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## AN ANALYSIS OF POND RAISED CATFISH PRODUCTION IN TEXAS

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### INTRODUCTION

Many farm operators strive to increase and stabilize the net returns of their farming operation. The opportunity to affect annual net returns may lie in the reorganization of products and inputs, firm growth and introduction of non-traditional enterprises. There has been considerable research on reorganization and firm growth. However, since new enterprises adaptable to a farm firm organization are often based on technological innovations, economic research usually lags behind for these new enterprises. This implies some farm operators may become involved in a non-traditional farm enterprise before the economic status of the enterprise is established.

One of the more popular new enterprises adaptable to a farm firm that has recently emerged is fish farming. For example, with exceptionally encouraging preliminary reports on the profitability of catfish production, many farm operators entered the industry. Catfish production is characterized by many problems typical of a developing industry. Producers have entered the industry with little factual knowledge about production costs, expected output, production system options, capital and labor requirements, strength and nature of demand or the problems of marketing. Therefore, there is a need to establish production characteristics and marketing implications for pond raised catfish. Studies focused on these questions have been completed relating to the industry in several Southern states but not for Texas [1, 2, 3, 6].<sup>1</sup> In addition, the question of efficiency of resource use was not examined in these other analyses. The purpose of this paper is to

provide production data for Texas catfish producers similar to that available for other Southern states and to provide implications relative to efficiency of resource use [4].

### PROCEDURE

A list of producers was developed from state license lists and association lists to provide a basis for surveying the industry. Every producer included on the list was contacted by telephone to establish the basic characteristics of the operation. Also, in this way, names appearing on the list that were not engaged in commercial production of catfish during 1971 could be identified and deleted.

Expanding from the data developed in the telephone survey, extensive production data for each commercial producer in Texas was obtained through personal enumeration. The production questionnaire contained detailed questions concerning all phases of the 1971 production of catfish. These data were used in budgeting analysis to establish typical capital and labor use for alternative Texas regions and size categories.<sup>2</sup> In addition, regression analysis was applied to the 1971 producer data to estimate a production function.

The production function aggregated all investments into one capital item. To evaluate the productivity of capital, an annual cost for a typical dollar of capital was estimated. This annual cost was \$0.121 per dollar and included opportunity cost of capital at 7 percent, a risk inclusion placed at 2 percent and depreciation averaged over all items

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<sup>1</sup> This is not intended as an inclusive list of research on costs and returns of catfish production, but rather representative studies that are available.

<sup>2</sup> The disaggregated data such as feed, fingerling and repair costs and pond, harvesting and building investment are available in reference [4].

(\$0.066). This was used as the price of one dollar of capital. Labor was priced at \$1.75 per hour.

It is emphasized that the production function was developed from Texas producer data and, therefore, caution should be exercised in generalizing from these findings to any other area.

## RESULTS

Results of this study are presented in two sections: (1) budgeting results and (2) production function analysis. The budget data results serve to indicate yields, costs and investment experienced by Texas producers and provides information that can be related to similar data for other states.

### Budgeting Analysis

This section indicates the type and magnitude of costs incurred by Texas catfish producers. The data are presented for a Texas average and for three size categories; i.e., less than 10 acres, 10 to 40 acres, and greater than 40 acres.

Table 1 presents typical investment, harvested yield and costs per pound for Texas catfish production. The land value was not included in the investment estimates.<sup>3</sup> The largest investment item was pond construction costs. Pond construction costs were \$507 per acre averaged over all producers (Texas average), about \$800 per acre up to the 40 acre size and \$378 for operations with 40 acres or more. Investment per acre for items other than pond construction declined substantially as size of operation increased (\$589, \$292 and \$125 for 10 or less, 10 to 40 and 40 or more acres, respectively).

