AQUACULTURE CRSP 21ST ANNUAL TECHNICAL REPORT

CHARACTERISTICS OF FISH BUYERS LIKELY TO PURCHASE FARM-RAISED TILAPIA IN HONDURAS AND NICARAGUA

Tenth Work Plan, Product Diversification Research 1 (10PDVR1)

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ABSTRACT

Nicaragua has the physical resources to develop a farm-raised tilapia industry. However no marketing studies have been done to assess the potential to develop a domestic market for farm-raised tilapia in Nicaragua. The purpose of this study was to assess the potential for increasing sales of farm-raised tilapia through the domestic restaurant market in Nicaragua. Direct personal interviews were conducted with 118 restaurant managers selected at random from telephone listings. Information was collected on tilapia and other seafood sales, restaurant and market characteristics, attitudes towards tilapia characteristics, and willingness to add tilapia to the menu. Logit analyses were used to measure the effects of consumer attitudes, entrée preferences, and restaurant characteristics on binary choice variables related to whether or not restaurants sold tilapia and the likelihood of adding tilapia to the menu. The most promising restaurant market for tilapia appeared to be older restaurants that offered a variety of food on the menu and those that served steaks. Larger restaurants that considered tilapia to be a high-quality product and that offered "ceviche" (fish marinated in lime juice) on the menu were those that tended to sell tilapia. Tilapia farmers and processors in Nicaragua will need to guarantee and ensure the flavor, quality, and safety of their product, and promote these attributes.

INTRODUCTION

Tilapia, both wild-caught and farm-raised, have become readily available in the Central American region. With 1.2 million ha of water surface area, low labor cost, available land, and a tropical environment, Nicaragua would appear to have the potential to develop a farm-raised tilapia industry. Neighboring countries such as Costa Rica and Honduras have significant farm-raised production of tilapia. Yet commercial aquaculture has developed slowly in Nicaragua.

Tilapia, an introduced, exotic species, currently inhabits all major rivers and lakes in Nicaragua (Saavedra, 2000). Originally introduced in the 1960s, the combination of government stocking programs and hurricane-induced flooding has resulted in established populations throughout the country. Lake Nicaragua supports a significant tilapia fishery that supplies local and export markets in other Central American countries. In addition to the wild catch of tilapia, there are 2,407 ha of reservoirs stocked by the government for villagers' subsistence for tilapia production (Durand, 1997). However, low technology and poor management have resulted in inconsistent harvests. The harvest of tilapia from both natural water bodies and stocked reservoirs represents both a source of income and protein for people living in the vicinity. Fish are typically produced in mixed-sex production systems and are harvested and consumed at a small size.

Much of the wild-caught tilapia from Lake Nicaragua is exported to other Central American countries. Tilapia are also sold in local markets by fishermen and a number of small farms (Fitzsimmons, 2000). Based on statistics obtained over the last three years from the Nicaraguan Ministry of Fisheries (MEDE-PESCA), tilapia accounts for at least 4% of the total finfish export from Nicaragua. More than 70% of the exported finfish per year went to the United States during the last three years. In 1997, the total finfish catch in Nicaragua was 5,525 metric tons, of which 35% was exported. Export marketing to the United States is difficult due to the small number of brokers handling tilapia. Most successful export companies in Costa Rica and Honduras have developed their own marketing companies in the United States. However, this requires a large scale of production and a developed production infrastructure that may not be possible at the present time in Nicaragua.

Developing the domestic market would provide stability by offering additional market alternatives. Volume requirements would likely be lower than required by export markets and it might be possible to sell smaller sizes of fish. Development of a domestic market would also provide broader economic benefits such as new sources of employment and additional protein sources for Nicaraguans. This study focuses on the potential for increasing sales of farm-raised tilapia through the domestic restaurant market in Nicaragua.

Nicaragua is one of the Northern hemisphere's poorest countries with an estimated Gross Domestic Product (GDP) of $450 per person in 1997 (World Bank, 2003). Notwithstanding, Nicaragua has made significant progress towards economic stabilization. The Nicaraguan GDP grew 5.0 percent in 1997 compared to 4.5 percent in 1996, 4.2 percent in 1995, and 3.2 percent in 1994. This robust expansion is being led by the export sector, agriculture, construction, and general commerce. Private investment, from both domestic and foreign sources, is rising and the private banking sector continues to expand.

The country has a poor road infrastructure and scarce refrigeration facilities. Some refrigeration facilities exist, but development of commercial aquaculture will likely require investment in additional facilities. However, the primary sources of

