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An Economic Analysis of Producing Pond-Raised Catfish for Food in Mississippi, A January 1980 Update

John E. Waldrop

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By John E. Waldrop and Roy D. Smith

Department of Agricultural Economics

Mississippi Agricultural and Forestry Experiment Station Mississippi State University

MAFES MISSISSIPPI AGRICULTURAL & FORESTRY EXPERIMENT STATION
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Foreword

This publication is an update of a portion of the research results of MAFES Bulletin 870, "An Economic Analysis of Producing Pond-Raised Catfish for Food in Mississippi." The level of technology and farm organization has not changed sufficiently since 1978 to warrant updating these sections of Bulletin 870. Therefore, these sections will be repeated essentially "as is" in this report. Prices of inputs and output, however, have undergone substantial changes. As a result, costs reported in Bulletin 870 are inadequate for planning new farms or expanding existing farms. These costs and returns are updated to January, 1980 in this report.

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An Economic Analysis of Producing Pond-Raised Catfish for Food in Mississippi: A January, 1980 Update

Introduction

In 1967, less than 4,500 acres of water were used to produce catfish for food in Mississippi. This acreage increased rapidly, and a 1969 survey indicated that over 13,000 acres were stocked with food fish. By 1977, acreage in Mississippi devoted to catfish for food had increased to about 15,000 acres. Also, improvements in production technology and management skills accounted for roughly a 100% increase in production per surface acre of water since the beginning of the industry.

Estimated cost of producing fish on a 160-acre farm developed into 20-acre ponds, stocked at the rate of 4000 six-inch fingerlings per surface acre and harvested when the fish averaged 1.25 pounds each, was approximately 44¢ per pound in 1977 (2). This cost included payments to all resources employed so that a price of catfish of 44¢ f.o.b. pond bank was sufficient for the enterprise to be economically feasible. The weighted average price paid by processors in 1977 was 58¢ per pound f.o.b. pond bank. This analysis showed that the catfish enterprise was profitable which suggested further increases in quantities of resources devoted to catfish production.

A 1979 survey conducted by the Department of Wildlife and Fisheries, Mississippi Cooperative Extension Service, indicated that more than 22,500 acres of catfish ponds are in use for food fish production. This represents an increase in acreage of approximately 48% since 1977, a substantial growth by any standards. Comments by producers and

experts in the field indicate that the production capacity of the industry is still growing rapidly.

There appears to be little to hinder the continued rapid growth of the catfish for food enterprise in Mississippi so long as profits warrant further expansion. Current cost and returns data are essential if the industry is to continue in an economically efficient manner.

Objectives

The objectives of this report are to: (a) Update estimated production cost using January 1980 prices; and, (b) to assess the implications of changes in costs on the current and near future economic feasibility of the production of catfish for food.

Procedures

The production system and level of production technology for which the cost estimates are appropriate is described in detail in MAFES Bulletin 870 (2). A brief summary will be included in this report, but readers interested in a more in-depth description should review the referenced study.

Input prices used in estimating production costs were collected from suppliers in January 1980, the date this study was initiated. Prices reported are retail price quotes by the respective suppliers. A list of input prices is provided in the appendix along with a partial list of sources of the price information.

The following costs are reported for each of three firm sizes: investment cost for the total firm and per acre; annual ownership costs for each firm and per pound of fish harvested; and, annual operating costs for each firm and per pound of fish harvested. The cost estimates include payments to all resources involved. Therefore, a product price,

f.o.b. pond bank, equal to the estimated cost would be sufficient to insure returns to all resources consistent with the amount these resources could earn in their most profitable alternative use.

The Production System and Firms

Synthetic firms were developed for operations with 163 land acres (Farm Situation I), 323 land acres (Farm Situation II), and 643 land acres (Farm Situation III). Assumptions underlying the synthesis of firms of each size were that the catfish enterprise was separate from all other enterprises and that the firms were to incorporate the most advanced production practices and procedures recommended at this time. In each case, 3 acres were used for buildings, operations, storage, roads, parking, etc.

The production system for hypothetical firms of each size specified stocking on March 15 with 4000 one-ounce fingerlings per surface acre of water and harvesting 210 days later on October 15.[1/] A loss of 200 fish per acre was projected to account for mortality and for fish that escape harvest. Estimated returns are based on an average harvest weight of 20 ounces--a net gain of 19 ounces. Costs were based on the consumption of 1.6 pounds of feed per pound of gain.

The assumption was made that total production would be reduced by 2.5% per year because of pond repairs and maintenance. The underlying assumptions and projected growth rates result in total production of 4631 pounds per acre of water (Table 1).

[1/] The production schedule is for the purpose of developing cost estimates. Missed feeding days during the year will likely lengthen the production period.

Table 1. Estimated production of catfish, three farm situations, Delta of Mississippi, 1980.

Item	Farm Situation		
	I	II	III
	----------Pounds----------		
Total Production	655,785	1,323,611	2,653,243
Production	81,973	82,726	82,914
Production per Acre of Water	4,631	4,631	4,631

Land

Synthesized firms of each size were assumed to be composed of level or nearly level land in 160 acre parcels and have an adequate supply of water within 100-125 feet of the surface. Soils were assumed to be clays with good water-holding capacity near natural drainage to enhance the movement of water from the farm when ponds needed to be drained.

