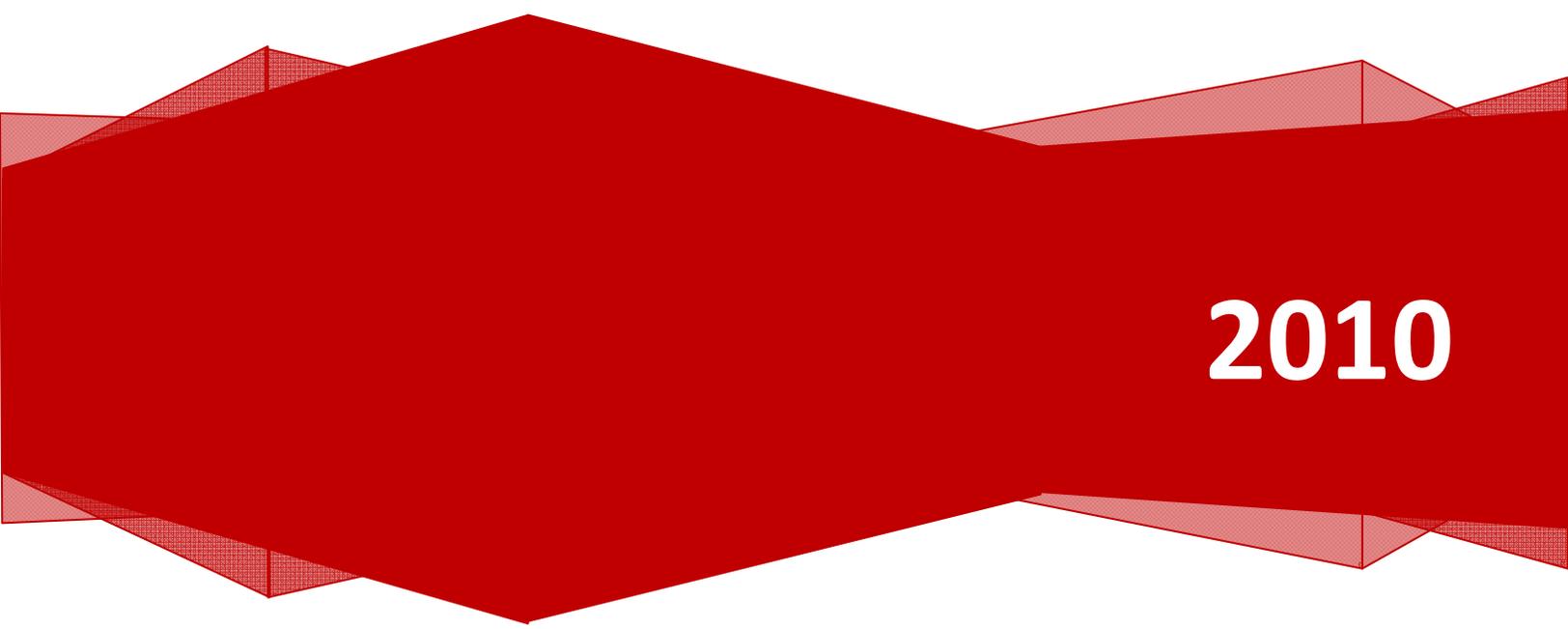


The Ohio State University South Centers

Ohio Aquaculture Industry Analysis

The Ohio Department of Agriculture



2010

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I. Executive Summary

The Ohio aquaculture industry represents less than one percent of the food fish (.14 percent) and less than one percent of crustacean sales (0.10 percent) in the United States (USDA, 2005). Ohio is a very small competitor in the national industry, and production rates do not meet current market demand. This positions the Ohio aquaculture industry for significant growth potential within the state and national markets. This study identifies the current Ohio aquaculture industry barriers, production methods, marketing strategies, and provides recommendations for acceleration of Ohio's aquaculture industry. When predicting industry growth, industry leaders estimate it will take five years to ten years in order to see a significant growth pattern or advancement. The growth timeframe depends on the acceptance of the various recommendations and implementation period.

The contents of this detailed report identify the following barriers and industry recommendations.

Identified Barriers:

- Access to capital
- Knowledge deficit
- Fingerling production and supply
- Marketing
- Genetic advancements and technology access

Recommendations for industry advancement:

- Loan guarantee program
- Educational programs and links to technology
- Pilot indoor recirculating system facility
- Alignment with current Ohio marketing programs
- Aquaculture industry informational packet
- Cooperative formations for distribution and processing facilities

Ohio's aquaculture industry is prime for growth. The current industry position is similar to the swine and poultry industries thirty years ago. If significant efforts are made to assist the acceleration of the Ohio market, it can be assumed that successes similar to the swine and poultry industries will be realized for aquaculture.

The Ohio grocers and current Ohio aquaculture production operations participated in information gathering activities used within this document. The Ohio Department of

Agriculture conducted an aquaculture producer survey by meeting 36 current producers on-farm. For the market analysis, The Ohio State University South Centers conducted phone interviews with Ohio grocers. The results are summarized within this document and full product results are listed in the appendix. These results assisted with the formulation of recommendations for this project.

The Ohio aquaculture industry needs significant assistance to reach full potential. With the appropriate partnerships, programs and willing entrepreneurs, Ohio could conceivably become an aquaculture production leader in the mid-west.

II. Aquaculture industry overview

National Policy (from the National Aquaculture Act of 1980):

"Congress declares that aquaculture has the potential for reducing the United States trade deficit in fisheries products, for augmenting existing commercial and recreational fisheries, and for producing other renewable resources, thereby assisting the United States in meeting its future food needs and contributing to the solution of world resource problems. It is, therefore, in the national interest, and it is the national policy, to encourage the development of aquaculture in the United States."

Aquaculture in the United States is a diverse industry which includes production of a variety of fish, crustaceans, mollusks, and plants. There are five principal aquaculture fish species in the U.S. (catfish, trout, salmon, tilapia, and hybrid striped bass) and two categories of non-food fish production (baitfish and ornamental fish) (USDA 2005)

Further development of the U.S. aquaculture industry is in the national interest. The Department of Commerce projects that, based on the current rate of population growth, U.S. seafood needs will increase by more than 1.4 million metric tons, round weight, between 1990 and 2025, if per capita consumption remains constant. Most of the United States demand for seafood has been met by overseas production. Although the U.S. is the world's largest exporter of seafood, it is also the second largest importer.

In the United States and throughout the world, natural commercial fisheries stocks are threatened. Many commercial stocks are now fully exploited, overexploited, or depleted. Most scientists agree that the natural fisheries are being harvested at or above their maximum sustainable yield. A consensus is developing that only a dramatic increase in aquaculture can supply increased demand for seafood. Worldwide seafood demand is projected to increase over 60 percent as projected world population grows from 5.3 billion to 8.5 billion by 2025.

With stable or declining harvests from capture fisheries, farm-raised aquaculture production would have to increase five-fold from present levels to supply the global demand for seafood. The United States has an important opportunity to develop an aquaculture industry to serve national needs in a global marketplace. As the domestic industry develops, it can meet the consumer demand for seafood and aquatic resources with high quality, safe, wholesome, and affordable products produced in an environmentally responsible manner with maximum opportunity for profitability in all sectors of the industry. The continued growth and competitive position of the U.S. aquaculture industry in a global marketplace will be directly related to the resources invested in research and technology development. The major research needs and opportunities for aquaculture are not unlike those of other agricultural commodities;

however, the state of the science may not be as well advanced. The diversity of species cultured and of production systems employed presents added challenges for aquaculture's future research agenda. (Joint Subcommittee on Aquaculture, 1980)

III. Current Ohio aquaculture industry

A significant opportunity exists for the state of Ohio and its aquaculture producers to play a critical role in the acceleration of the industry and satisfy the increased demand forecasts. The research indicates that there will be an increase in demand for U.S. based food products, and projections indicate a there will be a decrease in our import reliance.