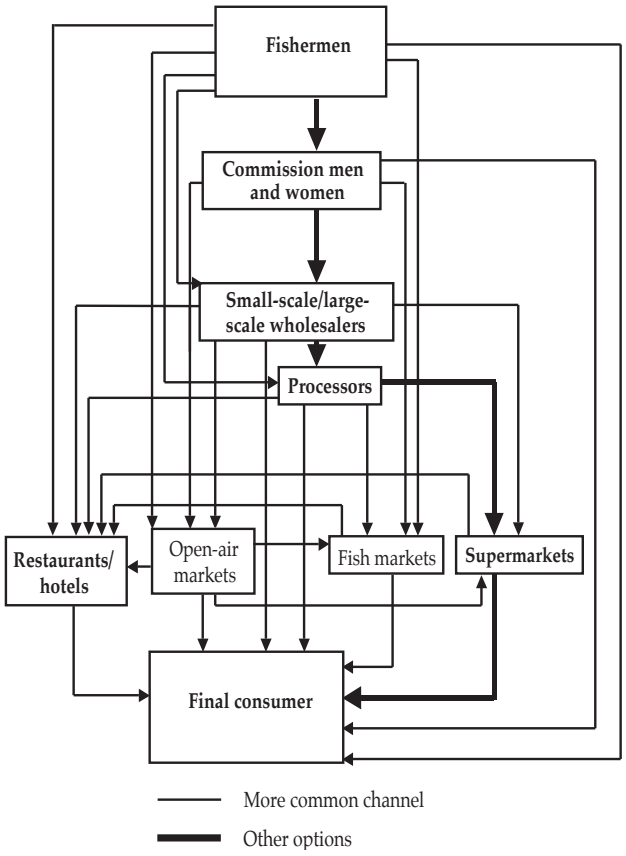

Figure 1. Market channels for wild-caught tilapia in Nicaragua.

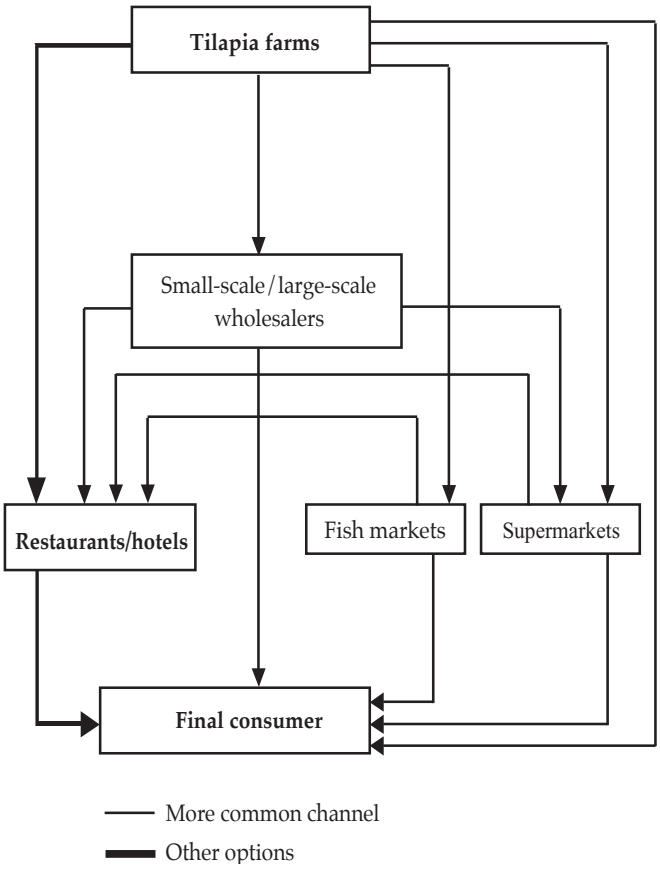

Figure 2. Market channels for farm-raised tilapia in Nicaragua.

wild-caught tilapia, Lake Managua and Lake Nicaragua, are less than one hour's drive from the principal population center, Managua. Prime areas for development of commercial-scale tilapia production are within three hours drive of Managua. Thus, travel distances to target markets are short and the main transportation routes, while not in excellent condition, are paved.

No marketing studies have been done on the potential to develop a domestic market for farm-raised tilapia in Nicaragua. The purpose of this research is to identify and characterize the types of restaurants that currently sell tilapia and those most likely to add tilapia to the menu. This information will provide guidelines for developing restaurant marketing strategies for farm-raised tilapia in Nicaragua.

Restaurant markets and demand for seafood products in Nicaragua

Nicaraguans are generally reported to prefer consumption of beef and other types of red meat to seafood. It is reported that consumption of fish and seafood in Nicaragua is only 3 kg per capita annually (U.S. Department of Commerce 2002), while consumption of meat in Nicaragua is reported to be 15 kg per capita annually (World Resources Institute, 2002). However, the prevalence of tilapia in the markets, the number of artisenal fishermen on the great lakes, and impoundments on both the Atlantic and Pacific coasts might indicate an under-reporting of fish consumption. Prices of fish dishes on menus in Nicaraguan restaurants generally fall between the prices of meat and chicken dishes.

The various cuisines found throughout Nicaragua have similarities as well as unique elements (Zingarelli et al., 2001). Among the staple foods found throughout the region are tortillas wrapped around or topped with various foods such as beans (boiled, fried, refried), platanos (ripe plantains cut lengthwise and either fried, boiled, or broiled with butter and served hot), and the ubiquitous rice. With the Atlantic and Pacific coastlines, several lakes and reservoirs, fish is a part of Nicaraguan cuisine. Immigrant groups have introduced Spanish, Chinese, Greek, Korean, Japanese, Middle Eastern, or Italian food in some surprising places and some of these exotic foods are fish-based (Zingarelli et al., 2001). A variety of restaurants in Managua serve local, specialized, and international foods. Outside the capital, only León, Granada, and San Juan del Sur offer international specialized food.

The most popular species of fish in restaurants in Nicaragua are drum, red snapper, guapote, and tilapia (Neira, 2002). Many types of restaurants, including those that are classified as steak or international restaurants offer several seafood dishes. The top fish and seafood dishes prepared in restaurants are fried fish, breaded fish, grilled fish, and fish fingers. The period of peak fish consumption is the Lenten-Easter season.

