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An Economic Analysis of Catfish Industry in Tennessee

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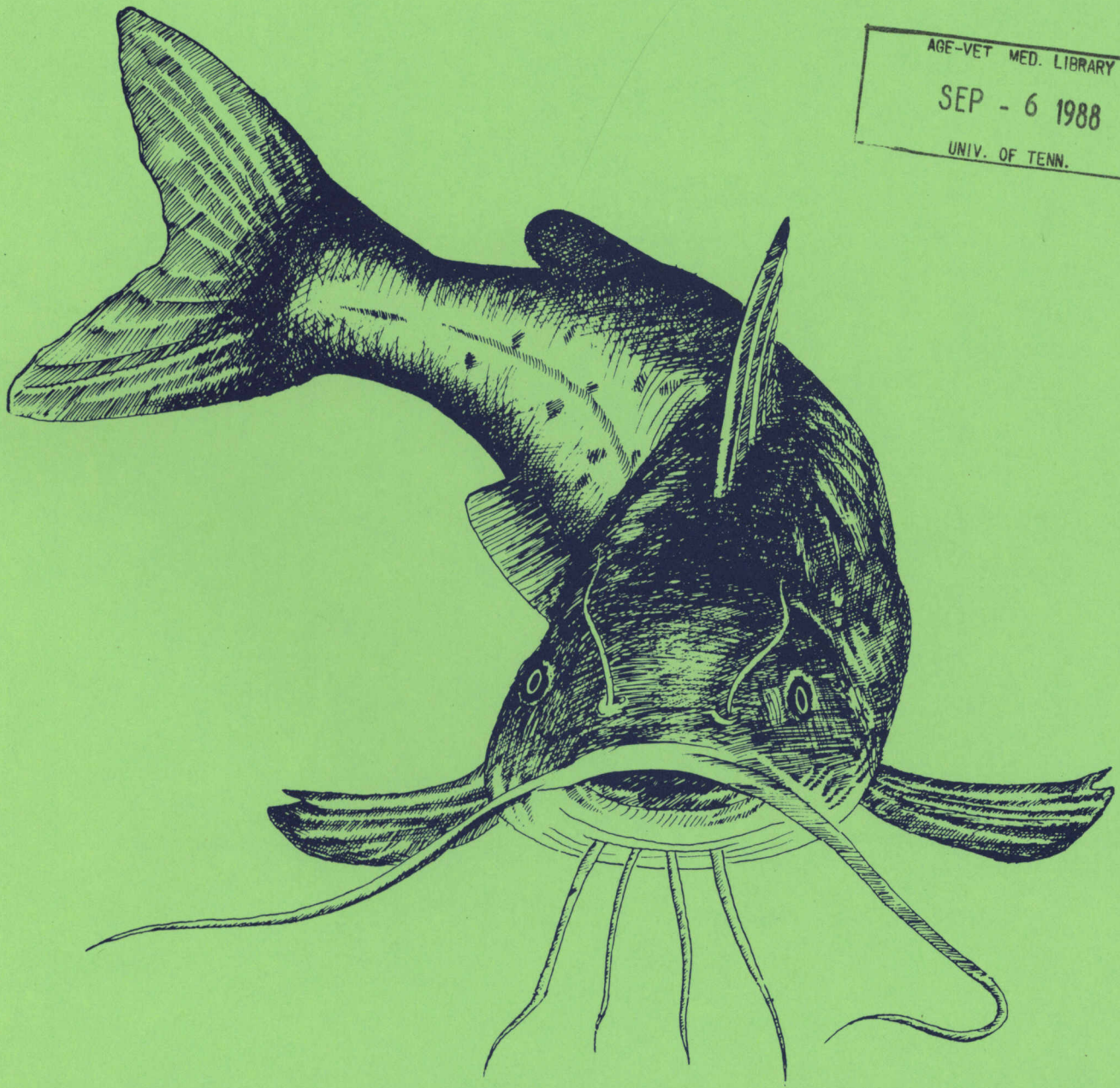

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Abstract

In 1984 twenty-nine commercial catfish producers in Tennessee reported 460 acres of ponds, 179,575 pounds of catfish produced and aggregate sales of $204,188. About 60 percent of the acreage was in West Tennessee. The average annual yield was 598 pounds per pond acre. About half of the producers produced both market catfish and fingerlings. Nearly half processed some or all of the food fish they produced. Fifty-three percent of total catfish production was sold live through five principal markets and forty-seven percent was sold in processed form. Principal market outlets included restaurants (some producer owned), direct-retail sales, live-fish haulers, and fee fishing. Producers indicated intentions to expand production substantially in 1986.

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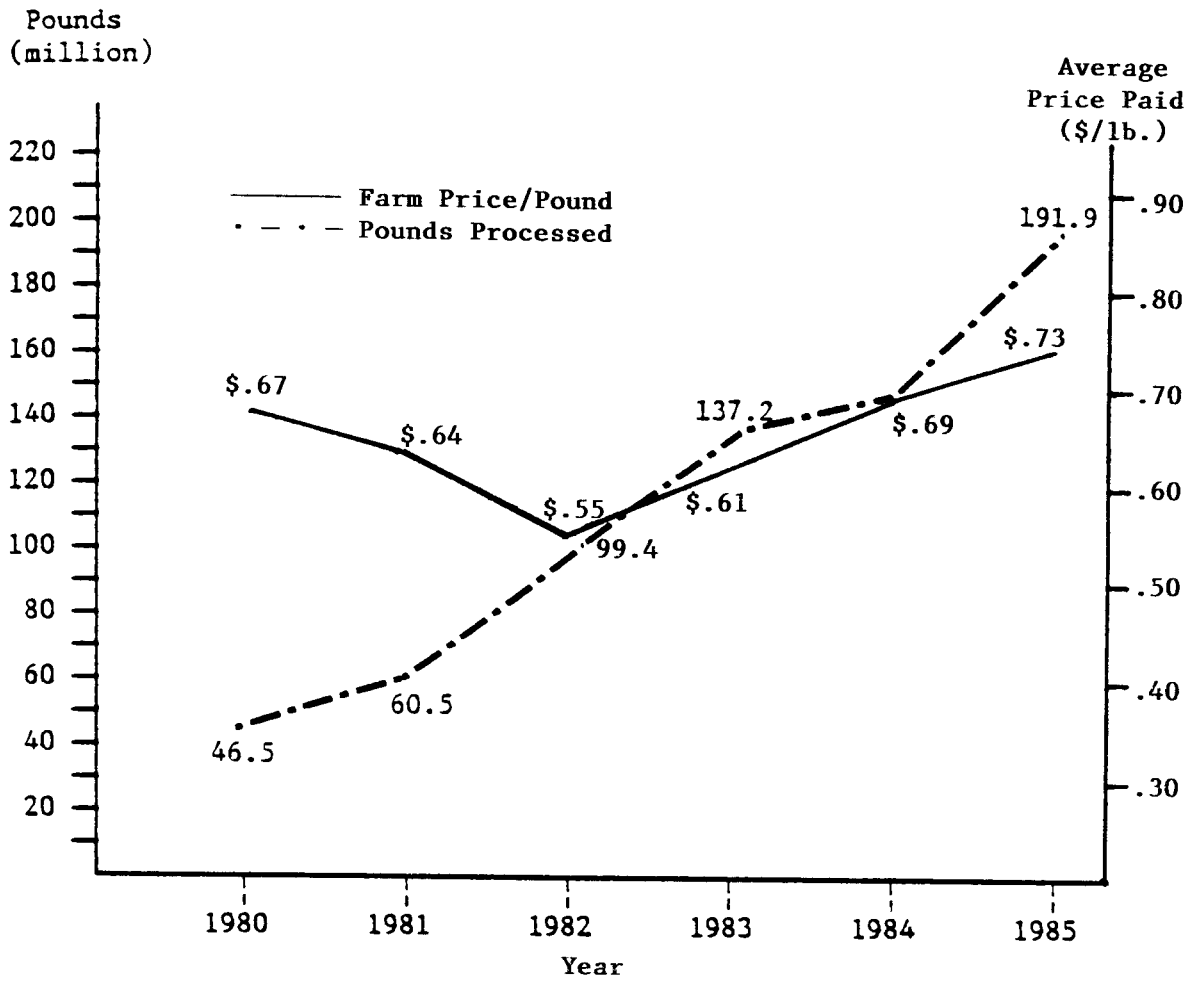
Table 1. Catfish Farms, Catfish Sales and Acres Under Water for Selected States and U.S., 1974 and 1982