The Ohio aquaculture industry must change drastically in order to play a more significant role in the U.S. domestic and export markets for aquaculture food products. Several barriers to market entry exist, as well as a lack of structured assistance for the producers. Ohio has several producer organizations that operate independently from each other, which creates a communication barrier between producers. A central hub for new producers or existing producers to gain assistance is also absent. This lack of structure creates a significant barrier for a unified Ohio industry.

A profile of the typical Ohio aquaculture producer reflects a white, male in his fifties. Farming is not his primary occupation and he is usually employed in a full-time job off the farm. More than half of Ohio aquaculture producers do not belong to an aquaculture association. Ohio aquaculture producers occasionally use the internet to obtain aquaculture production information, although over three-fourths report having access to the internet (Tiu, 2010).

Ohio aquaculture production and sales data

Year	# of Producers of Recreation and/or Food Fish	Gross Annual Sales
1990	33	1302000
1998	33	1788000
2002	100	338000
2005	55	3185000
2007	140	6600000

Production and sales data has been challenging to collect for Ohio. Aquaculture has not been included in the State of Ohio Agriculture Census. The only data available were from the two existing Census of Aquaculture reports in 1998 and 2005, and the last two National Censuses of Agriculture in 2002 and 2007. The Census of Aquaculture data numbers likely underestimate the number of aquaculture farms and total aquaculture sales in Ohio, as there were

approximately 200 licensed farms in 2005, but only 55 farms reported production data during the year (Tiu, 2010).

According to a 1990 survey of Ohio aquaculture producers, there were 33 aquaculture producers growing both recreation and/or food fish who reported a combined gross annual sales of \$1,302,000 (Hushak, 1993). In the 1998 Census of Aquaculture, Ohio aquaculture producers reported \$1,788,000 in combined sales (33 reporting). In the 2002 Census of Agriculture, there were 100 Ohio aquaculture producers reporting \$3,338,000 in combined sales. In the 2005 Census of Aquaculture, 55 aquaculture producers reported sales of \$3,185,000. In 2007, 140 Ohio aquaculture producers reported \$6.6 million dollars in sales (NASS, 2009). Two-thirds of Ohio Aquaculture producers report annual aquaculture sales of less than \$10,000, while 5 percent reported sales in excess of \$500,000 (Tiu, 2010).

Barriers to Ohio industry acceleration

Restricted capital and income from business: A barrier to many innovative aquaculture production plans is access to capital. The average annual sales from the industry do not sustain a growth strategy or allow significant cash flow to sustain a business. Many traditional capital sources are hesitant to lend to livestock-based entities, mainly due to collateralization issues and death loss. It is difficult for industry entrance or growth without significant access to both debt and equity financing options for start-up and expansion opportunities. Because of this lack of capital, many prospective producers have not entered into production, and current aquaculture entities have not expanded.

Knowledge deficit: As with many industries a lack of technical or applied knowledge in the industry is a barrier. Many Ohio producers struggle with what would be considered basic principles of aquaculture. Therefore, the lack of knowledge, or, limited knowledge, is a barrier to their success. Some areas of importance for educational focus include water quality/water chemistry, fish nutrition, and aeration. There is a lack of understanding of basic water chemistry. Producers are often not knowledgeable about the best fish feeds and often do not have access to these. Producers often do not know the critical need for providing supplemental air/oxygen to the ponds, do not know what type of aerator works best for their operation, or have been given erroneous information on what aeration equipment does and does not do.

Fingerling production and supply: Access to reliable fingerlings is a necessity for the advancement of the aquaculture industry. While this is a weakness for the Ohio industry, it is also an opportunity. The industry will need to address this barrier in order to successfully advance the production outcomes.

Marketing: As with many businesses, marketing is a gap in delivery and a key to success. Aquaculture marketing has barriers within itself, but there are also significant opportunities for locally grown initiatives. The current Ohio aquaculture industry is in need of alignment with

current marketing tactics and initiatives as well as creation of an industry specific initiative and resource.

Genetics: Ohio has limited domesticity of some of the most commonly raised fish, or, inferior strains are being passed off to Ohio producers as “top quality” fish. These fish fail to perform adequately and fail to get a majority to market size in a profitable time frame. An increase in accessibility to genetically improved fingerlings will significantly improve our Ohio industry outcomes and production rates.

Regulations: Aquaculture is a highly regulated industry. An average producer has problems with regulation distinction as it pertains to their farm operations. One regulation imposing a significant impact on Ohio is the USDA-APHIS restrictions on movement of fish from the Lake Erie that have put undue economic hardship on Ohio fish producers. From 2006 to this current date, fish producers must have VHS testing done for any lot (group) of fish that they want to sell live across state lines. This disease is a currently an issue limited to wild fisheries. The costs associated with this regulation are impacting the industry’s ability to grow. One lot (group) of fish requires 60 fish be sacrificed and sampled. Cost ranges from \$600 to \$1,500, this can be up to 20 percent of the total sale of the group of fish. (Tiu 2010)

Access to technology: According to a recent study/polling of the Ohio aquaculture industry by Dr. Laura Tiu, Aquaculture Specialist at The Ohio State University South Centers, aquaculture producers preferred to get their information via newsletters and mail. Many are either not computer/internet/email users, or don’t want to be. Additionally, our state has a significant number of Amish fish producers who do not use electronic technology. This trend for information gathering poses a significant barrier to information dissemination between researchers and producers. There is a communication linkage necessary between the two groups to bridge the gaps of services and address industry concerns (Tiu, 2010).

Access to raw materials or equipment: An adequate supply chain for the Ohio aquaculture industry is absent. Access to fingerlings, fish food, aerators, buckets, nets, etc. is a barrier to market entry and establishment success. Establishment of an adequate supply chain industry for sustainability is necessary for advancement. (Tiu 2010)

Industry information: The aquaculture industry is hindered by lack of information collection due to incomplete or inaccurate census data. The Census of Aquaculture conducted under the national census data numbers likely underestimate the number of aquaculture farms and total aquaculture sales in Ohio, as there were approximately 200 licensed farms in 2005 (Ohio Division of Wildlife aquaculture permit list), but only 55 farms reported production data to the Census of Aquaculture during the year. (Tiu 2010)

These identified barriers to advancement of the industry are obstacles that can be overcome. Recommendations for resolutions and solutions to barriers are identified within this strategic plan.

IV. Ohio aquaculture production analysis

Ohio aquaculture production review and recommendations

The purpose of this production review is to study the production aspects of the Ohio aquaculture industry. The three main areas focused on are as follows:

- The state of Ohio’s aquaculture industry as compared to the rest of the United States.
- A comparison of the aquaculture industry as compared to the poultry, beef and swine industries.
- A summary of the production costs and processes which are used to produce yellow perch, tilapia, large mouth bass, sunfish and freshwater prawn.

By focusing on these areas, it will be possible to determine strengths and weakness in the production practices and identify specific aspects of the industry which need to be improved.

Ohio aquaculture versus the rest of the United States

Ohio currently produces 0.14 percent of the food fish and 0.10 percent of the crustaceans (shrimp) nationwide (USDA, 2005). This is an extremely small percentage especially when considering that Ohioans consume over 100 million pounds of fish and seafood per year (USDA, 2010). From 1998 to 2005, Ohio production has increased by 30 percent while nationwide the production over the same period decreased from 692 million to 672 million dollars worth of production (USDA, 2005).

Given recent trends, the state of Ohio has ample opportunity for aquaculture production growth. Included in this study is data for yellow perch, tilapia, bass, sunfish and shrimp (fresh water prawns). These numbers are summarized in Table 1. The largest of this group by sales in Ohio is yellow perch. This is expected, due to Lake Erie Perch sales. The only other species with higher sales in the state is trout. Four of the five species have increased in sales from 1998 to 2005. Sunfish were not reported on the 2005 Census of Aquaculture (NASS, 2005).

