A Preliminary Survey of Tilapia Markets in North America

JURIJ HOMZIAK and BENEDICT C. POSADAS
Sea Grant Advisory Service
Mississippi Cooperative Extension Service
Mississippi State University
2710 Beach Boulevard, Suite1-E
Biloxi, MS 39531

ABSTRACT

The production of tilapia for sale to major urban North American markets has been promoted as being of significant economic potential to agricultural economies of the Gulf of Mexico and the Caribbean. Red or gold tilapia hybrids have been identified as having great potential. The market to support this contention has not been clearly identified or evaluated. This survey was designed to provide a preliminary description of existing tilapia/hybrid markets. Information on the size and value of current markets, market trends, and preferences (species, product forms, origin, etc.) was requested from 72 U.S. and Canadian tilapia brokers. A total of 21 responses were returned (29%).

The number of companies handling tilapia appears stable (annual change < 5% turnover < 20%). Companies handling tilapia had mean annual gross sales significantly greater than the industry average ($15.1 m vs. $9.93 m). The market is supplied at present by Asian (45%) and U.S. (40%) sources. Given a choice, most firms had no preference (57%). No preference for cultured tilapia was expressed. The trade was largely in red/gold (57%) or white/silver fish, those coming from cultivation. This suggests that education of the buyers may increase the preference and demand for cultured fish. Fresh tilapia (55%), divided equally among whole fish (45%) and fillets (45%), and frozen (40%, all forms) dominate the current market. Most respondents (45%) expressed no preference for any product form (fresh, frozen, processed) in the future. There were no evident trends in size, price, product form, or packaging preferences, suggesting that individual buyers are unable to predict future market conditions. Equal numbers (35%) either did not answer or reported no change in tilapia prices in the last 12 months, while 20% reported an increase, and 10% a decrease in price. A majority (40%) expressed no opinion on quantity trends in the same period, 25% saw no change, and 20% each reported either an increase or decrease in volume traded. It appears that factors limiting demand (low consumer regard, insufficient demand, objections to available product) control the current market for tilapia in North America, not producer prices. Producers should be aware of and have the resources to overcome these limits on the market.

INTRODUCTION

One goal of aquaculture development is to generate income by stimulating local and regional economies (Pillay, 1977; McGoodwin, 1982). The cultivation of high value fish and shellfish for export or shipment to luxury urban markets can provide both direct and indirect economic benefits to the producing region. Aquaculture has succeeded in stimulating regional economic growth in widely

differing regions. Shrimp culture in Ecuador and in Southeast Asia, catfish farming in the southern U.S., and salmon culture in Ireland, Chile, and the Canadian maritime provinces are examples of successful income-oriented aquaculture development.

The economic benefits of aquaculture development to a region can be illustrated by the U.S. catfish industry. Catfish is the single most valuable freshwater aquacultural commodity in the U.S. (Jensen, 1988). The Delta region of Mississippi, Arkansas, and Louisiana, a rural, low income region of traditional row crop agriculture, has been revitalized to become the center of U.S. catfish aquaculture (Keenum and Waldrop, 1988). The U.S. Department of Agriculture (1988) estimates that Mississippi food fish and fingerling producers, farming over 90,000 acres, received more than $242 million for their catfish. Catfish processing plants, many of them cooperatively owned, processed more than 280 million pounds of fish in 1987, with a total retail value more than $500 million. Because of the concentration of both farm enterprises and related industries in the state, the total value of the industry to Mississippi in 1987 was estimated to be over $2 billion (U.S. Department of Agriculture, 1988).

The desire to repeat this success in Mississippi and other states is great. Many aquaculture development plans for the Gulf of Mexico states (*e.g.* Glude, 1977; Stickney and Davis, 1981; Joint Subcommittee on Aquaculture, 1983; Conner, 1985) have suggested that tilapia culture has great economic potential for the region. Tilapia farming has been mentioned with increasing frequency in recent trade journals (*e.g.* Anonymous, 1989c; Jones, 1989; Redmayne, 1989; Anonymous, 1989b) and in the popular press as having the potential to repeat the economic success of catfish. While these reports mention that capital and management skills needed to successfully market the fish have often been lacking, most focus on production. Much less attention has been paid to identifying the markets where the product must be sold. Jones (1989) warns that production-led development, combined with inadequate information on prices, outlets, and consumer preferences may cause difficulties for the industry.

Attempts have been made to cultivate tilapia in Mississippi since at least the mid-1970's (National Research Council, 1978), but with little commercial success. There are now at least five tilapia producers in Mississippi. Two operations, one an intensive tank-based system and the other a raceway-pond system, have a current capability of about 200,000 pounds per year. Other farmers and investors in south Mississippi and other Gulf states are preparing to enter production.

We designed this survey to help producers by providing them with preliminary information on existing industrial tilapia markets in North America. Such information is essential for accurate financial and production planning by producers, investors, and financial institutions. Without adequate information on

product forms, prices, buyer preferences, and other market data, the economic viability of individual ventures and of the entire industry remains unknown.

METHODS

A survey using mailed questionnaires was directed to all listed tilapia buyers based in the United States and Canada. The 72 seafood companies we contacted were identified primarily from the 1989 Seafood Buyers Catalogue (Anonymous, 1989a) which provided basic information on addresses, telephone, and FAX numbers, points of contact and information on annual sales volumes and value, product types handled, company business activity, and other information.

The primary objective of this study was to define the tilapia market for actual and prospective tilapia producers in Mississippi. Company responses regarding current activities and preferences for species, product forms, volumes, and prices formed the basis of the survey. We combined this with data on the trading companies to estimate market size and growth, market stability, buyer preferences, market and buyer trends, and to determine if buyers identified Mississippi with aquaculture products.