State	1974			1982		
	Farms[a] (number)	Sales ($1,000)	Water Acres (number)	Farms[a] (number)	Sales ($1,000)	Water Acres (number)
U.S. total	773	12,681	28,732	1,494	71,539	70,321
Alabama	121	1,381	2,372	327	7,613	8,299
Arkansas	103	3,068	7,750	115	6,420	6,302
Georgia	53	159	1,920	114	627	997
Kansas	40	164	628	36	680	566
Kentucky	14	96	89	17	305	164
Louisiana	32	280	887	36	406	706
Mississippi	112	4,945	8,592	316	48,022	43,600
Missouri	55	421	807	76	786	872
Oklahoma	20	82	266	42	690	924
Tennessee	47	369	671	46	288	481
Texas	81	998	403	171	2,004	1,457
Florida	22	110	1,425	34	404	242
California	18	269	508	53	2,371	1,554

Sources: 1974, 1978 and 1982 U.S. Census of Agriculture.

[a]Farms with sales of over $2,500 from all farm products.

Until the late 1960's, most of the catfish produced were marketed to the consumer through fee-fishing ponds; however, as production expanded a processing industry for farm raised catfish developed [3]. Currently, most catfish produced in the United States are sold to processing firms [7, 8]. From 1980 to 1985, the volume of processed catfish increased at an annual average rate of 34 percent, rising from 46.5 million liveweight pounds in 1980 to 191.9 million liveweight pounds in 1985 (Figure 1). Despite this large increase in production,



Source: Catfish, Crop Reporting Board, SRS.

Figure 1. Pounds Processed and Average Price Paid for Liveweight Catfish By Processors, 1980-85

the farm price per pound of catfish sold to the processing industry in 1985 was only $.06 above the 1980 price (Figure 1). The driving forces behind the recent production expansion of the catfish industry have included an increase in consumer demand for farm raised catfish, extension of traditional market bounds northward, introduction of catfish into the fast food market segment in 1985, and the emergence of an efficient marketing system centered around the processing industry.

OBJECTIVES

The principal broad objectives of this study were to investigate the economic status of the catfish producing industry in Tennessee in 1984-1985 and to determine the potential for expansion of this industry in Tennessee. The specific objectives were to 1) identify and categorize the production and marketing systems used for channel catfish in Tennessee, 2) determine the existing limitations and potential for the production and marketing of channel catfish, and 3) estimate the costs and returns for a representative catfish enterprise.

PROCEDURE

A list of all known commercial sources of fish in Tennessee was compiled in the spring of 1985 by the Extension Division of the Department of Forestry, Wildlife and Fisheries at the University of Tennessee. From this list 30 commercial producers of catfish were identified. A survey questionnaire was used in producer interviews to facilitate obtaining standardized information. Interviews were conducted during the August-October 1985 period with 28 of the identified catfish producers; two producers refused the interview. One refusal did permit an inspection of his facility resulting in size and facility measurements for 29 of the 30 identified producers.

Costs and returns budgets were developed for a representative food-size catfish enterprise for three levels of production. The costs of production were based on 1985 input and facility costs for Tennessee and were provided by suppliers to the commercial fish farming industry. Estimated returns were based on the 1984 average price for live catfish in Tennessee.

SURVEY RESULTS

Enumeration of Producers and Demographic Characteristics

Twelve of the 30 identified commercial producers were located in Extension District I - West Tennessee; 7 were located in Extension District II - Middle Tennessee; 5 were located in Extension District V - Upper East Tennessee; 4 were located in Extension District IV - Cumberland Plateau; and 2 were located in Extension District III - Lower East Tennessee (Figure 2). The two producers who were not interviewed were in Extension District I - West Tennessee.

The average age of the 28 producers interviewed was 53 years and ranged from 29 to 84 years. The median age was 58 years. The average producer had been producing for 9 years; forty percent of all producers had been producing 6 years or less (Table 2).

Table 2. Classification of Catfish Producers by Length of Time in Production, Tennessee, 1985

Time in Production (years)	Producers (percent)
0-6	40
7-12	28
13-18	25
19-24	7
Total	100

Eighty-nine percent of the catfish enterprises were owned by a single proprietor, and 11 percent were partnerships. Twenty-nine percent of the producers had at one time borrowed money for the production of catfish. Twenty-five percent reported catfish sales as

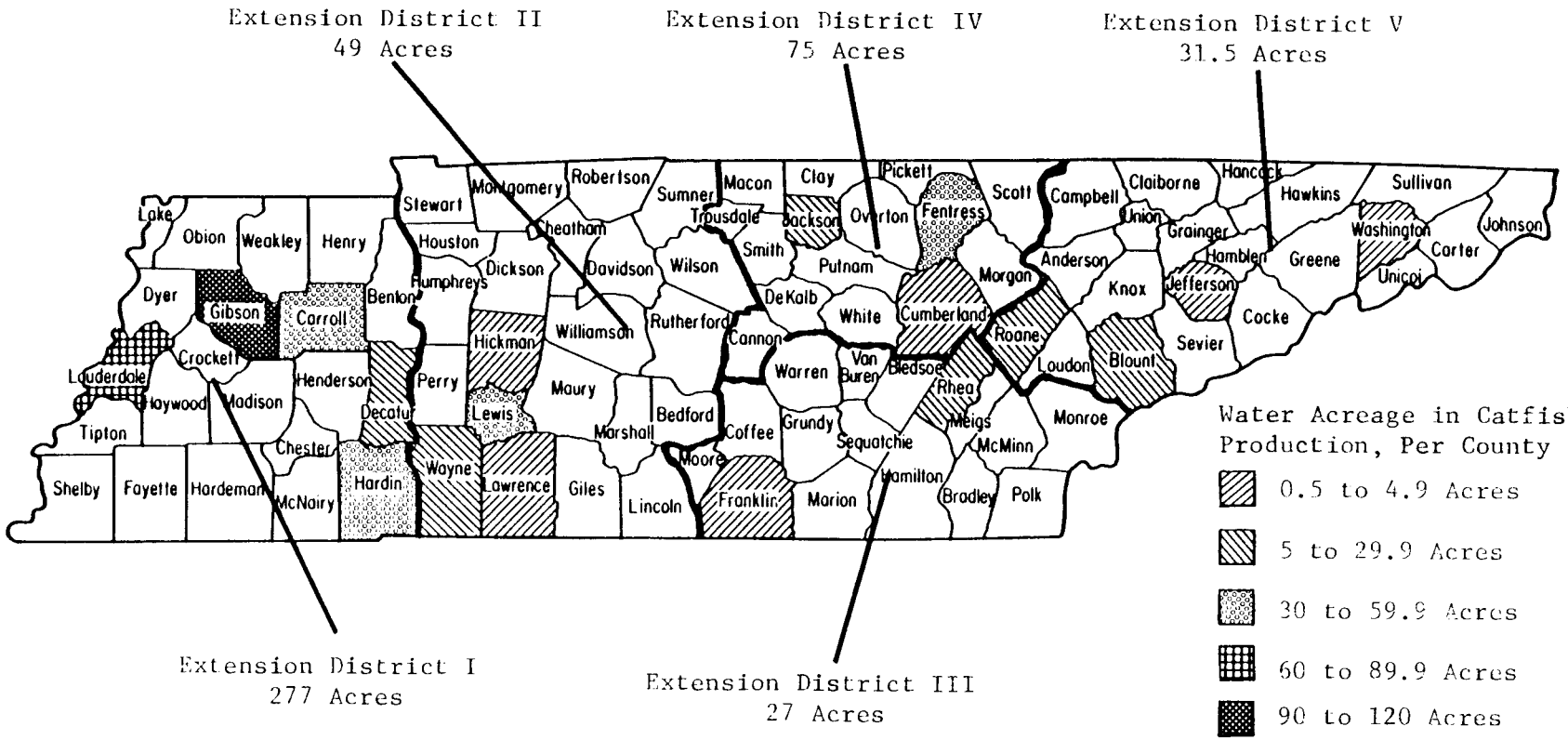


Figure 2. Geographical Location of Catfish Production Acreage, Tennessee, 1985

their primary income source. Only eleven percent of the producers had any experience or education related to fish culture prior to beginning the production of catfish.

