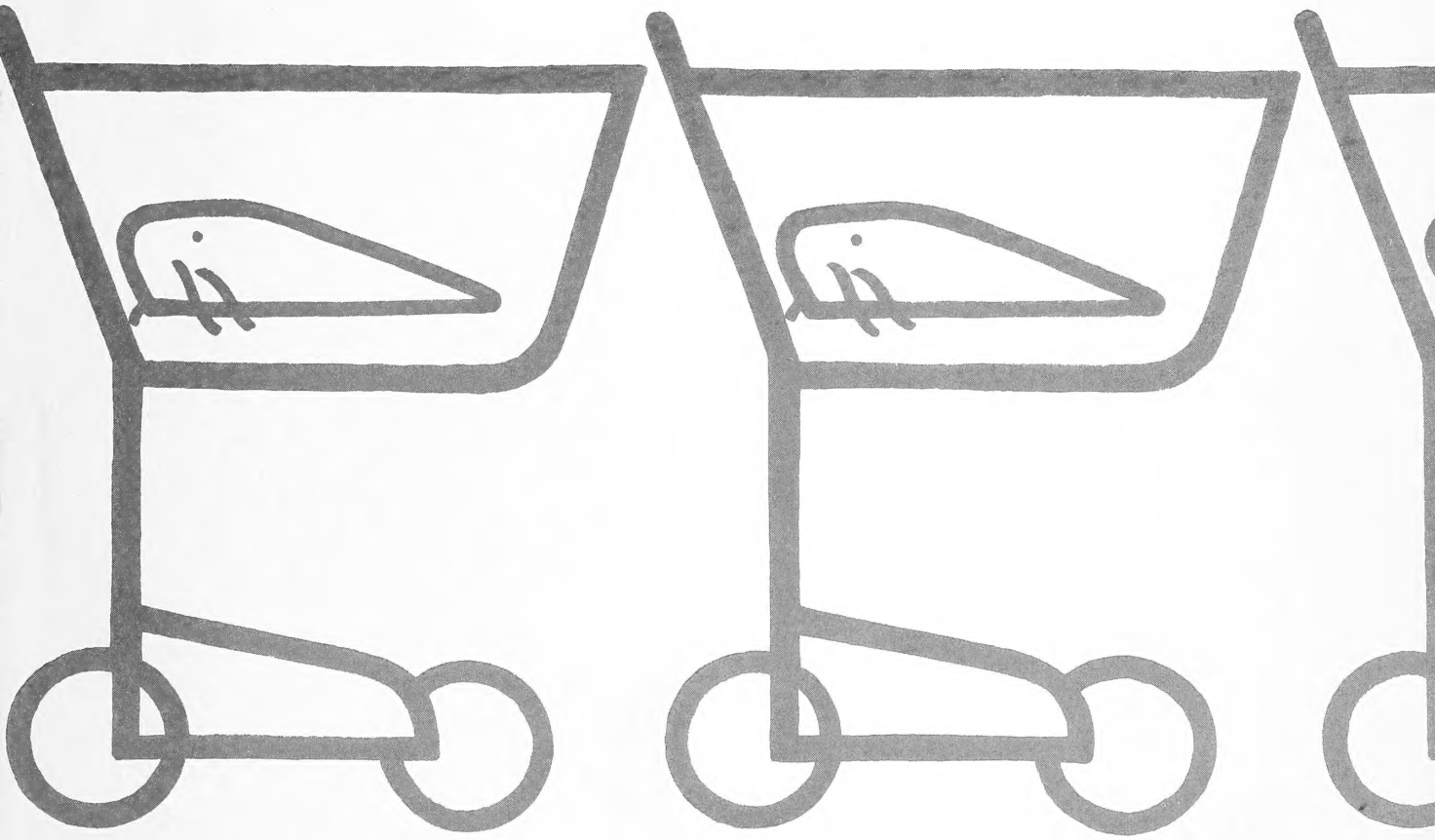
MARKETING RESEARCH REPORT NO. 993

DEMAND FOR FARM-RAISED CHANNEL CATFISH IN SUPERMARKETS: Analysis of a Selected Market



U. S. DEPARTMENT OF AGRICULTURE · ECONOMIC RESEARCH SERVICE

ABSTRACT

In March and April 1972, a controlled Latin square market experiment was performed in six Atlanta, Ga., grocery stores to determine the demand for fresh channel catfish in supermarkets. Prices ranging from $0.79 to $1.29 per pound in 10-cent increments were used to elicit quantity responses. These responses were used to estimate linear, log-linear, and log-log forms of a demand curve. The resulting demand curves indicate an elastic demand for catfish within the experimental price range. Only about one of every 150 customers purchased catfish at the current price of about $1.19 per pound. Results of a consumer questionnaire indicate the possibility of expanding the market by introducing more convenient product forms at a reasonable cost to the consumer.

Keywords: Catfish, demand, market potential, grocery stores, Georgia.

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PREFACE

This research represents a cooperative effort by the Marketing Economics Division (MED), Economic Research Service, U.S. Department of Agriculture; Winn-Dixie Atlanta, Inc.; Goldkist, Inc.; and the Institute of Food Marketing and Distribution at Georgia State University.

