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Perceptions of selected aquaculture practices: Shanghai residents' views on water and feed quality

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Abstract

The paper examines importance Shanghai consumers attach to four issues associated with the production of aquatic products. Three potential problems involve quality of production inputs, i.e., water quality, the use of feed without medication, and the use of only natural ingredients in feed. The fourth issue was the importance to consumers of releasing water from fish farms without treatment to surface water bodies. The estimation of four specified equations uses 394 observations and the ordered logit technique. Results consistently show the increasing importance of all issues as the educational attainment level of respondents' increases. The presence of children is associated with importance of feed quality, but has the opposite effect on the importance of releasing untreated water. Age also increases the importance of feed quality, but decreases the importance of releasing untreated water to rivers and the sea. Male as compared to women respondents view the issues as less important. Overall, the results are consistent with expectations of better educated or older consumers attaching more importance to presented issues associated with aquatic production, except for the unexpected effect of child presence in a household on treatment of water.

JEL: Q22, Q53, M31

Keywords: Natural feed ingredient, medication in feed, water quality, water treatment, survey

Introduction

Seafood is consumed in large volume in China. Per capita consumption amounted to 10.8 kg (about 26 lbs) in 2014. Seafood and aquaculture products are favored in particular by urban Chinese residents living in large cities such as Shanghai located in the coastal zone. The per capita consumption of seafood in Shanghai is double the level consumed in China as a whole. In response to the increasing demand, aquaculture farms have been established in order to satisfy the increasing demand for fish and shellfish. Per capita production of aquatic products has shown uninterrupted growth from about 30 kg in 2002 to nearly 50 kg in 2015 (Figure 1). In some provinces the development and growth of fish farming has been rapid, stimulated by the relatively higher prices of fish as opposed to plant production.

However, as aquaculture growth continues and the supply of various seafood products increases, Chinese consumers have also become increasingly aware of food safety issues, both

in general and as related to aquaculture products. Production methods used in fish farms, including feed ingredient quality, may affect the quality and safety of fish. In addition, the quality of water used in aquaculture farms can also affect fish quality while its return to surface waters can affect the environment.

This study identifies consumer characteristics influencing the perception of water and food quality in aquaculture operations among residents of Shanghai, China, the country's largest, fastest growing, and most affluent urban center. The increasing demand for fish and seafood cannot be met through wild catch alone. Aquaculture operations are therefore becoming a major source of marketed aquatic products. The quality of feed and water quality used in the production of fish in confined spaces as well as the discharge of water from aquaculture to surface waters raise potential concerns of among consumers about aquatic products and production method safety. This study examines the extent to which specific criteria influence the consumer perceptions of the stated issues in order to generate knowledge needed by the aquatic industry and marketers to gauge the seriousness of safety concerns and to understand the potential risks stemming from consumers' refusal to purchase aquatic products. Also, government regulators can gain insights from this study regarding the relative importance of input quality and water release from fish farms and thereby may consider taking action to reassure the public about product safety.

Conceptual framework

Perceptions are inherently difficult to measure. Many empirical studies of food product perceptions applied the theory of planned behavior to model choices made by consumers. This study is limited to examining factors influencing perceptions rather than the actual choices. It is assumed that perceptions are shaped by preferences and ultimately expressed in consumption

decisions subject to budget constraints. Perceptions, commonly measured using a Likert-type scale, are ordinal in nature, and the statistical method of choice to analyze such data is the ordered logit method. Once the statistically significant factors are identified, their marginal effects (or effects, in the case of binary explanatory variables) are calculated, and indicate changes in the probability of consumers choosing a specific category describing her perceptions.

The ordinal nature of the perception measuring scale assigns each step a different perception level. Empirical studies of consumer perceptions commonly apply a five step scale to measure the importance of an issue or product attribute to by a respondent. If selected as a dependent variable, a construct based on a scale requires application of a statistical technique different than an ordinary least square method. An ordered probit or logit technique is suitable, and the ordered logit is less restrictive in its assumptions. The estimation results identify statistically significant variables influencing the likelihood of a respondent choosing a particular option along the scale. To interpret the results, however, requires the conversion of the estimated coefficient into a probability change in response to change in the value of an explanatory variable. The obtained probabilities provide knowledge about the relative importance of explanatory variables. In consumer studies, typically consumer and household characteristics, providing insights useful in selecting marketing techniques, shaping consumer education messages, and refining the content of promotion efforts. Obtained knowledge can be useful in policy development, including regulations.

