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FARM AFRICA

FARM AFRICA: KENYA MARKET-LED AQUACULTURE PROGRAMME

Strategic Environmental Assessment and Environmental Management Plan

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REPORT

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Executive Summary

Introduction

Farm Africa is an international non-governmental organisation (NGO), working with smallholder farmers, government and the private sector to catalyse rural transformation in East Africa. Farm Africa intends to create an aquaculture industry in Kenya that will generate sustainable incomes, food security and employment, known as the Kenya Market-Led Aquaculture Programme (KMAP). Farm Africa would like to ensure that the proposed KMAP will be implemented in an environmentally sustainable way. For this reason, they requested that Golder Associates Africa (Pty) Ltd (Golder) in collaboration with Advance Africa Management Services (Advance Africa) conduct a Strategic Environmental Assessment (SEA) for the proposed KMAP, this report.

The purpose of the SEA was to assess, at a high level, the potential environmental impacts resulting from the intensification of pond aquaculture, hatchery operations, feed production and cage culture practices. It also addresses the potential environmental and social risks to the sustainability of KMAP. Furthermore it provides a framework for environmentally sound, climate sensitive, technical and economic decision making during project implementation, whilst ensuring legal compliance and providing recommendations on best practice.

Project Description

The KMAP has been developed in response to a decline in wild fish stocks in Lake Victoria (the Lake) and an increase in demand for fish in Kenya due to consumers recognising its nutritional value. Farming fish offers significant economic benefits and, unlike capture or marine fisheries, does not rely on a depleting natural resource.

The goal of KMAP is to develop a vibrant aquaculture industry that generates sustainable incomes, food security, and employment through the following objectives:

- Sustainably increasing productivity of medium to large scale fish farmers, hatcheries and fish feed producers;
- Increasing access to markets for medium to large scale fish farmers and service providers; and
- Enhancing the enabling environment to support aquaculture development.

The duration of the programme is expected to be four years, extending from January 2016 to December 2019. The programme aims to fully commercialise at least 1 100 aquaculture farmers by December 2019, including the establishment of a competitive industry based on many thousands of mid-sized enterprises. This should increase the availability of farmed fish in Kenya by 4 000 metric tonnes (MT) per year, thereby providing an affordable source of protein to around 1.2 million people.

In order to achieve this, Farm Africa intends to:

- Introduce new aquaculture technologies and improve service provider inputs (e.g. fingerling and feed);
- Provide technical aquaculture training and support across the industry value chain;
- Build the business and marketing skills of selected entrepreneurs; and
- Enable collective marketing with access to wider and more profitable markets.

For further information on KMAP please refer to APPENDIX B.

Policy, Legislation and Best Practice Guidelines

A review of Kenyan legislation applicable to aquaculture was conducted and compared with international voluntary instruments. A gap analysis resulted in the following findings:

- The existing regime of law governing aquaculture is fragmented as there are different statutes each addressing a particular sub-sector of the industry. There is therefore a need to review the current policies and laws of Kenya, to align them with the Constitution;
- Policy should be implemented that encourages collaboration between the agriculture and aquaculture sectors, especially regarding inputs (e.g. feed ingredients) and outputs (e.g. waste and fertilizers);
- Effective legislation needs to be in place to regulate the growth of national production, as well as to mitigate environmental damage and industry problems which can be associated with low quality seed (fish eggs);
- The Ministry of Fisheries should prioritise the development of aquaculture zone maps to facilitate effective sector management;
- A notable weakness of the Environmental Impact Assessment (EIA) regulations is that public participation is limited to affected parties only and thus reduces the opportunity for non-affected but interested parties from influencing decision making; and
- Certain government agencies in Kenya do not have adequate capacity to guide and review EIAs (UNEP, 2010; Ali, 2012). This has been attributed to a lack of resources such as funding, equipment and trained personnel.

Technical Aquaculture Assessment

A technical aquaculture assessment was conducted by visiting existing pond and cage culture operations in Nairobi and Kisumu and interviewing key stakeholders. The following was determined:

- Tilapia and Nile perch are the most traded fish in terms of value and are in high demand amongst local consumers. The demand for fish, specifically tilapia and Nile perch will continue to increase as wild stocks are declining:
  - The price of Nile perch and tilapia is relatively high and subsequently most of the consumers are from medium to high incomes.
- The value chain of the fish trade in Kenya has well-established linkages between stakeholders and operates as a closed system. The gate keepers to the fish market are the traders' associations that are made up of familial relationships. Entry into the trade is controlled by them and hence is limited (Lattice Consulting, 2016);
- Pumping water is expensive and electricity supply can prove unreliable, and so frequently has to be supplemented by a petrol/diesel generator. As power and fuel prices increase, such systems may prove to be economically unsustainable in the future. Gravity-fed water supply and/or clean energy solutions should be invested in;
- Imported feed is of better quality, but it is more expensive to local farmers. The local feed has an acceptable protein content. However, the local pressed pellet feed was observed to not be of a very high standard. The availability of feed is variable and so farmers use more than one supplier;
- In general, farmers are satisfied with the quality of fingerlings. However, it was communicated that the fingerling market is troublesome due to a seasonal mismatch between supply and demand; and
- Uneaten feed and faeces are the two most prominent waste streams in cage based aquaculture. Sinking feeds in cage culture practices may result in eutrophication in shallow (<12 m) Lake areas.

These findings resulted in the following recommendations:

- Regulations and guidelines governing cage culture in the Lake need to be put in place;
- Cage culture should be incorporated within the scope of the KMAP project;

- The Lake shore should be assessed for the most suitable cage sites and encouraged or incentivised in those areas;
- The development of reliable commercial fingerling production should enhance the profitability and expansion of cage culture in the region;
- The production of good quality locally made feed for cage aquaculture needs to be a focus of KMAP;
- Farmers should be encouraged to use bigger ponds (500 m^2 or larger) in order to benefit from the economies of scale associated with larger operations; and
- A common challenge in aquaculture is access to the right genetics of a species for production. As such, KMAP should initiate and support a Nile tilapia genetic improvement programme within its scope of work.

Potential Risks to KMAP Sustainability

Some of the key environmental and social risks to the implementation of KMAP include:

- To avoid user conflict, when selecting sites, farmers should consider the neighbouring land users and how their activities could potentially affect their farms, and vice versa;
- Potential user conflict over land ownership and natural resources;
- To avoid user conflict, communication channels for complaints (a grievance mechanism) should be established, so that should a member of the public, or a KMAP fish farmer, have a concern it will be dealt with by the appropriate authority in a timeous manner;
- To avoid user conflict, any acquisition of land must be done according to the correct protocols;
- Specialists in fish disease are not common in Kenya. Therefore, preventative measures will be key. Farmers must maintain suitable environmental conditions, select healthy fish, provide a nutritious diet, limit stress and vaccinate;
- Since eutrophication of Lake Victoria has already been identified as an issue, farmers need to ensure that they do not contribute to the problem further and must monitor the quality of the water they use carefully;
- Predators are a risk to fish stock both in ponds and in cages. Mitigation methods used must be environmentally sustainable;
- Extreme weather events can have detrimental effects on aquaculture operations. KMAP farmers should have access to climate change information and implement specific farm management measures for coping with the associated stresses. The aquaculture value chain, including fish distribution and markets, need to implement climate change adaptation measures;
- Farmers should be encouraged to collaborate in managing theft. This may be done through the joint hiring of a security company, joint funding of security infrastructure or by developing a ‘neighbourhood watch’ with the support of local police;
- There needs to be an awareness programme for ‘farm to fork’ on the health risks associated with the incorrect storage, handling and preparation of fish. Hazard Analysis Critical Control Point (HACCP) plans should be developed in alignment with the Fish and Fishery Products Hazards and Controls Guidance (FDA, 2011); and
- Aquaculture/fisheries courses are offered at several colleges and universities in Kenya, however, they do not offer practical training (Farm Africa, 2015). With the intensification there will be a demand for employees, across the sector with aquaculture knowledge.

Environmental Assessment

Potential negative environmental impacts resulting from the intensification include:

- Fish disease spread and infestation due to poor farm management strategies;
- Water quality deterioration due to fish farm waste (e.g. faeces and feed) and the use of chemicals and hormones;
- Abstraction resulting in competition for water and loss of aquatic habitat, particularly in times of drought;
- Dust generated by feed mills as well as emissions from auxiliary equipment such as generators and boilers will negatively impact on air quality;
- Habitat degradation through the clearing of land could result in erosion and sedimentation. Poor farm management measures could result in the pollution of receiving water bodies. The establishment of cages will suppress existing habitats; and
- Risks to indigenous fish health due to the introduction of disease, new genetic strains, hormones and medication.

Rapid Cumulative Impact Assessment

The International Finance Corporation (IFC) Good Practice Handbook presents a six step approach to conducting Rapid Cumulative Impact Assessments (RCIAs). Step 1 requires the determination of a proposed project's spatial and temporal boundaries. At this stage of KMAP's planning, specific temporal and spatial information is not available. It is therefore recommended that the RCIA for KMAP is developed in the EIA phase of the project planning, once more detailed information is available.

Environmental Management Plan

As KMAP is currently not at a point where specific farm locations and activities can be provided, a high-level EMP has been drafted that will need to be tailored to the intended operations (see section 7.0).

Standard Operating Procedures

High-level Standard Operating Procedures (SOPs) that are in-line with international best management practices (BMP) have been compiled for the management of fish genetics, hatchery and fingerling production, fish feed, fish health, biosecurity and the environment (see section 7.3). As this study was regional, it is also recommended that the SOPs are further refined to ensure that they are site-specific.

Future EIA Requirements

Legally, all commercial scale aquaculture operations require an EIA in Kenya. As "commercial scale" is undefined in the regulations, and as the permitting process may not be practical (or affordable) for small scale farmers, it is advised that Farm Africa works directly with the National Environment Management Authority (NEMA) to determine the scale of aquaculture operations that trigger an EIA.

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LIST OF ACRONYMS

AA	Aquaculture Agent
BMP	Best Management Practices
CCRF	Code of Conduct for Responsible Fisheries
DDT	Dichlorodiphenyltrichloroethane
DO	Dissolved Oxygen
DVS	Directorate of Veterinary Services
EAA	Ecosystems Approach to Aquaculture
EHS	Environment, Health and Safety
EMCA	Environmental Management and Co-ordination Act
EMP	Environmental Management Plan
ESP	Economic Stimulus Programme
EU	European Union
FAO	Food and Agriculture Organisation
FDA	Food and Drug Administration
FCR	Feed Conversion Ratio
HACCP	Hazard Analysis Critical Control Point
IFC	International Finance Corporation
IUU	Illegal, Unreported and Unregulated
KMAP	Kenya Market-Led Aquaculture Programme
KMFRI	Kenya Marine and Fisheries Research Institute
KSh	Kenyan Shillings
MOALF	Ministry of Agriculture, Livestock and Fisheries
MSDS	Material Safety Data Sheet
MT	Metric Tonnes
NEAP	National Environment Action Plan
NEMA	National Environment Management Authority
NGO	Non-Governmental Organisation
OIE	Office International des Epizooties
PPE	Personal Protective Equipment
PUM	Programma Uitzending Managers
PVC	Polyvinyl chloride
RAS	Recirculating Aquaculture System
RCIA	Rapid Cumulative Impact Assessment
SDF	State Department of Fisheries
SEA	Strategic Environmental Assessment
SOP	Standard Operating Procedure
tpa	Tonnes Per Annum
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
VEC	Valued Environmental and Social Component

1.0 INTRODUCTION

Farm Africa is an international non-governmental organisation (NGO), working with smallholder farmers, government and the private sector to catalyse rural transformation in Kenya, Tanzania, Uganda and Ethiopia. Farm Africa intends to create an aquaculture industry in Kenya that will generate sustainable incomes, food security and employment, known as the Kenya Market-led Aquaculture Programme (KMAP). This aquaculture development initiative is to be funded by the Embassy of the Kingdom of the Netherlands in Nairobi.

To ensure that the KMAP is implemented in an environmentally sustainable way, Farm Africa requested that Golder Associates Africa (Pty) Ltd (Golder) in collaboration with Advance Africa Management Services (Advance Africa) compile a Strategic Environmental Assessment (SEA), this report. The purpose of the study is to ensure that the proposed KMAP activities will comply with national environmental regulations as well as international best practices, and guarantee the long term sustainability of its operations with minimal impacts on downstream communities and/or other water users.

1.1 Kenya Market-Led Aquaculture Programme

The KMAP has been developed in response to a decline in wild fish stocks in Lake Victoria (the Lake) and an increase in demand for fish in Kenya due to consumers recognising its nutritional value. Farming fish offers significant economic benefits and, unlike capture or marine fisheries, does not rely on a depleting natural resource.

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In order to achieve this, Farm Africa intends to:

- Introduce new aquaculture technologies and improve service provider (e.g. fingerling and feed) inputs;
- Provide technical aquaculture training and support across the industry value chain;
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For further information on KMAP please refer to APPENDIX B.

1.1.1 Geographic Location

The KMAP is to be implemented by Farm Africa in two key project areas- Central and Western. The Central area encompasses the following counties Machakos, Nairobi and Kiambu. The Western area includes Siaya, Busia, Kakamega, Bungoma, Vihiga, Homa Bay, Kisumu, Kisii and Migori counties (Figure 1).

1.2 Purpose of the Strategic Environmental Assessment

The purpose of this study is to assess, at a high level, the potential environmental impacts resulting from the intensification of pond aquaculture, hatchery operations, feed production and cage culture practices in Kenya. It also addresses the potential environmental and social risks to the sustainability of KMAP.

Furthermore it provides a framework for environmentally sound, climate sensitive, technical and economic decision making during project implementation, whilst ensuring legal compliance and providing recommendations on best practice. The study covers the following:

- Describes and assesses the current environmental impact assessment and management regulations for fresh water cage- and pond fish farming in Kenya and makes recommendations for strengthening them in accordance with international best practice;
- A technical assessment of current and proposed KMAP aquaculture activities in Kenya, including recommendations for improvement;
- Assesses the potential environmental and social risks to KMAP;
- Assesses the environmental impacts of the future intensification of production from fresh water cage- and pond fish farming in the KMAP project areas; and
- Makes recommendations to the project for impact monitoring and management so as to ensure compliance.

1.2.1 Methodology

To inform the SEA study, the following was conducted:

- A desktop literature review (reference list in section 0), including information provided by Farm Africa;
- A site visit to the Central and Western KMAP project areas; and
- An information dissemination and gathering workshop in Kisumu with a selection of key stakeholders.

The site visit consisted of the following:

- Three fish farms were visited. One in the Central project area (Athi Fish Farm and Hatchery) and two in the Western project area (Mabro Fish Farm Enterprises and Winnie Owuor's Fish Farm). A questionnaire was administered at each site. To add to the information received during the site visits, a workshop was conducted at the Great Lakes Hotel in Kisumu on 7 July 2016. For information on the fish farm site visits and key informant interviews, please refer to the report in APPENDIX B.

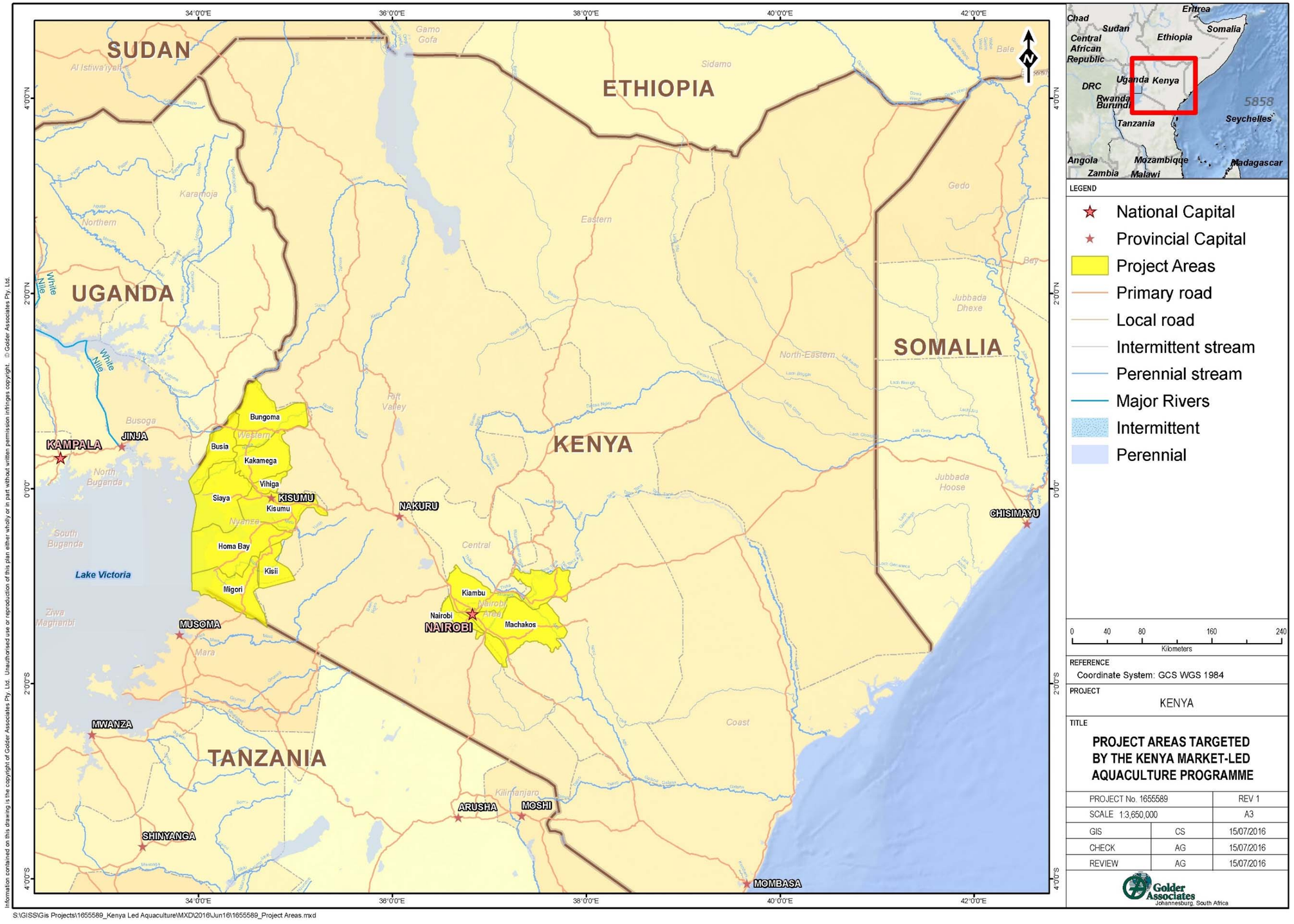

Figure 1: Locations of KMAP Project Areas

2.0 POLICY, LEGISLATIVE FRAMEWORK AND BEST PRACTICE GUIDELINES

A review of the relevant legal, institutional and administrative frameworks for aquaculture in Kenya was undertaken (APPENDIX C). The review highlighted gaps in the Environmental Impact Assessment (EIA) legislation pertaining to aquaculture, as well as issues that need effective implementation and enforcement. Recommendations based on these gaps are provided below.

2.1 Key Legislation

Key statutes relevant to this study include:

- Fisheries Policy, 2005;
- National Oceans and Fisheries Policy, 2008;
- National Aquaculture Policy, 2011;
- National Aquaculture Strategy and Development Plan, 2010 - 2015;
- The Fisheries Act CAP 378, revised, 2012;
- Fisheries (Safety of Fish, Fishery Products and Fish Feed) Regulations, 2007;
- Environmental Management and Co-ordination (Amendment) Act, No. 5, 2015;
- The Environmental (Impact Assessment and Auditing) (Amendment) Regulations, 2009; and
- Food and Agriculture Organisation (FAO) Code of Conduct for Responsible Fisheries, 1995.

A detailed analysis of these statutes is provided in APPENDIX C.

2.2 Findings and Recommendations

2.2.1 Fragmented Legislation

The existing regime of law governing aquaculture in Kenya is fragmented as there are different statutes each addressing a particular sub-sector of the industry. This can be seen in the legislation relating to EIAs, where aquaculture is not a scheduled activity directly subject to an EIA; however, the Fisheries Regulations clearly state that an EIA is mandatory for commercial aquaculture enterprises that are aimed at maximising profit. There is therefore a need to review the current policies and laws of Kenya, to align them with the Constitution.

Policy should be implemented that encourages collaboration between the agriculture and aquaculture sectors, especially regarding inputs and outputs (Ndanga *et al*., 2015). Facilitating this collaboration may result in increased waste utilisation efficiency and thereby maximise production and growth of the aquaculture sector. Aquaculture costs can be minimised by practicing an integrated system where wastes and by-products are used in other agricultural sectors (Ndanga *et al*., 2015).

2.2.2 Aquaculture Regulatory Framework

Although a comprehensive policy on aquaculture was developed in 2011, associated legislation needs to be implemented to enhance management and research efforts, encourage investment in aquaculture, and develop responsible production and growth of the industry.

The National Aquaculture Policy (2011) encompasses seed (fish egg) development, providing regulations for the supply of seed to the industry. However, effective legislation needs to be put in place to regulate the growth of national production, as well as to mitigate the environmental damage and industry problems which can be associated with low quality seed.

In addition, the Ministry of Fisheries should prioritise the development of aquaculture zone maps.

Zone maps will enable sector management as they can be used to control diseases, aid in the decision making processes, inform quality control and quarantine measures and advise planning and aquaculture policies. Given that spatial information in the EIA field is reasonably well developed in Kenya (Mwenda *et al.*, 2015); collaboration between environmental researchers and fisheries may fast-track the formation of aquaculture zone maps.

2.2.3 Environmental Impact Assessment Legislation

The United Nations Environment Programme (UNEP, 2010), notes that an important weakness of the EIA regulations in Kenya is that public participation is limited to affected parties only and thus reduces the opportunity for non-affected but interested parties from influencing decision making.

There is no regulation guiding the documentation of stakeholder engagement for EIA processes. The proponent should establish a list of interested and affected parties and develop methods for notifying them about the proposed development. Consultation with the public should entail two-way communication, whereby information about the proposed development is disseminated to stakeholders, who in turn are empowered to contribute local knowledge, relevant information and are afforded an opportunity to raise their concerns or suggestions for mutual benefit. The consultation process should record the community's concerns, interests and suggestions for mutual benefit so that relevant issues and suggestions can be considered in the EIA study (Rebelo and Guerreiro, 2006).

It is also imperative to mention that the EIA procedure in Kenya is more complex in comparison to other regions (e.g. European Union) and, consequently is more difficult to implement.

2.2.4 Institutional Capacity

An important limitation to the effectiveness of EIAs in Kenya is that certain government agencies do not have adequate capacity to effectively guide and review them (UNEP, 2010; Ali, 2012). This has been attributed to a lack of resources, such as funding, equipment and trained personnel. In addition, there is a lack of co-ordination between National Environment Management Authority (NEMA) and lead agencies, especially when dealing with weak enforcement structures within some institutions (Ali, 2012).

In an attempt to address the lack of institutional EIA capacity, the East African Association for Impact Assessment was established to build capacity amongst practitioners and government officials. Although effective, the organisation itself has limited capacity and action is required internally to address this (UNEP, 2010).

