



THE OCEAN FOUNDATION

WHY AQUACULTURE?

As we confront climate change and associated droughts and water challenges, our attention has naturally turned to the ocean and its huge potential to feed us. Farms in places like Yemen and Texas may be drying up, but fish consumption is exploding globally, as is fish and shellfish farming. According to the UN's Food and Agriculture Organization (FAO), aquaculture is the fastest growing food production activity in the world. Many factors besides climate change are also driving policymakers, industry officials and NGO leaders to look to the ocean as "fertile ground" for expanded agriculture and industrial scale food production.

TRENDS DRIVING INCREASED INTEREST IN AQUACULTURE

- **Global Food Supply Security Issues**
 - More people are eating fish. In the past 40 years, *per capita* fish consumption worldwide has doubled.
 - Continued human population growth threatens global fish populations, already severely compromised by overfishing, bycatch, habitat loss, etc., resulting in an overall decline in commercial fish species biomass
 - 1 in 7 people rely on fish for protein (1 billion people), but we reached "peak fish" wild catch in the ocean in the late 1980s
 - Food scarcity and rising food prices cause political and social instability
 - Instability inspires short-term, short-sighted reactions that undercut responsible resource management
- **Different Contexts Demand Different Solutions**
 - Greater control and better design of fish and shellfish farming may result in empowering communities, community resilience to disasters, and healthier food
 - Those concerned with "subsistence" food needs are focused on farming small, inexpensive fish for the urban poor, rural poor and for institutional distribution (e.g. school systems, government run elderly housing, and prisons)
 - Commercial interests, on the other hand, are focused on supplementing declining stocks of the "luxury" fish demanded by wealthy consumers, and on the ability to "scale" aquaculture as a profitable agricultural technique
 - Artisanal fishing communities and their advocates worry over the impact of aquaculture on remaining wild fish populations and their habitat
 - As supporters of ocean health broadly speaking, we see some potential for aquaculture to help meet rising demand for protein as we reduce wild fishing efforts in the short-term, in order to allow fish biomass to recover and maintain total catch at a level that is sustainable. We are concerned, however, about a "rush to aquaculture" that would result in poorly planned, environmentally destructive practices. [NB: how to possibly do wild fish catch sustainably is outside the scope of this short paper.]

- **New Trends Driving Changes in Demand for Seafood as well as the Technology to Produce It**

- **New Technologies:** A newer/better aquaculture industry sector has been catalyzed by the innovative technology that delivers sustainability. For example, RAS (Recirculating Aquaculture Systems) and aquaponics (the combination of RAS and hydroponics that enables the growing of both plants and fish together in one highly efficient recirculating system) can provide controls that allow production with lower contaminant loads, and may be an organic alternative. These are especially beneficial if powered by renewable energy, and are designed to prevent loss of water via evaporation.
- **Polyculture aquaculture:** Polyculture aquaculture has existed in Asia for centuries, but, as traditionally practiced, can involve unacceptable pollution and environmental degradation when moved to scale. With *integrated multi-trophic polyculture (IMTA)*, on the other hand, finfish can be raised with sea plants or shellfish that consume inorganic and organic waste resulting from finfish farming. One successful example is the Bay of Fundy project in Canada, which combines salmon farming with kelp and mussel cultivation. This IMTA project is showing impressive growth results as well as promising mitigation of a virus, which tends to plague farmed fish projects.
- **Focus on Herbivores:** Successful herbivore aquaculture could take pressure off the use of wild animals to feed humans or other animals destined for human consumption. Also, farming is an alternative way to produce marine species for the home and commercial aquarium trade and to reduce pressure on vulnerable reef systems. For example, mollusks require less wild catch fishmeal than finfish to grow in farm setting.
- **Better Fishmeal:** When we do farm carnivores, such fish farms increasingly are consuming a significant percentage of the “reduction” wild catch after it is made into fishmeal. Indeed, aquaculture now consumes up to 80% of global fishmeal production. Ironically, aquaculture thus plays a role in continuing and increasing demand for wild fish. However, another trend is in the improvements in feed content modifications to reduce the ratio of protein from meat.
- **Global Unemployment Problems:** Aquaculture can provide viable local jobs requiring a variety of skill sets and education levels; thus assisting us in meeting poverty alleviation goals [NB: these jobs are not necessarily alternative livelihoods for local fisher communities because these more industrial jobs do not normally appeal to those who love being watermen]
- **International cooperation:** Last year, 14 European research partners created IDREEM (Increasing Industrial Resource Efficiency in European Mariculture) to foster a more efficient European aquaculture industry, based on the development of IMTA and other economically and environmentally efficient technology
- **Changes in Market Demand:** Sustainable aquaculture can be designed to meet organic standards, avoid seafood fraud¹ and to encourage the “locavore” movement, while addressing legitimate concerns that “going to [global commercial] scale is the enemy of sustainability”
- **Rise of Community Based, Grassroots, Diverse Constituency:** In the USA (for example), many recirculating farms (Recirculating Farms Coalition members) are grassroots oriented; the farms are often run by lower-income and traditionally socially disadvantaged individuals and communities in blighted urban areas (including food

