Managing Iowa Fisheries

Getting Started in Aquaculture Enterprises

Introduction

Aquaculture, or fish farming, is the rearing of aquatic organisms under controlled or semi-controlled conditions. Although aquaculture was developed in China more than 3,500 years ago, fish farming only recently has become a specialized agricultural business in the United States. For the past two decades, aquaculture has been the fastest growing sector in agriculture. Common in many supermarkets today are fresh channel catfish, produced mainly by fish farms in the South, and trout from the Northwest. Recent emphasis on agricultural diversification has led many Iowans to consider fish as a potential crop.

Current Status

The number of private fish hatchery licenses issued in Iowa has doubled within the past 10 years. In 1988, the Iowa Department of Natural Resources issued 69 commercial permits to 62 Iowans and seven out-of-state fish producers. Most are located in eastern and southeastern Iowa where the soil and topography lends itself to the construction of farm ponds. Notable exceptions are several trout hatcheries, which need a constant supply of cold water from springs or wells, in central and northeast Iowa.

A survey of Iowa aquaculturists found that most operations produce fish for stocking purposes. However, many fish were reared for human consumption, and some operators generate income from ponds where members of the public pay to fish. Channel catfish were the most commonly reared fish for stocking and direct food use. Largemouth bass and bluegill were second in importance, sold exclusively for stocking purposes.

Other species common to Iowa's aquaculture business, in decreasing order of importance, were walleye, grass carp, fathead minnows, crappie, trout, smallmouth bass, northern pike, buffalo, wipers, and crayfish. "Wipers" is a common name given to a hybrid bass produced by breeding a white bass female with a striped bass male. Many producers in eastern and southern states consider farm-reared wipers comparable to striped bass, whose dwindling numbers along the Atlantic coast and Gulf of Mexico resulted in a ban on their commercial harvest several years ago.

About one-fourth of the Iowa aquaculturists surveyed indicated they were new to fish farming. Most seemed optimistic about the future of their operation but found the work to be more difficult than they had anticipated. In response to increased interest in aquaculture, several regional junior colleges and universities offer vocational or supplemental adult classes in fish farming.

Production Considerations

The widely accepted idea that Fish + Water + Food = Money is a misconception. Sound planning and collection of available information can help a prospective fish farmer decide whether or not to pursue this venture, and it can prevent expensive mistakes. Important factors to consider before pursuing a fish production are:

- water,
- rearing facilities,
- species to produce,
- feeds and feeders,
- disease and treatment,
- harvesting, and
- marketing.

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The following comments are not meant to encourage or discourage fish farming, but to provide factors on which to base a sound decision.

Water

The most serious threat to profitable fish production is poor water quality and lack of an acceptable quantity of water. Without adequate quantities of good quality water, fish production may be costly or impossible.

Three basic sources provide water for fishing operations: 1) wells, 2) springs, and 3) surface runoff. The preferred source is a deep well or spring; however, the most common source for most operations is the use of surface runoff. Surface water makes fish rearing difficult because the source often is polluted and contains wild fish populations with associated diseases.

Water from wells and springs is free of unwanted fish; however, both sources may be low in oxygen and require aeration. Well water also may be high in iron, carbon dioxide, or nitrogen gas, all of which can be toxic to fish, and must be removed before use. See table 1 for a description of those factors that affect water quality.

Portable test kits and meters can identify water quality parameters. For initial testing of important water parameters, several laboratories are available on a fee basis.

Water quantity is as important as water quality. For a pond culture, approximately 13 gallons/minute/pond surface acre should be available for flushing or refilling a pond. Several inches of water can evaporate from a pond during one year. Runoff water supplies make ponds difficult to manage because water may not be available when needed, such as in midsummer, or too much water may flush fish from the pond. For a raceway culture, enough water should be available to completely change the water in a raceway one to two times per hour.

Rearing facilities

Ponds: Many first-time fish farmers have an existing pond in which they would like to grow fish. This can work well, but a few guidelines must be followed:

- The pond bottom and water should be analyzed for pesticide contamination.
- The pond should be at least 8 feet deep to protect fish from summer drought and winterkill.
- The bottom should be uniform and free of stumps to simplify harvest.
- The pond should possess a screened outlet to prevent fish from escaping.
- The pond should be free of all unwanted fish.