Where possible, statistical comparisons were made among the data sets to determine significance of differences. The specific tests used (see Zar, 1984 for details on test statistics) and results are noted in the text.

Market Size, Market Share, Growth, and Strength

We estimated the size of the market for tilapia by determining the number of seafood marketing firms now handling tilapia. Changes in the number of companies handling tilapia over time were examined for trends in market growth.

We related the relative strength of seafood marketing companies handling tilapia, using their annual seafood sales estimates, to past, present, or future participation of these firms in the tilapia market. Market trends were estimated from this information. We estimated market share held by tilapia trading companies and the position of tilapia marketing firms in the seafood industry by comparing average annual sales figures among industry section.

Buyer Preferences

We determined the type of company involved in the tilapia trade, the sources of the tilapia traded (farmed or wild, imported or local), the species/hybrids handled, sizes traded, and the product forms coming into the market. To provide information on future market conditions we also determined buyer preferences in each category. We also examined the packaging methods and outlets used by these companies in the past/present and their preferences.

Price and Volume Trends

Confidential information on prices and quantities of tilapia handled by individual firms was used to identify trends over the past twelve months and to identify underlying causes for observed trends.

Product Association

We determined the extent to which tilapia marketing companies associated Mississippi with farmed-raised fish and catfish in general. We also determined the degree of interest these firms had in handling Mississippi farmed raised tilapia and in establishing contact with Mississippi tilapia producers.

RESULTS

Market Size and Share

The distribution of the 72 North American seafood companies that handle tilapia, by state, is shown in Figure 1. Most tilapia marketing firms are located in Florida (18), followed by California (12), and New York (10). Twenty-one of these companies (29%) responded to the mailed questionnaire. The remainder were either not returned or not useable.

The entire seafood industry (1,136 companies; Anonymous, 1989a) handled seafood products valued at $11.64 billion annually. The average seafood company generated annual sales amounting to $10.25 million in 1988 (Table 1). The 1988 sales of the 72 seafood companies handling tilapia amounted to $1.08 billion with average annual sales valued at $15.10 million each. Firms which handle tilapia account for 6.33 percent of the seafood industry numbers yet appear to control a greater than expected share (9.33 percent) of the North American seafood market.

Large companies (Figure 2) with sales over $20 million per year were the most prominent in the market (24 companies, 33%). Small (sales $0 – 5 million per year) and medium companies (annual sales $5 – 20 million) were equally represented, at 25% and 24% of the total number of firms respectively.

We compared average 1988 annual sales figures of tilapia marketing firms against sales figures from the seafood industry and from firms not marketing tilapia to determine the position of tilapia firms in the seafood market. Because variances for sales figures were large and significantly unequal (F-max test; Sokal and Rohlf, 1969), we used two tailed Welch's approximate t-tests (Zar, 1984) in comparisons of average annual sales figures. While we tested for differences among means, we retained the industry designation of "average" in reporting results in the text.

We concluded that the 21 respondent firms represented the 72 firms that form the industrial tilapia market in North America. We based this conclusion on three points. First, the return rate of 29% for the mailed questionnaires was higher than expected for this type of survey. Pomeroy and Kohl (1987), using a

Table 1. Average annual seafood sales of seafood companies in North America during 1988 (in million US dollars).

Industry	Mean annual sales ($)	Standard deviation	n	Total number of companies
All seafood companies	10.25	15.03	918	1,136
Companies not handling tilapia	9.93	14.08	860	1,066
Companies handling tilapia	15.10	16.90	58	72
Respondent tilapia companies	10.59	12.61	16	21

n = number of companies with annual sales data

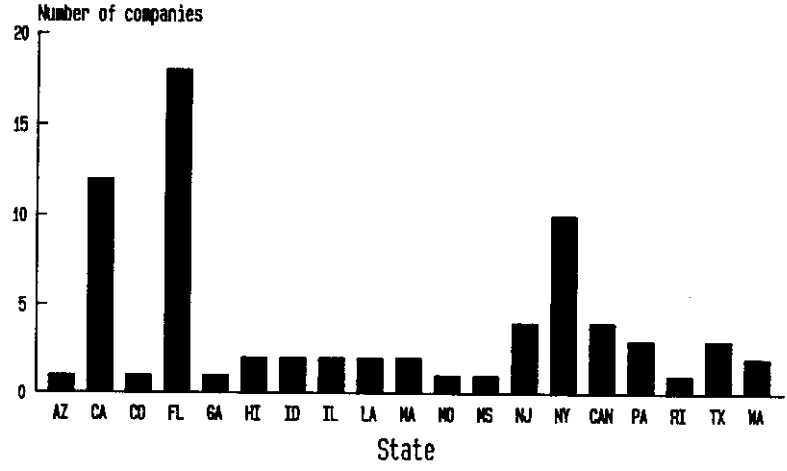

Figure 1. Number of seafood companies handling tilapia by state in North America during 1989 (Anonymous, 1989a).

