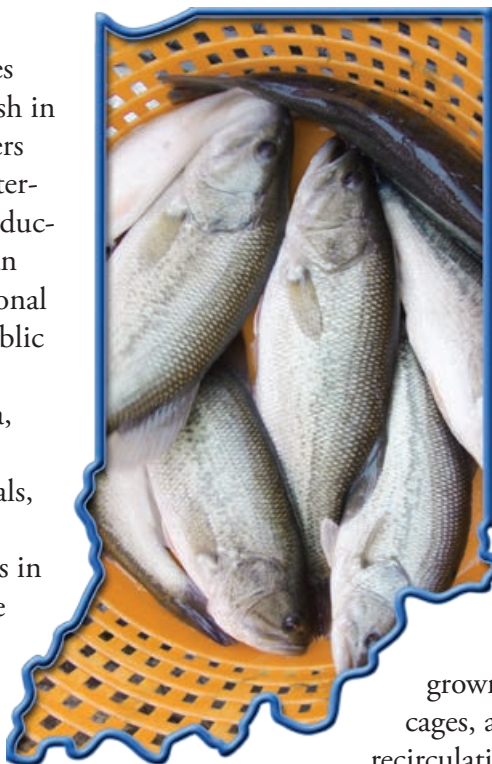


Economic Importance of the Aquaculture Industry in Indiana

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Abstract

Indiana's aquaculture industry ranges from small-scale producers growing fish in their back yards to large-scale producers growing fish to sell in national and international markets and includes the production of ornamental fish, fish for human consumption (food fish), and recreational fish that are stocked in private and public ponds and lakes. The types of fish produced include yellow perch, tilapia, baitfish, hybrid striped bass, marine shrimp, freshwater prawns, ornamentals, and trophy fish. Economic data was collected from a sample of fish farmers in Indiana in 2012 and used to assess the overall economic activities associated with the industry. The industry supports 280 jobs within the aquaculture industry and other supporting industries, 169 of which are direct jobs in the aquaculture industry. The industry generates \$3,731,842 worth of labor income and \$19,484,193 of added value. The value of output generated within the aquaculture industry is \$23,599,676 and a total value of \$37,892,895 with other supporting industries. A \$1.00 sale by the aquaculture industry results in additional local output of \$0.61, and for every direct job in the aquaculture industry, there is an additional 0.66 job in the local economy. For a \$1.00 increase in added value from the aquaculture industry, there is an additional \$0.62 increase in added value in the local economy.



Introduction

Aquaculture is a growing part of Indiana's agricultural economy, with estimated farm sales of over \$15 million, which is an increase from a farm sales value of about \$3.5 million (USDA-NASS, 2006). Indiana's industry includes the production of some major food fish and shellfish: yellow perch, hybrid striped bass, tilapia, trout, marine shrimp, and freshwater prawns. Some Hoosier farmers also produce sport fish such as catfish, largemouth bass, smallmouth bass, and sunfish/bluegill as well as ornamental fish for the aquarium industry. Fish are grown in ponds, flow-through systems, cages, and recirculating systems. Cages and recirculating systems are the most common production systems used in Indiana. Aquaculture growth in Indiana is buoyed by the state's proximity to major markets and the availability of the necessary production resources, including water and feed. Aquaculture production provides a ready local market for Indiana's corn and soybeans as commercial feed. Aquaculture also offers opportunities to utilize by-products from bio-fuel production such as soy meal and distillers dried grains for fish feed, industrial heat and hot water for indoor aquaculture, as well as aquaponics production. Thus, aquaculture supports rural economy and entrepreneurship.

