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AQUACULTURE BUSINESS DEVELOPMENT PROGRAMME

SUSTAINABLE COMMUNITY-BASED CAGE AQUACULTURE IN LAKE VICTORIA, KENYA

FACT SHEET

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SUSTAINABLE COMMUNITY-BASED CAGE AQUACULTURE IN LAKE VICTORIA, KENYA

BACKGROUND INFORMATION

- Cage aquaculture is quickly expanding in the African Great Lakes Region, with the potential to boost fish output and act as a source of food security, poverty reduction, and job creation.
- This is in line with Kenya's Vision 2030, East African Community Vision 2050, African Union Agenda 2063 and United Nations Sustainable Development Goals (SDGs).
- Lake Victoria is the largest tropical lake in the world and the largest in the African Great Lakes region. The basin is home to over 40 million people and sustains one of the world's most dense and impoverished rural populations, with densities of up to 1200 people per Sq. km. in parts of Kenya
- The growing population along Lake Victoria has increased pressure on the lake's capture fisheries, resulting in a decline in the resource. As a result of the reduction, many fishermen and investors have turned to cage fish farming for alternate livelihoods and trade.
- Fisheries and aquaculture are important change agents because they lower livelihood risks while also contributing to income generation and poverty alleviation. The concept of livelihood is central to the discussion about sustainable development, which seeks to promote "healthy lifestyles for all" by ensuring that everyone has access to inexpensive and nutritious food
- Cage culture has emerged in recent years as a new livelihood in Lake Victoria, in addition to safeguarding diminishing wild fish species. The practice has since spread to Lake Victoria's five riparian counties, namely Busia, Siaya, Kisumu, Homa Bay, and Migori
- Installation of cages has expanded significantly from 1663 in 2016 to 5242 presently. This has in turn spurred growth within the blue economy sector within the Lake Victoria region and provided employment opportunities for the people.
- There is growing concern that the proliferation of fish cages in Lake Victoria may have significant consequences on the lake’s ecology.
- Sustainable cage culture requires strict adherence to proper husbandry procedures which can be determined by water quality and biotic structure as well as fish health and the gross profit margin.
- A socioecological study across the five riparian counties of Lake Victoria, Kenya on sustainable community-based cage aquaculture, in close collaboration with stakeholders in the fisheries and aquaculture value chains was conducted in March- April 2022. The study assessed the existing investment models, production levels, cage inventory, ecological integrity, fish condition, emerging issues and lessons learnt.
- It’s against this background that, Kenya Marine and Fisheries Research Institute (KMFRI), Aquaculture Business and Development Program (ABDP) and Kenya Fisheries Service (KeFS) conducted a study to assess the status of cage culture, in Lake Victoria, Kenya.

STUDY AREA

- The study was conducted in the five riparian counties of Lake Victoria (Busia, Siaya, Kisumu, Homa-bay, and Migori) in Kenya (Figure 1)