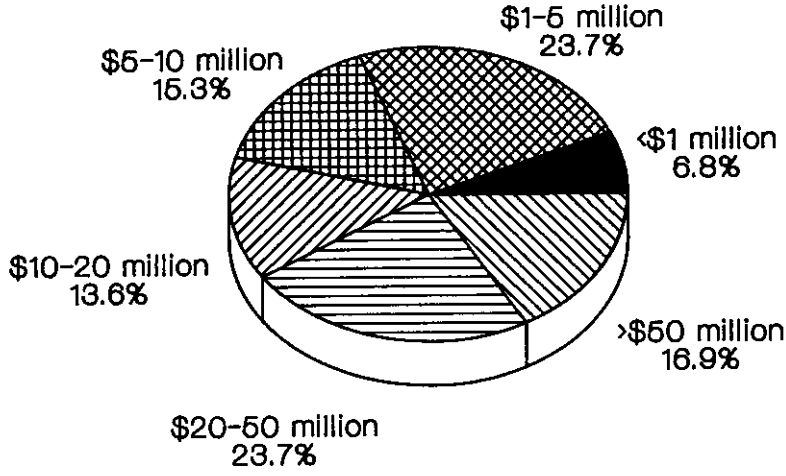

Figure 2. Number of seafood companies handling tilapia by annual seafood sales in North America during 1989 (Anonymous, 1989a).

similar survey, showed that survey returns over 25% were sufficient to characterize the South Carolina crawfish industry. Second, the average annual sales of respondent firms did not differ significantly from the average annual sales of all tilapia marketing firms ($t = 1.17$, $p > 0.05$, $n = 33$). Third, the proportions of small, medium, and large firms among the respondents did not differ significantly from the proportions of these groups determined for the entire tilapia marketing industry. These results suggest that the sample firms represented the tilapia industry.

The average 1988 seafood sales reported by firms that handled tilapia ($15.10 million, Table 1) were significantly greater than the $10.25 million average sales estimated for the North American seafood industry in the same period ($t = 2.13$, $0.01 < p < 0.05$, $n = 63$). Annual sales by tilapia companies were also significantly greater than the average 1988 seafood sales ($10.59 million) reported by firms that did not handle tilapia ($t = 2.27$, $0.01 < p < 0.05$, $n = 63$). These results suggest that larger seafood trading companies with greater than average sales revenues tend to engage in tilapia marketing. Because most tilapia marketing firms also import a wide range of seafood products (see Product Sources section below), they probably carry tilapia to diversify their product lines.

Table 2 shows the percent distribution of respondent companies by sales volume category (small, medium, and large firms; sales of $0 – 5, $5 – 20, and over $20 million, respectively) and by time of participation in the tilapia market—past, present, and future. We detected no significant differences among the proportions of small, medium, and large companies participating in the three time periods ($Z = 0.648$, $p \leq 0.05$, test for differences among proportions, Zar, 1984). This suggests little motion towards or away from marketing tilapia and no change in tilapia market share.

Market Growth

Twelve companies or 57% of the respondents indicated that they are handling tilapia at present (Figure 3). Fourteen companies or 67% replied that they handled tilapia in the past. Most of these companies have been handling tilapia during the past three years. Thirteen or 62% signified they anticipate handling or will continue to handle tilapia in the future.

The tilapia market appears to be stable, with little change in the number of companies over time. The annual change in the number of companies was less than 5%. Nine companies handled tilapia in all three time periods (Figure 3). Three new companies entered the industry in 1988 replacing the five companies which left the industry representing a turnover of 20%. Four companies reported that they intend to enter or re-enter the industry once the tilapia market expands.

The above average annual sales figures reported by tilapia marketing firms (Table 1), the low turnover of firms entering and leaving the market (Table 2), and the constant size of tilapia marketing firms over time (Table 2) suggest that the tilapia market is not in a growth phase (Chaston, 1983) but is, at best, in the introductory phase of its market cycle.

Buyer Preferences

Product sources

Most tilapia marketing firms were seafood importers (Figure 4), followed by distributors and wholesalers. Tilapia firms have access to a variety of sources of tilapia (Table 3). Most tilapia came from either domestic (40%) or Asian (45%) sources, primarily Taiwan and Thailand. Some respondents buy tilapia from the Middle East, primarily Israel, and Central America. Four-fifths of tilapia importers also import seafood products other than tilapia, supporting the view that tilapia is only one product in a diverse seafood line for most firms.

There were significant differences among current and preferred sources of tilapia by country of origin. Given a choice, most firms would switch sources of supply ($Z = 2.975$, $0.001 < p < 0.01$, test for differences among proportions, Zar, 1984) but would not change from wild to farmed supplies or vice versa ($Z = 0.755$, $0.10 < P$). Most firms would prefer to rely less on U.S. and Asian fish. When offered a choice of sources, over half of the respondents (57%) expressed

Table 2. Percentage distribution of respondent companies handling tilapia by 1989 annual sales among time periods.(Figures in parentheses are standard deviations).

Annual sales ($ million)	Currently handling	Previously carrying	Anticipating to handle
Not available	16.67	28.57	23.08
Below 5	33.33	28.57	23.08
5 - 20	25.00	21.43	30.77
Above 20	25.00	21.43	23.08
Total	100.00	100.00	100.00
Number of companies	12	14	13

