANNEXES

Aqua-enterprise Performance Target Template
Environmental Impact Assessment Summary and Staff Schedule
Financial Projections and Notes, Budgets, Cash-flows, Profit and Loss