Table 1. Ohio production by species based on the 2005 Census of Aquaculture (USDA, 2005)

Year		Yellow Perch	Tilapia	Bass	Sunfish	Fresh Water Prawn
2005	Farms	25	4	4	N/A	7
	Sales	222	N/A	62	N/A	55

	(\$1,000)					
1998	Farms	N/A	1	3	N/A	3
	Sales (\$1,000)	N/A	N/A	N/A	N/A	N/A

Another important factor in determining the direction of Ohio aquaculture is production methods. To have a consistent year-round supply, indoor recirculating systems are necessary. Of the 55 Ohio farms in the 2005 Census of Aquaculture (Table 2), 85 percent used pond systems, and 27 percent reported utilizing recirculating systems. These figures indicate that some farms utilize both methods of production. Most of these farms raise yellow perch, tilapia, bass, sunfish, and fresh water prawn, and only have an 8-month growing season due to Ohio’s cold winters. In comparison, Mississippi has a year-long growing season and produces 37 percent of the food fish in the United States (USDA, 2005). This production comes from 403 farms, of which 401 farms use a pond system and 5 use recirculating systems. For Ohio to match the production of southern states like Mississippi, indoor systems must be incorporated into the operation.

It should be noted however, that Ohio utilizes more recirculating systems (27 percent vs. 5 percent) than the average of the top five states (Table 2). This would be expected, because the top five aquaculture producing states are in much more temperate climates. This data also indicates that there is recognition by Ohio producers that indoor systems are necessary to accelerate industry growth and to be competitive in the national market.

Table 2. Ohio production and methods vs. the top five aquaculture production states by number of farms based on the 2005 Census of Aquaculture (USDA, 2005)

State	Sales (\$1,000)	Total Aquaculture Farms	Farms Utilizing Ponds	Combined Pond Acreage	Farms Utilizing Recirculating Systems	Combined Volume of Recirculating Systems
Ohio	978	55	47	576	15	431,150
Alabama	100,391	215	209	3,632	4	83,400
Arkansas	82,595	211	207	6,756	8	381,100
Florida	3,641	359	166	10,437	61	3,730,757
Louisiana	NA	873	293	2,312	6	N/A
Mississippi	248,466	403	403	9,963	5	954,000

Table 3. Ohio production and methods vs. the five neighboring states by number of farms based on the 2005 Census of Aquaculture (USDA, 2005)

State	Sales (\$1,000)	Total Aquaculture Farms	Farms Utilizing Ponds	Combined Pond Acreage	Farms Utilizing Recirculating Systems	Combined Volume of Recirculating Systems
Ohio	978	55	47	576	15	431,150
Indiana	N/A	18	N/A	443	8	181,500
Kentucky	2,341	65	256	548	9	154,200
Michigan	2,398	34	163	320	3	N/A
Pennsylvania	8,951	56	658	497	11	1,011,970
West Virginia	1,145	21	96	41	3	N/A

Fish and shell fish production as compared to poultry, swine and beef

To see the changes in meat and fish production over time in the United States, a historical comparison of poultry, pork, beef, and fish production is needed. This should help to give a view of where aquaculture might focus its growth.

By examining the production calculated on a per capita basis, the effect of population growth is eliminated. Per capita consumption of fish in the United States is 16 pounds per person (USDA, 2010). The per capita production of poultry, swine and beef are 82.9, 48.9, and 64.1 pounds respectively (USDA, 2010). A look at the history of the production of the three species tells a dramatic story however. In 1941 the production of pork was actually the highest at 64 pounds followed by beef at 49 pounds and poultry at 16 pounds. In 1961 poultry had nearly doubled its production per capita to 30 pounds, while beef production increase by about 30 percent and pork actually fell in per capita production. By 1991 per capita production of poultry doubled again (62 pounds) beef remained the same and pork decreased again to 50 pounds per capita retail (USDA, 2010). This means from 1941 to 1991 that poultry production increased by 13.6 billion pounds as compared to 10.2 billion pounds for beef and only 4.1 billion pounds for pork (table 3).

Table 4. Pounds (in billions) of U.S. retail production by species from 1941 to 2008. (Obtained by multiplying per capita production by the population for the given year.)

Year	Poultry	Beef	Pork	Fish
1941	2.1	6.5	8.5	1.5
1951	3.4	7.2	10.5	1.7

1961	5.5	12.1	10.3	2.2
1971	8.3	17.4	12.7	2.5
1981	11.2	17.7	12.4	3.7
1991	15.9	16.7	12.6	3.8
2001	21.9	18.8	14.2	4.2
2008	25.5	19.4	14.8	4.9

***this was figured by multiplying per capita production by the population for the given year**

The reason for the dramatic increase in poultry production was two-fold. From 1941 to present-day, poultry went from being produced in small quantities in outdoor systems to large, climate-controlled production units owned by large vertically integrated poultry farms (Boyd, 2001). This allowed for the production of more pounds at reduced production costs. Second, in the late 1970s to early 2000s poultry was perceived as a leaner and healthier alternative to beef or pork. These drastic changes in production practices and perceived health benefits combined to propel poultry production to the current status

Efficiency and production increases in poultry

Some of the most dramatic improvements to any of the species (poultry, beef or pork) are the increases in feed efficiencies, growth rates and carcass size. This point is important to discuss for the purpose of showing the potential production efficiency that could take place in aquaculture.

Growth, carcass size and feed efficiency have greatly increased over the last 50 years (Havenstein et al, 2003) in the poultry industry. In 2001, Havenstein (2003) compared the production traits of broilers from 1957 and 2001. A broiler genetic line from 1957 was compared to broiler genetic line from 2001. Each genetic line was fed a 1957 and a 2001 ration. The results on body weight and hot carcass weight are summarized in Table 4.

Table 4. Effects of genetic selection and feed ration on body weight and hot carcass weight at various ages (Havenstein et al, 2003)

Strain	Diet	Body Weight				Hot Carcass Weight			
		42d	56d	70d	84d	43d	57d	71d	85d
2001	2001	2672	3946	4808	5520	1926	2814	3552	4215
1957	1957	539	809	1117	1430	322	480	684	911
2001	1957	2126	2984	3844	4480	1460	2114	2775	3355
1957	2001	578	886	1226	1611	360	534	767	1031

*** Body weight is reported in grams**

As can be determined from these results, growth rate regardless of feed ration was greatly increased because of the difference in genetic line. The 2001 line fed the 1957 diet was 33 percent (696 grams) heavier at 42 days than the 1957 line fed the 1957 diet at 84 days. The researchers in this study estimated that it took the 2001 line 32 days to reach 1815 grams while they estimated that it would have taken the 1957 line 101 days to reach the same weight. The feed conversion at this weight would have been 1.46 for the 2001 strain, versus 4.46 for the 1957 strain. Thus, the 2001 line could reach the 1815 grams in one third the days with a third less feed, with most of the improvement attributed to genetics (Havenstein et al, 2003).

With the largely unimproved genetic lines (Brown et al, 2007) in the aquaculture species in this study, there is a huge amount of improvement that could be made in a short time, considering the short genetic interval and high reproductive rate. Through genetic selection for the appropriate traits, as with the poultry example, costs could be significantly reduced and production could be dramatically increased.

Current production expenses in aquaculture

The species reviewed in this section are yellow perch, tilapia, sunfish, largemouth bass and freshwater prawn. This section will give cost of production projections for each of these species and will give a general budget for fingerling production. There will also be a discussion on areas to focus for reduction of production costs.

After reviewing publications on the production costs associated with yellow perch, tilapia, largemouth bass, sunfish and freshwater prawn, total costs of producing a pound of these types of fish to market size varies from \$1.97/lb pound to \$4.32/lb (Table 5).

