

Aquaculture In Missouri:

A Perspective and Plan



PERSPECTIVES

The National Aquaculture Act of 1980, PL 96-362 recognizes the importance of establishing and implementing a national aquaculture development plan, and encouraging aquaculture activities and programs in both the public and private sectors of the economy. This plan will result in increased aquacultural production, the coordination of domestic aquaculture efforts, the conservation and enhancement of aquatic resources, the creation of new industries and job opportunities, and other national benefits. The success of this national plan will be related to and dependent upon the plans and programs organized and conducted within and among the states.

On December 7, 1981, a cooperative agreement between Missouri Fish Farmers Association, Missouri Department of Agriculture, and Missouri Department of Conservation was signed to create a Missouri Aquaculture Advisory Council (MAAC). The Missouri Aquaculture Advisory Council was charged to develop an aquaculture plan for the State of Missouri.

Aquaculture has been and will continue to be important in Missouri. In 1980, the level of commercial aquaculture in Missouri placed this state among the top seven states in the nation in the total water surface involved and in the number of commercial operations (USDA Statistical Bulletin No.644). Missouri is second in the number of small impoundments on private lands and ranks third in the nation in the number of recreational fee fishery operations (Carson et al. 1980)¹. The importance of fisheries to the state has resulted in the organization of the Missouri Aquaculture Advisory Council with representatives from the Missouri Department of Conservation, Missouri Department of Agriculture, Missouri Department of Natural Resources, University of Missouri, U.S. Department of Agriculture Cooperative Extension Service, Soil Conservation Service and Farmers Home Administration, and the Missouri Fish Farmers Association.

The primary goal of MAAC is to facilitate production of an adequate supply of quality fish as food, to satisfy the need for better management of recreational fisheries in private ponds, and to coordinate programs through development of an aquaculture plan for Missouri.

The purpose of MAAC and the Missouri Aquaculture Plan is to provide guidance for the orderly development of aquaculture, and to provide recommendations which will enhance and insure a healthy, growing industry. The plan is intended to serve as a coordinating document, information source, and a guideline for agencies, institutions, and private industry.

¹ National Directory of Recreational Fee Fisheries, Research for the Future, Inc., Washington, D.C.

Aquaculture, is defined as the controlled cultivation and harvest of aquatic organisms, has potential for solving problems of this state, the nation, and the world. World food supplies, especially animal protein, are limited. Aquaculture can provide additional high quality protein that is not now available, as well as greater opportunity for economic returns and fisheries oriented outdoor recreation. This industry and better management of aquatic habitats can produce larger quantities of valuable products.

Missouri has been involved in aquaculture and fish farming since the late 1800's and many Missouri producers have been leaders in the United States. However, the industry has not expanded in Missouri as rapidly as it has in some other states and most aquaculture products sold in Missouri are still imported. Increased production could help satisfy these demands. A cooperative program of state and federal agencies, the university, and private industry should provide the support for an expansion of aquaculture in Missouri. Implementation of the Missouri Aquaculture Plan will provide many benefits for citizens of Missouri.

MISSOURI AQUACULTURE

Commercial aquaculture in Missouri dates to around 1920. Major commercial emphasis has been on trout, baitfish, and ornamental fish production. It was not until the mid 1950's that catfish production gained impetus as a viable aquaculture enterprise. Such interest was closely aligned to the growth and interest in catfish in other sections of the country.

Increased production of baitfish, including crayfish, and increased production of trout following World War II, paralleled growth of domestic tourism. As mobility and affluence of the average citizen increased in the 1950's so did the demand for recreational pursuits including fish and fishing.

Missouri is the number one travel destination in the Midwest and among the top ten in the United States. Nearly 60 million people live within a day's drive of most Missouri recreational centers. As the cost of travel and energy increases, the demand for aquaculture products within Missouri will obviously increase. Missourians, too, will be looking to close-to-home recreational pursuits and food supplies. An alternative to already high import levels of fish is to increase production levels in Missouri.

Trout, catfish, baitfish, and ornamental fish are the primary species produced by commercial aquaculture. A MAAC survey produced replies and data from 286 commercial producers who were managing about 1,400 acres of ponds and over 20,000 feet of raceways. The total value of trout, catfish, black bass, sunfish, minnows, crayfish, and ornamental fish sold in 1980 was estimated at \$20,000,000.

