



**Article title:** Freshwater Integrated Multitrophic Aquaculture (FIMTA) technology in Lake Victoria

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## **Freshwater Integrated Multitrophic Aquaculture (FIMTA) technology in Lake Victoria**

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The decline in capture fisheries of the world has necessitated the production of fish under different aquaculture systems to bridge the gap in demand. According to FAO, 2016, aquaculture contributes about 50% of fish consumed worldwide. Today, the total annual fish production in Kenya is estimated at about 150,000 metric tons, against annual demand of 500,000 (J. Munguti et al., 2020). With the ever increasing human population, and demand for fish, technologies to improve aquaculture production must be embraced to bridge fish supply gap and to achieve nutritional sufficiency (Njiru et al., 2019). One of these technologies is cage aquaculture which is the rearing of fish(es) in water bodies like dams, lakes, ponds and reservoirs in floating enclosures that allow free flow and exchange of water between the cage the outer water body (Chakraborty, 2010). The frames of the cages can be made from bamboo, metal or High Density Poly Ethylene (HDPE). With the challenges associated with pond aquaculture such as competition for land with other uses and susceptibility to floods, cage aquaculture has gained recognition and is rapidly expanding in Kenya and world over. In Kenya, for example, the use of cages to produce fish is relatively new and is being practiced in Lake Victoria in the five riparian Counties of Migori, Homabay, Kisumu, Siaya and Busia (Anjejo, 2017). By 2017, there were are about 3, 696 fish cages spread throughout the lake and produced 318 metric tons valued at 9.6 million USD (Orina et al., 2018). These cages have several negative impacts on the lake's environment as highlighted below.



Figure 1: Circular HDPE Cage



Figure 2: Rectangular metallic fish cages

The problem associated with fish cages is the organic pollution from the leachates coming from them. The leachates include uneaten feeds, fish feces and other wastes that sink to the lakes

bottom (Ombwa et al., 2018). Upon decomposition, these wastes can lead to a reduction in O<sub>2</sub> concentration which can have negative effects on both the caged and wild fish. These organic wastes can also be mineralized into inorganic constituents becoming nutrients which can spur growth of algae in the lake resulting in eutrophication (Dias et al., 2011). With the cage aquaculture expanding rapidly in Lake Victoria, there is an urgent need to come up with methods to reduce its negative effects on the lake's environment.

One of the most effective technologies that can be used to reduce the negative impacts of fish cages in the lake is Integrated Multitrophic Aquaculture (IMTA) or Freshwater Integrated Multitrophic Aquaculture (FIMTA) in the context of freshwater systems like Lake Victoria. This technology involves rearing organisms that feed at different trophic levels of the food web (Thomas, 2011). It helps reduce wastage of resources (feeds and space) since wastes from one trophic level is utilized by organism in a lower level. It essentially involves the rearing of a fed organism (fish), organic extractive organism (filter feeders; mostly bivalves) and inorganic extractive plants. The fed organism (tilapia which is a pelagic feeder) is fed on complete diet, the excess and uneaten feeds are eaten by catfish (bottom feeder). The faeces and other wastes from the cage is taken up by the filter feeder (bivalves or gastropods) and the inorganic wastes and minerals utilized by aquatic plants as nutrients (Lee, 2019). This method has been shown to reduce feed wastage by over 40% and to increase profit margins (Park et al., 2018). This is because fish feeds contribute 40 to 60% of the cost of running aquaculture enterprises (Ali & Jauncey, 2004; J. M. Munguti et al., 2014).

According to Sukhdhane et al., (2018) and Thomas, (2011), the advantages of this technology include;

- a) It is environmentally friendly
- b) Enhances diversification in aquaculture through production of different products under the same systems
- c) Increases profits since it makes good use of space, factors of production like cage materials and feeds
- d) It reduces the risks associated with aquaculture production systems since there are chances of at least one of the products doing well even under unforeseen challenges during the production cycle.

The limitation facing the adoption of IMTA/FIMTA in Lake Vitoria is the lack of comprehensive research and data of this technology in freshwater ecosystems. There is therefore need to explore the FIMTA in Lake Victoria to not only reduce the negative impacts of fish cages on the lake but also diversify production and increase profits from aquaculture within the lake.

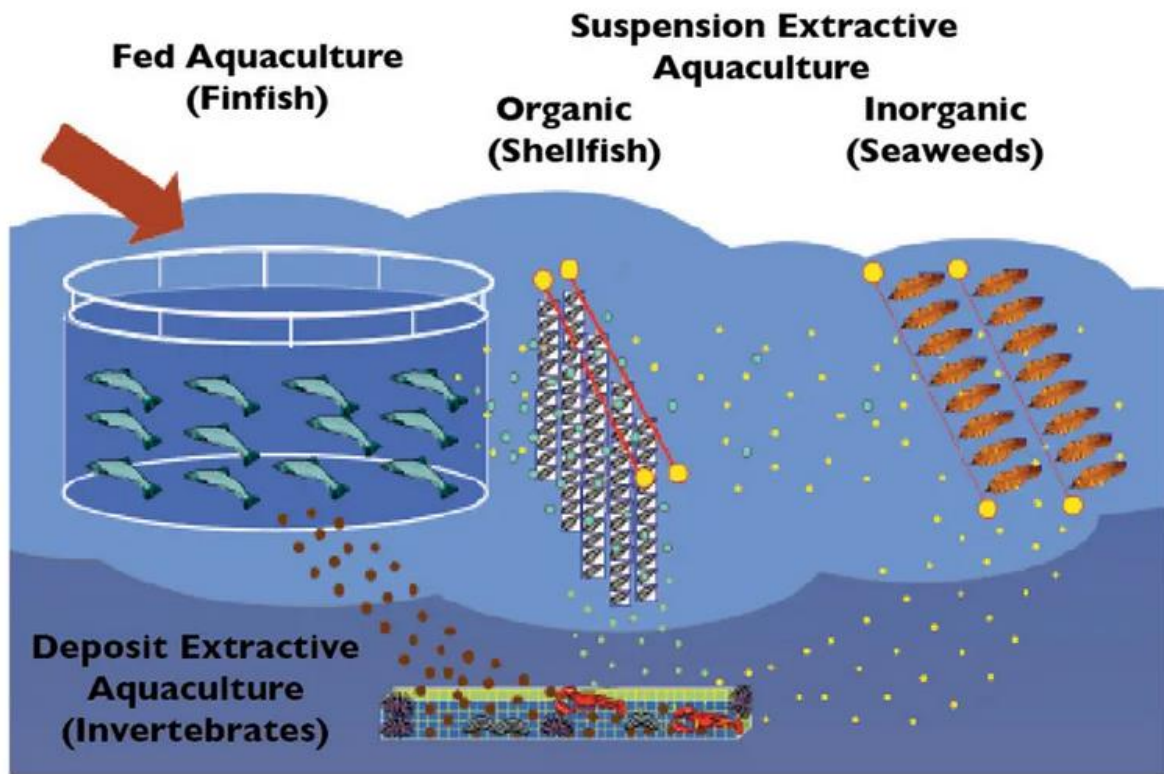


Figure 3: IMTA setup in Marine in a marine ecosystem

(<https://www.aquaculturealliance.org/advocate/integrated-multi-trophic-aquaculture-part-1/>)

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