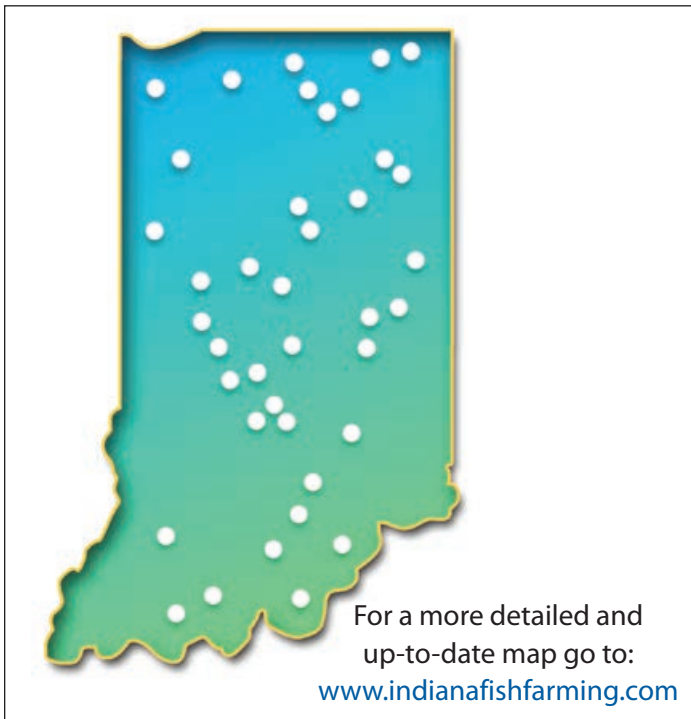
Figure 1. Location of Indiana Fish Producers

Figure 1 shows where the different fish producers are located in the state. The production facilities are located anywhere from the northeast to the southwest corners of the state. There were about 40 active fish producers in the state in 2012.

The aquaculture industry and allied industries affect Indiana's economy directly and indirectly. Through producers employing Indiana residents and the revenues generated from the production, the aquaculture has a direct effect on the local economy. This represents economic activities that are supported by aquaculture and would otherwise be absent in the local economy if the aquaculture industry were non-existent. The industry also affects the state's economy indirectly. The producers purchase products such as tanks, feed, chemicals, and much more and need the services of contractors, electricians, and other technical professionals from other companies within the state. The success of these allied businesses depends in part on the success of the aquaculture industry.

The feed for the fish is made from soybeans and corn that could have been produced in Indiana. Soybean meal is the number one protein ingredient used in fish feeds globally, with an estimated 10 million metric tons used annually. It was recently estimated that 1% of the United States soybean crop was utilized in aquaculture feeds. The farmers in the state who grow and harvest soybeans and corn benefit from the aquaculture industry.

Even though the farmers would continue to produce their products if the aquaculture industry were not present, the advantage of having a local marketing opportunity is very important. If the industry were to continue to grow, demand for soybeans and corn would continue to increase, and the soybean and corn farmers would benefit. These benefits could include increased local demand and higher prices for their products. The Indiana Soybean Alliance has recognized the aquaculture industry as a great opportunity to help grow their industry and has established an aquaculture initiative to assist in growing the industry in Indiana. The Indiana Soybean Alliance's website states, "The next major new market for soybeans is aquaculture...fish farming" (www.indianafishfarming.com).

There is also an induced effect of the aquaculture industry for the state's economy. The induced effect comes from the employees in the aquaculture industry spending the money they earn from their jobs in their communities. For example, an employee of a fish producer will go to the grocery store and spend money, which increases the business of the grocery store. If that employee did not work for the fish producer, he or she might be unemployed, and they would not be spending as much money at the grocery store, which would decrease their business. The various impacts can be determined for the aquaculture industry in Indiana by using the software, IMPLAN (IMPact analysis for PLANning) (www.implan.com). IMPLAN is an input-output model that quantifies interactions in a local economy between social institutions, industries, and firms. IMPLAN's software has procedures that can estimate local input-output models (Mulkey & Hodges, 2000).

This publication provides an assessment of the economic activities associated with the aquaculture industry of Indiana so that companies, universities, and other industry professionals can invest the proper resources into further research and development of the aquaculture industry. It is important to quantify economic activities associated with the aquaculture industry in Indiana.

Data Collection/Methodology

The data used for the study reported here was collected through a survey administered to 43 fish producers in Indiana. The survey gathered relevant information that best described farmers' activities in aquaculture. The survey was designed to determine the economic activity associated with the industry. It included questions about

the producers' cost structure, number of employees, and annual sales.