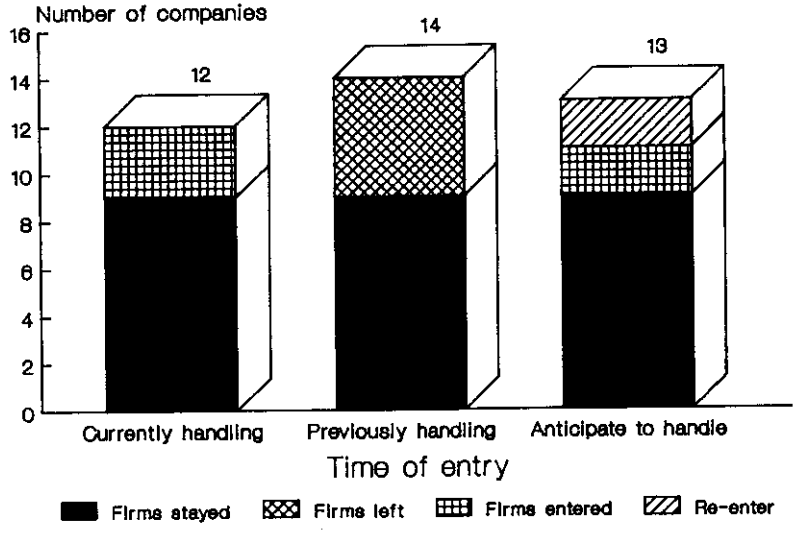

Figure 3. Number of tilapia companies active in 1989, before 1989, and anticipating activity in tilapia after 1989. Also shown are the numbers of firms that persist in the market in each period and numbers departing, entering, and re-entering the market. (Source: Survey, MS-SGAS)

Table 3. Current and preferred sources of tilapia during 1989.

Sources of tilapia	Current		Preferred	
	No.	%	No.	%
By country				
United States	8	38.10	5	23.81
Far East	10	47.62	4	19.05
Other	2	9.52	3	14.29
No preference	4	19.05	12	57.14
By production system				
Cultured	8	38.10	6	28.57
Caught	5	23.81	4	19.05
No preference	9	42.86	11	52.38

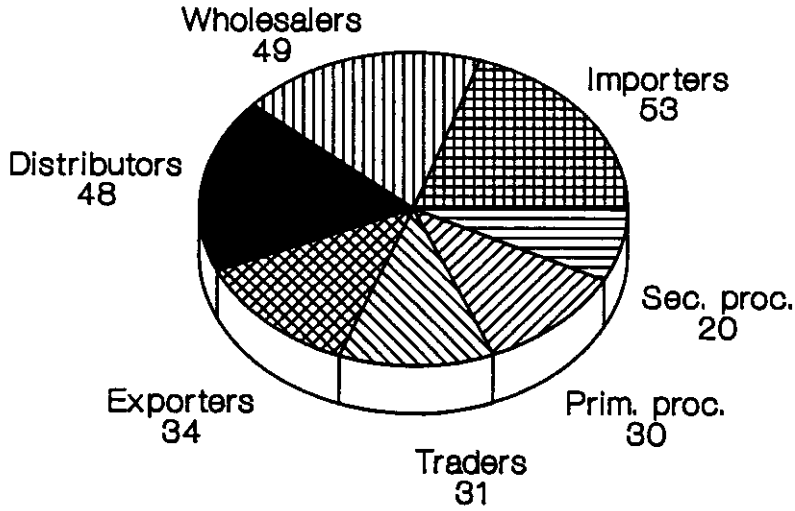

Figure 4. Numbers of tilapia marketing companies engaging in seafood sales activities during 1989. The sum exceeds the total number of tilapia firms because most engage in multiple business activities. (Anonymous, 1989a)

no preference among countries for imported tilapia or between imported and domestic fish (Table 3).

Nearly half (43%) of all active tilapia marketing firms do not carry or do not identify their fish as farm raised (Table 3). Over half (52%) would not express a preference for farm raised over wild caught fish if a choice were available. While not significant, the proportion of firms preferring farmed fish declined when compared to current supplies, while preferences for wild fish remained unchanged (Table 3). Almost all respondents which handled farm-raised tilapia imported them from other countries. A few seafood companies indicated that they viewed domestic, farm-raised tilapia as more expensive than those caught from the wild or imported. A few also stated that they would be interested in handling farm-raised tilapia if they were less expensive.

Tilapia species

We grouped all tilapia as either black, blue (including St. Peter's, silver, and white), golden, or red in our questionnaire results. This corresponds with the general way in which buyers reported they distinguished among the available species and hybrids of tilapia.

Most seafood firms reported that they handled more than one tilapia species (Table 4). Six out of ten handled red and golden species, and four-tenths also reported handling black tilapia. One-fifth of the respondents carried blue tilapia or St. Peter's fish. Combined, red and gold tilapia were carried by the most firms (57%). Black and blue tilapia were equally preferred at 43% each.

Seafood companies did not appear to have preferences for any particular tilapia species if a choice were offered. Table 4 shows that most marketing companies would change the species that they now carry ($Z = 3.608$, $P < 0.001$) and the number of species they trade at present ($Z = 2.921$, $0.001 < P < 0.01$). The number handling more than one species would decline from the current 47% to about 10%. Most firms indicated they would prefer not to commit to carrying a particular species (67%) or to carry multiple species of tilapia (67%). However, those that indicated a preference among species would choose red or gold species if the prices were competitive. Because red and gold tilapia are exclusively farm-raised, these results suggest that most tilapia buyers are unfamiliar with farm-raised tilapia species.

Product forms

Seafood companies buy tilapia in a variety of different forms. Fifty two percent buy fresh tilapia while 43% handle frozen tilapia (Figure 5). Ten percent carry live fish besides either fresh or frozen tilapia. Sixty-two percent expressed no preference among product forms, while about one-fourth preferred either fresh or frozen tilapia.

The most often purchased product was whole tilapia (48%). One fourth of

Table 4. Tilapia species handled during 1989.

