

Preliminary Environmental and Biological Assessment of Integrated Multi-Trophic Aquaculture (IMTA) of Pearl Oyster, Seaweed and Sandfish in Northern Sri Lanka

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Integrated multi-trophic aquaculture (IMTA) can enhance productivity while maintaining environmental sustainability. This preliminary study evaluated the one-year performance of an IMTA system integrating sandfish (*Holothuria scabra*), pearl oysters (*Pinctada fucata*), and seaweed (*Kappaphycus alvarezii*) at Valeippaadu, Ariyalei, and Mandathivu, Northern Sri Lanka. Culture units consisted of PVC frame pens (1 m × 2 m × 1 m) with seaweed attached to nylon ropes, pearl oysters stocked in plastic boxes (50 juveniles per box), and sandfish stocked at 10 animals per cage. Monoculture controls were maintained for each species, with three replicates per treatment. Monthly monitoring included growth, survival, water quality, sediment organic matter, and seagrass cover. Sandfish in IMTA reached Valeippaadu: 735 ± 48 g, 100 % survival, Ariyalei: 662 ± 55 g, 90 %, and Mandathivu: 620 ± 42 g, 90 %, whereas controls showed lower growth (Valeippaadu: 690 ± 50 g; Ariyalei: 610 ± 52 g; Mandathivu: 580 ± 45 g). Pearl oysters grew from 1.5 ± 0.8 g to 6.1 ± 0.4 g (Valeippaadu), 5.9 ± 0.5 g (Ariyalei), and 5.6 ± 0.3 g (Mandathivu) in IMTA, with survival >97 %. Seaweed biomass reached 1,940 ± 150 g per unit at Valeippaadu, 1,530 ± 170 g at Ariyalei, and 1,390 ± 140 g at Mandathivu, with ice-ice disease observed in Ariyalei from January to May. Temperature ranged between 28.7 to 30.2 °C, salinity 28.5 to 33.8 ppt, dissolved oxygen 5.0 to 6.5 mg L⁻¹ and, pH 7.4 to 8.1. Sediment organic matter was highest at Valeippaadu (3.2 ± 0.6 %). Seagrass cover was 40 ± 7 % at Valeippaadu, 55 ± 6 % at Ariyalei, and 60 ± 5 % at Mandathivu, indicating low environmental impact. These results demonstrate that IMTA of sandfish, pearl oysters, and seaweed is biologically feasible and environmentally sustainable in Northern Sri Lanka. IMTA enhanced growth and survival compared to monocultures, while maintaining water quality and seagrass integrity, supporting its potential for sustainable coastal aquaculture.

Keywords: IMTA, Sandfish, Pearl oyster, Seaweed, Northern Sri Lanka, Preliminary study