The survey was administered to fish producers in the summer of 2012. First, a phone call was made to all of the producers to schedule a face-to-face meeting. The purpose of these meetings was to tour the facilities in order to see the different species and production systems being used. A total of 10 facilities were toured throughout the summer. The producers who were not available during the summer were sent a survey through the mail. Of the 43 producers who were contacted, a total of 12 returned fully completed surveys, which gave us a total return rate of 27.91%. While this number may seem low, the producers who account for at least 80% of the sales in the state were captured in this 27.91%.

To calculate the economic activity associated with the aquaculture industry, the IMPLAN software was used. IMPLAN is used to find the economic activity associated with a certain industry or event in different countries and states in the country. IMPLAN distinguishes between basic and service industries. Basic industries "sell goods and services to markets located outside the local area." Service industries "provide goods and services to local businesses and residents." This is an important distinction within the IMPLAN data because basic industries bring money in from outside of the local economy and service industries recirculate money within a local economy (Mulkey & Hodges 2000).

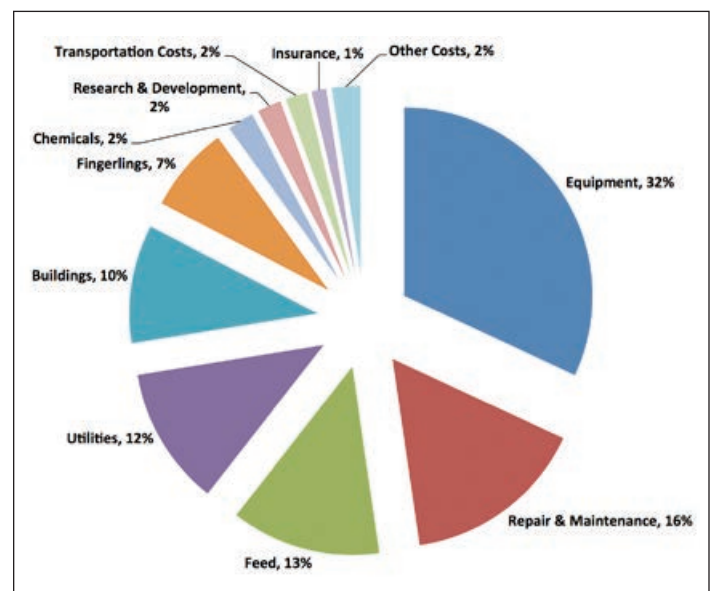
The economic multipliers are a very important aspect of the IMPLAN framework. "They measure total changes in output, income, employment, or value added." For each specific industry, there are three different effects of the total change within the local economy that the multipliers estimate. There are direct effects, indirect effects, and induced effects. The direct effect comes from the actual change in money and employment that comes from the industry or event. The indirect effect comes from businesses in the industry purchasing supplies and other things from another business that may be in another industry. Finally, the induced effect comes from employees of the industry being studied spending their income in the local economy (Mulkey & Hodges 2000).

To determine the economic activity associated with the aquaculture industry in the state of Indiana, both the information collected from the Indiana producers and the state level data in IMPLAN were used. First, the

data that was collected from the survey was added to the software database, which included the cost structure for the fish producers, annual sales, employment, and employment costs. The cost structure was determined by adding the different costs from each producer surveyed in the different categories. These numbers were then adjusted using a multiplier to account for the producers in the state who were not included in the survey data. For each different cost, the amount was divided by the total cost amount in order to estimate its percentage of the total cost. The annual sales, employment, and employment costs were totaled and then adjusted using a multiplier to account for the firms not included. IMPLAN was then used to analyze the data that was input, along with the state-specific economic data included in the software database. The direct, indirect, and induced effects of the aquaculture industry were then determined. Other information that was determined included employment, effects on other industries, and taxes generated by the industry.

For every industry included in the IMPLAN software, there is a cost structure already included. Aquaculture is included in industry (14), which is "Animal Production, except cattle and poultry and eggs." This industry includes more than aquaculture and is obviously too broad for the purposes of the study reported here. For this reason, the cost structure for the fish producers was updated in the software database based on the information obtained from the survey. The variable and capital expenditure cost structure for the producers are illustrated in Figure 2.