Tilapia species	Past/Current		Preferred	
	No.	%	No.	%
By species handled				
Red tilapia	8	38.10	2	9.52
Golden tilapia	4	19.05	2	9.52
Blue tilapia	9	42.86	3	14.28
Black tilapia	9	42.86	2	9.52
No preference	6	28.57	14	66.67
By number of species				
Single	5	23.81	5	23.81
Multiple	10	47.62	2	9.52
No preference	6	28.57	14	66.67

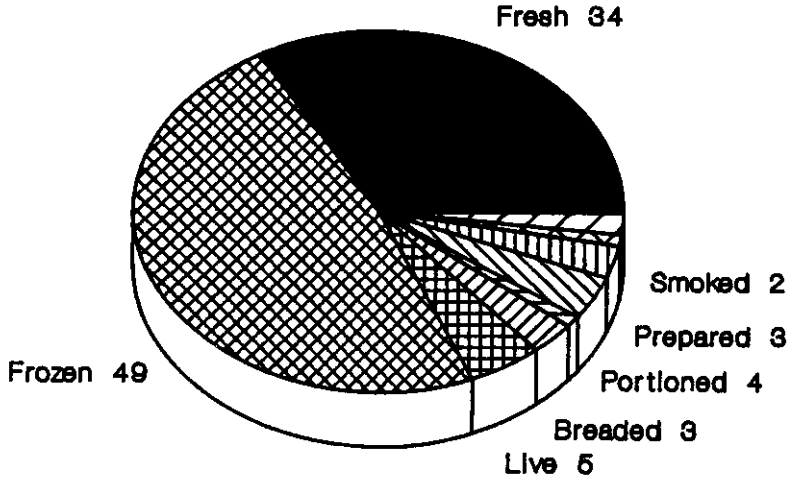

Figure 5. Number of companies handling different product types of tilapia during 1989. "Other" includes smoked, prepared, portioned, breaded, and live. (Anonymous, 1989a)

the seafood firms reported that they buy gilled and gutted tilapia. The tilapia fillets bought by 29% of the firms were skinless and boneless.

Over half carried only one product form. These firms generally sold the product in the same form they purchased it. While few of the respondents indicated that they processed the product into fillets, about 40% of tilapia companies operate either primary or secondary processing facilities (Figure 4).

Most companies marketing tilapia did not express any preferences among available product forms, not even for those they handle at present. This suggests that the companies themselves cannot accurately evaluate or predict market preferences.

Product weights

The companies which handle live tilapia tend to prefer smaller fish, about 300 to 340 grams (2/3 to 3/4 pound) each. Five of the eight companies which carried whole tilapia handled a range of product weights, from 150 to 1360 grams (1/3 to 3 pound) fish.

The ten firms that reported carrying whole tilapia, four of the ten reported handling fish from 250 grams to 1 kilogram (one-half to over two pounds). All five companies handling H&G tilapia took fish from 150 g to 1 kg (1/3 to 2.2 pounds). The four out of five companies which indicated they bought the gilled and gutted fish accepted red, golden, blue, and black tilapia from 300 g to 1 kg (two-thirds to over two pounds).

The preferred sizes of fillets reported by eight companies ranged from 110 to 340 g (four to twelve ounces). All tilapia species were accepted in fillet form.

Packaging methods

The most commonly reported packaging method was individual packaging, either quick frozen (IQF) or poly wrapped (IPW). Some firms reported they used flash freezing, tray or vacuum packing. When asked about their preferred packaging method, 71% gave no indication or no preference while 29% preferred individual freezing or wrapping.

Product outlets

Tilapia marketing companies sell their products through various outlets. Almost half used two or more outlets. The most frequent buyers of their products were wholesalers (65%), retailers (35%), and restaurants (30%). Tilapia marketing companies indicated they would retain this mix of buyers for their products if a choice were offered.

Market Trends

Buying prices

There was a general reluctance to answer questions regarding prices.

Because few usable responses were received, we can make no generalizations regarding tilapia prices. We present instead the reported prices paid for various forms of tilapia.

Two firms which handle live tilapia provided price information. Each company apparently operates successfully in a distinct market niche. One buys tilapia weighing at least 350 grams (3/4 pound) for the low end of the market at $0.77 per kilogram ($0.35 per pound). The other operates in a more affluent market, purchasing the more expensive red or golden tilapia, at $7.04 per kilogram ($3.20 per pound) for 300 g (2/3 pound) sizes.

Seven companies provided price information on frozen tilapia (all forms). Five bought the less expensive black and blue species at an average of $1.17 per kg ($0.53 per pound). The remaining two bought the red and gold species at $2.42 to $3.30 per kilogram($1.10 to $1.50 per pound).

Four companies reported purchase prices of $0.77 to $1.65/kg ($0.35 to $0.75 per pound) for whole tilapia, either fresh or frozen. They reported prices for black tilapia at $0.77 to $1.43 per kilogram ($0.35 to $0.65 per pound) and for blue tilapia at $0.77 to $1.65 per kilogram ($0.35 to $0.75 per pound). Red and gold tilapia fetch from $1.10 to $3.30 per kilogram ($0.50 to $1.50 per pound).

Four seafood companies which purchase H&G tilapia start as low as $2.31 and reach as high as $3.30/kg ($1.05 to $1.50 per pound). The lower prices are paid by mainland U.S. firms, while the higher prices were paid by a Hawaiian firm. The lone Canadian company responding to this question indicated that they buy H&G fish at U.S. $1.54/kg ($0.70 per pound).

Only two of the five companies buying H&G tilapia reported prices $2.75 to $3.00 per kilogram ($1.25 – $1.50 per pound). As noted earlier, the higher prices were for the company reporting from Hawaii.

