Aquaculture and the Environment

Impact Perspectives and Suggestions for Remediation

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Abstract

Dating back 2000 years, aquaculture is a method of food production that has grown rapidly over the last century. Worldwide, aquaculture poses some problems to global environmental sustainability. During an internship in India, I discovered how important fishery resources are to people that rely on them for everyday. Now, much of these resources are coming from aquaculture. The fundamental problems that exist in aquaculture methods are that it is profit driven and methods are not environmentally sustainable. Unsustainable impacts are largely from biological risks, habitat loss and waste. In my thesis, I discuss environmental problems associated with aquaculture and make recommendations for greater socio-economic and environmental sustainability.

What is Aquaculture?

The Food and Agriculture Organization defines aquaculture as, "The farming of aquatic organisms in inland and coastal areas, involving intervention in the rearing process to enhance production and the individual or corporate ownership of the stock being cultivated."

Aquaculture

http://www.freewebs.com/marinebiotechbhs/innovationsandinnovators.htm

Pile of shells in Gig Harbor Oyster Aquaculture

Growth & Economics

Aquaculture dates back to 1100 BC in China (Cao, 2007).

Increase in technology

Now, 40% of all fish consumed by humans worldwide are farmed (Naylor et al. 2005).

Between 1980 and 2000, aquaculture grew on all continents (Diana, 2009).

In 2001, seafood exports valued at $56 billion generated more money for developing countries ($28.1 billion) than did exports of coffee, tea, bananas, rice and meat (Diana, 2009 as cited in FAO 2005).

"Farming of aquatic organisms, including fish, mollusks, crustaceans, and aquatic plants, now the fastest growing food production system globally" (Diana, 2009 as cited in FAO, 2005).

World exports of fish and fishery products reached US $85.9 billion in 2006" (Nomera, 2009).

Traditional fishing is a way of life for many communities in developing countries. Aquaculture brings in new methods to these communities but often leaves them in debt to large firms. They are no longer self-reliant and lose their old livelihoods because they convert their croplands for aquaculture or owe too much money on their operation to go back to traditional ways.

Environmental Impacts

Biological risks

Escapes and introductions create competition and alter the structure of the ecosystem. A few that have been spread around the world that are recognized as problematic are (Bert et al. 2007):

Carp
Tilapia
Salmon
Nile Perch

http://www.montereybayaquarium.org/cr/cr_seafoodwatch/issues/aquaculture_escapes.aspx

Nile perch in Lake Victoria is an example of an introduction gone wrong. Since its introduction it has decimated the native fish and contributed to changes in the ecosystem, weakening it to the point of allowing an invasive species (water hyacinth) to now thrive there.

Habitat Loss

Wetlands, mangroves and swamps are the most documented habitat losses. 33% of mangroves that once existed today are gone. These habitats provide crucial ecosystem services like carbon storage, flood control, maintenance of biodiversity, fish production, and aquifer recharge (Keddy et al. 2009). The loss of these services to an ecosystem is detrimental.

Coconut, rice paddy and sugar croplands are other vulnerable areas because they are often converted to aquaculture. This conversion can in the long-term reduce the livelihoods of farmers who once relied on these habitats.

Rice Paddy in Coorg, India. Will it be turned into a site for aquaculture one day?

Waste

Nutrients include:
- Chemical fertilizers

Other chemical wastes
- Construction materials
- Disinfectants

Medicines
- Antibiotics
- Antimicrobials

Eutrophication is aggravated by these inputs, causing the ecosystem to become unbalanced and unhealthy, which leads to the overgrowth of organisms, depletion of oxygen and increased mortality in the ecosystem.

http://www.macalester.edu/environmentalstudies/threerivers/studentprojects/ENVI_133_Spr_08/Phosphorus/Phosphorus%20Effects%20Webpage.html

Conclusion and Suggestions

These environmental impacts effects long-term economic gains and aquaculture for future generations. Like the Green Revolution from the past, the Blue Revolution is geared more toward quick production methods rather than sustainability. In addition, there are still unknowns about what these impacts can cause, especially in a time where Global Climate Change is also a factor. The combination of current knowledge, unknowns and the unpredictable future is a troubling projection of events to come, but if aquaculture prepares by using recommendations for sustainability now, they will be better prepared for the future.

Recommendations

Policy
•Better International policy that allows countries to follow a sustainable framework

Be Site Specific
•Aquaculture should mimic natural environment

Choose a sustainable method
•Polyculture- multiple organisms
•Integrated multi-trophic aquaculture- Multiple organisms that improve the function of the system through biodiversity.

Economic
•Reducing costs/risk for traditional folk

Energy inputs
•Ratios 5:1 for farmed cod; 20:1 for ranched tuna are not sustainable (Volpe, 2005)

Monitoring
• Checking the amount of released effluents and monitoring their impact regularly

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