Size of Production Enterprises

Classification of catfish producers into size groups was based on the surface acreage of ponds used for the production of catfish. The total water acreage reported by all respondents was 459.5 acres (Table 3). The average enterprise size was 15.8 acres and consisted of an average of 6.6 ponds of approximately 2.4 acres each. Pond sizes ranged from 0.2 acres to 35 acres.

Table 3. Enterprise Size Distribution of Catfish Producers and Average Pond Size and Number, By Production Acreage, Tennessee, 1985

Size Category		Produces	Water Acreage in Production		Average Pond Size	Average Number of Ponds
			Average Per Enterprise	Total		
		number	acres			
I.	0.5-9.9 acres	14	2.8	39.5	0.7	3.8
II.	10-19.9 acres	6	14.0	84.0	1.6	8.5
III.	20-39.9 acres	4	24.8	99.0	9.0	2.8
IV.	40+ acres	5	47.4	237.0	3.1	15.2
	All Sizes	29	15.8	459.5	2.4	6.6

Seventy-three percent of the total acreage was owned by the nine producers with enterprises greater than 20 acres in size. The remaining 27 percent of the total acreage was owned by the 20 producers with enterprises less than 20 acres in size.

Location of Production Acreage

Two hundred and seventy-seven acres of ponds (60 percent of the total) were in Extension District I - West Tennessee (Figure 2). Several factors contribute to the greater concentration of the catfish industry in West Tennessee. Two physical factors are the extensive aquifers in West Tennessee and the warmer climate compared with other regions in the state. The abundance of aquifers, some relatively shallow wells yielding up to 2,000 gallons per minute, permit the use of larger, more efficient, levee-type ponds where level bottomlands are available. Fifty percent of the acreage in West Tennessee was supplied by underground wells. The warmer climate of West Tennessee allows a longer growing season for catfish which optimally feed and gain weight when water temperatures are between 80-86^{o}F [3]. The annual average temperature for West Tennessee (60.6^{o}F) is 1.8 degrees warmer on average than the annual average temperature for the rest of the state [8]. A third factor contributing to the greater concentration of catfish production acreage in West Tennessee may be the historical popularity of catfish with consumers in this region. Prior to the development of the commercial culture of catfish, catfish caught from the Tennessee and Mississippi Rivers were the chief sources of food catfish in the South. Historically, these rivers supported and continue to support a significant capture fishery for wild catfish and a few other species.

The acreage of catfish ponds in the other extension districts were as follows: District IV (Cumberland Plateau) - 75 acres; District II (Middle Tennessee) - 49 acres; District V (Upper East Tennessee) - 31.5 acres; and District III (Lower East Tennessee) - 27 acres (Figure 2).

Facilities and Equipment Inventory

The production of catfish was exclusively in earthen ponds. Pond designs were diverse, depending particularly on the type of water source and the topography of the site. Ponds utilizing watershed runoff usually consisted of a barrage dam across a gully or small valley; ponds utilizing groundwater wells were usually four-sided levee ponds. Barrage ponds are considered more difficult to manage because of: 1) the irregular contours of the pond bottom and sides which make harvest seining more difficult; and 2) the dependence on watershed runoff, often an unreliable water source [3]. Previous research has shown the 20-acre levee-type unit to be the most cost efficient pond size [2, 4]. The average size of the Tennessee catfish pond (2.4 acres) was considerably smaller.

Water for catfish production in Tennessee was derived from four principal sources: watershed runoff, springs, streams and wells (Table 4). Watershed runoff was the predominant source supplying 35 percent of the ponds. Lack of an adequate water supply can be a limiting factor to intensive catfish production. The minimum requirement for intensive

Table 4. Water Source for Catfish Production Ponds, Tennessee, 1985

Type of Supply	Ponds Supplied (percent of total)
Watershed runoff	35
Springs	30
Wells	25
Streams	10
Total	100

production is considered to be 13 gallons per minute for each acre in production [3].

An inventory of equipment used in the production of catfish was made for each producer (Table 5). The most commonly reported equipment item was harvest seines (83 percent reporting). Other items used by a majority of the catfish producers were tractors, mowers, trucks, spawning containers and water pumps. Pond aerators, oxygen monitors and water quality test kits, considered necessary equipment for the intensive production of catfish (stocking rates greater than 2,500

Table 5. Catfish Equipment Inventory: Percent of Producers Owning and Utilizing Various Equipment in the Aquacultural Enterprise, By Size Category, Tennessee, 1985

Equipment Description	Size Category .5-9 Acres	10-19 Acres	20-39 Acres	40+ Acres	All Sizes
	percent				
Tractor	50	100	25	100	65
Mower	71	100	25	100	76
Truck	71	100	75	80	79
Fish transport tanks	29	50	75	80	48
Pond aerators	14	33	0	60	24
Seines	86	83	50	100	83
Holding/grading nets	0	0	0	60	10
Culture cages	0	0	75	0	10
Oxygen monitor	21	17	25	40	24
Fish feeders	0	0	0	20	3
Water test kit	14	17	50	40	24
Catfish hatchery	7	0	0	20	7
Spawning containers	57	50	25	100	55
Storage shed	29	67	50	80	48
Irrigation pumps	0	33	0	0	7
Water pumps	64	67	75	100	72
Boat and motor	14	67	50	60	38
Fish holding vats	36	50	25	40	38
Bulk feed bins	0	0	0	20	3

fish per acre), were included in the inventories of 25 percent of the producers.

Fingerling Production

The production of food-size catfish requires fingerling catfish for stocking in ponds. These were either purchased (mainly from Arkansas suppliers) or produced on the farm. Among the producers, 54 percent were producing fingerlings--43 percent produced all the fingerlings required and 11 percent acquired fingerlings by both production and purchase.

A total of 39.4 acres of surface water were being used for fingerling production--an average of 2.8 acres per fingerling producer. On these farms, there was an average ratio of 2.8 acres of fingerling ponds to 16.7 acres of food-size ponds.

Two methods of producing fingerling catfish were used: 1) the open-pond method of spawning and hatching; and 2) pond spawning followed by removal of the egg mass from the pond and subsequent mechanical hatching in a hatchery facility. The open-pond method of spawning, where the eggs are hatched and cared for by the broodfish in spawning containers placed in the pond, was practiced by all producers raising their own fingerlings. Two producers were also artificially incubating some eggs in hatchery facilities. In general, mechanical hatching results in a higher hatch ratio and allows exact fry counts, facilitating proper stocking densities. Broodfish were stocked at an average density of 34 fish per acre--ranging from 8 to 80 fish per acre.

When catfish fingerlings are being cultured at high densities, feeding two or three times daily is recommended [3, pp. 56]. The

fingerling producers in Tennessee were, in general, feeding less frequently; only 36 percent fed every day, 28 percent fed 6 days per week, and 36 percent fed 5 days per week. The majority (64 percent) fed only one time daily; the remaining producers fed their fish twice daily.

Only one fingerling producer reported using a feed specifically formulated for fingerling catfish; the majority of producers (64 percent) fed the fines and crumbles of food-size fish formulations. Others were grinding food-size fish feeds and some used fingerling feeds formulated for fingerling trout.

Annual yields of fingerlings were unknown by the producers due mainly to the difficulty of counting fingerlings under the open pond method of production. The average size of fingerlings after the first growing season (mid-May through late October) was 5.2-inches--ranging from 4 to 7 inches.