Figure 2. Producer Cost Structure



Results

Total employment generated by the aquaculture industry in the state of Indiana is 280 jobs (Table 1). Total employment refers to the jobs supported by the direct, indirect, and induced effect of the aquaculture industry. This means that if aquaculture in Indiana ceased to exist, 280 jobs could be lost. The direct effect is 169 jobs, which means that fish producers in the state employ 169 workers. Indirect effect is 64 jobs, which means that by purchasing supplies from other companies in the state, fish producers are supporting another 64 jobs within those companies. The induced effect for employment is 47 jobs. The employees who work for the fish producers purchase household items and other things such as groceries, gasoline, clothes, etc. in the state. These companies that receive the business from the producers' employees are able to employ a total of 47 employees because of the business generated by the aquaculture employees. All the aquaculture operations in Indiana are located in rural communities; therefore, aquaculture plays a very important role in keeping economic activities in these communities.

Labor income in IMPLAN refers to, "all forms of employment income, including employee compensation (wages and benefits) and proprietor income." The aquaculture industry in Indiana generates a total of \$7,541,867 of labor income annually (Table 1). The direct effect of labor income for the industry is \$3,731,842, which means that employees who work for fish producers earn \$3,731,842 collectively each year. The aquaculture industry supports jobs in Indiana through the purchase of supplies from other companies in the state. Those employees who are supported by the aquaculture industry are paid \$2,104,664 annually, which is the indirect labor income effect. When the fish producers pay their employees, those employees purchase items within their communities and throughout the state, which supports other jobs. Collectively, those employees who are supported by this industry make \$1,705,361 annually, which is the induced labor income effect (Table 1).

Value added is defined as, "the difference between an industry's or an establishment's total output and the cost of its intermediate inputs (www.implan.com)." It can be considered the contribution that the industry makes to the national GDP. The total added value from the aquaculture industry is \$19,484,193 annually (Table 1). The direct value added is \$12,062,060, which means that the difference between total output and the cost of inputs for fish production in the state is \$12,062,060. It can also be said that fish producers in the state add that amount to the state and national GDP. The indirect value added is \$4,344,066, which means that companies in the state that are supported by fish producers purchasing inputs and supplies from them contribute that amount to the GDP. Finally, the induced value added was \$3,078,067. This means that the jobs that are supported by fish production employees purchasing their goods and services contribute to the GDP as well.

"Output" represents the total value of industry production. This amount denotes the prices for each specific industry. The total output for the industry is \$37,892,895 (Table 1). Production from the aquaculture industry is valued at \$23,599,676. This means that the fish producers in the state sold \$23,599,676 worth of fish and aquaculture products. The companies in the state that are supported by fish producers purchasing their supplies from them produced a total of \$9,232,306 worth of their products during the year. The companies that are supported by the employees of the fish producers purchasing their items produced a total of \$5,060,913 worth of their products.

Along with the amounts for employment, labor income, value added, and output, the results for which industries were affected most in each of these categories were also obtained. The local purchase percentage is the amount of money that companies in a certain industry spend within the state or county in which they reside. Based on this information, IMPLAN is able to determine which industries are affected the most by the actions of other industries.

Table 1. Impact Summary for Employment, Labor Income, Value Added, and Output

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	169	\$3,731,842	\$12,062,060	\$23,599,676
Indirect Effect	64	\$2,104,664	\$4,344,066	\$9,232,306
Induced Effect	47	\$1,705,361	\$3,078,067	\$5,060,913
Total Effect	280	\$7,541,867	\$19,484,193	\$37,892,895

Table 2. Top 10 Employment Industries

Industry	Employment
Animal production, except cattle and poultry and eggs	192
Real estate establishments	8
Food services and drinking places	7
Wholesale trade businesses	4
Support activities for agriculture and forestry	4
Transport by truck	4
Private hospitals	3
Employment services	3
Maintenance and repair construction of nonresidential structures	3
Monetary authorities and depository credit intermediation activities	2

First, the industries that are affected most by employment will be discussed. Table 2 shows the top 10 industries whose employment was affected the most from the aquaculture industry in 2012.