Marketing channels for wild-caught tilapia in Nicaragua are complex but represent the network linking the fisherman to the final consumer (Figure 1). Marketing channels for all species follow similar movements as the fish pass from producer to consumer. Some fishermen are able to sell harvested fish to small and large-scale wholesalers, to processors, to restaurants, to stand vendors in open-air markets, to fish markets (special-

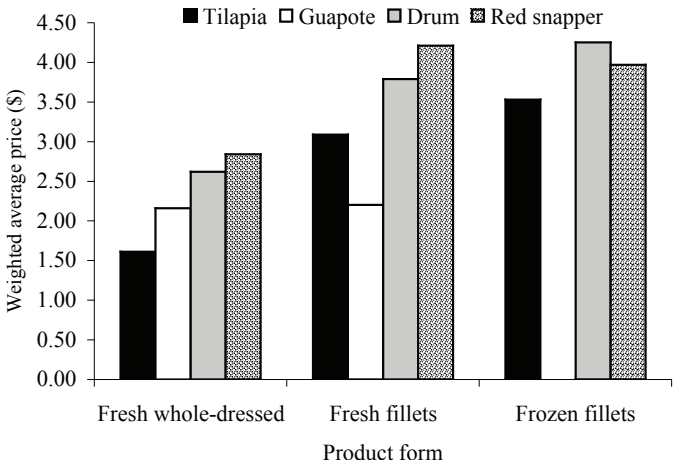

Figure 3. Supplier price of fish by most popular product form in Nicaragua.
Source: Neira (2002).

ized in-town stores that sell only fish and seafood), and to the final consumers. The majority of fishermen work with a "commissioner" who sells their fish for a commission. Commissioners commonly auction fish to small and large-scale wholesalers. Smaller wholesalers sell fish to small restaurants, to stand vendors in open-air markets, and to final consumers. Large-scale wholesalers more often sell fish to processors, to large restaurants, to large stand vendors in open-air markets, to fish markets, and to supermarkets. Typically, processors sell their fish to restaurants, to fish markets, to supermarkets and to the final consumer.

Marketing channels for farm-raised tilapia in Nicaragua are less complex. Tilapia farmers tend to bypass intermediaries (Figure 2). The majority of tilapia farmers sell directly to restaurants and to fish markets. Some of them sell to wholesalers and a few sell directly to the final consumer.

Figure 3 presents the average wholesale prices of three different forms of tilapia, guapote, drum, and red snapper fish species. Guapote, drum, and red snapper are important species of fish in Nicaragua. The prices are the purchase prices of restaurants reported in Neira (2002). The average wholesale price of fresh whole-dressed tilapia is $1.61 per kg compared to $2.85 per kg for red snapper, $2.62 per kg for drum, and $2.16 per kg for guapote. The average price that restaurants pay for fresh tilapia fillets is $3.09 per kg, lower than prices paid for fillets of red snapper ($4.21 per kg), and drum ($3.97 per kg). The average price of $3.52 per kg for frozen tilapia fillets is lower than the average price of frozen drum fillets ($4.62 per kg), and frozen red snapper fillets ($3.96 per kg).

METHODS AND MATERIALS

Studies on seafood marketing have increasingly focused on the use of disaggregated data to judge market sensitivity to changes in product characteristics, consumer demographics, and to intensive promotional campaigns. Use of disaggregated data is a way to overcome the difficulty of capturing short-term dynamics of seafood markets when aggregated, secondary times series data are used (Wessells and Anderson, 1992). Disaggregated studies could be useful to assess the potential market for tilapia in a country like Nicaragua because secondary times series data are incomplete and not readily available in many developing countries.

Demographic variables have been shown to influence consumer expenditures on seafood (Cheng and Capps, 1988), purchasing decisions by grocery store and restaurant managers (Kinnucan et al., 1993), grocery stores' likelihood of selling catfish (Olowolayemo et al., 1992), consumer acceptance (Engle and Kouka, 1995), choice of a particular seafood product (Gempesaw et al., 1995), and consumer purchasing behavior (Foltz et al., 1999). Hanson et al. (1994) suggested that, to increase sales of seafood in restaurants in the U.S., "white table cloth" restaurants catering to higher-income consumers with few small children should be targeted. Similar results were found for U.S. restaurants by Rauniyar et al. (1997).

Data Collection

A survey was conducted of restaurants throughout the populated regions of Nicaragua in August and September 2000. The Atlantic Coast was not considered because of its low population density and a dense, inaccessible rain forest. The restaurant survey instrument designed in Honduras by Engle et al. (2001) was used as a basis for this study.

The full-service restaurants registered with the Nicaraguan Institute of Tourism and restaurants listed in the telephone directory were combined and duplicate listings eliminated. Fast food establishments, roast chicken specialty stores, catering shops, and pizza stores were also excluded. This resulted in a total of 350 restaurants. However, given budget restrictions that would prevent a survey of all 350 restaurants, tables of random numbers were used to select a sample of restaurants for the survey. The sample size for the restaurant survey was calculated following Kinnear and Taylor (1983)

$$n = \left[\frac{y * s}{z * p}\right]^2 \quad (1)$$

where n is the sample size, y is the value for confidence level, s is the standard deviation for sample, z is the precision, and p is the sample mean value of the proportion of restaurants that sell tilapia.