Production of Food-Size Catfish

The selection of the fingerling stocking density in a food-size catfish grow out pond reflects the level of management and the risk preference of the producer. In extensively managed production systems, the stocking density per acre may range from 500 to 2,500 fingerlings with annual yields averaging less than 2,000 pounds per acre. In intensively managed systems, the stocking density may range from 3,000 up to 10,000 fingerlings per acre with annual yields in excess of 2,000 pounds per acre [3, p. 57]. The average stocking density reported by Tennessee producers was 1,732 fingerlings per acre (Table 6). The average fingerling stocked was 6.5 inches in length. Only producers in Size Category I stocked at densities over 2,500 fish per acre. Based

Table 6. Stocking Rates of Fingerling Catfish and Size of Fingerlings Stocked, By Size Category, Tennessee, 1985

Size Category	Stocking Rate Per Acre (number)	Fingerling Size (inches)
I. 0.5-9.9 acres	2,590	5.4
II. 10-19.9 acres	1,719	6.9
III. 20-39.9 acres	1,000	6.4
IV. 40+ acres	1,729	6.7
All Sizes	1,732	6.5

on these stocking densities, most catfish were produced in extensively managed production systems.

Food-size catfish were fed an average of 1.1 daily feedings at a frequency of 5.4 days per week. Most producers (76 percent) fed a 32-33 percent protein floating feed purchased from local feed suppliers. Other feeds utilized included 36 percent protein floating and 26 and 32 percent sinking feeds. Seventeen percent of the producers were purchasing feed from out-of-state suppliers usually because of a perceived price differential.

The use of floating feed allows the producer to observe the feeding response and determine the suitable quantity to feed. Seventy-two percent of the producers reported that they fed a daily quantity based on the amount of feed the fish would consume in a given time period (this ranged from 10 to 45 minutes with a mean of 17 minutes). The remaining producers based the quantity fed on a percentage (1 to 5 percent) of the estimated standing weight of the fish crop. Producers reported that fish, on the average, would actively feed from mid-April

through mid-November. The reported length of growing season was the same for West Tennessee as for Middle and East Tennessee.

Food-size catfish were harvested mainly by seining (74 percent reporting); half of those who seined would first draw down the pond level. Fee fishing was also a popular method of harvesting (30 percent reporting), while completely draining and trapping were methods used by 11 and 4 percent of the producers, respectively. The majority of producers (74 percent) selectively harvested the larger fish in a pond; the remaining producers harvested all the fish in a pond at one time.

The average weekly labor reported to maintain production during the growing season was 1.0 hour per surface acre of food-size catfish. Seventy-five percent of this labor was supplied by owner operators, 20 percent by hired labor, and 5 percent by other family members.

In the major producing areas of Mississippi, Alabama and Arkansas, fingerling catfish stocked in the spring are marketed at approximately 0.75 to 1.25 pounds after 1 growing season [7]. In Tennessee fish were harvested after 1 to 4 growing seasons--an average of 1.6 growing seasons (Table 7). The average weight of fish marketed was two pounds. Total production of food-size catfish from 300 pond acres in 1984 was 179,575 pounds. The average producer marketed 7,183 pounds and had an annual yield of 598 pounds per pond acre. Yields ranged from 85 to 2,500 pounds per acre. In 1985 yields in the Mississippi delta of Mississippi were estimated to average between 4,500 and 5,000 pounds per acre [13]. To attain these yields oxygen levels are monitored daily, and pond aeration equipment is a necessity to prevent oxygen depletion problems. Most Tennessee production was characterized by relatively low stocking rates resulting in low yields and low risk of oxygen depletion.

Table 7. Marketed Production, Yield Per Acre, Production Period and Average Weight of Food-Size Catfish, by Size Category, Tennessee, 1984

Size Category	Average Growing Seasons[a]	Average Market Weight	Marketed Catfish Average	Marketed Catfish Total	Yield Per Pond Acre
	(number)	pounds			
I. 0.5-9.9 acres	1.9	2.1	2,444	31,775	1,073
II. 10-19.9 acres	1.1	2.1	12,350	74,100	1,048
III. 20-39.9 acres	1.6	1.7	7,233	21,700	289
IV. 40+ acres	2.3	2.1	17,333	52,000	416
	1.6	2.0	7,183	179,575	598

[a]The average growing season according to survey response was mid-April through mid-November.

With most production of low intensity, few producers reported incidence of infectious disease or parasites in 1984. "Ich" (Icthyophthirius Multifiliis) and other protozoan parasites were reported by three producers, and two reported bacterial diseases; all others reported no disease problems in 1984.

Producer Markets for Catfish in Tennessee

The 179,575 pounds of food-size catfish produced in 1984 were sold in either a live or processed form by the producers. Approximately, 95,250 pounds of catfish were sold live (53 percent) to five principal market outlets, while 84,325 pounds of food-size catfish were producer-processed (47 percent) and sold to four principal market outlets (Table 8). The 1984 average live price per pound over all market outlets was $0.98 and per pound of processed catfish was $1.94.

Table 8. Market Outlets and Average Prices for Live and Processed Food-Size Catfish in Tennessee, 1984

Market Outlet	Live Market		Processed Market		Combined Volume (pounds)
	Volume Marketed (pounds)	Average Price Per Pound (dollars)	Liveweight Volume Processed (pounds)	Average Price Per Processed Pound (dollars)	
Producer-owned Restaurant	--	--	36,830	a	36,830
Retail Outlets	25,718	0.85	13,880	1.64	39,598
Live-fish Haulers	23,813	0.94	--	--	23,813
Other Restaurants	14,287	0.84	21,945	1.95	36,232
Direct Retail Sales	12,382	1.10	11,670	2.24	24,052
Fee Fishing	19,050	1.21	--	--	19,050
All Outlets	95,250	0.98	84,325	1.94	179,575

[a]Price per pound unavailable for producer-owned restaurants.

The largest volume outlet for live catfish was the retail outlet--mostly local grocers and fish markets. Although more live catfish were sold in this market outlet than any other, only 8 percent of the producers reported sales in it. The live-fish hauler outlet had the next largest volume and was used by 19 percent of the producers. Live-fish haulers provide transport and serve as the marketing link between pay-lake operators and catfish producers. Thirty-five percent of the producers reported live sales through their own fee-fishing facility. This outlet had the highest average live price of $1.21. The higher price, in part, reflects the higher marketing costs resulting from the additional fixed and variable costs of operating a fee-fishing facility.

Direct retail sale to the purchasing public was the most commonly used live fish outlet, reported by 38 percent of the producers.

Although most frequently used, this outlet had the lowest volume of all outlets. Restaurants were used by 8 percent of the producers marketing live catfish in 1984. Restaurants were a larger volume outlet in the processed fish market.

Forty-six percent of the producers were processing some or all of the fish they produced. Restaurants, primarily producer owned, were the largest volume outlet for processed fish with 70 percent of the total marketed in 1984 (Table 8). The remaining processed fish were marketed through retail outlets and direct sales to consumers.

In total, 41 percent of the food-size catfish produced in 1984 were marketed through restaurants. Twenty-four percent were ultimately marketed through fee-fishing facilities either by the producer or indirectly through the live-fish hauler outlet. Twenty-two percent were marketed through retail outlets and 13 percent through direct retail sale to the consuming public.

Twenty-one percent of the producers also marketed fingerling catfish in 1984. A total of 73,000 fingerlings, ranging from 2 to 10-inches were reported sold at an average price of $174 per thousand. All sales were to noncommercial pond owners for recreational stocking.

Estimated farm sales of all marketed forms of catfish in 1984 were $204,188 (Table 9). The average producer had sales of $8,508. The estimated value added in processing per pound of liveweight catfish was $0.18. Total value added was estimated to be $15,516. Sales were distributed fairly evenly across calendar quarters with the largest share of sales, 29 percent, occurring in the fourth quarter and the smallest share, 21 percent, in the first quarter. For the second and

Table 9. Catfish Sales, By Size Category, Tennessee, 1984

Size Category	Live Fish Sales	Estimated[a] Processed Fish Sales	Fingerling Sales	Average Sales Per Producer	Estimated Total Sales
			dollars		
I. 0.5-9.9 acres	29,570	5,657	3,000	3,186	38,227
II. 10-19.9 acres	32,315	44,253	2,750	13,220	79,318
III. 20-39.9 acres	11,058	9,391	2,184	7,544	22,633
IV. 40+ acres	20,402	38,853	4,755	21,337	64,010
All Sizes	93,345	98,154	12,689	8,508	204,188

[a]Total processed sales based on a 60 percent dress out weight of the liveweight processed from Table 8.

third quarters, sales were 24 and 23 percent of total sales, respectively.