The research was conducted by MED staff at the Richard B. Russell Agricultural Research Center, Athens, Ga., and was made possible by the special efforts of Lynn Fitzgerald of Winn-Dixie, who supervised the selection of test stores and provided the necessary liaison between MED researchers and Winn-Dixie market managers; John Tallent and James Marion of Goldkist, who managed the difficult transportation and temporary storage arrangements; and John Wright and Joyce Speck of Georgia State University, who helped in the selection of enumerators and kept study records. Victor Chew of the Biometrics Services staff, Agricultural Research Service, USDA, provided guidance and counsel on statistical considerations associated with the study. The authors wish to express their appreciation for the excellent help of all participants in the study.

Mention of firm names in this report is solely for purposes of acknowledging contributions to the study; this does not constitute endorsement of these firms by USDA.

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SUMMARY

Better efficiency in production, processing, and marketing, which would permit lower retail prices, and market promotion should help achieve wider consumer acceptance of catfish in supermarket outlets. This was indicated in a 1972 test in six Atlanta, Ga., area supermarkets. In terms of net returns above the prevailing wholesale price, the optimum retail price was shown to be $1.19 a pound. However, only one of every 150 or more Atlanta supermarket customers was estimated to have purchased catfish at this price, which indicates rather low consumer acceptance even in what might be considered a "good" catfish market. But, if cost-saving technologies were introduced, permitting a 17-percent price decrease to $0.99 a pound at retail, sales would increase 70 percent.

Six different prices were tested, ranging from $0.79 a pound to $1.29 a pound, in 10-cent increments. Average sales per 1,000 customers ranged from 10 pounds per week at $1.29 a pound to 40 pounds per week at $0.79 a pound. These levels occurred without any advertising or promotion other than a sign at the point of sale identifying the product and its price.

The product used in the test was an overwrapped traypack of four skinned and dressed catfish weighing about 2 pounds. The catfish were deep-chilled and of excellent quality and appearance. They were displayed in the regular fresh meat refrigerated case.

Given the current situation in production and marketing costs, and assuming per capita consumption of catfish greater for Atlanta than for the whole United States, an extrapolation of potential sales at $1.19 a pound yields an upper bound of about 109 million pounds, which would require farm production of about 188 million pounds. The present level of farm-raised catfish sales through supermarkets is not known precisely, but it is probably less than 10 million pounds (farm weight).

A farm-level demand curve was derived from the log-linear retail curve, using an estimated constant farm-retail marketing margin. The farm-level curve indicates that gross farm revenue is maximized at a farm price of $0.21 a pound and a retail price of $0.93. However, considering production costs, the farmer's net position does not become positive until a retail price of $1.14 is achieved. This result again was consistent with the prevailing retail price of about $1.19 a pound and indicated the estimated marketing margin and farm production costs used were fairly realistic.

A questionnaire distributed at the end of the test was used to derive a profile of actual catfish consumers and their opinions of the product. The replies indicated that the common cleaned, fresh catfish product was consumed regularly by about 77 percent of those who did buy catfish, while persons who may prefer a product with more built-in conveniences were not willing to buy the common form.

DEMAND FOR FARM-RAISED CHANNEL CATFISH IN SUPERMARKETS: ANALYSIS OF A SELECTED MARKET

By Richard C. Raulerson and Warren K. Trotter 1/

INTRODUCTION

Production of farm-raised channel catfish (Ictalurus punctatus) is an important farm enterprise in local areas in several Southern States. On a regional basis, these local enterprises are relatively important and offer farmpeople opportunities to more fully utilize their farm resources. In terms of crop size and value of production, precise data on the magnitude of this industry are not available, but yearly output ranges from 50 to 60 million pounds worth $20 to $24 million (farm value).

The major thrust of research for this industry has centered on solving production problems. As a result, from a purely technical standpoint, the possibility for expansion of production is virtually unlimited. However, very little research has been done to delineate the market potential for farm-raised catfish. This report is addressed to the demand for fresh, processed catfish. The processed catfish market, while not dominant, is growing in importance and must eventually provide the main outlet for the catfish farmer's product if the industry is to expand significantly in the future. There are several reasons for this. Historically, the processing market outlet has produced lower returns for the catfish farmer than recreational or local markets have. But the processing market, which did not exist before 1967 has been growing steadily. In 1970, about 6 million pounds of catfish--live weight--were utilized by processing firms (3). 2/ This increased to 12 million pounds in 1971 (3), and probably exceeded 17 million pounds in 1972. 3/ The reasons for this growth are not clear, but they may include lack of other alternatives as the industry expands, or growing confidence in the processed market. As farm production increases, recreational and local markets will tend to become saturated, and increasing market shares will go to consumers who eat at restaurants and buy through supermarkets. Both of these outlets prefer a constant supply of a uniform product, which only the commercial processor can furnish.

The objectives of the research in this study, conducted in March and April 1972, were to:

1. Estimate a demand curve for processed farm-raised channel catfish in supermarkets;
2. Obtain the resulting price elasticities;
3. Use the above results in a brief analysis of the potential for catfish farming; and
4. Develop information for use as a planning aid in future market research.

1/ Agricultural Economists, Marketing Economics Division, Economic Research Service.

2/ Underscored numbers in parentheses refer to items in References on p. 16.

3/ Based on production through June 1972 as reported in (3).

PROCEDURE

The usual time-series or cross-sectional approaches to estimating demand (or a combination of these) were not available for this study because relevant retail price and quantity data for farm-raised channel catfish did not exist. Instead of using secondary data, we selected a controlled experiment in six stores in the Atlanta, Ga., area as a technique for generating the necessary primary data. Specifically, the Latin square experimental design was utilized.