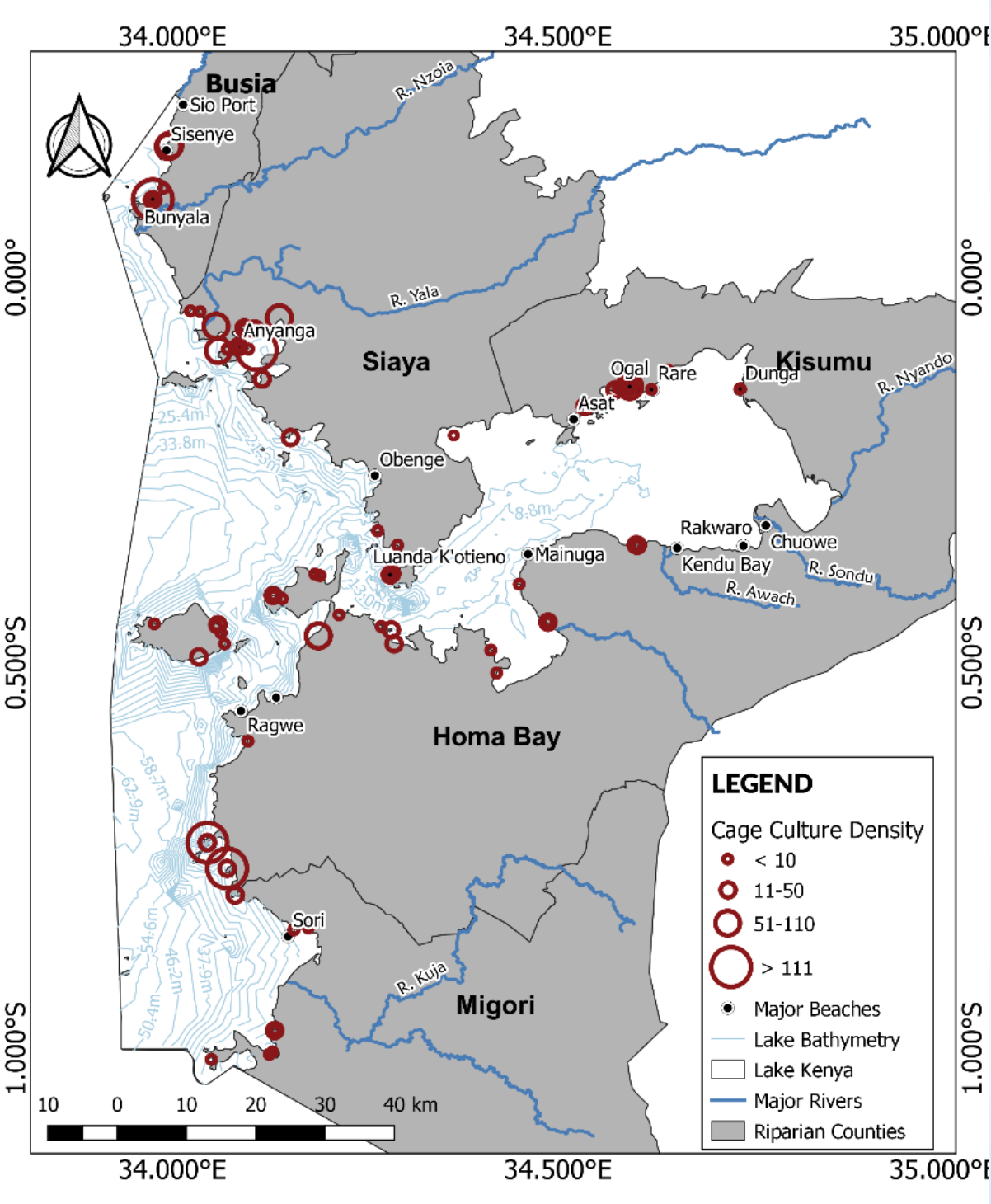

Figure 1. Map showing density of cages in riparian counties of Lake Victoria, Kenya where the socio-ecological survey on community cage culture was conducted.

Cage culture survey conducted by ABDP in Collaboration with KEMFRI in Homabay county.

HOW WAS THE STUDY CONDUCTED?

- A survey was carried out in March 2022, to collect socio ecological data on cage production. The study assessed the existing investment models, production levels, cage inventory, ecological integrity, fish condition, emerging issues and lessons learnt.
- The study used semi-structured questionnaires to collect information which was collected electronically using the Kobo collect application. The limnological parameters were collected and analysed using methods adapted from APHA 2012.
- Current estimated production and carrying capacity were calculated using the International Futures (IFs) Model.

