

CAP AND TRADE SYSTEMS WITH SHELLFISH MAY BE GOOD FOR THE ECONOMIC BOTTOM LINE

By Michael A. Rice*

The aim of this research has been to increase aquatic biomass production per unit area of aquaculture farms while increasing overall sustainability and resilience of the operation. Dr. Thierry Chopin of the University of New Brunswick in Canada, a respected pioneer in the field of IMTA particularly in the co-culture of seaweeds, shellfish & finfish, has drawn a distinction between this new term IMTA and the older term *polyculture* in order to emphasize that any combination of species cultured together regardless of their ecological niche could be considered a form of polyculture.¹

However, even with all of the research excitement and promise surrounding IMTA within scientific circles there has been some skepticism by many in the industry who basically see the time and effort put into cultivating lower valued species alongside higher valued species (often shellfish or seaweeds) as being wasted if measured using the simplest business metric of “time is money.” Nevertheless, there are a few visionary producers including some in the Northeastern United States and Canada willing to engage in co-culture of shellfish and

Since Dr. Yngvar Olsen of the Norwegian University of Science & Technology in Trondheim coined the term *Integrated Multitrophic Aquaculture (IMTA)* at his keynote address at the 2006 meeting of the World Aquaculture Society in Florence, Italy, there has been a considerable amount of work to develop systems for the co-culture of various aquatic species that occupy different aquatic niches or positions along the aquatic food chain.



Figure 1. Oyster farm (foreground), fish traps, and floating net cage culture of groupers and sea bass (background near far shore) in the Dagupan City Estuary System 1983. Photo by Michael A. Rice

seaweeds as a niche marketing strategy to appeal to knowledgeable, often upscale consumers. This is not the general case.

In the early 1980s, I had the opportunity to work with both oyster farmers and aquaculturists engaged in the farming of groupers and sea bass within the estuaries of Dagupan City in the Philippines (Figure 1). By then, the city had at least a century-long his-

tory of extensive (low-intensity) intertidal pond culture of milkfish (*Chanos chanos*) in which ponds were periodically drained into the estuaries.² Even back then in the 1980s, there was an appreciation by aquaculture practitioners that the numerous oyster farms acted as artificial reefs (or artificial mangrove prop roots) at which fish would aggregate to feed. Alongside the oyster farms, fish traps would be

placed to catch migrating fish, including fry and fingerlings, some of which could be sold live to aquaculturists as seedstock. The added feeds to the relatively few high-value fish cages in the estuary was seen as enriching the estuary productivity and promoting phytoplankton blooms that would be beneficial as feed for the oysters.

This simple form of oyster-fish IMTA had organically arisen locally and had slowly evolved over the decades in the Dagupan City estuary. But it is important to note that oyster farmers, grouper and seabass farmers and milkfish farmers were, in general, not the same people. The economic interest of each farmer was satisfied by focusing on their own individual species specialty and production method. Oyster farming which required the least capital outlay also resulted in the smallest economic returns (particularly since sanitary water quality issues kept prices low), but it was profitable enough to support a healthy number of small-scale farmers willing to undertake the business despite the small margins, and each of the farms contributed to the overall integrated aquaculture production system in the estuary.

This all changed in the early 1990s with the intensification of the milkfish industry by way of introduction of larger scale fish pen monoculture technology. Within five years of the initial introduction of the milkfish pens, hypoxic fish kills were occurring that degraded all aquaculture production in estuary. The overall short-term profitability of the pen cultured milkfish became far more valuable than all the oysters or other fish production, and proposals to properly manage the fish pen and fish cage densities became the all-consuming controversial issue among resource managers in the local government and aquaculture producers, even to the point of affecting the outcome of local elections.

Return to a modified form of the old informal IMTA system has been



Watch Hill Oyster Company of Winnipaug Pond in Westerly Rhode Island, 2010. Photo by Michael A. Rice

suggested as a solution to the problem of all the fish kills, but how can incentives be built in to compensate those engaged in the extractive aquaculture activities (shellfish & seaweeds) that contribute to overall system sustainability? One idea that has been around for about three decades is the notion of using environmental and economic modeling to determine impacts of fish farms on dissolved oxygen (DO) and dissolved nitrogen or phosphorous levels as pollution criteria, then developing a “cap and trade” pollution permit trading system.³ Under a system like this, the governmental entity responsible for the estuary would set a limit for fish biomass or the amount of fish feeds allowed to be fed to the fish.

Capping the allowable amount of feed to be put into the estuary might have advantages of forcing innovation in feed formulations to achieve greater feed conversion efficiencies, thus allowing greater numbers of fish to be cultured under the caps. But since shellfish and seaweeds are extractive forms of aquaculture that are removing nutrients (nitrogen and phosphorus), the biomass of these extractive species would count as removal of the nutrients from the estuary, so that in a nutrient trading

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scheme, those farming shellfish or seaweed would receive a monetary pay out from the funds initially paid in as part of the finfish farming permits. Of course the practical issues of trading schemes such as this would be a very careful accounting of feed use out on the farms, as well as fish and other IMTA products being produced and harvested.

Maintaining an ongoing pollution monitoring system to keep track of water quality trends in the estuary as the implementation goes forth would also be essential. A funding mechanism for all the required monitoring could be built into the IMTA finfish permit fee structure. Probably the most difficult hurdle to making all this happen may rest in the indus-



Dagupan City, Philippines oyster farmer January, 2017. Photo by Michael A. Rice.


try's willingness to begin educating key elected decision makers about its value and potential for building economic stability in their estuary.

Recently, Dr. Ramon Filgueira of Dalhousie University in Canada and 17 co-authors from around the world [*Marine Ecology Progress Series* 518:281-287] have extended the notion of shellfish farmers benefiting from "cap and trade" systems within

the context of IMTA and nutrient budgets to potentially taking part in any potential global trading of carbon dioxide credits in the effort to control greenhouse gases. Bivalves sequester a considerable amount of carbon in the form of carbonates in their shells and they also act as a very efficient form of protein production for human food while providing valuable ecosystem services (e.g. exerting

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control on phytoplankton population dynamics) that affect the carbon dioxide cycle. Based upon these considerations, the authors argue that bivalve aquaculture should be analyzed as part of an integrated ecosystem approach and be taken into consideration within carbon trading systems as they become developed.

The effort to make economic models run in tandem with global carbon cycle models is just in its infancy. It is one of those things that may not be of practical value right away but may be of considerable value to the industry in the future, so it may be an idea worthy of following. 



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¹See: Chopin, T. (2006). Integrated Multi-Trophic Aquaculture: What it is, and why you should care.... and don't confuse it with polyculture. *Northern Aquaculture* July/August 2006.

²See: Rice, M.A. & A.Z. Devera. (1998). Aquaculture in Dagupan City, Philippines. *World Aquaculture* 29(1):18-24.

³ For an example see: Hanley et al. (1998). Economic and environmental modeling for pollution control in an estuary. *Journal of Environmental Management* 52:211-225