3.0 TECHNICAL AQUACULTURE ASSESSMENT

3.1 Current Status of Freshwater Aquaculture in Kenya

Freshwater aquaculture in Kenya has advanced significantly over the last decade. However, the marine aquaculture sector remains under-developed. The Economic Stimulus Programme (ESP) had a momentous impact on the growth of aquaculture in Kenya. The ESP contributed towards the alleviation of poverty, spurred regional development, and championed the commercialisation of farming activities, including aquaculture (Munguti *et al.,* 2014a). The State Department of Fisheries (SDF) within the Ministry of Agriculture, Livestock and Fisheries (MOALF) is the lead agency responsible for aquaculture development. More specifically, the SDF has a mandate to commercialise fish farming through increased investments, capacity building, and field-based applied research with contact farmers.

National aquaculture production has increased from an estimate of 512 MT/annum in 2000 to 21 488 MT/annum, representing 7% of the national harvest, in 2014[1]. The dominant aquaculture systems in Kenya include earthen and lined ponds, whilst tanks and cage culture of tilapia are making rapid advances. The most commonly farmed species are Nile tilapia (*Oreochromis niloticus*) which accounts for about 75% of production, followed by African catfish (*Clarias gariepinus*), common carp (*Cyprinus carpio*) and rainbow trout (*Oncorhynchus mykiss*). In addition, ornamental koi and gold fish are also produced.

[1] Accurate data statistics remain an international challenge. Kenya still suffers from basic information challenges regarding fisheries statistics. Munguti *et al*. (2014a) and Omwoma *et al*. (2014) state reason to view the SDF's data reservedly.

The Kenyan aquaculture sector is still constrained by an inadequate supply of certified quality fingerlings and feed, and a low level of research support (Munguti *et al*., 2014a).

The Kenyan fish feed industry was boosted with the development of fish feed standards. The standards are expected to ensure the provision of quality fish feeds leading to an improvement in productivity and cost savings for aquaculture operations. Currently, aquafeeds are either produced in-country by commercial feed producers or on-farm (Munguti *et al.,* 2014b), they can also be imported from Uganda, Mauritius and Europe.

3.2 Product, Supply Chain and Markets

With a growing global population the total demand for fish is set to continue increasing even if per capita consumption levels off. The harvest from capture fisheries has stagnated, current harvest levels can be viewed as stable and sustainable only with qualifications regarding the illegal, unreported and unregulated (IUU) harvest and the levels of inaccuracy that this introduces to modelling. Increasing demand is driving improved resource utilisation and the development of value-chain infrastructure. The optimised use of by-catch and reduced use of fish for feed is contributing to efficiencies in the sector and resulting in reduced wastage. In practice, however, the growing demand for fish will mainly be met by increased production from aquaculture. Fish supply-demand research suggests that aquaculture production will need to double by 2030 to meet the world's growing demands and needs.

Tilapia and Nile perch are the most traded fish in terms of value and are most demanded by local consumers. The presence of wild African catfish is decreasing in the Western area markets but increasing in Central Kenya.

According to the market study conducted by Lattice Consulting (2016), the value chain of the fish trade in Kenya has well-established linkages between stakeholders and operates as a closed system. The gate keepers to the fish market are the traders' associations that are made up of familial relationships. Entry into the trade is controlled by them and hence is limited. The top fish traders seem to be considered as credit-worthy by banks and micro-finances as many have been granted access to loans. Trading in farmed fish is considered a 'risky venture' by most of the traders due to its continued negative reputation with their customers (Lattice, 2016). The majority of customers invariably believe that farmed fish is not as tasty as wild fish.

The price of Nile perch and tilapia is relatively high and subsequently most of the consumers are from medium to high incomes. The average farm gate price of fresh fish is KSh 250 - 300/kg for Nile perch and KSh 300 – 400/kg for tilapia, with higher prices in urban markets.

3.3 Aquaculture Production Systems

Depending on the species being farmed, fish production systems in Kenya typically comprise ponds (some of which are lined with polyvinyl chloride (PVC) sheeting to prevent seepage (see Figure 2)) for tilapia, African catfish and carp culture, raceways for trout, concrete tanks for the high density farming of African catfish and floating open water cages for the production of Nile tilapia.

The hatcheries for tilapia and African catfish vary in degree of sophistication from simple rearing troughs and tanks (Figure 3) to modularised water re-circulation systems.

Figure 2: Pond culture - Athi Fish Farm and Hatchery

Figure 3: Hatchery at Mabro Fish Farm Enterprises

3.4 Water Supply and Availability

Under ideal conditions, a hatchery should have a gravity-fed water supply or use clean energy pumping solutions, such as solar to deliver good water quality to the facility.

Two hatcheries and associated pond farming systems were visited. The water supply to both facilities was not optimal. One facility used pumped water from a borehole, whilst the other used water pumped from Lake Victoria. Pumping is expensive and electricity supply can prove unreliable, and so frequently has to be augmented by a petrol/diesel generator. As power and fuel prices increase, such systems may prove to be economically unsustainable in the future.

3.5 Human Resources

A small cross section of commercial fish farmers (n = 7) were consulted. Some farms are owner operated, whilst others use expat industry experts for hatchery and production management. It was mentioned by a key stakeholder that there is an unusually high and inexplicable human resource turnover. The hatchery personnel interviewed were found to be highly competent.

3.6 Preferred Fish Species

The following species are farmed in Kenya; Nile tilapia (contributing to over 80% of total production), African catfish (the contribution of African catfish to total production seems to be on a downward trend in the Western area but is increasing in Central Kenya), common carp, rainbow trout, and ornamental fish species (koi carp and goldfish). The Sagana research station is testing two indigenous cyprinid species as potential candidate aquaculture species.

Figure 4: Nile tilapia*, Oreochromis niloticus (FiMSeA, accessed 2016)*

Figure 5: African catfish*, Clarias gariepinus (FiMSeA, accessed 2016)*

3.7 Fish Feed Production and Sales

Various feeds are used by commercial fish farmers in the region, ranging from mash (for fingerlings) to pressed pellets (made locally by a number of companies such as Jewlet and Mabro Fish Farm Enterprises) and extruded floating feeds. Extruded feeds are mainly imported from Uganda (e.g. Ugachick, Raanan, Nile Aqua and Skretting) or from Mauritius (Livestock Feed Ltd.) with a small quantity manufactured in Kenya (Food TechAfrica).

The price of feed is variable ranging from KSh 170/kg for imported extruded feed to KSh 70/kg for local pressed and sundried pellets and KSh 80/kg for fingerling mash. Imported feed is of better quality, but it is more expensive to local farmers. The local feed has a protein content of 26% which is within an acceptable level of feed formulation. However, visual observations indicated that the local pressed pellet feed is not of a very high standard and this needs to be addressed by the KMAP project. This may be related to the quality of the ingredients. Most of the ingredients, such as cotton and soy oil seed cake, seems to be imported from Uganda. A common protein source used in local feeds is shrimp from Lake Victoria. As the aquaculture industry is intensified and demand for feed increases, so will the demand for shrimp. It will be important to ensure that harvesting is sustainable, or alternatively, the farming of shrimp for feed should be investigated. The availability of feed is variable and so most farmers use more than one supplier.

Figure 6: Feed samples - Athi Fish Farm and Hatchery

Figure 7: Drying 4 mm pellets – Mabro Fish Farm Enterprises

3.8 Production of Fingerlings

This section of the value chain seemed to be the most troublesome, suggesting that there is a seasonal mismatch between supply and demand. In general, farmers appear to be satisfied with the quality of fingerlings. The selection of broodstock by hatchery managers is based on morphometrics and KMAP should support a genetic improvement programme. Tilapia as well as African catfish fingerlings are sold at KSh 4 - 15 depending on size and number (Figure 10). All tilapia fingerlings are sex reversed to be male fish.

Figure 8: Clarias gariepinus fingerlings - Athi Fish Farm and Hatchery

Figure 9: Oreochromis niloticus - Mabro Fish Farm Enterprises

FINGERLINGS PRICE LIST

AGE	PRICE/PIECE
Catfish 1 Week Old	3.00
Catfish 2 Weeks Old	5.00
Catfish 3 Weeks Old	8.00
Catfish 4 Weeks Old	10.00
Tilapia 3 Weeks Old	10.00
Tilapia 4 Weeks Old	15.00

Figure 10: A fingerling price list observed at one of the farms visited

3.9 Use of Fertilizer

Some farmers may wish to use the 'greenwater' (fertilizer) farming system in which fish are dependent largely on algae for food and are provided with supplementary feed. KMAP will need to examine the economics of using animal manure for fish production versus the use of manufactured fertilizers, such as urea and super phosphate and advise farmers accordingly.

3.10 Waste Generation

As fish is generally sold whole, the main waste produced by fish farmers in Kenya is water containing elevated levels of nitrogenous (metabolic) fish wastes. Uneaten feed and faeces are the two most important waste streams in cage based aquaculture. Tilapia feed on the surface and consequently there are high food losses when using sinking pellets, which fall through the cage base to the Lake floor. Eutrophication may occur in shallow lake areas (<12 m), particularly in sheltered bays where there is very little water exchange. Moreover, in such areas, sinking pellets will most certainly change the nature of the sediment below the cages. Cage farmers should be incentivised to use extruded, floating feeds and discouraged from using poor quality, fast sinking feeds.

3.11 Recommendations for Proposed Aquaculture Intensification

3.11.1 Cage Based Aquaculture

Cage aquaculture has a number of advantages over pond culture. These include lower capital costs, higher stocking densities, more effective use of fish feeds, lower manpower and supervision requirements. Other advantages include easier handling, inventory and harvesting of fish, swift or immediate return of investment, better control of fish populations, fish competitors and predators and reduced mortality (KMFRI, 2015). The harvesting, handling or grading of fish in cages is easier than in pond culture as the nets just need to be lifted. For these reasons, it is recommended that:

- Regulations and guidelines governing cage culture in the Lake need to be put in place;
- Cage culture should be incorporated within the scope of the KMAP project;
- The Lake shore should be assessed for the most suitable cage sites and encouraged or incentivised in those areas;
- The development of reliable commercial fingerling production should enhance the profitability and expansion of cage culture in the region; and
- The production of good quality locally made feed for cage aquaculture needs to be a focus of KMAP.

3.11.2 Pond Based Aquaculture

The average size of a fish pond in the region is around 300 m^2. To intensify fish production, it is recommended that:

- Farmers be encouraged to use bigger ponds (500 m^2 or larger) in order to benefit from the economies of scale associated with larger operations.

3.11.3 General Recommendations

- Locally manufactured feed needs improvement. The pressed, sundried feed pellets made locally have limited water stability and sink rapidly to the bottom. Feed Conversion Ratios (FCRs) for locally produced feeds are most likely in the order of 2.5:1, whereas under optimal conditions they should be between 1.4 and 1.8:1. To achieve significant and environmentally sustainable intensification, affordable extruded feeds will be required; and
- A common challenge in aquaculture is access to the right genetics of a species for production. As such, KMAP should initiate and support a Nile tilapia genetic improvement programme within its scope of work.

4.0 POTENTIAL RISKS TO KMAP SUSTAINABILITY

4.1 Sustainable Aquaculture

Sustainability within the environmental sciences refers to an activity not being harmful to the environment or depleting natural resources[2]. In defining sustainable aquaculture, one should consider the bigger picture and look at it as the cultivation of aquatic organisms by means that do not negatively impact on the environment, contribute to local social community development and generate an economic profit.

In 2009, the Kenyan government initiated the ESP, which recognised that aquaculture was a viable option to revamp the country's food sector by increasing the production of farmed fish (Munguti *et al*., 2014). Despite the initiatives of the ESP, the industry still suffers from limited knowledge of aquaculture investment, inadequate supply of certified feeds, poor services, lack of comprehensive policy and low funding to mention a few (Munguti *et al*., 2014). This resulted in many fish farmers suffering considerable losses and returning to their previous practices.

In order for KMAP to be sustainable, it will need to address the shortfalls of the past, focusing on the value chain and training of farmers, more so than financial assistance. It is recommended that model farms be utilised as examples for farmers within an area or community. These farms can then be used as training facilities where farmers can learn through practical exposure.

The potential environmental and social risks to KMAP's sustainability are outlined below.

4.2 Environmental Risks

4.2.1 Land Uses

Land use activities in the catchment area of a water body can affect the quantity and quality of surface water in its system. For example, deforestation in Lake Tanganyika's catchment area resulted in erosion due to increased run-off and consequently caused significant increases in lake sediment. Increased amounts of suspended solids in water, and silt deposits in lakes and rivers, impact negatively on aquatic life (Ferman, 2013). Reduced water clarity can affect photosynthetic rates in aquatic plants and suspended elements may seal the branchial systems of fish or cause irritation. Muddy deposits reduce the quality of substrates in breeding areas (Ferman, 2013).

Other land uses, such as agriculture, can also contribute to erosion if the land is not managed appropriately. Run-off from agricultural lands and industrial plants can carry chemical residues that can be harmful to fish.

[2] Sustainability. (n.d.). Dictionary.com Unabridged. Retrieved July 15, 2016 from Dictionary.com website http://www.dictionary.com/browse/sustainability

When selecting sites for the KMAP, farmers should consider the neighbouring land users and how their activities could potentially affect their farms, and vice versa. When clearing land on the Lake's shore, either to install new ponds or to provide access to cages, farmers should implement methods to reduce the possibility of erosion e.g. appropriate drainage systems and planting indigenous vegetation in any exposed areas.

4.2.2 Disease

Intensive aquaculture is known to result in a spike in disease due to the movement of fish to new areas and their stocking in high densities. Transportation stresses fish and lowers their immune systems making them more susceptible to disease. Diseases bring risks to production and market access due to fish deaths and public health risks. For example, *Streptococcus* bacteria in tilapia populations can potentially affect humans.

Caged fish are at a greater risk to disease outbreaks, because they have a lower tolerance to poor water quality than those in open ponds (KMFRI, 2015). This needs to be considered by farmers when entering the industry.

Specialists in fish disease are not common in Kenya. Therefore, preventative measures will be key. Farmers must maintain suitable environmental conditions, select healthy fish, provide a nutritious diet, limit stress and vaccinate. KMAP farmers should make disease diagnostic testing part of their risk-management strategies.

4.2.3 Water

Water quality and quantity are major limiting factors in commercial fish production (Swann, 2000). KMAP site selection has to be made based on both the quality and quantity of water available.

4.2.3.1 Water Quality

The quality of water used in fish farming directly affects feed efficiency, growth rates and health. Most fish fatalities, disease outbreaks, slow growth, poor feed conversion efficiency and similar management problems are directly correlated with poor water quality. KMAP farmers must regularly test the quality of the water in which they keep their fish.

A few key water quality components that can negatively impact on fish health are outlined below:

Eutrophication

Nutrients such as phosphates and nitrates are naturally present in limited quantities in aquatic environments. However, run-off from livestock paddocks, washing detergents, or waste water, can result in excess phosphates (and to a lesser extent nitrates) causing a phenomenon known as eutrophication. Eutrophication results in algal blooms that on decomposing consume oxygen. A lack of oxygen in the water can result in asphyxiation of fish.

Eutrophication in Lake Victoria over the last 25 years is fairly well documented. The increased nutrient concentration in the Lake results from increased urbanisation, fertilisers, industrial effluent high in nitrogen and phosphorous compounds, sewage systems and pesticides (Ferman, 2013). This effect has resulted in heavy blooms of phytoplankton and a deterioration in water quality. As this has already been identified as an issue in the Lake, KMAP farmers need to ensure that they do not contribute to the eutrophication further and monitor the quality of the water they use carefully. Four parameters indicative of Lake health will need to be examined: temperature, chlorophyll, suspended matter and diffuse attenuation coefficient (KD490) (a measure of light penetration in surface waters). Water temperature influences physical, chemical, and biological processes in a lake, and is also an important parameter to indicate the impact of climate variability on the life in the lake. Chlorophyll concentration is an indicator of algal blooms, which thrive on pollutants/ undesirable nutrients, in the water. Chlorophyll concentration is therefore a measure of water quality.

Suspended matter can be organic or inorganic, mainly generated from within the Lake, or brought from the catchment by rivers draining into the Lake. The concentration of suspended matter in the surface layers influences light penetration and productivity, and can contribute to creation of hypoxia (low oxygen) zones. The KD490 can provide an indication of light penetration, which has implications on productivity and biological processes in surface waters.

Pesticides

Chemical pesticides are widely used in the agricultural industry. Not all pesticides are toxic to fish, some however, are lethal in small doses such as pyrethroids (permethrin, deltamethrin) and organochlorines (DDT, dieldrin, endrin, endosulfan, malathion, lindane) (Ferman, 2013).

In addition to their immediate toxicity, these chemicals build up over time and become concentrated in food webs thereby poisoning tertiary consumers, such as humans.

Heavy Metals

Heavy metals are usually present at very low concentrations in natural ecosystems. However, humans can contribute to their natural concentrations through agricultural activities, discharge from refineries treating non-ferrous metals and discharge from tanneries or paper factories. Mercury pollution can originate in industrial activity, gold refining, and use of organomercury fungicides. These heavy metals can accumulate in organisms until they reach toxic levels (Ferman, 2013).

KMAP farmers must monitor the quality of the water that they use in their ponds and that their cages are suspended in.

Oxygen

Low-dissolved oxygen levels are responsible for more fish kills, either directly or indirectly, than all other problems combined (Swann, 2000). KMAP needs to ensure that farmers have the adequate knowledge to maintain functioning aerated systems. Where possible, aeration systems must not be reliant on electricity as it is not consistently available.

Farmers must test their water and should be educated on recognising early warning signs of eutrophication.

Temperature

After oxygen, water temperature may be the single most important factor affecting fish health. Water temperature affects activity levels, behaviour, feeding, growth, and reproduction. African catfish and tilapia are examples of warm water species. KMAP farmers must monitor water temperature and have emergency systems in place for extreme fluctuations.

4.2.3.2 Water Scarcity

Aquaculture requires a reliable freshwater source. If freshwater flow is reduced there is an increase in the risk of disease outbreaks. KMAP should promote practices that conserve water, such as recirculation, re-use (e.g. aquaponics and irrigation) or zero-exchange. However, water conservation practices, such as recirculation, come at a cost. This is because it requires the pumping of water, which if electrical, is expensive and unreliable. The use of gravity-flow or solar pumps should be investigated.

4.2.4 Macrophytes

Lake Victoria is frequently infested by the free floating, aquatic weed- water hyacinth (*Eichhornia crassipes*) (KMFRI, 2015). The decomposing water hyacinth provides substrate for macrophyte hippo grass (*Vossia cuspidata*) to proliferate, and then sink. The water hyacinth can smother or relocate cages and the sunken hippo grass causes oxygen depletion as it decomposes. The submerged macrophyte populations results in a high saturation of oxygen during the day and a depletion of oxygen at night. Each of these effects is detrimental to cage aquaculture (KMFRI, 2015).

KMAP farmers wishing to undertake cage culture need to be aware of these risks as they could result in fish stock fatalities. In addition, pond farmers extracting water from the Lake must monitor the quality of the water regularly.

4.2.5 Predators

The fish farmers consulted mentioned that predators were an issue in terms of fish stock fatalities. The following recommendations are made based on a study by the National Agricultural Research Organisation (NARO) in Uganda (2007) and best management practices utilised globally:

- Maintain a minimum depth of 0.8 m of water in the ponds especially in the dry season when the water levels drop;
- Fertilise the ponds with manure, the algae generated reduces visibility for the birds (NARO, 2007);
- Patrol the ponds regularly (NARO, 2007);
- If funds are available, purchase sunlight (ultra-violet) resistant netting; and
- Undertake 'good housekeeping', keep land within the fish farm boundary neat. This could include:
  - Clearing alien shrubs and trees from the pond edges so that birds do not have a place to roost. Replace the alien plants with indigenous thorn bushes that would prove to be difficult resting places; and
  - The grass along the ponds' perimeters should be trimmed so that predatory animals have no shelter.

There is a risk that cages will be destroyed by hippopotamus in the Lake as they inhabit sheltered bays which are also preferred for cage culture. The destruction of cages may allow for the escape of fish into the natural environment. Cages must be built from robust materials and should be monitored for damage and wear and tear.

Ultimately, predators must be managed in an environmentally sustainable way. Animals must not be poisoned, trapped or shot.

4.2.6 Climate Change

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

4.2.6.1 General Circulation Model Projections for Kenya

According to a climate change study conducted for the United Nations Development Programme (UNDP) in 2010, an increase in mean annual temperature and an increase in annual rainfall is projected for Kenya. The details of these projections are described below:

Temperature

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

Precipitation

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

4.2.6.2 Effect of Climate Change on Aquaculture

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

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

The predicted increase in heavy rainfall events may result in flooding which can cause physical damage to farm structures, and consequential loss of fish. In addition, floods can cause great changes to water quality such as siltation or the transportation of pesticide residues from nearby agricultural practices. Flood waters may introduce predators into a farm, or new pathogens, and may also provide an opportunity for fish to escape confinement (FAO, 1989).

Severe storms over Lake Victoria could damage cages resulting in the release of fish stock into the natural environment. Depending on the species and genetics of the fish farmed, this could have negative impacts on the wild fish stock.

Inland aquatic environments are critically dependent upon rainfall. Thus, any change in climate will have major consequences for the water balance that can cause an increase or reduction in aquatic habitats. In the case of drought, a decline in water resources will limit the carrying capacity of the ponds. Cages located in shallow waters could also be at risk. This could possibly drop the functioning of fish farm operations below profitable levels.

The extraction of water for aquaculture during drought will exacerbate water shortages and could result in user conflict.

As mentioned in section 4.2.3.1, changes in temperature can also have significant impacts on the reproductive cycles of fish, including the speed at which they reach sexual maturity, the timing of spawning and the size of the eggs they lay.

Ultimately, the success of a fish farm operation is highly dependent on temperature, water quality and quantity. It is therefore imperative that the KMAP fish farmers are well informed of the climate characteristics specific to their regions and associated risks, such as 100-year flood levels and drought (FAO, 1989).

Climate Change Management Measures

For most climate change-related impacts, improved management and better aquaculture practices would be the best and most immediate form of adaptation, such as the ecosystem approach to aquaculture (EAA) management (FAO, 2008).

Genetic knowledge and management in aquaculture are not as developed as in other husbandries, and provide both a major challenge and an opportunity (FAO, 2008). Genetics can be improved resulting in more efficient feeding and diet specificity, and for increasing species resistance to higher temperature, lower oxygen and pathogens. Climate change may increase pathogen risks and so biosecurity and prevention measures need to change accordingly. Early identification and detection mechanisms may need to be improved, and suitable treatment strategies and products developed (FAO, 2008). Table 1 below summarises climate change adaptation measures for aquaculture.

Table 1: Climate change-related impacts and potential adaptation measures in aquaculture (FAO, 2008)

Climatic change element	Impacts on aquaculture or related function	Adaptive measures
Warming	Raise temperature above optimal tolerance range of farmed species	■ Selective breeding and genetic improvements for higher temperature tolerance.
	Increase in growth rate- higher production	■ Increase feed input; and ■ Adjust harvesting and market schedules.
	Increase in eutrophication- mortality of farmed stock	■ Improve planning and siting to conform to climate change predictions; and ■ Establish regular monitoring and emergency procedures.
	Increased virulence of dormant pathogens and expansion of new diseases	■ Focus management to reduce stress; ■ Set up biosecurity measures; ■ Monitor to reduce health risks; ■ Improve treatments and management strategies; and ■ Make genetic improvements for higher resistance.
	Limitations on fish meal and fish oil supplies/price	■ Identify fish meal and fish oil replacement; ■ Develop new forms of feed management; ■ Make genetic improvement for alternative feeds; and ■ Shift to non-carnivorous species.
Circulation changes	Loss of agricultural land	■ Provide alternative livelihoods through aquaculture, building capacity and infrastructure.
	Seed stock disruptions; reduced options for aquaculture feeds; and income loss to fisherman	■ Make greater use of hatchery seed; ■ Protect nursery habitats; ■ Develop/use formulated pellet feeds (higher cost but less environmentally degrading); and ■ Develop alternative livelihoods for suppliers.
	Increase of harmful algal blooms (HABs)	■ Improve monitoring and early warning systems; and ■ Change water abstraction points, where feasible.
Water stress and drought conditions	Limitations for freshwater abstraction	■ Improve efficacy of water usage; and ■ Encourage non-consumptive water use in aquaculture.
	Change in water-retention period	■ Use different/faster growing fish species; and ■ Increase efficacy of water sharing with primary users.