Given the similarity in socio-economic and demographic characteristics between Honduras and Nicaragua, data from a similar Honduran survey conducted in 1999 by Engle et al. (2001) were used to estimate a sample standard deviation. This assumes that the variability in the Honduran data for the dependent variable would have the same standard deviation as respondents of the Nicaraguan population. Thus, 0.051 was used as the sample standard deviation to estimate sample size. A confidence interval of 95% and a precision level of 3.75% were selected for y and z, respectively, to provide a conservative estimate of a sample size of 118 restaurants. Table 1 indicates the number of restaurant managers interviewed by city or town. Of the 118 restaurants surveyed, 82% were located in the South-Central and 21% in the Northwest region (Figure 4). The greater percentage in the South-Central region corresponds to the higher population density and higher standards of living compared to the Northwest region.

Figure 4. Principal urban centers and small towns in Nicaragua.

All 118 restaurants responded to the survey, providing a response rate of one hundred percent. This is likely due to the novelty of market surveys in Nicaragua. Restaurant managers were enthusiastic to be asked to participate and were very cooperative. The only caveat was that some managers were hesitant to admit that they sold tilapia. Some restaurant managers appeared to fear declining patronage by customers if they admitted selling or having sold tilapia. Some restaurants that are listed as buyers of tilapia initially denied selling tilapia. There is a widespread and commonplace concern among many Nicaraguan citizens that fish from Lake Managua are contaminated. This concern affects consumption of all freshwater fish, including an important species like guapote. Nevertheless, with patient and persistent interviewing, restaurant manager responses were obtained that satisfied the equivalent forms reliability test. A recent study showed that mercury concentration in tilapia muscle from fish caught in Lake Managua averaged 0.0262 μg/g. These levels are considered non-toxic to humans (Gutierrez, 2001).

The survey instrument included questions on both tilapia and other types of fish and seafood sold, fish or seafood dishes on the menu, most popular fish sold, purchase prices, marketing channels, and information on suppliers. Awareness and availability of tilapia were addressed through questions related to the owner's familiarity with tilapia as well as questions related to its supply. Information on restaurant managers' attitudes towards statements related to the flavor, supply, quality, ease of preparation, size, and price was elicited by asking respondents to assign a value of from 1 to 10 in response to each statement. A score of 1 represented complete disagreement with the statement, and a score of 10 represented complete agreement. Information on restaurant characteristics was obtained by asking questions about the seating capacity of the restaurant, type of ownership, location, and years in business.

Model Specification

Two logit models were developed to identify the characteristics of two categories of restaurants; (1) one that sold tilapia and (2) one that indicated that they were likely to add tilapia to the menu. The logistic model has the following functional form:

Table 1. Number of restaurant managers interviewed by city and region in Nicaragua.

Location	Region			
	South-Central		*Northwest*	
	No.	%	No.	%
Managua	62	64	0	0
Estelí	8	8	0	0
Masaya	7	7	0	0
Rivas	6	6	0	0
Granada	5	5	0	0
Los Pueblos	5	5	0	0
Boaco	4	4	0	0
Jinotega	0	0	3	14
Matagalpa	0	0	4	19
Chinandega	0	0	6	29
León	0	0	8	38
Total respondents[a]	97	82%	21	18%

[a]This row indicates the number of respondents who answered this question and the percent these represent of the total number of respondents.

$$\ln\left[\frac{P}{1-P}\right] = \beta_0 + \beta_1 X_1 + \ldots + \beta_n X_n + \varepsilon \quad (2)$$

where, P is the probability that restaurants either sold tilapia or were likely to add tilapia to the menu; $X_1, X_2, \ldots, X_n$ are independent variables; β_0 is the intercept term; $\beta_1, \beta_2, \ldots, \beta_n$ are the coefficients on the regressors $X_1, X_2, \ldots, X_n$ respectively; and ε the error term (Ramanathan, 1998). By solving equation (2) for P (by first exponentiating both sides), we then obtained:

$$P = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + \ldots + \beta_n X_n + \varepsilon)}} \quad (3)$$

The two logit models were developed to provide an estimate of how product and restaurant characteristics affect (1) the probability that a given restaurant sold tilapia and (2) the probability that a restaurant not currently selling tilapia would be likely to add farm-raised tilapia to the menu the next year.

Model I. Probability that a restaurant sold tilapia

This model evaluated factors that affect the probability that a restaurant sold tilapia. This analysis provides information relating to which restaurant characteristics are most important in determining whether or not restaurants sold tilapia. There were 104 data points useful for this analysis. The restaurants that sold tilapia were assigned a value of one and those that did not sell tilapia were assigned a value of zero. The specific model estimated was:

$$Log\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 Dceviche + \beta_2 Ttle + \beta_3 Clet + \beta_4 Prlv + \beta_5 Yb + \beta_6 Tbusiness + \beta_7 Tfvariety + \beta_8 Tfsteak + \beta_9 Mincome + \beta_{10} Ows1 + \beta_{11} Ows2 \quad (4)$$

where, P is the probability that a restaurant sold tilapia; "Dceviche" is a dummy variable that refers to ceviche (fish marinated in lime juice) being one of the most important fish dishes in terms of fastest sales; "Ttle" is a dummy variable that equals one if the restaurant manager agrees with the statement that tilapia is off-flavor (tastes like earth); "Clet" is a dummy variable with a value of one for responses of managers who agreed with the statement that customers like to eat tilapia; "Prlv" is a dummy variable with a value of one if the restaurant manager agreed with the statement that patrons like the variety that tilapia adds to the menu; "Tbusiness" is a dummy variable that equals one if the restaurant is owned independently; "Yb" is a continuous variable representing years in business; "Tfvariety" is a dummy variable that equals one if the restaurant mainly sells a variety of different types of food; "Tfsteak" is a dummy variable that equals one if the restaurant mainly sells steaks; "Mincome" is a dummy variable that equals one if the larger part of the customer base is middle income; "Ows1" is a dummy variable that equals one if the overall weekly sales are less than $792; and "Ows2" is a dummy variable that equals one if the overall weekly sales are between $792 and $4,743. Details of all variables are presented in Table 2.