Different buying prices were reported for tilapia fillets in three different locations. Black tilapia fillets sell to Florida companies from $1.32 to $3.30/kg ($ 0.60 to $1.50 per pound). An Illinois company buys red and black tilapia fillets at $3.96/kg ($1.80 per pound). A price of $4.95/kg ($2.25 per pound) is paid by a New York firm for all fillets purchased, regardless of species.

Price trends

During the past 12 months, 38% of the respondents reported stable buying prices. Around one-fifth reported they paid higher prices for tilapia during the same period. A third of the companies did not respond to this question. The rest reported lower prices paid for tilapia during this period.

Taiwan tilapia price trends may suggest future trends in U.S. prices. Taiwan supplies most of the tilapia consumed in Japan (Underwood, 1989). Calculations based on data from the Taiwan Fisheries Bureau (Underwood, 1989) suggest prices of tilapia were $1.28/kg in 1985, $1.17/kg in 1986, $1.06/kg in 1987, and

$0.99/kg in 1988. While the volume of tilapia exported to Japan increased, the price of Taiwanese tilapia declined at a rate of 8.79% per year for the past four years.

Volume purchased

Eleven companies provided information on the quantities of tilapia they handled each week. The quantities varied from 660 to 55,000 kg/wk (300 to 25,000 pounds per week). Most, however, reported handling between 2,200 and 11,000 kg (1,000 and 5,000 pounds) of tilapia each week. Extrapolated to the entire tilapia marketing sector, total tilapia sales fall between 8.24 and 41.18 million kg (3.74 million and 18.72 million pounds) annually.

Tilapia purchases are highly correlated with the value of seafood sales (Spearman rank correlation, r = 0.785). This result suggests that companies with higher seafood sales tend to carry more tilapia products.

The volume of weekly tilapia purchases were not correlated with the average buying prices of tilapia (r = 0.219). While the prevailing view has been that consumer tilapia purchases tend to increase if buying prices decrease (*e.g.* Jones, 1989), industrial demand for tilapia appears to be very inelastic, insensitive to price fluctuations. While lower prices may allow producers to gain market shares, other factors appear to control buyer demand.

When asked about the trend in the quantities purchased in the last 12 months, 29% reported no change volume while about one-fifth reported a change in volume. The remaining 38% provided no information on volume trends.

Those who reported buying more tilapia during the last 12 months anticipated an expansion in the tilapia market and improved product quality and packaging. Those who bought lesser tilapia cited limited markets for tilapia and poor product quality as major limiting factors.

Product Identification

Mississippi is associated by seafood companies with farm-raised fish in generai and farm-raised catfish in particular. One-third of the respondent companies, positively identified Mississippi with farm-raised fish while less than one-fourth did not associate the state with farm-raised fish. Forty-three percent did not have any opinion/answer.

Farm-raised catfish were positively associated with the state of Mississippi (38%). While less than five percent of the respondents found no association. Around 57% of the respondents did not answer.

DISCUSSION

The size of the tilapia market in North America appears to be limited. The potential for growth exists because of the strong financial position of tilapia

marketing firms in the seafood market. Companies handling tilapia control nearly 10% of the entire seafood market and generate higher than industry average annual sales. Because buyers do not appear very sensitive to changes in producer prices, factors other than cost will be important in expanding future market demand. The relative stability of tilapia marketing firms, their financial strength, and the diversity of their product lines provide favorable conditions for increasing the exposure of tilapia in the marketplace.

Domestic producers and Far Eastern tilapia farmers supply most of the current North American supply of tilapia. Most firms, however, reported they would prefer to rely less on their current sources of supply and, if offered the opportunity, would change suppliers. Because buyers generally showed no preference among countries or among domestic or imported fish, tilapia producers are on equal footing in providing product to the market place The lack of established preferences and the expressed desire to change suppliers suggest that opportunities exist for new producers to move product into the marketplace. However, because the tilapia market, as a whole, is not expanding and because buyers expressed no apparent preference for particular product forms, the entry of new producers will be at a cost. Market shares of existing suppliers will have to be reduced to make room for new entrants.

The major species handled are red, golden, black, and blue tilapia in both fresh and frozen forms. Most of the companies buy whole tilapia. A high proportion of firms carry red or gold tilapia (57%). Nearly as many firms preferred silver fish (43%). Both species come from farms. At the same time, most firms reported no preference for farmed fish among current suppliers or in the future. This suggests that most tilapia marketing firms do not associate red, gold, or silver fish with their farm-raised origins. An educational effort aimed at tilapia buyers, on the advantages of farm-raised tilapia, may provide an opportunity to increase sales. Those who carry fillets prefer them skinless and boneless. The products are generally individually quick frozen (IQF) or poly wrapped (IPW) and sold mostly to wholesalers, retailers and restaurants.

Producers in Mississippi and other areas often cite the high prices reportedly paid for tilapia fillets ($7.78 to $8.89/kg for 85 g to 140 g fillets or $3.50 to $4.00/lb for 3 – 5 oz. fillets; Redmayne, 1989) as the main reason for producing tilapia. Few realize that the prices paid for tilapia fillets are limited by the current market prices of whole fish. Tilapia producers frequently recognize they cannot rely primarily on the market for whole fish to sustain their operations and attempt to produce for the fillet market. The costs of producing and processing tilapia fillets are often unknown or inaccurate. These costs, in relation to market conditions, must be considered before culturing tilapia for the fillet market.