Climatic change element	Impacts on aquaculture or related function	Adaptive measures
	Reduced availability and period change of wild seed stocks	■ Shift to artificially propagated seed (extra cost); ■ Improve seed quality and production efficiency; and ■ Close the life cycle of more farmed species.
Extreme weather events	Destruction of facilities; loss of stock; loss of business; mass scale escape with the potential to impact on biodiversity	■ Encourage uptake of individual/cluster insurance; ■ Improve siting and design to minimize damage, loss and mass escapes; ■ Encourage use of indigenous species to minimize impacts on biodiversity; and ■ Use non-reproducing stock in farming systems.

Climate Change Adaptation for Post-harvest, Distribution and Markets

Aquaculture feeds into an extensive network of suppliers and traders that connects production with consumers. A range of adaptation measures to climate change impacts on the market chain can be seen below (Table 2).

Table 2: Climate change-related impacts potential adaptation in post-harvest/distribution (FAO, 2008)

Impact on post-harvest, distribution/markets	Potential adaptation measures	Responsibility
Reduced or more variable yields, supply timing	Source products more widely; and/or change species.	Private
	Develop more flexible location strategies to access materials.	Private/Public
	Improve communication and distribution systems.	Private/Public
	Reduce costs to increase efficiency.	Private
	Diversify livelihoods.	Private
Temperature, precipitation, other effects on post-harvest processes	Change or improve processes and technologies.	Private/Public
	Improve forecasting information.	Private/Public
Vulnerability of infrastructure and communities to extreme events	Add new or improved physical defences, accommodation to change.	Private/Public
	Rehabilitate infrastructure, design disaster response.	Private/Public
	Set up early warning systems, education.	Private/Public
Trade and market shocks	Diversify markets and products.	Private/Public
	Provide information services for anticipation of price or market shocks.	Private/Public

4.3 Social Risks

4.3.1 User Conflict

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

At a national scale, aquaculture competes with a number of other industries that require land and water e.g. electrical generation, agriculture and forestry. The tourism and recreational industries also compete with aquaculture for natural resources. In this regards, it is important that KMAP has support from the Kenyan Government.

Farmers involved in the intensification must comply with regulated environmental standards and implement the recommended monitoring and management measures to ensure that their practices do not negatively impact on their neighbours' resources, and ultimately livelihoods. For example the discharge of water and/or contamination of the domestic water supply would prove an issue to all users reliant on the resource especially if the quality of drinking water deteriorated. On the contrary, other land and water users in the area, e.g. flower farmers, may affect the quality of the land and water sources used by the fish farmers.

It is important that KMAP establishes communication channels for complaints (a grievance mechanism), so that should a member of the public, or a KMAP fish farmer, have a concern it will be dealt with by the appropriate authority in a timeous manner.

4.3.2 Theft and Vandalism

Theft was a key concern that was voiced by all the fish farmers interviewed. Fencing, patrolling guards/policemen and dogs are commonly used for fish farm security in Kenya. Cages are easy to poach from as they are located close to the lake shores.

KMAP should encourage the farmers to collaborate in managing the theft problem. This may be done through the joint hiring of a security company, joint funding of security infrastructure or by developing a 'neighbourhood watch' with the support of local police.

4.3.3 Human Resources

The stakeholders interviewed mentioned that a high staff turnover was proving to be problematic. Perhaps this is due to the low level of aquaculture education, particularly practical knowledge, in Kenya. People hired to work on fish farms would then likely be manual labourers who may not receive salaries competitive with other industries such as agriculture. This should improve with KMAPs training programmes and intention of hiring an expert to review current aquaculture curricula at tertiary education institutions.

4.3.4 Market/Traders

It is important that the KMAP farmers have traders in place that they trust to handle their produce. For example, the sale of contaminated fish would have negative implications on both the trader and the farmer in terms of future sales. The traders therefore need adequate facilities to handle and store the fish. Storage should be clean and maintained at an optimal temperature. Again, in the case of cold storage, backup generators are a necessity due to the irregular supply of electricity. KMAP should educate traders on the health risks of incorrect fish storage and handling.

The identification of markets for the KMAP farms' products, and forecasting of its growth trends requires considerable knowledge and skill. The findings of the new market study conducted for KMAP should be shared. As markets are dynamic, it is important that the farmers are trained in reading them, or else have access to an expert that can provide them with updates. For example, an increase in the importation of frozen fish from China could negatively affect the farmers, as the Chinese fish are relatively cheap.

In this light, KMAP will also need to ensure that their famers will be able to compete on the market as fish production and consumption increases. The benefits of eating farmed fresh, local fish should be promoted and campaigns should be initiated to support Kenya's aquaculture entrepreneurs.

There is currently a perception in Kenya that wild caught fish are tastier than pond or cage- farmed fish. However, as fish stocks are currently low in Lake Victoria, people are having to buy farmed fish. KMAP should undertake an awareness campaign highlighting the benefits of eating farmed fish and perhaps conduct 'tastings' to prove the theory wrong.

There appeared to be a seasonal mismatch between the supply and demand for fingerlings. Fingerling producers said that they experienced times when there was no demand for the fish, and so they scaled down production. They were then faced with a high fingerling demand, which they could no longer support. KMAP should investigate the driving forces behind the market fluctuations.

4.3.5 Consumer Related Risks

As mentioned above, the farmer needs to trust that his trader will handle his produce with care. The quality of fish is very susceptible to poor handling in the kitchen. For the individual consumer the risks can be reduced by information on short-term storage, cooking instructions, and even suggested recipe preparations. On a larger scale, the circle of consumers can be increased (to reduce the risk) by consumer programmes sponsored by the marketing and farmers' associations (FAO, 1989).

One of the greatest risks, not only to the individual farmer and his trader, but to the industry as a whole, is if the health of a consumer is compromised. Any risks to public health could cause closure of the producer's farm and a stringent examination of all neighbouring farms. Consumer faith in the product (and sometimes other farming products) could be lost.

KMAP must ensure that the value chain is educated on the correct handling of fish, from 'farm to fork'. Hygiene and appropriate storage must be emphasised. Health risks and symptoms should also be communicated. The Fish and Fishery Products Hazards and Controls Guidance (FDA, 2011) is intended to assist processors of fish and fishery products in the development of their Hazard Analysis Critical Control Point (HACCP) plans. Processors of fish and fishery products can use the guidance to identify hazards that are associated with their products, and help them formulate control strategies. The guidance will help consumers and the public generally to understand commercial food safety in terms of hazards and their controls. The guidance does not specifically address safe handling practices by consumers or by retail establishments, although many of the concepts contained in the guidance are applicable to both. The guidance is also intended to serve as a tool to be used by federal and state regulatory officials in the evaluation of HACCP plans for fish and fishery products (FDA, 2011).

In July 2015, Kenya received certification to export farmed fish to the European Union (EU). In order to export fish to the European Union, import conditions for fishery products as provided by the European Commission's Directorate-General for Health and Consumers (SANCO) need to be met. The European Commission provides training, technical assistance and facilities for institutional capacity building to help developing countries comply with EU rules. For example, DG SANCO's Better Training for Safer Food initiative runs training for official control staff of developing countries on EU standards for fishery and aquaculture products.

4.3.6 Aquaculture Education

Aquaculture/fisheries courses are offered at several colleges and universities in Kenya, however, they do not offer practical training (Farm Africa, 2015). With the intensification there will be a demand for employees, across the sector, with aquaculture knowledge. KMAP needs to ensure that this demand can be met.

5.0 POTENTIAL ENVIRONMENTAL IMPACTS OF INTENSIFICATION

5.1 Disease, Parasites and Biosecurity

Diseases in aquaculture are largely due to stress (depressed immune systems). By farming fish under best management practises it is highly unlikely that diseases will manifest.

The most likely occurrence of diseases/pathologies will be in hatcheries. In most instances a reduction of densities (except in the case of *Clarias*) will result in improved health. Sodium chloride and potassium permanganate are commonly used, as is oxytetracycline.

The use of antibiotics should not be encouraged and should only be administered under instruction of a veterinarian. Section 7.1.6 describes chemicals commonly used in the aquaculture industry.

Strict biosecurity measures should be adhered to in hatcheries, including restricted access, hand washing and foot baths. Should new strains of *Oreochromis niloticus* be introduced then these should be appropriately quarantined to ensure disease free status. Standard Operating Procedures for biosecurity are provided for in section 7.3.5.

5.2 Pollutants

The potential for the deterioration of water quality in the receiving ecosystem as a result of fish farm intensification is considered high if no mitigation and monitoring is implemented. Organic enrichment mainly produced by overfeeding and over fertilisation can result in the eutrophication of water especially in systems that are not filtered or flushed regularly. Avnimelech's (2009) preliminary calculations revealed that, "*an intensive aquaculture system farming three tons of freshwater fish can be compared, in respect to waste generation, to a community of around 240 inhabitants*".

As aquaculture waste originates mainly from the metabolism and excrement of the fish, as well as from waste feed, it is typically rich in carbon, nitrogen and phosphorous. The most profitable use of the sludge generated by aquaculture operations is as a source for biogas or as fertiliser for agriculture (Kim *et al*., 2015). By treating the sludge in biogas plants, it may be used to produce fuel. Fish farm sludge can be sent to regional biogas plants and in this way make a positive contribution to the fish farmer's environmental accounts (Kim *et al.*, 2015).

In high density farming, stress levels are elevated and the likelihood of diseases/pathologies increase. This requires treatment through the use of chemicals (as mentioned above in section 5.1), that over time will accumulate in the water. Antibiotics, disinfectants and hormones are also typically used in more intensive enterprises.

With the above mentioned in mind, water quality is a crucial aspect of aquaculture and needs to be monitored closely to prevent contamination of the receiving ecosystems and compromising operations.

5.2.1 Air Emissions

It is difficult to predict air emission impacts at this stage of the KMAP planning. Fish feed mills are however, known to generate dust. Table 3 provides the potential sources for dust generation at fish feed mills, and high level measures on how to manage it. Auxiliary equipment such as diesel generators or boilers would also require investigation. A detailed impact assessment would need to be conducted in the EIA phase of the programme. The World Bank Environmental Health and Safety (EHS) Limit for dust is 20 mg/m^3 (World Bank Group, 2007).

Dust generation by fish feed mills needs managing through:

- Installation of mitigation measures as per Table 3;
- Ensuring all emission controls are in place and maintained (dust collectors, exhaust fans, scrubbers etc.);
- Monitor dust levels within feed mills; and

- Ensure all staff members working in the feed mill that may be subjected to excessive dust are provided with personal protective equipment (dust masks).

Table 3: Dust Sources at the Feed Mill

Source	Installed Dust Control Measure
Feeding inlet of bulk raw materials	Use of dust-collecting hoods and fabric filters.
Grinding process	The grinding process should be undertaken within a sealed enclosure. Use of dust-collecting hoods and fabric filters.
Bulking and drying process	Bulking and drying processes should be completed under an airtight state, and the water vapour and dust containing foul gas generated during the bulking process should be gathered through a vapour gathering system incorporating flash evaporation. Water vapour and dust containing foul gas generated during the drying process should be gathered and processed by a cyclone separator.

5.3 Habitat Degradation

The destruction of habitats for the establishment of aquaculture farms will be negative if the habitat is considered ecologically or economically important. Such areas would include breeding, nesting, nursery and foraging areas for a range of species with emphasis on rare and endangered species and species of conservation importance.

The construction of ponds and associated infrastructure will require rudimentary earthworks. These earthworks and the clearing of vegetation may lead to erosion and the smothering of habitat through the associated deposition.

Poor environmental management (at both pond and cage operations) could result in the pollution of receiving water resources. This could negatively affect the health of indigenous aquatic species.

The establishment of cages in the Lake will smother existing habitats. Sensitive habitats such as bird nesting or fish breeding areas, must be identified prior to cage establishment and avoided. Should KMAP wish to include cage culture, the preferred cage sites would need to be assessed in the respective EIA report.

The KMAP intensification should take cognisance of existing habitats and appropriately develop farms so as to not impact on ecosystem functioning or rare/endangered species.

5.4 Risks to Indigenous Fish Species

The exotic Nile tilapia is currently farmed and widely distributed within Kenya, and as such the risk of hybridisation already exists. The importation of fish and the countrywide shipment of fingerlings will increase the chance of diseases being spread.

Hormones and treatments used in the production of fish may also influence indigenous fish communities if exposed. As a wide variety of chemicals are currently used in aquaculture production, control measures have been introduced over the years (Rawn *et al*., 2009). A list of chemicals commonly used in the aquaculture industry is provided in section 7.1.6 below. A risk assessment should be conducted prior to the introduction of new chemicals.

5.5 Water Level Drawdown

Abstraction of surface and groundwater resources for consumptive aquaculture practices must take cognisance of other users. Water use would need to be monitored carefully in times of drought to avoid loss of habitat for aquatic species and potential user conflict. As mentioned previously, KMAP should promote practices that conserve water, such as recirculation, re-use (aquaponics, irrigation) or zero-exchange, although this would likely come at an additional cost to the farmer.

6.0 CUMULATIVE ENVIRONMENTAL IMPACTS

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of a project and its associated activities when added to other existing, planned, and/or reasonably anticipated future ones (Pablo and Lorne, 2013).

It is important during the process of identifying environmental and social impacts and risks that developers:

- Recognise that their activities may contribute to cumulative impacts on valued environmental and social components (VECs) on which other existing or future developments may also have detrimental effects;
- Avoid and/or minimise these impacts to the greatest extent possible; and
- Furthermore, recognise that their developments may be at risk because of an increase in cumulative effects over ecosystem services they may depend on.

Good practice requires that, at a minimum, project sponsors assess during the EIA process whether their development may contribute to cumulative impacts on VECs and/or may be at risk from cumulative effects on VECs they depend on.

The following is recommended:

- Follow a six-step rapid cumulative impact assessment (RCIA) process;
- Engage stakeholders as early as possible and throughout the decision-making process; and
- Clearly record the fundamental reasoning behind each important decision made, supporting it with as much technical evidence as possible.

Figure 11 illustrates the RCIA logical framework proposed in the International Finance Corporation (IFC) Good Practice Handbook.

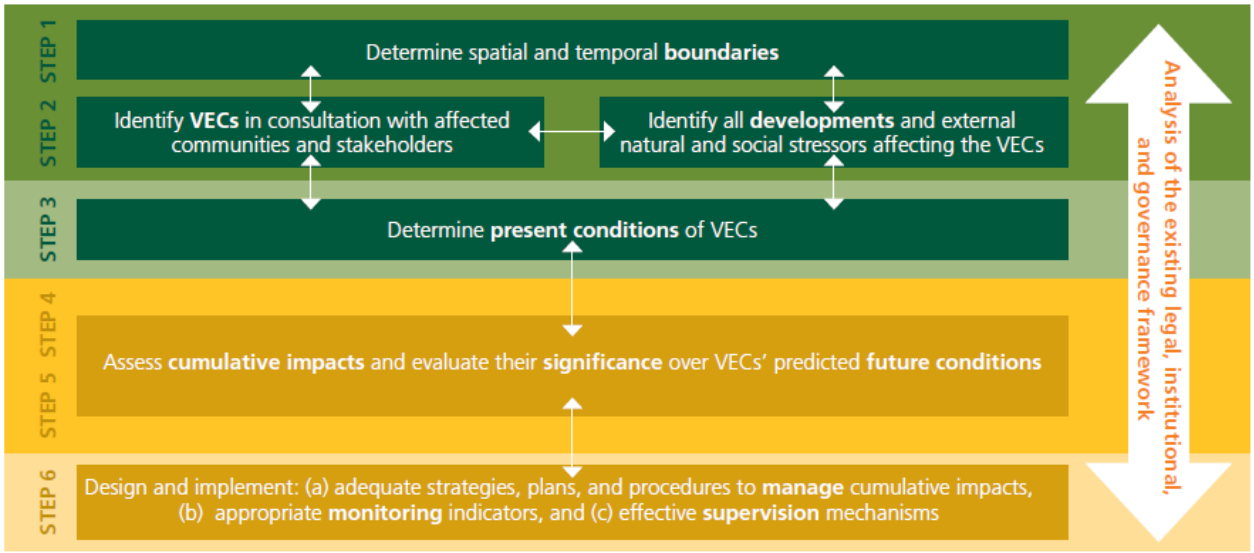

Figure 11: Six step approach to a Rapid Cumulative Impact Assessment (Pablo and Lorne, 2013)

As seen above, Step 1 of an RCIA requires the determination of a proposed project's spatial and temporal boundaries. At this stage of KMAP's planning, specific temporal and spatial information is not available, for example, it is unknown as to where the proposed farms are to be located, whether they will be grouped or spread out, in what landscapes they will be located, what the surrounding land uses will be, what the future development plans for these areas are, whether the farmers are conducting just pond culture or whether cage culture will also be incorporated and if cage culture is to be incorporated- where the cages will be located, how many will be established and when the proposed development will occur.

To illustrate this point, Figure 12 provides two hypothetical spatial scenarios for KMAP. Scenario A would likely result in a higher cumulative impact than Scenario B as the farms are tightly grouped thereby concentrating their impacts in one area. Fish Farm 3 of Scenario B may have a disproportionate cumulative impact on water quality as perhaps the nearby water resource is already polluted by industrial activities taking place in Nairobi, and perhaps there are existing fish farms in this area further contributing to the damage.

It is therefore strongly recommended that a cumulative impact assessment be conducted during the EIA phase of KMAP's planning.

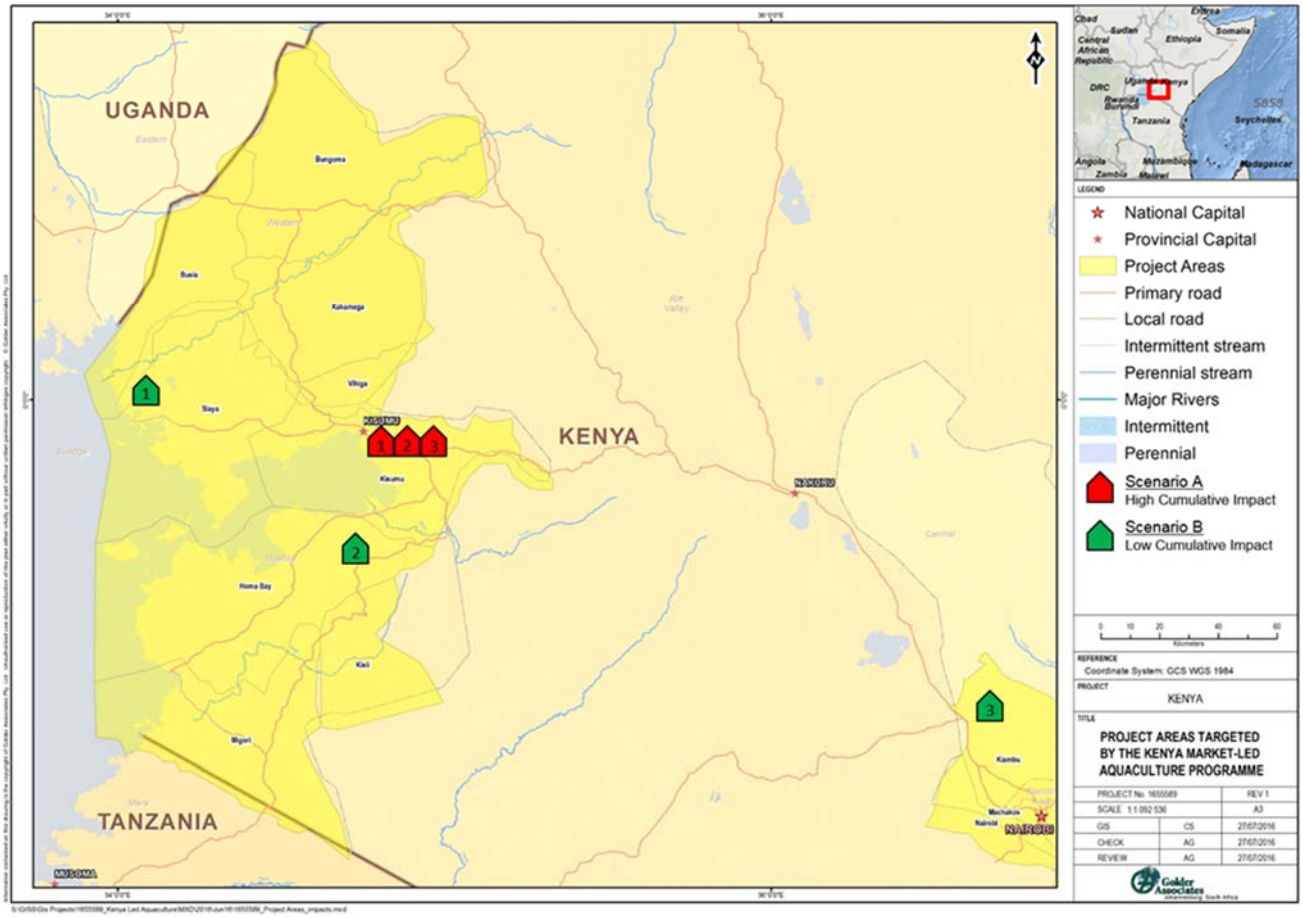

Figure 12: Hypothetical RCIA scenarios to consider

7.0 EMP REQUIREMENTS

An environmental management plan (EMP) provides a mechanism to address any negative environmental impacts of a proposed project and aims to promote benefits. The EMP provides a document that assists in detecting the development of any negative environmental issues through the monitoring of environmental parameters. The document defines the responsibilities and evaluates performance.

As with the RCIA, an EMP document needs to be designed for a specific project (in this case farm), as the monitoring requirements need to be tailored to the activities, the size of the farm and the location. All of these will in turn determine the frequency of sampling, methods and the details thereof (parameters and positions).

In conjunction with an EMP, other plans that may need to be formulated include:

- Emergency Response Plan;
- Waste Management Plan;

- Workers Health and Safety Plan; and
- Disease, Parasite and Pest Management Plan.

As KMAP is currently not at a point where specific farm locations and activities can be provided, a high-level EMP has been drafted that will need to be tailored to the intended operations.