Total investment per acre was \$714 for Texas and declined from \$1327 for the operations of 10 or less acres to \$503 for those of 40 or more acres. The annual per acre fixed cost for the producer with 40 acres or more was only one-third the annual fixed costs of the smaller producers (\$58 compared to \$157). Considering all producers, the annual per acre fixed cost was \$83.

The average per acre yield harvested by Texas producers was less than that indicated for other states; i.e., 685 pounds over all Texas producers. Producers in the 10 acres or less size category harvested an average yield of 933 pounds per acre. The 10 to 40 acre size had a 515 pounds per acre yield while producers over 40 acres had an average yield of 690 pounds per acre. An average yield of 1228 pounds per acre has been reported in Alabama

[1] and between 1000 and 2000 pounds per acre for Mississippi [5]. This would suggest that producers in Texas have an opportunity to increase yields through improved production and marketing practices.

Variable costs per pound of fish were separated into three groups (repair, labor and operating).<sup>4</sup> Table 1 indicates that labor and operating costs comprised the majority of total variable costs (labor was priced at \$1.75 per hour and included manager and family labor). For both items, the cost per pound of fish declined significantly as size of operation increased. The reduction in labor costs for large operations indicates the smaller producers used much more labor relative to output. It should be recognized that for small operations, some of the labor used may have been surplus family labor, hence the labor cost in these cases was somewhat misleading. The operating cost category was the largest variable cost incurred with feed and fingerling purchases the major specific cost items in this classification. Variable costs per pound of fish were \$0.30 for Texas and \$0.51, \$0.42 and \$0.23 for the alternative size operations beginning with the 10 acre or less size, respectively.

With a yield established, the annual fixed cost was allocated to the catfish production (Table 1). Fixed costs per pound of fish were \$0.12 for Texas and \$0.17, \$0.26 and \$0.08 for the size classifications beginning with the smallest. The overhead cost per pound of catfish reflects the yields. For example, although the 10 to 40 acre size did not have the largest annual fixed cost, it did have the smallest per acre yield and as a result, this size group had the largest fixed cost per pound of fish. By increasing yields, these costs would be reduced.

By adding fixed and variable costs, total costs of production were estimated. For Texas, this total cost was \$0.43 per pound, \$0.68 for both size categories with less than 40 acres and \$0.31 for operations with over 40 acres. Again with regard to cost, the advantage of size is emphasized (a 50 percent reduction in costs comparing the less than 40 acre size to over 40 acre size group).

A disadvantage of increasing size that was observed in this study was price per pound received declined as size increased. The apparent price roll-back associated with larger sizes may result from smaller producers developing their own specialized market, whereas, larger producers tend to market through processors which offer a lower price. This causes the producer some difficulty when considering

<sup>3</sup> The approximate value of land allocated to catfish ponds was \$300 per acre.

<sup>4</sup> Operating costs refer to all variable costs other than repair and labor (such as fuel, oil, electricity, feed, fingerling, etc.).

Table 1. TYPICAL INVESTMENT, YIELD AND VARIABLE AND FIXED COSTS PER POUND OF CATFISH BY SIZE OF OPERATION FOR TEXAS, 1971.

Size	Investment per Acre <sup>a</sup>	Yield per Acre	Cost Per Pound					
			Variable Cost				Fixed Costs	Total Costs
			Repair	Labor	Operating <sup>b</sup>	Total		
	dollars	pounds	-----dollars-----					
Texas	714	685	.0142	.0542	.2306	.30	.12	.43
10 or less	1327	933	.0035	.1711	.3355	.51	.17	.68 <sup>c</sup>
10 to 40	1150	515	.0320	.0774	.2966	.42	.26	.68
40 or more	503	690	.0121	.0231	.1916	.23	.08	.31

<sup>a</sup>Investment does not include the value of land which was approximately \$300 per acre.

<sup>b</sup>Operating costs refer to all variable costs other than repair and labor (such as fuel, oil, electricity, feed, etc.)