A producer interested in selling to the fillet market must be aware of certain market limitations. For this discussion, English units will be retained. Tilapia

fillets 85 – 140 g (3 – 5 oz) reportedly sell at $7.70 to $8.80 per kilogram ($3.50 – $4.00 per pound), depending on freight expenses (Redmayne, 1989). The conversion from round fish to fillet ranges from 28 – 32% (personal observation), depending on variables such as size of fish, machine adjustment, cutter skill (if hand filleted), and others. If the costs of processing, packaging freezing, and processor's margin, are similar to those developed by Cato and McCullough (1976), these costs amount to 36.9% of the current selling price for tilapia fillets. The cost of hauling from farm to plant must also be considered. Cost estimates made by Keenum and Dillard (1984) adjusted for inflation are useful.

With these assumptions, the expected farm-gate price of tilapia at different potential fillet prices and hauling distances can be estimated (see Appendices I and II). English units of weight and distance and U.S. dollar prices are used to calculate production costs in the apprentices and in the following examples. At a hauling distance of one mile and a market price of $3.50/lb for fillets, processors would pay $0.63/lb for whole fish at a conversion ratio of 30% (Appendix II, Figure A-1). If the conversion ratio drops to 25%, the price processors would pay declines to $0.53/lb for whole fish. At a conversion ratio of 35%, the price of whole tilapia would rise to $0.74/lb. At current market prices of $3.50/lb for tilapia fillets, processing companies are estimated to buy round tilapia for $0.53 – $0.74 per pound, as Figure A-1 shows.

For longer hauling distances (Appendix II, Figure A-2), lower producer prices are expected. For tilapia farms located 100 miles from the plant, the whole fish price would be $0.61/lb.

The possibility of exporting tilapia to European or Japanese markets may also exist. Japanese markets are particularly attractive because of the high prices for seafood and consumer recognition of tilapia (Mr. Tom Asakawa Commercial section, U.S Embassy, Tokyo, pers. comm.). The preferred color is either pink or red because it is sold as an inexpensive substitute for red porgy. In the Tsukiji market, the estimated sales volume is around 1 mt/wk. Most of this demand is supplied by imports from Taiwan.

The Japanese consumers prefer live, whole, and fresh fish, and fresh tilapia fillets. The preferred size for live tilapia ranges from 0.5 to 1.0 kg and sold in the Tsukiji market from $7.15 to $10.71 per kg.

Whole and ungutted tilapia are sold fresh. The commonly sold size ranges from 1.0 to 1.2 kg. The most preferred size, however, is over 1.5 kg fish. This great demand for large fish is due to the unavailability of cultured red porgy at comparative sizes and prices. The price for the grey (silver or blue) species is less than $5.00 kg. For tilapia weighing 1.0 – 1.5 kg, the price is about $7.15/kg, and over $8.60/kg for fish more than 1.6 kg. Fresh fillets, processed from fish over 1 kg, are sold at $11.42 to $12.85/kg.

The price of tilapia produced in Taiwan, the major world suppliers of tilapia

(Underwood, 1989), declined persistently during the past four years. Taiwanese tilapia may present a competitive threat to domestic tilapia producers because U.S. fish are more costly to produce. Some seafood companies mentioned that they are willing to carry locally farm-raised tilapia provided they are sold at comparative prices. While most buyers appear to be indifferent to minor price differences in choosing their source of tilapia, a major difference in price may affect at least some buyers preferences.

The effort of tilapia producers around the Mississippi Gulf Coast to capture a significant share of the domestic market is highly constrained by the limited size of the market and the availability of relatively less expensive imports. There are several possible ways to overcome these problems. The first is to expand the demand for tilapia by promotion of farm-raised tilapia stressing product quality. The identification of Mississippi with farm-raised catfish by seafood buyers may be useful. The other approach is to improve technology to produce fish at lower costs. This may increase domestic demand and make tilapia culture an economically profitable venture.

ACKNOWLEDGEMENTS

This work is a result of research sponsored in part by the NOAA/National Sea Grant College Program, U.S. Department of Commerce, under Grant Number NA89AA-D-SG016, the Mississippi/Alabama Sea Grant Consortium, and Mississippi Cooperative Extension Service/Mississippi State University. The U.S. Government and the Mississippi/Alabama Sea Grant Consortium are authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notation that may appear hereon. NOTE: This paper is MASGP-89-032.

LITERATURE CITED

Anonymous. 1989a. Seafood Buyer's Catalog. *Seafood Business* 7(5):27-88.

Anonymous. 1989b. Situation and outlook see rapid growth for tilapia. *Washington, Aquafarm Letter* **6**(18):3.

Anonymous. 1989c. Tilapia is the boom coming at last? *Catfish and Aquaculture News* 3(6/7):5.

Cato, J. and W. McCullough, eds. 1976. Economics, biology, and food technology of mullet. Florida Sea Grant Program Report No. 15.

Chaston, I. 1983. *Marketing in Fisheries and Aquaculture.* Farnham, Surrey: Fishing News Books, Ltd.

Conner, D. 1985. Florida aquaculture plan. Florida Department of Agriculture and Consumer Services, Tallahassee, FL 79 pp.

Glude, J.B. 1977. NOAA aquaculture plan. U.S. Department of Commerce, Washington, DC. 37 pp.

Jensen, G.L. 1988. Commercial production of farm-raised catfish. Louisiana

Cooperative Extension Service Publication, Louisiana State University, Baton Rouge, LA 67 pp.

Joint Subcommittee on Aquaculture. 1983. Nation of aquaculture development plan. Volume 2. Washington, DC 196 pp.

Jones, K. 1989. Aquaculture: Progress report. Tilapia: a boom at last? *Seafood Business* 8(6):94-96.