7.1 Water Quality Monitoring and Management

Best practice guidelines must be used for monitoring water bodies potentially impacted by the proposed pond and cage farming. It is especially important to take samples downstream of the fish farm sites to ensure that any impacts relating to feed and return effluents are identified. The water quality variables of concern (to be monitored) are as follows (Table 4):

Table 4: Water quality variables to be monitored

VARIABLES	METHODS
Dissolved oxygen (mg/ℓ)	*In situ* using a dissolved oxygen meter
Temperature (ºC)	*In situ* using a temperature meter
pH	*In situ* pH using an oxygen meter
Turbidity (NTU)	Standard Methods in laboratory
Secchi (m) – Visibility	*In situ* using Secchi disc
Nutrients (mg/ℓ, ortho-phosphates, total phosphates, nitrate, nitrite, ammonia)	Standard Methods in laboratory
Chlorophyll-a (µg/ℓ)	Standard Methods in laboratory
Algal cell counts	Standard Methods in laboratory
Algal identification	Standard Methods in laboratory

The samples must be collected at both the surface and bottom (0.5 m above the substrate so as not to collect sediments) of the receiving water body. The following equipment will/may be required:

- Motorboat;
- pH, dissolved oxygen and temperature meter that enable samples to be read in situ at the bottom and surface of the dam;
- Standard Secchi disk; and
- Sample bottles for nutrients, algal and chlorophyl-a collection.

The samples must be preserved and stored on ice for a maximum of 24 hours before analysis is undertaken at an accredited laboratory.

Table 5: EMP for proposed pond and cage farming activities

Component/Activity	Environmental Impact	Mitigation	Responsibility	Monitoring Mechanism	Indicator/ Performance Criteria
Fish feeding	Water quality impacts as a result of feed wastage	■ Only high quality aquaculture feeds must be purchased from recognised feed producers; ■ Information on the nutrient makeup, primary ingredients and production techniques, e.g. extrusion, should be available to the farmers; ■ Feed producers must provide the date of feed manufacture and shelf life; ■ Feed must be stored and used on a “first-in-first-out” basis; ■ Feed storage areas must be well ventilated, dry and free of vermin that can damage, contaminate and consume feeds; ■ Feed stores must be lockable; ■ Feed must be stored on pallets to allow for full ventilation of bags that would otherwise be in contact with floor surfaces; ■ The required amount of feed per day per production unit and the FCR must be recorded in a logical fashion to prevent overfeeding; ■ Feeding rates must be correlated to water quality sampling to allow detection and alteration of over-feeding. This will be done by the water quality monitoring programme to be implemented; ■ Correct feed pellet size must be used to ensure low levels of feed wastage; ■ Factors such as feed position (floating or sinking) and feeding times of day must be considered when attempting to minimise feed wastage (and the associated water pollution); ■ Feeding staff must be trained in feed application, as the detection of subtle changes in feeding behaviour is important. If fish are not actively feeding it may be necessary to suspend or delay feeding; ■ Feedbags must be collected, recycled or re-used if possible, or disposed of in an environmentally responsible manner; ■ Feed stores should be inspected once a week; ■ The calculation of suitable feeding rates, record keeping of feeds and management to lessen feed wastage must be calculated on a daily basis; ■ Water quality monitoring results must be correlated to feeding rates and production biomass once a month so that the necessary adjustments can be made; ■ Establish effluent rapids so as to increase oxidation of nitrogenous matter; and ■ Installation of settling ponds to allow the capture of sediment, organic matter and other pollutants by deposition, infiltration, absorption, decomposition and volatilisation.	Farmers Feed producers	Water quality monitoring programme.	Water quality results which fall within the predetermined parameters
General aquaculture operations	Security breach	■ Access to the farms must be controlled for security reasons and to prevent uncontrolled movement of individuals and vehicles that may cause environmental degradation; ■ Unpaved roads into and around the production facilities should not contribute to erosion; ■ Aquaculture facilities must be fitted with a gate for access control. Prohibition of entry by unauthorised persons must be displayed on gates; ■ Perimeter fences and boundaries must disallow free access of unauthorised persons; ■ Facilities and stores must be kept locked after hours and when the site is not occupied; and ■ The integrity of the production facility against unauthorised access must be inspected at least once in three months by the on-site management team.	Farmer Feed producer	Quarterly inspections.	Security breach incidents
General aquaculture operations	Predator related fish fatalities	■ Sunlight resistant cover netting on aquaculture facilities should be used for keeping predatory birds out; and, for providing shade over the production activities. This netting must be erected and maintained in a manner that does not pose a threat to any birds and other animals.	Farmer	Although ensuring the integrity of cover netting is ongoing, this must be actively checked at least once a month.	Fish stock numbers

Component/Activity	Environmental Impact	Mitigation	Responsibility	Monitoring Mechanism	Indicator/ Performance Criteria
		■ Shade cloth or bird netting must be of such a mesh size, structure and of rigid material so that entrapment or injury of any birds (and other animals) is prevented; ■ Netting must be ultra violet (UV) and weather resistant to prevent it from tearing and becoming tattered; ■ Netting must be firmly secured to prevent it from tearing in windy conditions; and ■ Although the colour of such netting must be neutral, it must also be clearly visible by birds approaching the facility.			
General aquaculture operations	Potential fish escapees	■ Install screens on all inlet and outlet points in the fish farm to minimize the escape of fry, juveniles and broodstock; ■ Filter screens in fish farms shall be designed to retain the smallest life stage present; ■ Filter devices should be capable of screening all water; ■ Cages should be made of sturdy, non-corrosive materials; ■ Make thorough inspection of nets before they are deployed so as to avoid possible escapees from the cages; ■ Follow protocols when transferring, changing nets or harvesting fish from the cages e.g. use of fish boxes; ■ Divers or underwater cameras must periodically inspect cages for holes, rips and tears; ■ No production stock may be kept in settlement and filtration ponds or any other unit not specifically designated as part of the production cycle; ■ The moving of fish (cage stocking, grading and harvesting) must be done in a manner, which prevents escape; and ■ During the inspection of fish a ‘catch net’ must be placed between the working platform where the fish are being handled and the open water. This must ensure that any fish that mistakably fall on the working deck must not escape.	Farmer		Fish escape incidences
Cage culture	Cage structure failure and loss of fish stock	■ The cage anchor lines must be regularly (once a month) inspected to ensure the stable positioning and anchoring of the cage system at all times; ■ Cage platforms must be kept in good order (clean, tidy and free of unnecessary equipment etc.); ■ Cage netting must be kept clean, free of algal growth and free of any damage or holes that could lead to fish escape or the penetration of predators; ■ No chemicals may be used in the cleaning of the cage nets unless approval is obtained from the relevant authorities; ■ The HDPE piping of floating cage collars must be checked for corrosion and leaks so that these can be repaired or replaced if necessary; and ■ The cage units may be moved from time to time to lessen the localised build-up of organic sediments directly underneath the cage facilities. These positions must remain within the areas zoned/approved for the operation of the cage culture system.	Farmer	Inspection of the entire structural safety of the cages, including floatation, anchor lines and general safety must be undertaken every six months. Cleaning of the cage netting must be undertaken on a rotational basis so that the net of each cage is inspected at least once a month and cleaned as required to prevent bio-fouling. The status of the netting (damage and holes) must be inspected at the same time as the net cleaning operation. Production cages may not be moved more than four times per annum (quarterly basis).	Fish escape incidences
General aquaculture operations	Outbreak of disease: spread of diseases to wild populations; and, evolution of drug resistant fish pathogens	■ Practice good animal husbandry; ■ Limit the use of chemicals; ■ Aquaculture farmers must be aware of the impacts that fish disease could have and must manage units so as to prevent infection, whilst being able to deal with any outbreaks effectively if they occur;	Farmer Accredited aquaculture pathologist	A routine scanning for diseases must be conducted by a recognised aquaculture pathologist.	Outbreak of disease

Component/Activity	Environmental Impact	Mitigation	Responsibility	Monitoring Mechanism	Indicator/ Performance Criteria
		■ The Aquatic Animal Health Code issued by the Office International des Epizooties (OIE) applies. None of the listed diseases under this code are permitted on any fish farm; ■ No aquaculture organisms may be imported into the aquaculture production facility from unrecognised sources and all imported ova and fingerlings need to be certified disease free by the supplier; ■ It is required to have all stock checked and certified as disease free prior to introducing such organisms into the production facility; ■ Treatment of diseases must be done by recognised methods and under the guidance of recognised aquaculture pathologists. All treatments must be recorded; and ■ The storage and use of aquaculture chemicals and medications must be done in a safe and responsible manner as per the relevant Material Safety Data Sheet (MSDS).		Internal aquaculture disease monitoring is ongoing. Representative samples of the fish must be dispatched to a recognised aquaculture pathologist twice a year for complete diagnostic investigations and for inspection of the presence of OIE listed diseases. Results of disease inspections must be attached to the site audits so that all authorities have access to this information. The internal detection of disease on the farm must be reported to a recognised fish pathologist without delay.	
Chemical treatments	Chemical spills and incorrect application of chemicals	■ The use of chemicals must be done in a responsible manner and operators must ensure that no downstream environmental impacts emanate from such chemical use; ■ Chemicals must be used for specific and not general purposes; ■ The handler must wear appropriate Personal Protective Equipment (PPE); ■ Dosages, application methods and resultant outcome must be known and recorded in a treatment register; ■ Chemicals must be stored in a dry, well-ventilated and lockable chemical store; ■ Chemical purchase dates, use and expiry dates must be recorded; ■ Expired chemicals must be disposed of at a suitable hazardous waste disposal site; ■ The advice of a recognised fish pathologists or aquaculturists must be sought where the application of chemicals is uncertain; and ■ Responsible use of chemicals in aquaculture is ongoing.	Farmer Accredited aquaculture pathologist	Specific inspection of the suitability of chemical stores (expiry dates, etc.) must be done once in three months and according to the relevant MSDSs	Chemical spills
General aquaculture operations	Fish mortalities	■ Bacterial action and autolysis of dead fish results in the excretion of ammonia in lake waters; ■ Live fish preying on dead fish can result in the spread of disease; and ■ Mortalities attract fish predators e.g. birds, to the farm and birds and crocodiles at the cages.	Farmer	Conduct a daily routine of collecting mortalities on the farm. All mortalities should be burnt at an incinerator.	Outbreak of disease Accumulation of predators
General aquaculture operations	Disease outbreak	■ It is a normal occurrence for some aquatic organisms in production systems to die from natural causes. As a general norm no more than 0.1% of the total number of individual fish in a single production unit should die in a 24 - hour period; ■ All mortalities must be recorded and the associated behaviour of the remainder of the organisms monitored, e.g. loss of appetite; ■ If greater numbers die (more than 0.1% of the stock) or if the associated behaviour of the organisms indicates a problem, the first step is to monitor the physical and chemical characteristics of the water (temperature, pH, oxygen content, etc.). Failing the detection of any adverse water conditions a recognised pathologist should be approached to determine the cause; ■ A database must be kept of the numbers of dead organisms and the behavioural patterns of the population as a whole;	Farmer Accredited aquaculture pathologist	All units must be inspected daily for dead organisms and these must be removed and disposed of without delay. Diagnosis of the cause of large-scale mortalities must be done as soon after such an event as possible. Clear records must be kept.	Outbreak of disease

Component/Activity	Environmental Impact	Mitigation	Responsibility	Monitoring Mechanism	Indicator/ Performance Criteria
		■ Dead aquatic organisms must be removed from the production systems as soon as they are detected. If samples are required for diagnostic purposes, these must be taken and appropriately stored for this purpose; and ■ During normal rates of mortality any dead organisms must be disposed of responsibly. Dead organisms from normal mortality events must be ensiled so that the resultant protein material can be used in animal feed or fertiliser production.			
Fish processing	Disease from incorrect handling of fish during processing	■ After conducting inspections of fish, the farmer must check for any mortalities caused by injury. Such dead fish must be removed and discarded of via the fish ensiling process; ■ Fish must be killed humanely; ■ No blood or any other fish waste (intestines, gills and heads) may enter the Lake. All of this material must be added to the fish ensiling process; ■ The phyto-sanitary management of the slaughtering facilities must be taken care of under the agreements closed with the fish buyers; ■ The prevention of the escape of fish during handling is ongoing and must be ensured during any handling activities; and ■ The safety, hygiene and working order of fish handling equipment must be checked prior to any handling activities.	Farmer Fish processor	Audits	Disease from incorrect handling of fish during processing
General aquaculture operations	Endangering predators	■ Various predatory animals are attracted to aquaculture production facilities as the high concentration of prey items could lessen the effort of obtaining a meal. The intention is to prevent these predators from accessing the production units while not injuring, trapping, harming or killing them; ■ Bird netting must be positioned so as not to hinder the natural movement of the birds. They should be visible to the birds; ■ No traps may be used to injure any predators of aquaculture organisms. Traps may only be set if these predators can be caught live (without injury) for translocation to alternative areas. This may only be done under the supervision of recognised organisations or authorities; ■ No poisons may be left out for aquaculture predators; ■ No animals that prey on the aquaculture species may be shot; ■ The main aquaculture predators and their control methods include cover netting for birds (Cormorants, Kingfishers, Fish Eagles, Herons, Storks and others) and fencing and netting for otters; and ■ Ensuring the exclusion of predators is ongoing.	Farmers	Specific consideration and inspection of all fences, predator netting, inlets and outlets must take place at least once a month to determine their suitability	Predator injury or death
Pond effluent	Increase in accumulation of waste in the receiving water body affecting the bottom dwelling organisms: increase in phytoplankton productivity; and, organic anions may become a part of the total alkalinity in polluted waters.	■ Introduction of the hapas system minimizes the rate of nutrient loading from the draining ponds; ■ Reduce rate of disposal by minimizing draining of ponds; ■ Settling ponds retains effluent for 48 hrs allowing the waste to sink and allowing for breakdown and hydrolysis of organic matter; ■ Anaerobic bacteria in the settling ponds which hydrolyses organic matter; and ■ Ensure that the inlet and discharge points are independent from each other so as to guarantee that water supply and effluent do not mix.	Farmer	Water quality monitoring	Water quality degradation
General aquaculture operations	Degradation of water quality	The farmer needs to establish a comprehensive water quality monitoring programme (section 7.1) that includes the following: ■ Monitoring of dissolved oxygen, temperature, pH, turbidity, Secchi, nutrients, total P, chlorophyll, algal cell counts and identification, and whatever else is required for good management of fish health and water quality;	Farmer	Audits	Monthly water quality reports

Component/Activity	Environmental Impact	Mitigation	Responsibility	Monitoring Mechanism	Indicator/ Performance Criteria
		■ This needs to be done 500 m upstream and downstream of the aquaculture site, in the middle of the site, at the surface and at the bottom of the water column; ■ Frequency needs to be at least monthly; ■ Substrate Sampling (Sediment monitoring): ▪ The substrate under each fish cage and for 30 m around each cage will need to be sampled by means of grab sampling in order to sample the underlined benthos; ▪ This needs to be done 500 m upstream and downstream of the aquaculture site and in the middle of the site; and ▪ Frequency needs to be done at least monthly.			
Oil changing and refuelling of vehicles and pumps	Soil and water contamination due to improper handling, usage and management of hydrocarbons	■ Drip trays should be used when refuelling; ■ Spillage procedures for containing and cleaning up oil/fuel spills (i.e. provision of spill kits including absorbent materials etc.); and ■ Any soil contaminated by hydrocarbons will be treated as hazardous waste and disposed of accordingly.	Farmer	Visual inspection	Method statement in place and hazardous waste removed offsite for recycling or best practice disposal.
General aquaculture operations	General waste resulting in: contamination of the environment; attraction of scavengers; injuring of wildlife; spread of diseases and the emission of odours (air pollution).	■ Containers must be supplied for general waste, within the farm perimeter; and ■ Recyclable waste will be disposed of with a suitable contractor.	Farmer Waste contractor	Visual inspection	Farms will remain clear of waste
General aquaculture operations	Nuisance	■ A grievance procedure and complaints record will be developed so that complaints can be registered; and ■ The register will contain information regarding the identity of the complainant, the reason for the complaint, and the means in which the complaint was dealt with as well as any feedback given to the complainant.	Farmer Farm Africa	Grievance mechanism	Complaints register in place - grievances addressed within one week of complaint.
Cage Mooring	Health and safety compliance at the cage mooring site	■ Cages need to be towed to the mooring sites by an appropriately sized vessel; ■ All involved personnel need to have adequate floatation safety gear and need to be fully trained in health and safety codes related to water borne activities; and ■ Skippers need to be licensed.	Farmer		Health and safety incidents
Fish processing	Disease from processed fish waste	The waste generated in the primary processing of the harvested fish (heads, gills and intestines) and the mortalities experienced from production must be ensiled to produce a stable and odour free high protein supplement for animal feeds or fertilizer. This waste must be milled and chopped and then stabilised (ensiled) by means of adding organic or mineral acids. The mineral or organic acids decrease the pH, which inhibits the growth of bacteria, and hence enables long-term storage of the raw material. The following is a commonly used method for ensiling fish waste: ■ The raw material is first minced; small particles can be obtained by using a hammer mill grinder fitted with a screen containing 10 mm diameter holes; ■ Immediately after mincing, 3.5% by weight of 85% formic acid is added, that is 35 kg or about 30 litres of acid to one tonne of fish; ■ It is important to mix thoroughly so that all the fish comes into contact with acid, because pockets of untreated material will putrefy; ■ The acidity of the mixture must be pH 4 or lower to prevent bacterial action; and	Fish processor Health authority	Audit	Disease free processing facilities which have been audited.

Component/Activity	Environmental Impact	Mitigation	Responsibility	Monitoring Mechanism	Indicator/ Performance Criteria
		■ After the initial mixing, the silage process starts naturally, but occasional stirring helps to ensure uniformity. The silage production tank can be of any size or shape provided it is acid resistant; some steel containers used for making or carrying the silage may need a polyethylene liner to prevent corrosion. Concrete tanks treated with bitumen are suitable for holding large quantities. The size and number of tanks depend on the amount and type of raw material available: ■ Acids, including formic acid must be handled with care; ■ Personal Protective Equipment (PPE) must be worn when dealing with acids or any other chemicals, e.g. operators must always wear rubber gloves and goggles; ■ The acid storage tank must be made of resistant material; ■ All chemicals including formic acid must be kept in a locked storeroom at all times; ■ Only authorised personnel have access to the storeroom; and ■ MSDS must be displayed together with the appropriate chemicals in storage. The size of the facility must be adequate to ensure the processing of the envisaged waste that will be generated.			

7.1.1 Frequency

It is recommended that the sampling be undertaken on a monthly basis (unless stated otherwise). If trends are determined that could indicate possible fish farming impacts then the frequency of sampling must be increased (twice a month). The water quality analysis must be completed within one week of reaching the analytical facility so that corrective measures can be undertaken if required.

7.1.2 Standards

In Kenya, the discharge of water into the environment is governed by the Environmental Management and Co-ordination (Water Quality) Regulations, 2006. The Third Schedule of the Regulations describes the required water quality parameters to be met. The Sixth Schedule provide monitoring guidelines for the discharge of treated effluent into the environment. The Seventh Schedule provides a form for the application for an effluent discharge licence.

7.1.3 Reporting

The results of these water quality surveys must be reported on a monthly basis to the stakeholders. The results and trends should be reviewed and audited on an annual basis.

7.1.4 International Monitoring Compliance

As per “global best practice”, the following should be implemented:

1) Spatial Considerations:

Licence holders shall monitor and inspect:

- 500 m upstream of the site, 500 m downstream of site and in the middle of the aquaculture site;
- At the surface and at the bottom of the water column within the aquaculture site; and
- The substrate under each fish culture cage and for 30 m around each fish culture cage. The substrate will need to be sampled by way of ‘grab samples’ in order to sample the underlying benthos.

2) Time Considerations:

- Licence holders shall obtain a full set of water quality and substrate analyses prior to the start of culturing operations and at a time when water levels are at their highest;
- Thereafter, licence holders shall conduct standard water quality, sediment and environmental monitoring monthly; and
- Licence holders shall take water quality samples on a set day and time of each month so as to make accurate considerations.

3) Analyses:

- Water quality and sediment analyses shall be undertaken by an accredited laboratory;
- Water samples for organic pollutants (nitrogen (N) and phosphorous (P)) are to be transported on ice or fixed according to instructions from the laboratory (these instructions to be reported) to prevent changes in water chemistry between sampling and analysis; and
- The licence holder shall monitor the following parameters in particular:

Parameter	Unit	Regularity
Temperature	*Degrees C*	*Daily*
Total P	*$mg.m^{-3}$*	*Monthly*
Orthophosphate	*$mg.m^{-3}$*	*Monthly*
Turbidity	*FTU*	*Monthly*

Parameter	Unit	Regularity
Total Nitrogen	*$mg.L^{-1}$*	*Monthly*
Dissolved oxygen	*$mg.L^{-1}$*	*-*
Total suspended solids	*$mg.L^{-1}$*	*Monthly*
Total dissolved solids	*$mg.L^{-1}$*	*Monthly*
Visual monitoring and inspection of substrate	*-*	*Every six months*
P content of feed	*-*	*Every six months*

7.1.5 Emergency Procedure

Table 6 summarises the emergency procedure that must be followed in the event that poor water quality (over the predetermined threshold) is detected.

PRELIMINARY ACTION: Clarify parameters, degree of water quality degradation and cause

Table 6: Emergency Plan in event of poor water quality

DEGREE	**Threat to internal ecology**		**Threat to farmed fish health**		**Threat to external ecology (downstream or terrestrial)**		**Threat to quality of water**	
CAUSE	**By fish farming**	**Independent of fish farming**	**By fish farming**	**Independent of fish farming**	**By fish farming**	**Independent of fish farming**	**By fish farming**	**Independent of fish farming**
ACTIONS	■ Reduce/stop feed; ■ Investigate and adapt feed programme; ■ Investigate and adapt biomass; ■ Move cages; ■ Audit feed analysis; ■ Audit fish health and growth environment; and ■ Inform water authority.	■ Reduce/stop feed; ■ Monitor effects on health and growth; and ■ Identify cause and address with water authority.	■ Reduce/stop feed; ■ Investigate and adapt feed programme; ■ Investigate and adapt biomass; ■ Move cages; ■ Audit feed analysis; ■ Audit fish health and growth environment; and ■ Inform water authority.	■ Reduce/stop feed; ■ Monitor effects on health and growth; and ■ Identify cause and address with water authority.	■ Reduce/stop feed; ■ Investigate and adapt feed programme; ■ Investigate and adapt biomass; ■ Move cages; ■ Audit feed analysis; ■ Audit fish health and growth environment; and ■ Inform water authority.	■ Reduce/stop feed; ■ Monitor effects on health and growth; and ■ Identify cause and address with water authority and external responsible parties.	■ Reduce/stop feed; ■ Investigate and adapt feed programme; ■ Investigate and adapt biomass (immediate reduction if required); ■ Move cages; ■ Audit feed analysis; ■ Audit fish health and growth environment; and ■ Inform water authority.	■ Reduce/stop feed; ■ Monitor effects on health and growth; and ■ Identify cause and address with water authority and external responsible parties.

7.1.6 Aquaculture Chemicals

The use of chemicals must be done in a responsible manner and operators must ensure that no downstream environmental impacts emanate from such chemical use. Table 7 contains a schedule of the chemicals that are commonly used by fish farmers.

