

AN OVERVIEW OF AQUACULTURE IN ONTARIO

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World Aquaculture

Aquaculture is the propagation, cultivation or rearing of aquatic organisms. This practise began over two thousand years ago in China with the culture of carp in rice fields. Today, aquaculture is practised world wide and involves the farming of many different species of finfish, crustaceans, molluscs and aquatic plants. Over the last decade, world aquaculture production grew from 11 to 25 million tonnes. By the year 2000, the world's total landed catch from the wild fishery is expected to remain at approximately 85 million tonnes, while the demand for fish and seafood is expected to grow from 100 to at least 120 million tonnes. The availability of high quality protein sources in light of declining wild fish stocks and continued population growth is crucial. Aquaculture is ideally suited to solve this need.

Canadian Aquaculture

In Canada, commercial aquaculture has grown rapidly from a small cottage industry with a value of \$7 million in 1984 to an industry that generated \$289 million in revenue in 1995. Aquaculture now accounts for more than 17% of the total landed value of the Canadian fisheries sector and provides jobs for more than 5,200 Canadians in the production, supply and services sectors. Continued aquaculture growth is a priority for the federal and most provincial governments and a development strategy has been initiated to promote increased growth of the industry. The industry projects farm-gate sales of \$680 million by the year 2000.

Canadian aquaculture production exceeded 55,000 tonnes in 1995. Salmon is the predominant cultured finfish species with production of 35,000 tonnes. Cage culture of Atlantic salmon is centred in the Bay of Fundy in New Brunswick and both Atlantic and Pacific salmon are cultured in cages along the coastline of British Columbia. Over 5,000 tonnes of trout were raised in Canada in 1995, with most of the production coming from Ontario. Other cultured finfish include arctic charr and cod.

"Aquaculture is...
the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated."

SOURCE: FAO FISHERIES CIRCULAR NO. 815 REVISION 7, 1995

Shellfish accounted for approximately 12,000 tonnes of aquaculture production in Canada in 1994. The East and West coast produced 6,500 tonnes of oysters and the Prince Edward Island mussel industry produced 5,100 tonnes of mussels. Other shellfish species raised in small quantities are manila clams and scallops.

Ontario Aquaculture

In Ontario, fish culture has been practised since the turn of the century by the provincial government, mainly for lake and stream stocking. Fish culture remained exclusively a government endeavour until 1962. Changes to the Game and Fish Act allowed the private sector to culture and sell rainbow and brook trout for human consumption or stocking and smallmouth and largemouth bass for stocking only. Since then, the commercial aquaculture industry has grown to a value of \$40 million annually. In 1995, over 3,300 tonnes of rainbow trout were produced from some 200 licensed facilities. Most facilities are located in southern and central Ontario but there has been recent expansion into northern Ontario, particularly in the waters of Georgian Bay.

Currently, rainbow trout accounts for over 95% of the production output from Ontario aquaculture. This is primarily a result of the legislative restrictions on the species which could legally be farmed, coupled with well established culture techniques, availability of domesticated stocks, good quality commercial feeds, and a recognized demand for the species. Amendments to the Game and Fish Act in 1995 now permit the culture of 38 different aquatic species. These include most endemic game fish, crayfish, baitfish and tilapia. In addition to trout, there is also small-scale culture of perch, walleye, sturgeon, arctic charr, tilapia and several species of baitfish in Ontario.

Future Opportunities

Ontario possesses many assets for continued aquaculture development including the availability of water resources, access to large domestic markets and a well developed

industry infrastructure with good availability of equipment, services, supplies and technical expertise. The recently revised species list will enable production of new species for niche markets. With declining harvests of some species from the wild fishery, Ontario is in an enviable geographic position to take advantage of the free trade market with the United States.

Commercial Aquaculture

Private sector fish culture in Ontario initially involved the production of rainbow trout in ponds. These were often specifically designed for fish production with steep sloping sides and a rectangular shape to facilitate stock management and harvesting. This type of extensive culture is characterized by low stocking densities and high labour costs with resulting high variable costs of production. The low capital costs normally associated with pond culture makes this a favourable production system for the hobby-farmer.



Concrete circular tanks under cover to protect fish from sun and other predators.

Since the mid 1970's, the industry has steadily evolved with the construction of highly intensive facilities utilizing long rectangular concrete raceways or circular tanks. These land-based systems are designed for high fish stocking densities, maximal water usage, and require good animal husbandry practices. Improved feed conversions and labour efficiency usually result in lower production costs. Most commercial salmonid (trout, salmon, char) aquaculture in Ontario today is achieved through intensive culture.