Keenum, M. and J. Dillard. 1984. Operational characteristics and costs of custom harvesting and hauling farm-raised catfish. Agricultural Economics Report No. 153. Mississippi Agricultural & Forestry Experiment Station.

Keenum, M.E. and J.E. Waldrop. 1988. Economic analysis of farm-raised catfish production in Mississippi. Mississippi Agricultural and Forestry Experiment Station Technical Bulletin 155. [Starkville] 27 pp.

McGoodwin, J.R. 1982. Aquaculture development in atomistic societies. Pages 61-76 *in* L.J. Smith and S. Peterson, ed. *Aquaculture development in less developed countries: social, economic and political problems.* Westview Press, Boulder, CO.

National Research Council. 1978. *Aquaculture in the United States. Constraints and opportunities.* National Academy of Sciences, Washington DC. 123 pp.

Pillay, T.V.R. 1977. *Planning of aquaculture development. An introductory guide.* Fishing News Books, Ltd., Fornham Surrey, England. 69 pp.

Pomeroy, R.S. and K.H. Kohl. 1987. Crawfish in South Carolina: development and current status of the industry. South Carolina Agricultural Experiment Station Bulletin No. 661. Clemson University, Clemson, SC 14 pp.

Redmayne, P. 1989. U.S. Fish farmers bet big on tilapia. *Seafood Leader.* 9(4): 110-116.

Sokal, R.R. and F.J. Rohlf. 1969 *Biometry.* W.H. Freeman and Co., San Francisco, CA 757 pp.

Stickney, R.R. and J.T. Davis. 1981. Aquaculture in Texas. A status report and development plan. Texas A & M Sea Grant Report TAMU-SG-81-119, College Station, TX 103 pp.

Underwood, L. 1989. Taiwan puts its stamp on Asian aquaculture. *Seafood Leader* 9(4):118-124.

United States Department of Agriculture. 1988. *Catfish.* National Agricultural Statistics Service, Agricultural Statistics Board, Washington, DC., 1975-1988.

Zar, J.H. 1984. *Biostatistical analysis.* Prentice-Hall, Inc., Englewood Cliffs, NJ. 469 pp.

APPENDIX I

W - expected farm-gate price of whole fish ($/lb)
F - expected sale price of fillet ($/lb)
F_o - current sale price of fillets ($/lb)
R - fillet weight to whole fish weight ratio
H - hauling cost of whole fish ($/lb)
P - processing cost, C x F

C = 0.369, a processing constant equal to the ratio of processing cost to fillet selling price (Cato and McCullough, 1976)

$H = H_o + hD$, where H_o is the fixed hauling cost, h is the variable cost of hauling, and D is the distance hauled.

For a given sales price of fillets (F), the whole fish farm gate price can be determined by:

$$F = (W + H)(1/R) + P$$

The farm-gate price for whole fish (W) is:

$$W = R(F - P) - (H_o + hD)$$

Using hauling cost estimates (H) derived from Keenum and Dillard (1984), adjusted for inflation, the formula is:

$$W = R(F - 1.38) - (0.003701 + 0.000217D)$$

APPENDIX II

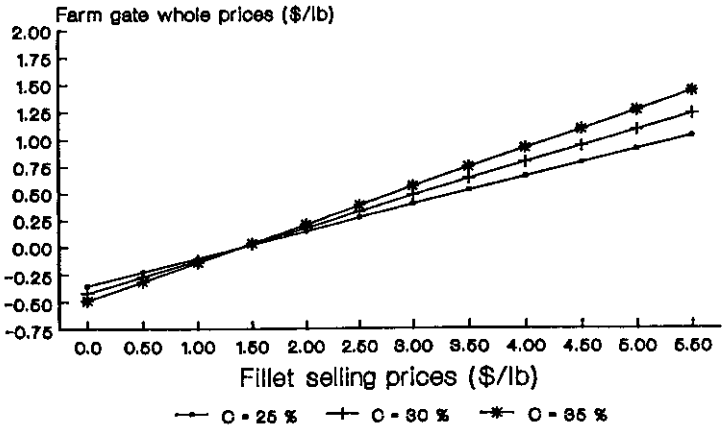

Figure A-1. Relationship between farm-gate price for whole fish and fillet selling prices at fillet to whole fish conversion ratios of 25, 30, and 35%. Hauling distance (D) = 1 mile. (Source: MS-SGAS)

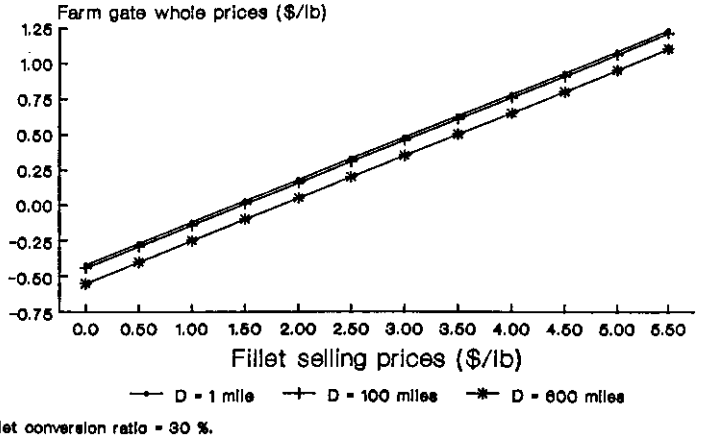

Figure A-2. Relationship between farm-gate price for whole fish and filet selling prices at hauling distances of 1,100 and 600 miles. Fillet conversion ratio is fixed at 30%. (Source: MS-SGAS)