In the usual controlled market study, relevant market data are collected from a specified number of market participants for a specified time period. In the Latin square experimental design, the number of columns (stores) must equal the number of rows (weeks) and the treatments (prices) should be so assigned that each treatment appears once in each column and in each row. In this study, the technique allowed the separation of the price effect from the effects of different stores and weeks. 4/

The size of square chosen was dictated by cost and statistical considerations; a 6-by-6 square allowing 20 error degrees of freedom was chosen. Test prices ranged from $0.79 to $1.29 per pound in $0.10 increments. To eliminate volume of customer traffic as a variable, the quantity of catfish purchased was stated in terms of pounds per 1,000 customers. To minimize the effects of variables other than price, the location and size of catfish displays within each store were held constant throughout the study. In addition, store management agreed not to advertise catfish during the study.

The product used for the test was deep-chilled, cleaned, headed, and skinned farm-raised channel catfish. 5/ Figure 1 depicts the product and figure 2 a typical display used in this experiment. The product was identified at point-of-sale as "farm-raised channel catfish."

4/ One underlying assumption was that variations in week-to-week sales caused by changes in the level of general business activity, weather, and the like were similar for all six stores. Another assumption was that store-to-store variations caused by differences in the effectiveness of merchandising by the individual stores were reasonably constant from week to week.

5/ Exploratory work on quality aspects of the product was conducted by Ruth Durning of Goldkist, Inc. For this work, enumerators periodically sampled catfish that were actually on display during the study. James Marion, Director of Research, Goldkist, Inc., indicated that deep chilling to 28° F. resulted in a sizable increase in shelf-life of the product compared with that of conventional ice-packed fish. The product maintained a fresh color and aroma for 10 to 12 days, after which deterioration was fairly rapid. Quality deterioration was caused primarily by the development of bacteria, since no molds were isolated from the fish. Bacteria were characterized mainly as *Pseudomonas*, *Proteus*, *Citrobacter*, *Myxobacter*, and *Peptostreptococcus* species, as well as *Escherichia coli*, *Serratia marcescens*, and *Chromobacterium violaceum*. When deterioration occurred in storage, the growth of *Pseudomonas* and *Proteus* species increased while viable organisms of other species decreased. Taste panel evaluation of fish indicated that taste, aroma, texture, and appearance of the fried product remained very good up to 14 days.

Figure 1
Tray pack of deep-chilled farm-raised channel catfish used in experiment

The product used in the study was purchased from Goldkist Fish, Quitman, Ga.; transported to Atlanta weekly by truck, and stored at a central point until transferred to store displays. Three marketing students from Georgia State University transferred the product to stores as needed, maintained store displays, and kept store sales, inventory, and customer records.

The choice of market area was based on the criterion of using a market where consumers had prior knowledge of the product and yet where costs of conducting the experiment could be minimized. The Atlanta area met this criterion. The six particular stores selected sold to a cross-section of urban, suburban, and rural consumers.

During the last 2 days of the pricing experiment, and on the weekend following its termination, questionnaires were given to catfish purchasers. The object of the questionnaire was to learn something about the consumers' attitudes and opinions about the product and to gather information concerning repeat purchases, substitute products, catfish cooking methods, and consumer socio-economic characteristics. 6/

6/ The questionnaire is reprinted in the appendix.

Figure 2
Typical display of farm-raised channel catfish used in experiment

MODEL

The Latin square experimental model can be expressed as:

$$Y_{ijk} = \mu + \rho_i + \gamma_j + \tau_k + \varepsilon_{ijk}, \; i, j, k = 1...6$$

where

μ = grand or overall mean,

ρ_i = row (week) effect,

γ_j = column (store) effect,

τ_k = treatment (price) effect, and

ε_{ijk} = random error term associated with y_{ijk}th observation.

It is assumed the ε_{ijk}'s are normally and independently distributed with common variance and zero mean.

Usually, the Latin square is investigated through analysis of variance (ANOVA), and the 6-by-6 square used in this experiment would be analyzed as in table 1.

In this study, the concern was with prices (treatments), while the stores and weeks were of only passing interest. Specifically, there was interest in whether a price-quantity relationship existed. Regression can be tested by dividing the degrees of freedom for prices (five) into a single degree of freedom for regression and four degrees of freedom for deviations from regression. For the purposes of this study, the F test for regression had to yield an F value sufficiently large to assure that regression was an important (significant) factor in determining the size of Y_{ijk}.

Within this framework, three price-quantity functional relationships--linear ($Q = a + bP$), log-linear ($\log Q = a + bP$), and log-log ($\log Q = \log a + b \log P$)--were investigated 7/ to provide comparisons of the different forms. There were some a priori notions as to which form would be most desirable, provided it met the usual statistical criteria. It was expected that the two relationships involving log forms would provide a better fit than the natural numbers relationship because most demand functions are curvilinear. It was also thought that the two log forms would better satisfy the specification of homogeneous variance. A consideration of direct price elasticities led to the

7/ Due to the nature of the experiment, the relationships correspond to estimates of a demand curve. At each given price, supply is perfectly elastic, so consumers are allowed to purchase the maximum quantity they desire at any given price. Observance of the maximum quantities desired (purchased) at various prices results in a demand schedule by definition. Regression is then used to estimate a demand curve.

