Policy advice no: KMF/RS/2018/ C1.8.i.
Title: Socio-Ecological assessment of status of Cage Culture Development in Lake Victoria

Preparation

This brief has been generated from the latest scientific data to offer advice to fisheries managers on the mushrooming cage culture investments in Lake Victoria, Kenya. Information contained herein should provide guidance geared towards sustainable exploitation of the Lake while reaping economic benefits for the riparian communities dependent on the resource.

Executive summary

- Cage aquaculture in Lake Victoria provides good prospects for income, besides conserving declining wild fish stocks.
- In spite of increase in the technology's adoption, its sustainability remains uncertain owing to several socio-ecological challenges within the lake such as resource use conflicts, water hyacinth, increased inputs into the Lake ecosystem in terms of feeds and wastes among others.
- There is a need to protect the ecological integrity of the Lake while reaping benefits from it for sustainability of the resource.

Introduction

Cage culture has presented itself as a new socioeconomic frontier with good prospects for income in Lake Victoria, besides conserving declining wild fish stocks. Whereas there is an increase in adoption of cage culture in Lake Victoria owing to prospects of better income, the sustainability of this technology within the lake remains uncertain. With rise in cage culture investments, concerns on environmental degradation arise, since it brings about discharge of particulate and dissolved nutrients such as uneaten waste feed, fecal matter, and excretory products which are bound to negatively impact the fishery environment by causing anoxic conditions in sediments underlying the cages thus changing the abundance and composition of biotic communities.

When sustainably managed, Cage technology has the potential to provide significant contribution to national fish production, increased job opportunities, enhanced food security and incomes for both rural and urban dwellers in light of the blue economy.

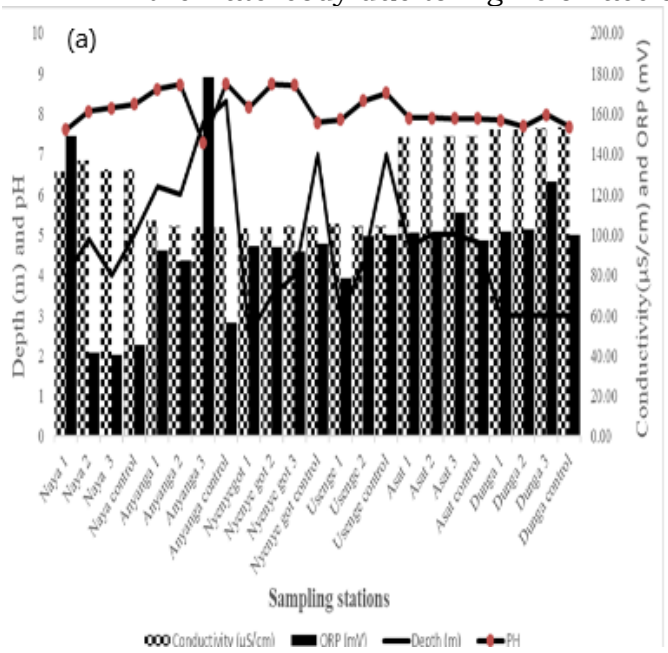
Approach and results

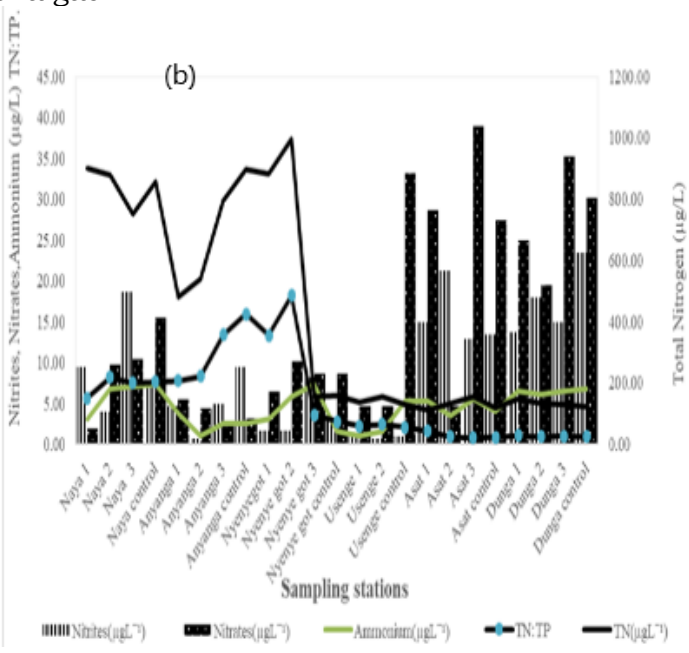
The study used standard procedures and protocols to assess the ecological status of the cage culture sites and semi-structured questionnaires to provide socio economic impacts arising from cage culture.