ESTIMATED COST AND RETURNS OF PRODUCING FARM-RAISED CATFISH IN TENNESSEE

Cost and return budgets were estimated at three levels of production intensity for a 16.8 acre catfish enterprise.[1] The enterprise was assumed to consist of seven ponds of 2.4 acres each (the average pond size among survey respondents) and would require 20.5 acres of nearly level land. Ponds would be of a levee design with shared levees (Appendix Figures 1 and 2). Average pond depth would be 4.7 feet. A 210 g.p.m. spring was assumed available as a water supply, the water to be gravity fed through 8-inch pvc pipe to each pond.

[1]Based on the survey, producers had an average of 6.6 ponds, averaging 2.4 acres each. Seven ponds averaging 2.4 acres each was assumed for the cost-returns analysis.

The lowest level of output for which costs and returns were estimated, Production Level I, assumed the 1984 reported average yield of 598 pounds per acre. The budgeted yield per acre, grow-out period, market size, equipment inventory, and size of fingerling stocked for this level of output were all obtained from the survey means of these parameters [6]. The middle level of output, Production Level II, assumed an average yield of 2,500 pounds per acre, and the highest level of output, Production Level III, assumed an average yield of 4,500 pounds per acre. The middle and highest output levels differed from the lowest level by the size of catfish marketed (one pound versus two pounds) and the grow-out period (one growing season versus 1.6 growing seasons).

Estimated Investment Costs of the Catfish Enterprise

Estimated total investment cost (excluding the cost of land) was $71,194 for Production Level I and II, and $87,318 for Production Level III (Table 10). The largest portion of total investment would be for pond construction, representing 87 percent of total investment at Level I and II and 75 percent of total investment at Level III (see Appendix Tables 1, 2 and 3 for details regarding investment cost for each production level). The higher investment requirements at Level III resulted from the need for additional feeding and aeration equipment, additional tractor power, and for more graveled levee tops necessary for harvesting with trucks and tractors.

Estimated Net Returns of the Catfish Enterprise

Production costs, other than labor, were estimated using 1985 prices obtained from suppliers to the fish farming industry, while

Table 10. Estimated Total Investment for Three Levels of Production on a 16.8-Acre Catfish Production Enterprise, Tennessee, 1985

Item	Production Level I 598 Pounds Per Acre	II 2,500 Pounds Per Acre	III 4,500 Pounds Per Acre
	dollars		
Pond construction -	62,154	62,154	65,638
Earth moving	42,379	42,379	42,379
Drainage and inlet pipe and valves	17,434	17,434	17,434
Gravel	2,018	2,018	5,550
Vegetative cover	323	323	275
Feeder	0	0	6,000
Aeration equipment	0	0	5,200
Harvesting	2,800	2,800	2,800
Miscellaneous equipment -	6,240	6,240	7,680
Tractors - 40 hp	3,000	3,000	4,440
1/2-ton truck	700	700	700
7-foot reciprocating mower	1,220	1,220	1,220
Water quality test kit	220	220	220
Boat	500	500	500
Motor	300	300	300
Waders	300	300	300
Total	71,194	71,194	87,318
Investment per surface acre of water	4,238	4,238	5,197
Investment per acre of land	3,473	3,473	4,259

revenues were based on the reported 1984 price for live catfish of $0.98. The net returns above variable expenses for Production Level I, II and III were $4,521, $19,329 and $35,726 (Table 11). At all three levels of production, feed would be the single largest variable expense item. The net returns to land, operator's labor, capital and management were -$853, $14,452 and $28,678 for Production Level I, II, and III

Table 11. Estimated Annualized Returns and Expenses for a 16.8-Acre Catfish Enterprise[a] Under Three Levels of Production Intensity, Tennessee, 1985

Item	Description	Unit	Unit Price	Quantity			Amount Production Level		
				I	II	III	I	II	III
			(dollars)				(dollars)		
REVENUE									
Food-size catfish[b]	I - 2 lb. fish II & III - 1 lb. fish	cwt.	98.00	95.68	400	720	9,377	39,200	70,560
EXPENSES									
a. Variable[c]									
Fingerling catfish[d]	5"-7" fingerlings	1000	150.00	5.4	43.5	78.3	810	6,525	11,745
Feed[e]	32% protein floating	ton	292.00	7.6	35.1	65.0	2,219	10,249	18,980
Fuel, oil, lube[f]	For 40 hp. tractor	hour	2.20	30.0	30.0	220.0	66	66	484
Chemicals[g]	For medicinal use						0	335	614
Equipment repair	(See Appendix Tables 15, 16, 17)						1,367	1,367	2,098
Hired labor[h]	For harvesting	hour	4.50	87.5	175	203	394	787	913
					Total Variable Expenses		4,856	19,329	34,834
					Net Return Above Variable Expenses		4,521	19,871	35,726
b. Fixed									
Depreciation[i]	(See Appendix Tables 15, 16, 17)						5,419	5,419	7,048
						Total Fixed Expenses	5,419	5,419	7,048
						Total Fixed and Variable Expenses	10,230	24,748	41,882
						Net Return to Land, Labor, Capital and Management	-853	14,452	28,678

Table 11 (Continued)

Item	Description	Unit	Unit Price	Quantity I	Quantity II	Quantity III	Amount Production Level I	Amount Production Level II	Amount Production Level III
Interest									
Fingerling catfish	Purchase price for 7 mos.	dollar	0.12	810	6,525	11,745	57	456	822
Ponds and Equipment	(See Appendix Tables 15, 16, 17)	dollar	0.12	34,137	34,137	43,658	4,271	4,271	5,239
					Total Interest Expense		4,328	4,727	6,061
				Net Return to Land, Labor, and Management			-5,181	9,725	22,617
Labor[j]	Operators	hour	4.50	504	650	622	2,268	2,925	2,797
				Net Return to Land and Management			-7,749	6,800	19,820

[a]The "typical" catfish enterprise had 15.8 acres of ponds consisting of 6.6 ponds of an average size of 2.4 acres requiring 20 acres of land. These budgets were developed for seven levee ponds of 2.4 acres or a total of 16.8 acres and requiring 20.5 acres of nearly level land (See Appendix Figures 1 and 2). Five percent of pond acreage was assumed unavailable annually due to repair and maintenance.

[b]Catfish of Production Level I would be harvested at 2 pounds after 1.6 growing seasons (these values are from the survey). Catfish of Production Level II and III would weigh one pound at harvest after one growing season.

[c]Variable expenses for Production Level I would be incurred over a production period of 1.6 growing seasons but were adjusted to an annualized basis for the budget.

[d]Total death loss and harvest escape of 12 percent was assumed for Production Level I; 8 percent for Production Level II and III.

Table 11 (Continued)

[e]A feed conversion of 1.5 pounds of feed per pound of gain was used for Production Level I catfish up to 1.1 pounds; from 1.1 pounds to two pounds, a feed conversion of 1.6 pounds of feed per pound of gain was assumed. For Production Level II and III feed conversions of 1.8 and 1.85 were assumed respectively. Feed utilized was a 32 percent protein floating ration assumed available locally, fed manually at Production Level I and II, and by automatic p.t.o. driven feeder at Level III.

[f]Fuel, oil, and lube were required for tractor power used for mowing levees at Production Level I and II and for mowing levees, running aeration equipment and the automatic feeder at Production Level III.

[g]Chemicals would be used as prophylaxis and in the treatment of disease. In accordance with the survey results no chemicals were budgeted at Production Level I; at Production Level II and III, the cost of chemicals was estimated at 2 percent the cost of feed and fingerlings.

[h]A four-man crew would be required to assist with the pond harvests. A seine would be pulled by hand at Production Level I and II and by two tractors at Production Level III.

[i]Depreciation was calculated by the straight line method.

[j]Operator's labor at Production Level I was based on survey results; labor at Production Level II was estimated to be somewhat higher due to increased manual feeding; labor at Production Level III was based on estimated labor requirements for a similar production system in Mississippi [5].

after deducting fixed expenses (depreciation on equipment and ponds). Using an interest cost of 12 percent on the nonland capital, net returns to land, operator's labor, and management was estimated to be -$5,181, $9,725 and $22,617 for Production Level I, II and III, respectively. If operator's labor was charged at an hourly wage rate of $4.50, net returns to land and management would be -$7,749, $6,800 and $19,820 for Production Level I, II and III, respectively [6].