Table 7: Schedule of main chemicals

Chemical	Use	Expected rate of use	Approach
Hydrocarbon Fuels	Vehicle/generator propellant	As required for vehicles and other machinery	■ Store must be bunded; ■ Bio remedial kit to be on site; and ■ Extinguishers to be kept on site.
Hydrocarbon Lubricants	General lubricants	As required for vehicles and other machinery	■ Store must be bunded; ■ Bio remedial kit to be on site; and ■ Extinguishers to be kept on site.
Virkon S	Cleaning and disinfectant agent – virocide and biocide	Use 5 – 10 ppm for cleaning of hatchery, slaughtering facilities and treatment of fish disease	■ This product is environmentally safe; ■ To be used as per MSDS; and ■ Stored under lock and key.
Aqui S	Anaesthetic for fish	5 – 40 ppm when fish are slaughtered (i.e. approximately 160 ml per week)	■ This product is environmentally safe; ■ To be used as per MSDS; and ■ Stored under lock and key.
Salt	Treatment of certain fish diseases	Various rates of application	■ Responsible use.
Isopropyl Alcohol	Sterilising agent for hatchery equipment	Various rates of application	■ Responsible use; and ■ Stored under lock and key.
Buffered Iodine	Disinfection of eyed eggs	As required	■ Responsible use; and ■ Stored under lock and key.
Hyamine	Detergent and treatment gill disease	As required	■ Responsible use; and ■ Stored under lock and key.
Chloramine T	Disinfectant, biocide	Use 5 – 15 ppm for cleaning of hatchery, slaughtering facilities and treatment of fish disease.	■ This product is environmentally safe; ■ To be used as per MSDS; and ■ Stored under lock and key.
Praziquantel	For killing fish fluke and other parasites	Use 50 – 100 ppm in isolated treatment.	■ To be used as per MSDS; and ■ Stored under lock and key.

7.2 Review and Update of the EMP

Both internal and external audit reports must contain recommendations for the improvement of the management system. This is especially relevant to any shortfalls in standards that are detected. Each audit report must contain explanations of any shortfalls in compliance as well as mitigation and improvements as to how the measures, management or standards can be improved on the project and in the EMP. It is specifically noted that the EMP is a live document and improvement in management and technology that can enhance good management practice and reduce risk or impacts to the environment must be tabled and implemented as and when these arise.

7.3 Standard Operating Procedures

This section provides generic high-level Standard Operating Procedures that are in-line with international best management practices (BMP). In a more site-specific operation, it is recommended that these be elaborated on and adapted such that they are fit for purpose.

7.3.1 Genetics

It is important that suitable species and genetic stock is sourced and used in any aquaculture systems to ensure optimal production and to reduce the risks to the environment and biodiversity (Hinrichsen, 2007).

BMP concepts and approach:

- Prior to the commencement of any aquaculture activities, use of the target species must be authorised in terms of the applicable legislation;
- Unless authorised, only locally indigenous species may be used;
- Genetic Modified Organisms of fish species shall only be allowed to be imported if they fulfil requirements in country Protocols and Conventions of Biodiversity;
- Aquaculture species that are able to hybridise should not be farmed together, while species that are able to hybridise with indigenous species (e.g. *O. niloticus* can hybridise with other *Oreochromis spp.*) in the surrounding environment should not be used as production candidates where they do not occur;
- Non-native species should not be introduced to an area where they do not already occur;
- It is important that care is taken to use candidate species that occur within that area so as to minimise the impacts on the gene pool of species within that area;
- Adequate steps must be taken to prevent the escape of production organisms, especially from the hatchery environment where individual organisms may be very small. In this regard, regular inspection of production infrastructure and escape barriers is important. Escape barriers may include netting, grids, sand and other filters, predator ponds, chemical treatment areas, soak away systems, etc. Barriers should be adequate to prevent escape during flooding, overflows and during other unforeseen circumstances; and
- Aquaculture species are propagated from a tailored gene pool and thus not suitable for restocking or supplementation of natural stocks.

7.3.2 Hatchery Management and Fingerling Production

Cage and pen culture require large numbers of quality fingerlings for grow-out. Fry are collected from spawning units and stocked into ponds for rearing till the fingerling stage, before they are stocked into grow-out facilities (ponds or cages). Tilapia can spawn and breed in open ponds, tanks and hapas:

- Farmers must source the best available genetic stock for breeding purposes;
- Production methods (open ponds, hatchery tanks or hapa-based method) should be adopted according to the available capital, expertise and objectives of the farm (open ponds being the simplest and most common method of tilapia fingerling production);

- Management practices need to be tailored to the specific production method employed (e.g. open ponds, hatchery or hapa-based);
- Fry rearing in hatcheries requires high water quality standards;
- Genetic improvements for desired traits requires a well-designed selective breeding programme and the relevant grading, separation and record keeping practices which effect the programme require implementation; and
- Duties assigned within the management team that include:
  - Grading to target overall selection for the fastest growing individuals in the population for further rearing and discarding the slow growers;
  - Specific facility-based management practices incorporating harvest of fry from spawning units, feeding regimes and replacement of brood stock;
  - Accurate record keeping of production procedures must be kept up to date; and
  - Hatchery management and planning which facilitates the flow of operations, including the preparation of suitable nursery environments and subsequent grow-out environments for the transferral of fish from hatchery environments.

7.3.3 Fish Feed Management

The appropriate type and quantity of feed for a given species is influenced by fish size, water temperature, dissolved oxygen (DO) levels, health status, reproductive status, and management goals. An optimal rearing regimen requires detailed monitoring and record keeping of fish weight, food consumption, mortalities, temperature, pH, DO and the health status of the stock.

Waste feed and fish faeces constitute most of the wastes generated by a fish farm. An effective way to reduce the potential environmental impact of farms is to aggressively and proactively manage feed selection, storage and feeding practices. Effective feed management is based on two components: waste reduction and optimal feed conversion ratio. Waste reduction focuses on ensuring that feed used by the farm is not lost or discharged prior to intake by the fish. Optimal conversion focuses on ensuring that all feed offered to the fish is actually consumed, digested, and utilised. Monitoring long- and short-term changes in feed conversion ratios allows farmers to quickly identify significant changes in feed consumption and waste production rates in individual ponds or cages.

- Ensure compliance with the Fisheries (Safety of Fish, Fishery Products and Fish Feed) Regulations, 2007;
- Only registered aquaculture feeds should be purchased from recognised feed companies that produce high quality feeds. Aquaculture operators should be familiar with the nutrient make-up, the primary ingredients and production techniques of feeds used;
- Optimise all operations related to feed delivery, storage and handling to minimise waste and the creation of fines (feed dust);
- Where applicable farmers should be guided by feeding tables provided by the manufacturer;
- Maintain feed conversion ratio records by using feed and fish biomass inventory tracking systems;
- Where possible use species specific formulations designed to enhance nitrogen and phosphorus retention efficiency, and reduce metabolic waste output;
- Use efficient feeding practices, monitor active feed consumption, and reduce feed loss;
- Feed pellet size should be appropriate for the size of fish being fed;
- Feeding behaviour must be observed to monitor feed utilisation and evaluate health status;

- Water quality monitoring should be correlated and checked against feeding rates and production biomass so that adjustments can be made to the feeding programme;
- Maintain and properly operate feeding equipment;
- Conduct employee training in fish husbandry and feeding methods to ensure that workers have adequate training to optimise feed conversion ratios; and
- Interactive feedback feeding systems such as “lift-ups,” should be used to optimise feed consumption and to reduce feed waste.

7.3.4 Fish Health

Good husbandry is critical for aquatic animal health. Maintaining proper environmental conditions, selecting healthy fish, providing a nutritious diet, minimising stress, vaccinating fish, and rapidly diagnosing, isolating, and treating disease outbreaks are important aspects of good husbandry.

BMP for fish health involves:

- Ensure compliance with the Fisheries (Safety of Fish, Fishery Products and Fish Feed) Regulations, 2007;
- Utilise disease prevention strategies as a first line of defence against disease, including:
  - Applying good animal husbandry and management practices;
  - Maintaining good water quality in all rearing units;
  - Conducting routine inspections of farm stocks to observe behaviour and early indications of health problems and stress;
  - Using stocking densities, handling techniques and feeds that are appropriate to the species and size of fish;
  - Using stocking densities that meet the holding capacity of the system and environment in which the species is cultured;
  - Removing dead and dying fish from the pond, cage or tank in a manner that does not compromise the health and welfare of the remaining stock;
  - Implementing appropriate biosecurity measures; and
  - Using immuno-stimulants and vaccines, where appropriate.
- Develop a written Fish Health Management Plan for each farm site;
- Utilise professional fish health services and/or veterinary expertise to diagnose disease prior to initiating any disease treatment;
- No veterinary therapeutic-products and medicinal premixes for inclusion in fish feeds may be applied to fish unless they are approved for use under the terms of the Pharmacy and Poisons Act (Cap. 244);
- When therapeutic agents are required:
  - Follow manufacturer’s/veterinarian’s instructions regarding dosage, frequency and duration;
  - Keep a current copy of the veterinarian’s written recommendation;
  - Institute procedures to assure that the identity of treated animals is carefully maintained; and

  - Strictly uphold and verify prescribed withdrawal times before harvest to assure that no unsafe accumulation of therapeutant residues occur in the flesh of any fish intended for human consumption.
- When medicated feed is used, ensure that:
  - A prescription is obtained from a qualified veterinarian;
  - Feed is applied at the prescribed level for the prescribed period;
  - Staff are trained in the safe handling of pharmaceuticals;
  - Medicated feed is stored separate from regular feed and is properly identified; and
  - Necessary documentation and records are maintained.
- Purchase therapeutic agents and medications through authorised channels;
- Maintain accurate records of purchase, use and disposal of therapeutic agents, medicated feed, detergents, antifoulants, etc. to assure compliance with mandatory inspection regulations and any information required by processors;
- Dispose of unutilised therapeutic agents and medicines according to conventional hazardous waste disposal practices;
- Ensure that the potential for contamination of the environment will be minimised when using disinfecting agents and other therapeutic agents;
- Use environmentally-friendly detergents;
- Report mortalities to the relevant agencies as required; and
- Ensure all chemicals and drugs are secured to prevent unauthorised use.

7.3.5 Biosecurity

Biosecurity in aquaculture is of critical importance. The control of pathogen entry and proliferation is an essential aspect of any intensive animal production unit and is one of the most difficult challenges facing the industry worldwide.

Biosecurity plans should include:

- Appointment of a biosecurity manager;
- Registered veterinary health contacts;
- Providing staff training in fish health management and disease recognition;
- Identify the risks of contracting and spread of disease through fish movements. One of the greatest risks of introducing an infectious disease into an operation comes with movement of fish;
- Identify the risks of contracting and spreading disease as a result of site procedures.
- Implement risk limitation measures, which may include:
  - Train all staff to comply with all biosecurity measures;
  - Early identification of disease through regular stock inspections;
  - Training staff to recognise clinical signs of disease and enable them to identify procedures that carry a risk of introducing or spreading disease;
  - Ensure that fish husbandry techniques are suitable for the species being held or cultivated;

- Inform visitors of biosecurity measures and what they have to do;
- Use suitable disinfectants and disinfection procedures for personal protective equipment and other equipment;
- All protective clothing must be disinfected and then washed in clean water every week;
- All equipment (including nets, buckets, bins, graders and pumps, etc.) must be disinfected after use; and
- Each site should have a biosecurity diary where all details of biosecurity operations will be recorded, i.e. footbath changes, visitors, and deliveries, etc.

- Monitoring the plan: maintain a clear recording system for results of checks made and actions, e.g.:
  - Stock health inspections;
  - Visitor procedures and details; and
  - Disinfection procedures.
- Contingency planning.

7.3.6 Environmental Management

The culture, facilities and environment determine success and the level of fish production. The primary goal in site selection for aquaculture is in the choice of an area that is capable to accommodate a venture that will be economically viable, socially acceptable and environmentally responsible.

- Production systems should be designed and constructed in a manner that allows for the safety of employees, the farmed organisms and the surrounding environment;
- Where water is discharged, care must be taken that the legal water quality criteria are met. Where applicable, some form of postproduction water treatment can also be used (e.g. sedimentation or filtration);
- Aquaculture ponds and tanks must be designed and constructed to allow for complete drainage;
- Access to sensitive areas should be kept to a minimum by means of designing access around these areas, by fencing them off and by educating employees of their existence and sensitivity;
- Where possible, general waste should be separated into glass, paper and plastics for recycling;
- For small mortalities (e.g. less than 50 kg per week), a system of liming and burying or incineration may be employed, provided that this does not cause groundwater pollution or other impacts of significance (e.g. health risks, odours, etc.); and
- For large scale mortalities (>50 kg. per week), it is recommended that a silage system be employed, which can liquefy and stabilise waste material by grinding and lowering the pH. This silage can then be incorporated into monogastric animal feeds as a high protein supplement.

Environmental best practice in aquaculture includes the development of environmental contingency plans. These plans should contain details on the tasks and actions to be taken in addressing environmental emergencies, the performance criteria for such actions, the responsible persons, reporting procedures and post-contingency review mechanisms. The plans must be communicated to all employees, the applicable local and district authorities and emergency services. In order to maintain an acceptable level of preparedness, the plans should be put to practical testing and regularly updated.

8.0 FUTURE ENVIRONMENTAL AUTHORISATION

8.1 Legislation and Scale of Operations

Considering that many aquaculture initiatives in Africa are at a small-scale, the threshold at which an EIA becomes mandatory for aquaculture is significant (FAO, 2009). Table 8 illustrates the variability in scale of aquaculture EIA triggers in Africa.

Table 8: EIA triggers for aquaculture in African countries (FAO, 2009)

All aquaculture requires EIAs irrespective of size	Specific to development size	All aquaculture excluded from EIAs	Two tier permitting system
Ghana	Mozambique (>5 ha)	Algeria	South Africa (small scale developments are subjected to basic assessments as opposed to a full EIA) >20 t/annum (wet weight)
Liberia	Zambia (>100 t/annum)		Togo (simplified EIA <300 ha and in-depth EIA >300 ha)
Namibia	Malawi (water capacity over 100 m^3)		

8.1.1 Kenyan Legislated Requirements

As mentioned in section 2.2.1, the Second Schedule of the Environmental Management and Co-ordination (Amendment) Act, No. 5, 2015 does not specifically list aquaculture projects as requiring an EIA. However, the Third Schedule of the Fisheries (Safety of Fish, Fishery Products and Fish Feed) Regulations, 2007, clearly states **that commercial scale fish culture shall be subjected to an EIA prior to implementation**. Therefore, any farmer selling fish for financial gains is legally required to conduct an EIA.

As conducting a full EIA may not be practical (or affordable) for the smaller fish farms, and as there is no definition for “commercial scale” in the regulations, it is advised that Farm Africa consult with NEMA directly to determine the scale of the aquaculture specific triggers.

8.1.2 FAO Recommendations

The FAO recommends that any new aquaculture development be subjected to:

- A permitting or licensing procedure;
- Screening and scoping;
- EIA- if the development is designated as high risk (e.g. located in a sensitive area or could potentially impact on a wetland);
- Simple environmental assessments or statements for smaller farms or low risk activities; and
- Monitoring related to local threats and risk levels.

The above reaffirms that discussions need to be held with NEMA, and other relevant government authorities, to determine the scale of aquaculture activities that trigger EIA permitting. It is important to note that there is great diversity in defining the scale of fisheries, and as such no universal definition can be prescribed. For the purpose of this study the FAO’s definitions will be used, as follows (Muir, 1995):

- Large-scale aquaculture: an aquaculture system with a large annual production (maximum of 50 tonnes per unit and around 500 tonnes in total) that is fully commercial.

Large scale producers would include: multiple units, a high level of management input, financial planning, will be at least partially mechanised, have one or more sites and a number of staff employed. The hatchery equivalent would be a major centre;

- Medium-scale aquaculture: an aquaculture system with a medium annual production (maximum of five tonnes per unit and around 100 tonnes in total) that usually consists of several production units. It would be either family or commercially run, with moderate to high input and management levels and some external labour. The hatchery may be more specialised; and
- Small-scale aquaculture: an aquaculture system with a small annual production (maximum of one tonne per unit and around 10 tonnes in total), made of one or more small production units. It would typically be family or communally run with low to moderate input levels and limited external labour. Subsistence food supply may be the main motive.

From an environmental perspective, it is therefore recommended that large to medium scale aquaculture operations be subjected to the full EIA process.

Should it be decided by the government authorities that an EIA not be required for small scale commercial aquaculture, the farms should not be excluded from the environmental permitting requirements altogether, as they too can have significant environmental impacts. Small scale farmers should not be excluded because:

- There is always a potential for an aggregation of small farmers to collectively create unexpected environmental impacts i.e. cumulative impacts;
- This category of farmer would benefit from some formal protection from negative impacts on their resources as a result of other external activities; and
- Environmental issues are often a key part of the message working towards “best aquaculture practice” (for example in sustaining good water quality).

It is thus recommended that small-scale farmers should form co-operatives for ease of management. KMAP should co-ordinate the formation of these groups based on locality. KMAP should then provide support to the co-operatives, in the form of a simple environmental checklist approach, which informs the farmer of best management options for aquaculture and draws attention to acceptable or unacceptable practices. It is recommended that all small scale farms:

- Have the required water use and discharge permits in place;
- Develop waste management plans;
- Conduct an environmental monitoring programme monthly; and
- Implement Best Management Practices.

Table 9 illustrates the FAO-recommended management mechanisms relative to the scale of aquaculture operations, as adapted in the above text.

Table 9: Applicability of different management mechanisms at different scales (FAO, 2009)

	Global	Regional*	National	Local	Large farm	Small farm or cluster
Strategy	EAA, EAF	X	X	X		
Planning		ICZM	ICZM	Zoning	Farm site	
Risk analysis		X	X	X	X	
SEA		X	X	X		
Local plan				X		
EIA					X	

	Global	Regional*	National	Local	Large farm	Small farm or cluster
Environmental declaration						X
Permit/Licence					X	X
Monitoring			X	X	X	X
Control				X	X	X
BMP/CoP					X	X
Certification	X	X	X	X	X	X

* Could also include international waters/watersheds.

EAA: Ecosystem approach to aquaculture; EAF: Ecosystem approach to fisheries; ICZM: Integrated coastal zone management; SEA: Strategic Environmental Assessment; BMP: Best management practices/Code of practice

9.0 SUMMARY OF KMAP RECOMMENDATIONS

In addition to the implementation of the EMP and Standard Operating Procedures, KMAP should consider the recommendations listed below. A number of the recommendations are already aligned with KMAP's current targets (APPENDIX B).

9.1 Policy and Legislative Framework

- The National Aquaculture Policy (2011) and the National Aquaculture Strategy and Development Plan (2010-2015) should be updated with development targets and timelines and both should have a new focus on cage culture;
- There is a need to synchronise the current environmental policies and laws of Kenya. For example, aquaculture projects are not directly referred to in the Second Schedule of the Environmental Management and Co-ordination (Amendment) Act (No 5 of 2015) (EMCA);
- Policy should be implemented that encourages collaboration between the agriculture and aquaculture sectors, especially regarding inputs/outputs;
- Effective legislation needs to be put in place that prevents environmental damage and industry problems associated with low quality seed;
- The Ministry of Fisheries should prioritise the development of aquaculture zone maps to facilitate effective sector management;
- The voluntary instruments and technical guidelines, outlined in APPENDIX C, should be promoted strongly by Farm Africa for the responsible intensification of the aquaculture sector;
- There is no Kenyan regulation concerning the documentation of public engagement. The proponent should establish a list of interested and affected parties and also develop methods for notifying them about the proposed project. Consultation with the public should be free, prior and informed. Consultation with the public should be a two-way process, whereby information about the project is disseminated, and useful local information and opinions received. The consultation process should record the community's concerns and needs so that they can be addressed in the EIA study; and
- Certain government agencies do not have adequate capacity to effectively guide and review EIAs. This is due to a lack of funding, equipment and trained personnel. If possible, KMAP should host workshops with the relevant government agencies to enhance their knowledge of aquaculture and the likely environmental and social impacts associated with the different practices.

9.2 Technical Recommendations

- Diesel/petrol pumps should be replaced with gravity fed water supply or clean energy pumping solutions e.g. solar pumps;
- Local, pressed pellet feed is not of a very high quality and sinks rapidly, this is likely due to the inputs. As mentioned in APPENDIX B, this is aligned with KMAPs target to improve input quality and availability;
- Cage farmers should be incentivised to use extruded, floating feeds and discouraged from using poor quality, fast sinking feeds;
- The use of animal manure for fertilising ponds, as opposed to urea and super phosphate, should be explored;
- Appropriate effluent standards for the discharge of aquaculture waste water need to be developed;
- It is recommended that cage culture be incorporated into KMAP. As mentioned in APPENDIX B, cage culture will be incorporated into KMAPs agenda should the regulations be gazetted prior to the conclusion of the project;
- A cage site alternatives assessment should be conducted for targeted areas in Lake Victoria;
- The production of good quality locally made feed for cage aquaculture needs to be a focus of KMAP;
- To intensify fish production, it is recommended that farmers use larger ponds (500 m^2 or larger) to benefit from the economies of scale; and
- A common challenge in aquaculture is access to the right genetics of a species for production. As such, KMAP should initiate and support a Nile tilapia genetic improvement programme within its scope of work.

9.3 Managing Environmental and Social Risks

- It is recommended that model farms be used as training facilities, so that farmers can learn through practical exposure. This is aligned with one of KMAP's existing targets, 'Farmer Training and Demonstration' (see APPENDIX B), where 50 farmers will be selected to act as peer models;
- When selecting sites for KMAP ponds and cages, it is important to consider the neighbouring land uses and potential pollution sources;
- Disease diagnostic testing should be carried out frequently by fish farmers;
- Farmers must regularly check the quality of the water that they use in their practices. They should have emergency procedures in place should the water quality be severely compromised;
- Cage farmers should be made aware of the effects of eutrophication and how to recognise and manage it;
- Farmers should be trained in using effective aeration technology, and how to maintain the equipment. This is an existing KMAP goal (see APPENDIX B) involving the role-out of an 'Aerated Fish Farmer Kit';
- KMAP should encourage farmers to use conservative water use practices, where economically feasible;
- As electricity is unreliable, green technology should be used to pump water- for example the use of gravity or solar pumps;
- Farmers should be educated on managing fish predators and pests in an environmentally friendly manner;
- Farmers should be educated on the potential occurrence of extreme weather conditions. For example, 100 year flood levels and the prevalence of drought.

Farm management measures should be implemented for dealing with the associated climate change stresses. The aquaculture value chain, including fish distribution and markets, also needs to implement climate change adaptation measures;

- The correct land acquisition procedures should be followed so as to not create rivalry with local community members;
- KMAP must inform and include government departments in their planning;
- Farmers must monitor their outputs (water, waste, fish species etc.) and ensure that they meet regulated environmental standards;
- KMAP should establish a grievance mechanism so that community members, as well as the farmers, have a formal channel to address issues with Farm Africa, and potentially the relevant authorities;
- In dealing with theft, KMAP should encourage the farmers to collaborate. This may be done through the joint hiring of a security company, joint funding of security infrastructure or by developing a 'neighbourhood watch' with the support of local police;
- KMAP should encourage the acquisition of back-up generators for cold storage service providers;
- Farmers need to be trained in reading the fisheries market, or have access to someone who can provide suitable advice;
- Awareness programmes on: the benefits of farming fish and supporting local farmers should be carried out. This is aligned with KMAP's goal to 'Raise Consumer Awareness of Farmed Fish' (APPENDIX B);
- Organoleptic tastings should be held to disprove the belief that wild caught fish are more flavoursome. This is aligned with KMAP's goal to 'Raise Consumer Awareness of Farmed Fish' (APPENDIX B); and
- An awareness campaign on the appropriate way to handle and store fish should be conducted so as to prevent loss of stock and potential consumer dissatisfaction and illness. Hazard Analysis Critical Control Point (HACCP) plans should be developed in alignment with the Fish and Fishery Products Hazards and Controls Guidance (FDA, 2011).

