Aquaculture in Indiana: Opportunities & Constraints (Marketing)

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Report Submitted by

Paul Brown
Professor of Aquatic Nutrition
Department of Forestry and Natural Resources
pb@purdue.edu

Steven Hart
Soy-in-Aquaculture Project Coordinator
Department of Forestry and Natural Resources
sdhart@purdue.edu

Kwamena Quagrainie
Aquaculture Marketing Specialist
Department of Agricultural Economics
kquagrai@purdue.edu

Purdue University
West Lafayette, Indiana

SECTION I: PRODUCER SURVEY

[Summary of Producer Survey Results are Presented in Appendix I]

An Exploratory Study of Farmers' View on Aquaculture Development in Indiana

Abstract

This study involved a mail survey of Indiana aquaculture producers to determine the level of Indiana aquaculture and what producers thought were constraints to aquaculture development. Aquaculture is a minor part of Indiana's agricultural economy. Suggested constraints were generally ranked as significant but the top 3 constraints were identified as high start-up costs, lack of well-established market for aquaculture products, and high costs of day-to-day operation. Consequently, research and extension programming have focused on funding aquaculture businesses, analyzing market potential, assessing aquaculture's place in the general seafood industry, and developing value-added aquaculture products.

Introduction

In 1998, a number of individuals from the Indiana Aquaculture Association, Indiana state government and Purdue University developed the "Indiana Aquaculture Plan" designed to offer insights into Indiana's aquaculture industry, describing various methods of production, species suitable for culture, regulatory policies, marketing strategies, information on financing aquaculture operations, and management of fish culture facilities (Reed and Isaacs, 1998). The primary goal of the plan was to assist planning efforts for Indiana's aquaculture development.

The first USDA aquaculture census in 1998 reported 24 aquaculture farms in Indiana with a sales value of $2.7 million (USDA-NASS, 2000). By 2002, the number of farms had increased to 47 with a sales value of $3.2 million (USDA-NASS, 2004), indicating an increase, but relatively low compared to neighboring states. In Ohio for example, the number of aquaculture farms in 2002 was 100 compared to 33 in 1998 (USDA-NASS, 2002, 2004). Undoubtedly, there is increased interest in aquaculture in the Midwest and the North Central region but the growth of the industry has generally been slow compared to growth in other parts of the nation, particularly in the south. Climatic conditions in the south favor outdoor pond culture, which is relatively cheaper than other production methods. In Indiana, about 50% of aquaculture production occurs in ponds, and the rest in cages and re-circulating systems (USDA-NASS, 2000).

Purpose

The purpose of the study was to assess Indiana aquaculture and determine what producers thought were hindrances to its development in the state.

Methodology

This study involved a mail survey of Indiana aquaculture producers in 2005. The list of producers was obtained from the Indiana Department of Natural Resources and the Indiana Aquaculture Association, Inc. The questionnaire solicited information on number of years in the aquaculture business, income from aquaculture and allied industries, type of operation, species reared, product forms, and marketing strategies. A second section asked respondents to rank a

series of 11 statements relating to what they believed to be constraints to the development of aquaculture in Indiana. These statements were developed from discussions with the Indiana Aquaculture Association, Inc. The survey questionnaire was pre-tested. Responses from the pre-test were used to develop the final survey instrument.

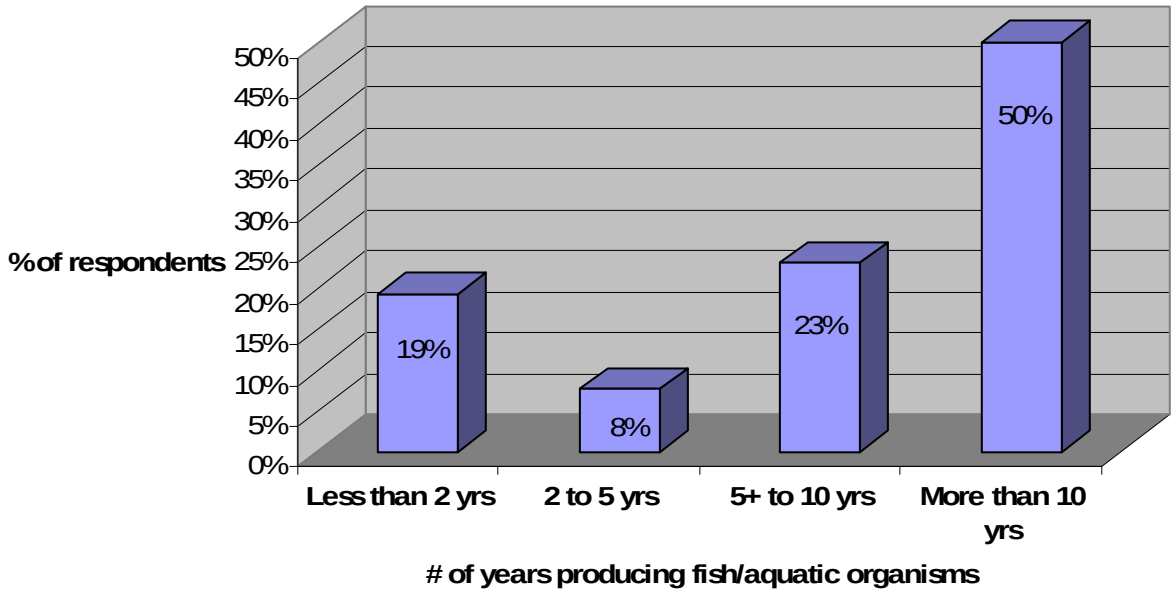
There were 3 mailings to every contact name from the list; an introduction postcard, the survey and cover letter, and a reminder/thank you notice. Two additional mailings including a cover letter and survey were sent to non-respondents of the initial mailings. A test-retest method was adopted to check the reliability of survey responses. Three respondents were contacted in 2006 asking them to rank again the 11 statements relating to constraints to Indiana aquaculture development. The correlation coefficient between the two sets of responses was 0.93.

Results and Discussion

A response rate of 42% was obtained (38 out of 91 contacts responded). Twenty three of the 38 that responded were actively involved in aquaculture production. Most (73%) had been in aquaculture for at least 5 years (Figure 1). This level of experience of respondents could be beneficial to learning about constraints to aquaculture development in the state.

The results presented here must be interpreted with some caution because of the sample size and the response rate. However, given that the 2002 USDA agricultural census indicated 47 Indiana aquaculture farms, responses from 23 producers is quite representative of the level of aquaculture and what is perceived as significant constraints to the development of the industry in the state. Most Indiana operations are for food fish production and recreational or sports fishing.

Figure 1



Percentage of responses by years producing fish/aquatic organisms

Level of Indiana Aquaculture

The level of Indiana aquaculture production is generally low (Figure 2). Over 84% of respondents produce at most 10,000lb of aquaculture products a year. It suggests aquaculture is a minor part of Indiana's agricultural economy. Most operations are part-time business ventures. This is collaborated with figure 3, which shows that aquaculture constituted at most 25% of total agricultural sales for 67% of respondents (Figure 3). It confirms that the level of production in the state is largely small-scale. There are few producers in the state that produce quite substantial amounts of aquaculture products. About 12% of respondents reported total gross sales estimates from aquaculture and allied activities of over $100,000 in the previous year. These producers are among the 8% that produced from 50,001-100,00lb (figure 2) and have aquaculture accounting for at least 75% of total gross farm sales (figure 3). Allied aquaculture activities include fee fishing operations, design and sale of aquaculture equipment, sale of other inputs, and management/consulting services.