Pond Construction

Levee design for all farm situations include a 14-foot crown with gravel sufficient to permit all-weather access, a 3:1 side slope, a fifty-foot base, and a minimum water depth of four feet with a two-foot freeboard.[2/] Each pond is bordered on at least one side by a drainage ditch that measures three feet at the bottom and twelve feet at the top. An eight-foot berm between the ditch and the base of the levee is included in the levee design.

[2/] Depth of water will approach five feet on the average. Alternative designs and/or levee dimensions would result in different levee cost estimates.

Pond Size

Farm Situation I contains 8 ponds of 20 land acres each; Farm Situation II, 16 ponds of 20 land acres each; and Farm Situation III, 32 ponds of 20 land acres each.[3/] The 20 acre pond size was selected because it was reported earlier to permit minimum per pound cost of producing catfish [6]. Also, many producers appear to be favoring ponds of this size and current stocking rates, coupled with processing plant capacity, indicate this to be the appropriate pond size for analysis. Surface acres of water per pond are less than 20 because some land is used for levees and drainage structures. (Table 2).

Table 2. Size and number of ponds for catfish production, three farm situations, Delta of Mississippi, 1980.

Item	Farm Situation		
	I	II	III
Total land acres	163	323	643
Surface acres of water	141.6	285.8	572.9
Number of ponds	8	16	32
Surface acres per pond	17.7	17.8	17.9

Water Supply

Water is the medium of growth and a critical management element in catfish production. Therefore, factors other than the minimum requirements in determining water quantity needed to sustain catfish must be considered. Major considerations in addition to supplying fresh water to sustain growth are replacement of evaporation and water requirements

[3/] This does not include the three acres available for buildings, equipment storage and other support facilities.

during periods of stress. Provisions also must be made for adequate aeration and chemical treatment of water.

Wells were selected as the water source and numbers of wells for each farm situation (Table 3) were based on minimum flow requirements and on observations of numbers and placement of wells on catfish operations. Wells are rated at 3000 g.p.m.

Table 3. Wells and discharge pipe required, three farm situations, Delta of Mississippi, 1980.

Farm Situation	Number of Wells	Feet of Discharge Pipe
I	2	300
II	4	600
III	8	1200

Feeding

Annual feed requirements were estimated to be 7448 pounds of pelleted feed per surface acre of water. This estimate was based on a 1.6:1 feed conversion ratio and includes 60% of the quantity of feed that would have been consumed by the fish that were assumed to die or escape harvest. Facilities required for handling the feed for each situation (Table 4) are 2000 pound capacity p.t.o.-driven feeders and 23-ton capacity gravity feed storage bins.

Table 4. Estimated annual catfish feed requirements, three farm situations, Delta of Mississippi, 1980.

Farm Situation	Feed Requirements
	Tons
I	527.32
II	1,064.32
III	2,133.11

Harvesting

Producers typically use two tractors to position and haul the seine when harvesting catfish. All commercial catfish are harvested using this, or some variation of this technique.

Disease, Parasite and Weed Control

The disease, parasite and weed control program was developed by Dr. Thomas L. Wellborn, Leader, Department of Wildlife and Fisheries, Mississippi Cooperative Extension Service, Mississippi State University. Equipment for applying materials consists of a boat, fitted with a chemical mixing and application chamber, an outboard motor, a boat trailer, and an oxygen meter probe.

Investment Requirements

Investment requirements for each farm situation are segmented into seven major groups. These include land; pond construction; water supply, feeding; disease, parasite and weed control; harvesting; and miscellaneous equipment.

Total investment was $431,557 for Farm Situation I, $740,172 for Farm Situation II, and $1,377,412 for Farm Situation III (Table 5).

Table 5. Estimated investment requirements for catfish production, three farm situations, Delta of Mississippi, 1980.

Item	Farm Situation I	II	III
	dollars		
Land[1]	163,000	323,000	643,000
Pond Construction	87,414	165,863	330,534
Earth moving	62,546	117,626	235,588
Drainage structures	11,040	22,080	44,160
Gravel	12,895	24,539	47,557
Vegetative cover	933	1,618	3,229
Water supply (wells and drainage pipes)	37,640	75,280	150,560
Feeding (feeder and bulk storage)	10,740	14,940	25,680
Disease, parasite, and weed control	3,708	3,708	3,708
Harvesting	14,008	14,008	14,008
Miscellaneous equipment	115,047	143,373	209,992
Tractors (90-100 h.p.)	61,940	86,716	136,268
1½ ton truck	10,875	10,875	10,875
½ ton truck	7,000	7,000	14,000
18' x 42' service building	16,000	16,000	16,000
16" p.t.o. driven high lift pump	10,647	14,196	21,294
6' side-mount mower	2,900	2,900	5,800
Farm shop equipment	4,800	4,800	4,800
Fiberglass transport tank	460	460	460
Waders	425	425	425
TOTAL	431,557	740,172	1,377,412
Investment per surface acre of water	3,048	2,590	2,404
Investment per acre of land	2,648	2,292	2,142

[1]Value at $1000 per acre.