9.4 Environmental Impact Management

- Strict biosecurity measures should be adhered to in hatcheries, including restricting access, hand washing and foot baths. Compliance with international guidelines on biosecurity and food safety in aquaculture requires an assessment of measures used to prevent introduction of unwanted biological agents, particularly infectious pathogens and to manage adverse effects associated with contagious agents, including related pharmaceutical and other chemical and toxic residues;
- Food safety needs to be considered as this project aims to address the demand for fish in Kenya. Therefore a mechanism such as the Hazard Analysis Critical Control Point (HACCP) needs to be implemented to ensuring the sustainability of farmed fish production and access to suitable markets. The HACCP concept of quality control was developed to ensure safety of the final food product throughout the entire chain of production and processing (from farm to fork).The HACCP is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product;
- Should new strains of fish be introduced then they should be appropriately quarantined to ensure a disease free status. The approach to manage prevention, which is likely more cost effective than cure, involves both management of the farm and the supply chain (where fish come from) (FAO, 2008).

The Food and Agricultural Organisation's (FAO) Procedures for the quarantine[3] of live aquatic animals and the Technical Guidelines for responsible fisheries: Aquaculture development:

  - Health management for responsible movement of live aquatic animals; and
  - Genetic Resource Management provides general guidelines on safe transboundary movement of live aquatic animals, risk assessments and monitoring; should be adhered to when bringing new strains of fish into Kenya.

- Water quality needs to be monitored closely to prevent contamination of the receiving ecosystems;
- Dust generated by feed mills and solid waste needs to be managed onsite to prevent a deterioration in air quality; and
- Site selection should take cognisance of existing habitats and farms should be developed in such a way as to limit impacts on ecosystem functioning.

9.5 KMAP Recommendations Received in Key Informant Interviews

- Fish feed ingredients need to be regulated;
- Farmers need technical training as well as business training in the Western project area;
- Producers and consumers need to be linked, and the market stabilised;
- The marginalised (youth and women) must be included in KMAP;
- New exotic species must not be imported;
- Discharge from ponds needs to be regulated;
- The risks of using hormones in fish farming needs to be researched;
- Potential threat of disease break-out with the intensification of fish farming. As a result, there is a need for fish health specialists in Kenya;
- There is a need to get financial institutions to invest in aquaculture;
- Government should subsidise aquaculture as it does agriculture;
- The cage farming policy needs to be finalised and implemented; and
- Cumulative environmental impacts resulting from the intensification need to be assessed.

9.6 Future Environmental Authorisation

Legally, all commercial scale aquaculture operations require an EIA. As "commercial scale" is undefined in the regulations, and as the permitting process may not be practical (or affordable) for small scale farmers, it is advised that Farm Africa works directly with NEMA to determine the scale of aquaculture operations that trigger an EIA.

[3] Quarantine means maintaining a group of aquatic animals in isolation with no direct or indirect contact with other aquatic animals, in order to undergo observation for a specified length of time and, if appropriate, testing and treatment, including proper treatment of the effluent waters (FAO, 2008).

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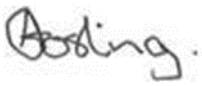

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APPENDIX A

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APPENDIX B

Proposed KMAP Intensification

August 2016
Report No. 1655589-306435-1

PROPOSED KMAP INTENSIFICATION

In order to reach the target of 4 000 MT, KMAP aims to achieve the following targets:

To sustainably increase production and productivity of medium to large scale fish farmers, hatcheries and fish feed producers

This will be achieved through the following key activities:

1. Input Quality and Availability

KMAP aims to improve the availability and quality of aquaculture inputs. This will be achieved by working with hatcheries and feed producers, such as Jewlet and Mabro, who have confirmed interest in upgrading their products. KMAP will recruit 10 - 20 input suppliers to participate in, and benefit from, the programme.

FoodTech Africa is aiming to open a new Nutreco/Unga fish feed factory which KMAP will support through its agrodealer networks and by promoting the feed directly to farmers.

Farmers will be encouraged to test the feed they are buying. Initially, KMAP will subsidise the costs of testing raw materials and finished feed, this will be phased out over 2 - 3 years.

2. Business and Innovation Facility

This is a KMAP fund that is intended primarily for entrepreneurs but is also open to experts, researchers, other development actors and Dutch companies that would like to test their aquaculture related technologies and other technical solutions in Kenya.

3. Farmer Training and Demonstration

KMAP intends to use Aquaculture Agents (AAs), private extension workers, to do a variety of jobs, from selling for hatcheries and fish feed suppliers, through to working for larger farmers as consultants, and trading fish. The AAs will provide a critical link between input suppliers and farmers. A total of 25 AAs will be selected and trained.

In the first year, project staff will train 50 lead farmers to act as peer models. In order to be chosen they must have at least three ponds and a record of technology adoption and commercial success.

4. Aerated Fish Farming Kit

The recirculating aquaculture system (RAS) developed by FoodTech Africa has demonstrated positive results regarding productivity, feed conversion ratio (FCR) levels and production volumes. KMAP will partner with FoodTech Africa to design, develop and pilot the ‘Aerated Fish Farmer Kit’, which will be aimed at the medium-sized farmer.

5. Cage Culture

KMAP will produce a manual of best practices for cage culture. If regulations are gazetted before the end of the project and commercial operations are allowed to take place, cage culture could become incorporated into the KMAP.

6. Educational Courses

Aquaculture courses at certificate, diploma, degree and postgraduate levels are currently offered at several colleges and universities in Kenya. However, they do not offer practical training. Programma Uitzending Managers (PUM[4]) and Farm Africa will provide an expert to advice on ways to make courses more skills based and practical.

[4] PUM stands for ‘Programma Uitzending Managers’ which is Dutch for ‘Manager Deployment Programme’, a Netherlands business support organization. https://www.pum.nl/

To increase access to markets for medium to large scale fish farmers and input suppliers

This will be achieved through the following key activities:

1. Increase Organisational Capacity of Hatcheries and Feed Producers

The enhancement of aquaculture in Kenya will require an increase in inputs. KMAP will link feed producers and hatcheries to farmers through wholesalers and retailers of inputs. Specific networking events will also be organised to link suppliers to retailers, and to reduce transaction costs and prices.

2. Improve Farmers' Financial and Business Management Skills

To meet the 4 000 MT production target, the 1 100 farmers will need to manage an average of six ponds each. The majority of the farmers will own three ponds at start-up. KMAP will assist farmers to prepare and implement growth strategies with business plans and cash flow projections.

KMAP will facilitate linkages with financial institutions and assist fish farming enterprises to access financial services, when needed.

3. Link Farmers to Distribution Networks, Buyers and Aggregation Centres

KMAP is initiating the installation of cold store fish aggregation centres in Western Kenya.

Other market distribution channels can also act as aggregators and facilitate access to markets for farmers. These include traders, direct linkages with Beach Management Units on Lake Victoria where wild caught fish is sold, and Aqua Shops since some are already trading in fish.

4. Integrate Cultured Fish into Existing Trade Channels

The project's value chain approach will improve linkages between farmers and traders. The market study informs and validates current data on trade channels, market demand and consumer preference for cultured catfish and tilapia.

Farm Africa will take the same approach with traders as with input providers and farmers. Capacity assessments will be conducted, and capacity building plans implemented, to encourage and enable interested traders in expanding their businesses with the inclusion of cultured fish.

5. Raise Consumer Awareness of Farmed Fish

Consumption of farmed fish is currently low. KMAP will co-ordinate a joint effort to promote the consumption of fish and especially cultured fish (including catfish).

KMAP will allocate resources to develop content, design and produce materials and launch the campaign that will disseminate positive messages about cultured fish through various types of media and methods including radio, internet, recipe books, and celebrity chef endorsement.

To enhance the enabling environment to support aquaculture development

This will be achieved through the following key activities:

1. Develop Organisational Capacity and Lobbying Skills of Aquaculture Associations

The project will offer technical support to associations to influence public policy making and act as vehicles for promoting aquaculture. Depending on the findings of the needs assessments, interventions will include designing or updating their strategic plans, developing new member services, codes of best practices and training in negotiating/lobbying skills. In addition, workshops and exchange visits will be organised to align strategies, share information and promote learning across the sector.

2. Create a Platform for Co-ordination of Public and Private Stakeholders

Farm Africa will take an active role in organising bi-annual meetings with donors and implementing agencies in the aquaculture sector.

APPENDIX C

Policy, Legislative Framework and Best Practice Guidelines

August 2016
Report No. 1655589-306435-1

POLICY, LEGISLATIVE FRAMEWORK AND BEST PRACTICE GUIDELINES

This section provides a review of the relevant legal, institutional and administrative framework for aquaculture in Kenya. International laws and conventions that are relevant to environmental assessments and stewardship within the aquaculture industry are also highlighted. The review identifies gaps in the regulatory framework which need to be addressed and provides recommendations for future aquaculture intensification.

Policies and Strategies

The policies and strategies that are in force to date have been reviewed. Refer to **Table A**. These form the backbone upon which legislation and regulations are based and are considered to be adequate to provide a framework within which to promote the intensification of aquaculture in Kenya in an environmentally sustainable manner. However, to maintain the momentum of the development of the sector it is recommended that the National Aquaculture Policy (2011) and National Aquaculture Strategy and Development Plan (2010 - 2015) be updated to reflect development targets and implementation timelines and both documents would benefit from a new focus on cage culture

Legislation and Regulations

The legislation and regulations (**Table B**) are development orientated and enable the establishment and intensification of aquaculture in Kenya. The Fisheries Act is currently under revision.

Environmental Regulatory Framework

The National Environment Action Plan (NEAP) and the National Policy on Environment stipulate the need for Environmental Impact Assessments (EIAs) for development projects. In the NEAP, the Government proposes to "integrate environmental conservation in economic development to provide sustainable development for posterity. This includes the integration of environmental considerations in development planning at all levels; promotion of environmentally sound use of both renewable and non-renewable resources in the process of national development; establishment of an institutional framework for co-ordinating, monitoring, and enforcing environmental regulations and standards; and finally providing human and financial resources to support an environment and development coordinating agency and an EIA institution".

To legally affect the National Environment Action Plan, the Environmental Management and Co-ordination (Amendment) Act (No. 5 of 2015) (hereafter EMCA) provides a legal and institutional framework for the management of environmental related matters. EMCA comprises of the parts covering all aspects of the environment EIA requirements. The Second Schedule of the Act clearly stipulates that an EIA is mandatory for all projects specified in the Act. EIA Guidelines and Administrative procedures have been developed in response to the above policy framework and legal provisions (NEMA, 2002).

The projects to be subjected to EIA are specified in the Second Schedule of the EMCA and require the submission of an EIA Study Report.

- There is no direct mention of aquaculture as an activity that warrants an EIA within the Second Schedule of the EMCA. However, various indirect activities within the development of an aquaculture project may trigger an EIA process, for example:
  - Major changes in land use;
  - Projects located within a distance prescribed by a written law from a wetland, lake, river, dam, spring, stream or any other water body;
  - River diversions;
  - Widespread introduction of new animals;
  - Processing and manufacturing industries including large scale fish processing plants;
  - Introduction of alien species into ecosystems;
  - Any projects likely to affect wetlands; and
  - Projects that affect any areas designated as environmentally sensitive areas.

Table A: Policies and Strategies

Title	Description	Implementing institution	Role in aquaculture
Millennium Development Goals (2000)	Ten broad-based objectives for social and environmental change in Kenya.	All Ministries, Departments and Agencies	▪ Provide impetus for sustainable aquaculture development as a food security and economic empowerment strategy.
Vision 2030 (2007)	Long-term strategy to transform Kenya to a globally competitive middle-income country. Defines national sustainable development objectives aligned with the Millennium Development Goals.	Government of Kenya (all ministries)	▪ Identifies the importance of aquaculture as a food security strategy.
Fisheries Policy (2005)	Policy to guide the sustainable development of the Kenya fisheries sector.	Previously Ministry of Livestock and Fisheries Development. Currently Ministry of Agriculture, Livestock and Fisheries (MOALF)	▪ Promotes development of responsible and sustainable aquaculture; and ▪ Objectives include: Development of Master Plan for Aquaculture, creation of enabling environment for aquaculture investment, development of infrastructure and support services including inputs such as seed and feed, capacity, capacity building and training, and development of centres of excellence for research, training and demonstration.
National Food and Nutrition Security Policy (2011)	Overarching framework addressing the multiple dimensions of food security and nutrition improvement.	Agricultural Sector Co-ordination Unit, Government of Kenya	▪ Identifies the need for improved support for aquaculture development; ▪ Promotes the production of nutrient-rich foods such as fish; and ▪ Emphasises the need for improved storage and processing of fish products.
National Oceans and Fisheries Policy (2008)	Ensure increased and sustainable fish production and utilisation in Kenya.	Ministry of Agriculture, Livestock and Fisheries (MOALF) - State Department of Fisheries (SDF)	▪ One of the key strategies is that the Government will develop an aquaculture policy and master plan; and ▪ Defines the organisational structure and functions of the Directorate of Aquaculture Development.

Title	Description	Implementing institution	Role in aquaculture
National Aquaculture Policy (2011)	Sets out the main policy principles, objectives, the legal and regulatory framework that the Government envisages for aquaculture.	MOALF – SDF; and Directorate of Aquaculture Development	▪ Identifies the challenges and opportunities for aquaculture development; ▪ Policy guidelines and objectives; ▪ Policy statements; ▪ Strategies; ▪ Aquaculture policy implementation framework; and ▪ Monitoring and evaluation.
National Aquaculture Strategy and Development Plan (2010-2015)	Promote and facilitate sustainable development of aquaculture through addressing critical issues relating to aquaculture development.	MOALF – SDF	▪ Strategy and development objectives and plan for aquaculture to contribute significantly to economic development; and ▪ To promote best practice in aquaculture.
Ministry of Agriculture, Livestock and Fisheries Strategic Plan (2015)	Create an enabling environment for aquaculture development, increase productivity and outputs, enhance national food and nutrition security, improve market access and trade, strengthen institutional capacity, and enhance the role of youth in aquaculture.	MOALF – SDF	▪ Recommends upgrades to National Aquaculture Hatcheries to boost fingerling production capacity for different fish species; ▪ Promotes establishment of aquaculture markets; and ▪ Promotes enhancement of access to affordable and quality inputs including seed, feed, fertiliser, and genetic resources.
National Environment Policy (2013)	Provide the framework for sustainable management and use of the environment and natural resources	Ministry of Environment, Water and Natural Resources	▪ Promotes sustainable aquaculture development; and ▪ Identifies importance of community participation in fisheries resource management, value addition and marketing.
National Environment Action Plan Framework (2009-2013)	Main objectives are to ensure that environmental considerations are taken into account in all development policies, programmes and projects, and that independent Environmental Impact Assessment (EIA) reports are prepared for projects before implementation.	Ministry of Environment, Water and Natural Resources: National Environment Management Authority (NEMA)	▪ Identifies need to develop fish ponds at household/institutional level.

Title	Description	Implementing institution	Role in aquaculture
Agriculture Sector Development Strategy (2010 – 2020)	Outlines the characteristics, challenges, opportunities, vision, mission, strategic thrusts and various interventions that the ministries will undertake to propel the agricultural sector.	Government of Kenya (all Ministries)	▪ Promotes aquaculture development as an important intervention for addressing economic development and food security.

- The Third Schedule of the Fisheries (Safety of Fish, Fishery Products and Fish Feed) Regulations, 2007 clearly states that commercial scale fish culture shall be subjected to an EIA before implementation. However, there is no mention in the respective Regulations as to what is considered as "commercial". Generally speaking, commercial aquaculture has the aim of maximising profit and thus depends on the nature or business model of the project (Ridler and Hishamunda, 2001).

EIA Process

The following documents are essential outcomes/deliverables of the EIA process: Project Report (Screening), Terms of Reference (Scoping), EIA Study report, EIA licence, Environmental Audit Reports and Monitoring Reports.

The EIA process in Kenya follows common international practice in that it incorporates the traditional screening, scoping, study, public consultation, review and monitoring stages (Rebelo and Guerreiro, 2006; UNEP, 2010). **Figure A** below illustrates the EIA process in Kenya.

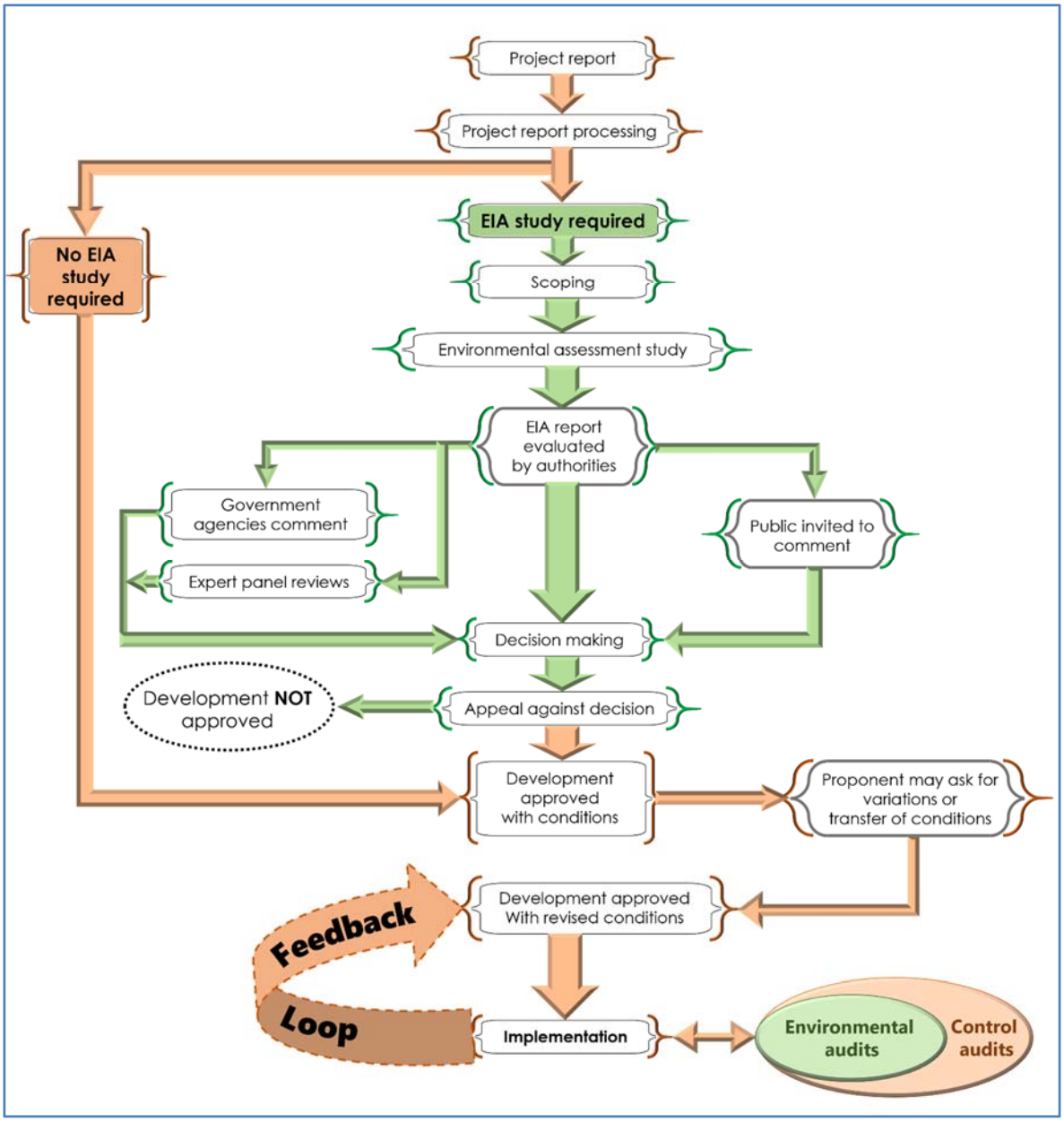

Figure A: EIA process in Kenya

Table B: Legislation and Regulations

Title	Description	Implementing institution	Role in aquaculture
The Fisheries Act CAP 378, revised (2012)	Provides legal framework and regulations for "fish culture" practices in Kenya including "fish feed" and "fish culture products."	Director of Fisheries; Minster of Fisheries Development	▪ Legal requirements for the culture of fishery products; ▪ Provides for the establishment of regulations and schedules that control aquaculture inputs and outputs; ▪ Licensing provisions; and ▪ Offences and penalties.
Fisheries (Safety of Fish, Fishery Products and Fish Feed) Regulations (2007)	Regulations relating to the control of fish, fishery products and fish feed.	Director of Fisheries; Minster of Fisheries Development;	Legal requirements for the following: ▪ Site location and selection; ▪ Pond conditioning, fertiliser and feeds; ▪ Veterinary medicines and withdrawal periods; ▪ Harvesting equipment and materials; ▪ Hygiene; ▪ Cleaning, disinfection and pest control; ▪ Record keeping and batch identification; ▪ Minimum monitoring requirements for the internal control system; and ▪ Conditions for export and import of fish, fishery products and fish feed.
Standard Operating Procedures for Inspection and Quality Assurance in Capture Fisheries and Aquaculture Use in Kenya	Kenya-specific guidelines for inspecting fisheries and aquaculture products to ensure they meet accepted food safety and food quality standards.	MOALF – SDF	▪ Provides food safety and food quality guidelines for fisheries and aquaculture products.

Title	Description	Implementing institution	Role in aquaculture
Specification for Compounded Tilapia and Catfish Feeds (2015)	Prescribes requirements for compounding tilapia feeds used as a complete diet and serving as the only source of nutrients for tilapia fish.	Kenya Bureau of Standards MOALF - SDF	▪ Mechanism to streamline the aquaculture sector and ensure high quality fish feed in the market; and ▪ The standards also help manufacturers to improve quality of their products and reassure consumers thus maintaining high sales.
FAO Code of Conduct for Responsible Fisheries (CCRF) (1995)	The CCRF sets out principles and international standards of behaviour for responsible practices with a view to ensuring the sustainable and effective conservation, management and development of living aquatic resources (FAO, 1995).	MOALF – SDF (Promoted in "The National Aquaculture Strategy and Development Plan (2010-2015) and "The Fisheries Policy (2005)"	▪ Provide best practice guidelines for responsible development of aquaculture in line with environmental and social objectives.
FAO Technical Guidelines on Aquaculture Certification (2011)	The application of certification in aquaculture is now viewed as a potential market-based tool for minimising potential negative impacts and increasing societal and consumer benefits and confidence in the process of aquaculture production and marketing. These guidelines provide guidance for the development, organization and implementation of credible aquaculture certification schemes.	MOALF – SDF (Promoted in "The National Aquaculture Strategy and Development Plan (2010-2015)	Standard setting processes required to develop and review certification standards. Accreditation systems needed to provide formal recognition to a qualified body to carry out certification: ▪ Certification bodies required to verify compliance with certification standards.