THE POTENTIAL OF THE CATFISH INDUSTRY AND ITS CURRENT CONSTRAINTS

An expansion of the catfish industry in Tennessee could be accomplished by (1) current producers attaining higher yields than the 1984 average of 598 pounds per acre, (2) an expansion of the production acreage among existing producers and/or (3) the entrance of new producers into the catfish industry. However, there exist certain marketing and production obstacles which seem to be limiting the development of the catfish industry.

Constraints of Producing and Marketing Catfish in Tennessee

Catfish producers were asked what was the largest marketing problem and largest production problem they faced in Tennessee. Among the producers of fingerling catfish, 69 percent reported difficulty in achieving successful spawns on a consistent yearly basis as their major production problem. Other fingerling producers cited difficulty in obtaining a proper fingerling feed formulation, predation by birds and other predators, and the problem associated with not being able to readily view and assess the condition of the fingerlings. Among the producers of food-size catfish, high feed cost was reported by 33

percent; oxygen depletion problems were reported by 17 percent; and 12 percent reported the short growing season in Tennessee. Other problems mentioned less frequently included a lack of seasonal labor, unsuitability of pond sites for proper construction, and fish poaching.

The short growing season mentioned by 12 percent of the producers, is due to a relatively colder climate in Tennessee than is found in the major producing states of Mississippi, Alabama, and Arkansas. When the mean annual temperature for West Tennessee is compared to the mean annual temperatures of the major catfish producing areas of these states, it is 1.7 degrees cooler than East Central Arkansas, 4.3 degrees cooler than the Delta area of Mississippi, and 5.3 degrees cooler than the Black Belt region of Alabama (Table 12). In the Mississippi and Alabama areas, the mean monthly temperature is above $80^{\circ}F$ for 3 months, while only in July is it above $80^{\circ}F$ in West Tennessee. In general, Tennessee catfish ponds experience a shorter period of optimal water temperatures ($80\text{-}86^{\circ}F$) for catfish production than do the major producing areas of Mississippi, Alabama, and Arkansas.

As indicated earlier, the markets for farm-raised catfish in Tennessee consisted of six different outlets, none of which had a volume greater than 40,000 pounds in 1984. Fifty-eight percent of the producers indicated that the outlets they utilized were saturated and that they could not have sold more fish without lowering the price. The lack of an organized market i.e., processing plant, where large quantities of fish could be marketed in a single transaction, forced many producers to advertise. Forty-six percent of the producers were advertising, mostly through local newspapers and radio.

Table 12. Mean Temperatures for Major Catfish Producing Areas of Selected States

Location	January	February	March	April	May	June	July	August	September	October	November	December	Annual
	degrees Fahrenheit												
West Tennessee	40.8	43.1	50.9	60.4	68.9	77.7	80.4	79.6	72.7	62.1	49.4	41.7	60.6
East Central Arkansas	42.7	45.4	52.4	62.2	70.4	78.4	81.4	80.8	74.4	63.8	51.3	44.1	62.3
Black Belt Alabama	50.4	52.0	58.1	65.1	73.1	80.0	81.6	81.3	76.9	67.2	55.7	49.9	65.9
Delta Mississippi	47.3	49.7	56.7	64.7	72.5	80.1	82.2	81.9	76.2	65.9	54.0	47.8	64.9

Source: Climates of the States, NOAA, 1978.

Fifty percent of the producers did not indicate any problem in marketing their fish. These producers were mostly from Size Category I, which had an average output per enterprise of only 2,483 pounds in 1984. Twenty-three percent of the producers said price competition from other sources of catfish--primarily from commercial fisherman on the Tennessee and Mississippi Rivers and from catfish processors in Mississippi was a significant problem. Twelve percent of the producers felt that the lack of an organized market, as would be provided by a processing plant, was the biggest obstacle to marketing catfish in Tennessee.

Planned Production in 1986 and Producer Assessment of the Profitability of Catfish Production

Producers were asked to rate subjectively the profitability of catfish farming in Tennessee as: 1) highly profitable, 2) profitable, 3) moderately profitable, 4) break even, and 5) doesn't cover costs. The results indicated that none of the producers considered the enterprise either highly profitable or not covering costs (Table 13).

Table 13. Producer Assessment of the Profitability of Catfish Farming, By Size Category, Tennessee, 1985

Size Category	Highly Profitable	Profitable	Moderately Profitable	Break Even	Doesn't Cover Costs
	percent				
I. 0.5-9.9 acres	0	15	46	38	0
II. 10-19.9 acres	0	33	33	33	0
III. 20-39.9 acres	0	0	75	25	0
IV. 40+ acres	0	33	0	66	0
All Sizes	0	19	42	38	0

Forty-two percent felt the catfish enterprise was moderately profitable; 38 percent considered it a break even venture; and 19 percent considered it a profitable enterprise.

As production and harvesting for 1985 had not been completed at the time the survey was taken, producers were asked to estimate: (1) the expected production in 1985, expressed as a percentage of the total pounds produced in 1984 and (2) planned production for 1986. An increase in production of 300 pounds for 1985 was estimated (Table 14); increases were expected by 25 percent of the producers; while decreases were also expected by 25 percent of the producers. Catfish production in 1986, based on producers' plans would be considerably above 1984 levels. Overall, a net increase in production of 280,950 pounds was projected for 1986. The largest portion of this anticipated increase in production (+275,000 pounds) was expected to come from the largest enterprise group (40+ acres). Among those producers planning to increase production in 1986 (29 percent of total), plans were to

Table 14. Expected Production of Food-Size Catfish for 1985 and 1986, By Size Category, Tennessee, 1985

Size Category	1984 Production	Expected 1985 Production		Expected 1986 Production	
		1985 Production	Net Change	1986 Production	Net Change
	pounds				
I. 0.5-9.9 acres	31,775	34,110	+2,335	33,950	+2,175
II. 10-19.9 acres	74,100	81,390	+7,290	99,575	25,475
III. 20-39.9 acres	21,700	12,375	-9,325	0	-21,700
IV. 40+ acres	52,000	52,000		327,000	275,000
All Sizes	179,575	179,875	+300	460,525	280,950

construct 43.4 acres of new ponds and to bring 117 acres of existing unused ponds into production. Among those producers intending to decrease production in 1986 (29 percent of the total), all but one planned to cease production entirely in 1986. These producers estimated that a total of 123 acres of ponds used to produce catfish commercially in 1984-85 would not be used for production in 1986. None of the producers in Size Category III (20-39.9 acres) planned to produce catfish in 1986. The expected net increase in pond acreage to be used for food-size catfish production in 1986 was 37.4 acres.

Among the 15 producers raising their own fingerlings, 64 percent expected 1985 production to remain unchanged from 1984, 14 percent expected higher production in 1985, 7 percent expected lower production in 1985, and 14 percent had not produced fingerlings in 1984. In 1986 sixty-four percent anticipated no change in production levels from 1985; twenty-one percent planned to expand by increasing their pond acreage in fingerling production by 10.3 acres and increasing the inventory of broodfish. Fourteen percent planned to discontinue production of fingerlings, removing 7 acres from production. Overall, an additional 3.3 acres of fingerling ponds were to be producing in 1986 over the 1984 acreage total.

SUMMARY AND CONCLUSIONS

Summary

During the early development of the catfish industry in the South Central United States, Tennessee farmers were among the first in the South to attempt the commercial production of catfish. The number of

catfish farms, amount of sales, and water acres in production increased by 93 percent, 464 percent, and 145 percent, respectively, for the United States as a whole over the 1974 to 1982 period. In Tennessee these industry statistics either declined or remained stagnant. A major force in the expansion of catfish production in the United States has been the development of an efficient marketing system centered around large-scale processing plants in Mississippi, Arkansas, and Alabama.

The principal objective of this study was to investigate the economic status of the catfish producing industry in Tennessee. Primary production and marketing data were collected from 29 of the 30 identified producers in the state through personal interviews. Cost and return budgets were estimated for a representative catfish enterprise developed from the survey results under three levels of production intensity.