Land

Land was valued at $1000 per acre. This price represents an average price quoted by new producers visited. Land prices can be expected to vary by location.

Pond Construction

Initial investment in levee construction did not increase in proportion to the increase in land acreage because of differences in the proportion of inner and outer levees. Construction costs were based on an estimated charge of 50 cents per cubic yard of earth moved. Since the charge per cubic yard of earth moved is subject to rapid change due to rising energy and other prices, any plans for new ponds should contain the latest charge in the area. Each increase of 1 cent per cubic yard will increase earth moving cost by $1,251, $2,353, and $4,712 for Farm Situations I, II, and III respectively.

Water Supply

Other sizes of wells are available but the 3000 g.p.m. unit met both flow requirements and least cost criterion for facilities of each size, with one well serving four ponds. Slight size economies were realized because surface acres of water per pond increased with increases in farm size.

Feeding

Economies of size were observed in investment requirements for the feeding operation. In other words, the amount of equipment did not increase in proportion to the increase in fish produced.

Disease, Parasite, and Weed Control

Substantial economies of size occurred, because the same equipment was required for the three farm sizes.

Harvesting

Significant economies of size were realized in harvesting equipment because total investment was $14,008 for farms of each size.

Miscellaneous Equipment

Investment in miscellaneous equipment was substantial. Items included in miscellaneous were required in two or more investment categories.

Annual Ownership Costs

Annual ownership cost is made up of depreciation charges, interest charges, taxes, and insurance. These costs are reported in Table 6.

Depreciation

The straight line method was used to calculate depreciation of all equipment and facilities except ponds. Estimates of expected life were obtained from dealers, manufacturers' specifications, and other published material.

Current knowledge of life expectancy of ponds is not adequate for determining the "best" method of depreciation. After consultation with many producers, it was decided that an expenditure of one-half of the original investment on pond construction would be required after ten years in production. This is not to say that one-half the levees must be restored after ten years; however, those levees deteriorating to the point that production is adversely affected must be restored. This was converted to an annual cost for each farm situation. Depreciation of

Table 6. Estimated annual ownership costs for catfish production facilities and equipment, three farm situations, Delta of Mississippi, 1980.

Item	Farm Situation I	II	III
	dollars		
Annual Ownership costs			
Depreciation[1]			
Ponds	4,371	8,293	16,527
Water supply (wells and discharge pipe)	3,496	6,992	13,984
Feeding (feeder and storage)	1,039	1,459	2,498
Harvesting Equipment	1,995	1,995	1,995
Disease, Parasite and weed control equipment	324	324	324
Miscellaneous equipment	11,317	13,737	19,694
Interest on Investment[2]			
Land	16,300	32,300	64,300
Pond construction (drainage structures gravel and vegetative cover)	4,371	8,293	16,527
Water supply (wells and discharge pipe)	2,258	4,517	9,034
Feed equipment (feeder and storage)	644	896	1,552
Disease, parasite and weed control equipment	222	222	222
Chemicals on hand	116	116	116
Harvesting equipment	840	840	840
Miscellaneous equipment	6,902	8,602	12,175
Taxes and Insurance	3,072	3,953	5,872
TOTAL	57,267	92,539	165,660

1/ Computed by the straightline method with zero salvage value for depreciable items.

2/ Charged at the rate of 10% on total land cost, pond construction, chemicals on hand and 12% on one-half of the investment in depreciable items.

water supply facilities was calculated by summing the depreciation of separate components of the system.

Depreciation of the feeding system includes a charge for feeders and feed bins.

Interest on Investment

Interest costs are the sum of interest charged on investment items and were computed at a rate of 10% of the full value of land and chemicals on hand, 10% on one-half of the initial cost of pond construction and 12% on one-half the investment in other depreciable items.

Taxes and Insurance

Identification of a typical tax rate for land in the Delta of Mississippi is difficult. However, information was available on 10 representative farms in Sunflower County, Mississippi (3). Based on this information a charge of $2.30 per acre was made for each situation.

An insurance company estimated insurance rates for labor and equipment. We applied these to each farm situation to determine insurance costs.

Annual Operating Costs

Annual operating costs are incurred if production occurs. These costs include repairs and maintenance, fuel, chemicals, fingerlings, feed, labor, and interest on operating capital. The costs are reported in Table 7.

Repairs and Maintenance

Repair and maintenance costs were based on dealers' estimates, manufacturers' specification and other published material as to expected

Table 7. Estimated Annual Operating costs for catfish production, three farm situations, Delta of Mississippi, 1980.