Title	Description	Implementing institution	Role in aquaculture
FAO Technical Guidelines for Good Aquaculture Feed Manufacturing Practice (2001)	The guidelines were compiled for FAO in support of Article 9 of the CCRF concerning Aquaculture Development (FAO, 1997), and in particular in support of Article 9.4.3 of the CCRF concerning the selection and use of feeds and additives.	MOALF – SDF (Promoted in "The National Aquaculture Strategy and Development Plan (2010-2015)	▪ Ingredient purchasing; ▪ Processing; ▪ Bulk storage; ▪ Handling; ▪ Monitoring; ▪ Documentation; ▪ Training; ▪ Safety; ▪ Customer relations; and ▪ Delivery.
Environmental Management and Co-ordination (Amendment) Act, No. 5 (2015)	Legal and institutional framework for the management of the environment and for the matters connected therewith and incidental thereto.	NEMA	▪ General principles relating to a clean and healthy environment for all people in Kenya; ▪ Organisational structure of NEMA; ▪ Aspects relating to the protection and conservation of the environment; ▪ Aspects relating to EIAs in Kenya; ▪ Lists the activities/projects that trigger an EIA; and ▪ Regulations relating to environmental management.
The Environmental (Impact Assessment and Auditing) (Amendment) Regulations (2009)	These Regulations contain rules relative to content and procedures of an EIA, auditing and monitoring and SEA, as well as regulate matters such as appeal and registration of information regarding EIA.	NEMA	▪ Guidelines for conducting an EIA Study; ▪ Regulations concerning procedures of EIA, granting of EIA licences and public hearings; ▪ Issues to be considered in EIAs; ▪ Content of EIA Study Report; and ▪ Registration of EIA experts.

Title	Description	Implementing institution	Role in aquaculture
EIA Guidelines and Administrative procedures (2002)	Provides guidelines and administrative procedures for conducting EIAs in Kenya according to EMCA.	NEMA	▪ Provides guidelines for conducting EIA and approves ESIA for fish farming; ▪ EIA process and screening of activities; ▪ EIA Study and approval process; ▪ Format of an EIA Study Report; and ▪ Environmental monitoring and audit processes.
Environmental Management and Co-ordination (Water Quality) Regulations (2006)	Applies to drinking water, water used for industrial, agricultural, recreational, fisheries and wildlife, and any other purposes.	Ministry of Environment and Natural Resources	▪ Defines water quality standards and monitoring parameters; ▪ Application for effluent discharge into aquatic environment; and ▪ Specifies the fees that may be charged under the Regulations.
Environmental Management and Co-ordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations (2009)	These Regulations make provision for the management, conservation and sustainable use of wetlands and wetland resources and the sustainable utilisation and conservation of (resources on) river banks, lake shores, and the seashore.	Ministry of Environment and Natural Resources	▪ Permit to be obtained for activities set out in section 42 of EMCA; ▪ No person shall carry out any of the activities stipulated in that section without a permit issued by the relevant lead agency and an EIA licence issued by NEMA; and ▪ Projects having a significant impact on a wetland, river bank, lake shore or the sea shore also require an EIA.
The Environmental Management and Co-Ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations (2006)	The Act states that no person shall engage in any activity that may have an adverse impact on any ecosystem, lead to the introduction of any exotic species, or lead to unsustainable use of natural resources, without an EIA License.	Ministry of Environment and Natural Resources	▪ EIA required for introduction of exotic species.

Title	Description	Implementing institution	Role in aquaculture
Water Act (CAP 372) No. 8 (2002)	To promote sustainable use of water for production purposes for attainment of national cultural and socio-economic development aspirations' (Promote efficient use).	Water Resource Management Authority	▪ Provides guidelines for the use of water; and ▪ Provides requirements and procedures for water use permits.
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 management of fish disease outbreaks.
The County Governments Act (2012)	Provides the county governments' power, functions and responsibilities to deliver services.	County Governments	▪ Monitor fish farming in County.
Land Act (2012)	An Act to give effect to Article 68 of the Constitution, to revise, consolidate and rationalize land laws; to provide for the sustainable administration and management of land and land based resources, and for connected purposes.	Government of Kenya	▪ Administration and management of public, community and private land.
The Occupational Safety and Health Act (2007)	An Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes.		▪ Functions provided for health and safety of workers; and ▪ Liability clauses for non-compliance.
The Science, Technology and Innovation Act, No. 28 (2013)	Provision for the co-ordination and regulation of the progress of science, technology and innovation in Kenya.	National Commission for Science, Technology and Innovation; Kenya Marine and Fisheries Research Institute (KMFRI); academic institutions	▪ Promote and undertake research on current cultured species; new culture species; fish seed and feeds; monitor impacts of aquaculture.
Investment Promotion Act, No. 6, revised (2012)	Promote and facilitate investors to obtain the necessary licences to invest.	Kenya Investment Promotion Authority	▪ Promote and facilitate private sector investment in aquaculture.

Title	Description	Implementing institution	Role in aquaculture
Pest Control Products Act, No. 6 (revised 2012)	Regulates the importation, exportation, manufacture, distribution and use of products used for the control of pests and of the organic function of plants and animals and for connected purposes.	Pest Control Products Board	▪ Provides guidelines on use of chemicals.
Pharmacy and Poisons Act, CAP 244, (revised 2009)	Management of the use of veterinary supplements/medicinal in aquaculture.	Pharmacy and Poisons Board	▪ Provides guidelines for the use of veterinary supplements/medical medicines.

Voluntary Instruments and Technical Guidelines

Numerous guidelines exist that aim to guide and improve the environmental assessment of project developments in general. These guidelines provide detailed practical and technical information to reduce and mitigate the environmental and social impacts of such developments and optimise production. **Table C** below lists those guidelines that relate to environmental assessment best management practices for aquaculture, as well as those for EIAs in general. These are included as insights but should be promoted strongly by Farm Africa for the responsible intensification of the aquaculture sector.

Gap Analysis and Recommendations

The following section highlights important aspects that are missing in the legal framework for EIAs and aquaculture in Kenya, as well as issues which need effective implementation and enforcement. Recommendations are provided, where possible, that aim to assist in addressing these gaps and issues.

Fragmented Legislation

The existing regime of law governing aquaculture is fragmented as there are different statutes each addressing a particular sub-sector of the industry. This can also be seen in the legislation relating to EIAs, where aquaculture is not a scheduled activity directly subject to an EIA; however, the Fisheries Regulations clearly state that an EIA is mandatory for commercial aquaculture enterprises that are aimed at maximising profit.

There is therefore the need to review the current policies and laws of Kenya, to synchronise them with the spirit of the Constitution. Policy should be implemented that encourages collaboration between the agriculture and aquaculture sectors, especially regarding inputs/outputs (Ndanga *et al*., 2015). Facilitating this collaboration may result in increased waste utilisation efficiency and thereby maximise production and growth of the aquaculture sector. Aquaculture costs can be minimised by practicing an integrated system where waste and by-products are used in other agricultural sectors (Ndanga *et al*., 2015).

Aquaculture Regulatory Framework

Although a comprehensive policy on aquaculture was developed in 2011, associated legislation needs to be implemented to enhance management and research efforts, encourage investment in aquaculture, and responsibly develop production and growth of the industry.

Development of legislation and certification regarding the fish seed industry- the National Aquaculture Policy (2011) provides for policy pertinent to quality seed development and regulations regarding the supply of seed to the industry and seed is now produced commercially in Kenya. However, effective legislation needs to be in place to regulate the growth of national production, as well as to mitigate the environmental damage and industry problems which can be associated with low quality seed.

Established aquaculture zone maps - the Ministry of Fisheries should prioritise the development of aquaculture zone maps in order to facilitate the control of aquaculture products and cultured species present in specific areas. Zone maps can be used to control disease, aid in decision making processes, inform quality control measures and quarantine measures, facilitate planning for the sector and prove integral to informing a comprehensive policy on aquaculture. Given that spatial information in the EIA field is reasonably prolific in Kenya (Mwenda *et al.*, 2015), collaboration between EIA specific research and fisheries and aquaculture may fast track the formation of aquaculture zone maps.

Table C: Voluntary Instruments and Technical Guidelines

Title	Organisation/ institution/author (date)	Description	Role in aquaculture
FAO Environmental impact assessment and monitoring in aquaculture	FAO (2009)	Addresses key issues of environmental assessment and monitoring in aquaculture with a view to generate strategic advice and technical guidance information for use in policy-making, capacity-building and training in the sector, in particular on improved use of EIA and monitoring approaches in aquaculture, and on complementary measures useful and effective in further promoting sustainable aquaculture development.	▪ Regional review papers on EIA and monitoring in aquaculture in Africa, Asia-Pacific, Europe, Latin America and North America; ▪ A review of implementation by countries of EIA in aquaculture; and ▪ Recommendations and best practice guidelines.
FAO Ecosystems Approach to Aquaculture (EAA)	Soto et al. (2008)	A strategy for the integration of aquaculture within the wider ecosystem such that it promotes sustainable development, equity, and resilience of interlinked social-ecological systems	▪ Defines principles for EAA; ▪ Technical guidelines on the implementation of the EAA; and ▪ Monitoring and evaluation.
Technical Guidelines for responsible fisheries: aquaculture development	FAO (1997)	This document provides annotations to the Principles of Article 9 of the CCRF.	▪ Each principle is specifically addressed in order to provide the reader with related annotations containing suggestions and observations; and ▪ Deals with issues to be considered in areas under national jurisdiction, transboundary issues, aquatic genetic resources and production level issues
CCRF	FAO (1995)	International framework considered to be the foundation upon which to promote sustainable fisheries and aquaculture development for the future at national levels.	▪ Sets out principles and international standards of behaviour for responsible practices with a view to ensure sustainable development and management of living aquatic resources.

Title	Organisation/ institution/author (date)	Description	Role in aquaculture
Safeguard Policies: Operational Policy/Bank Procedure 4.01: Environmental Assessment	World Bank (revised 2013)	The Bank requires environmental assessment of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making.	▪ Guidelines and procedures for conducting EIAs to international standards.

Environmental Impact Assessment Legislation

UNEP (2010) notes that an important weakness of the EIA regulations is that public participation is limited to affected parties only and thus reduces the opportunity for non-affected but interested parties from influencing decision making.

There is no regulation guiding how the involvement of stakeholders in EIA process should be documented. The proponent/consultant should establish a list of interested and affected parties and also develop methods for notifying them about the proposed development that is the subject of an EIA. Consultation with the public should entail two-way communication, whereby information about the proposed development is disseminated to stakeholders, who in turn are empowered to contribute local knowledge, relevant information and are afforded an opportunity to raise their concerns or suggestions for mutual benefit. The consultation process should record the community's concerns, interests and suggestions for mutual benefit so that relevant issues and suggestions can be considered in the EIA study (Rebelo and Guerreiro, 2006).

It is also important to mention that the EIA procedure in Kenya is more complex in comparison to other regions (e.g. the EU) and, because of that is more difficult to implement.

Institutional Capacity

An important limitation to the effectiveness of EIA in Kenya is that certain government agencies do not have adequate capacity to effectively guide and review EIAs (UNEP, 2010; Ali, 2012). This has been attributed to a lack of resources such as funding (Ali, 2012), equipment and trained personnel. In addition, there is a lack of co-ordination between NEMA and lead agencies, especially when dealing with weak enforcement structures within some institutions (Ali, 2012).

In an attempt to address the lack of institutional EIA capacity, the East African Association for Impact Assessment was established to build capacity amongst practitioners and government officials. Although effective, the organisation itself has limited capacity and action is required internally to address this (UNEP, 2010).

APPENDIX D

KMAP Key Informant Interview Report

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FARM AFRICA

Kenya Market-Led Aquaculture Programme: Key Informant Interviews for Strategic Environmental Assessment

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REPORT

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Golder Associates

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LIST OF ACRONYMS

CDF	Constituencies Development Fund
CFS	Changing Food Situation
EMP	Environmental Management Plan
ESP	Economic Stimulus Programme
KMAP	Kenya Market-Led Aquaculture Programme
NEMA	National Environmental Management Authority
NGO	Non-Governmental Organisation
SEA	Strategic Environmental Assessment

1.0 INTRODUCTION

Farm Africa has requested that Golder Associates Africa (Pty) Ltd (Golder) in collaboration with Advance Africa Management Services (Advance Africa) undertake a high-level Strategic Environmental Assessment (SEA) and Environmental Management Plan (EMP) for their proposed Kenya Market-led Aquaculture Programme (KMAP). The KMAP has been developed in response to a decline in wild fish stocks in Lake Victoria (the Lake) and an increase in demand for fish in Kenya due to consumers recognising its nutritional value. Two project areas are being targeted namely the Central (Kiambu, Nairobi and Machakos) and Western (Bungoma, Busia, Kakamega, Siaya, Vihiga, Kisumu, Homa Bay, Kisii and Migori) project areas. Farming fish offers significant economic benefits and, unlike capture or marine fisheries, does not rely on a depreciating natural resource. KMAP will support farmers and traders through provision of technical and business support training as well as link them to markets and service providers to ensure sustainable growth of their business. Service providers such as fingerling and feed producers will receive technical support and market training to aid in the development of their businesses. KMAP's ultimate goal is to develop a vibrant aquaculture industry that generates sustainable incomes, food security, and employment through the following objectives:

- Sustainably increase productivity of medium to large scale fish farmers, hatcheries and fish feed producers;
- Increase access to markets for medium to large scale fish farmers and service providers; and
- Enhance the enabling environment to support aquaculture development.

In order for Golder to develop an understanding of on-ground aquaculture practices in the Central and Western KMAP project areas, a number of key informant interviews were conducted. The interviews targeted a wide range of stakeholders including: fish farmers (cage and pond), fingerling producers, feed producers, fish traders and a member of the regulating authority.

2.0 INTERVIEW METHODOLOGY

Three fish farms were visited. One in the Central project area (Athi Fish and Hatchery) and two in the Western project area (Mabro Fish Farm Enterprises and Winnie Owuor's Fish Farm). The questionnaire (APPENDIX B) was administered at each site.

2.1 Brief Descriptions of Fish Farms Visited

2.1.1 Athi Fish and Hatchery

Due to time constraints only one fish farm was visited in Nairobi, the Central project area. A meeting was set up on 5 July 2016 with Athi Fish and Hatchery. The farm is located in Machakos County in the Athi River Area. Athi Fish Farm and Hatchery is a relatively new aquaculture company that focuses on fingerling production using recirculation technology to produce African catfish (*Clarias garipinus*) and tilapia (*OreoChromis niloticus*, mono-sex all male tilapia).

The farm provides the following services:

- Production and supply of African catfish and tilapia fingerlings;
- Selling of fresh catfish and tilapia: live fish, whole gutted, filleted and smoked;
- Buying fish from farmers;
- Selling brood stock of both catfish and tilapia;
- Selling of imported good quality feeds, starter and grow out feeds;
- Consultancy and advice on catfish and tilapia farming; and
- Training of farmers on the setup of fishponds.

2.1.2 Winnie Owuor Fish Farm

Winnie Owuor, a resident of Usenge sub-location, Yimbo West ward, has established a cage fish farm. The project was initiated in 2013 in collaboration with a local non-governmental organisation (NGO) and Siaya Fisheries Department. She started with only four cages but now owns 60 (2 x 2 m) cages each carrying 2 000 tilapia fingerlings. She hires 20 people to assist with the farm operations.

A Member of Parliament, Mr Ochando, has invested KSh 19 million from the Constituencies Development Fund (CDF) to invest in cage farming through the initiative Changing Food Situation (CFS) in Bondo. This will help to supply 140 primary schools with fish. The aim is to establish 300 cages to be shared amongst the primary schools' CFS initiative, and then extend it to post primary institutions. Mr Ochanda aims to assist in restocking Lake Victoria with 4-6 million fish per year. Restocking sites have been identified at Wagusu Bay, Utonga/Warianda Bay, Kadimo (Oele-Nyandenge) Bay, Uwaria, Singu and Sare. Each of the bays is to be managed by a Beach Unit in partnership with the CDF office. This should ensure that the community members take ownership of the projects thereby creating buy-in which should prevent issues such as over-fishing and fish thievery.

Winnie Owuor supplies:

- Fish cages to other farmers within the Lake Victoria region;
- Tilapia and catfish to consumers from Nairobi, Kisumu, Busia, Siaya and Nakuru counties; and
- Technical training to over 100 farmers.

2.1.3 Mabro Fish Farm Enterprises

Mabro Fish Farm Enterprises is located on the Uwaria Beach of Lake Victoria in Bondo, Siaya. The farm was established in 2011. It hosts a small plant for producing fish feeds, a hatchery, 32 fish ponds (lined and earthen) and 16 fish cages inside Lake Victoria. The farm also conducts free training sessions for farmers.

The fish ponds host mono-sex tilapia and catfish. Each pond hosts an average of 1 000 fish, and the fingerlings are kept in 18 hatchery tanks located inside a building to protect them from the harsh temperatures. Mabro sells the fish when they mature at about eight months to traders at KSh 300/kg for catfish and KSh 350/kg for tilapia. The fingerlings go for KSh 5 for tilapia and KSh 7 for catfish. Mabro sells fingerlings all year round. Mabro also has eight brood stock ponds which are 11 x 17 m in size. The brood stock was obtained from Uganda.

The 16 cages are 2.5 x 4 m in size. 3 000 fish are kept in each cage and are harvested after around 10.5 months when they are 450 g in size.

At the feed making plant, there is a hammer machine, a grinder and a pelletiser. The ingredients include wheat bran, fresh water shrimps, fish meal, blood meal, yam and banana leaves, maize and rice bran, etc. The ingredients are milled in the hammer machine. Mash retails at around KSh 70/kg and pellets (about 4 mm in size) cost KSh 80/kg.

The farm trains groups of farmers on pond and feed management and how to ensure they get quality fingerlings.

2.2 Workshop 1: Information Gathering

To add to the information received during the site visits, a workshop was conducted at the Great Lakes Hotel in Kisumu on 7 July 2016 (Figure 1). A broad spectrum of stakeholders attended the workshop, the register can be found in APPENDIX C. The workshop agenda was as follows:

- Individual introductions;
- Presentation of the Kenya Market-Led Aquaculture Programme (Teddy Nyanapah- KMAP Project Co-ordinator);

- Introduction of the Golder and Advance Africa team, presentation of what an SEA incorporates and how it fits into the KMAP (Warren Aken- Golder Biodiversity Group Lead); and
- Questionnaire session with the key informants.

Figure 1: Golder presenting at the workshop

3.0 INFORMATION RECEIVED

3.1 Questions on the Presentations

Q: How will the project be sustained?

- Farm Africa should have a model farm that covers all types of agricultural pursuits e.g. dairy, beef, maize and aquaculture. That way farmers can learn from the model;
- Another concern based on experience is there is generally a high turnover of farm assistants. The workers are trained up and then they leave;
- It is important to involve the County Government; and
- There is a need for increased investment in aquaculture.

Teddy Nyanapah (TN): the County Government is to be involved. However, it must be noted that KMAP focusses on the private sector, the aim is to make farmers better entrepreneurs. Government is aware of the project and want their officers involved in it. KMAP has no reason to exclude County Government but they must fund themselves as the donor funds do not include Government involvement.

Q: Golder, why did you present on both pond and cage culture when Farm Africa only presented on ponds?

TN: Farm Africa is going to consider cage culture eventually, but we want the findings of a rigorous impact assessment before we promote it. Also, currently the entrepreneurs are mainly pond farmers.

3.2 Key Informant Interview Responses

This section includes the responses from discussions with the fish farm managers on the site visits as well as those received at the workshop. The total number of people interviewed was 11. It must be noted that the responses provided are as they were received and have not been edited or checked for correctness. The responses do not reflect the opinions of Golder or Advanced Africa.

The interview questions were generated with the intention for Farm Africa and Golder to gain a better understanding of on-ground aquaculture in Kenya, including the market variables and business risks. The questions were also important in gaining an understanding of the local level of awareness of environmental impacts and regulations, the perceptions of KMAP and recommendations on how it can be improved.

Q: Were you aware of KMAP prior to Farm Africa's presentation?

Eight of the respondents were aware of KMAP prior to the presentation. One said that she had heard someone speak of the programme but that she did not know what it involved. Farm Africa representatives had visited most of the stakeholders in person.

Q: What is your perception of KMAP? Positive or Negative.

Responses were unanimously positive.

The reasons given were:

- Farm Africa is going to help society through developing aquaculture;
- Government is mandated to promote aquaculture and therefore welcomes collaborators;
- KMAP encourages stakeholders with different interests and perspectives to sit together and communicate e.g. traders, farmers and government officers; and
- Farm Africa provides valuable training to fish farmers.

Q: Aquaculture has been promoted in Kenya since the 1960's, there have been a number of programmes initiated since then. Why did the other programmes fail?

- Several organisations have tried to initiate programmes, including churches. The cost of production is too high and so they are unable to break even;
- People are now better educated;
- People only used to eat fish along Lake Victoria's shores, now those living inland also eat it;
- Kenya has a growing population, particularly a growing middle class who can afford to buy fish;
- Economic Stimulus Programme (ESP) was not successful because it excluded the youth. The youth do not own land in Kenya. They inherit it from the older generations. They were thus disgruntled at not being able to benefit from the programme and so stole fish out of spite;
- There is a lack of aquaculture knowledge and technical ability; and
- A feed production machine was given to the Fish Farmers Association as a part of the ESP. Raw material input prices increased as the resources declined. Feed producers like Sigma are very expensive. There is a need for subsidising of fertilisers and feed. There is much fighting between service providers, farmers, fingerling producers and traders as each have a different perspective and experience in the industry.

Q: What do you see as the negative environmental impacts emanating from fish farming?

- Fertilisers for agriculture affect the soils and is cancerous. These fertilisers can run into the fish ponds and ultimately be consumed by the fish and then humans;
- Unsure of the chemical components in the fish feed. Could they be harmful to humans when consuming fish? The Kenyan Bureau of Standards needs to regulate feed. A Fisheries Manual is currently with the Senate for approval. The standards need to include both floating and sinking feeds;
- The use of sinking feeds in cage culture can impact the environment as it sinks to the bottom of the lake and accumulates. Floating feed is better because it stays within the cage and can be scooped off the surface if it does not get eaten;
- The intensification may result in an increase in fish diseases. There are very few fish disease specialists in Kenya;
- There is a risk of importing the wrong brood stock and it escaping into the Lake. Common Carp was imported but it must not get into the Lake. Exotics must not be imported as they can negatively affect the indigenous fish species;
- The quality of the water can present a risk to fish farmers. They do not know what is in the water;
- A concentration of fish cages may result in eutrophication due to feeding. This needs to be monitored as it could affect the wild fish population;
- With an increase in the number of ponds there will be more water discharged into the Lake. May be an issue;
- With improved technology people are now directing the sex of their fish by using male hormones. Unsure of what the negative impacts resulting from this could be. These impacts should be covered in the new regulations;
- The metal cages rust over time and could affect the quality of the Lake's water;
- Some feed sinks through the cage bottom and is eaten by the wild fish population. It can also build up and affect the water quality; and
- Clearing of land to access the Lake shore.

Q: Are you aware of the environmental legislation regulating fish farming?

- Yes, the farms have to be certified;
- No, and the majority of farmers do not abide by the regulations;
- Yes, we have annual audits conducted by the National Environmental Management Authority (NEMA) officers;
- NEMA officers never come to my farm. We pay their fees so they should come;
- There is no cage farming policy at the moment- it is currently in a draft format. If the bill is passed then it will be implemented;
- There has been a lot of confusion since the devolution of Government. Some policies have been suspended. There is confusion surrounding responsibility. Essentially, Central Government develops the policies and County Government implements them;
- My farm borders a game park. I am not allowed to kill hippos if they come onto my farm. I have to report them. If the hippo is damaging my farm they will shoot and kill it. My farm is on Lunga beach. The NEMA officers do not audit me;
- Would like to farm ornamental fish- goldfish and koi. Unsure of the regulations surrounding this;

- Positive impact on the wild fish population as they eat the food and faeces that drops through the cages;
- People are not allowed to keep undersized fish that they obtain from the Lake. The laws are in place, there are just management issues. People have been arrested but Government officials need support from the police as the traders can become aggressive. The undersized fish sell well because they are cheap. Selling undersized fish bred on a fish farm or in cages is allowed. However, a permit is required;
- Fishing nets need to be regulated in Kenya. In the Ugandan and Tanzanian waters of Lake Victoria, if you are caught using the wrong fishing equipment you can be imprisoned for up to 10 years;
- It is difficult to obtain chemicals and hormones for fish farming. You have to be certified by Government to be able to obtain them;
- We cannot release pond water into the Lake without treating it first. The Department of Fisheries comes to check the fish annually;
- Yes, there are rules and regulations surrounding the brood stock that is used. As the tilapia is imported it needs to be checked;
- Most fingerling suppliers abide by the regulations. Government officers visit the operation once a year. You receive a certificate saying that you are an approved supplier; and
- Yes, NEMA officers are visiting this week to compile an environmental report. The Fisheries Act is old and silent on cage culture. She is aware that they are formulating new policies.