Tilapia is sometimes used to prepare ceviche to serve as an appetizer in some restaurants. Since new fish products can sometimes be introduced effectively as ceviche appetizers, it is hypothesized that there will be an increasing probability that a given restaurant sold tilapia if ceviche is the most important fish dish served by the restaurant. Based on that assumption, β_1 in equation (4) is expected to be positive. "Ttle," "Clet," and "Prlv" are variables associated with tilapia characteristics. One problem associated with tilapia in Nicaragua is off-flavor. Therefore β_2 in equation (4) is hypothesized to be negative. On the other hand, the coefficients β_3 and β_4 in equation (4) associated with the variables "Clet" and "Prlv" are hypothesized to be positive due to the fact that those restaurants sell tilapia because customers like to eat tilapia and patrons like the variety that tilapia adds to the menu.

Newer restaurants "Yb" may be more willing to experiment with newer products than older restaurants that sell other species of fish. Thus, it is hypothesized that β_5 would be negative in equation (4).

Many Nicaraguan restaurants are diverse, and serve a variety of types of cuisines such as seafood, chicken, steak, Italian, Mexican, etc. Restaurants that sold a variety of different types of food "Tfvariety" and restaurants that mainly sold steaks "Tfsteak" tend to sell appetizers that contain fish. The variables related to overall weekly sales were taken as an indicator of restaurant size. Small "Ows1" (sales < $792/week) and large "Ows2" (sales of $792–$4,743/week) restaurant size groupings were created from the data. A middle-income level variable was included to identify income level effects on tilapia sales. Most of the restaurants selling fish had middle-income patrons. There were no prior expectations regarding signs for the coefficients associated with variables related to the type of cuisine, type of restaurant ownership, middle income clientele, or weekly sales.

Model II. The likelihood that a restaurant not currently selling tilapia would be likely to add farm-raised tilapia to the menu the next year

Table 2. Independent variables selected for Model I (whether or not restaurants sold tilapia).

Explanatory variables	Meaning of the variables	Mean (from survey)
Dceviche	1 if one of the four most important top fish and seafood dishes in terms of fastest sales is ceviche, 0 otherwise;	0.17
Ttle	1 if the restaurant manager agreed with the statement that tilapia tasted like earth, 0 otherwise;	0.79
Clet	1 if the restaurant manager agreed with the statement that customers like to eat tilapia, 0 otherwise;	0.22
Prlv	1 if the restaurant manager agreed with the statement that patrons like the variety that tilapia adds to the menu, 0 otherwise;	0.62
Tbusiness	1 if the restaurant is owned independently, 0 otherwise;	0.68
Yb	Years in business;	1.00
Tfvariety	1 if a variety of types of food are sold, 0 otherwise;	0.67
Tfsteak	1 if the main type of food sold is steak, 0 otherwise;	0.19
Mincome	1 if the larger part of the customer base is middle-income, 0 otherwise;	0.50
Ows1	1 if the overall weekly sales are less than \$792 > 0 otherwise; and	0.35
Ows2	1 if the overall weekly sales is between \$7924,743 > 0.	0.49

Table 3. Independent variables for Model II (likelihood of adding tilapia to the menu).

Explanatory variables	Meaning of the variables	Mean (from survey)
Awareness	1 if the restaurant is aware of tilapia, 0 otherwise;	0.79
Clet	1 if the restaurant manager disagreed with the statement that customers like to eat tilapia, 0 otherwise;	0.35
Thqf	1 if the restaurant manager disagreed with the statement that tilapia is a high quality fish, 0 otherwise;	0.18
Tlfo	1 if the restaurant manager disagreed with the statement that tilapia has a little fishy odor, 0 otherwise;	0.60
Tnff	1 if the restaurant manager disagreed with the statement that tilapia has a nice fresh flavor, 0 otherwise;	0.12
Yb	Years in business;	1.00
Tfvariety	1 if a variety of types of food are sold, 0 otherwise;	0.69
Tfchicken	1 if the main type of food sold is chicken, 0 otherwise;	0.02
Tfsteak	1 if the main type of food sold is steak, 0 otherwise; and	0.17
Region	1 if restaurant is located in the South-Central region, 0 otherwise.	0.80

This model evaluated the probability that a restaurant not currently selling tilapia would be likely to sell it the next year if a consistent supply of farm-raised tilapia were available. There were 84 data points useful for this analysis. The restaurants that were very likely to sell farm-raised tilapia were assigned a value of one, while those restaurants that were unlikely to sell farm-raised tilapia the next year were assigned a value of zero. The specific model estimated was

$$Log\left(\frac{P}{1-P}\right) = \alpha_0 + \alpha_1 Awareness + \alpha_2 Clet + \alpha_3 Thqf + \alpha_4 Tlfo + \alpha_5 Tnff + \alpha_6 Yb + \alpha_7 Tfvariety + \alpha_8 Tfchicken + \alpha_9 Tfsteak + \alpha_{10} Region \quad (5)$$

where P is the probability that a restaurant manager will start to sell farm-raised tilapia the next year; "Awareness" is a

