AQUACULTURE NEWS

Integrated Multi-Trophic Aquaculture (IMTA) - the right move for sustainability?

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OVER the past twenty years, there has been a very substantial growth in human consumption of fish worldwide. The aquaculture sector has increased at a rate of 9.2 % per annum since 1970, compared with only 1.4 % for capture fisheries, and 2.8% for terrestrial farmed meat production systems (FAO, 2005). Aquaculture is now the fastest-growing sector of world food production.

To meet demand, there has been a dramatic expansion of the global aquaculture industry. To illustrate, witnessed by farmed salmon, there was a rise from 50,000 metric tonnes in 1985 to currently more than 1 million metric tonnes, with Norway, Canada, Chile and Scotland as the key producers.

This dramatic increase has resulted in higher levels of waste being generated (nitrates and phosphates), which gathers in inshore areas, together with nutrient loading from raw sewage disposal, septic tank leakage and run-off from land.

Carrying capacity limit

This increased nutrient load causes bays with intensive aquaculture to quickly reach their carrying capacity.

Increased nutrient loading can be the underlying cause, for example, of green tides such as *Ulva* blooms witnessed in Dublin and Courtmacsherry Bays. There are other associated problems such as rotting seaweeds that wash-up onto beaches, creating an anoxic bottom layer (devoid of oxygen) which kills bottom life.

Increased nutrient levels may also create ideal conditions for harmful algae blooms (HABs) to flourish. These HABs, which are blooms of microalgae such as the dinoflagellate genus *Alexandrium* or *Dinophysis* sp, constitute a serious threat to the shellfish industries worldwide from risks associated with Paralytic Shellfish Poisoning (PSP) or Amnesic Shellfish Poisoning (ASP). These blooms cause shellfish areas (mussels and oysters) to be closed-off as the produce is not fit for human consumption and cause associated economic effects.

Nutrient loading

To mitigate the problem of blooms, the aquaculture sector should capitalise on this nutrient loading to recapture what is food and energy, in an extractive aquaculture system. These extractive systems are in essence integrated multi-trophic aquaculture (IMTA) systems that utilise different species with a bio-mitigating function.

• **A natural match, *Porphyra umbilicalis* growing on mussels. Photo: Irish Seaweed Centre**

These extractive species can be shellfish and seaweed, resulting in the production of value-added crops that improve economic and environmental conditions, while reducing the environmental impact associated with finfish cultivation.

Appropriate extractive species will have to be selected based on their biology, cultivation and harvesting methodologies.

Recently, through the search for bioactive compounds, these extractive species may very well represent a large untapped source of compounds of marine origin, that could be used for nutraceuticals, functional foods, cosmeceuticals and pharmaceuticals, to name a few.

Pioneering work on IMTA systems has taken place by a group led by Prof Thierry Chopin and co-workers in Canada (Prof Chopin is one of the keynote speakers in the mini symposium on IMTA at the 11th International Conference of Applied Phycology, June 22-27 at NUI, Galway).

The group contends that economic stability (product diversification and risk reduction) is key to increasing profitability and resilience of these systems over finfish or mussel monoculture alone, and represents significant incentives for the cultivation of extractive species, thus helping the aquaculture sector to become more efficient and sustainable.

According to Chopin, this IMTA approach is not new as Asian countries (which provide more than two-thirds of the world's aquaculture production) have been practicing it for centuries.

Prof Thierry Chopin states that a renewed interest in IMTA practices emerged in western countries in the late 1980s and early 1990s, based on the common-sense approach that the solution to nitrification is not dilution, but conversion within an ecosystem-based management perspective.

Co-cultivation

Interestingly, Chopin's team found that by co-cultivating mussels and seaweed with finfish, not only were the economic risk and environmental issues alleviated, but that a significant increase in seaweed and mussel production (46% and 50%, respectively) arose, compared to monoculture of seaweeds or mussels, due to a more beneficial use/conversion of nutrients.

The answer for Ireland might be an IMTA approach. Think of salmon farms alongside mussel and kelp cultivation, in order to increase production and to cultivate other value-added crops, while reducing environmental problems and economic risk.

Other examples could be to combine mussel cultivation with kelp cultivation to combat the conditions in which harmful algae blooms develop.

As the infrastructure for seaweed cultivation is already present, it should be relatively easy to take seaweed cultivation on board. With the current interest in cultivating kelp to develop bio-fuels, the perfect opportunity also exists to mass cultivate seaweeds in tandem with finfish and shellfish.