KEY FINDINGS

- The inventory established a total of 5242 cages across the five counties with Siaya County having the highest number of cages attributed to the special support from the Ministry of Devolution in 2018. (Table 1)

Table 1. Distribution of cage culture establishments in the five riparian counties of Lake Victoria, Kenya with their respective number of establishments (Active Cages = Stocked cages as at the time of the survey; Inactive = Abandoned, Awaiting restocking and Undergoing repairs)

County	Beach of operation/No.	Number of cage establishments	Total No. of Cages	No. of Active Cages
Busia	**3**	**13**	**478**	**313**
	Rudacho	1	8	5
	Mulukhoba	9	273	195
	Bumbe	3	197	113
Homa Bay	**23**	**42**	**719**	**594**
	Litare	3	11	10
	Lwanda Nyamasare	1	21	8
	Nyandiwa	3	111	78
	Obaria	4	13	12
	Roo	1	300	300
	Alum	2	18	6
	Nyagwethe	1	8	5
	Kaimbo/Akungo	1	2	0
	Kamolo	10	35	22
	Kisaka	1	2	2
	Nyachebe	1	78	60
	Kolunga	1	15	7
	Luanda Rombo	1	5	5
	Uyoga kombe	1	2	2
	Wayando	1	6	4
	Kaugege	2	9	9
	Wakula	2	2	2
	Kitawi	1	13	12
	Mrongo	1	8	8
	Rasira	1	23	18
	Ndhuru	1	9	0
	Likungu	1	26	22
	Kisaka	1	2	2
Kisumu	**8**	**30**	**219**	**199**
	Paga	3	7	7
	Ogal	14	157	140
	Kaloka	2	11	11
	Othany	6	14	11
	Nyamaruaka	1	4	3
	Dunga	2	14	18
	Achuodho	1	9	9
	Rare	1	3	0
Migori	**4**	**14**	**78**	**22**
	Sori	4	9	6
	Matoso	7	22	8
	Oodi	2	46	7
	Bamgot	1	1	1
Siaya	**13**	**28**	**3838**	**3796**
	Nyenye Got Agulu	1	5	5
	Uwaria	4	47	44
	Anyanga	11	3538	3530
	Luanda Disi	1	33	10
	Usenge	1	106	103
	Ugambe	1	6	4
	Utonga	1	11	9
	Kowang'e	1	1	1
	Midori	1	3	3
	Luanda Kotieno	3	43	43
	Kadiala	1	10	10
	Siungu	1	8	7
	Uyawi	1	27	27
Total	**51**	**127**	**5242**	**4824**

- The floating cage system is the technology adopted in the lake with square-metal frames dominating while the UV treated PVC frames is preferred by large producers.
- Majority of the employees were men mainly due to the labor-intensive nature of cage production system.
- The profitability of the cages varied depending on the scale of operations (Table 2).

Table 2. Perceptions of cage culture farmers on initial capital investment per production cycle in Lake Victoria Kenya in March 2022. Asterix (*) means related cost for establishment

Cage size	**2*2*2**	**5*5*2.5**	**6*6*6**	**10*10*4**	**10 m diameter**
No. of fish stocked per cage	1793	5100	7513	13750	36500
Average price of fingerlings at stocking	4.5	4.7	4.6	6.3	6.8
Size of the fingerling (g) at stocking	2.0	2.8	3.4	1.6	5.2
Survival Rate (%)	50	88	91	88	91
Time taken to harvest (months)	10	9	9	9	8
Amortized cage – cost of construction *	69,285	134,508	268,453	305,000	800,000
Cost of fingerlings	11,980	24,175	37,992	68,500	249,750
Cost of feeds	53,392	14,4605	228,723	450,000	1,350,000
Cost of labor	38,111	69,032	58,697	98,500	59,500
Cost of transport	8,322	47,889	25,226	20,000	22,500
Cost of security	15,400	31,797	12,859	15,063	8,800
Other input e.g., extension service	13,200	11,950	8,094	3,000	
Total Production Cost	171,625	440,581	60,1945	95,7813	2,490,550
Quantity (Number) of fish harvested	893	4465	6822	12138	33250
Price per kilo of fish	314	303	294	338	325
Total weight at Harvest (Kg)	887	2,474	4,897	7,238	16,500
Value of fish per harvest (KES)	268,491	746,370	1,456,429	2,401,875	5,400,000
Net profit	64,349	305,789	828,417	1,444,063	2,909,450

- The current production from cage culture in Lake Victoria, Kenya is 21,000 mt yet the estimated carrying capacity is 109,226 mt alongside using the best management practices. This estimated capacity is more than 500% of the current production (Table 3).

