An economic analysis of producing pond-raised catfish for food in Mississippi

Robert L. Burke
John E. Waldrop

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An Economic Analysis of Producing Pond-Raised Catfish for Food in Mississippi

By Robert L. Burke and John E. Waldrop
An Economic Analysis of Producing Pond-Raised Catfish for Food in Mississippi

by

Robert L. Burke, Graduate Research Assistant and John E. Waldrop, Agricultural Economist, MAFES Department of Agricultural Economics

Mississippi Agricultural and Forestry Experiment Station Mississippi State, Mississippi

July 1978
PREFACE

This report is Mississippi's contribution to Objective II, Regional Project S-83 Revised.

We express our appreciation to many individuals and agencies for their contribution. Personnel of the Mississippi Cooperative Extension Service, the Soil Conservation Service, Cooperative Feed Mill, Isola, Mississippi and others that supply equipment, materials and services to the catfish industry contributed essential data.

Special appreciation is extended to Dr. Chester M. Wells, Head, Editorial Department, Mississippi Agricultural and Forestry Experiment Station for editing the bulletin.
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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 Situations 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. Water was supplied by one 16-inch well powered by a 60 h.p. diesel engine for each 4 ponds. The research method used was economic engineering or synthetic firm analysis.

Estimates of production costs per pound of harvested fish were: $.436 for Farm Situation I, $.392 for Farm Situation II; and $.373 for Farm Situation III.

The cost information was used to develop cash flow schedules. Monthly cost and return schedules were developed for each of the three farm situations for one production period. In addition, expected cash expenditures and receipts developed for selected lengths of loan and interest rates, selected equity situations, and selected product prices. At 1977 prices for catfish, expected revenues exceeded estimated production costs for all equity situations and for all length of loan situations.

Cost sensitivity analysis was performed to estimate the cost effect of changes in prices of feed and fingerlings (the major cost components) and for selected stocking rates. A 10% change in feed price results in less than a 3 cent change in total cost per pound. A 10% change in fingerling price results in a very small change in total cost per pound. Each 500-fish-per-surface-acre increase in stocking rate increases total costs but reduces per pound cost.

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. Results of the cost sensitivity analysis included in this study indicate that catfish production would remain feasible even at product prices much lower than those now faced by producers.
An Economic Analysis of Producing Pond-Raised Catfish for Food in Mississippi

The area used to produce food fish in the Delta of Mississippi was estimated to be 15,000 acres in 1976, up about 13,000 from 1967. This acreage accounts for about one half of the total area devoted to the production of catfish for food in the United States. Growth of the industry has not, however, been limited to acreage increases because advancements in technology and production practices have allowed the productivity of individual units to increase significantly.

THE PROBLEM

Reports of the relatively favorable incomes derived from producing catfish for food have led numbers of individuals and groups to seek entry into the industry. However, the industry is relatively new and much of the information necessary for assessing its status and potential is not readily available. Also, much of the available technical information does not reflect the latest technology and earlier economic studies do not reflect current prices for many inputs; i.e., fuel, feed, machinery, and labor.

OBJECTIVES

This study was designed for assessing the economic feasibility of current and/or new capacity for the production of catfish in Mississippi.

Specific objectives of the study were to:

1. Estimate costs of commercial catfish production with current production practices and input prices.
2. Construct cash flow schedules of capital requirements and use them to assess the adequacy of revenues to meet "payback" requirements for assets financed by credit.
3. Assess the sensitivity of costs to changes in prices of selected inputs.

PROCEDURE

Economic-engineering synthesis was used to develop hypothetical firms representative of the three sizes of catfish operations most prevalent in Mississippi [23].

Each hypothetical firm reflects the combination of production resources and the production practices recommended in 1977. The

Numbers in brackets refer to literature cited at the end of this report.
input-output coefficients generated by analysis of each synthetic firm were used to estimate costs of production, with each resource valued at its opportunity cost [12, p. 144].

The estimates of production costs were used to construct schedules of monthly cash expenses of each hypothetical firm for one year. Schedules of cash expenses and receipts were constructed to permit evaluation of the economic feasibility of expanding commercial catfish production under different equity situations and with repayment of loans over different time periods. Feed and fingerling costs account for a relatively large percentage of total costs; therefore, changes in total costs associated with specified changes in prices of these items were determined. Also, the impact of different stocking rates on cost of production and net returns was estimated for specified catfish prices.

Detailed discussions of each segment of the catfish operation are presented in the Appendix.

SOURCES OF DATA

Coefficients for pond construction were developed with the aid of Mr. Tom E. Blaylock, District Engineer, Soil Conservation Service, Greenwood, Mississippi. Information on costs of wells and pipe was obtained from Mr. Max Harper, Butane Gas Company, Greenwood, Mississippi. The disease, parasite and weed control program was developed with the aid of Dr. Thomas L. Wellborn, Leader, Department of Wildlife and Fisheries, Mississippi Cooperative Extension Service, Mississippi State University. Feed prices were calculated from data supplied by Producers Feed Mill, Isola, Mississippi. Harvesting coefficients were developed with the aid of Mr. Donald C. Greenland, Fishery Biologist, and Mr. J. Mayo Martin, Extension Biologist, U. S. Fish and Wildlife Service Fish Farming Experiment Station, Stuttgart, Arkansas.

Prices of seines, live cars, and other harvesting equipment were obtained from Delta Net and Twine, Greenville, Mississippi and McCrary's Farm Supply, Lonoke, Arkansas. Prices of feed bins were supplied by Butler Manufacturing Company, Taylorsville, Illinois. The price of a feeder was supplied by Neilson Metal Industries, Salem, Oregon.