Results

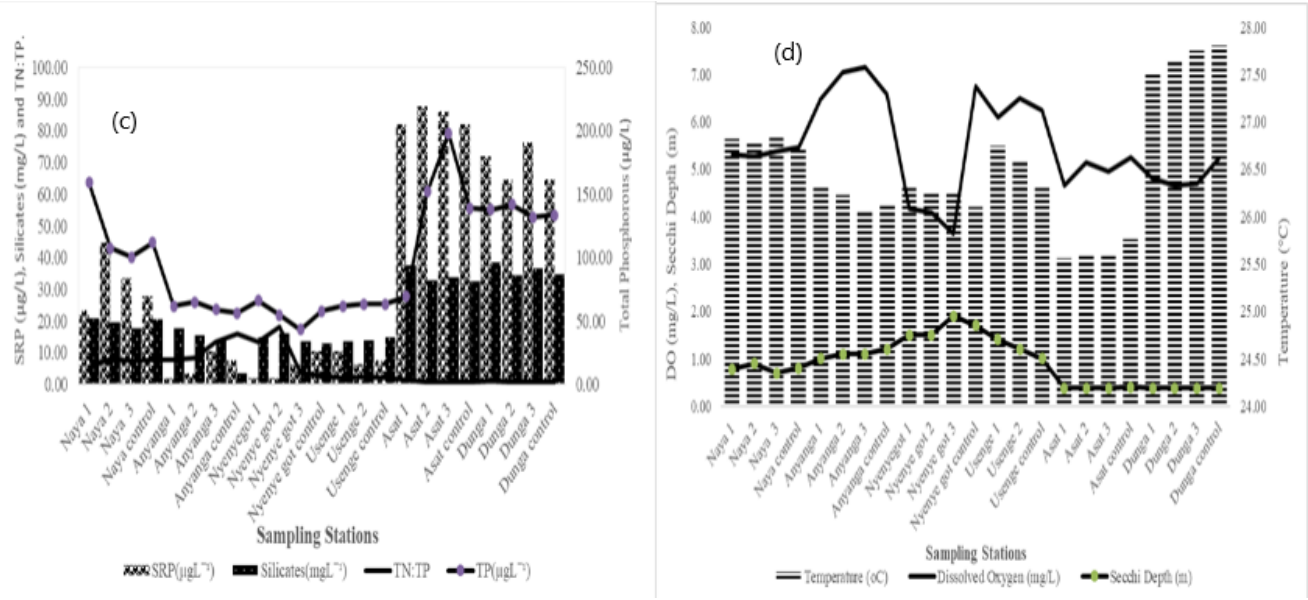
a) Ecological status

- Dissolved oxygen ranged from 2.04- 8.64mgL^{-1}.
- Cage sites located in shallow regions had lower Dissolved oxygen levels.
- Oxidation Reduction potential (ORP) values were positive indicating the good potential of the water to oxidize the cells of micro-contaminants by removing electrons from the cells making them inactive thus not generating the toxins to the water.
- Most of the fish cage sites had high buffering capacity hence no much changes in pH.
- Total nitrogen was very high in some sampling stations, an indication of high hypertrophic conditions in the fish cages hence pollution is highly pronounced.
- Some stations had hypertrophic conditions hence high eutrophication with many cyanobacteria species which could possess toxins that can affect humans and animals.
- Chlorophyll - a was high in most stations, an indication of high primary production in the waterbody due to high biomass of algae