Table 5. Production cost budget, per pound of live fish produced (Dasgupta, 2007; Kentucky State University, 2009; Lutz, 1998; Malison and Held, 2008; North Carolina Department of Agriculture and Consumer Sciences, 2001; Woods et al, 1998)

Variable Costs	Yellow		Large Mouth		
	Perch	Tilapia	Bass	Sunfish	Prawn
Fingerlings (juveniles)	2.25	0.26	0.79	2.51	1.60
Feed	0.24	0.41	0.80	0.91	0.58
Chemicals	0.01	0.05	0.02	0.02	0.01
Electricity	0.06	0.28	0.29	0.06	0.20
Maintenance	0.06	0.06	0.01	0.09	0.01
Operating Interest	0.09	0.03	0.05	0.10	0.06
Labor	0.06	0.13	0.07	0.15	0.19
Total Variable Costs	2.77	1.22	2.03	3.84	2.65
Payment of Land and Building	0.17	0.33	0.03	0.47	0.03
Payment on Equipment	0.00	0.33	0.09	0.00	0.09
Taxes and Insurance	0.02	0.09	0.12	0.01	0.05
Total Fixed Cost	0.19	0.75	0.24	0.48	0.17
Total Costs	2.96	1.97	2.27	4.32	2.82

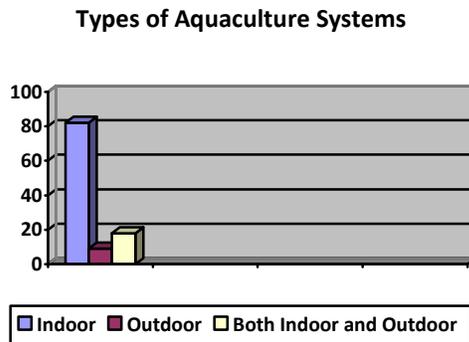
***The budget for the yellow perch, large mouth bass, sunfish and freshwater prawn are for pond systems. The tilapia budget contains figures for an indoor recirculating system.**

The vast range in production costs makes it difficult to be confident in these numbers. For this reason it was also determined to request that Ohio Producers complete a production survey to have a more realistic idea of production costs for recirculating systems.

Aquaculture production survey

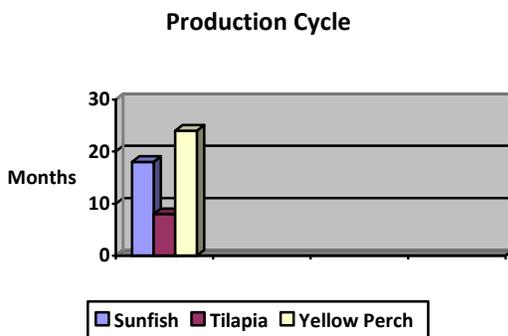
Lindsey Mandau, Aquaculture Coordinator for the Ohio Department of Agriculture conducted a producer survey of (#) aquaculture producers throughout Ohio. Producers were surveyed about the species of fish raised, production practices, and the types of systems utilized, production costs, feed conversion, and marketing.

Eighty-two percent of the respondents use an outdoor pond system, 9 percent reported utilizing indoor systems, and 18 percent indicated that they utilize both outdoor ponds and indoor systems for their aquaculture enterprises.



The pounds of fish produced per farm annually ranged from 500 to 100,000 pounds of sunfish with an average market weight of .5 to 1 pound each. Farmers raising tilapia reported producing from 4,000 to 100,000 pounds annually, with an average market weight of 1.5 to 2 pounds each. Yellow perch averaged .33 pound at market weight, with 50 to 30,000 pounds produced per farm annually.

The average cost of fingerlings varied from \$0.06 to \$0.45 for per fingerling sunfish, \$0.12 to \$0.20 per fingerling for tilapia, and \$0.05 to \$0.10 per inch for yellow perch. Sunfish are stocked at 10,000 per acre, tilapia are stocked at 1.1 lb. /gallon (indoor Recirculating Aquaculture System), and yellow perch are stocked at 10,000 per acre. The production cycle ranged from 8 months to 2 years, depending on the species.



Utility costs ranged from \$700 to \$30,000 per year. Producers reported that feed prices ranged from \$0.42 to \$1.00 per pound. Most producers fed Silver Cup and Purina brand feeds.

The ranges of reported average feed conversion ratios were as follows:

- Sunfish 1.8:1 to 1:1
- Tilapia 1.5:1 to 1:1
- Yellow Perch 1.5:1

All respondents reported that they market some amount of live fish. Four respondents have retail product sales, and four sell their fish wholesale.

The results verify a wide range in production costs with varying production practices and minimal production data. For this reason, the production cost budget numbers from Table 5 are the most accurate.

The production cost budget (Table 5) gives the best guide to determine where improvements in production need to be made. In pond-raised species, the highest costs are associated with the purchase of fingerlings and feed. The cost of fingerlings accounted for 60 percent of the total cost of the four species with feed costs taking up 20 percent of the budget. However, with tilapia raised in indoor recirculating systems, the largest cost (34 percent) was the land, buildings, and equipment that are needed to raise the fish. This cost is followed by feed costs at 21 percent of the budget. Therefore, the three main cost areas which need to be reduced are fingerling, feed and the fixed costs of land, buildings and equipment.

Reducing the costs of fingerling production

After much research, there was only one budget found related to fingerling production. This budget is for yellow perch fingerlings. The budget is summarized in Table 6. This budget clearly shows how much the cost of producing a fingerling varies depending on the survival rates. As seen in Table 6, the cost of fingerlings greatly varies and verifies that the cost of fingerlings can be greatly reduced by improving survivability.

Table 6. Fingerling production budget for indoor spawning system with various survival rates (Wallat et al, 2005)

	Survival Rate		
	17 percent	50 percent	80 percent
Total Variable Costs/Fingerling	0.14	0.05	0.03
Total Fixed Cost/Fingerling	0.16	0.05	0.03
Total Costs/Fingerling	0.30	0.10	0.06

To reduce the cost of fingerlings, two avenues need to be pursued; fingerling production on-farm and reduced mortality of the fingerlings purchased. A budget for fingerling production follows in the fingerling production section. Reviewing the projected numbers, the survivability of the fingerlings (or juveniles) ranged from 25 percent for the sunfish (Borisova, 2009) to 80 percent for the tilapia (North Carolina Department of Agriculture and Consumer Sciences, 2001). The highest mortality was in the pond systems where the fingerlings have no protection and their well-being cannot be monitored. In contrast the indoor tilapia system allows for monitoring of the fish at all times and protection of the fingerlings from predators.

Producers need to examine ways to reduce the costs of fingerlings. In addition to on-farm production, the opportunity for cooperative fingerling production can be explored. This is an area where an organized cooperative to produce fingerlings could help reduce the cost to the producer.

Fingerlings for numerous farms could be raised cooperatively on one farm. Or, a simple purchasing cooperative could be formed for the farms to purchase their fingerlings together from one provider in order to get a better price per fingerling. Additionally, fingerling mortality rates in a recommended indoor system should drop due to the lack of predators.

Feed cost

The reduction in feed costs should be addressed in two ways. In Ohio, this could be done by first encouraging more Ohio feed mills/suppliers to make feed available for aquaculture. According to Ohio's aquaculture producers, a large portion of the feed for Ohio's aquaculture comes from out-of-state. Feed costs and costs of trucking the feed from out of state could potentially be reduced with the formation of an aquaculture feed purchasing cooperative. This cooperative, along with Aquaculture Specialists from The OSU South Centers, could work with an Ohio-based feed mill to develop unique feeds for various aquaculture needs.

The other area to focus is on the conversion of feed consumed by the fish to market weight. As has previously been discussed, genetic selection has been proven to make large improvements in efficiency. An aquaculture genetic selection program focusing on feed efficiency could accomplish results similar to those of poultry and swine. For example, if the feed conversion of sunfish was reduced by two thirds (like in the previous example of the poultry) then the total cost of feed would be reduced by \$0.60 per pound.

Fixed costs of the land, buildings, and equipment

The reduction of these costs can be accomplished in two ways. The first is by developing a common production system which can be used by all producers. This would allow for

improvements in building efficiency and allow for the production and purchase of equipment in mass quantities (similar to poultry and hogs). The second is through genetic selection. The time on feed to market weight ranges from 8-24 months, depending on the species. If through improvements in genetic selection, the time it took for each species to reach market weight were reduced (as with the poultry example) the fixed costs would also be reduced. For example, if tilapia were ready for market in 6 months instead of 12, allowing for additional months of production, then the fixed cost could be reduced from \$0.75 to \$0.37/lb.

Production recommendations summary:

1. Improve fingerling survivability (fingerling cost), feed efficiency (feed cost) and growth rate (reducing fixed cost) by initiating an intensive genetic selection program.
2. Reduce feed costs by developing local feed production.
3. Reduced fixed cost by developing standardized indoor facility design.