Figure 2
Percentage of responses by category of production levels

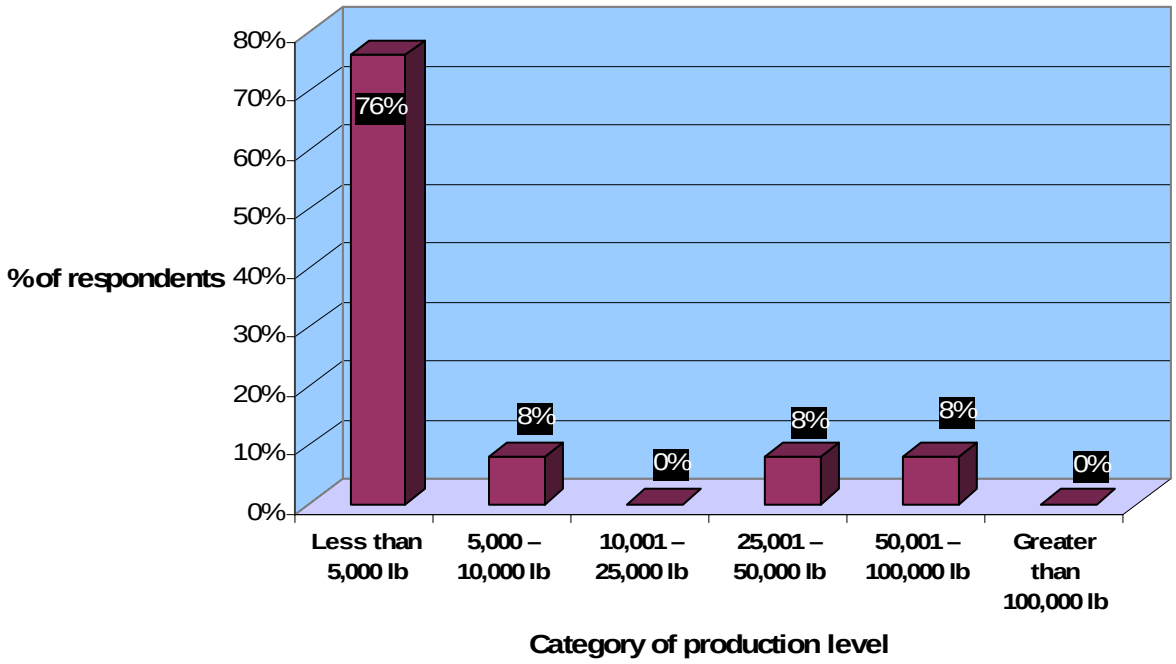
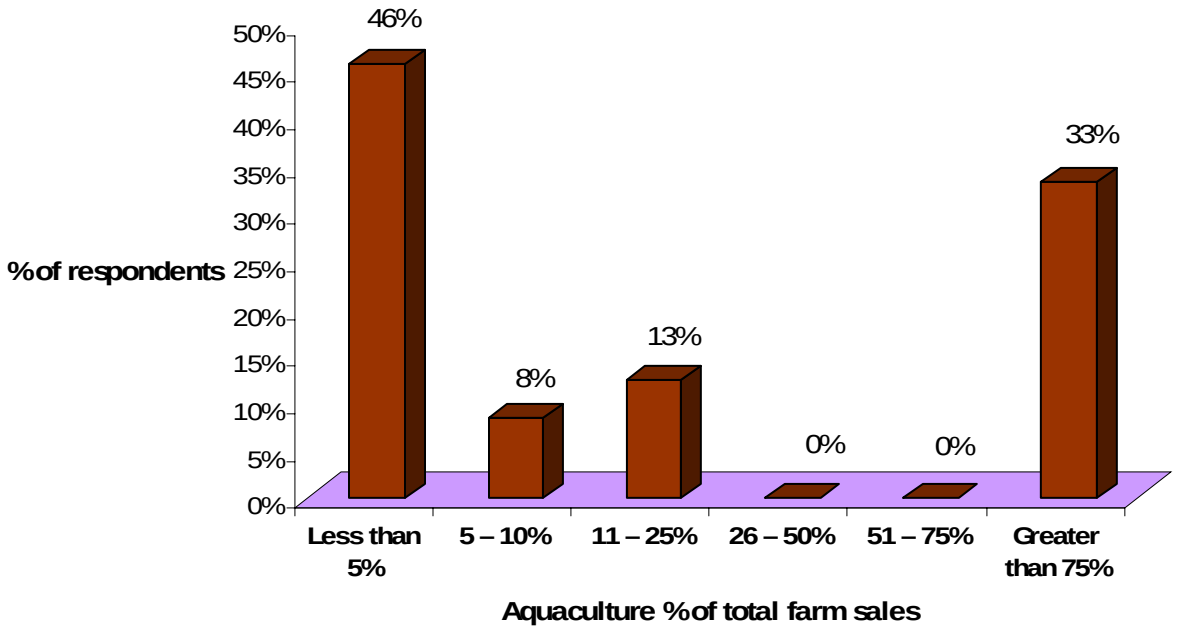


Figure 3
% of responses by aquaculture % of total gross farm sales

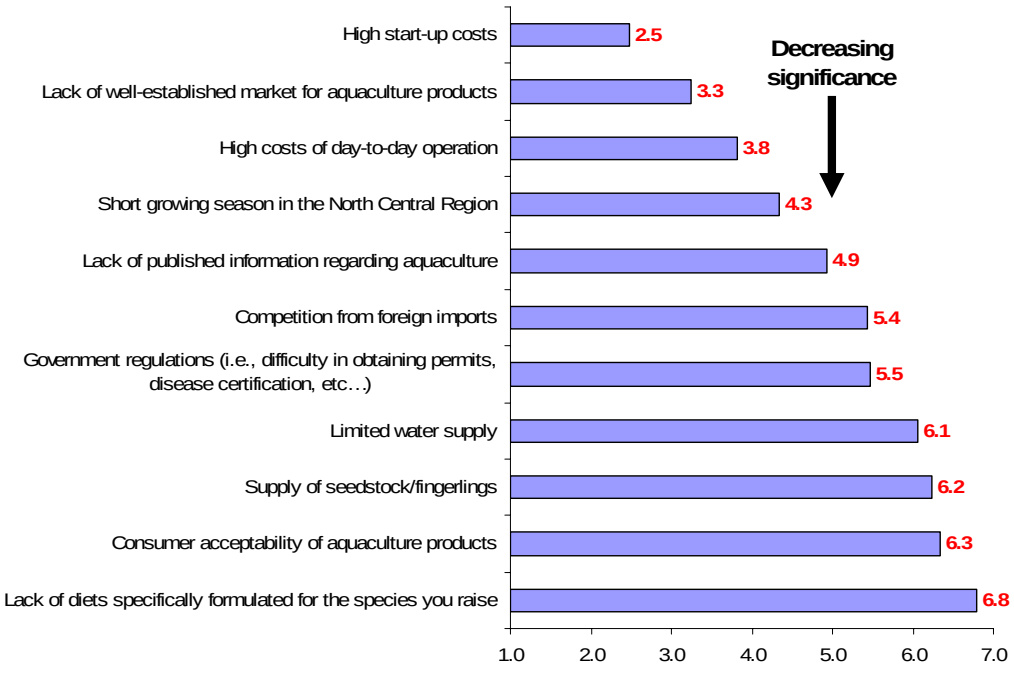


Constraints to development

Respondents were asked to rank 11 constraints in terms of significance to aquaculture development in Indiana (where 1 is the most significant and 11 is the least significant). Figure 4 presents the average ranking for the suggested constraints. Overall, it appears from figure 4 that no single factor constituted a major constraint, but rather, several factors need to be addressed if Indiana aquaculture is to develop. The average rankings reported in figure 4 are all below 7 in a scale of 1 – 11, suggesting that no individual constraint was ranked consistently low in terms of significance.

However, the top 3 constraints to aquaculture development were identified as high start-up costs, lack of well-established market for aquaculture products, and high costs of day-to-day operation. These constraints relate to economics and management of aquaculture enterprises, which is consistent with previous assessment of the industry. In a 2004 fact sheet titled "The Midwest is Hungry for Aquaculture," the Illinois-Indiana Sea Grant College program reported that economics and marketing were key factors to proceeding beyond the region's crossroad in aquaculture development (IISG, 2004).

Figure 4
Average ranking of constraints



Findings from this study suggested a course of action involving programming and policy that will help address economics and marketing issues confronting aquaculture. Currently, the level of investment in aquaculture by commercial lending institutions in Indiana is either minimal or non existent. Consequently, Purdue university aquaculture applied research and extension programs have focused on aquaculture business development, analysis of market potential, assessment of aquaculture's place in the general seafood industry, and development of value-added aquaculture products. One major focus of extension programming for the industry is educating financial lending institutions on the economic potential of aquaculture, exploring the services of the agriculture insurance industry in aquaculture, and exploring investment capital for aquaculture development. Hopefully, these efforts would provide a promising platform for expanding aquaculture in the region.

Conclusions and Implications

The level of aquaculture production in Indiana is largely small-scale. Several constraints plague the industry's development particularly, issues related to economics and management of aquaculture enterprises. The approach adapted to helping aquaculture develop has primarily focused on funding aquaculture businesses, analyzing market potential, assessing aquaculture's place in the general seafood industry, and developing value-added aquaculture products. Recent county aquaculture workshops emphasizing economics of production and marketing has played a major role in helping to address these constraints. Aquaculture is considered an alternative agriculture in Indiana, and it is likely that some minor fruits and vegetable industries have similar constraints. Consequently, the form of assistance to Indiana's alternative agriculture enterprises should be from a holistic perspective to address issues that include financing, economics, marketing, policy, science, and technology transfer. In particular, financial lending institutions in the region should be educated in these forms of agricultural enterprise.