Table 3. The estimated annual carrying capacity of Lake Victoria using International Futures (IFs) Model

Demand side	**Without accounting for population growth**			
	Units	**Ballpark**	**Notes**	**Actual**
Population of Kenya	Millions	50000000	Wikipedia	53770000
Fish consumption per capita	kg ind-1 y-1	5	FAO	
Food security target	kg ind-1 y-1	20	FAO world average	
Shortfall	kg ind-1 y-1	15		
Total annual need	ton y-1	750000		
				Bottom up
Supply side				
KMFRI assessment (zoning)	km2	190	Available for aquaculture	Lake area
Typical density at harvest (tilapia)	ind m-3	20	Reported by farms	% Kenya
Typical harvest weight	g per fish	350	Reported by farms	% Aquaculture within Kenya
Culture duration	days	180	Reported by farms	Aquaculture area
Cage depth	m	8.1	Average cage depth	
Harvest weight per unit area	kg m-2 y-1	114.975		
Precautionary factor for zoning	no units	0.005	0.5% precautionary factor	
Potential total annual harvest	ton y-1	109,226.25		
Mass balance				
Food security	extra kg ind-1 y-1			
		2.184525	Raw production biomass	
		0.6	40% losses	
		1.310715		

- The water quality parameters were generally within the optimal levels recommended for aquaculture. However, there was no clear gradient on the concentration of the parameters in cage locations probably due to the dilution effect of the lake water which may in the long run lead to deterioration.
- Fish exhibited normal growth with uniform length and weight gain.

CHALLENGES

- Major climate risks constraints to cage aquaculture operations included strong winds and waves, unpredicted movements of water hyacinth mats and algal blooms. This sometimes goes alongside upwelling, decomposition and low oxygen phenomenon that are associated with fish kills.
- Cage farmers also identified lack of seed supplies, high feed costs, and lack of institutional backing as primary roadblocks to expanding their farming operations.

OPPORTUNITIES

- Opportunities for cage investment were noted to include the availability of materials for cage structure, adequate labour, rising demand for fish and political goodwill.
- The water quality parameters were generally within the optimal levels recommended for aquaculture.

CONCLUSION

- This study concluded the floating cage system is the preferred technology by majority of cage investors who prefer metal frames due its sturdiness during operations such as changing fouled nets, grading, and harvesting.
- Majority of the employees were men mainly due to the labour-intensive nature of cage production system. Women were mainly employed as casual laborers during harvesting while men were employed as feeders, security personnel, and managers. Very few marginalized and vulnerable groups were considered as employees.
- The cost of production and the gross margin for the various cage sizes indicate that cage aquaculture is an economically viable business. However, the profitability of the cages varied depending on the scale of operations with the 10.0 m diameter cage having the highest return on investment.
- It was established that fish farmers had no access to quality affordable seed and feed, and extension services thereby limiting cage productivity.

RECOMMENDATIONS

	Recommendations	**Lead Institutions**
i.	Monitor the certified hatcheries and feed manufacturers to ensure production standards are adhered to, explore and prioritize fish feed manufacture using locally available ingredients and capacity build the farmers through trainings.	KMFRI/KeFS/ County Governments
ii.	Based on present aquaculture production and the estimated carrying capacity of the most suitable cage production sites in Lake Victoria, the lake is currently underutilized, necessitating additional investment in cage culture alongside best management practices.	SDFA & BE
iii.	Geographical information systems (GIS) can be utilized to organize and show spatial data for zoning the lake in order to allow for effective environmental management planning.	KMFRI
iv.	Cage investors should adhere to the guidelines of good cage farming practices that include proper siting for better productivity.	KeFS/ County Governments
v.	Due to the high capital and operational costs of cages, the small cage investors are highly recommended to form groups or Savings and Credit Cooperative Organizations (SACCO's) to enable them to have the financial capacity to purchase and operate them.	County Governments
vi.	Appropriate policies and regulations are required for improved lake and resource management, as well as to guide cage culture business, improve security, and facilitate resource usage dispute resolution procedures.	SDFA & BE/ KeFS

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CITATION

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