V. Ohio aquaculture marketing analysis

To explore the marketing of aquaculture products in Ohio a list of retailers/groceries by North American Industry Code Selection (NAICS) code were generated by county. Grocery stores were then randomly selected from those respective counties. Some counties didn't show any grocery stores through the NAICS code list that currently sold fish. The initial list covered 54 out of the 88 counties (61percent) and 66 total retailers in those counties. A survey was then administered to those retailers. After all surveys were completed, we were able to obtain results from 44 out of the 88 counties (50 percent) and with 51 total retailers participating from those counties, equaling a 77 percent return rate for surveys attempted.

The list included most of the major chain groceries in the state of Ohio including Kroger, Giant Eagle and Whole Foods, as well as smaller groceries including Foodland, Save-A-Lot, IGA, Sheetz Inc., Buehler Food Markets, Town Market, Norwalk Cardinal and Hawkins.

When asked to list the top species of fish that they sell, the following potentially Ohio-raised species were sold by the largest percentages of stores:

Type of fish/shrimp	Percent of stores surveyed listing this species as a top seller
Tilapia	92.16%
Shrimp (all varieties)	90.20%
Perch (all varieties)	68.63%
Catfish	66.67%

Seventy-five percent of stores surveyed indicated that they sell 250 pounds or less of fish per week. Freshness, quality, and supply consistency were rated as the most important factors when purchasing fish/shrimp. When assured availability and quality, tilapia, prawn, and yellow perch were rated as the Ohio-raised species the stores would most likely be interested in stocking. Overall, comments from grocers were positive regarding their willingness to stock/sell Ohio-raised fish.

Ohio marketing study analysis

Through our research conducted with the Ohio retail market industry, several realizations were discovered. This study should be an indicator of the focus species for the Ohio producers and indications of potential market demand. From the retail market survey some overall themes are evident as follows:

1. A significant increase in supply is required to meet the market demand.
2. There is significant interest in Ohio-raised aquaculture products including a significant interest in Ohio raised prawns (shrimp). Given the most recent Gulf disaster, this is an opportunity to establish a supply chain substitute in this market area. The prawn demand is significantly higher than the current Ohio supply.
3. This should be a focus for a recirculating system product within the state so the market demand can be met.
4. The current most popular species sold that can easily be farm-raised include: tilapia, shrimp, perch, and catfish. Additionally, when asked if assured availability and quality, the following Ohio-raised species were identified as the most marketable: tilapia, shrimp, and perch.
5. Significant interest is apparent in Ohio aquaculture products, however In order to meet the supply and demand of the market, processing and distribution strategies on a larger scale are required.
6. The current producers in the industry need a stronger supply chain established in order to move their existing product.
7. A price point for the product needs to be established in relationship to other Ohio food products so the market place accepts the aquaculture products. The natural evolution

of price will evolve with the rise demand in relationship to supply, however an appropriate entry price into the market will have to be evaluated for successful market introduction.

VI. Ohio aquaculture industry strategic plan

The strategic plan portion of this study addresses the identified barriers within the Ohio aquaculture industry and supplies recommendations for state supported industry assistance initiatives and programs. The conclusions and recommendations outlined derive from the conducted industry research, knowledge of industry, evaluation of current environment and business strategy assessments. This plan provides a pathway for industry growth and acceleration. Additional assessments and research may be necessary to fully execute the recommendations.

One assumption that has been made throughout this process is that the existing producer market wants assistance and wants to grow their business operations. It is highly recommended that an assessment of the current producers is conducted to indicate if they want to grow out of a “hobby” operation and into a production operation on a larger scale. While all research indicates this is a prime industry for growth, the market demand is realized and capacity is available, if the entrepreneurs/producers are not willing to escalate into this larger spectrum of the industry, all recommendations and efforts to expand the industry will not be necessary.

SWOT Analysis

This analysis illustrates the apparent strengths, weakness, opportunities and threats that exist within the Ohio aquaculture industry, present and future.

<p>Strengths:</p> <ul style="list-style-type: none"> - Market interest for Ohio raised fish products - Opportunity for indoor system industry establishment - State of Ohio agency industry support - Industry is prime for growth - Nationwide market demand 	<p>Weakness:</p> <ul style="list-style-type: none"> - Current supply does not satisfy market demand - Lack of access to adequate fingerlings - Supply chain infrastructure is inadequate to meet large scale market distribution - Distribution and processing facilities are inadequate for large scale production - Current Ohio aquaculture producers are more "hobby" than established businesses - A significant capital investment is required for aquaculture business start-up - Currently, financial institutions view the aquaculture industry adversely due to the risk and undefined markets for the product - Statewide support organizations are loosely formed and lack structure - Marketing strategies for current or potential industry are weak
<p>Opportunities:</p> <ul style="list-style-type: none"> - Market demand for Ohio raised aquaculture products - Industry atmosphere will support indoor system implementations - US aquaculture industry is growing - Focus on local foods is strong within Ohio and a current focus of US in general - Farm raised products are increasing in demand - Aquaculture industry is a current focus of US in general - Farm raised products are increasing in demand - Aquaculture industry is positioned for growth similar to the past trends of the poultry or swine industries. - Genetics research is being conducted within the state - Ohio can become a leader in fingerling production, which is a nationwide weakness - Industry is prime for growth - Industry is optimal for cooperative formations to assist with industry advancement 	<p>Threats:</p> <ul style="list-style-type: none"> - Other states contiguous to Ohio are also focusing on this industry, Ohio needs to position for being a leader and first to market - Lack of entrepreneurial interest in indoor facilities and fingerling production businesses - Failure to establish a significant and adequate supply chain to support the industry growth with processing and distribution - Lack of cooperation between current and established famers to assist with industry growth and advancement - Financial industry's cooperation and willingness to address lending opportunities within this industry

Addressing identified industry barriers

Access to capital

Access to capital is an issue with many agricultural based industries or businesses. Traditional financing options are difficult to attract due to the collateralization opportunities within the aquaculture industry. Collateralization of stock and equipment is difficult for traditional financiers to justify due to the risk assessment with dead loss and lack of resale value on aquaculture equipment. Land is always an adequate source of collateralization, but many commercial loans require more than land value for acquisition of funds. In order to significantly grow and accelerate the Ohio aquaculture industry the access to capital issue needs to be resolved.

Recommendations:

- Create an Agriculture-based loan fund through a state supported industry
 - *The Ohio Department of Agriculture has completed and designated aquaculture as a signature focus of the new loan program.*
- The State of Ohio develop a “loan guarantee program” that covers the twenty-five to thirty percent gap in Loan to Value ratio that the traditional loan programs require in a collateralization value. This concept is similar to traditional business gap financing programs and the Small Business Administration loan guarantee program currently in place for traditional business ventures.
- Provide educational training to financing institutions about the aquaculture industry in correlation with the roll-out of the loan guarantee program. This industry is “unproven” when compared to traditional livestock ventures. Significant educational outreach to financing organizations will be necessary and vital to the success of producers accessing adequate capital.

Knowledge deficit and access to technology

Limited knowledge by entrepreneurs entering into the aquaculture industry is a barrier for growth. Insufficient information creates barriers for successful operations, livestock survival and regulation violations. Traditionally the Ohio based producers have engaged the aquaculture industry in a hobby fashion rather than a business venture opportunity approach. Adequate and continuing education of current producers and potential entrepreneurs will increase the supply of Ohio raised fish through more successful operation and new ventures into the industry. Adequate access to technology is an also an identified barrier to industry acceleration that can be addressed in conjunction with the knowledge deficit.

Recommendations:

- Development of a state-wide curriculum for new and emerging aquaculture farms in the areas of water quality, fish nutrition, and equipment. This curriculum and educational material should be available via the web through a series of podcasts, a CD delivery method, a series of semi-annual workshops, and a standard resource packet.
 - Multiple organizations such as ODA, Farm Bureau, and OSU should be involved with this curriculum delivery and educational initiative.

