

Development of Integrated Multi-trophic Aquaculture in Sanggou Bay, China

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Integrated Multi-trophic Aquaculture (IMTA) is a form of marine farming that utilizes the ecosystem services provided by organisms of low trophic levels (e.g. shellfish and seaweed) raised in appropriate ratio to mitigate the effects of organisms of high trophic levels (e.g. fish). Because the Contribution of IMTA is to recycle food and energy for increased sustainability and profitability of the aquaculture industry, therefore, the IMTA has rapidly developed in the world, especially in Sanggou Bay, China since last several years the best approaches for China.

Longline culture of IMTA has been well developed in Sanggou Bay, where is located in the east of the Shandong Peninsula, China, with the total area of 13,300 ha. With the annual production of 2,100 ton of scallop *Chlamys farreri* in fresh weight, 110,000 ton of oysters *Crassostrea gigas* in fresh weight, 80,000 ton of kelp *Laminaria japonica* in dry weight, and about 100 ton of finfish respectively, Sanggou Bay is becoming the one of most famous IMTA area in the world.

There are three kinds of IMTA approaches, the suspending IMTA of Fish, seaweed *Laminaria japonica* and shellfish oyster/scallop, seaweed, abalone and sea cucumber cultured, and sea ranching of seaweed, abalone, scallop and sea cucumber, have been developed in the bay. Among the three kinds of IMTA, the suspending IMTA of Fish, seaweed *Laminaria japonica* and shellfish oyster/scallop is the major one developed in the bay. The IMTA of abalone *Haliotis discus hannai*, kelp *L. japonica* and sea cucumber *Apostichopus japonica* has also well been developed since last 5 years. The large scale sea ranching of sea urchin, abalone, sea cucumber and clams is another kind of IMTA that mainly developed in south cape of the bay. Such sea ranching is usually practiced by releasing the hatchery produced juveniles of scallop, abalone, and sea cucumber onto the natural seabed where is enriched in the seaweed. To improve ecological



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conditions and the sustainability of the operation, the artificial reef is constructed in offshore. The research on the carrying capacity is the key point for the three kind of IMTA.

Besides the development of demonstration and applied research to clearly show farmers and regulators the benefits of IMTA, basic research on IMTA, for example, the environmental requirements for the growth of seaweeds and shellfish for the nutrient recycling efficiency with the variation of culture conditions (depths, relative position with respect to the fish cages in relation to the prevailing currents, distance from the cages and culture density), how to use the seaweed and shellfish as both a high biofiltering efficiency and increased biomass production capacity to make the IMTA approach commercially attractive has been also carried out in recent years in the bay.