

## Near Future Opportunities for Floating Closed Containment Flow Through Systems for Fish Farming

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There are primarily two types of system that have been used for sea based aquaculture activities: open containment systems and closed containments systems. Open containment systems rely entirely on natural ecological resources. The three most important functions: correct temperature, oxygen supply and waste removal are all taken care of by the external environment. Hence site selection is of vital importance. Under the influence of increased criticism towards this type of system in harming the local ecosystem, fish farm operators are considering moving their farms from calm protected inshore waters to harsher offshore sites where there is abundant pristine water supply and sufficient space to spread the waste. This opens an opportunity for closed containment systems in nearshore waters.

In contrast to closed Recirculating Aquaculture Systems (RAS) where water is constantly re-used floating closed containment systems that we know today, generally function as a semi-closed system. The water that is pumped into the system can be controlled by different treatment processes depending on the internal environment requirements; the same can be done for the water outflow. We shall refer to this type of system, where the water essentially flows through the tank, as a floating closed containment flow through system (FCCFTS).

Examples of FCCFTS that have been built are: The Eco-Ark®, FishGLOBE, Salmon home #1, EcoCage and Preline Extended Smolts farm. The Eco-Ark® as shown in Fig. 1 [1] is deployed in Singapore waters off Pulau Ubin. The existing Novel Offshore Advanced Hull System (NOAHS) Eco-Ark® has four large tanks of 500m<sup>3</sup> and is about the size of an Olympic swimming pool. It has the capacity to produce 166,000kg of barramundi fish annually, and enables sustainable farming out at sea in volumes that are 20 times more than average minimum production levels at traditional coastal farms. This integrated floating platform uses offshore and marine technology, IOT and treats the influent sea

water to cultivate the fish. It has a flow-through water supply system which cleans the water before discharging it safely back to the sea. It can be switched to recirculation mode when needed. These technologies mitigate the effects of spread of waste to the sea and algae blooms that threaten both the farm and our sea and offshore sites. She has a roof equipped with BIPV solar panels to supply electricity for the fish farm. This is to transform fish farming practices to be more productive, use less sea space, sustainable and climate-resilient.

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