Production of trout eggs, fingerlings, and adults is primarily for stocking or recreation; trout are also sold to restaurants on a fresh-dressed basis. Fresh, frozen, or

smoked trout produced in Missouri are virtually nonexistent in supermarkets and institutions.

Catfish production is primarily fingerlings for stocking and larger fish for recreation or consumption. Fresh or frozen Missouri produced catfish are virtually nonexistent in restaurants, markets, or institutions, though the product's regional demand makes it a common imported item in those outlets.

Baitfish production consists mainly of minnows and crayfish for recreational fishing. Production has fallen behind the increasing demand for baitfish.

Ornamental fish are raised by a Missouri firm which is probably the world's largest producer of goldfish. Their sales are international in scope. This major facility has produced new strains of goldfish which carry names indigenous to Missouri such as the Ozark Black Moor. New techniques have been developed such as the innovative packaging system, "golfipack".

The basic technology for intensive production of trout, catfish, baitfish, and ornamental fish is in place, but industry growth is presently limited by inadequate information to producers and potential producers. A primary need is for an effective aquaculture extension program.

Sources of financing are needed to increase production of existing facilities and to establish new ones. Lending institutions inexperienced in aquaculture is a factor limiting development, not only in Missouri, but nationwide.

Trout have specific requirements which will limit expansion of production. Few new sites with necessary water quantity and quality are available for trout production. Increased production at existing facilities will occur as research leads to more intensive and efficient methods.

Catfish production probably has a promising future both as a food source and for recreation. The market nationwide is strong and the outlook good for it to remain so.

Production of baitfish and other species such as crayfish, bass, and bluegills, is limited only by the demand for recreational fishing. Such demand is expected to increase and remain strong in the future.

The possibility for increasing production of ornamental fish, a major aquaculture export from Missouri, hinges on increased demand. Such demand is expected to increase.

With the basic technology available for production of trout, catfish, baitfish, and ornamental fish, and available markets, these species show promise for contribution to growth of aquaculture in Missouri. Emphasis for increased production should be placed on those species and sizes which show the greatest potential demand and return. Catfish

and trout presently have the greatest potential as a food source. There is a market for fingerling production for stocking private ponds and for sale and export to other producers. There is room for development and growth in production of other fishes.

There is potential for growth of recreational fee fisheries, particularly near urban and recreation centers. Of the 68 reported operations in Missouri, 46 replied to the MAAC survey. A total of 665 acres of water were reported as managed for fee fisheries. These outlets create a demand for aquaculture; of trout and catfish sales reported in 1980, 37% and 26% respectively, went to fee fisheries.

A great potential for growth and improved aquaculture production and harvest in Missouri may be achieved by better management of the 300,000 or more small impoundments, most of which are on private lands. Missouri has been in the forefront of research on management of small impoundments. There is a pressing need for information transfer to the public on extensive or intensive management programs for these waters.

PRODUCTION STRATEGIES

The controlled production of fish can range from self-sustaining populations of largemouth bass and bluegills in a well managed pond to the intensive production of catfish or trout in ponds, cages, pens, or raceways. Annual production and harvest can range from 50 pounds per acre of largemouth bass and bluegills, or over 1,500 pounds per acre of catfish that are fed controlled rations, to over 100,000 pounds per acre of trout in a pool or raceway with continual exchange of well aerated spring waters.

Important keys to success in any aquaculture operation are to maintain the efficiency of production and the quality of the product. The ecological efficiency of production and quality of largemouth bass and bluegills can be sustained in a pond with good habitat and water quality by maintaining the appropriate balance of numbers and sizes of both kinds of fish. Successful intensive production of trout and channel catfish is dependent upon good water quality, the appropriate feeding of a balanced diet, and the maintenance of fish health. Appropriate information is essential for successful producers to make the best decisions regarding development and management.

MARKETING OF AQUACULTURE PRODUCTS

Success in commercial aquaculture is dependent upon marketing capabilities. Fish are not sold at auction or to processing plants in Missouri as are livestock and poultry. However, with growth of aquaculture, marketing cooperatives and commercial processing plants may develop in the future.