dummy variable which equals one if the restaurant was aware of tilapia; "Clet" is a dummy variable that equals one if the restaurant manager disagreed with the statement that customers like to eat tilapia; "Thqf" is a dummy variable that equals one if the restaurant manager disagreed with the statement that tilapia is a high quality fish; "Tlfo" is a dummy variable that equals one if the restaurant manager disagreed with the statement that tilapia has a little fishy odor; "Tnff" is a dummy variable that equals one if the restaurant manager disagreed with the statement that tilapia has a nice fresh flavor; "Yb" is a continuous variable representing years in business; "Tfvariety" is a dummy variable that equals one if the restaurant mainly sold a variety of different types of food; "Tfchicken" is a dummy variable that equals one if the restaurant mainly sold chicken; "Tfsteak" is a dummy variable that equals one if the restaurant mainly sold steaks; "Region" is a dummy variable that equals one if the restaurant was located in the South-Central region. Details of all variables are in Table 3.

Restaurants aware of tilapia were also aware of the Lake Managua contamination issue and therefore managers would be likely to start selling farm-raised fish that would not be considered contaminated. Awareness of tilapia by restaurant managers was hypothesized to be positively associated with the likelihood to begin selling farm-raised tilapia the next year if a consistent supply of farm-raised tilapia were available.

The following relationships were hypothesized to be positively associated with the likelihood of adding farm-raised tilapia to the menu in the next year if a consistent supply of farm-raised tilapia was available: 1) disagreement with the statement that customers like to eat tilapia currently available in Nicaragua "Clet"; 2) disagreement with the statement that tilapia has some fishy odor "Tlfo"; and 3) disagreement with the statement that tilapia currently available on the market has a nice flavor "Tnff." Tilapia currently available in the market is wild-caught and customers have negative perceptions of it. Restaurant managers who were not selling tilapia expressed the fear of contamination as a reason why customers do not like to eat tilapia and expressed their disagreement with the statement that the customer likes to eat tilapia. However, they said that customers would be willing to eat tilapia if it was a new product not raised in waters thought to be polluted. Most of the wild-caught tilapia supply in Nicaragua is stored under poor conditions without adequate chilling to preserve fish. Fish products release strong odors if not preserved well. Moreover, tilapia are often mixed with other species of fish.

Disagreement with the statement that tilapia is a high quality fish "Thqf" and years in business "Yb" were hypothesized to be negatively associated with the likelihood of adding farm-raised tilapia to the menu even if a consistent supply of farm-raised tilapia was available. Restaurant managers who perceived tilapia as a poor quality fish, regardless of whether it was farmed or wild-caught, would not be likely to add farm-raised tilapia the next year. Newer restaurants may be more willing to experiment with newer products than older restaurants that sold other species of fish.

There were no prior expectations regarding signs for the coefficients associated with the "Tfvariety," "Tfchicken," and "Tfsteak" variables nor with region where the restaurant was located.

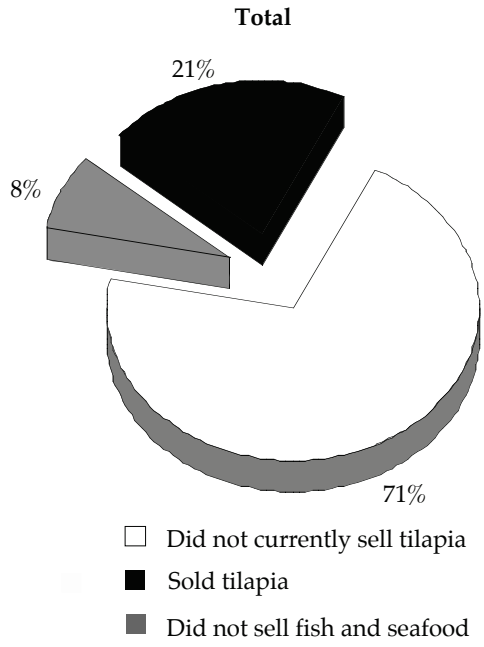

Figure 5. Percentages of restaurants that sold or did not sell fish and seafood in Nicaragua.

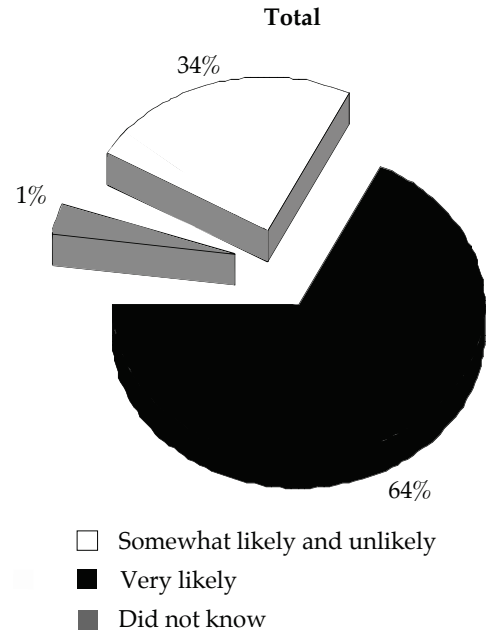

Figure 6. Likelihood of restaurants in Nicaragua selling tilapia the next year.

RESULTS

The majority (92%) of restaurants in Nicaragua sold fish and seafood; only a small percentage (21%) of restaurants in the survey sold tilapia (Figure 5). Overall, 64% of the respondents not currently selling tilapia were very likely and 35% somewhat likely or unlikely to begin selling tilapia the next year if they had a consistent tilapia supply and could get a farm-

Table 4. Maximum likelihood estimates of Model I.