It is important to note that the industry whose employment is affected most by the industry is animal production, except cattle and poultry and eggs, which includes the aquaculture industry. The total employment for the industry is 192, and 169 of those come directly from employees of the fish producers. The rest of the jobs are from other animal production facilities. These could possibly include fish producers purchasing feed for their fish. Other industries that have jobs supported by the aquaculture industry include real estate establishments, support activities for agriculture and forestry, and food services and drinking places. These jobs could be supported indirectly by the fish producers purchasing their products or services, or it could be an induced

effect with the employees supporting the jobs. For example, the “food services and drinking places” industry is probably supported by the employees of the fish producers going out or taking their families out to eat in a local community.

Many of the industries are the same as the ones whose employment was affected the most, which makes sense because employment and labor income are related (Table 3). The difference between the two is that employment is the number of jobs supported and labor income is the money that is earned by employees. The differences between the two lists can be attributed to the difference in the wages between the industries. If an industry is lower on the list for employment but higher on the labor income list, the employees in that industry earn a higher wage. Similar to the employment list, the animal production, except cattle and poultry and eggs industry is first on the list. As stated above, this is the

Table 3. Top 10 Labor Income Industries

Industry	Labor Income
Animal production, except cattle and poultry and eggs	\$4,024,353
Wholesale trade businesses	\$279,035
Transport by truck	\$204,347
Offices of physicians, dentists, and other health practitioners	\$198,970
Private hospitals	\$165,860
Support activities for agriculture and forestry	\$162,287
Maintenance and repair construction of nonresidential structures	\$124,923
Real estate establishments	\$110,300
Food services and drinking places	\$108,332
Nondepository credit intermediation and related activities	\$104,559

Table 4. Top 10 Total Value Added Industries

Industry	Total Value Added
Animal production, except cattle and poultry and eggs	\$12,964,112
Real estate establishments	\$804,616
Imputed rental activity for owner-occupied dwellings	\$535,756
Wholesale trade businesses	\$493,174
Electric power generation, transmission, and distribution	\$381,875
Monetary authorities and depository credit intermediation activities	\$289,986
Transport by truck	\$246,317
Other animal food manufacturing	\$238,914
Offices of physicians, dentists, and other health practitioners	\$205,436
Private hospitals	\$181,113

industry in which the aquaculture industry is in, and \$4,024,353 of labor income is earned by employees in this industry alone. One industry that is on this list that was not on the top 10 employment list is offices of physicians, dentists, and other health practitioners. Employees in the state in that industry earned \$198,970 in 2012 because of business generated by the aquaculture industry. All of the money generated by employees in these different industries is money that could possibly be lost if the aquaculture industry ceased to exist in the state.

Many of the industries whose total value is affected by the aquaculture industry are similar to the ones listed in the tables for employment and labor income. Table 4 shows the top 10 industries whose value added is affected the most by the aquaculture industry. One of the industries affected by the aquaculture industry is other animal food manufacturing. That would make

sense because that includes food for fish. Many fish producers in the state purchase their fish feed from other companies in the state, increasing their business, thus their total value added is increased as well.

The output refers to the value of products sold in the industry, with industry price taken into consideration. As can be expected, Table 5 shows many of the same industries as in previous tables. Other than the animal production industry that the aquaculture industry is a part of, another important industry that is positively affected by the aquaculture industry is the animal food manufacturing industry. The aquaculture industry supports \$1,777,011 worth of the animal food manufacturing output in the state. Another industry whose employment, labor income, value added, and output were all affected by the aquaculture industry is transportation by truck.

Table 5. Top 10 Output Industries

Industry	Output
Animal production, except cattle and poultry and eggs	\$25,326,519
Other animal food manufacturing	\$1,777,011
Real estate establishments	\$927,366
Monetary authorities and depository credit intermediation activities	\$702,435
Imputed rental activity for owner-occupied dwellings	\$608,116
Wholesale trade businesses	\$589,260
Transport by truck	\$457,320
Electric power generation, transmission, and distribution	\$427,803
Petroleum refineries	\$409,591
Private hospitals	\$355,688

Table 6. Sales Tax Supported by the Aquaculture Industry

Type	Output	Sales Tax Rate	Sales Tax Collected
Direct	\$23,599,676	3.72%	\$877,908
Indirect	\$9,232,306	3.72%	\$343,442
Induced	\$5,060,913	3.72%	\$188,266
Total	\$37,892,895	3.72%	\$1,409,616