<sup>c</sup>Cost was .92 if water was supplied by source other than a well.

increasing size to take advantage of lower costs. For example, it is possible that yield declined for the second size group (10 to 40 acres) because producers with 10 acres or less elected to increase size and in doing so, some increased production capability beyond the capacity of their specialized markets.

The discussion above is directed principally to production and inputs required. For meaningful comparisons with other regions and other enterprises, costs and returns on a per acre basis are useful. Total costs per acre (fixed plus variable) were \$285 for Texas and \$632, \$343 and \$214 for the size classifications beginning with the smallest. The variable costs per acre comprised about three-fourths of total costs. Comparing per acre costs to returns (based on average yield and \$0.65 per pound) net returns were \$160 for the average Texas operation, \$235 for the 40 acres or more classification, and negative returns or losses were observed for operations with less than 40 acres. Once again the advantage of size emerges. A shortcoming of this estimate is the previously mentioned price roll-back that appears to be associated with larger size operations.

Since price is variable for catfish, an analysis was made of net returns over a price range. For a price of \$0.20 to \$0.80 per pound, net returns were estimated

for the different classifications assuming average yields and costs. Estimated net returns per acre by size category are presented in Figure 1 for alternative catfish prices.

Of course, as price increases, net returns become more favorable. However, looking at the approximate processors price of \$0.36 per pound, net revenue per acre was a negative \$48 for Texas, a negative \$297 for 10 acres or less, a negative \$163 for 10 to 40 acres and \$34 for 40 acres or more. These values represent returns above both fixed and variable costs. However, if returns exceed variable costs, the producer would be rational to continue production in the short run. Returns above variable costs would be positive for the Texas average but remain negative for the two smaller size classifications. This suggests catfish farming in Texas based on 1971 yields and costs is marginal at best using a price of \$0.36 per pound for the fish.

Another way of viewing these net returns is determining the price per pound of catfish required for a specific per acre profit. For example, to make a \$100 per acre profit for catfish farming (based on average yields and total costs), the price per pound of catfish would have to be \$0.57 for the Texas average and \$0.78, \$0.87 and \$0.45 for the three size classifications beginning with the smallest.

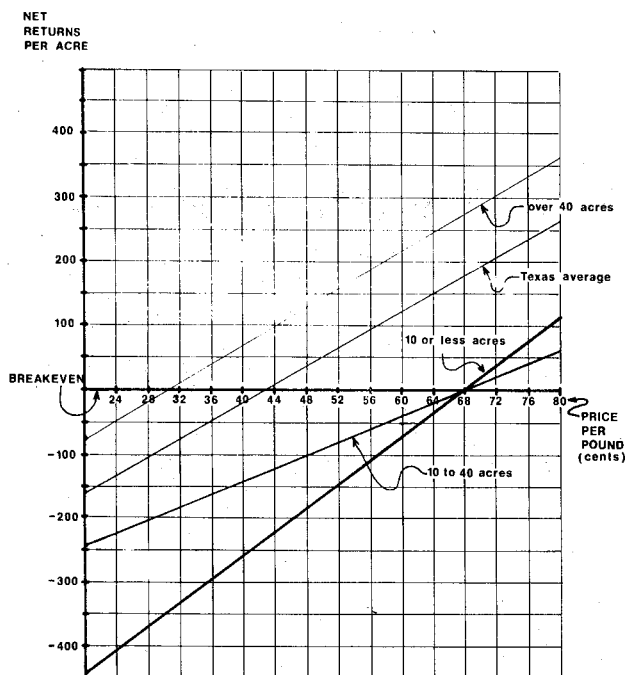


Figure 1. PER ACRE RETURNS ABOVE FIXED AND VARIABLE COST FOR CATFISH PRODUCTION IN TEXAS BY SIZE CLASSIFICATION, 1971.