Total acreage in catfish production in Tennessee in 1984 was 459.5 with an average of 15.8 acres per producer. Geographically, production acreage was greatest in Extension District I (West Tennessee) with 277 acres of catfish ponds. Demographically, the "typical" catfish producer was male, 53 years of age, and had been producing catfish commercially for nine years. Forty percent of all producers had been producing for 6 years or less.

Fingerling catfish for stocking were either purchased (mainly from Arkansas suppliers) or produced. Fifty-four percent of the producers were producing fingerlings on a total of 39.4 acres of ponds. On these farms there was an average ratio of 2.8 acres of fingerling ponds to 16.7 acres of food-size ponds. Two methods of producing fingerlings

were used: the open pond method of spawning and the mechanical hatching of catfish eggs in a hatchery facility.

Food-size production ponds were stocked at a mean density of 1,749 6.5-inch fingerlings per acre. Market catfish were harvested after an average of 1.6 growing seasons at an average live market weight of 2.0 pounds. Total poundage marketed in 1984 was 179,575 pounds. The average producer marketed 7,183 pounds and had an annual yield of 598 pounds per pond acre.

Of the 179,575 pounds of food-size catfish produced in 1984, approximately 95,000 pounds (53 percent) were sold live to five principal market outlets; the remaining catfish production was processed by producers (47 percent processed catfish) and sold to four principal market outlets. In all, a total of six different market outlets for catfish were identified in Tennessee. Restaurants, both producer owned and other restaurants purchased 41 percent of the 1984 production, mainly in processed form. Retail outlets purchased 22 percent of 1984 production in both live and processed forms. Consumers purchased 13 percent of 1984 production in both live and processed forms in direct retail sales from the producer. Live-fish haulers also purchased 13 percent of 1984 production in a strictly live form. Eleven percent of production was sold through fee-fishing. The 1984 average live price per pound was $0.98 and the average price per pound of processed catfish was $1.94.

Twenty-one percent of the producers also marketed fingerling catfish in 1984. A total of 73,000 fingerlings were marketed in a range of sizes from 2 to 10 inches at an average price of $174 per thousand.

Estimated farm sales of all marketed forms of catfish in 1984 were $204,188. The average sales per producer were $8,508. Total live fish sales were $93,345, estimated total processed sales were $98,154 and total fingerling sales were $12,689.

Budgets were estimated for a representative catfish enterprise comprised of seven food-size production ponds of 2.4 acres in size. Budgets were developed for three levels of production; Production Level I was based on typical 1984 production practices and the average yield of 598 pounds per acre reported by the producers interviewed. Production Level II utilized the same facilities and equipment as Level I, but a yield of 2,500 pounds per acre was assumed. Total investment in facilities and equipment (excluding land) was estimated to be $71,194 for Production Level I and II. Production Level III assumed management practices characteristic of intensive production systems in the Mississippi Delta of Mississippi. A yield of 4,500 pounds per acre was assumed. Estimated investment in facilities and equipment was $87,318 for Production Level III.

Based on 1985 prices for production inputs and returns based on the 1984 live market price of $0.98 per pound, the net returns to the factors of production were estimated. Total revenues for Production Level I, II and III was estimated to be $9,377, $39,200 and $70,560 from the sales of 9,568 pounds, 40,000 pounds and 72,000 pounds, respectively. After deducting total annual variable and fixed expenses, the net returns to land, labor, capital and management for Production Level I, II and III was estimated to be -$853, $14,452 and $28,678, respectively.

At the time the survey was taken, 1985 harvesting had not been completed. In the aggregate producers expected a slight increase of 300 pounds in the 1985 total harvest over the 1984 level. For 1986 producers planned to produce 459,025 pounds, an increase of 280,950 pounds over 1984 production. Producers intending to increase production planned to bring 117 acres of existing ponds into production and to construct 43.4 acres of new ponds. Seven producers planned to cease production entirely in 1986. The expected net increase in food-size pond acreage for 1986 was 37.4 acres.

Conclusions

Catfish production in Tennessee can be characterized by low yields on relatively small-scale enterprises and based on budget estimates low net returns to production factors. The six market outlets currently used by Tennessee producers face considerable price competition from catfish producers in the neighboring states of Mississippi, Arkansas, and Alabama where a lower cost structure and well developed marketing system give these producers a competitive advantage. Further expansion of these market outlets is necessary if the production of catfish in Tennessee is to expand. Lowering the costs of production in Tennessee would help increase the local market share for farm raised catfish. One method of lowering the cost of production would be to use more intensive production methods, and to achieve a higher yield than the 598 pounds per acre average currently realized.

Of the six market outlets currently used, the live-fish hauler outlet perhaps offers the most market potential. In 1981, nearly 6

million pounds of live catfish were sold by producers to live-fish haulers in the United States [9]. In 1984 Tennessee producers sold only 23,600 pounds to this market outlet. Of the 6 market outlets used by Tennessee producers, the transactions of this outlet are generally of the largest volume. Producers who might wish to increase their yields, but are hesitant because of saturated local markets, should investigate the possibility of producing for the live-fish hauler market as part of their marketing strategy.

The development of the catfish industry in Tennessee will depend on the continuing growth in the consumer demand for catfish and the success of Tennessee producers in the competition with Mississippi, Arkansas, and Alabama producers for local markets in Tennessee. With the abundant water resources throughout the state and a generally mild climate, the physical requirements for catfish production are adequate at many locations, especially in West Tennessee. However, the prospective catfish producer needs to examine and plan carefully the production system and marketing strategy before production is undertaken.