Table 1--Analysis of variance with a consideration of regression for a 6-x-6 Latin square

Source of variation	Degrees of freedom	Sum of squares	Mean square	F
Total (T).....	35	TSS	--	--
Weeks (W).....	5	WSS	$\frac{WSS}{5} = WMS$	$\frac{WMS}{EMS}$
Stores (S).....	5	SSS	$\frac{SSS}{5} = SMS$	$\frac{SMS}{EMS}$
Prices (P).....	5	PSS	$\frac{PSS}{5} = PMS$	$\frac{PMS}{EMS}$
Regression (R).....	1	RSS	$\frac{RSS}{1} = RMS$	$\frac{RMS}{EMS}$
Deviations (D).....	4	DSS	$\frac{DSS}{4} = DMS$	$\frac{DMS}{EMS}$
Error (E).....	20	ESS	$\frac{ESS}{20} = EMS$	--

-- = not applicable.

supposition that the linear form would probably yield unrealistic elasticities toward the extremes of the data. 8/ It was also felt that the log-log form would be somewhat unrealistic because of the wide price range over which its constant elasticity would have to be operative. The log-linear form was known to yield an elasticity estimate which would change with price, and it was expected that the elasticity estimates would not be completely unrealistic at the data extremes.

A comparison of the predicted versus actual sales, using the three functional forms, is shown in figure 3.

ESTIMATES OF DEMAND

An analysis of the experimental results in natural numbers resulted in the ANOVA presented in table 2. 9/

8/ The interest here was to look at elasticity estimates throughout the data range, and not only at some arbitrary point such as the midpoint of the data.
9/ The raw data obtained from this experiment are shown in app. table 1.

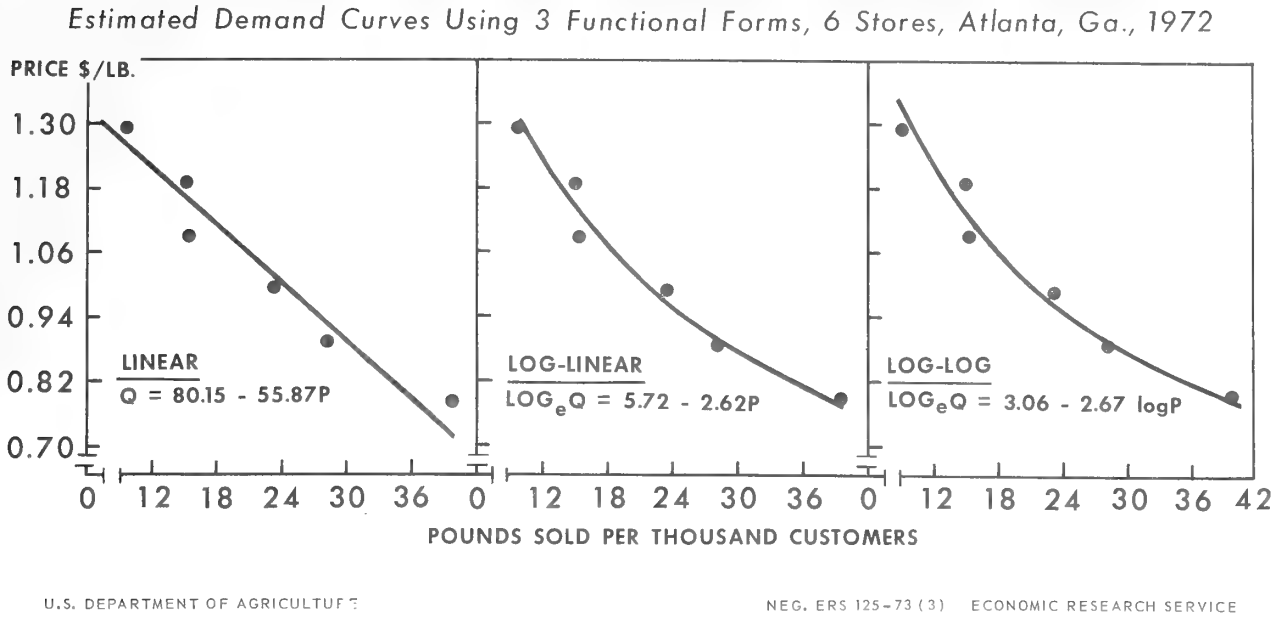

Figure 3

Table 2--Analysis of variance of pounds of catfish sold per 1,000 customers, 6 stores, Atlanta, Ga., 1972

Source of variation	Degrees of freedom	Sum of squares	Mean square	F
Total (T).....	35	7,830.07	--	--
Weeks (W).....	5	608.62	121.73	4.94
Stores (S).....	5	3,208.30	641.66	26.03
Prices (P).....	5	3,520.11	704.02	28.56
Regression (R).....	1	3,278.03	3,278.03	132.98
Deviations (D).....	4	242.08	60.52	2.46
Error (E).....	20	493.02	24.65	--

-- = not applicable.

All of the calculated values of F were significant at the 0.01 level. Only the effect of prices will be discussed here. 10/ The regression equation corresponding to the ANOVA in natural numbers is:

$$Q = 80.1526 - 55.8743\,P \qquad R^2 = .93$$
$$(t = -7.38)$$

where

Q = pounds/1,000 customers

P = retail price

An analysis of this equation yielded the information contained in table 3.