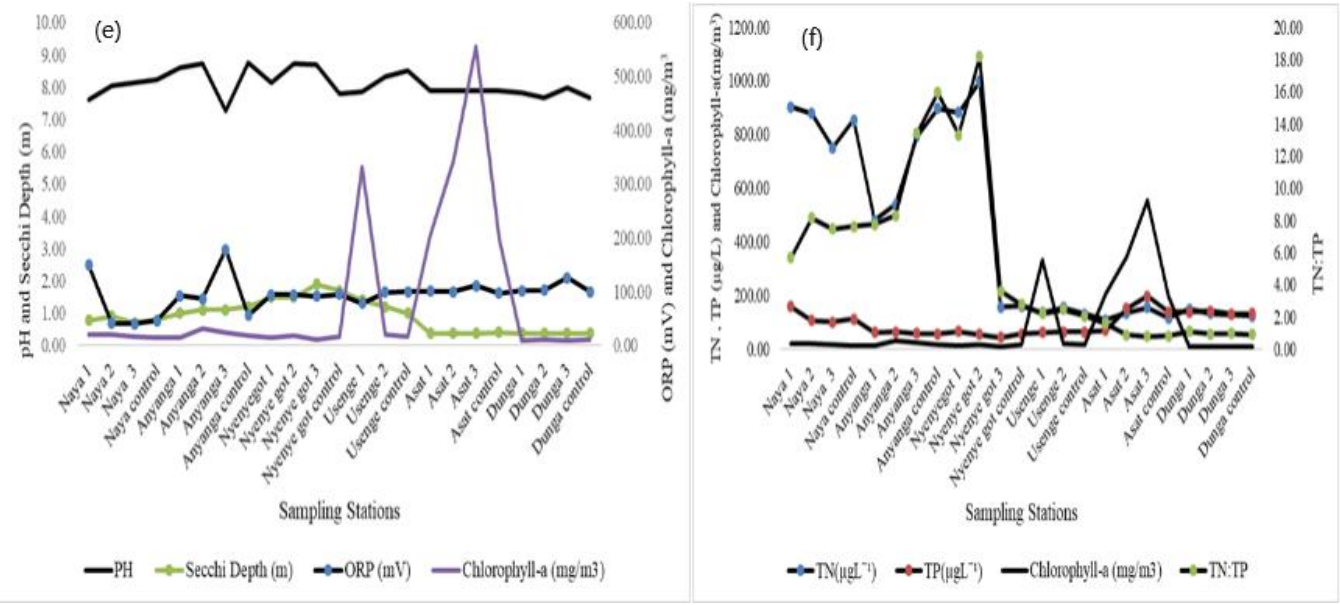




Graphs **(a)** showing parameter comparisons of pH, depth (m), conductivity (µS/cm) and Oxidation Reduction Potential (mV). **(b)** Nitrites (µg/L), Nitrates (µg/L), Ammonium (µg/L), TN:TP ratio and Total Nitrogen (µg/L) during monitoring of water quality across the surveyed cage sites.



c)Comparisons of soluble reactive phosphorous (µg/L), Silicates (mg/L), TN: TP ratio and Total phosphorous (µg/L) **(d)** Dissolved oxygen (mg/L), secchi depth (m) and Temperature (°C) during Monitoring of water quality at the surveyed cage sites.



e) Comparisons of pH, secchi depth (m), ORP (mV)and Chlorophyll-a (mg/m^3) **(f)** Total Nitrogen and Phosphorous (µg/L), Chlorophyll-a(mg/m3), and TN:TP ratio during Monitoring of water quality at the surveyed cage sites.

- Chlorophytes dominated in terms of numerical abundance and diversity in all sampled sites.
- Compared to previous studies, a considerable increase in *Bacillariophytes* was noted.

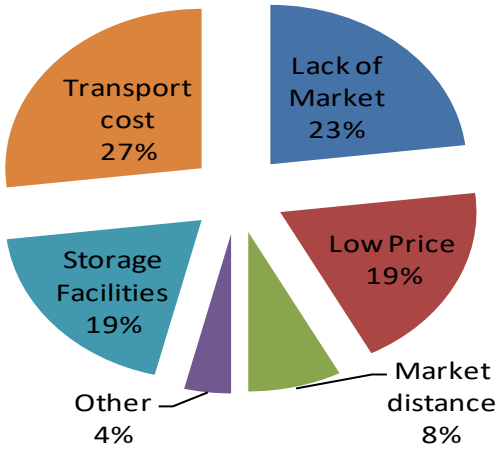
b) Socio – economic status

- Results indicate that most (93%) cage farmers fall within the most productive age of the Kenyan public workforce which is 18 - 55 yrs.
- Cage culture is highly male – dominated.
- Most cage investors are in marital relationships; which could indicate possible advantages from enhanced household resource mobilization towards investment
- 54% of those involved in fish cage farming had education levels beyond secondary schooling, with 97% of all the farmers having at least basic education.
- Most farmers practice cage aquaculture as an alternative livelihood activity.
- Socio demographic findings show that the monthly income for cage employees was bimodal, with junior employees earning between Ksh 5,000 – 10,000 and senior employees earning beyond Ksh 20,000.