Item	Farm Situation I	II	III
	dollars		
Annual Operating Costs:			
Repairs and Maintenance			
Vegetative Cover	712	1,235	2,464
Water Supply (Wells and discharge pipe)	1,129	2,258	4,517
Feeding Equipment (Feeder and Storage	874	1,084	1,558
Disease, Parasite, and weed control	159	159	159
Harvest Equipment	1,016	1,016	1,016
Miscellaneous Equipment	7,316	8,835	12,582
Fuel			
Pumping	16,720	32,720	66,009
Power Transportation feeding, harvest, etc.	8,071	13,380	26,095
Chemicals	2,467	4,960	8,977
Fingerlings	45,312	91,456	183,328
Feed (35% protein floating)	152,080	306,986	614,112
Labor			
Management	24,000	24,000	38,400
Hired Labor (full time)	23,335	30,335	37,335
Hired Labor (full harvest)	2,121	4,224	9,331
Interest on operating capital[1/]	11,412	20,918	40,234
TOTAL	296,724	543,566	1,046,117

[1/] Charged at 12% for 4 months

repairs over the life of the item. They were computed as a percentage of the estimated purchase price (2,4).

Fuel

Estimates of fuel consumption were developed with the aid of Mr. Francis E. Rhodes.[4/] The two fuel-use categories were pumping and power. Cost of pumping refers to fuel requirements for the diesel engines supplying power to pump water. Power cost refers to cost of fuel for tractors, trucks, and the outboard motor.

Chemicals

Calculations were done per surface acre of water. The costs reported are the sum of chemicals used for parasite, disease, and weed control.

Fingerlings

Fingerling costs were based on a stocking rate of 4000 six-inch (1 oz.) fingerlings per acre at $.08 each.

Feed

The price used in estimating total feed cost for each situation was $280.00 per ton--the price reported in January 1980. An additional charge of $100 per ton was included for any medicated feed used in the disease program.

[4/] Mr. Rhodes is a Teaching Research Assistant with the Department of Agricultural and Biological Engineering, at Mississippi State University.

Labor

Labor costs for the three farm situations include costs of full-time production labor and additional part-time labor for harvest. Labor costs for Farm Situation I included the services of a manager, a foreman, two full-time people, and 606 hours of harvest labor. Farm Situation II employed a manager, a foreman, three full-time people, and 1207 hours of harvest labor. A manager, an assistant manager, a foreman, four full-time people and 2666 hours of harvest labor were included in labor costs for Farm Situation III.

Annual Cost Summary

Total annual cost was $353,991, $636,105, and $1,211,777 for Farm Situation I, II, and III, respectively, Table 8. This represents an increase of approximately 24% since 1977.[5/]

Total annual cost per pound of harvested fish was $.540 for Farm Situation I, $.481 for Farm Situation II, and $.457 for Farm Situation III.

Because of a lack of knowledge of the risk involved in producing catfish, and the risk preference of catfish producers, no attempt was made to estimate the cost of entrepreneurship for the catfish industry. A per pound price of catfish substantially higher than these estimated costs might be required to attract and hold resources in catfish production because no charge was made for that portion of management provided by the entrepreneur.

[5/] 1977 cost reported in Table 8, page 8, MAFES Bulletin 870, July 1978 [2].

Table 8. Summary of costs of catfish production, three farm situations, Delta of Mississippi, 1980.

Item	Farm Situations		
	I	II	III
	----------dollars----------		
Total Annual Cost	353,991	636,105	1,211,777
Annual Ownership Cost	57,267	92,539	165,660
Annual Operating Cost	296,724	543,566	1,046,117
Total Cost per pound[1/]	.540	.481	.457
Ownership Cost per pound[1/]	.087	.070	.063
Operating Cost per pound[1/]	.453	.411	.394

[1/] Based on harvested pounds of 655,785; 1,323,611; and 2,653,243 for Farm Situations I, II, and III, respectively.

Summary and Conclusions

Recommendations obtained from professionals in the field of catfish production, and data supplied by producers, suppliers, and other experts were used to estimate total and per pound costs of producing catfish on farms of three sizes. The three farm sizes were 163 acres, 323 acres, and 643 acres--Farm Situation I, II, and III, respectively. Pond size was 20 land acres for each of the three farm situations, with 3 acres used for facilities, roads, and buildings. The research method used was economic engineering or synthetic firm analysis.

Estimates of production cost per pound of harvested fish were: $.540 for Farm Situation I, $.481 for Farm Situation II; and $.457 for Farm Situation III.

It appears that, under current conditions, the catfish enterprise is feasible and relatively profitable. However, substantial increases in production may decrease the product price but lack of knowledge of the demand for catfish precludes determination of the price effect of increased production. Obviously, demand has increased over the past 10 to 12 years, but the rate of increase is not known.

Under the current Production Cost-Product Price levels, the farm-raised catfish enterprise appears sufficiently profitable to attract substantial additional resources.

APPENDIX[6/]

Technical coefficients used in this study are a combination of recommendations of producers and professionals in the area of catfish production. The recommended practices used are not to be interpreted as "optimal" levels, but should serve as a guide for the industry.

The remainder of this section will be an attempt to outline the development of the technical coefficients that made up the basic production system.

Production System

The production system was designed to produce fish that average 1.25 pounds in 210 days. The growing season runs from March 15 through October 15.

Coefficients dealing with stocking rates, size of fingerlings stocked, feed conversion rates, mortality rate (including those that escape harvest), and total production per acre are estimates based on consultation with catfish producers and with professional workers in the area of catfish production.