Table 7. Income Tax Supported by the Aquaculture Industry

Type	Labor Income	Income Tax Rate	Income Tax Collected
Direct	\$3,731,842	2.72%	\$101,506
Indirect	\$2,104,664	2.72%	\$57,247
Induced	\$1,705,361	2.72%	\$46,386
Total	\$7,541,867	2.72%	\$205,139

The information stated above shows just how important the aquaculture industry is for the economy of the state of Indiana. Obviously the fish producers in the state and the employees who work for them are better off because of the aquaculture industry; however, many other industries gain from the presence of the industry as well. Whether it is a company who is able to hire an extra person or making a little extra money for the year, the aquaculture industry definitely adds to the economy.

As with any other business or industry, the aquaculture industry also brings money to the state and the counties within the state. The sales tax generated by the state from the aquaculture industry was estimated using the direct, indirect, and induced output generated by the aquaculture industry. The sales tax rate was found using a ratio of the sales taxes collected in the state and the total state income in 2011. The total sales taxes collected by the state of Indiana in 2011 were \$6.27 billion, and the total state income was \$168.54 billion. This gives a sales tax rate for the state of approximately 3.72% (Telles et al., 2012). In total, \$1,409,616 worth of sales tax is generated by the state from the output supported by the aquaculture industry (Table 6).

The amount of income taxes generated by the state was also estimated (Table 7). These amounts were found using the direct, indirect, and induced amounts for labor income from the aquaculture industry. The income tax rate was estimated using a ratio of the state income taxes collected by the state and the total income in the state in 2011. The state income taxes collected in 2011 were \$4.58 billion and the total income in the state in 2011 was \$168.54 billion. This gives an income tax rate of approximately 2.72% (Telles et al., 2012). Total income taxes collected by the state of Indiana from the labor income generated from the aquaculture industry are \$205,139.

The multipliers for output, employment, labor income, and total value added were estimated for the aquaculture industry in Indiana (Table 8). The multipliers are estimated by taking the sum of direct, indirect, and induced amounts for each category and dividing that amount by the direct amount for the given category.

A multiplier of 1.61 for output means that a change in sales to final demand of \$1.00 by the aquaculture industry would result in additional change in local output of \$0.61. For employment, the creation of one

Table 8. Multipliers for the Aquaculture Industry

Type	Direct	Indirect	Induced	Multiplier
Output	\$23,599,676	\$9,232,306	\$5,060,913	1.61
Employment	169	64	47	1.66
Labor Income	\$3,731,842	\$2,104,664	\$1,705,361	2.02
Value Added	\$12,062,060	\$4,344,066	\$3,078,067	1.62

new direct job in the aquaculture industry would result in an additional 0.66 job in the local economy. The 2.02 multiplier for labor income means that a \$1.00 change in income in the aquaculture industry will produce an additional income change of \$1.02 in Indiana's economy. Finally, a \$1.00 change in value added in the aquaculture industry will result in an additional \$0.62 change in value added in the local economy.

Conclusion

While aquaculture is not the most well-known industry in Indiana's agriculture sector, it is definitely present and very important to the state's economy. The industry has seen steady growth over the past few years, and it is important to know exactly how much economic activity is associated with aquaculture in Indiana.

Because of the money generated within the state, people being employed, and taxes generated for the state, the Indiana economy benefits from the aquaculture industry. There are 280 citizens of Indiana who have jobs that are supported by this industry, and \$37,892,895 worth of output is generated through the local economy because of this industry. Employees in the state are paid \$7,541,867 annually in the aquaculture industry and other industries supported by aquaculture. The aquaculture industry generates

\$19,484,193 worth of total value added to the state's GDP annually. These are jobs and revenue that could possibly disappear if the aquaculture industry were non-existent in Indiana. These results show the importance of the industry to Indiana's economy, which will enable industry professionals and those interested in aquaculture to better justify investments into further research and development of the aquaculture industry. This is important for the future growth and sustainability of the industry as it continues to expand and keep up with aquaculture in the rest of the country and the world.

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