The potential markets for aquaculture production are as diverse as the products themselves. Live fish may be sold or distributed to: private pond owners for recreational fishing or personal food production; to fee fishing lakes and sport shows; to other

commercial producers who specialize in grow out, or live fish hauling; to retailers such as bait dealers or variety stores selling fish for home aquariums. Other markets for live fish include research laboratories, state or federal agencies, and biological supply houses. There are also foreign markets for live fish. Missouri goldfish or channel catfish have been shipped to Canada, Europe, Japan, and the Mideast.

Dressed fresh and frozen fish are often sold to restaurants, grocery stores, and institutions. A dependable supply of a quality product is necessary in order to satisfy the needs of these outlets and to maintain periodic and repeated sales. Large producers and processors may sell to brokerage houses or export companies.

REGULATIONS AFFECTING AQUACULTURE

Regulations affecting commercial aquaculture are enacted and enforced at both federal and state levels. Federal regulatory agencies include the Corps of Engineers, Environmental Protection Agency, Food and Drug Administration and Departments of Agriculture and Interior. State agencies involved in regulatory procedures include Departments of Conservation, Natural Resources, Transportation, Social Services, and Revenue.

The Corps of Engineers requires a permit for any aquaculture development which would involve a dredge or fill operation of a stream. The Environmental Protection Agency may require a permit to discharge wastewater from an aquaculture facility. Permits are needed for trout facilities that produce more than 20,000 pounds of fish per year and feed more than 5,000 pounds of food in any month. Catfish operations may be exempt from permit if not more than 100,000 pounds of fish are produced in a year. These permits are issued by the Missouri Department of Natural Resources.

The Missouri Department of Natural Resources can provide information on or copies of the Federal Clean Water Act, discharge regulations, policies adopted by the Missouri Clean Water Commission, Missouri water quality standards, and rules pertaining to the disposal of solid wastes and emissions of odors.

Any pesticide or chemical used in water to control algae, fish, snails, or fish parasites, and any drug used to control fish diseases can only be used according to instructions on the label. All drugs and chemicals used must be approved by the Food and Drug Administration and registered with the Environmental Protection Agency. Any deviation from these regulations is a violation. This regulation is a significant constraint on the production of food fish since relatively few drugs and chemicals for aquaculture have been registered by 1982.

Interstate transport of fish may be subject to federal and state regulations. Trucking regulations vary widely from state to state. Aquaculture operations are considered as agriculture in most states. Farmers in Missouri may use a local license

plate when hauling products of their own farming operations. However, mileage or temporary fuel permits may be required due to interstate agreements.

The U.S. Department of Interior requires a permit for importers or exporters of fish or fish products if the total value shipped or received exceeds \$25,000 annually. Applications for the \$50.00 license must be filed with U.S. Fish and Wildlife Service, Division of Law Enforcement.

Products sold for human consumption including fish or other aquatic animals are subject to state regulations. Facilities used for dressing, processing, or packaging fish as food are subject to inspection by the Missouri Division of Health. All scales used for products of commerce must be certified by the Missouri Department of Agriculture.

The Missouri Department of Conservation no longer requires a fish farming permit for buying, selling, propagating, transporting, or possessing fish, crayfish, salamanders, and snapping turtles. However, the person in possession of the above must have a written, dated statement showing the number or quantity of each species purchased or other proof that such animals were obtained from other than waters of the state. Animals from outside the state must be obtained legally. Also, the Department requires that a person buying, selling, propagating, transporting, or possessing fish must comply with all provisions of the Wildlife Code of Missouri pertaining to importation, purchase or sale of endangered species, and importation of live fish or viable fish eggs of the family Salmonidae. Dealers or fish farmers may not take or attempt to take or possess fish, crayfish, salamanders, and snapping turtles on or from waters of the state for commercial purposes.

Waters of the state are defined as all rivers, streams, lakes, and other bodies of surface water lying within or forming a part of the boundaries of the state which are not entirely confined and located completely upon lands owned or leased by a single person or by two or more persons jointly or as tenants in common. Waters of the state include any waters which have been stocked by the state or which are subject to movement of fishes to and from waters of the state.

The Missouri Department of Revenue requires that sales taxes be collected on fish sold at retail or for individual use. Producers involved with retail sales must obtain a sales tax registration number.