If a pond is constructed for personal use only, no other special features are needed. For commercial use, the following pond features are recommended:

- The soil should be at least 20 percent clay below pond bottom.
- The pond should be drainable within 7 to 10 days.
- The facility may have a concrete harvest basin with water supply.
- The area must be accessible to vehicles.
- The pond must be at least 4 feet deep in the shallow end and 10 feet deep at the harvest end.
- The facility must have an overflow if it is built on a substantial floodplain.

Cages: Small wire enclosures, about 4' x 4' x 8', float in existing ponds and are anchored to the shore or a dock by rope or cable. Fish reared in cages are easy to observe, feed, and harvest; however, disease treatment is difficult without removing the fish from the cage or treating the whole pond.

Raceways: Raceways are used by commercial producers interested in the intensive (concentrated) culture of fish, such as the rainbow trout and channel catfish. Water usually is obtained from a spring or stream and is passed through the raceway using gravity, a “once-through” or “open” system. Raceways are arranged in a series on slightly sloping terrain, thus taking advantage of gravity to move the water through each unit. Raceway dimensions vary, but generally a length:width:depth ratio of 30:3:1 provides favorable characteristics. Most raceways are 3 to 6 feet wide and 20 to 100 feet long, but they also can be circular.

Raceway construction or purchase can be expensive and a **large** supply of good quality water is required. Raceways are constructed of concrete, block, tile, bricks, wood, or other durable materials, or they can be earthen. Earthen raceways may be less expensive to construct than other types; however, the high volume of fast-moving water cause varying degrees of erosion. Thus, raceways are not often used. They often require daily cleaning to maintain a good environment.

Table 1. Factors that affect water quality.

Water parameter (when to check)	Recommended levels	Importance
Oxygen (daily)	Minimum: 4-5 ppm Maximum: not to exceed 150% saturation for 4-6 hours	Main cause of fish stress and death during high production.
pH (daily)	Minimum: 6.5 Maximum: 8.5	Fish do not grow well outside these ranges; a good indicator of water quality.
Alkalinity/ total hardness (weekly)	Minimum: 20 ppm Maximum: 400 ppm	Acts as buffer against water pH changes, affects behavior of chemicals in water and fish survival.
Iron (annually)	Maximum: 0.5 ppm or below	Kills young fish by suffocation, commonly found in wells and springs.
Ammonia (weekly)	Maximum: 0.012 ppm (trout) : 0.12 ppm (catfish)	Excess causes gill damage, reduced growth, and death; toxicity affected by pH.
Temperature range	Trout: 45°F-60°F Catfish: 65°F-85°F	Outside these ranges reduced growth occurs and extremes may cause stress.

Production in raceways is greater than that of ponds or cages as a result of the continual exchange of freshwater, which removes the wastes. Production is based, in part, on the amount of water flowing through the raceways, yields are measured in pounds per gallon per minute (lb./gal./min.). Yields exceeding 82 lb./ gal./min. have been obtained in very intensive raceway production.

Water reuse systems: A closed reuse system recirculates water rather than passing it through the system only once. Less water is needed for this system than for ponds or open raceways. Most reuse systems are located indoors, which allows the grower to maintain control over the water, such as temperature. Reuse systems have additional advantages; however, their major disadvantage is the start-up cost.

Closed reuse systems have four parts: the culture chambers, a primary settling chamber, a biological filter, and a final clarifier or secondary settling chamber. Each unit is important to the system, although some closed systems do not contain all four components. Components may be separate units or they may be arranged in combinations that make the system appear to have only one or two units. Components may be large or relatively small, but each must be in proper proportion to one another if the system is to perform properly.

Production rates in closed reuse systems vary considerably depending upon the type of system and the user's expertise. Yields can range from 0.25 to 0.8 pounds per gallon (lb./gal.), although these figures can be misleading. Large-scale reuse systems are not recomended for persons with little experience in aquaculture.