Explanatory variable	Expected signs	Coefficient	Asymptotic t-ratio
Ceviche on menu	+	4.05	2.11**
Agreed tilapia tastes like earth	-	-2.80	-2.12**
Agreed customers like to eat tilapia	+	7.38	3.78**
Agree patrons like variety tilapia add to the menu	+	-0.83	-0.66
Years in business	-	-0.75	-0.94
Type of business	+/-	0.46	0.38
Variety of food	+/-	5.71	1.91*
Steak restaurant	+/-	7.66	2.20**
Middle-income level	+/-	2.19	1.70*
Overall weekly sales less than $792	+/-	-1.32	-0.78
Overall weekly sales between $792–4,743	+/-	3.27	1.77*
Constant		-6.99	-2.18**

* Evaluated at 90% significance level.
**Evaluated at 95% significance level.

raised tilapia product differentiated from wild-caught tilapia (Figure 6).

Model I: Probability that a restaurant sold tilapia

The maximum likelihood parameter estimates of the logit model and the asymptotic ratios are presented in Table 4. All parameter estimates are distributed asymptotically normal. The likelihood ratio test of 79.84 with 11 degrees of freedom, was significant at the 95% confidence interval indicating a reasonable fit for the model. No evidence was found of heteroskedasticity in the model.

All estimated coefficients were evaluated at the 95% and 90% significance levels. The McFadden R^2 measure of goodness-of-fit was estimated to be 0.73. The estimated coefficients on the following variables were significant at the 95% level: 1) restaurants that included ceviche on the menu (positive sign); 2) agreement with the statement that tilapia was off-flavor (tastes like earth) (negative sign); 3) agreement with the statement that customers like to eat tilapia (positive sign); and 4) the main type of food sold is steak (positive sign). Chefs indicated that tilapia has a good texture for preparing ceviche and restaurants selling ceviche were likely to sell tilapia. Off-flavor discouraged restaurants from selling tilapia and those restaurants that had experienced off-flavor tilapia were less likely to sell tilapia. Restaurants with managers who agreed with the statement that customers like to eat tilapia were restaurants that sold it because of their customers' preferences. Restaurants serving steaks as the main food also tended to serve a variety of different dishes. Steak restaurants tended to be those willing to experiment with new dishes such as tilapia.

The following estimated coefficients were significant at the 90% confidence level: 1) restaurants that have a variety of different types of food on the menu (positive sign); 2) restaurants for which the largest part of the customer base is middle-income (positive sign); and 3) restaurants with overall weekly sales between $792–4,743 (positive sign). Nicaraguan restaurants offering a variety of types of food on the menu were likely to sell tilapia. Restaurants in which the largest part of the customer base is middle-income are restaurants likely to offer a variety of food and experiment with new products. Larger restaurants (overall weekly sales greater than $792) are expected to have more capacity and storage and to be more willing to experiment with new products.

Agreement with the statement that patrons like the variety that tilapia adds to the menu was not significant in the model. Other non-significant variables included whether the business was owned independently or by a chain and the variable related to smaller restaurants (overall weekly sales less than $792).

Table 5 presents the estimated probabilities associated with the likelihood that a given restaurant is selling tilapia for two different ranges of overall weekly sales in dollars for restaurants with two different types of cuisine. A restaurant with the largest part of the customer base as middle-income and that sold ceviche was assumed. Restaurants with these baseline sets of characteristics had probabilities of 84–100% of selling tilapia. The probability of selling tilapia to restaurants with weekly sales less than $792 was higher than those for larger restaurants. In addition, for those restaurants that sold steaks as the main type of food, the probabilities were somewhat higher that a given restaurant sold tilapia than if the restaurant sold a variety of food. The high probabilities associated with tilapia sales in restaurants that offered a varied menu or were considered as steak restaurants indicated that an effective marketing strategy for tilapia farmers would be to target these types of restaurants.

Table 5. Estimated probabilities that a given restaurant sold tilapia.

Overall weekly sales ($)	Estimated probabilities by type of food	
	Variety	*Steaks*
Less than $792	0.97	1.00
$792–4,743	0.84	0.97

steaks as the main type of food.

Responses to the following statements reflecting perceptions of tilapia were also significant at the 95% level: 1) disagreement with the statement that tilapia currently available in the market is a high quality fish (negative sign); and 2) disagreement with the statement that tilapia currently available in the market has some fishy odor (positive sign). The signs were as expected. Those restaurants that disagreed that tilapia currently available in the market is high quality perceived tilapia, regardless of whether it was wild-caught or farm-raised, as a poor quality fish and were less likely to add it to their menu the next year.

Table 6. Maximum likelihood estimates of Model II.

Explanatory variable	Expected signs	Coefficients	Asymptotic t-ratio
Awareness	+	0.51	0.65
Disagreed customers like to eat tilapia	+	1.15	1.65*
Disagreed tilapia is high quality fish	-	-2.24	-2.44**
Disagreed tilapia has a little fishy odor	+	1.35	2.02**
Disagreed tilapia has a nice fresh flavor	+	1.86	1.74*
Years in business	+	0.88	1.97**
Variety of food	+/-	2.26	2.31**
Chicken restaurant	+/-	1.27	0.75
Steak restaurant	+/-	3.73	2.78**
Region of the country	+/-	0.94	1.24
Constant		-4.43	-2.99**

* Evaluated at 90% significance level.
**Evaluated at 95% significance level.