Table 3--Quantity demanded, price elasticity, total revenue, and net revenue at different points on a linear demand curve for catfish, 6 stores, Atlanta, Ga., 1972

Price per pound	Quantity demanded per 1,000 customers	Elasticity 1/	Total revenue	Net revenue 2/ Pw = $.89/lb. 3/
	Pounds		Dollars/1,000 customers	
$0.79	36.01	-1.23	28.45	-3.60
.89	30.42	-1.63	27.07	0
.99	24.84	-2.23	24.59	2.48
1.09	19.25	-3.16	20.98	3.85
1.19	13.66	-4.87	16.26	4.10
1.29	8.08	-8.93	10.42	3.23

1/ Elasticity for linear demand curves is $N = b\left(\frac{P}{Q}\right)$.
2/ Returns to all retailing inputs.
3/ Wholesale price.

Note that demand was elastic throughout the actual range of prices used in the study. This was a reasonable outcome, because at these prices, there were several seafood and meat substitutes for channel catfish. Total revenue decreased as price increased because demand was always elastic. The net revenue schedule

10/ The weeks were significant because of an apparent overall buildup of store sales during the course of the study. The store effects were significant because of an apparent difference in sales between urban and nonurban stores. However, these observations came to light *after* the data were collected; therefore, any further statistical analysis of weeks and stores to test these observations would not be valid. Still, these observations should help to guide future studies.

was based on a wholesale price of $0.89 a pound which was the approximate current wholesale price for the deep-chilled product used in the study. Assuming constant costs of retailing, this schedule shows that the profit-maximizing price from the retailers' point of view would be about $1.19 a pound. This was a common retail price in the Atlanta area during the period immediately preceding this study.

The regression equation for the log-linear functional relationship was:11/

$$\log_e Q = 5.7177 - 2.6211\ P \qquad R^2 = .97$$
$$(t = -11.33)$$

Note that this relationship fitted the data better than the linear relationship (as expected). An analysis of this equation yielded the information in table 4. The demand was elastic but not constant throughout the data range. The demand elasticity increased as price increased because of the functional form (as was the case with the linear relationship). However, the change in elasticity as price increased was less abrupt, so that a reasonable elasticity estimate of -3.38 was obtained at the highest study price of $1.29. An examination of the revenue position of the retailer indicated that a retail price slightly greater than $1.29 would maximize his net revenue.

Table 4--Quantity demanded, price elasticity, total revenue, and net revenue at different points on a log-linear demand curve for catfish, 6 stores, Atlanta, Ga., 1972

Price per pound	Quantity demanded per 1,000 customers	Elasticity 1/	Total revenue	Net revenue 2/ Pw = $.89/lb. 3/
	Pounds		Dollars/1,000 customers	
$0.79	38.36	-2.07	30.30	-3.84
.89	29.52	-2.33	26.27	0
.99	22.71	-2.59	22.48	2.27
1.09	17.47	-2.86	19.04	3.49
1.19	13.45	-3.12	16.01	4.03
1.29	10.35	-3.38	13.35	4.14

1/ Elasticity for the log-linear relationship is N = bP.

Proof: $\log Q = a+bP \Rightarrow Q = e^{a+bP}$; $\frac{dQ}{dP}\frac{P}{Q} = (be^{a+bP}/e^{a+bP})\ P = bP$, q.e.d.

2/ Returns to all retailing inputs.

3/ Wholesale price.

11/ ANOVA tables for the log-linear and log-log forms will not be presented. The logarithm forms use natural (base e) logarithms.

The regression equation for log-log functional relationship is:

$$\log_e Q = 3.0593 - 2.6708 \log_e P \qquad R^2 = .97$$
$$(t = -11.09)$$

This relationship fitted the data as well as the log-linear relationship. An analysis of this equation yielded the information in table 5. The outstanding difference between this relationship and the log-linear was the constant elasticity associated with the former. From the retailers' point of view, net revenue was maximized at about $1.42 a pound (assuming a correct prediction beyond the range of the data).

Table 5--Quantity demanded, price elasticity, total revenue, and net revenue at different points on a log-log demand curve for catfish, 6 stores, Atlanta, Ga., 1972

Price per pound	Quantity demanded per 1,000 customers	Elasticity 1/	Total revenue	Net revenue 2/ Pw = $.89/lb. 3/
	Pounds		Dollars/1,000 customers	
$0.79	40.00	-2.67	31.60	-4.00
.89	29.09	-2.67	25.89	0
.99	21.89	-2.67	21.67	2.19
1.09	16.93	-2.67	18.45	3.39
1.19	13.39	-2.67	15.94	4.02
1.29	10.80	-2.67	13.93	4.32

1/ Elasticity for the log-log demand relationship is N = b.
2/ Returns to all retailing inputs.
3/ Wholesale price.

A striking similarity among the elasticity estimates derived from the three functional relationships occurred approximately at the midpoint of the data. The ranges in elasticity based on the prices of $.99 to $1.09 a pound were -2.23 to -3.16, -2.59 to -2.86, and -2.67 (constant). Actually, this result would be expected since all relationships fitted the data well and therefore tended to have the same slopes at the approximate midpoint of the data.