This study applies ordinary logit technique to identify factors influencing the importance consumers attach to quality of inputs, feed and water, used on aquaculture farms in China. But the study also explores attitudes towards the handling of water released from fish farms to

surface waters, e.g., river, sea. The importance of input quality in food production has received wide attention, but the handling of water used in production has been of little interest to economics. On one hand consumers have not been aware of any specific risks stemming from water release, yet should the regulations change, water treatment costs will affect aquaculture products. The general view could be that water released by fish farms has not been altered and it is acceptable to mix it with water from rivers or the sea. This study considers both the importance of quality of inputs and the handling of inputs after their use on fish farms perceived by Shanghai residents.

Data

This study uses data collected through in-person interviews with consumers in Shanghai, China between July 1 and July 30, 2016. The enumerators were graduate and undergraduate students from one of Shanghai's universities, trained by faculty in procedures needed to successfully implement the survey. A pilot study was conducted in the area of "Da run Fa" Supermarket in PuDong district in Shanghai. The pilot study did not indicate any difficulties on the part of a respondent in understanding questions. However, later during the survey implementation, some respondents appeared to become bored during the interview, while others did not want to answer questions about their income and marital status. The survey locations were randomly selected in the vicinity of several supermarkets and other shopping areas in Shanghai. The consumer intercept method was used to select the survey participants. A total of 419 questionnaires were collected, 394 of which were fully completed.

The average respondent is 36.7 years old and 38 percent are women. The average number of children per household was 0.68. There are 114 single person households representing 28.9% of the sample. The average educational attainment level (2.93) is 3 or 4

years of college. The vast majority of respondents (85%) were born in Shanghai area, reflecting the general constraints limiting mobility. The average total household disposable income is 18,604 renimbi and corresponds to about \$2,800 at the average exchange rate on August 1, 2016 (XE Currency Converter, 2017).

The perceived importance attached to four ~~features~~ specific criteria associated with aquaculture and seafood products differs. Respondents could choose from among five levels of importance ranging from “not important at all” (value of 1) to “very important” (value of 5). The highest average importance level is associated with the practice of not using medication in farm-raised fish production, 3.94. The second highest average importance level is 3.54 and relates to the requirement that water used in aquaculture production be clean. A slightly smaller average value of 3.44 is associated with the expectations by respondents that farm-raised fish are fed feed using only natural ingredients. The lowest level of importance, 2.85, is associated with the statement about treatment of water used in aquaculture prior to its release into surface waters such as rivers or the sea. The differences in the average importance ~~level~~ levels are not surprising. Consumers are commonly very concerned about issues related to the wholesomeness of food they eat and the quality of inputs is perceived as influencing the quality of the ultimate product. In this context, the highest importance of withdrawing medication from aquaculture production practices is understandable. Somewhat surprising is the decidedly lower level of importance attached to the release of untreated water into surface waters. During aquaculture production there is a potential buildup of organic matter in farm ponds that negatively effects water quality, for example, by changing the level of oxygen in released water or microbiological composition. Untreated water can harm the natural conditions in rivers or sea waters in the area of aquaculture water release. However, consumers are more likely to

connect input quality, including water, with the quality of the food product, but the recognition of the effects of releasing water from aquaculture farms into surrounding bodies of water is relatively weak among those surveyed.

Results

Estimation results identify statistically significant factors and directional effects on the importance attached by respondents to the three input quality attributes and the practice of releasing untreated fish farm water ~~to~~ into bodies of surface water such as a river or the sea. The average importance level across all responses varied among the four issues, with avoidance of medicated feed ranking highest in importance.

Water quality

Water quality used by aquaculture farms is quite important, especially among higher educated respondents. Also, a higher level of importance was attached to water quality on fish farms by respondents who reported having a child in the household. Both positive influences are consistent with expectations, namely that those with more education likely recognize the connection between polluted waters and quality of aquatic products, while parents are logically concerned about water quality as since they are concerned about potential impacts on the health of their children. Gender differences suggest men attached less importance to water quality than women. The result echoes other studies regarding food quality and safety, which have shown men being less concerned.

Release of untreated water from aquaculture farms

Confined production of fish and shellfish changes organic matter content and microbial load of water. Water from production ponds is periodically changed, but without prior treatment. Older respondents were less likely to view the release of untreated water as an important issue.

It is possible that they have witnessed such handling of water throughout their life and are not convinced about the link between any environmental harm and untreated water release. Surprisingly, those from households with children also showed less concern than those from household without children. Oftentimes, those with children show concern about the quality of environment including air and water quality, but this study finds the opposite is true. Perhaps, additional research is needed in this regard.