AQUACULTURE FINANCING

The Farmers Home Administration (FmHA) extends credit to aquaculture operators, farmers, and ranchers. Producers may obtain information on operating, ownership, recreation, or emergency loans from any FmHA office and Program Aid Publication Number 1242, "Aquaculture Loans".

There are several commercial lending institutions which may provide financing for aquaculture purposes. This would include, but would not be limited to commercial banks, the Production Credit Association, the Federal Land Bank Association, and savings and loan associations. Basic requirements for loans from a commercial lender include collateral and repayment ability.

AQUACULTURE RESEARCH

Resources devoted to research and development of intensive fish production in Missouri have been limited by a lack of funds and appropriate personnel. As a result, few publications authored by individuals in Missouri are evident in the fishery literature. Articles that have been published relate to production of channel catfish. Significant recent research and developments have resulted in techniques for the artificial propagation of paddlefish. This is an example of a coordinated and cooperative effort involving Department of Conservation fishery research and hatchery personnel.

At the University of Missouri over the course of 35 years and 99 graduate students in fisheries, only three research projects have dealt with intensive aquaculture -- one on the influence of light intensity on channel catfish, another on cage culture of channel catfish, and a recent project on zooplankton dynamics in ponds for paddlefish production.

Several new developments in aquaculture have resulted from the efforts of individuals in commercial aquaculture in Missouri. Although not often recorded in the literature, break-throughs in the use of new chemical control methods, diet formations, and advancements in fish transportation were the result of private initiatives.

In contrast to the small amount of research effort devoted to intensive production, considerable effort has been devoted to management of small impoundments for recreational fisheries. A research facility with 22 drainable ponds was built in 1961. Most of the years since that time, the fishery research staff of the Missouri Department of Conservation has included a position for a pond biologist. These research efforts, along with those at the University, have resulted in an effective and successful pond program in Missouri.

The current situation for research in aquaculture in Missouri is weak. Adequate research facilities are a primary limiting factor. The Department of Conservation has included plans for a research and development hatchery for warm- and cold-water fishes as part of the Design for Conservation. A time frame for construction has not been developed.

The University farms and agricultural lands have many small impoundments that could be used for a development and demonstration program in aquaculture. The limiting factor for this expansion in the fishery program is a lack of funds for appropriate staff. The fishery and aquatic program at the University of Missouri has had limited growth

since the first fishery scientist was hired in 1944. Another fishery scientist was added in 1952, two U.S. Fish and Wildlife Service personnel were added with the establishment of the Cooperative Fishery Unit in 1963, and an additional regular faculty member in limnology was added in 1976. Proposals for staff expansion in the area of aquaculture have been made to the College of Agriculture.

The U.S. Department of Agriculture is now the lead federal agency for aquaculture. Funds were budgeted for aquaculture research for the first time in 1981. These funds should be an important catalyst for research and staff expansion, in aquaculture at the University of Missouri. Potential areas for research include: fish nutrition, feed technology, and feeding practices in order to reduce food and feeding costs; selective breeding and strain evaluation; methods for spawning, incubation, and satisfying requirements during early life history; fish pathology and health management; development of improved production systems and water quality management; evaluation of new species, and economic and marketing research.

AQUACULTURE INFORMATION AND EDUCATION

During the past decade, a great amount of information on aquaculture has been published in the United States. On the international scene, many foreign countries have also published papers related to this subject. These publications are available from national, state, university, and private sources. However, many fish farmers and other potential users do not have access to the information. Until recently, no one in Missouri has attempted to coordinate the effort necessary to assemble and disseminate information to our aquaculture community.

The people who most need aquaculture information are the private individuals who are presently engaged in fish farming and those who are now considering this activity for future investment. The private sector may be subdivided into three interest groups: large commercial producers, small or part-time producers, and the non-commercial or home-use producers. Each group has many of its own special information requirements. Other information would be of use to all three categories. The majority of fish farmers who responded to the MAAC survey indicated that they could use educational assistance.

Agencies charged with responsibilities for research, education, marketing, financial, legal or technical assistance in aquaculture also need information. Those federal agencies which operate in Missouri are: USDA, Science and Education Administration-Extension, Soil Conservation Service, Farmers Home Administration, Economics, Statistics, and Cooperative Service, Agricultural Marketing Service, and Federal Crop Insurance Corporation; U.S. Department of Interior, Fish and Wildlife Service; Department of Health and Human Services, Food and Drug Administration; and Environmental Protection Agency. State agencies include: Department of Conservation; Department of Natural Resources, Division of Environmental Quality, Soil and Water

Conservation Program, and Water Quality Program; Department of Agriculture; and Division of Health.