POTENTIAL FOR CATFISH FARMING

Although results of a marketing study for one geographic region are not statistically valid for predicting sales in other localities having different consumer characteristics, some useful conclusions concerning the overall potential of processed catfish can be drawn. A recent USDA study showed that consumer acceptance of catfish was higher in the South and Midwest than in the Northeast and West Coast Region of the United States (4). Sales of catfish in the Atlanta area should be reasonably representative of the South and Midwest, but would probably be somewhat higher than the average per capita sales for the United States. Thus, an extrapolation of sales for Atlanta should yield an upper bound on potential sales for the entire United States under the present level of consumer acceptance (table 6).

Table 6--Upper bound estimates of annual U.S. sales of processed catfish in supermarkets at various prices, 1972

Price per pound	Weekly sales per 1,000 Atlanta customers	U.S. customers per week 2/	U.S. sales per week	Annual U.S. sales	Annual farm equivalent 3/
	Pounds	Thousands	Million pounds		
$0.79	38.36	156,000	5.98	311.0	536.2
.89	29.52	156,000	4.61	239.7	413.3
.99	22.71	156,000	3.54	184.1	317.4
1.09	17.47	156,000	2.73	142.0	244.8
1.19	13.45	156,000	2.10	109.2	188.3
1.29	10.35	156,000	1.61	83.7	144.3

1/ Based on log-linear demand curve.
2/ Based on shopping habits in the Atlanta area.
3/ Based on 58-percent dressout.

At the current Atlanta price of around $1.19 a pound, the maximum estimate of sales is a little over 109 million pounds, and would require farm production of about 188 million pounds. Relative to other meat production, this is quite small. For example, in 1970, Arkansas alone produced over eight times this many pounds of broilers (2). In the Atlanta study, where no promotional effort was made, less than one of every 150 customers purchased catfish at $1.19 a pound. 12/ Even at a price of $0.79 a pound, only one of every 50 customers purchased catfish, which indicates that, at the present time, catfish does not have wide consumer acceptance in what might be considered a "good" catfish market area.

A more promising result of this study for the catfish farmer is the relatively high demand elasticities over the range of prices tested (table 7). For example, if the industry becomes more efficient so that price can be reduced from $1.19 to, say, $0.99 a pound, this study indicates that catfish sales would increase by approximately 70 percent. Also, results from other studies show that products with elastic demand are responsive to promotional activities. Thus, it can be hypothesized that catfish sales would be responsive to promotion. A combination of promotion and lower prices (through better efficiency in production, processing, and marketing) may allow for a fairly substantial increase in output. 13/

12/ Individual packages contained about 2 pounds of catfish; so, assuming each catfish customer purchased only one package at a time, a maximum of 6.7 catfish purchasers per 1,000 store customers is indicated, or only one of every 149 store customers.

13/ It is recognized that information-promotion activities may change the elasticities as estimated by this study. Additional research is needed to furnish further evidence regarding this matter.

Table 7--Demand elasticity and net revenue based on 3 forms of a retail demand curve for farm-raised channel catfish, 6 stores, Atlanta, Ga., 1972

Price per pound	Linear		Log-linear		Log-log	
	Elasticity	Net revenue 1/	Elasticity	Net revenue 1/	Elasticity	Net revenue 1/
		$/1,000 customers		$/1,000 customers		$/1,000 customers
$0.79	-1.23	-3.60	-2.07	-3.84	-2.67	-4.00
.89	-1.63	0	-2.33	0	-2.67	0
.99	-2.23	2.48	-2.59	2.27	-2.67	2.19
1.09	-3.16	3.85	-2.86	3.49	-2.67	3.39
1.19	-4.87	4.10	-3.12	4.03	-2.67	4.02
1.29	-8.93	3.23	-3.38	4.14	-2.67	4.32

1/ Assuming a constant wholesale price of $0.89 per pound, net revenue refers to returns to all retailing inputs.

This study was designed to estimate a demand curve for processed catfish at retail. However, catfish farmers would be rightly concerned with the farm-level demand. As pointed out earlier, price and quantity data appropriate to estimating demand are simply not available. However, by considering estimated processing and marketing charges and taking into account processing and marketing losses, the farm-level demand can be derived from the retail demand. The farm price may be estimated from the retail price by use of the following conversion: 14/

$$P_f = \frac{P_r - \$0.532}{1.91}$$

where

P_f = farm price and P_r = retail price.

14/ This conversion is based on app. table 2. A careful examination of this table reveals that the farm price can be stated in terms of the retail price according to the equation

$$P_f = \frac{P_r - \left(C_r + \frac{(C_w + C_p)}{1 - b}\right)}{(1/a)/(1 - b)}$$

where

P_r = retail price and P_f = farm price,

C_p, C_w and C_r = costs of processing, wholesaling, and retailing,

a = dressout fraction, and

b = fraction of product loss at retail

Using the schedule of estimated farm prices and quantities, the resulting farm-level demand curve is:

$$\log_e Q_f = 4.92 - 4.85 P_f$$

This equation can be analyzed in terms of demand elasticity and revenue position of the farmer. These results are presented in table 8. Since the derived demand curve is presented in terms of pounds per 1,000 customers, only the changes in the revenue position of the farmer are of interest. Note that the demand is inelastic in the lower price ranges, whereas the retail demand was always elastic over the price range used in the study. Total revenue is maximized at unitary elasticity 15/ or a farm price of $0.21 and a retail price of $0.93 a pound. However, the farmer's net position does not become positive until a retail price of $1.14 a pound is achieved. The farm-level demand curve derived above is based on sales of six supermarkets in Atlanta; however, the results can be thought of as ball-park estimates. These results are consistent with the retail price of about $1.19 per pound that was current in Atlanta at the time of the study.