Feed without unnatural ingredients

Natural ingredients or lack thereof, increased in importance with the age of the respondent. Such preference associated with age could reflect culturally conditioned preferences for natural ingredients that are considered more wholesome in comparison to highly processed feed. Moreover, the preference may also reflect the long period of living in urban environments which contain very few natural elements, while exposing residents to detrimental effects like poor air quality. The preference of natural feed ingredients by more highly educated respondents as compared to the less educated is consistent with greater education allowing individuals to understand both the benefits and also the negatives of unnatural ingredients in feed on aquaculture farms. It is possible that the better educated recall past incidents of using formaldehyde in Nanjing crayfish just a few years earlier.

Feed without medication

Results show the largest number of statistically significant variables associated with importance of this issue to respondents. The older the consumer, the higher the level of attached importance. Age implies life experience and, therefore, concerns about inappropriate use of medication are not a surprise. The positive effect of education is an expected result. Those with higher levels of education are more likely to be aware of the harmful effects of wide use of

medication, including antibiotics which can become less effective when truly needed due to overuse over time. Also, as expected, respondents from households with children were more likely than those without children to prefer that feed used on aquaculture farms not contain medication. Finally, those born in Shanghai expressed greater preference for feed that is free of medication as compared to residents born elsewhere. Shanghai is considered a leading indicator for consumption trends in China, thereby making the confirmed preferences for non-medicated feed an important signal to the aquaculture industry.

Conclusions

Consumers attach most importance to the use of medication in feed in raising fish and shellfish. The displayed attitude is consistent with the growing concerns about the use of antibiotics in animal feed. The very restrictive use of antibiotics in animal feed has been advocated over an extended period of time. Although in some countries such use has been subject to regulations aiming at reduction of their use, but not all countries restrict antibiotics and other medication use as animal feed additives. More importantly, even if regulations limit their use, the actual practice may differ because the monitoring system is inadequate. Porous enforcement does not eliminate the risk that the detection of inappropriate use of medication in feed used in aquaculture and could undermine confidence of consumers in product quality. Past incidents of antibiotics presence in shellfish in China led to per capita decline of all aquaculture products in Shanghai.

This study established consumer and household characteristics influencing the importance of four issues faced by the aquaculture industry in China. The relative importance of the issues is captured by the average scores. Both the score value and the factors with their directional effects provide insights what needs to be done to reduce the concerns. Water

quality and the restrained use of medications in feed can be self-regulated, while the government agencies can monitor the feed quality traded in the marketplace. To effectively address consumer concerns requires a cooperative effort of fish farmers, input sellers, and regulators. Additional requirements may be placed by aquatic product marketers by testing products and monitoring production practices. The next stage of research could be a future study focused on the cost of modifications and their effects on consumer prices.

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Table 1. Descriptive statistics of variables.

Variable	Description	Mean	Std. dev.	Min	Max
<i>Dependent variables</i>					
Water quality	How important is it that water in aquaculture production be clean ¹	3.54	0.957	1	5
Release treated water	How important is it that water is treated before being released into river or sea ¹	2.85	1.065	1	5
Natural feed ingredients	How important is it that feed used in aquaculture production be without artificial ingredients ¹	3.44	0.943	1	5
No medication in feed	How important is it that fish in aquaculture farms should not receive medicine ¹	3.92	1.049	1	5
<i>Explanatory variables</i>					
Gender	1=male; 0=female	0.38	0.486	0	1
Age	Respondent's age in years	36.17	10.87	18	66
Number of children	Number of children younger less than 18 years	0.68	0.691	0	3
Marital status	Single=1, married=2, divorced=3, widowed=4	1.73	0.48	1	3
Education	Middle school or lower=1, high school or technology school=2, 3 or 4 years of college=3, Master's=4, PhD=5	2.93	0.78	1	5
Income	Total monthly household income in renimbi	18603.5	12713.36	180	100000
Birthplace	1=born in Shanghai, 0=otherwise	0.85	0.36	0	1
Occupation	1=blue collar worker, 2=white collar, 3=civil servant, 4=housewife, 5=other				

¹ 1=Not important at all, 2=not important, 3=neither important, nor unimportant, 4=important, 5=very important.