Cage aquaculture is another type of production system that has gained popularity over the last decade. In these systems, fish are raised from fingerling to market-size in net-pens moored in open water. Many of the recently established large cage culture operations are in the Georgian Bay area, primarily centred in the North Channel area near Manitoulin Island.

What's Required

Though commercial aquaculture might appear to be quite different from other livestock industries in the province, the same factors which govern the success of any agribusiness apply to aquaculture. Proper business planning, market research, efficient rearing systems and good animal husbandry and management skills are necessary for

profitability. Typically, the business of fish farming is capital intensive and has a moderate level of risk, especially to the novice producer. Many factors need to be considered in starting a commercial aquaculture business including sources of financing, water supplies, site selection requirements, rearing system design, legislation, financial planning and marketing.

Site Selection

The suitability of a site for establishing a land-based commercial fish farm is dependent on several factors. A water source with a sufficient year round supply of high quality water is paramount to successful fish rearing. Site accessibility and the costs of site servicing (access roads and power supplies), along with the distance to markets (transportation costs) and suppliers needs to be considered.

Site elevations will have a significant effect on facility design in allowing the gravity flow of water through the production facility. The soils in the area on which the facility is to be built should be assessed to determine whether they can support the type of facility planned. Though most aquaculture facilities require a small amount of land-area, other sites may be required for disposal of fish manure.

Water Supply

Water supplies suitable for fish farms include groundwater from springs, artesian or pumped wells, and surface water supplies diverted from natural watercourses such as ponds, streams or lakes. For salmonid aquaculture, groundwater sources are preferred because of relatively uniform water quality and these sources are generally free of disease causing organisms and pollutants. However, groundwater temperatures are generally too low for the most rapid growth of rainbow trout. Spring water sources are advantageous because they usually require minimal or no pumping.

Water diverted from surface watercourses is also used in aquaculture because it is often available in abundant supply. Surface waters have higher summer temperatures which promote faster growth but also very cold temperatures in the winter. Surface water can have fluctuations in water quality and are more easily affected by other water users. Fish farms in Ontario operate on all of the above water sources and in some cases groundwater and surface water are used in combination.

The quantity of water required is highly variable but generally the larger the operation the more water is required. Most farms operate with water supplies between 36 litres per minute (lpm) and 45,000 lpm. In spite of these high flow rates, aquaculture is not a net user of water since all the water flowing through the facility is returned to a receiving watercourse.

Ingenuity has been demonstrated in the industry to manage water quality and quantity. Some facilities have advanced, indoor recirculation systems which allow temperature control and reduced water requirements. Other fish farms heat water by utilizing excess energy produced from unrelated industrial processes. Liquid oxygen is sometimes used to maintain oxygen levels in the rearing

systems, permitting higher stocking densities. These practises can be economically feasible for medium to large-scale producers.

Legislation

Aquaculture is unlike most other forms of animal livestock production because of the use of common water resources and the production of both native and exotic species. Legislation is in place to conserve and manage water resources for all users and to protect habitat and natural fish populations. As a result, both the provincial and federal governments regulate aquaculture operations in Ontario.

The Ontario Ministry of Natural Resources administers several licences under the Game and Fish Act. All fish farms require a *Licence to Culture and Sell Fish* which will stipulate which species may be raised at a particular location. A *Licence to Stock Fish in Ontario Waters* may also be necessary if fish are being stocked in ponds connected to open water. Fee fishing on private property requires a *Fishing Preserve Licence*, which enables the recipient to market recreational fishing opportunities without catch limits or season restrictions.

The Ontario Ministry of the Environment and Energy administers the Ontario Water Resources Act (OWRA) which requires all water users in the province who use more than 50,000 litres of water a day to obtain a *Permit to Take Water*. The OWRA also regulates the discharge of wastewater from any industrial facility including fish farms. Any commercial fish farm that has an off-property discharge of water must obtain a *Certificate of Approval*. This often requires some form of waste treatment system for solids settling and removal.

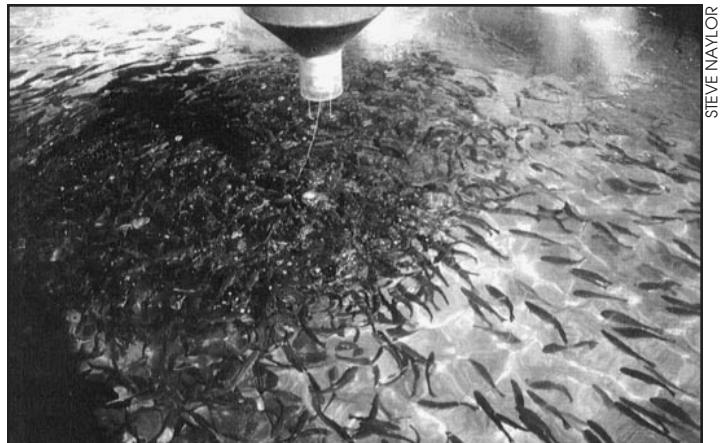
In different circumstances, a variety of other approvals may be required by other provincial and federal government agencies such as the Department of Fisheries and Oceans, and Health Canada. Fish farmers must thoroughly investigate the regulatory requirements prior to purchasing land or commencing construction.