Six-inch fingerlings weighing 1 ounce each allow production of a marketable fish in one growing season and make full use of the entire season.

The mortality rate, including those that escape harvest, of 5% is a collective opinion of producers and professional workers. This figure is considered to be readily attainable in light of the disease and parasite control and water quality programs assumed for the study.

6/ Materials contained in this Appendix, for the most part, are taken directly from MAFES Bulletin 870 (2).

There is no collective opinion as to the most appropriate stocking rate. For this study a stocking rate of 4000 fish per acre was chosen. This rate as well as rates higher and lower were reported by commercial operators. However, the average rate of stocking over the area is less than 4000 per surface acre of water.

The feed conversion ratio was 1.6 pounds of feed per pound of gain.

Pond Construction

The designs and coefficients for construction of ponds were developed in consultation with Soil Conservation Service personnel.[7/] The farm design is common in the Delta of Mississippi. There are two basic assumptions underlying the development of pond construction coefficients. The first is that land for pond construction is available in square 160-acre tracts and the second is that the land is level or essentially so (0-2 percent slope). The latter assumption is a very practical one for several reasons. First, the Delta of Mississippi is characterized by a topography that fits this assumption. Second, SCS personnel report that coefficients developed under the level land assumption do not differ significantly from actual earth moving requirements encountered in construction. Third, this allows individuals to adapt the study to fit their particular situations.

All levees are of the same dimensions. The levees are designed to hold water at a minimum depth of four feet and a maximum depth of six feet with a two foot freeboard. A pond bottom slope of approximately 0.1 foot per 100 feet of run is incorporated into the levee coefficients. The levees have a side slope of 3:1 and a top width of fourteen

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7/ Mr. Tom E. Blaylock, District Engineer, Soil Conversation Service, Greenwood, MS.

feet. Earth moving requirements in this study are estimated to be 6.2 cubic yards per linear foot of levee run (Appendix Table 1).

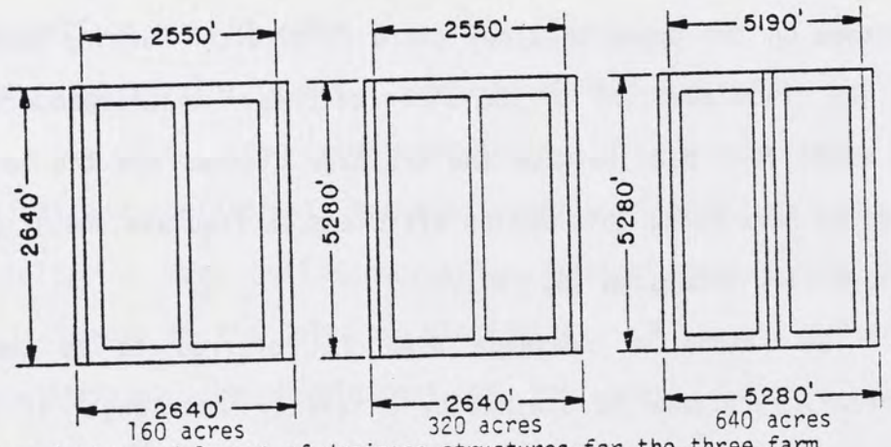
The 160 and 320 acre farms were designed with drainage ditches on two opposite sides and the 640 acre tract was designed with drainage ditches on two opposite sides and a third ditch running down the center of the tract parallel to the other ditches. An allowance was made for an eight foot berm between the drainage ditches and the levees. Other studies have found this design efficient in land use and it provides for future firm expansion (6, 14).

The method of drainage used is referred to as the "gate and screen". Each pond is drained by a seventy-foot length of 16 inch pipe fitted with a gate and screen.

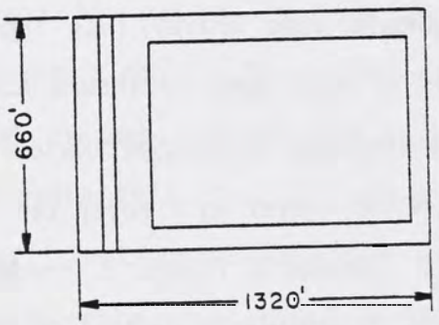
A layer of standard road gravel four inches deep and eight feet wide on three levees of each pond to insure access to the ponds in all types of weather was included in cost estimates. Under these specifications, one cubic yard of gravel will cover ten linear feet of levee run (Appendix Table 2). Appendix Figure 1 presents schematics of farm designs, pond design, and cross section of levee, berm, and ditch.

Erosion of levees is a major problem. To help prevent this deterioration, all exposed portions of each levee require vegetative cover that is maintained annually. The area of exposed levee was treated as fescue pasture to develop a charge for establishment and maintenance of vegetative cover (19). These coefficients are shown in Appendix Table 3.