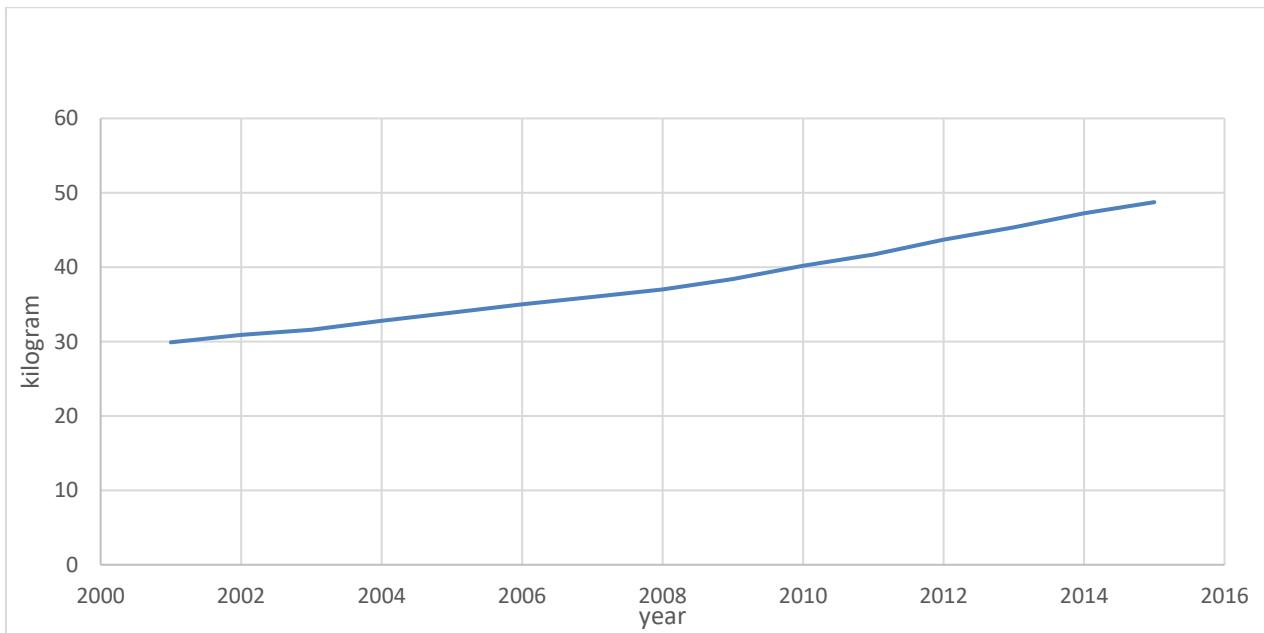
Table 2. Ordered logit estimation results of four equations modeling consumer perception of four issues associated with aquaculture production: water quality, release of treated water, natural feed use, and absence of medication in feed.

Variable name	Estimated coefficient	Std. error	Wald test
<i>Dependent variable</i>			
Water quality 1	-3.187	1.63	3.84**
Water quality 2	-.471	1.57	.09
Water quality 3	1.054	1.57	.45
Water quality 4	3.127	1.58	3.92**
<i>Explanatory variables</i>			
Income	-.044	.41	.01
Age	.005	.01	.31
Education	.432*	.14	9.53*
Gender	-.579*	.20	8.85*
Presence of children	.408**	.202	4.06**
Shanghai residents	-.009	.269	.01
<i>Dependent variable</i>			
Release treated water1	-2.878	1.559	3.41
Release treated water2	-1.227	1.554	.62
Release treated water3	.427	1.552	.08
Release treated water4	2.192	1.560	1.97
<i>Explanatory variables</i>			
Income	.127	.401	.10
Age	-.029***	.010	9.04
Education	.030	.136	.05
Gender	-.141	.191	.55
Children	-.574***	.201	8.13
Shanghai	.767	.268	8.17
<i>Dependent variable</i>			

Natural feed ingredients1	.697	1.610	.19
Natural feed ingredients2	2.900	1.581	3.36
Natural feed ingredients3	4.715	1.590	8.79
Natural feed ingredients4	6.747	1.610	17.57
<i>Explanatory variables</i>			
Income	.569	.408	1.95
Age	.018*	.010	3.58
Education	.533***	.141	14.29
Gender	-.181	.194	.87
Children	.191	.202	.89
Shanghai	.284	.270	1.11
<i>Dependent variable</i>			
No medication in feed1	1.035	1.712	.37
No medication in feed2	3.926	1.625	5.84
No medication in feed3	5.371	1.631	10.85
No medication in feed4	6.704	1.644	16.63
<i>Explanatory variables</i>			
Income	.694	.415	2.80
Age	.035***	.010	12.14
Education	.641***	.147	18.87
Gender	-.502***	.196	6.57
Children	.405**	.203	3.96
Shanghai	.633**	.280	5.11

* Significant at 1%. ** Significant at 5%.

Figure 1. Per capita production of aquatic products in China, 2001-2015



Source: Chinese Fishery Statistical Yearbook, selected issues 2002-2015.