Aquaculture extension staff and state agricultural officials can use the findings from this study to strengthen subject matter of their programs geared toward alternative agriculture development.

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SECTION II: CONSUMER SURVEY

[Summary of Consumer Survey Results are Presented in Appendix II]

Consumer Acceptance of Locally Grown Food: The Case of Indiana Aquaculture Products

Summary

Many Indiana small and medium-sized farm and ranch operators are looking at aquaculture to diversify their operations, but the underlying thought for most of these potential aquaculturists is how competitive they can be, and whether consumers will be interested in Indiana aquaculture products. The study used an ordered probit model to examine Indiana consumers' preference for farm-raised aquaculture products and interest in Indiana aquaculture products. The model predicted 18% probability of consumers that are somewhat interested, 58% for consumers that are interested and 24% for consumers that are strongly interested, which shows a strong locally-grown appeal. Several factors were found to influence interest in farm-raised aquaculture products from Indiana. Consumers who purchase farm-raised seafood, eat seafood at home regularly, are older, and have household income from $20,000 to$60,000 and are willing to pay $8.00 - $12.49/lb for Indiana shell-on headless shrimp; $3.00 - $5.99/lb for Indiana catfish fillets; $5.00 - $5.99/lb for Indiana hybrid striped bass fillets; and $3.00 - $6.99/lb for Indiana tilapia fillets have a higher probability of being interested in Indiana aquaculture products.

Introduction

Aquaculture continues to be a viable alternative agriculture enterprise in the nation with total US production reaching a billion-dollar industry; sales of fish, shellfish and related products grew by 11.7% from $978 million to nearly $1.1 billion over the past seven years (U. S. Department of Agriculture, National Agricultural Statistics Service, 2006). The 2005 Census of Aquaculture results show that food fish including catfish, perch, salmon, hybrid striped bass, tilapia and trout accounted for 62% of all aquaculture sales in 2005.

Aquaculture constitutes a minor portion of Indiana's agricultural economy with farm sales of over $5 million. The 1997 aquaculture census showed a farm sales value of about $3.5 million (US Department of Agriculture, National Agricultural Statistics Service, 2000). Indiana's industry includes the production of some major food fish and shellfish - yellow perch, hybrid striped bass, tilapia, trout, 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. Some Indiana aquaculture companies design, sell, and manage indoor re-circulating aquaculture systems. In spite of the variety of Indiana's aquaculture operations, the size of the industry has remained fairly static over the past two decades, though the industry has the potential to grow. As Indiana continues to experience its share of challenges with regard to the changing U.S. agricultural economy, economic pressures are forcing small and medium-sized farm and ranch operations to find innovative ways to stay competitive. Many small and medium-sized farm and ranch operators are looking at aquaculture, but the underlying thought for most of these potential aquaculturists is how competitive they can be, and whether consumers will be interested in Indiana aquaculture products.

In 1998, the Indiana Aquaculture Association Inc., Indiana Office of the Commissioner of Agriculture, and Purdue University developed the "Indiana Aquaculture Plan" designed to offer insights into Indiana's aquaculture industry, describing various methods of production, species suitable for culture, regulatory policies, marketing strategies, information on financing aquaculture operations, and management of fish culture facilities (Reed and Isaacs, 1998). The primary goal of the plan was to assist planning efforts for Indiana's aquaculture development.

In 2004, the Indiana Office of the Commissioner of Agriculture funded a study under the Livestock Development program to examine the opportunities and constraints for Indiana aquaculture development. This was part of efforts to advance aquaculture in Indiana to provide alternative economic opportunities for the long-term viability and competitiveness of rural agricultural enterprises. The top 3 constraints to aquaculture development identified in the study were high start-up costs, lack of well-established market for aquaculture products, and high costs of day-to-day operation (Quagrainie, Hart and Brown, 2006). Market development has also been identified in other studies as a major limiting factor to aquaculture growth in the North Central region of the US (Peterson and Fronc, 2005; IISG, 2004).

The market for seafood is well established but the scale of aquaculture will develop in Indiana if there is domestic market potential for aquaculture products. Issues that require attention include how Indiana consumers will perceive farm-raised seafood in Indiana. Will Indiana consumers buy locally-raised seafood products and how much are they willing to pay for these products? Understanding consumers' preferences and trends in demand for Indiana aquaculture products form the basis of decisions related to production and marketing strategies for Indiana aquaculture producers. Information about consumer interests could be utilized to

prepare effective marketing strategies that involve development of desired products at prices Indiana consumers are willing to pay. The objectives of this study therefore are to examine Indiana consumers' 1) preference for farm-raised aquaculture products; 2) interest in Indiana aquaculture products, and; 3) willingness to pay for Indiana-produced aquaculture products.

Empirical Framework

The study utilizes stated interests of consumers to achieve the above objectives. Interest in purchasing Indiana farm-raised aquaculture products as opposed to interest in alternatives of wild-caught or farm-raised products from other sources is examined in the context of a consumer choice problem. A consumer who expresses interest in Indiana farm-raised aquaculture products is assumed to do so because their utility increases with consumption of such products compared to consumption of alternative products from elsewhere, *ceteris paribus*. In terms of willingness-to-pay for Indiana products, it is expected that the utility of consuming or purchasing Indiana aquaculture products will change, therefore a rational consumer will be willing to pay more. However, an increase in price would result in a lower level of utility compared to the base level of utility.

Choice modeling is based on the economic theory that a consumer's choice results from their individual tastes and preferences, income, attitudes, and perceptions of the different types of products, as well as household and other demographic characteristics. Thus, an individual's interest in Indiana aquaculture products (INT) could be specified as a function of a change in utility arising from the consumption choice, i.e.,

$$INT = f(\Delta U); \quad and \quad f' > 0, \tag{1}$$

where ΔU is the change in utility, and marginal utility, f' is positive. The consumer's discrete choice is commonly formulated in a random utility framework, and choice of the i^{th} alternative is expressed as a utility function composed of a deterministic component and a random component:

$$U_i = \boldsymbol{X_i}'\boldsymbol{\beta} + \varepsilon_i, \tag{2}$$

where U_i is the utility arising from the choice of the i^{th} alternative, $\boldsymbol{X_i}'\boldsymbol{\beta}$ is the deterministic component of the utility function, $\boldsymbol{X_i}$ is a vector of observable factors that influence utility, $\boldsymbol{\beta}$ is a parameter vector and ε_i is the random component. The deterministic component reflects observable attributes and factors that influence the level of utility realized by choosing the i^{th} alternative. The random component represents unobservable factors, such as variations in

preferences, random behavior and measurement error. In this framework, alternative i is assumed to be chosen if and only if the change in utility is positive, i.e., $U_i > U_j$ for all $j \neq i$. Empirically, equation (2) is modeled as a latent regression,

$$INT_i^* = \boldsymbol{X_i'\beta} + \varepsilon_i, \tag{3}$$

where INT_i^* is the i^{th} level of interest and the observed counterpart of INT_i^* is INT_i.

Interest in Indiana aquaculture products is observed in an ordinal ranking therefore, the ordered probit model is used for the analysis. The ordered logit model assumes that there is an underlying continuous variable with certain threshold points. Threshold points are points at which the change in utility is sufficiently high to cause a consumer to change the level of interest. The regression (3) uses maximum likelihood methods and estimates coefficients to predict the probability that an observation falls into a particular interest category as

$$\text{Prob}[INT_i = j] = \text{Prob}[INT_i^* \text{ is in the } j^{th} \text{ range}] \tag{4}$$

This means that positive coefficients increase the chances that an observation will fall into a higher category of interest and negative coefficients increase the chances that an observation will fall into a lower category of interest (Aldrich and Nelson, 1984).

Data and Methods

To assess the interest for Indiana aquaculture products, a survey was developed to assess Indiana consumers' stated interests and willingness to pay for different potential aquaculture products. The primary purpose of the survey was to assess interest in Indiana aquaculture products as opposed to wild-capture fish and aquaculture products from other sources. The survey collected information on fish preferences, purchasing attitudes, and demographic factors about respondents and their households. The survey was developed from survey design principles outlined in Dillman (2000). Input was also provided by the Indiana Aquaculture Association as well as three social scientists at Purdue University, Indiana.