Aquaculture informational packet

Creation of a start-up packet for aquaculture producers will be a resource for growth and development for the Ohio industry. This should be readily available to new and existing producers at various locations; The Ohio Department of Agriculture, The Ohio State University South Centers and county Extension offices, Farm Bureau offices and any other partner outlets that current producers or potential producers may seek information on the aquaculture industry. This informational packet should be available in electronic and traditional formats, as Dr. Tiu identified in her research the aquaculture industry gathers and seeks information in different venues. This addresses the barrier of information access that the current industry is experiencing.

The packet should include:

- Start-up outdoor facility business plan template
- Start-up indoor recirculating facility business plan template
- Existing outdoor facility business plan template for growth financing
- Financial projections template documents
- Scientific data/recommendations on water quality, aeration systems and other identified issues that need addressed in regards to aquaculture facility operations
- Resource guide; listing of financing opportunities, assistance organizations, resources and access to additional information.

State-wide conference – a joint conference between The Ohio Department of Agriculture, Farm Bureau, The Ohio State University, The Ohio Department of Development and the two established Aquaculture organizations should be planned for 2011. The topics of this conference should include sessions on:

- Recirculating systems implementation
- Access to capital
- Access to fingerlings

- Aquaculture practices: water quality, aeration, filtering etc.
- Matchmaker session with retailer outlets to establish connections for product wholesale opportunities

The organization of this conference will assist with introduction to new practices, establish a farmer network of the producers and assist with identification of new producers. The matchmaker session will assist with establishing wholesale connections, a variety of identified retailers should be invited to communicate their product needs, volume, distribution avenues and facilitate connections with the producers.

Fingerling production and supply

Access to adequate fingerlings is a significant industry barrier. While this is a threat to the industry viability, it also presents an opportunity for industry growth. An entrepreneur can enter into the Ohio aquaculture supply chain as a fingerling producer and gain a significant market share in a relatively short time period.

- Educational outreach to the current industry and potential entrepreneurs on the opportunity of fingerling production could encourage the entrance of new vendors into this supply chain model. The feasibility study includes data about fixed and variable costs associated with fingerling production facilities.
 - A campaign to encourage entrepreneurs interested in the aquaculture industry to gaps in the supply chain should be considered. This campaign will include an educational packet about starting a fingerling production facility, business planning and financial assistance available for this venture.
 - Having access to adequate fingerlings within Ohio is a key factor to the industry acceleration and this aspect should be the initial and core focus of the execution of the Ohio aquaculture strategic plan.

Marketing

Marketing is a challenge for many industries and business sectors, this remains true for aquaculture producers and processors. Based upon data collected, a significant interest exists in the selling and consumption of Ohio raised fish and prawn, but with Ohio's current production rate, the demand cannot be met. While the supply and demand of the product must be calculated to fully implement a state-wide marketing plan, initial steps by producers can be taken to increase the opportunity for additional sales.

Recommendations:

- Utilize the current Ohio infrastructures for marketing of Ohio aquaculture products. Aquaculture enterprises should explore the current direct marketing channels and take advantage of the increase interest in local foods.
 - MarketMaker is a program that connects producers and buyers throughout the food supply chain. This can assist the aquaculture industry by providing access to additional outlets for sales and distribution. A campaign to encourage existing and emerging aquaculture producers to utilize this program should be included in future marketing efforts. The Ohio Direct Marketing Team can provide training and education for producers in this strategy.
 - Utilize Ohio based food promotion programs, such as Ohio Proud. Ohio Proud is a statewide branding effort used to designate Ohio-based products. Aquaculture producers through the state could take advantage of this program by selling their product with this well-known branding attached.
- When an adequate supply of Ohio aquaculture production is established to meet the demand of consumers, a state-wide supported educational program/campaign about Ohio raised fish should be launched in conjunction with existing agricultural based support entities. This campaign should target retailers, wholesalers for restaurants, and largescale opportunities, such as the identified grocers from the market survey. A cooperative formation for distribution and marketing is an option for execution of this recommendation. A successful marketing plan for Ohio's aquaculture producers to model after would be that of Ohio Signature Beef, a member-owned cooperative.
- An avenue for marketing and selling aquaculture products would be through Farmers' Markets. Farmers' Markets are multiplying throughout the state and are a known source for locally grown products. Aquaculture producers could capitalize on this market share by selling at markets. One potential constraint is the requirement for refrigeration units. The Farmers' Market Management Network recently issued a letter of opinion on storage regulations. These storage regulations are a barrier for some producers to sell at these markets that require refrigeration units. The Ohio Department of Agriculture can initiate an opinion to the Ohio Health Departments stating that coolers and ice packing are adequate methods for aquaculture products at Farmers' Market establishments, understanding that the local health departments have the authority to still require refrigeration units at these markets, the recommendation of coolers and ice may enhance probability of not requiring the units.

Genetics

Genetics enhancement and improvement is a focus for the aquaculture industry as a whole and significant research in this sector is being conducted by The Ohio State University. Market entrance is anticipated within two to three years. Barriers to new genetically enhanced strains

of fish are market entrance and acceptance strategies. While the university will have developed the technology, an outside entrepreneur will need to commercialize the new product. This process will be achieved through the university technology transfer process where and entrepreneur licenses the rights to the product

Recommendations:

- The state could provide assistance to the individual(s) willing to enter into this new venture in the form of loan guarantees, access to capital, assistance with state grant funding and additional support as necessary.
- The availability of new genetically enhanced fingerlings will assist with the closing the current gap within the Ohio aquaculture supply chain.
- A public/private partnership structure pilot facility may be beneficial to a new fingerling producer in this space.

Assess to raw materials or equipment

Access to appropriate raw materials or equipment is a barrier for growth within the Ohio industry. This is an illustration of a lacking supply chain within the current structure. In order to accelerate the industry not only are additional producers necessary but, additional supplier of aeration equipment, indoor recirculating system components, feed mills, fingerling production and other attributes necessary for operation.

Recommendations:

- Identify business needs associated with the industry. Host workshops across the state providing information regarding new business start-up or expansion opportunities in this space.
- Cooperative formations of producers for purchasing of these necessary items are also a method to overcome the access barrier.

Pilot Facility

Research has shown that a pilot growing/processing and distribution facility is necessary to prove that the aquaculture model can reach full potential in the state of Ohio. Because of the lack of access to capital, this pilot facility could be a joint venture between ODA and private industry. Existence of the facility would serve multiple purposes such as developing a supply chain and genetically enhanced strain of fingerlings, provide education and contacts to potential producers through data gathered from the initial growing cycle, and developing a market throughout the state. The facility should initially be centrally located within the state and should have four primary operating components:

- Indoor recirculating system
- Processing and distribution facility

- Marketing division
- Facility development division

Development of an indoor recirculating system growing method is recommended for several reasons. This system would allow genetically improved fingerlings to be produced in a controlled environment. The climate in the state of Ohio is not suited for year round growing seasons. States that lead the nation in aquaculture products generally have a much longer outdoor growing season than Ohio. This system will also allow for more accurate monitoring of feed programs. Developing the correct feed program while pairing with genetically enhanced fingerlings will expedite the growing cycle as demonstrated with poultry (Table 4). Exact feed costs per species will also be determined. If maintained properly, this system can greatly increase the survival rate, overall health and availability of the product.

As a second step, a processing and distribution facility must also be created. This facility should have the capability to process the product and either freeze and store the product or deliver to the end user. This facility would be responsible for developing a distribution strategy to ensure that demand for the product can be fulfilled. To maximize potential of the facility, a wholesale factor should be considered and the facility should be open statewide to aquaculture producers as a means of processing and distributing fish from individually owned farms throughout the state.

A marketing division must be present and should work hand-in-hand with the processing and distribution facility to create the demand for the product. A survey conducted by the OSU South Centers concluded that most grocers would carry and sell Ohio raised fish if there were a consistent supply of the product. This department will focus on the statewide demand for specific species.

A facility development division should be present to educate and potentially recruit investors for expansion of similar facilities into the four corners of the state.

The ownership structure for this type of venture could develop two ways. A completely private venture may not be desirable because if the pilot is a success, private investors would not be receptive to sharing information and trade secrets with other potential investors.