¹ A February 2013 study published by Oceana found that one-third of seafood is mislabeled.

deserts). These grassroots groups often support high quality standards to prevent new entrants who undercut them on quality and price – changing the industry from overwhelmingly sustainable to something more like factory farming.

LEARNING FROM TERRESTRIAL HISTORY – PREDICTING THE FUTURE

We have plenty of terrestrial examples (from Bison to Passenger Pigeons) that showed we were unable to take “wild-caught” animals to a global commercial scale for consumption without driving them to extinction. For most wild prey species, we stopped hunting them, or domesticated them before they disappeared. The chart below shows how issues surrounding terrestrial livestock management have corollaries in the ocean today.

Terrestrial	Ocean
Hunting wild animals to meet global food needs is not sustainable and has been largely abandoned-- It is encouraged only where it is the best (and perhaps only) choice for local food supply, such as for subsistence hunters.	Hunting and killing wild animals in the ocean at levels intended to meet part or all of the protein needs for 1+ billion people is not sustainable. Globally, historic biomass was 10x what it is today, the catch is “fishing down the food chain” to prey fish.
Transition from hunting to ranching, grazing via feeding deer and other hoofed animals through the winter and hunting them the following year.	Augmenting hunting by releasing large quantities of fish via hatcheries. The releases from the hatcheries “graze” on resources in the commons, and are then captured at a later stage in life.
Hog and steer finishing operations.	Tuna ranching: (capture of juvenile wild animals and then fattening them in captivity).
When grazing became economically prohibitive, or in conflict with other land uses, we moved to feedlots (polluting, inhumane, required more drugs).	Seafood suppliers have moved to open pen /open water aquaculture and shrimp farms (polluting, inhumane, require more drugs).
Beef, pork and chicken producers have been forced by regulators, neighbors and NGOs to stop polluting, capture and biogas waste, and begin improvements to reduce inhumane treatment and kill practices.	Now in transitional movement to recirculating farming (RAS and aquaponics) (ideally closed systems prevent pollution, escapes, disease introduction) [but will have to watch for humane treatment and best slaughter practices].
Anti-CAFO (Concentrated Animal Feeding Operations) Laws and private certifying producers (e.g. Niman Ranch for pork) establishing framework for humane, drug free production, and slaughter.	RAS theoretically can be “no discharge,” so possibly a divergence of the land/water analogy in manner needed for regulatory structure; ELI Aquaculture Gold Standard.
Humans moved from sometimes eating carnivores to mostly only eating herbivores (chicken, pigs, cows and turkeys)	At this time, we are primarily eating carnivorous or omnivorous fish.

Eating carnivorous fish such as tuna or salmon is like feeding cows to lions so we can eat the lions. Why does this matter? First, both the tuna and the salmon have to be fed a large volume of fish products to become a marketable size and flavor for the wealthy country markets where they are sold. Second, their feed is derived from other wild fish populations such as anchovies, herring, pollock, and menhaden that play a significant role IN the water as prey for larger animals. Third, these so-called “oily fish” tend to contain high concentrations of mercury, PCBs or other contaminants. Fourth, the prey fish are a significant source of protein for people in all poor, coastal regions.

Thus, we predict we will move toward eating more herbivorous fish (tilapia, carp, and catfish, among others) via RAS because of global population growth and feed conversion ratios. This prediction is not without debate, and it may be on a long time scale that we see it play out in wealthy nations like the USA, but worldwide it may be unavoidable if we wish to avoid a continued downward trend in biomass in the ocean.²

² Almost all the seafood preferred by consumers requires some kind of protein to grow properly and taste good to humans (Even some lower-on-the-food-chain fish - like herring - which some conservation organizations advocate should be a regular menu choice, are omnivores). And, of course there are limits to how much grain we can sustainably produce. Thus, as a transitional option, or as an modified option, we will also support improving management of "reduction" fisheries, and examine whether the focus needs to be on improving the feed content – that way even carnivores can be raised appropriately and sustainably – using alternative yet still natural ingredients like worms, insects, and raised herbivores to make feed, or use as live feed (and encourage natural feeding behaviors in captivity).