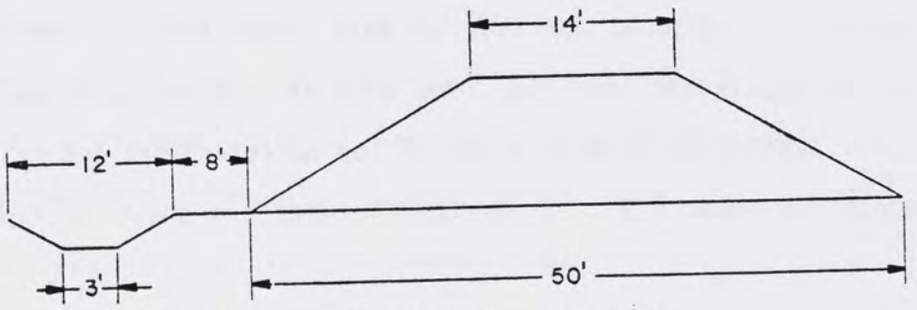
Appendix Figure 1. Schematics of farm designs, pond design and cross section of levee, berm and ditch.



Farm design and layout of drainage structures for the three farm situations.



Specifications for a 20 land acre pond



Levee specifications and design of ditch and berm

Water Supply

Wells were selected as the source of water. The operations are dependent on a supply of readily available water that is free of undesirable fish and other pollutants. After viewing the capacity of many on-going operations and determining requirements for water during stress periods it was concluded that one 3000 g.p.m. well could supply the needs of four ponds (80 land acres). This would give a total capacity of approximately 43 g.p.m. per surface acre.

Diesel was chosen as the fuel source. Other fuels are being used but the choice of the majority of producers was diesel. In any given situation one of the other fuels: butane, electricity, or gasoline could be the least cost alternative, but this decision must be made by individuals after analysis of their particular situations.

The fuel consumption rate for the 3000 g.p.m. well was estimated at 3.698 gallons per hour of pumping time. This estimate was developed in consultation with Mr. Francis E. Rhodes.[8/] Water requirements were converted to hours of pumping time (Appendix Table 4).

Water requirements for the initial filling of ponds were calculated by standard engineering procedures. Data on pan evaporation by month were converted to pond surface evaporation at a rate of .70 and correlated with monthly precipitation data (15, 22).[9/] In those months in which evaporation exceeds precipitation the difference must be replaced.

[8/] Francis E. Rhodes is a Teaching Research Assistant in the Department of Agricultural and Biological Engineering, Mississippi State University.

[9/] The recording station for these data is located at Scott, Mississippi.

Appendix Table 1. Estimated linear feet of levee run, cubic yards of earth per linear foot of levee, and total volume of earth moved, three farm situations, Delta of Mississippi, 1980.

Farm Situation	Linear feet of levee run	Cubic yds. per linear ft.	Total volume of earth moved
I	20,176	6.2	125,091.2
II	37,944	6.2	235,252.8
III	75,996	6.2	471,175.2

Appendix Table 2. Linear feet of levee requiring all-weather surfacing and total cubic yards of gravel, three farm situations, Delta of Mississippi, 1980.

Farm Situation	Linear feet of levee	Total volume of gravel
		--cubic yards--
I	15,260	1,526
II	29,040	2,904
III	56,280	5,628

Appendix Table 3. Land requiring vegetative cover, three farm situations, Delta of Mississippi, 1980.

Farm Situation	Land
	acres
I	10.1
II	17.52
III	34.96

Appendix Table 4. Estimated total hours pumping time and diesel fuel required, the first year, three farm situation, Delta of Mississippi, 1980.[1/]

Farm Situation	Hours of Pumping Time	Fuel Consumption
		gallons
I	4,521	16,720
II	8,907	32,938
III	17,850	66,009

[1/] Hours of pumping time will be reduced in subsequent years if the ponds are not drained.

Twenty-two % of the initial volume must be replaced in May, 38% in June, 54% in July, 53% in August, 52% in September, and 21% in October.

Feeding

A majority of producers fed floating feed which contained 35% protein. Recommendations on feeding rates were given as 3 to 5% of body weight per day under normal conditions. The feeding program incorporates the initial weight of the fingerlings stocked and the 1.6:1 feed conversion ratio in determining weekly feed requirements.

Feeding is accomplished through the use of a p.t.o. driven fish feeder. The hopper capacity is 2000 pounds and the calibrated discharge has a maximum weight of 200 pounds. Specifications for the feeder show that it is adequate for Farm Situations I and II, but two feeders must be incorporated into Farm Situation III to meet the requirements during the later part of the growing season. Bulk storage bins are provided for storing the feed. The bins are the gravity flow design with a 23-ton capacity. One bin is included in the program for Farm Situation I. Farm Situation II has two bins and Farm Situation III has three bins. The storage capacity shown for each situation will hold as much as a six day supply early in the growing season, and at least a two-day supply in the latter part of the season. This is not unlike many actual operations.

Disease, Parasite and Weed Control

The disease, parasite, and weed control program was set up to address some of those problems that a producer in Mississippi could expect to encounter. All, none, or other problems may arise. In some cases, the producer would not be faced with all the costs estimated. However, the management system assumed for this study allows for the costs of the treatments specified.