Household addresses were purchased from Survey Sampling International, Fairfield, CT, USA. The sample population was randomly generated from a listed Indiana household database. A sample of 4,000 was generated and 4,000 survey packages were sent to households in Indiana in January 2006. Three mailings were sent to all 4,000 households. Each household received one survey, a cover letter explaining the purpose of the study and a stamped, return-addressed envelope. The first mailing informed the household of the impending survey and solicited their

participation on receiving the questionnaire. The second mailing was the survey questionnaire, and the third mailing was a thank-you/reminder letter. A total of 2,000 non-respondents were randomly selected and sent a second copy of the questionnaire 2 weeks after the first mailing, and 1,000 non-respondents were randomly selected and sent a third copy of the questionnaire 4 weeks after the first mailing. Gift certificates were offered as incentives for participation to increase the response rate. Of the materials mailed, 286 were returned as undeliverable; 1,455 were returned with complete and incomplete responses. Fifteen runner-up winners were given a $10 McDonald's restaurant gift certificate and a grand-prize winner was given a $50 Wal-Mart gift certificate. Winners were randomly selected from respondents that returned completed questionnaires.

For this study, 870 responses which had completed responses to the relevant questions were used for the analysis. Completed questionnaires contained information on seafood purchasing patterns, willingness to pay for Indiana aquaculture products, and demographic characteristics. Table 1 shows a description of the variables used in the empirical model. The first row of variable set in Table 1 is the dependent variable, which were coded "Not Interested = 0," "Somewhat Interested = 1," "Interested = 2," and "Strongly Interested = 3." One variable from each discrete group of the explanatory variables was excluded as the omitted variable in the estimation procedure. Consequently, interpretation of the effects of discrete variables is relative to the omitted reference variable for that category of question. The empirical model was estimated using the LIMDEP 8.0 (Greene, 2002), which uses a maximum likelihood estimation procedure for ordered probit models.

Results

Table 2 shows the maximum likelihood estimates of the ordered probit model. The performance of the model is satisfactory with a χ^2 statistic of zero slope coefficient of 235. The estimated threshold levels defining the different categories of interest in Indiana aquaculture products are both significant at the 5% level.

There were 42 variables in the model that controlled for demographic characteristics, willingness to pay for Indiana aquaculture products, seafood preferences, and frequency of seafood purchase. A positive sign on a coefficient indicates the effect of a higher probability of interest, while a negative sign indicates a lower probability of interest. The coefficients for age of

respondents are significant in 3 categories and the coefficients are positive. This suggests that Indiana consumers aged 36 and above are more interested in Indiana products compared to younger consumers. One other demographic variable that exhibited statistical significance is single (unmarried), which has a negative coefficient. In general, the results for these demographic variables suggest that younger Indiana consumers who are unmarried are less likely to be interested in Indiana aquaculture products compared to other consumers.

Of the preference variables, consumers who purchase wild-capture seafood are less interested in Indiana aquaculture products while those who purchase farm-raised aquaculture products are more likely to be interested. Coefficients on both variables are statistically significant with anticipated signs (Table 2). Regarding frequency of seafood at-home consumption, consumers who eat at least 1 to 3 times seafood per month have a higher probability of interest with statistically significant positive signs. It means that the more frequent seafood is eaten at home, the increased probability of interest in Indiana aquaculture products; a potential key to developing the industry in Indiana. Promotional campaign for aquaculture in Indiana could emphasize the dietary guidelines from the Federal Department of Health and Human Services and US Department of Agriculture that advise Americans to consume more fish to live "longer, healthier, and more active lives." The guidelines recommend eating fish at least twice a week.

To capture price effects in this choice model, the responses to the question “How much more would you be willing to pay for farm-raised seafood items from Indiana compared to wild-caught or farm-raised products from elsewhere?” were combined into a continuous variable as indicated in Table 1. From Table 2, the negative sign on this variable is expected and suggests that as the price of Indiana aquaculture products increases relative to wild-capture and farm-raised aquaculture products from other sources, there is a high probability that Indiana consumers will be less interested in the domestic product. That suggests a need for a pricing strategy for Indiana products in order not to make Indiana products less competitive in the seafood market. In terms of willingness to pay, price categories for different hypothetical products indicated in Table 2 indicates a higher probability of consumers’ interest in Indiana products. Consumers are willing to pay $8.00 - $12.49/lb for Indiana shell-on headless shrimp; $3.00 - $5.99/lb for Indiana catfish fillets; $5.00 - $5.99/lb for Indiana hybrid striped bass fillets; and $3.00 - $6.99/lb for Indiana tilapia fillets. The price ranges were determined from actual prices at various grocery stores in Indiana and the products come from different sources, including imports and other states. These price range categories provide

some useful information that can assist the Indiana aquaculture industry in positioning their products on the seafood market.

The estimated coefficients in Table 2 do not express marginal effects of the explanatory variables. Marginal effects of the explanatory variables are provided in Table 3. The table also provides estimates of predicted probabilities for the various categories of interest, which must sum to one. Consequently, the marginal effects of each variable must sum to zero across interest categories. Predicted probabilities for the 4 categories of interest were evaluated at the sample means of the data. The predicted probabilities indicate very strong probability of interest in Indiana aquaculture products, i.e., 18% for somewhat interested, 58% for interested and 24% for strongly interested. The model did not predict any probability for the "not interested" category. These probability estimates are very informative and indicate consumers' interest in local products so that aquaculture marketing efforts should focus on promoting Indiana-grown. Locally-grown products usually have an appeal maybe because of freshness and taste, but also important may be home-bias. Differentiating Indiana aquaculture products this way could provide an opportunity for the industry to capture a greater share of consumers' seafood budget.

The marginal effects presented in Table 3 also provide valuable information on the level of interest. For continuous variables, the marginal effect represents the change in the predicted probability resulting from a one unit change in the explanatory variable, *ceteris paribus*. For a discrete variable, the marginal effect is the change in predicted probability based on whether a response falls into that category or not, i.e., the difference of the two probabilities with and without the variable (Greene, 2002).

From Table 3, the marginal effect of age indicates that being at least 20 years old increases the probability of being strongly interested in Indiana products. The marginal effects are stronger for consumers aged 36 and above than for consumers aged 20-35 years old. Since interpretation of coefficients of these variables is relative to the omitted variable, "less than 20 years old," it suggests that, generally, younger consumers, mainly teenagers are less interested in Indiana aquaculture products. Marital status also indicates differing levels of interest in Indiana aquaculture products. Single (unmarried) consumers show stronger disinterest than the married and divorced. The results show there is some variability among Indiana consumers regarding interest in domestic aquaculture products when it comes to demographics, and any promotion of Indiana products could target older (at least 36 years) and/or married consumers.

Regarding income, marginal effects varied according the income categories. While the marginal effect for households with annual income from $20,000 to $59,999 per year generally had statistically significant negative effects at the three lower levels of interests, households with annual income $80,000 and above had positive effects at the two lower levels of interest. It appears that there is a higher probability of having interest in Indiana products when household income is low compared to when household income is high. Households with higher incomes are less interested in Indiana aquaculture products. This result could be an indication of ability to pay for seafood products irrespective of the source.

The seafood preference variables show opposite effects. Purchase of wild-harvest seafood show positive marginal effects for the first two categories of interest, i.e., not interested and somewhat interested categories, but a negative effect on the other categories. Purchase of farm-raised seafood shows negative marginal effects for the first three categories of interest, i.e., not interested, somewhat interested, and interested categories, but positive effect on the "strongly interested" category. The marginal effects tend to be stronger for the "purchase farm-raised seafood" variable than for the "purchase wild-harvest seafood" variable. It seems to indicate that consumers who are used to farm-raised seafood are strongly interested in Indiana products. Relating to frequency of at-home seafood consumption, all respondents appear interested in Indiana aquaculture products. A similar pattern can be seen in all the variables on willingness to pay specified price ranges for hypothetical Indiana products.

Generally, these results are in line with expectations; consumers who have previous experience with farm-raised aquaculture products, and those who eat seafood frequently would be expected to be interested in Indiana aquaculture food products, and they are willing to pay prices that are within the range of existing seafood prices. Moreover, the results suggest an opportunity for differentiated Indiana products from the competition. Such an approach could enable differentiated pricing, which could include some premiums. These results underscore the potential for the Indiana aquaculture industry to develop marketing strategies designed to attract consumers' interest based on preferences, attitudes, and demographic segmentation of the market place. The fact that respondents are interested in Indiana aquaculture food products based on the predicted probabilities suggests that with the right marketing approach the market can be developed for domestic aquaculture products.