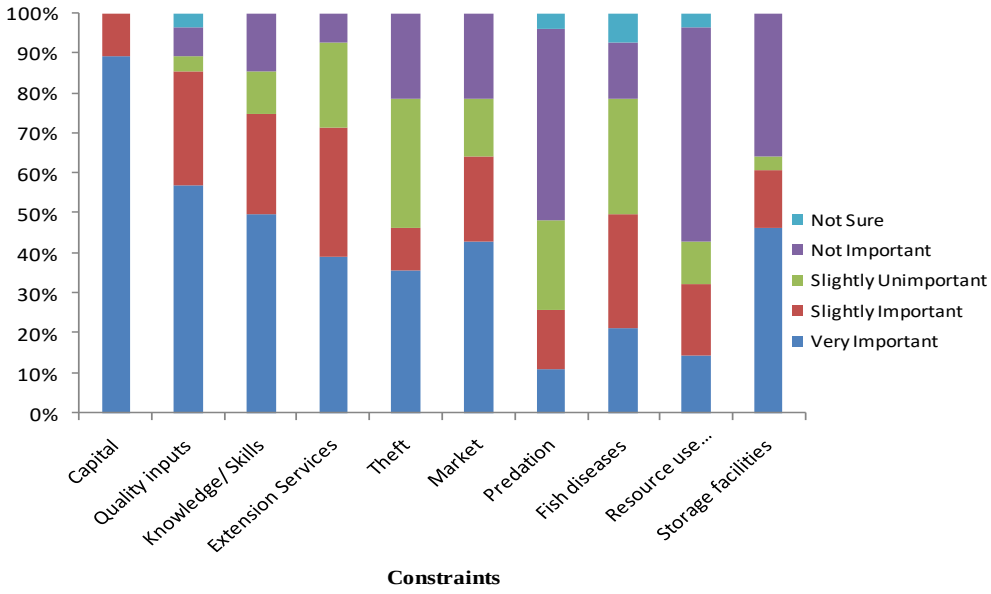
Socio-demographic characteristics of cage farmers (N=28)

Indicator	Category	Statistic
Age (Yrs)	<=25	25%
	26-35	32%
	36-45	25%
	46-55	11%
	>=56	7%
Gender	Male	93%
	Female	7%
Marital Status	Married	78%
	Single	18%
	Widowed	4%
Education	None	3%
	Primary	43%
	Secondary	36%
	Diploma/Certificate	7%
	Degree	11%
Main Occupation	Full time Fish Farmer	36%
	Part time Fish Farmer	11%
	Fisherman	25%
	Other	28%
Monthly Income (Ksh)	< 5,000	24%
	5,000 - 10,000	36%
	10,001 - 20,000	12%
	>20,000	28%

- The average cost of acquiring a cage was found to be Ksh 145,000 (Std. error = 233,744) with a range of Ksh 12,000 - 5,000,000.
- The main sources of capital for cage farming included personal savings (59%), bank loans (23%), and other sources (14%) such as pensions and member contributions.
- Major market constraints in cage culture included;



- Relative importance of constraints to cage farmers;



Conclusion

Fish cage culture is generally considered one of the most promising ways for development of industrial fresh water fish in the region. However, large-scale development of cage culture involves also a number of risks, including water pollution. Nevertheless, pollution may be controlled if the number of fish cages or the amount of feed used does not surpass the carrying capacity of that particular waterbody. Risks posed by cage culture should be solved by a clear understanding of the ecological impact brought about by unregulated and illegal installation of fish cages in the waterbody and lack of using the laid down regulations. It has been established in this study that fish cage culture in Lake Victoria is a viable business venture involving the most active age group of the riparian population as a full time occupation or alternative livelihood

activity. Investment in fish cage culture is relatively expensive with a startup of Ksh 686,900 which is beyond the acquisition of a typical artisanal fisherman. Whereas demand for fish from cages was evident, market imperfections such as transportation and limited market information limited proper marketing of fish from cages.

Implication and recommendations

- With the continuous uptake of cage culture, there should be continuous monitoring of water quality for sustainability of the Lake ecosystem.
- Policy development of cage culture should be fast tracked to ensure protocol is followed in siting and placement hence guard against conflicts among the various Lake stakeholders.
- Fish cage investment costs should be subsidized in order to allow the typical fishermen in Lake Victoria to participate and ease the already high fishing pressure in capture fisheries.
- Specific capacity building support should be accorded to investors in cage farming in terms of equipment and skills, in order to enable them to adhere to best management practices in this business venture.
- Appropriate policies and regulations concerning fish cage aquaculture in Lake Victoria should be developed in order to standardize procedures and benchmark on during resource use conflict resolution.
- Security of fish cages should be prioritized by relevant implementing agencies in order to safeguard the business income and minimize risks.