To conform to the assumption of a high level of management, cost estimates for particular practices and pieces of equipment were included in total costs. The practices included were frequent oxygen determination, especially at night, and careful observation of the activities of the fish in order to detect early symptoms of stress and/or disease problems. These practices assume that the manager possesses the necessary skills to recognize early symptoms. To aid the manager in carrying out his program there are several pieces of necessary equipment. Each farm situation should be equipped with an oxygen meter and probe to be used in oxygen checks, and a boat, fitted with a chemical mixing and application chamber, for disease and weed control. The boat may be powered by a 10 h.p. motor and a standard boat trailer is provided.

The disease, parasite and weed control program includes: (1) Fingerling treatment using formalin. Treatment is accomplished by placing fingerlings in a vat containing 250 p.p.m. formalin for one hour. The amount of formalin required was 3.89 gallons, 7.88 gallons, and 15.79 gallons for Situations, I, II, and III respectively. (2) Parasite treatment. This treatment was administered twice annually on 20% of the ponds. Potassium permanganate was used at rates of 1922.4 pounds, 3888 pounds, and 6819.2 pounds for Farm Situations I, II, and III, respectively. Treatment of bacterial infections was accomplished using Terramycin (TM-100) added to the feed. (3) Weed control. This treatment was administered once annually on 75% of the ponds. Copper sulfate and Karmex both were incorporated into the program. Quantities of copper sulfate used were 720.9 pounds, 1396.4 pounds, and 2922.48 pounds for Farm Situations I, II, and III respectively. Karmex was used at a rate of 26.7

pounds for Farm Situation I, 54 pounds for Farm Situation II, and 108.24 pounds for Farm Situation III. Details of these programs are reported in Appendix Table 5.[10/]

Harvesting

The harvesting technique incorporated into the cost estimates is one in use by many producers in the Mississippi Delta area. The system employs two tractors, one pulling a seine reel and the other anchoring the free end of the seine, to position and haul the seine. This system adapts well to the overall operation in that it does not violate any of the restrictions placed on labor or equipment availability.

Coefficients for the system were developed in consultation with personnel of the U.S. Fish and Wildlife Service, Fish Farming Experiment Station, Stuttgart, Arkansas, and were tested for accuracy through observation of the harvesting process on several commercial operations. The labor required for harvesting is presented separately. The coefficients are for a trained harvesting crew. Harvesting equipment for each Farm Situation includes 2000 feet of haul seine, a brailing basket, a 20,000-pound and a 10,000-pound capacity live car, a crane with 17-foot reach, a seine storage reel, and 50 feet of cutting seine.

With the advances made in the catfish processing industry it is possible to move up to approximately 80,000 pounds of fish a day through the plants. This allows the fish to be moved from one 20 land acre pond.

It is assumed that 90% of the fish are captured on the first sweep and the remaining fish are removed on the second sweep. Some fish

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[10/] A producer should check with specialist on disease, weed control, and parasite treatment prior to using the ones included in this study.

likely will be left in the ponds, but for purposes of this study were included in the 5% mortality rate. Estimated labor requirements for harvesting are presented in Appendix Table 6.

Miscellaneous

Each of the farm situations requires a storage and service building. Design of the faciltiy came from the study done by Foster and Waldrop (6, p. 50). The building is 18 feet wide and 42 feet long and contains an area for office space, chemical storage and a service or repair area equipped with those tools necessary to handle normal farm needs. This building is situated on the three acre service area assumed available on each farm. This plot of land also is used for access roads, parking, equipment storage, and bulk feed storage.

All tractors used in this study are in the 90-100 h.p. range, the size necessary to power the 16 inch p.t.o.-driven relift pumps.[11/] Each situation is assumed to have one relift pump for each tractor. Farm Situation I is equipped with three tractors and relift pumps, Farm Situation II has four tractors and relift pumps, and Farm Situation III has six tractors and relift pumps. One tractor in each situation is assumed to be second hand. These "used" tractors are valued at one-half the estimated cost of new tractors.

One ½-ton pickup truck is assumed to be adequate for Farm Situation I and II, but two pickups are necessary for Farm Situation III. Each farm situation is assumed to have the services of a 1½-ton truck for heavier jobs.

[11/] Many producers use both relift pumps and paddle wheels in treating oxygen deficiencies.

Appendix Table 5. Basic disease, parasite, and weed control program, three farm situation, Delta of Mississippi, 1980.

Item	Frequence of Occurrence	Ponds Requiring Treatment	Possible Treatment
		percent	
Fingerling treatment	Annually at stocking	100	250 P.P.M. formalin for one hour
Parasite incidence	Twice annually	20	2 P.P.M. of potassium permanganate
Bacterial incidence	Twice annually	20	Maintain feeding schedule with feed treated with TM-100 for 10 days
Weed control	Once annually	75	One half of acreage with copper sulfate at 1 P.P.M. and one half of acreage with Karmex at .5 lb. per surface acre

Appendix Table 6. Estimated labor requirements for harvesting a 20 acre pond, by operation, Delta of Mississippi, 1980.