Summary and Conclusions

This study sought to assess the interest of Indiana consumers for Indiana farm-raised aquaculture products. Indiana has a relatively small industry compared to other states and aquaculture products would be considered new in the seafood market. Summary statistics of a survey of randomly selected households in Indiana indicate that 4% of respondents are not interested in farm-raised aquaculture products from Indiana, 25% are somewhat interested, 40% are interested and 31% are strongly interested. However, an ordered probit model predicted 18% probability of consumers that are somewhat interested, 58% for consumers that are interested and 24% for consumers that are strongly interested. These results are consistent with other studies that examined locally grown commodities. Locally-grown products usually have an appeal maybe because of freshness, taste, and home-bias. The ordered probit analysis shows several factors influence interest in farm-raised aquaculture products from Indiana. Consumers who purchase farm-raised seafood, eat seafood at home regularly, are older, and have household income from $20,000 to$60,000 and are willing to pay $8.00 - $12.49/lb for Indiana shell-on headless shrimp; $3.00 - $5.99/lb for Indiana catfish fillets; $5.00 - $5.99/lb for Indiana hybrid striped bass fillets; and $3.00 - $6.99/lb for Indiana tilapia fillets have a higher probability of being interested in Indiana aquaculture products. Marketing efforts should focus on reaching consumers who fit this profile. A strategy for farm-raised Indiana aquaculture producers could be to promote the product emphasizing on local-grown, and differentiating it from the competition. Promotion that reinforces the health benefits of eating fish for longer, healthier and more active lives will be a good marketing strategy.

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Table 1: Description and summary statistics of variables

Variable	Mean[1]	Min	Max
If available, how would you describe your interest in purchasing farm-raised seafood from Indiana as opposed to wild-caught or farm-raised products from elsewhere?			
Not interested	0.045		
Somewhat interested	0.246		
Interested	0.401		
Strongly interested	0.308		
Which form of seafood do you normally purchase?			
1 = Harvested from the wild, 0 otherwise	0.128	0	1
1 = Farm-raised, 0 otherwise	0.154	0	1
1 = Indifferent, 0 otherwise*	0.303	0	1
1 = Don't know, 0 otherwise	0.415	0	1
How frequently does your household eat seafood products at-home?			
1 = Less than once per month, 0 otherwise*	0.226	0	1
1 = One to three times per month, 0 otherwise	0.497	0	1
1 = Once per week, 0 otherwise	0.198	0	1
1 = More than once per week, 0 otherwise	0.079	0	1
Are you aware that Federal law mandates that seafood you purchase from the grocery counter must be labeled with country of origin and whether or not the product is wild caught or farm-raised?			
1 = Yes, 0 otherwise	0.214	0	1
1 = No, 0 otherwise*	0.786	0	1
How much more would you be willing to pay for farm-raised seafood items from Indiana compared to wild-caught or farm-raised products from elsewhere?[2]	0.018	0	0.1
How much would you be willing to pay for shell on, headless freshwater shrimp from IN?			
1 = $8.00 – $9.49/lb, 0 otherwise	0.387	0	1
1 = $9.50 – $10.99/lb, 0 otherwise	0.169	0	1
1 = $11.00 – $12.49/lb, 0 otherwise	0.036	0	1
1 = $12.50 – $13.99/lb, 0 otherwise	0.007	0	1
1 = I would not buy this item, 0 otherwise*	0.401	0	1
How much would you be willing to pay for channel catfish fillets from IN?			
1 = $3.00 – $3.99/lb, 0 otherwise	0.354	0	1
1 = $4.00 – $4.99/lb, 0 otherwise	0.224	0	1
1 = $5.00 – $5.99/lb, 0 otherwise	0.056	0	1
1 = $6.00 – $6.99/lb, 0 otherwise	0.009	0	1
1 = I would not buy this item, 0 otherwise*	0.356	0	1
How much would you be willing to pay for hybrid striped bass fillets from IN?			
1 = $4.00 – $4.99/lb, 0 otherwise	0.310	0	1
1 = $5.00 – $5.99/lb, 0 otherwise	0.169	0	1
1 = $6.00 – $6.99/lb, 0 otherwise	0.048	0	1

1 = $7.00 – $7.99/lb, 0 otherwise	0.010	0	1
1 = I would not buy this item, 0 otherwise*	0.462	0	1
How much would you be willing to pay for tilapia <u>fillets</u> from IN?			
1 = $3.00 – $3.99/lb, 0 otherwise	0.289	0	1
1 = $4.00 – $4.99/lb, 0 otherwise	0.202	0	1
1 = $5.00 – $5.99/lb, 0 otherwise	0.120	0	1
1 = $6.00 – $6.99/lb, 0 otherwise	0.031	0	1
1 = I would not buy this item, 0 otherwise*	0.359	0	1
How much would you be willing to pay for yellow perch fillets from IN?			
1 = $7.00 – $7.99/lb, 0 otherwise	0.331	0	1
1 = $8.00 – $8.99/lb, 0 otherwise	0.124	0	1
1 = $9.00 – $9.99/lb, 0 otherwise	0.034	0	1
1 = $10.00 – $10.99/lb, 0 otherwise	0.005	0	1
1 = I would not buy this item, 0 otherwise*	0.506	0	1
What is your gender?			
1 = Male, 0 otherwise*	0.479	0	1
1 = Female, 0 otherwise	0.521		
What is your age?			
1 = Less than 20 years old, 0 otherwise*	0.005	0	1
1 = 20 – 35, 0 otherwise	0.134	0	1
1 = 36 – 50, 0 otherwise	0.334	0	1
1 = 51 – 65, 0 otherwise	0.349	0	1
1 = 66 and over, 0 otherwise	0.177	0	1
What is your marital status?			
1 = Single (unmarried), 0 otherwise	0.116	0	1
1 = Married, 0 otherwise	0.697	0	1
1 = Divorced, 0 otherwise	0.110	0	1
1 = Widow, 0 otherwise*	0.077	0	1
What is your annual household income before taxes?			
1 = Less than $20,000, 0 otherwise*	0.102	0	1
1 = $20,000 – $39,999, 0 otherwise	0.217	0	1
1 = $40,000 – $59,999, 0 otherwise	0.241	0	1
1 = $60,000 – $79,999, 0 otherwise	0.186	0	1
1 = $80,000 – $99,999, 0 otherwise	0.105	0	1
1 = $100,000+, 0 otherwise	0.149	0	1
How many people (including yourself) live in your household?	2.637	1	10

*: variable was omitted during estimation.
[1]: for discrete responses, the means represent the proportion of responses.
[2]: responses were combined into a continuous variable as follows:
□ I would not be willing to pay more (0)
□ 2% more (0.02)
□ 4% more (0.04)
□ 6% more (0.06)
□ 8% more (0.08)
□ 10% more (0.10)
This approach captures the price effect on the dependent variable.

Table 2: Maximum likelihood estimates of the ordered probit model

Variable	Parameter estimate	Asymptotic t-statistic
Constant	-0.016	-0.025
Purchase wild-harvest seafood	-0.288**	-2.263
Purchase farm-raised seafood	0.455**	3.652
Indifferent	-0.018	-0.190
Eat seafood at home one to three times per month	0.164*	1.672
Eat seafood at home once per week	0.380**	3.077
Eat seafood at home more than once per week	0.319*	1.894
Aware of country of origin label mandate	-0.067	-0.669
Willingness to pay (WTP) more for Indiana farm-raised aquaculture products	-0.0004**	-2.080
WTP $8.00 – $9.49/lb for Indiana shell-on headless shrimp	0.399**	4.447
WTP $9.50 – $10.99/lb for Indiana shell-on headless shrimp	0.248**	1.978
WTP $11.00 – $12.49/lb for Indiana shell-on headless shrimp	0.418*	1.670
WTP $12.50 – $13.99/lb for Indiana shell-on headless shrimp	0.426	0.738
WTP $3.00 – $3.99/lb for Indiana catfish fillets	0.367**	3.625
WTP $4.00 – $4.99/lb for Indiana catfish fillets	0.498**	4.453
WTP $5.00 – $5.99/lb for Indiana catfish fillets	0.427**	2.118
WTP $6.00 – $6.99/lb for Indiana catfish fillets	0.182	0.365
WTP $4.00 – $4.99/lb for Indiana hybrid striped fillets	0.059	0.597
WTP $5.00 – $5.99/lb for Indiana hybrid striped fillets	0.294**	2.325
WTP $6.00 – $6.99/lb for Indiana hybrid striped fillets	0.194	0.870
WTP $7.00 – $7.99/lb for Indiana hybrid striped fillets	0.709	1.349
WTP $3.00 – $3.99/lb for Indiana tilapia fillets	0.360**	3.544
WTP $4.00 – $4.99/lb for Indiana tilapia fillets	0.510**	4.481
WTP $5.00 – $5.99/lb for Indiana tilapia fillets	0.599**	4.157
WTP $6.00 – $6.99/lb for Indiana tilapia fillets	0.773**	2.919
WTP $7.00 – $7.99/lb for Indiana yellow perch fillets	0.073	0.781
WTP $8.00 – $8.99/lb for Indiana yellow perch fillets	0.080	0.572
WTP $9.00 – $9.99/lb for Indiana yellow perch fillets	0.229	0.929
WTP $10.00 – $10.99/lb for Indiana yellow perch fillets	0.664	0.778
Female	-0.017	-0.201
20 – 35 years old	0.895	1.546
36 – 50 years old	1.107*	1.915
51 – 65 years old	1.027*	1.766
66 and over years old	0.997*	1.703
Single (unmarried)	-0.378*	-1.905
Married	-0.249	-1.418
Divorced	-0.208	-1.067
$20,000 – $39,999 household annual income	0.162	1.085
$40,000 – $59,999 household annual income	0.249	1.612