## Production Function

Since catfish is a relatively new enterprise in Texas, there was a need to determine if a gross misallocation of resources in the production of catfish had emerged. To extend the study to an analysis of efficiency of resource use, a Cobb-Douglas production function was estimated from the 1971 producer data.<sup>5</sup> The analysis was confined to capital and labor with the objective to determine if capital and labor were being used in a least-cost combination.

The estimated function was as follows:<sup>6</sup>

$$Y = 0.796 K^{0.694} L^{0.476}$$

(4.11)\*      (1.31)

$$r^2 = .74$$

$$F = 21.4^{**}$$

Where:

- Y = total output of catfish (pounds)
- K = capital made up of investment items (dollars) and
- L = labor use (hours)

<sup>5</sup> Due to very erratic output and levels of input, those producers with less than 3000 pounds of output were not included in estimating the equation.

<sup>6</sup> The "t" values are given in parentheses under the coefficients; \* indicates significance at the 0.05 level; \*\* indicates significance at the 0.01 level.

Considering this function, two characteristics are readily obvious. First, the coefficients add to 1.170 which indicates increasing returns to size. This indicates a declining average cost curve for increased levels of catfish output. In addition, a profit maximizing condition cannot be derived from this function.

Second, the calculated t-value indicates that the coefficient for labor (L) is insignificant. This is partially due to the existence of correlation between capital and labor (.64). While not statistically significant, the coefficient of labor is, however, greater than its standard error. Recognizing the limitations, an analysis of the function provides the following information on efficiency of resource use.

The marginal physical product for capital and labor estimated at the geometric mean was 0.643 and 9.618, respectively. Pricing capital at \$0.121 per dollar and labor at \$1.75 per hour the marginal physical product per dollar of capital and labor was 5.31 and 5.50, respectively. This implies that producers in 1971 were approximating the least-cost combination of capital and labor.

If one chooses to ignore an analysis of labor due to the indicated insignificance of the coefficient, an analysis of the capital input is still useful. The marginal physical product per dollar of capital was 5.31 pounds. This means that if the producer receives more than \$0.19 per pound for catfish, more capital could profitably be added to the enterprise. However, capital is aggregated over pond and other investments, and the specific location of the additional dollar of capital for maximum return is unavailable from the function.

The purpose of the production function should be reemphasized. It was used to determine if there was evidence that a gross misallocation of capital and labor existed in the production of catfish in Texas. It should be recognized that this function was estimated using catfish yields that were, in some cases, held at a reduced level to avoid producing more than a particular market could absorb. With 1971 yields, the production function indicates that producers are approximating the least-cost combination of capital and labor. However, hypothesizing to the future, an improved price situation for catfish could induce producers to increase per acre yields. If they increase per acre yields with present capital but additional labor use, they would shift from the least-cost combination of capital and labor. The increased use

of labor, relative to capital and associated with increased yield, would be expected to decrease the marginal productivity of labor and result in the marginal physical product per dollar of labor being lower than the marginal physical product per dollar of capital. This serves to indicate how easily an improper resource mix could evolve and how sensitive the analysis is to change.

### CONCLUSIONS

Catfish producers in Texas tend to have lower per acre yields but receive higher prices than those in other Southern states. With higher prices, the net returns of Texas producers may be comparable to other states but lower yields cause costs (especially fixed costs per pound of output) to be greater than reported in other states.

The advantage of size in reducing costs required to produce a pound of catfish were indicated in the

budgeting analysis. However, evidence in this study indicates Texas producers have excess capacity in catfish production facilities; i.e., the lower per acre yields compared to other states. This means the Texas producer in considering size of operation and attempting to gain the economies associated with size, will have to consider any marketing limitations and expected price roll-back he might experience with increases in output.

Production function analysis indicates that producers are presently using capital and labor in a least-cost combination. However, there is a need to disaggregate capital into its components and express labor in terms of hours per acre or other similar adjustments to more fully analyze resource use and reduce the correlation between capital and labor. Also, adjustments within capital items may be profitable such as additional expenditures for automatic feeders.

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