Educational institutions, fish farming industries, legislative and regulatory bodies, trade and professional associations are examples of others who often seek out aquaculture related information at one time or another.

At the present time, our universities do not offer an educational program designed to meet all the varied needs of today's intensive aquaculture. The graduates have inadequate experience in the day-to-day requirements of practical aquaculture. Based on demand, a graduate level program could be designed to provide training in management necessary to meet aquaculture needs. The program must provide for practical skills as well as broad academic education.

There is a need for continuing education for commercial producers. Training has been provided for prospective fish farmers. Future programs should be designed to provide training in the latest techniques, practices and new theories of aquaculture production and management. The MAAC survey has shown there is already strong interest in fish disease diagnosis and marketing information. Educational needs can be coordinated through the Missouri Fish Farmers Association. Programs could be delivered in the form of short courses, workshops, seminars, and formal presentations.

Aquaculture information will be requested by a number of different audiences. Subject matter will vary from basic general information for the beginner, to highly detailed data needed to correct a specific problem for the large commercial producer. The former may be satisfied with an off-the-shelf brochure, while there may be no existing answer for the latter. Specific requests could identify new research projects needed to update the current state of the art.

Information needs which have already been identified by Missouri fish farmers relate to markets, health care, feeds and feeding, laws and regulations, and aquacultural economics. Specifically included are: market determination and market expansion techniques; disease prevention, diagnosis, and equipment development; water quality, pollution control, zoning, inspections, and out-of-state shipments; sources of financing, taxation, and economic analysis systems.

Information delivery could be in the form of publications, mass media techniques, consultative assistance, tours, and demonstration projects. Formal presentations, seminars, workshops, and short courses could provide the best delivery system for certain subjects. The mail survey showed a strong interest in a need for on-site technical assistance and a continuing education program in aquaculture. A monthly newsletter for fish farmers could provide information on news items of interest. Any delivery system must be flexible to meet the ever-changing needs of this industry.

AN AQUACULTURE PLAN

Missouri Department of Conservation has been and will continue to be a major producer in aquaculture. It also has been the lead agency in aquaculture research, fish health services, and aquaculture information. The Department of Conservation recognizes the need for an expanded aquaculture research and development program in order to improve the efficiency of their hatchery program. Their role in the Missouri Aquaculture Plan is to:

1. Provide leadership, facilities, and support for aquaculture research and development.
2. Provide diagnostic services and assistance in the management of fish health.
3. Provide largemouth bass, bluegills, and channel catfish to private owners of new or reclaimed ponds.
4. Provide information to owners of ponds managed for self-sustaining populations.
5. Assist as appropriate and feasible in the development and delivery of seminars, workshops, and short courses.
6. Make available surplus eggs or fish of unique species or characteristics to commercial producers on an exchange or fair cost basis.

University of Missouri, through its College of Agriculture, Agriculture Experiment Station, and Cooperative Extension Service is to provide the lead for formal education and information transfer on commercial aquaculture. Their role in the Missouri Aquaculture Plan is to:

1. Maintain an active program in the education of fishery scientists with an interest in aquaculture.
2. Provide support through the Agriculture Experiment Station for a fishery scientist with an interest in aquaculture.
3. Establish an aquaculture demonstration program including selected ponds managed by the College of Agriculture.
4. Develop extension capabilities to assist in development of commercial aquaculture in Missouri and to disseminate results of fishery research.
5. Provide technical assistance and information from appropriate individuals in the College of Agriculture and School of Forestry, Fisheries, and Wildlife to appropriate agencies and organizations.

Missouri Department of Agriculture recognizes the important role that aquaculture has in the future of agriculture for the state of Missouri. Aquaculture will give the Missouri farmer the potential of added flexibility for his farming operation and farmland. The Missouri Department of Agriculture, through its programs and offices, will provide assistance and information to Missouri farmers interested in aquaculture. Their role in the Missouri Aquaculture Plan is to:

1. Provide advice and services for aquaculture in keeping with established advice and services given to other agriculture commodities.