$60,000 – $79,999 household annual income	0.002	0.012
$80,000 – $99,999 household annual income	-0.083	-0.437
$100,000+ household annual income	-0.036	-0.203
Household size	0.010	0.273
Threshold parameter, μ_1	1.358**	27.158
Threshold parameter, μ_2	2.587**	45.991

Log likelihood = -938.074
Chi squared statistic of zero slope coefficients= 235.026**
*: significant at the 0.10 level.
**: significant at the 0.05 level.

Table 3: Predicted probabilities and marginal effects from the estimated ordered probit model

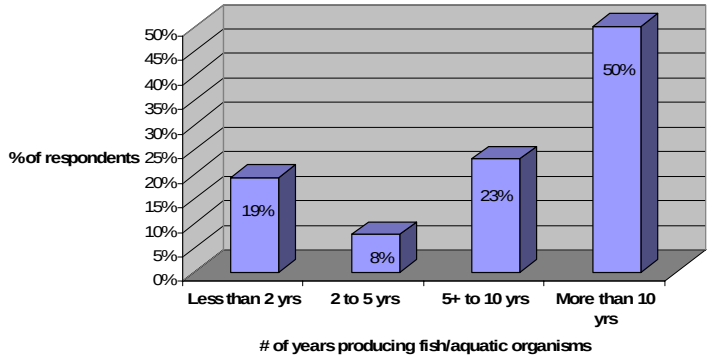
Variable	Not Interested = 0	Somewhat Interested = 1	Interested = 2	Strongly Interested = 3
Predicted Probabilities	0.000	0.179	0.578	0.243
Purchase wild-harvest seafood	0.021	0.081**	-0.014	-0.088
Purchase farm-raised seafood	-0.020	-0.116**	-0.026	0.162
Indifferent	0.001	0.005	0.000	-0.006
Eat seafood at home one to three times per month	-0.010	-0.045**	0.001	0.054
Eat seafood at home once per week	-0.018	-0.099**	-0.015	0.132
Eat seafood at home more than once per week	-0.014	-0.082**	-0.016	0.113
Aware of country of origin label mandate	0.004	0.018	-0.001	-0.022
Willingness to pay (WTP) more for Indiana farm-raised aquaculture products	0.000	0.000**	0.000	0.000
WTP $8.00 – $9.49/lb for Indiana shell-on headless shrimp	-0.022	-0.107**	-0.005	0.134
WTP $9.50 – $10.99/lb for Indiana shell-on headless shrimp	-0.012	-0.066**	-0.007	0.085
WTP $11.00 – $12.49/lb for Indiana shell-on headless shrimp	-0.017	-0.104**	-0.031	0.151
WTP $12.50 – $13.99/lb for Indiana shell-on headless shrimp	-0.016	-0.105**	-0.034	0.155
WTP $3.00 – $3.99/lb for Indiana catfish fillets	-0.020	-0.098**	-0.006	0.124
WTP $4.00 – $4.99/lb for Indiana catfish fillets	-0.023	-0.128**	-0.025	0.175
WTP $5.00 – $5.99/lb for Indiana catfish fillets	-0.017	-0.106**	-0.031	0.154
WTP $6.00 – $6.99/lb for Indiana catfish fillets	-0.009	-0.048**	-0.006	0.063
WTP $4.00 – $4.99/lb for Indiana hybrid striped fillets	-0.003	-0.016	0.000	0.020
WTP $5.00 – $5.99/lb for Indiana hybrid striped fillets	-0.014	-0.077**	-0.011	0.102
WTP $6.00 – $6.99/lb for Indiana hybrid striped fillets	-0.010**	-0.051**	-0.006	0.067
WTP $7.00 – $7.99/lb for Indiana hybrid striped fillets	-0.021	-0.158**	-0.088	0.267*
WTP $3.00 – $3.99/lb for Indiana tilapia fillets	-0.018	-0.095**	-0.009	0.123
WTP $4.00 – $4.99/lb for Indiana tilapia fillets	-0.023**	-0.130**	-0.028	0.181
WTP $5.00 – $5.99/lb for Indiana tilapia fillets	-0.023**	-0.145**	-0.052	0.219
WTP $6.00 – $6.99/lb for Indiana tilapia fillets	-0.023**	-0.169**	-0.100	0.292*
WTP $7.00 – $7.99/lb for Indiana yellow perch fillets	-0.004	-0.020	0.000	0.024
WTP $8.00 – $8.99/lb for Indiana yellow perch fillets	-0.004	-0.022	-0.001	0.027
WTP $9.00 – $9.99/lb for Indiana yellow perch fillets	-0.011**	-0.060**	-0.009	0.080
WTP $10.00 – $10.99/lb for Indiana yellow perch fillets	-0.021**	-0.150**	-0.079	0.250
Female	0.001	0.005	0.000	-0.006
20 – 35 years old	-0.030**	-0.201**	-0.100	0.331**
36 – 50 years old	-0.052**	-0.265**	-0.068	0.385**
51 – 65 years old	-0.050**	-0.251**	-0.053	0.355**
66 and over years old	-0.034**	-0.220**	-0.111	0.367**
Single (unmarried)	0.029**	0.106**	-0.023	-0.112

Married	0.013**	0.067**	0.004	-0.084
Divorced	0.014**	0.058**	-0.008	-0.065
$20,000 – $39,999 household annual income	-0.009**	-0.044**	-0.002	0.055
$40,000 – $59,999 household annual income	-0.013**	-0.066**	-0.005	0.085
$60,000 – $79,999 household annual income	0.000	-0.001	0.000	0.001
$80,000 – $99,999 household annual income	0.005**	0.023*	-0.001	-0.027
$100,000+ household annual income	0.002	0.010	0.000	-0.012
Household size	-0.001	-0.003	0.000	0.003

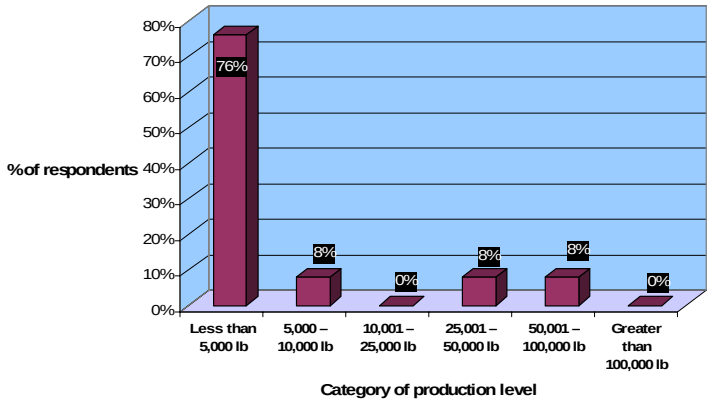
*: significant at the 0.10 level.
**: significant at the 0.05 level.