This facility could be cooperatively owned by producers throughout the state including leadership input from ODA. This structure presents interesting challenges as a board of directors would essentially be the decision makers, however input from producers or

educational institutions throughout the state must be considered. This also presents funding and operational sustainability challenges for the first harvesting cycle.

A joint ownership venture between public and private entities (ODA and private investors) could provide the best scenario for management and sustainability. With state leadership involved and proven success of a pilot facility, the expansion privately owned or cooperatively owned facilities into other areas of Ohio is more likely to happen.

Cooperative Formation

The Ohio Cooperative Development Center (OCDC) will analyze all data and determine the feasibility of cooperative formations for areas of the aquaculture industry.

Based on Table 5, production cost budget per pound of live fish produced, the greatest area of variable cost reduction impact would be with the purchasing of fingerlings and feed. A cooperative of many producers could negotiate a preferred vendor contract(s) to reduce this major variable expense. A cooperative could also investigate the shared use of land and facilities fixed costs. This could also have some impact on utility costs.

Table 5. Production cost budget, per pound of live fish produced (Dasgupta, 2007; Kentucky State University, 2009; Lutz, 1998; Malison and Held, 2008; North Carolina Department of Agriculture and Consumer Sciences, 2001; Woods et al, 1998)

Variable Costs	Yellow	Tilapia	Large Mouth	Sunfish	Prawn
	Perch		Bass		
Fingerlings (juveniles)	2.25	0.26	0.79	2.51	1.60
Feed	0.24	0.41	0.80	0.91	0.58
Chemicals	0.01	0.05	0.02	0.02	0.01
Electricity	0.06	0.28	0.29	0.06	0.20
Maintenance	0.06	0.06	0.01	0.09	0.01
Operating Interest	0.09	0.03	0.05	0.10	0.06
Labor	0.06	0.13	0.07	0.15	0.19
Total Variable Costs	2.77	1.22	2.03	3.84	2.65
Payment of Land and Building	0.17	0.33	0.03	0.47	0.03
Payment on Equipment	0.00	0.33	0.09	0.00	0.09
Taxes and Insurance	0.02	0.09	0.12	0.01	0.05
Total Fixed Cost	0.19	0.75	0.24	0.48	0.17
Total Costs	2.96	1.97	2.27	4.32	2.82

*The budget for the yellow perch, large mouth bass, sunfish and freshwater prawn are for pond systems. The tilapia budget is figures for an indoor recirculation system.

Based on Table 6 processing, marketing, and distribution cost budget per pound of live fish produced can also be a significant cost for determining the sale price of the product. A cooperative of many producers could negotiate preferred vendor contract(s) or establish common facility/service operation(s) to reduce this major expense.

Table 6. Cost budget, per pound of live fish produced (as calculated considering processing and yield loss)

	Yellow Perch	Tilapia	Large Mouth Bass	Sunfish	Prawn
Processing	\$4.61	\$4.41	\$3.91	\$10.46	\$3.45
Marketing	\$.21	\$.18	\$.17	\$.43	\$.18
Distribution	\$.15	\$.12	\$.12	\$.28	\$.12

The purpose of this project was to determine ways to develop Ohio as one of the leading states in the aquaculture industry. The benefit of this development would be providing more jobs and enhancement of aquaculture businesses in Ohio. As discussed earlier, a cooperative of many producers could negotiate preferred vendor contract(s), establish common facility/service operation(s), and network in many other areas to reduce operational costs/expenses. Also, it is likely that to increase production and have Ohio become one of the leading states in the aquaculture industry, there will be an increasing need for core business services to support more full-time staffing and business operational costs. A cooperative of many producers could also have a major impact in this area. Health insurance/plans, liability insurance, payroll, taxes, transportation, accounting, and legal are examples of expenses that would play a part in any successes towards this goal. Healthcare insurance/plans can be a very important business services which can be greatly impacted cooperatively using the power of large numbers and shared purchasing.

Core Business Services cost budget (Health insurance, retirement, liability insurance, payroll, taxes, transportation, accounting, legal, etc.) per pound of live fish produced

	Yellow Perch	Tilapia	Large Mouth Bass	Sunfish	Prawn
	\$.55	\$.55	\$.55	\$.55	\$.55

The research data validates the theory that a cooperative model is an appropriate strategy to help develop Ohio as one of the leading states in the aquaculture industry. The center will then provide assistance in cooperative formations. This includes one-on-one assistance, bylaw, committee and board formation assistance, and other assistance necessary for the cooperative formations.

OCDC's mission is to support improving economic conditions through the development of cooperative businesses and "cooperative like" groups. Types of cooperative purposes/activities/projects include:

- Producers
- Processing
- Marketing
- Education/networking
- Employee recruitment/hiring
- Training
- Services
- Ownership/shared equipment/facilities/services
- Purchasing
- Any other area that is a legal business in the state of Ohio

The OCDC's services are designed to assist new and emerging cooperatives with:

- One-on-One technical counseling
- Group technical support and strategic planning
- Bylaws and board development counseling/workshops
- Business/marketing plan development
- Business financial planning and funding procurement assistance
- Linkages to funding, grants, services, and resources
- Seed grants for start-up or implementation
- Training scholarships
- Incubator web sites development
- Facilitate cooperative-among-cooperatives linkages
- Feasibility studies

The OCDC is ready to meet with any group or association to explore or begin to form a cooperating in the aquaculture industry.

- Trial full scale production/processing/distributions facility
- Educational programming/state conference
- Work with contiguous states for product sales
- Market Maker

Summary

Significant opportunities are present within the industry and growth potential is evident. Willingness of producers and new entrepreneurs is the key to successfully accelerating the Ohio aquaculture industry. Partnerships between support organizations are necessary to execute the recommendations contained within this strategic plan. This industry could diversify many current operations that have experienced an economic downturn. In addition, additional business opportunities exist within the supply chain.

Additional business opportunities for the state include:

- Fingerling production facilities
- Feed mill facilities
- Facility construction
- Production suppliers
- Processing facilities
- Distribution facilities
- Indoor system suppliers

Formation of multiple aquaculture support businesses will be helpful with our unemployment rates within Ohio and also valuable economic development driver. The market suggests they are interested in Ohio raised aquaculture products; consumer demand and willingness of entrepreneurs to enter into businesses are variables at this time.

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Aquaculture Production Survey

Survey conducted by Lindsey Mandau

Aquaculture Coordinator, Ohio Department of Agriculture

1. Average cost of either producing or purchasing fingerlings?

Sunfish- \$0.06 to \$0.45

Tilapia- \$0.12 to \$0.20

Yellow Perch- \$0.05 to \$0.10 per inch

2. Indoor or outdoor system?

Indoor-9percent

Outdoor-82percent

Both-18percent

3. Pounds of fish produced per year by species?

Sunfish- 500 pounds to 100,000 pounds

Tilapia- 4000 pounds to 100,000pounds

Yellow Perch- 50 pounds to 30,000 pounds

4. Stocking density of the fish by species?

Sunfish- 10,000/acre

Tilapia- 1.1 lb/gallon (indoor RAS)

Yellow Perch- 10,000/acre

5. Death Loss?

No response

6. Kind of feed used?

Silver cup, Purina, Aquamax (a Purina product)
Prices were \$0.42 to \$1.00 per pound

7. Feed Conversion?

Sunfish- 1.8:1 to 1:1
Tilapia- 1.5:1 to 1:1
Yellow Perch- 1.5:1

8. Yearly utility cost?

\$700 to \$30,000 per year

9. Average marketing weight (live weight)?

Sunfish- .5 to 1 lb
Tilapia- 1.5 to 2 lb
Yellow Perch- .33 lb

10. Production cycle length (time from fingerling to marketing)?

Sunfish- 18 months
Tilapia- 8 to 9 months
Yellow Perch- 2 years

11. How do you market?

Live- all respondents market some amount of live fish
Retail- 4 respondents have retail sales
Wholesale- 4 respondents sell their fish wholesale

Ohio Grocery Store Marketing Survey

1. Is your store part of a chain?

	Number of responses
yes	44
no	2

2. Do you sell fish/shrimp (live, fresh, frozen, processed) in your store?

	Number of responses
yes	29
no	17

Notes:

No room, no plan on selling in future

Lobster Only, health dept. rules on shellfish, tanks needed

Have never sold, no tanks to sell live.