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APPENDIX

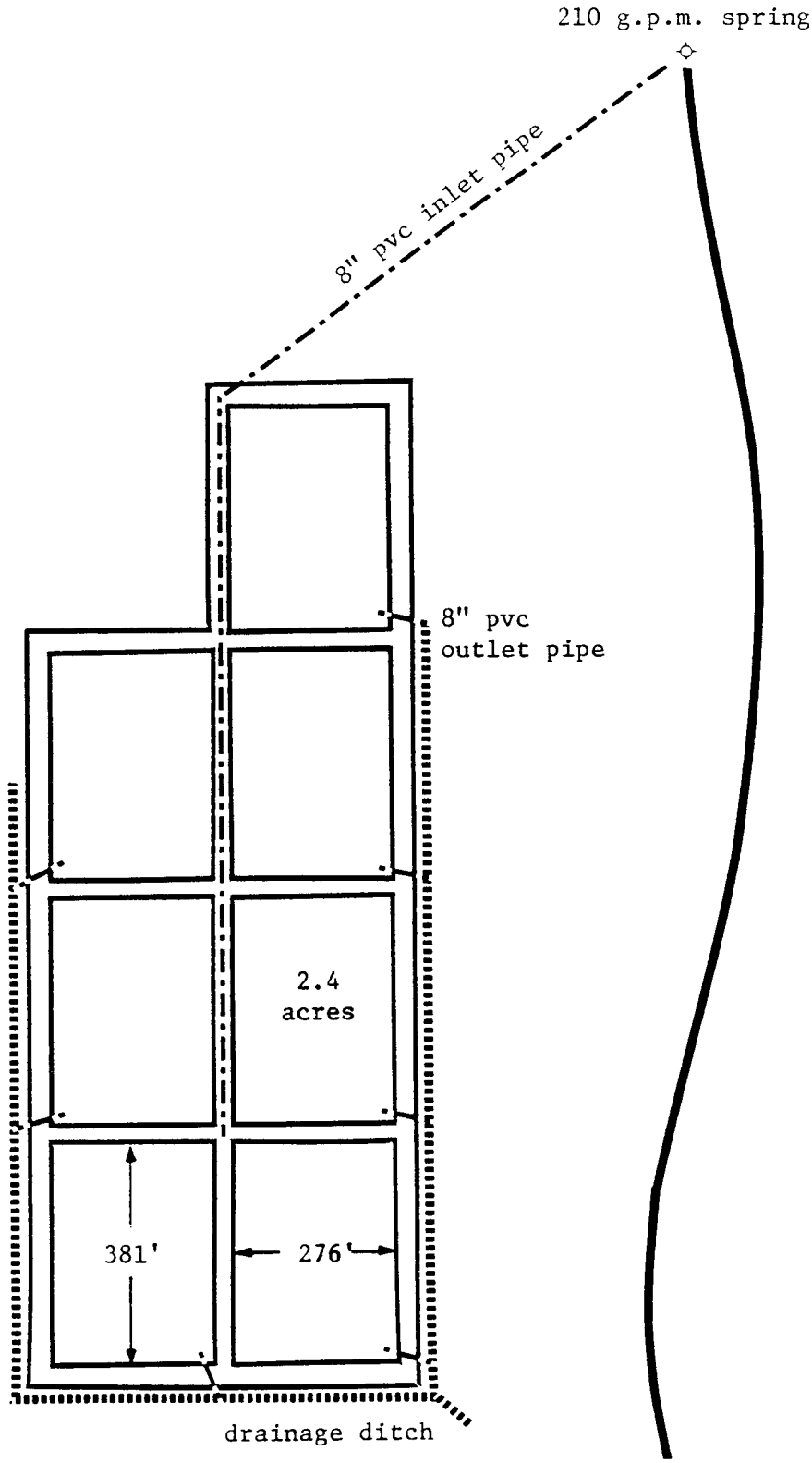
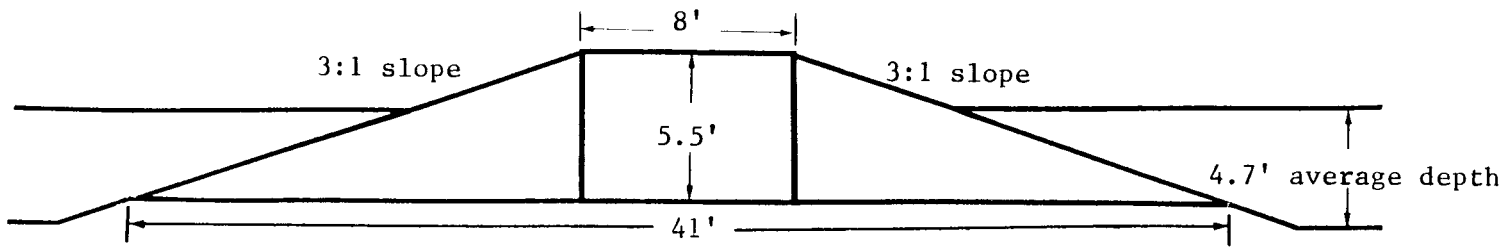
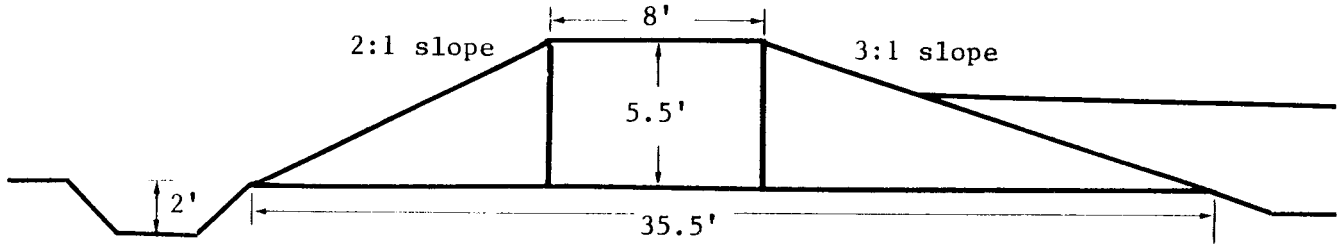


Figure 3. Pond Layout and Dimensions for a 16.8-Acre Catfish Enterprise



Dimensions of inside levees



Dimensions of outside levees and drainage ditch

Figure 4. Schematics of Pond Levees and Drainage Ditch

Table 1. Estimated Catfish Pond Investment and Annual Maintenance Costs, Seven 2.4-Acre Ponds, Tennessee, 1985

Item	Description	Unit Cost (dollars)	New Cost (dollars)	Esti-mated Life (years)	Annual Depreciation (dollars)	Repairs as Percent of Cost (percent)	Annual Repairs (dollars)	Annual Interest Cost (dollars)
Pond levees								
Inside	2,555 lin. feet; 12,751 cu. yds.	1.25	15,939	15	1,063	30	319	956
Outside	4,440 lin. feet; 19,672 cu. yds.	1.25	24,590	15	6,639	30	592	1,475
Drainage ditch	2,854 lin. feet; 1,480 cu. yds.	1.25	1,850	15	123	30	37	111
Drainage pipe	322 lin. feet; 8-inch pvc	8.35	2,690	15	179	10	18	161
Inlet pipe	1,640 lin. feet; 8-inch pvc	8.35	13,694	15	912	10	91	822
Gate valves	Seven 8-inch valves	150	1,050	15	70	30	21	63
Pasture establishment[a]	Fescue - 3.4 acres	95	323	10	32	n/a	82	19
Gravel road[a]	212 cu. yds. of 1 1/2 inch crushed stone	9.52	2,018	15	134	30	40	121
Total			62,154		4,152		1,100	3,725

[a]The figures for pasture establishment and gravel road are for Production Level I and II; for Production Level III where tractor harvesting requires more graveled levees and less pasture. Pasture establishment would be 2.9 acres costing $275 and gravel would be 583 cubic yards costing $5,550 such that total investment, annual depreciation, annual repairs and annual interest cost would be $65,638, $4,383, $1,171 and $3,934, respectively, for Production Level III.

Table 2. Estimated Equipment Investment and Annual Maintenance Cost for a 16.8-Acre Catfish Enterprise at Production Levels I and II,[a] Tennessee, 1985

Item	Description	New Cost (dollars)	Estimated Life (years)	Annual Depreciation (dollars)	Repairs as Percent of Cost (percent)	Annual Repairs (dollars)	Annual Interest Cost (dollars)
Tractor[b]	40 hp	3,000	10	300	60	180	180
Mower[b]	7 ft. reciprocating	1,220	8	153	60	91	73
Truck[b]	1/2 ton	700	10	70	60	42	42
Harvest seine	800 ft. x 9 ft. w/1 1/2-inch mesh	2,800	5	560	5	28	168
Boat	14 ft. aluminum jon	500	10	50	10	5	30
Motor	2 hp gasoline	300	10	30	60	18	18
Water quality test kit	Hoch	220	5	44	--	--	13
Waders	5 pairs, chest high	300	5	60	50	30	18
Total		9,040		1,267		394	542

[a]Production Level I was based on an annual yield of 598 pounds per acre. Production Level II was based on an annual yield of 2,500 pounds per acre.

[b]These equipment were assumed to be shared among other farm enterprises. The percentages of new cost charged to the catfish enterprise were 25 percent, 50 percent and 10 percent for the tractor, mower and truck, respectively. All other equipment were charged fully to the catfish enterprise.

Table 3. Estimated Equipment Investment and Annual Maintenance Cost for a 16.8-Acre Catfish Enterprise at Production Level III,[a] Tennessee, 1985

Item	Description	New Cost (dollars)	Estimated Life (years)	Annual Depreciation (dollars)	Repairs as Percent of Cost (percent)	Annual Repairs (dollars)	Annual Interest Cost (dollars)
Tractor[b]	Two - 40 hp	4,440	10	444	60	266	266
Mower[b]	7-ft. reciprocating	1,220	8	153	60	91	73
Truck[b]	1/2 ton pickup	100	10	70	60	42	42
Paddlewheel aerator	Two - p.t.o. driven	5,000	10	500	60	300	300
Feeder	6,000 lbs. capacity p.t.o.	6,000	10	600	30	180	360
Oxygen meter and probe	50-ft. cable	200	10	20	30	6	12
Harvest seine	800 ft. x 9 ft. w/1 1/2-inch mesh	2,800	5	560	5	28	168
Boat	14-ft. aluminum	500	10	50	10	5	30
Motor	2 hp gasoline	300	10	30	60	18	18
Water quality test kit	Hoch	220	5	44	--	--	13
Waders	5 pairs - chest high	300	5	60	50	30	18
Total		21,680		2,531		966	1,300

[a]Production Level III was based on an annual yield of 4,500 pounds per acre.

Table 3 (Continued)

[b]These equipment were assumed to be shared among other farm enterprises. The percentages of new cost charged to the catfish enterprise were 18.5 percent, 50 percent and 10 percent of the tractors, mower and truck, respectively. All other equipment were charged fully to the catfish enterprise.