APPENDIX I: PRODUCER SURVEY RESULTS

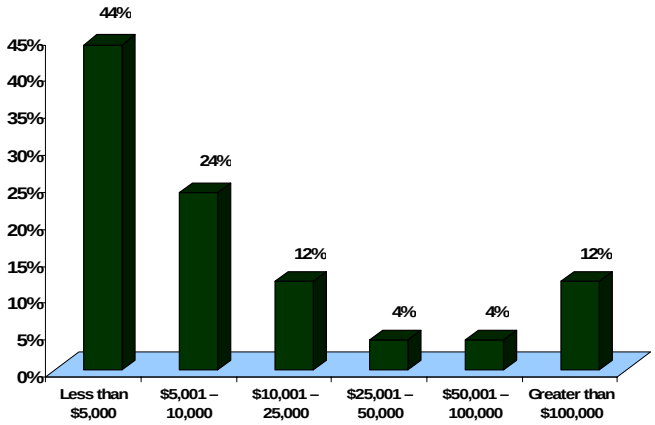
How many years have you been producing fish/aquatic organisms?



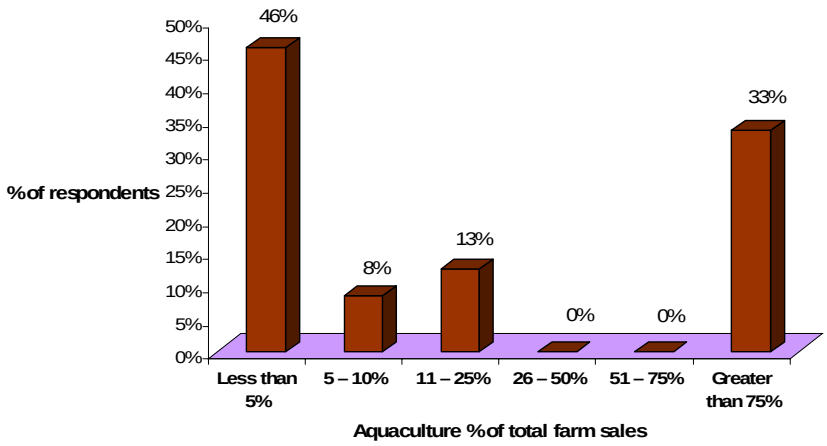
How many pounds did you produce in the last fiscal year?



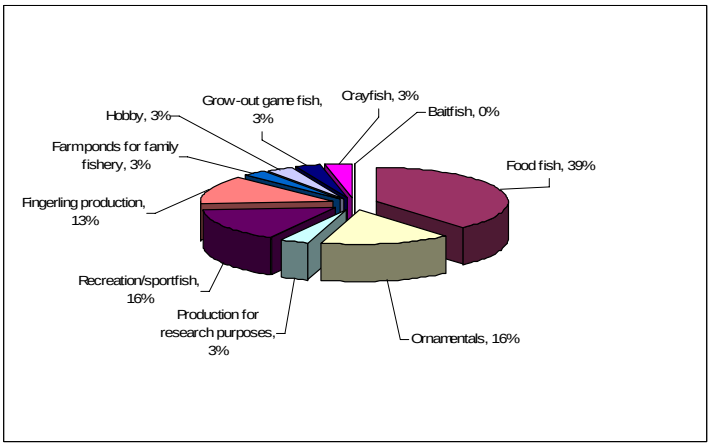
What would you estimate your total gross sales from aquacultured products in the last fiscal year to be?



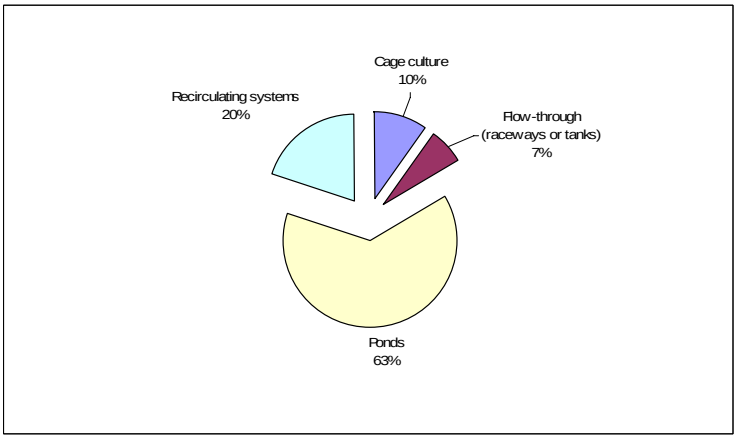
What percentage of total farm gross sales did your aquaculture venture account for in the last fiscal year?



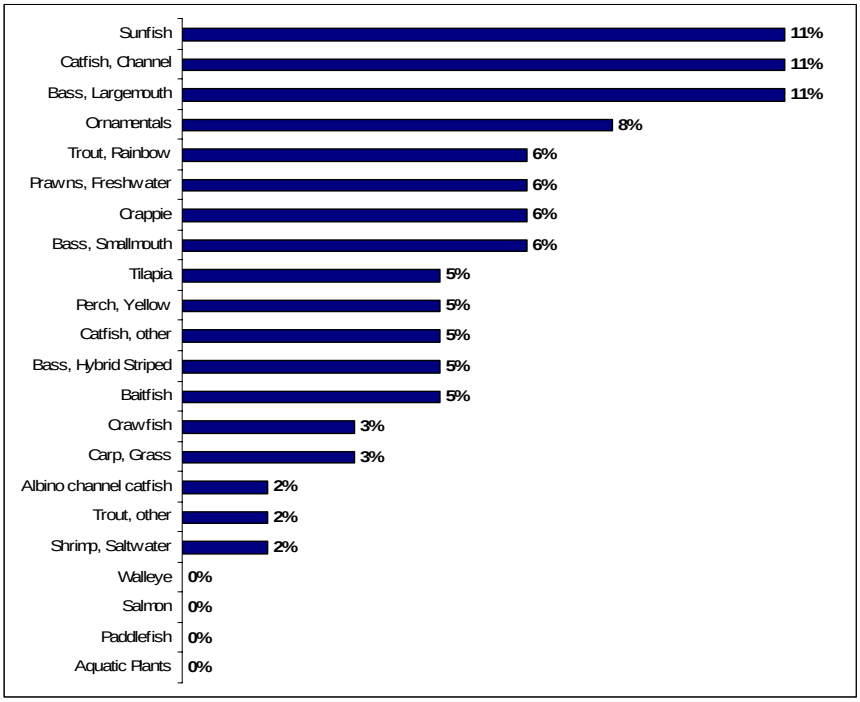
What best describes your operation?



What best describes your production system?



What species do you raise? Please check all that apply.



What product form(s) do you market to your customers? Please check all that apply

What product form(s) do you market to your customers? Please check all that apply.	# of Response	% of response
Drawn fish (entrails removed)		0.0
Dressed fish (cleaned with head intact)		0.0
Fillets	2	5.9
Headed and gutted		0.0
Live fish (adult food fish)	8	23.5
Live fish (baitfish)	3	8.8
Live fish (grow-out and/or recreational stocking)	8	23.5
Live fish (ornamentals)	5	14.7
Smoked		0.0
Whole in the round (whole fish on ice)	4	11.8
Opportunity to fish	1	2.9
Sustenance	1	2.9
Whole frozen in shrink wrap	1	2.9
Live softcraws	1	2.9
Total	**34**	

Who do you market your product to? Please check all that apply.

Who do you market your product to? Please check all that apply.	# of Response	% of response
Baitfish retailers	1	2.4
Direct to consumer (farmer's market, farm-side sales, roadside stand, etc…)	11	26.2
Fee fishing operation	3	7.1
Ornamental retailers	3	7.1
Pond stocking (grow-out and/or recreational stocking)	8	19.0
Processor	2	4.8
Restaurants	2	4.8
Retail, other than supermarkets (ethnic groceries, health food stores, seafood markets, etc…)	2	4.8
Supermarkets	2	4.8
Wholesaler	6	14.3
Fishing by permission	1	2.4
Taxidermists and schools across the country	1	2.4
Total	**42**	

What description best characterizes the location of your customers?

What description best characterizes the location of your customers?	# of Response	% of response
Urban markets (i.e., Chicago, Detroit, etc…)	9	36.0
Rural markets	16	64.0
Total	25	

If you deliver your product, what is the farthest distance you travel to reach a customer?