Model II: Likelihood of restaurants adding tilapia to their menu in the next year (if a consistent supply of farm-raised tilapia were available).

The maximum likelihood estimates of the logit model and their asymptotic ratios are presented in Table 6. All parameter estimates were distributed asymptotically normal. The likelihood ratio test statistic is 27.93 with 10 degrees of freedom, which is significant at the 95% confidence interval. There was no evidence of heteroskedasticity in the model. All estimated coefficients were evaluated at the 95% and 90% significance level. The Mcfadden R^2 for this model was estimated to be 0.26.

The following restaurant characteristics: 1) years in business (positive sign); 2) serving a variety of types of food (positive sign); and 3) steaks as the main type of food served (positive sign) were significant at the 95% significance level. Older restaurants selling fish have more experience than newer restaurants and may be willing to experiment with newer products, thus, older restaurants were very likely to add tilapia. In addition, restaurants serving a variety of food may have better capacity to add new products. In the logit model, the probability to add tilapia next year increased if the restaurants served

Restaurant managers that disagreed with the statement that tilapia currently available in the market has some fishy odor were more likely to be willing to add farm-raised tilapia to the menu. Odor of the fish is an important attribute considered by restaurants due to storage concerns with perishable products; fish without strong odors are generally preferable to fish with strong odors.

The estimated coefficients associated with the variables: 1) disagreement with the statement that customers like to eat tilapia currently available in the market (positive sign); and 2) disagreement with the statement that tilapia currently available in the market has a nice fresh flavor (positive sign), were significant at the 90% significance level. The signs were expected, and reflected more the concerns of restaurant managers relating to a lack of consumer acceptance of tilapia available on the market. The positive sign could be an indication that restaurant managers believe that consumers may view farm-raised tilapia as distinct from tilapia currently available in the market. This result provides some evidence that consumers could be convinced of the safety and flavor of a farm-raised tilapia. Most of the restaurants in Nicaragua commented favorably on the texture of tilapia and were likely to add farm-raised tilapia

Table 7. Estimated probabilities that a given restaurant would likely add farm-raised tilapia to the menu the next year.

Years in business	Estimated probabilities by type of food served		
	Variety	*Chicken*	*Steak*
Less than 10	0.94	0.84	0.98
11–20	0.97	0.93	0.99
More than 20	0.99	0.98	1.00

to the menu if flavor would be guaranteed. Tilapia growers may need to prepare samples for restaurant managers as part of a marketing strategy. Tilapia farmers could perhaps take advantage of the negative perceptions of wild-caught tilapia by differentiating their farm-raised product from the wild-caught fish, which is commonly associated with contamination, off-flavor, and poor quality. Tilapia farms and processors in Nicaragua will need to guarantee and ensure the flavor, quality, and safety of their product and promote these attributes.

Radio and other advertising programs could also be used for farm-raised tilapia to compete effectively in the whole-dressed form. Broad-based consumer education and labeling programs may be needed to assist consumers to differentiate between farm-raised and wild-caught tilapia. Issues related to quality of fish and seafood need to be addressed on a broad-scale. Nicaraguan fish buyers and consumers alike do not have a clear idea how to handle fish properly. The government could conduct broad-based consumer and buyer education programs. Manuals and other printed materials with guidance on proper fish handling as well as educational meetings would be of great benefit.

Awareness of tilapia, chicken as the main type of food served, and the South-central region of the country are factors that did not have any effect on the likelihood that a restaurant would add tilapia the next year. Tilapia is a well-known product in Nicaragua; thus, there was little variation to explain. Restaurants in Nicaragua that primarily sell chicken tend to be highly specialized and did not offer other types of dishes. Location of these restaurants was not a determinant for the likelihood of adding tilapia in the future.

Table 7 presents the estimated probabilities associated with the likelihood that a given restaurant not currently selling tilapia would add farm-raised tilapia to the menu. The hypothetical restaurant is examined for three ranges of years in business and for different types of food to characterize possible markets for tilapia farmers in Nicaragua. A restaurant with a manager who disagreed with the statement that "customers like to eat tilapia", "tilapia has some fishy odor", and "tilapia has nice fresh flavor" was assumed as the base scenario. Estimated probabilities ranged from 0.84 to 1.00. The estimated probabilities demonstrate to tilapia farmers that there is a high probability for steak and variety-cuisine restaurants to add tilapia to the menu. It suggests that the most effective marketing strategy to increase tilapia sales through restaurants would be to target more established steak and variety-cuisine restaurants. The probabilities for restaurants selling steaks were greater than restaurants selling chicken and those selling a variety of different types of food for different numbers of years in business. Probabilities increased with the number of years in business.

CONCLUSIONS

The results suggest that the most promising restaurant markets for tilapia farmers appear to be older restaurants that offer a variety of different types of food on the menu and those that served steaks. Larger restaurants that consider tilapia to be a high-quality product and that offer ceviche on the menu are those that tend to sell tilapia. Restaurants that do not sell tilapia appear to be newer, smaller restaurants that specialize in seafood. Experience with off-flavor and poor quality tilapia are the reasons why some restaurants do not sell tilapia.

This study demonstrated some potential to develop a restaurant market for farm-raised tilapia in Nicaragua and identified those types of restaurants that would be best to target in a marketing campaign. Nevertheless, a substantial effort will need to be made to clearly differentiate farm-raised tilapia in the minds of both consumers and restaurant managers. Tilapia farms and processors will also have to be vigilant with quality control programs to be successful.

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