2. Assist in promoting and marketing aquaculture products on a statewide basis.
3. Assist in identifying potential foreign buyers, arranging participation in foreign trade promotions, and establishing direct or indirect marketing channels.
4. Perform sample analysis of feeds and assist as needed, in locating appropriate registered feed medication or medicated feeds as the need arises.
5. Make nursery inspections at point of aquatic plant propagation and assist in making determinations of plant diseases and/or weed problems, and enlist the aid of other professionals from outside sources as needed.
6. Provide assistance as feasible, related to fish health with the aid of the diagnostic labs in Springfield and Cameron, Missouri.
7. Provide scale testing, packaging, and labeling information, metrology laboratory calibration of test weights and LPG and petroleum meter testing.
8. Provide counseling on procedures used in international trade.
9. Certify operators as pesticide applicators in the event needed pesticides are classified for restricted use by the EPA, and make emergency use or special local need registration of pesticides should the need arise.

To accomplish its goal of a strong aquaculture program in the state of Missouri, the **Missouri Fish Farmers Association** will participate in the Missouri Aquaculture Plan. Their role in the Missouri Aquaculture Plan is to:

1. Develop a strong state association.
2. Promote and develop the aquaculture field and programs favorable to aquaculture.
3. Encourage the development of better production methods, markets, and processing facilities.
4. Monitor existing and proposed legislation affecting aquaculture.
5. Assist in sponsoring workshops to keep abreast of current development in aquaculture research.
6. Coordinate with other private and governmental entities involved in aquaculture and related activities.
7. Consider the establishment of a Fish Farming Cooperative for Missouri.

USDA, Soil Conservation Service (SCS) recognizes that fish raised on farms and ranchlands are a part of the agricultural resource, and that the planned production of such is a specific kind of water use. Through Missouri Soil and Water Conservation Districts, the SCS provides technical assistance in use of water for the production of fish as either a primary or secondary use. With field offices in nearly all counties in Missouri, the SCS is able to work directly with landowners and operators whose desires and farm resources indicate a satisfactory opportunity for some aspect of aquaculture. Their role in the Missouri Aquaculture Plan is to:

1. Provide and interpret soils information in the selection of sites for facilities such as ponds, reservoirs, raceways, and waste disposal systems.
2. Assist the aquaculturist to assess his resources for growing and marketing a fishery product.

3. Provide engineering assistance in design and layout of impoundments, water supply systems, and related facilities.
4. Assist other agencies in information and technology transfer including participation, as needed, in seminars, workshops, short courses, and meetings.

Farmers Home Administration provides financial assistance to aquaculture operators as the financing institution of USDA. Their role in the Missouri Aquaculture Plan is to:

1. Provide financial counseling and technical assistance.
2. Work with applicants and borrowers, as well as with state and local officials, planning groups, and government agencies.
3. Provide a supplemental source of credit, augmenting the efforts of the private lenders rather than competing with them.

On a national, as well as state basis, there are many other USDA agencies which will provide some form of assistance to the aquaculture industry. Their responsibilities are outlined in a recently developed department plan titled, "Aquaculture - A Program for the Eighties." The plan outlines the resources required, the internal mechanisms needed and budget disbursements.

The USDA plan proposes an array of activities including a research and technology transfer program, marketing and economic analysis, food safety, and consumer acceptance work. A high priority item is to conduct a survey of the industry to generate a data base which is essential for industry growth and stability and for use by government planners. Many of those engaged in Missouri aquaculture activities will be asked to supply information for this survey.

Missouri Aquaculture Advisory Council has served the state of Missouri by preparing this plan for the orderly development of aquaculture. It is a dynamic plan which will evolve to meet industry and resource needs. The future role of the Missouri Aquaculture Advisory Council is to:

1. Provide an industry presence.
2. Provide liaison between the state agencies and other interested organizations.
3. Review major issues affecting development of aquaculture in Missouri.
4. Review all proposed legislation affecting the aquaculture industry and provide comments and recommendations.
5. Update the Missouri Aquaculture Plan as necessary to keep it current with new technological growth and needs.
6. Meet at least twice a year or as necessary.

The Missouri Aquaculture Plan was developed by
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