Q: How many cages and/or ponds do you own? Why?

- 31 ponds and 8 cages- prefers a combination;
- 7 ponds- only ponds as he is not near the Lake and so cage culture is not an option;
- 7 ponds- prefers ponds as you cannot farm catfish in cages, also pond management is easier;
- People say that there is a difference in taste between pond and cage cultured fish. This is unlikely to be the case for ponds where the water is obtained from the Lake. Farmed fish are tenderer than wild fish as they are not as muscular. Although people complain, they will take what they can get. Ultimately, people prefer cheap fish;
- The one operation has 60 cages. Cages are preferred because the owner feels that ponds are unsuccessful- the water temperature fluctuates too much depending on the weather, the water has to be changed often and you need the technical know-how; and
- 32 ponds and 16 cages. Their aim is to be a one-stop model fish farm.

Q: What fish species do you sell? Why?

- Two respondents said that the people prefer tilapia so that is why they farm it- they are market driven;
- The one respondent produces mainly tilapia and some catfish; and
- Tilapia as the owner has a cage culture operation. Tilapia is more popular, the market is better and wider. It is easy to fillet tilapia. Nile perch needs deeper water.

Q: At what price do you sell your fish at?

- KSh 300-350 /kg.

Q: Where do you obtain your feed from and at what price?

- The one respondent is trying to make his own feed, he has an extruder. However, he does not have access to the right inputs. Needs advice from a nutritionist. They will use their own feed in an emergency. Otherwise they buy from Farm Africa, Aller-Aqua and Jewlet;
- Imported feed is of good quality- for example Skretting. The fish grow big quickly. The feed is however not always available so they need to source it from a variety of companies. The imported feed is expensive though, one pays KSh 170/kg for tilapia feed;
- Others buy their feed from local producers such as Aquashops and Jewlet, but the feed is also found to be expensive at KSh 80/kg;
- We produce our own feed. Hash for the fry we obtain from Germany;
- Jambo supplies our feed at USD 1.7/kg for Catfish and USD 1.5/kg for Tilapia. The feed is of good quality, it is Skretting feed; and
- Jewlet and Pioneer supplies the feed. The quality of the feed is good and it is always available. The cost of feed is KSh 60/ kg for fry feed and KSh 100/kg for other.

Q: Who do you sell your feed to?

- Farmers in the area.

Q: On average how much feed do you sell a month?

- Not much we are a medium scale feed producer, the machine is not efficient, we need an extruder.

Q: What is the composition of your feed?

- Instead of fish mill we use freshwater shrimps, some soy, sunflower seed, cotton seed. It is all locally sourced.

Q: What price do you sell your feed at?

- Mash sells at KSh 70/ kg and pellets at KSh 80/ kg.

Q: Do you ever run out of feed to sell?

- Yes, due to power failures.

Q: Where do you obtain your fingerlings from and at what price?

- Fingerlings are obtained from ESP, Jewlet, Dominion and Source of the Nile;
- Some produce their own fingerlings and sell at KSh 4 per fingerling;
- The average price for buying fingerlings is KSh 5 per fish; and
- Jewlet and Pioneer supply the operation. They are normally healthy, although once they had fin rot. The price of the fingerlings is KSh 4-8 per fish. The smaller fingerlings are better to start with, as they are hardier.

Q: How many fingerlings do you sell a month and at what price?

- We sell around 85 000 tilapia fingerlings (throughout the year) and around 40 000 catfish fingerlings. The fingerlings sell at between KSh 5-7 per fish; and
- In a good season, we sell 10 000 catfish fingerlings and 20 000 tilapia fingerlings.

Q: What species of fingerlings are preferred by the fish farmers?

- Tilapia, as they are what the market is demanding.

Q: Who do you sell your fingerlings to?

- Within the local area and Western region, we do not sell to Nairobi; and
- We sell to Machakos, Nairobi and Tanzania.

Q: Who do you sell your fish to and at what price?

- Just completed his first harvest and produced six tonnes. He contacted hotels in Nairobi but was sold out on the local market beforehand;
- Fish generally sell at KSh 300/kg;
- The traders like to bargain but will generally sell a plate sized piece of fish (~350 g) for KSh 70. As people are starting to realise the health benefits of eating fish they can start to increase their prices;
- There is a very high demand for tilapia in the Western and Central regions. The hotels want constant orders of 2-300 kg/week;
- Large scale fish farmers sell by weight. Small scale farmers and traders sell by size, in pieces; and
- Locally to contacts in Kisumu, Nairobi, Siaya and Kukumega. We sell the fish at around KSh 300/kg.

Q: Do you medicate your fish? If yes, what do you use?

- Antibiotics- when the fish are sick;
- Potassium permanganate and industrial salt- if the fish have fungal issues;
- Two respondents do not use medication as they do not have the knowledge to administer it;
- We do not have a problem with disease, just parasites. The fish are quarantined and treated with sodium chloride;
- Yes, we rarely have to medicate the tilapia. We use tetracycline (antibiotics) and industrial salt to fight fungal infections; and
- Yes, she uses sodium chloride to help with stress.

Q: What do you find is the main reason for fingerling fatalities?

- Poor water quality.

Q: What is the main reason for fish fatalities?

- A drastic change in weather and ultimately water temperature.

Q: What are the main risks or challenges to your fish farming operation?

- Predators are a problem: birds, hippos, otters, monitor lizards and snakes;
- Disease is currently not a problem but can get fungal infections if the hatchery is not cleaned properly;
- Losses vary, the one farmer works on a loss of 20 000 out of 100 000 fish;
- Theft;
- Electricity cuts requires the pump to run off petrol which is expensive;
- The market fluctuates a lot. Sometimes we have to throw away fingerlings. We then minimise production according to the market;
- The weather affects the fish breeding. When it is cold the tilapia are very affected, the catfish are also affected but not as badly;

- Theft is a major problem. She hires police to guard her cages; and
- Feed, she asked Jewlet to adjust their feed composition to suit the farmers better.

Q: Are fish farmers interested in becoming commercial?

- All respondents said yes; and
- Yes, they want to build their knowledge. Her farm assists community members to invest in and own cages. With a decline in the Lake's fish stock people are poor. Her farm hosts cages for the community members, the cages are small (2 x 2 m) and therefore affordable.

Q: How can KMAP be improved?

- It will require good collaboration with Government;
- The people of the Central and Western regions vary. The people of the Central region are natural entrepreneurs. There is a need to train those in the Western region, they need to improve their business skills;
- Need investment to grow to a large scale farmer;
- There is a need for technical training;
- Finance institutions are willing to invest in poultry and maize production but not in aquaculture. Financial institutions do not understand aquaculture. Fish farmers must keep records of their businesses and develop business models. Aquaculture is a new industry, it will take time to convince the financial institutions that it is worthy of investment;
- Women and youth are marginalised, they must be included in the programme;
- The cumulative impacts must be considered when looking at the proposed intensification;
- The market between the producer and consumer needs to be linked. This is a big challenge;
- There has been a lot of research done by the various organisations but she has received no feedback; and
- She would like to see the market expand exponentially. The European Union gave Usenge an ice making machine, the other side of the building could be used for filleting. The export market should be assessed.

4.0 SUMMARY OF FINDINGS

- KMAP is a positive initiative because it:
  - Provides technical training;
  - Encourages sharing of knowledge between different stakeholder groups; and
  - Will assist fishing communities that are struggling with the drop in Lake Victoria's wild fish stocks.
- Previous initiatives failed because:
  - Cost of production is high;
  - The market was not as big- Kenya's population has grown and people are realising the health benefits of eating fish; and
  - There was a lack of aquaculture knowledge.
- Currently, the market is preferential towards tilapia production and there is a very high demand for it.

- Problems with fish feed include:
  - Feed is not consistently available as the inputs are not always obtainable. In addition, electricity supply is not constant; and
  - Imported feed is thought to be of better quality but it is very expensive.
- Fish health is generally good, diseases are rare. The following is used to medicate fish:
  - Antibiotics;
  - Salt; and
  - Potassium permanganate.
- Negative environmental impacts identified included:
  - Potential human health risks due to fish feed ingredients and the use of hormones;
  - Fish disease spread with the intensification;
  - Biosecurity impacts surrounding the possible importation of exotics;
  - Water quality deterioration due to discharge from ponds;
  - Water quality deterioration due to accumulation of feed under cages; and
  - Clearing of land to access the Lake's shores.
- Awareness surrounding environmental legislation:
  - The medium to large scale fish farmers were aware of the environmental legislation as they are audited annually. It was understood that they cannot release water from their ponds directly into the environment and their brood stock needs to be checked and certified; and
  - Traders acknowledged that they cannot sell undersized fish that has been caught in the Lake.
- The following are the main business risks presently identified by fish farmers:
  - Market fluctuation;
  - Change in weather;
  - Water quality;
  - Availability of feed;
  - Availability of electricity;
  - Theft; and
  - Predators.
- Recommendations for the planned KMAP intensification:
  - Fish feed ingredients need to be regulated;
  - Farmers need technical training as well as business training in the Western project area;
  - Producers and consumers need to be linked and the market stabilised;
  - The marginalised (youth and women) must be included in the programme;

- Exotic species must not be imported;
- Discharge from ponds needs to be regulated;
- The risks of using hormones needs to be researched;
- Potential threat of disease break-out with the intensification of fish farming. There is a need for fish health specialists in Kenya;
- Need to get financial institutions to invest in aquaculture;
- Government should subsidise aquaculture as it does agriculture;
- The cage farming policy needs to be finalised and implemented; and
- Cumulative environmental impacts resulting from the intensification need to be assessed.

GOLDER ASSOCIATES AFRICA (PTY) LTD.

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APPENDIX A

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GOLDER ASSOCIATES AFRICA (PTY) LTD

APPENDIX B

Questionnaire

PROJECT NO. 1655589 **DATE** 7 July 2016

KEY STAKEHOLDER QUESTIONNAIRE

1.0 GOVERNMENT OFFICIALS

1) Were you aware of KMAP prior to Farm Africa's presentation? Yes/No

2) If yes, where did you hear about it? .....

.....

3) What is your perception of the KMAP? Positive or Negative.

4) If positive, why? .....

5) If negative, why? .....

6) What legislation is applicable to fish farming in Kenya?

.....

.....

7) Who regulates the compliance with legislation? .....

8) Do you feel that the regulation is sufficient? Yes/No

9) If yes why? .....

10) If no, why? .....

11) Do you think that fish farmers are aware of the legislation? Yes/ No

12) If no, how could this be improved? .....

.....

13) Do you think that the legislation is adequate? Yes/No

14) If no, what changes would you recommend?

.....

.....

15) What do you see as positive (environmental, social and health) impacts resulting from KMAP?

.....

.....

16) What do you see as negative (environmental, social and health) impacts resulting from KMAP?

.....

.....

17) How could KMAP be improved? .....

.....

18) What risks do you identify to the sustainability of KMAP? .....

……..

……

2.0 NON-GOVERNMENTAL ORGANISATIONS

1) Were you aware of KMAP prior to Farm Africa's presentation? Yes/No
2) If yes, where did you hear about it? .....
3) What is your NGO's name?
   .....
4) What is the purpose of your NGO? .....
5) What is your perception of KMAP? Positive or Negative.
6) If positive, why? .....
7) If negative, why? .....
8) What do you see as positive (environmental, social and health) impacts resulting from KMAP?……
   ……..
9) What do you see as negative (environmental, social and health) impacts resulting from KMAP?
   …….....
   .....
10) Are you aware of the environmental legislation regulating fish farming activities? Yes/No
11) If yes, which ones?…….....
12) What percentage of fish farmers do you think abide by the regulations? .....
13) Do Government officials check if they comply with legislation? Yes/No
14) If yes, how often do they visit in a year? .....
15) What do they check? ……..
16) How could KMAP be improved?
    ……..
    ……
17) What risks do you identify to the sustainability of KMAP?
    ……..
    ……..

3.0 FISH FARMERS ASSOCIATION

1) Were you aware of KMAP prior to Farm Africa's presentation? Yes/No

2) If yes, where did you hear about it? ……

3) What is your perception of the KMAP? Positive or Negative.

4) If positive, why? ……

5) If negative, why? ……

6) Which communities fall within your association? ……

7) How many famers do you represent? ……

8) On average how many ponds does each farmer have? ……

9) What is the preferred technique for fish farming? Pond vs cage? Why?
……

10) What fish species do you prefer to stock? ……

11) Why that species? ……

12) Where do the farmers obtain their feed? ……

13) Is the quality of the feed good? Yes/No Explain:
……

14) Is the feed always available? Yes/No Explain:
……

15) What is the cost of the feed? ……

16) Who do the farmers obtain their fingerlings from? ……

17) Do farmers consider the fingerlings healthy? Yes/No Explain:
……

18) What is the cost of the fingerlings? ……

19) Who do the farmers sell their fish to? ……

20) At what price do they sell fish? ……

21) Are the farmers interested in becoming commercial? Yes/No Explain:
……
……

22) What are the current risks that the fish farmers face on a day to day basis?
……

23) How do they deal with the risks?
……
……

24) What risks do the fish farmers foresee if they expand and become commercial?
……
……

25) What impacts do the fish farmers think that their activities have on the environment?
……
……

26) Would the fish farmers be interested in alternative means of aquaculture? Such as cage farming? Yes/No Explain:
.....
.....

27) Do the fish farmers medicate their fish? Yes/No

28) If yes, what medication do they used? .....

29) What is the main reason for fish stock fatalities? …….....

30) How do you manage this? …….....

31) Does a change in weather affect the fish farmers? Yes/No Explain:
……..……
……..

32) Are the fish farmers aware of the environmental legislation regulating their activities? Yes/ No Explain:
……

33) What percentage of fish farmers do you think abide by the regulations? …….....

34) Do Government officials check if they comply with legislation? Yes/No

35) If yes, how often do they visit in a year? .....

36) What do they check? .....

37) What risks do the fish farmers see in relation to the proposed KMAP intensification?
……..……
……

38) How do you think KMAP could be improved?
……..……
……

4.0 COMMUNITY REPRESENTATIVE (CHIEF OR WARD OFFICER)

1) Were you aware of KMAP prior to Farm Africa's presentation? Yes/No

2) If yes, where did you hear about it? …….....

3) What is your perception of the KMAP? Positive or Negative.

4) If positive, why? …….....

5) If negative, why? …….....

6) Which communities fall within your jurisdiction?
……

7) Does your area contain fish farmers? Yes/No

8) If yes, on average how many ponds does each farmer have? ……

9) What is the preferred technique for fish farming? Pond vs cage?
Why?.....
.....

10) Which fish species do they prefer to stock?
……

11) Why that/those species?……

12) Where do the farmers obtain their feed? ……

13) Is the quality of the feed good? Yes/No Explain:
……
.....

14) Is the feed always available? Yes/No Explain:
……

15) What is with the cost of the feed? ……

16) Who do the farmers obtain their fingerlings from? ……

17) Is the health of the fingerlings good? Yes/No Explain:
……

18) Who do the farmers sell their fish to? .....

19) What price do they receive for their fish? ……

20) Are the farmers interested in becoming commercial? Yes/ No

21) If yes, why? ……

22) If no, why? ……

23) What are the current business risks that fish farmers face on a day to day basis?
……
……

24) How do they deal with the risks?
……

25) Does a change in weather affect the fish farmers? Yes/No Explain:
……
……

26) What risks do the fish farmers foresee if they expand and become commercial?
……
……

27) What impacts do the fish farmers think that their activities have on the environment?
……
……

28) Would the fish farmers be interested in alternative means of aquaculture? Such as cage farming?
……

29) Do the farmers medicate their fish? .....

30) What do they medicate them with? ……

31) What is the main reason for death of fish stock? …….....

32) How do the farmers manage this?
……

33) Are the fish farmers aware of the environmental legislation regulating their activities? Yes/ No Explain:
……
……

34) What percentage of fish farmers do you think abide by the legislation? …….....

35) Do Government officials check if they comply with legislation? Yes/No

36) If yes, how often do they visit in a year? …….....

37) What do they check? …….....

38) What risks do the fish farmers see in relation to the proposed KMAP intensification?
…….....
.....

39) Would the community members that catch wild fish be interested in fish farming? Yes/No

40) If yes, why? …….....

41) If no, why? …….....

42) How do you think KMAP could be improved?
……
……

5.0 FINGERLING SUPPLIERS

1) Were you aware of KMAP prior to Farm Africa's presentation? Yes/No

2) If yes, where did you hear about it? …….....

3) What is your perception of KMAP? Positive or Negative.

4) If positive, why? …….....

5) If negative, why? …….....

6) Which communities do you supply to?
……

7) On average how many fingerlings do you sell a month? ……

8) What species of fingerlings do you supply? ……

9) Which species are preferred by the fish farmers? Explain:
……
……

10) Where do you obtain feed for your fingerlings? ……

11) What is the cost of feed? ……

12) Is the quality of the feed good? Yes/No Explain:
……

13) Do you medicate your fingerlings? Yes/No

14) If yes, what do you medicate them with? ……

15) What do you find is the main reason for fingerling fatalities?
……

16) What price do you sell your fingerlings at? ……

17) What are the current business risks that you face on a day to day basis?
……

18) How do you manage these risks?
……
……

19) Does a change in weather affect your fingerling production? Yes/No Explain:
……
……

20) Are fingerling suppliers aware of the environmental legislation regulating their activities? Yes/No Explain:
……
……

21) If yes, what percentage of fingerling suppliers abide by the legislation? ……

22) Do Government officials check if they comply with legislation? Yes/No

23) If yes, how often do they visit in a year? ……

24) What do they check? ……

25) What risks do the fingerling suppliers see in relation to the proposed KMAP intensification?
……
……

26) How do you think KMAP could be improved?
……
……
……

6.0 FISH FEED PRODUCERS

1) Were you aware of KMAP prior to Farm Africa's presentation? Yes/No
2) If yes, where did you hear about it? ……
3) What is your perception of the KMAP? Positive or Negative.
4) If positive, why? ……
5) If negative, why? ……
6) Which communities do you supply to?
……
7) On average how much feed do you sell a month? ……
8) What is the composition of your feed?
……
9) What price do you sell your feed at? ……
10) Do you ever run out of feed to sell? Yes/No
11) If yes, why? ……
12) What are the current business risks that you face on a day to day basis?
……
13) How do you manage these risks?
……
14) Does a change in weather affect your feed production? Yes/No Explain:
……
……
15) Are you aware of any environmental legislation regulating your activities? Yes/No Explain:
……
16) What percentage of fish feed producers abide by the regulations? ……
17) Do Government officials check if fish feed producers comply with legislation? Yes/No
18) If yes, how often do they visit in a year? ……
19) What do they check? ……

20) What risks do the fish feed suppliers see in relation to the proposed KMAP intensification?
……
……

21) How do you think KMAP could be improved?
……
……
……

7.0 FISH BUYERS AND SELLERS

1) Were you aware of KMAP prior to Farm Africa's presentation? Yes/No
2) If yes, where did you hear about it? ……
3) What is your perception of KMAP? Positive or Negative.
4) If positive, why? ……
5) If negative, why? ……
6) Which communities do you buy fish from?
……
7) Which communities/cities do you sell fish to?
……
8) How many famers do you buy from? ……
9) How much fish do you buy on average in a month? ……
10) How much fish do you sell on average in a month? ……
11) Do you have a preference as to where you buy your fish from? Yes/ No
12) If yes, why? ……
13) Are the consumers satisfied with the fish they buy? Yes/No
14) If no, why?
……
15) What species of fish do people prefer to buy? ……
16) Why that species? ……
17) What price do you sell your fish at? ……
18) Do you need the farmers to supply more fish to meet demand? Yes/No Explain:
……
19) What are the current business risks that you face on a day to day basis?
……

20) How do you manage the risks?
……
……

21) Does a change in weather affect the availability of fish to buy/sell? Yes/No Explain:
……
……

22) Do you think that fish can present health risks to consumers? Yes/No Explain:
……
……

23) What risks do you foresee if the fish farmers expand and become commercial?
……

24) How do you think KMAP could be improved?
……
……
……

8.0 CONSUMERS

1) Were you aware of KMAP prior to Farm Africa's presentation? Yes/No
2) If yes, where did you hear about it? ……
3) What is your perception of KMAP? Positive or Negative.
4) If positive, why? ……
5) If negative, why? ……
6) Where do you buy your fish from? ……
7) How much fish do you buy on average in a month? ……
8) Do you have a preference as to where you buy your fish from? Yes/ No
9) If yes, why? ……
10) Are you satisfied with the fish that you buy? Yes/No
11) If no, why?
……
……
12) What type of fish do you prefer to buy? ……
13) Why that type of fish? ……
14) How much do you pay for fish? ……

15) Are there times when you cannot buy fish? Yes/No Explain:
……
……

16) Do the farmers need to supply more fish to meet demand?
.....

17) Are you aware of any health risks with consuming fish? Yes/ No Explain:
……
.....

18) What risks do you see in relation to the proposed KMAP intensification?
.....
.....

19) How do you think KMAP could be improved?
……
……
……

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APPENDIX C

Attendance Register

The Great Lakes Hotel Ltd.

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Cell: 0702169131 / 0735-021803
Email: info@thegreatlakeshotel.com Website: www.thegreatlakeshotel.com

DAILY ATTENDANCE LIST

ORGANIZATION'S NAME:- FARM AFRICA

DATE:- 07/7/16 FROM:- 8AM TO:- 5PM.

NO	NAME	ROOM NO.	TEL.NO.	ID.NO.	REGION	SIGNATURE
1	Teddy Nyanupak	N/A	0723762336	14655206	Kisumu	
2	BENJAMIN M'ONDIJO		0728379368	8923649	HOMA BAY	
3	Thomas Onchangu		0728766357	16073184	KISII	
4	Amanda Gosling		0726948165		South Africa	
5	WARREN AKEN		011 6806800		South Africa	
6	Thomas Hecht		0828501363		South Africa	
7	Mark OKWaro	N/A	0723143723	10842830	KISUMU	
8	ELIZABETH A. CHIENJO		0723319484	4423716	SIAYA.	
9	SUSAN C. ADHIAMBO		0723435428	21264814	KISUMU	
10	MARY OMUHO		0712638635	8443674	KISUMU	
11	STEVE Khoma		0721744041	6952212		
12	Odhiambo Mbeo		0722285323	14859537	NAIROBI Homa Bay	
13	Kenneth Otieno		0722741665	10034648	KISUMU	
14	Charles Ngala		0722443086	5818703	Kisumu	
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28						

ORGANIZER/FACILITATOR:- farm Africa | Golfer Asst DATE:- 7th July 2016.

ACCOUNTANT:- DATE:-

FRONT OFFICE MANAGER:- DATE:-

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