Operation	Time per Operation	Number in Crew
	hours	
1. Preliminary Equipment Check	1	1
2. Lower Seine into water and prepare to pull	1	5
3. Attach live car	.083	2
4. Pull Seine	1.75	5
5. Detach 1st live car and attach 2nd live car	.167	2
6. Load fish/1000#	.085	5
7. Maintenance of fish overnight	8	1
8. Second Seine pull (sum of items 2-4 above)	2.83	5
9. Load fish/1000#	.085	5
10. Cleanup, gear maintenance and storage/ 100 ft. of seine	1	2

Each farm situation was assumed to have a service and repair shop equipped with an electric welder, oxyacetylene torch, and other general shop equipment.

One 6-foot side-mounted mower was considered adequate for Farm Situations I and II, but two mowers were required for Farm Situation III.

Each farm was equipped with a 275-gallon capacity fiberglass transport tank.

The data used in calculating depreciation and interest on investment for each piece of machinery and each building are presented in Appendix Table 7. Charges for each segment of the operation, such as harvesting and feeding, were computed by summing the charges for each item of equipment within that segment.

The costs of selected miscellaneous items needed to adjust cost estimates to correspond to individual situations, and not reported elsewhere in the study, are presented in Appendix Table 8.

Appendix Table 7. Estimated annual ownership and operating cost of selected equipment and facilities, Delta of Mississippi, 1980.

	Description	Estimated New Cost	Repairs as a % of new cost	Estimated Life	Average Investment	Depreciation	Interest	Fuel	Repairs & maintenance
		dollars							
Seine storage reel	2,000'capacity	836.00	50	10	432	86	52		43
Boat & motor	Standard capacity	1,450.00	75	10	725	145	87	55	109
Boat & trailer	Standard capacity	350.00	40	10	175	35	21		14
Crane	17' reach	7,200.00	100	10	3,600	720	432		720
Feeder	2,000# capacity	6,540.00	75	10	3,270	654	392		491
Feed storage	23 ton capacity	4,200.00	50	10	2,100	420	252		210
Building	18' x 42'	16,000.00	100	20	8,000	800	960		800
Relift pump	pto drive 16"	3,549.00	50	10	1,775	355	213		177
Tractor	100 hp	24,776.00	65	12	12,388	2,065	1,487		1,342
Mowing machine	6' side mount	2,900.00	40	12	1,450	242	174		97
Haul seine with funnel & hoop	2000' section of 10' seine with 1" mesh	5,200.00	20	5	2,600	1,040	312		208
Cutting seine	50' section of 6' seine with ½" mesh	165.00	25	5	83	33	10		8
Live car	20,000# capacity	300.00	32	5	150	60	18		19
Live car	10,000# capacity	220.00	32	5	110	44	14		14
Brailing basket	450# capacity	60.00	3.00	5	30	12	4		4
Truck	½ ton	7,000.00	70	8	3,500	875	420	591	612
Truck	1½ ton	19,875.00	70	10	5,438	1,088	653	628	761
Oxygen meter & probe		720.00	5	5	360	144	43		7
Fiberglass transport capacity tank	275 gallon	460.00	10	5	230	92	28		9
Shop equipment		4,800.00	50	5	2,400	960	288		480

Appendix Table 8. Prices of Selected Inputs used in Producing catfish for food, Delta of Mississippi, 1980.

Item	Unit	Dollars
Fingerlings	Each	.08
Feed	Ton	280.00
Gravel	Cubic Yard	8.45
Pipe		
Water Supply	Linear Foot installed	10.00
Drainage	Linear Foot installed	16.00
Chemicals		
Formalin	Gallon	6.00
Potassum Permanganate	Drum (110 lbs.)	115.50
Copper Sulfate	100 lbs. Bag	48.00
Karmex	Pound	2.95
Hired Labor (Part-time)	Hour	3.50
Diesel	Gallon	1.00
Earth Moving	Cubic Yard	.50
Vegetative Cover		
Establishment Cost	Acre	92.38
Annual Maintenance	Acre	70.50
Tractors	Each	24,776.00
½ Ton Truck	Each	7,000.00
1 ½ Ton Truck	Each	10,875.00
Relift Pumps	Each	3,549.00
Gate & Screen	Each	180.00

Appendix Table 9. Sources of Data used in Estimation Production Costs

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Tractor - Average of 2 prices from Rice Equipment Co., Starkville, MS MS, and Delta Implement Co., Indianola, MS.

Truck (½ & 1½) Average of 2 prices from Ben Garner Ford, Starkville, MS, Starkville and Slaughter Chevrolet, Starkville, MS.

Wells & Pipe - Mr. Max Harper, Greenwood Butane Gas Co., Greenwood, MS.

Feeders - Neilsen Metal Industries, Salem, Oregon.

Seines, Live Cars - Delta Net ad Twine Co., Greenville, MS.

Chemicals - McCrary's Farm Supply, Lonoke, Arkansas.

Relift Pump - Layne Central, Cleveland, MS.

Mower - Belzoni Motor Co. (Mr. Walter Martin), Belzoni, MS.

Gravel - J. J. Fergurson Gravel Co., Greenwood, MS.

Oxygen Meter - Dr. Tom Wellborn, MSU.

Feed & Fingerlings - Called various suppliers in the MS Delta and they quoted prices charged by them at the time.

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