If you deliver your product, what is the farthest distance you travel to reach a customer?	# of Response	% of response
I do not deliver my products	8	33.3
Less than 50 miles	5	20.8
51-100 miles	4	16.7
101-250 miles	4	16.7
251-500 miles	1	4.2
Greater than 500 miles	2	8.3
Total	24	

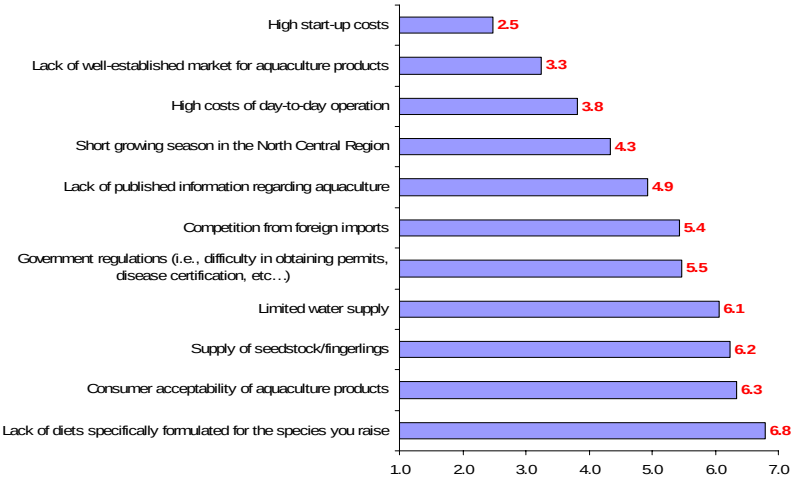
What is the farthest distance a customer will travel to come to you?

What is the farthest distance a customer will travel to come to you?	# of Response	% of response
I only deliver my products	2	9.1
Less than 50 miles	8	36.4
51-100 miles	4	18.2
101-250 miles	4	18.2
251-500 miles	4	18.2
Greater than 500 miles		0.0
Total	22	

What marketing techniques do you use to advertise your product? Please check all that apply.

What marketing techniques do you use to advertise your product? Please check all that apply.	# of Response	% of response
Flyers	5	9.3
Magazines	3	5.6
Newspapers	9	16.7
Posters		0.0
Radio	1	1.9
Sell directly to wholesaler	8	14.8
Word of mouth	23	42.6
INDNR list of suppliers and haulers	2	3.7
Shows (booths)	1	1.9
Internet	2	3.7
Total	**54**	

What do you consider to be the biggest constraint to successful aquaculture in the North Central Region? Please rank them in order of relative significance, with one being the most significant constraint.



APPENDIX II: CONSUMER SURVEY RESULTS

Do you or anyone in your household consume seafood products?	# of Response	% of response
Yes	1373	93%
No	103	7%
Total	**1,476**	

If no one in your household eats seafood, why not? (please check all that apply)	# of Response	% of response
Don't like the taste/smell	64	46%
Allergies	19	14%
Believe it is unsafe	7	5%
Too expensive	19	14%
Don't know how to prepare	13	9%
Vegetarian	8	6%
Pregnant household member	2	1%
Other reason	6	4%
Total	**138**	

Does your household eat seafood at home or restaurants?	# of Response	% of response
Only at home	35	3%
Only at restaurants	113	8%
Both home and restaurants	1245	89%
Total	**1,393**	

Which form of seafood do you normally purchase?	# of Response	% of response
Harvested from the wild	257	17%
Farm-raised	281	19%
Indifferent	363	24%
Don't know	588	39%
Total	**1,489**	

If you have specifically purchased farm-raised seafood, what was your reason for doing so?	# of Response	% of response
Wanted to support farmers	133	14%
Believed it was safer to eat	292	32%
Less expensive	173	19%
Farm-raised product was all that was available of the item I wanted	321	35%
Total	**919**	

How frequently does your household eat seafood products at-home?	# of Response	% of response
Less than once per month	311	24%
One – three times per month	621	48%
Once per week	256	20%
More than once per week	106	8%
Total	**1,294**	

Are you aware that Federal law mandates that seafood you purchase from the grocery counter must be labeled with country of origin and whether or not the product is wild caught or farm-raised?	# of Response	% of response
Yes	288	23%
No	962	77%
Total	**1,250**	

If available, how would you describe your interest in purchasing farm-raised seafood from Indiana as opposed to wild-caught or farm-raised products from elsewhere?	# of Response	% of response
Strongly interested	368	28%
Interested	469	36%
Somewhat interested	278	21%
Not interested	57	4%
No opinion	124	10%
Total	**1,296**	

How much more would you be willing to pay for farm-raised seafood items from Indiana compared to wild-caught or farm-raised products from elsewhere?	# of Response	% of response
I would not be willing to pay more	617	49%
2% more	311	24%
4% more	169	13%
6% more	98	8%
8% more	13	1%
10% more	63	5%
Total	**1,271**	

How much would you be willing to pay for shell on, headless freshwater shrimp from IN?	# of Response	% of response
$8.00 - $9.49/lb	464	37%
$9.50 - $10.99/lb	194	16%
$11.00 - $12.49/lb	36	3%
$12.50 - $13.99/lb	9	1%
I would not buy this item	547	44%
Total	**1,250**	

How much would you be willing to pay for channel catfish fillets from IN?	# of Response	% of response
$3.00 - $3.99/lb	444	35%
$4.00 - $4.99/lb	253	20%
$5.00 - $5.99/lb	64	5%
$6.00 - $6.99/lb	10	1%
I would not buy this item	500	39%
Total	**1,271**	

How much would you be willing to pay for hybrid striped bass fillets from IN?	# of Response	% of response
$4.00 - $4.99/lb	399	32%
$5.00 - $5.99/lb	194	15%
$6.00 - $6.99/lb	55	4%
$7.00 - $7.99/lb	12	1%
I would not buy this item	604	48%
Total	**1,264**	

How much would you be willing to pay for tilapia fillets from IN?	# of Response	% of response
$3.00 - $3.99/lb	360	29%
$4.00 - $4.99/lb	243	19%
$5.00 - $5.99/lb	124	10%
$6.00 - $6.99/lb	35	3%
I would not buy this item	490	39%
Total	**1,252**	

How much would you be willing to pay for yellow perch fillets from IN?	# of Response	% of response
$7.00 - $7.99/lb	430	34%
$8.00 - $8.99/lb	140	11%
$9.00 - $9.99/lb	32	3%
$10.00 - $10.99/lb	5	0%
I would not buy this item	644	51%
Total	**1,251**	

This question relates to you as an individual adult. Given how often you eat out, how would you categorize your frequency of seafood consumption at restaurants?	# of Response	% of response
Less than once per month	521	39%
One – three times per month	626	47%
Once per week	120	9%
More than once per week	53	4%
Total	**1,320**	

If Indiana raised seafood entrees were on the menu at local restaurants, how would you describe your interest in purchasing those products?	# of Response	% of response
Strongly interested	310	23%
Interested	569	43%
Somewhat interested	313	24%
Not interested	34	3%
No opinion	102	8%
Total	**1,328**	

If Indiana-raised seafood entrees were on the menu at local restaurants would you be willing to pay more compared to other seafood entrees?		# of Response	% of response
Yes		448	35%
No		829	65%
	Total	**1,277**	

What is your gender?		# of Response	% of response
Male		711	49%
Female		744	51%
	Total	**1,455**	

What is your age?		# of Response	% of response
Less than 20 years old		4	0.3%
20 – 35		187	13%
36 – 50		454	31%
51 – 65		460	32%
66 and over		349	24%
	Total	**1,454**	

What is your marital status?		# of Response	% of response
Single		175	12%
Married		969	67%
Divorced		163	11%
Widow		148	10%
	Total	**1,455**	

What is your ethnic origin?		# of Response	% of response
White/Caucasian		1,346	92%
Black/African American		57	4%
Hispanic, Latino, Chicano		16	1%
Asian or Pacific Islander		10	1%
Native American		32	2%
Other (please specify below)		4	0.3%
	Total	**1,465**	

What is the highest level of education you have completed?	# of Response	% of response
Some high school	58	4%
High school graduate	437	30%
Some college	369	25%
Associate degree	146	10%
Bachelor's degree	255	17%
Advanced degree	193	13%
Total	**1,458**	

What category best describes the area in which you live?	# of Response	% of response
Urban	297	21%
Suburban	589	41%
Rural	554	38%
Total	**1,440**	

What is your annual household income before taxes?	# of Response	% of response
Less than $20,000	156	12%
$20,000 – $39,999	317	24%
$40,000 – $59,999	310	23%
$60,000 – $79,999	236	18%
$80,000 – $99,999	126	10%
$100,000+	180	14%
Total	**1,325**	

How many people (including yourself) live in your household?	# of Response	% of response
1	286	20%
2	606	42%
3	233	16%
More than 3	330	23%
Total	**1,455**	