Species to produce

Many species are produced commercially in Iowa; however, channel catfish, rainbow trout, large-

mouth bass, and bait fish are most common. The choice remains with the fish farmer, although available rearing facilities, potential market, water supply, and water temperature should influence the decision. Catfish, bait fish, and bass prefer 70°F to 85°F water temperatures while trout do best in 45°F to 65°F water. The most important factor to remember is that the growing time from egg to finished food product will be at least two years in Iowa. Bait fish and small stocking fish require less time and effort to produce, however, competition in this market is intense both from in-state and out-of-state producers.

Feeds and feeding

The fish farmer must have a knowledge of fish nutrition and be able to manipulate natural foods (plankton) along with formulated dry diets. Good commercial feeds are available for a variety of fish, and for particular species, such as channel catfish, trout, and salmon. The fish farmer must know how water temperature, water quality, feed quality, feed size, and feeding frequency affect eating habits, especially if feeding species other than channel catfish, trout, and salmon.

A good aquaculture program requires fish be fed 3 to 5 percent of their body weight 6 to 7 days per week, and at the same time and place in the pond or raceway. With good management practices, a pond can produce 1,500 to 2,000 pounds of channel catfish per acre of water.

Disease and treatment

The aquatic environment contains a variety of disease organisms and, thus, potential for disease problems. Disease can be caused by anything that produces stress; such as low dissolved oxygen and other water quality problems, handling, poor feed or feeding practices, drastic temperature fluctuations, and crowding. Bacterial and parasites are the most common disease-causing organisms, which can result in the death of many fish. However, fish usually will give the attentive fish farmer advance signs of a potential problems. Common indicators of fish stress and disease include reduced feeding activity, lazy swimming, and the appearance of dead fish.

The best control for disease is prevention. This is accomplished through proper management, maintenance of good water quality, and insistence that the newly acquired fish be free of stress and disease.

Even with these precautions, disease may occur and chemical treatment may be necessary. Before selecting a chemical, the culturist must identify the disease and know how the chemical, water, fish and disease will respond to the treatment. Chemical treatments can be expensive, are no panacea, and may cause higher mortality than the disease outbreak. Experience indicates disease problems and fish loss will continue to reoccur until the stress factor (crowding, poor water quality, handling, etc.), which precedes a disease outbreak, has been identified and removed. The fish farmer must know which chemicals are legal to use and their correct application.

Harvest

Harvest is an important aspect of fish farming and is often given low priority. Any damage to salable fish during harvest or transport can lead to a lower fish value, or fish death, and a complete loss. Harvesting techniques are similar for all species; however, scaled fish (walleye, bait fish, bass) are more prone to injury and require careful handling.

The time of harvest can be affected by market availability, the size of the fish needed, and weather. In general, fish handled in cool water are stressed less than those handled in warm water. Fish also should not be fed 24 to 36 hours prior to harvest to reduce fish stress and fouling of hauling tanks. Harvest during hot weather can cause “off flavor,” oxygen depletions, fish loss, and generally poor quality fish. Common equipment needed include seines, holding facilities, graders, dip nets, scales, boats, hauling units, aeration equipment, tractors, and trailers.

Marketing

This last section should be first in the minds of all potential fish farmers. Before fish rearing facilities are built or fish are stocked in existing ponds, a fish farmer **must** know where to sell the product.

The three types of fish commonly produced—food fish, small fish for stocking, and bait fish—appeal to different markets. Food fish are sold to area consumers and must be processed, either at a central plant, which are limited in Iowa, or at the farm. These fish also are sold live wholesale or retail to local customers or haulers. Food fish can be sold to lake owners as catchable fish or harvested from the production pond by anglers for a fishing fee. Fish raised for stocking fish or bait can be sold to local pond owners and

anglers, but often transportation of these fish over a large area is necessary.

A final consideration is when to sell. Due to similar growing seasons, many producers sell fish at the same time. This can create an over-supply and lower prices. Fish farmers can be flexibile by adjusting stocking dates or fingerling size at stocking, partial harvesting, or harvesting during an off-season.

Fish farming is similar to the production of other livestock. A successful operation requires technical expertise. If you're considering fish farming, look at all points discussed above, then discuss your situation with an experienced fish producer. This should help ensure a satisfying and profitable investment in fish.

Legal Considerations

The Department of Natural Resources and the Department of Inspection and Appeals should be contacted as soon as possible to determine permits needed for an aquaculture operation. The following laws and regulations are summarized for convenience. In addition to these laws, local zoning, health, and other regulations may apply.

