

Five ways to make aquaculture more sustainable

Combining rice paddles and fish ponds, and using locally caught fish as feed, are just two of the ways that fish farming, or aquaculture, can be made more environmentally friendly.

By Laura Reynolds, [Nourishing the Planet](#) / March 28, 2012

Aquaculture, or the rearing of fish in captivity, is the [world's fastest-growing protein-producing activity](#), with nearly 50 percent of all seafood being farmed rather than caught in wild fisheries.

This rapid growth has provoked questions of sustainability in the global aquaculture industry, including how to handle the [massive amounts of salt water](#) being



imported inland for fish farms. While researchers warn of [dangerous overfishing and decline](#) in the world's wild fish population, aquaculture stands as a potentially sustainable alternative, and recent innovations promise to enhance the efficiency, safety, and sustainability of aquaculture while improving the lives of its fish farmers.

Today, *Nourishing the Planet* examines five innovations that are improving the sustainability of aquaculture around the world.

1. Integrating rice-and-fish farming: In many parts of [Asia](#), rice farming provides a major source of income. Rice paddies and fish have long coexisted incidentally, since many fish species find their way into flooded rice fields and actually [prefer the fields for reproduction and habitation](#). But, recently farmers have intentionally imported fish into their rice fields. The [advantages of integrated rice-fish farming](#) include a more productive and nutrient-rich rice crop, because fish increase the availability of phosphorous and nitrogen in soils; a reduction in disease-carrying aquatic weeds and algae, which compete with rice for nutrients but are a favored food among fish; and an extra source of income for farmers who can find markets for their fish.

Rice-fish farming in action: In [Bangladesh](#), where approximately [80 percent](#) of its total cultivable land is devoted to rice farming, [two researchers from Charles Darwin University in Australia](#) studied the benefits of integrating fish into rice cultivation in 2010. They found that for *aman*, the most popularly raised rice variety in Bangladesh, the yield was 12 percent higher in integrated systems than in rice monocultures, and fertilizer and pesticide inputs were reduced. In addition, another researcher from Shimane University in [Japan](#) found that rice-fish farmers had [5–11 percent higher revenue](#) than farmers of rice monocultures.

2. *Combating salmon lice with wrasse fish:* The spread of disease in aquaculture [poses a serious threat](#) not only to farmed fish, but also to wild fisheries. Although one such disease, salmon lice, occurs naturally in the wild, salmon lice has been intensified by aquaculture because of its high concentrations and varieties of species – in some areas of [Norway](#), for example, wild salmon and sea trout had [3-5 times more lice](#) than what is considered to be a “fatal dose.” Furthermore, the lice can be transmitted from fish to fish or across large distances via currents, making the disease very difficult to contain. If aquaculture contributes to the incidence of a potentially fatal disease in wild habitats, then it may contribute to the collapse of global wild fisheries. For these reasons, [scientists from Stirling University in Scotland](#) are studying the effect of wrasse, a family of fish that cleans other fish of parasites and has been shown to help control lice in farmed salmon. If wrasse can effectively control the incidence of salmon lice, fish farms can reduce their use of medicines and other inputs, and limit their environmental impact.

Using wrasse to reduce salmon lice in action: In September 2011 Scotland’s two largest salmon-farming operations [announced](#) a joint study with Stirling University in Scotland to determine the best species of wrasse to combat salmon lice. The companies are each investing nearly \$700,000 to develop and grow enough wrasse to deploy in Atlantic salmon farms throughout Scotland.

3. *Recirculating aquaculture systems:* A form of aquaculture that has gained popularity in the last few years is called recirculating aquaculture systems, or RAS. These systems recirculate the water used in the fish tank after flowing through a treatment tank, so they use up to [99 percent](#) less water than other aquaculture systems. Because they are maintained in controlled environments, RAS can reduce the discharge of waste and the need for antibiotics or chemicals used to combat disease, as well as prevent fish and parasite escapes. RAS can also incorporate hydroponics, or the water-based cultivation of plants, because the plants thrive in the nutrient-rich water and actually help purify it for reuse. In addition, RAS are less damaging to the environment than many other aquaculture systems, such as open-ocean farms, because of their limited pollution and low demands for space.

RAS in action: Clifford Fedler, a professor of civil engineering at [Texas Tech University](#), has taken the idea of RAS and created a system that can also [treat wastewater and create biomass](#) to be used as renewable fuel, potentially helping rural and underserved communities become largely self-sufficient. The systems use the wastewater to grow plants such as water hyacinth, which produces one of the highest biomass yields and is the fastest-growing plant in a hydroponic system. In 2004, the system was implemented in a Peruvian village, and it now turns human and animal wastewater into reusable fuel, providing electricity for cooking and lighting.

4. Using locally caught fish as feed: The question of how to feed fish raised in aquaculture operations is controversial. Many researchers, such as [Rosamund Naylor and Marshall Burke from Stanford University](#), now estimate large-scale, industrial aquaculture to be a “net drain” on the world’s fish supply, meaning that farms raising larger fish such as tuna actually consume more fish in the form of ground-up feed than they produce for human consumption. In addition, farmers are increasingly cutting costs by [feeding fishmeal to traditionally herbivorous fish](#). Aquaculture that relies on local supplies of fish to feed their fish stock could reduce the inputs of industrial operations.

Locally caught fish feed in action: Many tuna farms and “ranches” in [Baja California](#) rely predominantly on seasonal, locally caught [Pacific sardine](#) as feed. This alternative feeding method reduces many of the dangers of industrial aquaculture because the feed comes from natural populations, reducing the risk of introducing exotic species that could cause negative interactions with wild fish. In addition, the feed does not have to be processed and pelletized for transport, which greatly reduces the carbon emissions of these operations, [according to Peter Tyedmers of Dalhousie University in Nova Scotia](#).

5. Involving women in aquaculture: Women in developing countries can have a large role in small-scale, sustainable aquaculture systems because they are often charged with managing their family’s land while the men seek work in cities. Commercial aquaculture often replaces paddy fields or other agricultural activities in which women are traditionally involved. Because there is often [bias against employing women](#) in these larger aquaculture operations, the involvement of women in home-based aquaculture systems, such as backyard ponds, would provide them with a reliable source of income. These operations would also provide nutritional, monetary, and social benefits for the family and community.

Women in aquaculture in action: In a southern state of [India](#), researchers from the [M.S. Swaminathan Research Foundation](#) are training 30 women to run home-based aquaculture operations, raising ornamental fish for sale. Ornamental fish were chosen as the crop because they require limited space, technical skill, and time, and can be sold at markets for around \$9-to-\$14 per household, per month. The program linked women with credit, technology, infrastructure, training, job security, and trade, providing a powerful tool to improve the lives of women in poor, rural areas.