RECIRCULATING SYSTEMS

A recirculating farm uses clean recycled water as a basis to grow food. These farms can grow plants (hydroponics), fish (aquaculture), or both plants and fish together (aquaponics). There has been an increasing interest in recirculating farms from the community level to industrial. DCO2 supports these systems that are embedded in the communities for local food production, processing, and distribution. Recirculating farms have the potential to empower communities while growing culturally appropriate produce and fish. The following guiding principles lead to model standards for sustainable recirculating farms.

Water Conservation: Recirculating farms reuse most of the water in the system. Wastes are removed; water is filtered and then recycled throughout the farm. Aquaponics (plants and fish grown together) increases the efficiency of water usage by producing a wide variety of plants — vegetables, herbs, fruits and more, plus seafood. Many systems are able to recapture about 90 percent of water and re-use it in the farm.

Energy Usage: Recirculating farms require varying amounts of energy to move water through the system and support plants and/or fish. Many farms use wind, solar, and geothermal power. Some farms partner with other operations to share energy and reduce consumption while boosting efficiency. Farms should use alternative and renewable energy sources and/or partner with other existing facilities to minimize energy use and maximize function.

Closed Loop: Recirculating farms should be mostly closed loop: fish, plants, and waste are contained. Keeping the farms biosecure helps to protect the environment and the farm. And, because parasites and infections have a harder time getting in, the farms can run without antibiotics or other drugs and chemicals, providing a more natural product for consumers. A sustainable farm should be a biosecure, on-land, and mostly closed-loop system that captures, recycles, and treats the waste that is generated.

Location: Recirculating farms can be located almost anywhere when they are mostly closed loop, scalable, eco-friendly, and efficient. These farms can produce plants and fish year-round and take up less space than other forms of agriculture and fish farming. Since they don't rely on natural water sources, they can be located anywhere, including inland and urban areas. The versatility in design of recirculating farms, including vertically and off the ground, indoors or outside, allows for growing in spaces that might be otherwise unsuitable for food production - places that are rocky, small, awkwardly shaped, in backyards, on terraces, inside buildings, and other abandoned or vacated sites.

Natural Products: Recirculating farms are mostly closed loop — so a wide range of fish and plants can be grown without the risk of escaping into the natural environment. It is also harder for contaminants to enter a mostly closed system, so recirculating farms can run without antibiotics, other drugs, or chemicals. The national organic standards apply to produce grown in recirculating farms. Recirculating farms should not use genetically modified fish or plants to enhance production. Recirculating farms can be a source of local, non-GMO foods grown without antibiotics, other drugs, or chemicals.

Above: Student worker growing food for the community at Berea College Aquaponics Facility, Berea KY. Image courtesy of Wikimedia Commons.

Stocking Density: Ideal stocking densities are complex to determine, comprising both physiological and behavioral needs of each specific type of fish. With some fish, in particular those that school, lower densities may actually be harmful to the individuals, due to increased stress of being exposed to a more open environment. Such fish will thrive in higher stocking densities to mimic natural schooling behavior, whereas fish that are more territorial may require lower stocking densities to reduce aggressive behavior. The recommended stocking range should be determined based on the individual needs of each type of fish to be grown in the farm.

Feed Conversion Ratio: Traditionally, large amounts of wild fish are used in feed for farmed fish. Removing massive amounts of prey fish from the oceans to feed farmed fish can disrupt ocean food chains. It also depletes primary protein sources for coastal communities around the world. Research is ongoing to improve fish food, including reducing the amount of wild fish used in feed; finding alternative feed ingredients that are healthy and natural (like worms and algae), and even repurposing waste to create a natural food source. The feed conversion ratio should be less than one pound of wild fish to raise one pound of farmed fish.

Humane Treatment: Water quality, stocking density levels, monitoring, handling and slaughter techniques are all important factors for humane treatment of fish. Water quality values vary depending on the type of fish, but farms should always include monitoring and adjusting of dissolved oxygen, metabolic waste (solid waste, ammonia, nitrite and nitrate), pH, and temperature to meet the needs of the fish being raised. Handling and transport should be kept to a minimum. When handling and transport are necessary, measures should be taken to reduce stress on the fish. The proper nets, gloves, and buckets should be used to prevent removal or irritation of the mucus coat and/or scales that protect the fish. Adequate water circulation, maintenance of dissolved oxygen levels, and waste removal are all key in transport situations. Steps should be taken to ensure the fish are slaughtered quickly, with minimal pain and stress. Air exposure should be brief. Recirculating farms should maintain proper water quality and stocking density for the type of fish being raised, regularly monitor the fish, minimize handling, maintain low stress levels and practice humane slaughter techniques.

Social and Economic: Recirculating farms that are located on the coast can grow fish that differ from those naturally occurring. This decreases the competition with local fishermen who make their living selling popular fish from the area. Since these farms can be situated anywhere, they support communities to source their own food, reduce fuel needs for transportation and refrigeration, and provide fresher food for consumers. Recirculating farms can serve as community gardens that provide nutrients and protein local people need.

Above: Hydroponic farmers in Ahmedabad, Gujarat. Image courtesy of Wikimedia Commons.