These licenses are available from the Department of Natural Resources: 900 East Grand, Des Moines, Iowa 50319.

Aquaculture unit license: Needed to operate a hatchery, to engage in the business of propagating fish in private waters, or to hold fish for commercial purposes. The state conservation officer in your area must approve the application before a license can be issued. The licensee is allowed to possess, propagate, buy, sell, deal in, and transport fish produced from breeding stock lawfully acquired.

Operators must secure breeding stock from licensed private fish hatcheries in Iowa or from lawful sources outside the state. The Department of Natural Resources can provide a list of licensed Iowa fish hatcheries and a list of conservation officers for each county.

When purchasing fish, keep the bill of sale that allows possession to spawn, rear, and harvest fish. Additionally, anyone bringing fish or fish eggs into Iowa that are not native must submit an application to the DNR and receive a permit prior to transporting the fish into the state. The DNR may require certification that the source of fish or fish eggs is disease-free.

Bait dealers license: This license is required if minnows, frogs, or clams are sold for fish bait. The license also allows the licensee to obtain bait from lakes and streams where permitted.

NPDES permit: This permit, from the National Pollutant Discharge Elimination System (NPDES), is needed for discharge of "used" water. Generally, only relatively large operations or flow-through hatcheries will need an NPDES permit.

Water withdrawal permit: This permit is required if withdrawal from a groundwater or surface water source is in excess of 25,000 gallons per day.

Water storage permit: The permit is needed if natural runoff is captured and stored (e.g., a dam across a waterway) and the permanent storage is in excess of 18 acre feet.

Well construction permit: This permit is required prior to construction of new water wells.

Floodplain development permit: This permit may be needed if a fish farm is constructed on the flood plain of a stream or if a dam is constructed across a waterway or stream.

The Department of Inspection and Appeals requires a permit to operate a processing plant or slaughterhouse where fish are killed or dressed for food. Persons planning to raise fish for food should contact: Department of Inspection and Appeals, Lucas State Office Building, Des Moines, Iowa 50319.

Fish Farming Publications

Numerous publications are available on aquaculture. Suggested reading materials and sources are:

• *Aquaculture Magazine Annual Buyer's Guide.* Address purchase requests to Aquaculture Magazine, P.O. Box 2329, Asheville, N.C. 28802

• *Fish Hatchery Management*. Piper, et al. 1983. American Fisheries Society and the U.S., Fish and Wildlife Service, Washington, D.C.

• *The Freshwater Aquaculture Book: A Handbook for Small Scale Fish Culture.* McLarney, W. 1984 Harley and Marks, Inc.

• *A Guide to Approved Chemicals in Fish Production and Fishery Resource Management*, National Fisheries Laboratory, U.S. Fish & Wildlife Service, La Crosse, Wis. 54602

• *Northern Aquaculture.* 4611 William Head Road, Victoria, British Columbia V8X 3W9 Canada

• *Progressive Fish-Culturist*. American Fisheries Society, 5410 Grosvenor Lane, Suite 110, Bethesda, Md. 20814-2199

• *Third Report to the Fish Farmers*. U.S. Fish and Wildlife Service. Covers warm water aquaculture. Purchase from Superintendent of Documents, U.S. Printing Office, Washington D.C. 20402, pub. #S/N 024-010-000654-4

• *Water Quality in Ponds for Aquaculture*. Boyd, C.E. 1990. Alabama Agricultural Experiment Station, Auburn University, Ala.

Other Sources for Information

For more information about aquaculture contact the following offices or agencies:

• U.S. Department of Agriculture's Soil Conservation Service for information on soil suitability for pond construction and engineering expertise.

• Local Iowa State University Extension Office for general information on aquaculture.

• Department of Agriculture and Land Stewardship for marketing aspects of fish farming. Contact: Agricultural Diversification Bureau, Marketing Division, Wallace Building, Des Moines, Iowa 50319

• Investment Division, Office of the Treasurer of Iowa, for information on low interest loans available through the Linked Program for Horticulture and Alternative Crops. Contact: Office of Treasurer, State Capitol Building, Des Moines, Iowa 50319

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