Table 8--Price elasticity and net revenue per pound at different points on a derived log-linear farm-level demand curve for catfish, 6 stores, Atlanta, Ga., 1972

Retail price per pound	Farm price per pound 1/	Elasticity	Gross farm revenue	Net farm revenue 2/
	Dollars		Dollars/1,000 customers	
$0.79	0.135	-0.65	9.38	-12.84
.89	0.187	-0.91	10.54	-7.50
.99	0.240	-1.16	10.41	-3.47
1.09	0.292	-1.42	9.74	-0.94
1.19	0.345	-1.67	8.86	+0.64
1.29	0.397	-1.93	7.85	+1.52

1/ Price paid to farmers at processing house door.
2/ Returns to farmer labor and management assuming constant costs of production, harvesting, and transporting at $0.32 a pound.

In the analysis of retail sales presented earlier, it was pointed out that there is probably some room for expansion via market development and cost-saving efficiency. The analysis of farmer returns assumes that no market development occurs and that technology is constant. Under these assumptions, further allocation of farm production to supermarkets would not be desirable.

15/ Unitary elasticity indicates maximum revenue for all demand curves which are less convex than a rectangular hyperbola.

QUESTIONNAIRE RESULTS

Although the questionnaire used at the end of the study did not yield statistically valid results because of problems in sampling the nonrespondents, there was a 45-percent return (48 of 106) and some of the results are presented. 16/

Of those who returned questionnaires, 77 percent indicated that they had purchased catfish from a grocery store before. Since the demand results indicated that less than one of every 150 customers purchased catfish at the normal price of $1.19 a pound, then only one of about every 650 customers was a "new" customer. At the relatively low price of $0.79 a pound, only one of about 200 customers was willing to purchase catfish for the first time. This strengthens the observation made earlier that catfish has a marketability problem, even in what is considered a good catfish market area.

Answers to other questions indicated that consumers purchasing catfish tended to be traditional catfish eaters. For example, only 6 percent indicated that catfish need to be easier to cook, 94 percent indicated that they preferred fresh catfish (while no respondents preferred precooked or prebreaded forms), and 98 percent indicated that they fried their catfish--the traditional Southern cooking method for this fish.

The product used in the study was apparently acceptable to consumers. Of consumers who answered the questionnaire, 58 percent indicated that they preferred farm-raised catfish, 8 percent favored wild catfish, and 33 percent were indifferent.

RECOMMENDATIONS FOR FURTHER RESEARCH

The controlled market experiment using a Latin square design appeared to work quite well in an investigation of the demand for catfish in the Atlanta area. Similar research in other geographical areas is needed to better estimate the demand for farm-raised channel catfish in supermarkets. 17/ Future studies could incorporate more objectives with little extra investment. For example, the possible difference in sales between urban and nonurban stores could be readily investigated.

The questionnaire analysis indicated that most of the customers who purchased catfish had previously purchased catfish in supermarkets, and that virtually all of those customers preferred fresh, fried catfish. Therefore, a

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16/ Telephone interview was attempted as a means of sampling the nonrespondents. Unfortunately, the procedure did not work well. Of 16 nonrespondents contacted by telephone, five said that the party who could answer the questions was not at home, four were wrong numbers, three directly refused, one was not a working number, and three answered the questionnaire. App. table 3 summarizes questionnaire replies.

17/ The statistical results obtained in this study indicate that a 5-by-5 square allowing 12 error degrees of freedom would probably provide statistically significant results in future studies.

study of different product forms (precooked, breaded, and so forth) may reveal a segment of consumers who were not reached by this study and who prefer a convenience product.

Since so few customers purchased catfish during this study, and since most consumers who answered the questionnaire indicated that they liked the product, the possibility exists that the market for farm-raised channel catfish could be expanded if additional consumers tried the product. Therefore, a study of the response to catfish promotion and the nature of the repeat business (the advertising decay curve) is recommended.

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APPENDIX

Appendix table 1--Raw data for catfish marketing study, 6 stores, Atlanta, Ga., 1972

Weeks	Store 1	Store 2	Store 3	Store 4	Store 5	Store 6
Week 1:						
Sales (pounds).....	79.84	74.90	67.79	59.43	65.43	71.68
Customers (number)....	6,541	4,404	4,245	2,300	5,278	5,810
Price ($/lb.).....	.89	.79	1.09	1.19	1.29	.99
Week 2:						
Sales (pounds).....	27.14	60.63	85.41	148.19	124.35	28.88
Customers (number)....	6,665	3,978	3,863	2,863	5,294	6,015
Price ($/lb.).....	1.29	.89	.99	.79	1.09	1.19
Week 3:						
Sales (pounds).....	138.45	33.87	30.43	91.46	126.87	41.09
Customers (number)....	6,123	3,556	3,612	2,333	4,446	5,170
Price ($/lb.).....	.79	1.19	1.29	.99	.89	1.09
Week 4:						
Sales (pounds).....	49.34	32.17	79.07	119.86	165.08	156.23
Customers (number)....	4,672	3,591	3,727	2,191	4,213	4,095
Price ($/lb.).....	1.09	1.29	1.19	.89	.99	.79
Week 5:						
Sales (pounds).....	39.17	71.13	130.64	70.38	305.16	48.54
Customers (number)....	6,724	4,237	4,089	2,471	5,344	5,860
Price ($/lb.).....	1.19	.99	.89	1.09	.79	1.29
Week 6:						
Sales (pounds).....	75.91	27.38	206.44	42.24	139.59	156.67
Customers (number)....	6,524	4,194	4,011	2,416	5,630	5,808
Price ($/lb.).....	.99	1.09	.79	1.29	1.19	.89