Have never sold, no plans to sell.

* Yes, Fresh, Frozen

Sell live lobster

* Yes, Fresh

3. List the top six species of fresh/frozen/processed fish/shrimp that you sell.

Type of fish/shrimp	Number of stores listing this species as one of their top species fish/shrimp sold	percent of stores surveyed listing this variety as a top seller
Tilapia	47	92.16 %
Atlantic Salmon	46	90.20 %
Shrimp (All varieties)	39	76.47 %
Perch (All varieties)	35	68.63 %
Catfish	34	66.67 %
Cod (All varieties)	30	58.82 %
Trout (All varieties)	8	15.69 %
Walleye	7	13.73 %
Tuna	5	9.80 %
Bass (All varieties)	3	5.88 %
Bluegill	1	1.96 %
All other species	22	43.14 %

4. What quantity of processed fish/shrimp do you sell per week?

	Number of responses
Up to 100 pounds	15
101pounds-250 pounds	18
251pounds-500 pounds	4
Over 500 pounds	3
Other**	1
Don't Know	3

Other Answers:

* 400 pounds.

**1500-2000 pounds

5. What period of the year do you sell fish/shrimp the most?

	Number of responses
Spring	13
Summer	5
Fall	5
Winter	12
No answer	22

Notes:

* More shrimp in winter

* Spring = Lent

6. How many suppliers of processed fish/shrimp do you have?

	Number of responses
1-2	12
3-4	11
More than 4	14
Don't Know	7

Notes:

* Whole Foods Facility

* Warehouse

* 7+

7. How important are these factors to you when purchasing fish/shrimp?

	Very Important	Somewhat Important
Price***	18	11
Supply consistency	19	10
Freshness	30	1
Origin**	7	20
Customer demand	19	10
Overall quality	28	3
Size		25
Longer Survival*	8	1

- * Lobster
- ** As long as not from China, good to go.
- ** Lake Fish
- *** Corporate determines

8. Do you currently sell Ohio or locally grown fish/shrimp?

	Number of responses
yes	14
no	26
Don't know	3

Notes:

- Yes (Walleye from Lake Erie)
- Catfish
- * Sell walleye when in season.
- yellow perch & walleye (must go through parent company)
- * Bluegill and Perch
- * Bluegill (doesn't do well)
- * Farm Raised Bluegill (x2)

8a. If yes, how much locally grown fish do you currently sell?

Percentage of total sales	Count
75 percent	1
50 percent	1
5-10 percent	2
20 percent	1
10 percent	2
<5 percent	1
5 pounds – 1 percent	1
5-10 pounds	1
Very Little	3

9. If you had a supply of Ohio grown fish/shrimp, would you be willing to sell the product?

	Number of responses
yes	35

no 0
 Maybe* 8
 * Depending on price, corporate management.

10. If you had a supply of Ohio grown fish/shrimp, how much space would you be able to provide in your store?

Space	Number of responses
3-5 Feet	1
Didn't know	4
4 Feet	1
1-2 Feet	2
5 Feet	1
2 Feet	7
2-4 Feet	1
Depends on frozen/bulk & how it's packaged	1
Price and Availability - Promote on periodic basis	1
8 Feet	2
8-16 Feet	1
1 Foot	1
2-3 Feet	5
3-4 Feet	1
3 Feet	3
As much space as demanded	2
Market in case	1
1 Row	1
1 1/2 Feet (corporate mandated)	2
Less than 8 feet	1
6-8 square foot	1
Case Space depending on Sale	1

11. If you were assured of availability and quality of the following species from Ohio, which of these live or processed fish would you buy?

	Yes	No
Yellow Perch	37	6

Tilapia	42	1
Bluegill & Other Hybrids	18	23
Large Mouth Bass	16	24
Prawn	40	1

Notes:

- * If it meets standards of Whole Foods Corp.
- * Education of prawn
- * Depends on owners
- * Would also sell Ohio Walleye

12. What specifications (i.e. antibiotics, hormones, production practices or lack thereof) do you think your customers would desire other than Ohio grown?

- Prefer to buy no color added or hormones.
- Everyone would rather have fresh, no additives.
- Lack of all the above.
- All natural; meets standards of Whole Foods.
- Antibiotic free
- Lack thereof
- They would like the non-antibiotic, hormone-free, etc.
- All the above. (x3)
- Would like to see no hormones, antibiotics, no additives.
- Few hormones
- Fresh (x2)
- Filletted for them
- Don't like to purchase whole fish.
- Don't like farm-raised, want wild caught fish.
- Nothing in particular
- None (x4)
- No preference (x2)
- Medications - food being fed.
- N/A Locally Grown
- Minimally processed, wild caught
- Organic, no hormones
- Antibiotics, hormones, production practices or lack thereof
- Ohio Grown would do it.
- Lack of hormones.
- More natural, none of the above.

Wild caught.

Don't want "farm raised", Customers prefer "Wild Caught"

13. Are there any other suggestions or comments about selling Ohio grown fish/shrimp in retail stores?

Good catfish species would be popular.

Chain market; must go through corporate office.

Thinks people would be willing to pay more for Ohio grown just like Ohio produce/organic.

People ask for the whole fish.

People like seabass.

A lot from other countries; customers would like to see more home grown; willing to pay more money for homegrown.

Supply chain consistency, quality, distressed product, consistent. Ohio grown - will pay more.

Make customers aware of/educate the customer.

Fresh fish suppliers (salmon)

Fresh, Availability needs to be there.

Seabass - Fresh Halibut; People ask for but sometimes price still scares them.

No, it's a good idea. (x2)

No (x3)

Lake Erie Fish

Wish the Kroger Co. would sell more Ohio grown fish products.

Would be a good thing.

Good! Get it Rolling!

Supply consistency (x3).

Competitively Priced.

Price to be competitive.

Live fish - sustainability

Make available, price point, job creation in Youngstown

Great idea. (x2)

Thinks it would be a great idea.

Keep cost down. Today's society and economy wants good quality @ low cost.

Would be good.

More advertisement

Seemed interested in Ohio Raised prawn. Surprised it was raised in Ohio.

Would be good to promote.

Quality (x2)

14. In this particular market, do you see an opportunity for a premium (higher priced) product? If so, what is it?

Not in this store. This is inner city.

Nothing particular.

No

Probably not.

Yes. Some ask where it comes from.

Not really

Ohio raised would sell better.

Store Names	City
Kroger	Delaware
Giant Eagle	Westerville
Kroger	Defiance
Whole Foods Mkt. Inc.	Cleveland
Giant Eagle	Strongsville
Kroger	Bucyrus
Giant Eagle	East Liverpool
Kroger	Blanchester
Kroger	Springfield
Kroger	Athens
Sheetz Inc.	Ashtabula
Giant Eagle	Geneva
ESG Stores LLC (Hawkins)	Ashland
Kroger	Cincinnati
Kroger	Mt. Vernon
Kroger	Toledo
Kroger	Hilliard
Kroger	Dayton/ Beavercreek
Kroger	Newark
Kroger	London
Kroger	Steubenville
Norwalk Cardinal	Norwalk
Kroger	Jackson
Kroger	Washington Court House
Kroger	Lancaster
Buehler Food Market	Wooster
Buehler Food Market	Medina

Town Market	Wooster
Buehler Food Market	Orrville
Buehler Food Market	Canton
Giant Eagle	Youngstown
Giant Eagle	Rootstown
Kroger	Portsmouth
Kroger	Urbana
Kroger	Amelia Station
Howell's IGA	New Breman
Giant Eagle	Elyria
Foodland	Gallipolis
Giant Eagle	Newark
Kaltenbach IGA Foods	Oberlin
Kroger	Findlay
Kroger	Dublin
Giant Eagle	Chesterland
Giant Eagle	Mentor
Kroger	Hillsboro
Kroger	Toledo
Giant Eagle	Regional
Giant Eagle	Medina