Rearing Systems

The design of efficient production systems is essential for reducing labour costs and ensuring proper animal husbandry. Systems are species specific and need to be designed with consideration to the available space, water supply, production level and ease of stock management. In intensive salmonid aquaculture, fish may be raised in tanks, such as raceways or circulars, or cages secured in open bodies of water. For other species such as carp, baitfish, perch or walleye, pond systems are often preferred.

Feeding Systems

A variety of feeding methods are used in aquaculture. Hand feeding allows for observation of fish feeding behaviour which is a good indicator of health or water quality problems. Hand feeding is very labour intensive and impractical for larger production systems and many types of automatic feeding systems have been developed. Fish-activated demand feeders are the feeding system of choice for raceway and circular tank production of salmonids. With demand feeders, fish push a submerged rod to activate the



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Trout fingerlings congregating at a fish-activated feeding station.

feeder. Timer controlled feeders are often used for small fish in hatcheries which require multiple feedings throughout the day. Pond operators may use pneumatic timer-controlled feeding systems which disperse feed over a large area of the pond. Sophisticated, large-scale aquaculture systems also use computer controlled flex-auger feed delivery systems which transfer a weighed feed ration to individual tanks. The ration is automatically adjusted to compensate for fish growth.

It is essential that the commercial aquaculturist have a thorough knowledge of feed management practices. Feed is the largest variable expense in the cost of raising fish and typically represents about one-third to one-half of the variable cost of production. Salmonids are carnivores and require a high percentage of fish meal in their diets. Feeding practices influence waste production, feed conversion, health, growth rate and ultimately financial return to the farmer. Commercial feed for commonly cultured fish species is readily available in Ontario.

Seedstock Supply

Virtually all fish farmers raise domesticated stocks of fish which are faster growing, hardier and utilize commercial diets better than their wild counterparts. Many fish farms have their own broodstock but there are also fish hatcheries in the province which supply seedstock of the commonly cultured salmonid species. Other species may not be readily available in Ontario but are usually sold elsewhere in North America. At the present time, the commercial production of most non-salmonid species is poorly developed in Ontario.

Financial Considerations

The capital cost of intensive commercial aquaculture operations is highly dependent on site-specific considerations previously discussed. Cash-flow budgeting can be essential to financial survival in the start-up phase of a new business like aquaculture. Depending on the length of the grow-out period for the fish species being raised, there may be no revenue generated for over a year or more after initial construction of an operation. There are few government grants available to start fish farms in Ontario. The economics of aquaculture production are highly variable and are not unlike many other commercial agricultural enterprises. Fish farming can present itself in many different forms, from small

part-time operations to large, vertically integrated corporations. Opportunities for profitability are highly varied based on the marketplace and business skills of the producer.

Marketing

Most Ontario trout are sold to processors, fish markets or directly to grocery stores and restaurants throughout the province and the northeastern United States. The ability to distribute fresh, premium product to these markets has allowed Ontario trout producers to compete with less expensive frozen trout imported from the mid-western United States. Ontario trout is typically sold live, fresh,



Marketing aquaculture and fisheries products to an Ontario consumer.

whole, smoked or filleted. Live fish are sold to owners of recreational ponds, as well as to the many commercial fee fishing preserves in the province.

In recent years, there has been a trend towards producing rainbow trout larger than the traditional 340g - 400g, single portion size. This has occurred because fillets are becoming the product of choice, requiring a larger 1kg fish for processing.

Industry Organization

The Ontario Aquaculture Association represents and promotes the industry at the federal and provincial levels, and encourages the sustainable growth of fish farming in the province. The Ontario Ministry of Agriculture, Food and Rural Affairs provides both research and extension support to the industry, primarily at the University of Guelph. Research focuses on new species culture, reproductive technologies, disease management, least-cost diet formulations, genetics and growth enhancement. Extension activities are geared towards assisting novices entering the business, as well as providing technical and diagnostic services to existing commercial fish farms.



For More Information

For more detailed information on aquaculture in Ontario, write to the Aquaculture Centre for a list of other related publications, or, check out our website at:
<http://www@aps.uoguelph.ca/~aquacentre>.

The Aquaculture Centre also provides a full day seminar called, '*Getting Started in Aquaculture*' at the Alma Aquaculture Research Station.

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