Appendix table 2--Estimated value added approach to price determination per pound for farm-raised channel catfish, 1972

Item	Amount
Producer:	
Production expense	$0.26
Harvest and transportation	.06
Profit	.02
Grower price	.34
Processor:	
Price of product 1/	.59
Processing expense	.17
Profit	.01
F.o.b. processing plant	.77
Wholesaler: 2/	
F.o.b. processing plant	.77
Selling and transportation	.10
Profit	.01
Wholesale price	.88
Retailer:	
Price of product 3/	.98
Expense	.20
Profit	.01
Retail price	1.19

1/ Assuming a dressout of 58 percent.
2/ Processor may assume this function.
3/ Assuming a 10-percent product loss.

Source: Adapted from (1).

Appendix table 3--Tabular results of channel catfish questionnaire, 1972

Question	Percent or average 1/
Have you (or someone in your family) ever bought catfish from a grocery store before:	
No	23
Yes	77
(If yes) How many other times in last 6 weeks?	1.8
Did you buy catfish anywhere else in the last 6 weeks?	
No	79
Yes	21
(If yes) Seafood market	8
(If yes) Other	12
How many pounds of catfish would you prefer to buy at one time?	3.9
In the future, how often do you intend to buy catfish from a grocery store?	
At least once every 2 weeks	60
At least once a month	35
At least once a year	2
Never	2
Concerning the catfish you bought recently in your grocery store, which of the following product improvements are needed most? (Check as many as apply)	
Easier to cook	6
Lower price	44
Better taste	17
Less bones	21
Better smell	8
None of these	29
How would you prefer to buy catfish? (Check as many as apply)	
Frozen	19
Fresh	94
Fillet	15
Heat and serve	0
Breaded frozen	0
Breaded fresh	0

See footnote at end of table.

Continued

Appendix table 3--Tabular results of channel catfish questionnaire--Continued.

Question	Percent or average 1/
Which kind of catfish would you rather buy?	
Farm-raised	58
Caught from a river or lake	8
No difference	33
If you had not made your recent purchase of catfish, which of the following would you have bought in place of catfish?	
Beef	33
Chicken	19
Other fish or seafood	48
Pork	10
How is catfish usually cooked in your home?	
Fried	98
Baked	2
Broiled	6
Barbecued	0
What is the age of the head of your family?	
Less than 25	8
25-34	12
35-49	42
50 and over	37
How many people in your family are living at home, including yourself?	3.5
What is the approximate annual income for your family?	
Less than $5,000	13
$5,000-$9,999	33
$10,000 and over	54

1/ Percentages may not total correctly for some questions because of rounding or multiple answers.

Questionnaire

PURCHASES OF CHANNEL CATFISH

Dear Consumer:

By purchasing farm-raised channel catfish, you have participated in a market study of this fish. Your answers to the questions below will help us to complete this study which is designed to help in providing you with food that is wholesome and enjoyable. Please answer all the questions even if you or members of your family may not eat catfish regularly, and mail this questionnaire promptly in the envelope which needs no stamp. Thank you.

Richard C. Raulerson
Agricultural Economist

1. Have you (or someone in your family) ever bought catfish from a grocery store before? No /_/ Yes /_/
   (If Yes) How many other times in the last six weeks? Number ___
2. Did you buy catfish anywhere else in the last six weeks?
   No /_/ Yes /_/ (If Yes) Where? Seafood market /_/ Other _____
3. How many pounds of catfish would you prefer to buy at one time? ___pounds
4. In the future, how often do you intend to buy catfish from a grocery store? At least once every two weeks /_/ At least once a month /_/
   At least once a year /_/ Never /_/
5. Concerning the catfish you bought recently in your grocery store, which of the following product improvements are needed most? (Check as many as apply) Easier to cook /_/ Lower price /_/ Better taste /_/
   Less bones /_/ Better smell /_/ None of these /_/
6. How would you prefer to buy catfish? (Check as many as apply)
   Frozen /_/ Fresh /_/ Fillet /_/ Heat and serve /_/ Breaded frozen /_/
   Breaded fresh /_/
7. Which kind of catfish would you rather buy?
   Farm-raised /_/ Caught from a river or lake /_/ No difference /_/
8. If you had not made your recent purchase of catfish, which of the following would you have bought in place of catfish?
   Beef /_/ Chicken /_/ Other fish or seafood /_/ Pork /_/
9. How is catfish usually cooked in your home?
   Fried /_/ Baked /_/ Broiled /_/ Barbecued /_/
10. What is the age of the head of your family?
    Less than 25 /_/ 25-34 /_/ 35-49 /_/ 50 and over /_/
11. How many people in your family are living at home, including yourself?
    Number ___
12. What is the approximate annual income for your family?
    Less than $5,000 /_/ $5,000-$9,999 /_/ $10,000 and over /_/

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