Agents of the Mississippi Cooperative Extension Service in various counties furnished valuable service in locating producers and supplying other general information about the catfish industry in the Delta. Many other individuals and groups who contributed to the development of this study are not named because of limited space.

The practices outlined through consultation with the above-named public and private experts were reaffirmed by visits with cooperating catfish farmers.

SYNTHESIZED FIRMS

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.

The Basic Production System

The production system for hypothetical firms of each size specified stocking on March 15 with 4000 1-ounce fingerlings per surface acre of water and harvesting 210 days later (October 15). 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).

Production was based on stocking with 4000 1-ounce fingerlings per acre, 5% loss, 19 ounce gain per fingerling and 1.6:1 feed conversion. Details of the basic system are discussed at length in the Appendix.

*Assumptions about repair and maintenance of ponds are discussed in detail in the section of this report entitled "Annual Operating Costs".*
Land
Synthesized firms of each size were assumed to have level or nearly level land available in 163-acre plots with an adequate supply of water within 100-125 feet of the surface [9]. Available soil was a clay type with good water-holding capacity and near to natural of water depth of four feet with a two-foot freeboard. 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.

Pond Construction
Levee designs 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 pond size of 20 acres per pond. 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 capacity indicated 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).

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. 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 capacity indicated 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).

Water Supply
Water is the medium of growth and a critical management tool 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 during periods of stress. Provisions also must be made for adequate aeration and chemical treatment of water.

Wells are selected as the water source and numbers of wells for

Table 1. Estimated total production and production per pond and per acre, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Farm Situation</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>--</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Total Production</td>
<td>655,785</td>
<td>1,323,611</td>
<td>2,653,243</td>
</tr>
<tr>
<td>Production per Pond</td>
<td>81,973</td>
<td>82,726</td>
<td>82,914</td>
</tr>
<tr>
<td>Production per Acre of Water</td>
<td>4,631</td>
<td>4,631</td>
<td>4,631</td>
</tr>
</tbody>
</table>

Table 2. Total acres of land, surface acres of water, number of ponds, and surface acres per pond, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Farm Situation</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total land acres</td>
<td>163</td>
<td>323</td>
<td>643</td>
</tr>
<tr>
<td>Surface acres of water</td>
<td>141.6</td>
<td>285.8</td>
<td>572.9</td>
</tr>
<tr>
<td>Number of ponds</td>
<td>8</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>Surface acres per pond</td>
<td>17.7</td>
<td>17.8</td>
<td>17.9</td>
</tr>
</tbody>
</table>

Table 3. Number of wells and feet of pipe required, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Farm Situation</th>
<th>Number of Wells</th>
<th>Feet of Discharge Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>2</td>
<td>300</td>
</tr>
<tr>
<td>II</td>
<td>4</td>
<td>600</td>
</tr>
<tr>
<td>III</td>
<td>8</td>
<td>1200</td>
</tr>
</tbody>
</table>

³Depth of water will approach five feet on the average.

⁴This does not include the three acres available for buildings, equipment storage and other support facilities.
each farm situation (Table 3) were based on minimum flow requirements and on observations of numbers and placement of wells on the catfish operations visited. Wells are rated at 3000 g.p.m.

Feeding
Feed requirement was estimated to be 7448 pounds of pellet per surface acre per year. 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 tonnage of feed for each situation (Table 4) are feeders (p.t.o.-driven 2000-pound capacity) and feed storage bins (23-ton capacity gravity feed bin 25' from ground to top).

Table 4. Estimated annual feed requirements, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Farm Situation</th>
<th>Feed Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>527.32</td>
</tr>
<tr>
<td>II</td>
<td>1,064.32</td>
</tr>
<tr>
<td>III</td>
<td>2,133.11</td>
</tr>
</tbody>
</table>

Harvesting
Producers have changed from the “mechanized haul seine technique” to using two tractors to position and haul the seine. All producers observed used some variation of this technique.

Disease, Parasite and Weed Control
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 and probe.

Miscellaneous
Some inputs associated with production are used by more than one segment of the operation. These were grouped under “Miscellaneous”.

ESTIMATED INVESTMENT REQUIREMENTS AND ANNUAL PRODUCTION COSTS

Catfish production is capital intensive and the high capital requirement usually presents two problems to producers: (1) financing the original investment, and (2) financing annual production expenses. Estimates of capital requirements are needed to assess the economic feasibility of production. Prices obtained from suppliers were used to derive estimates of investment requirements in 1977.

Investment Requirements
Investment requirements for each farm situation can be 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 $291,334 for Farm Situation I, $490,001 for Farm Situation II, and $902,796 for Farm Situation III (Table 5).

Land---Land was valued at $552 per acre—the average value of land in the Delta of Mississippi in 1974 adjusted for the reported increase in land values in the State from 1974 to 1977 [18].

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 40 cents per cubic yard of earth moved (Appen-


Table 5. Estimated total investment, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Item</th>
<th>Farm Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Land</td>
<td>85,086</td>
</tr>
<tr>
<td>Pond construction</td>
<td>68,316</td>
</tr>
<tr>
<td>Earth moving</td>
<td>50,036</td>
</tr>
<tr>
<td>Drainage structures</td>
<td>10,800</td>
</tr>
<tr>
<td>Gravel</td>
<td>6,547</td>
</tr>
<tr>
<td>Vegetative cover</td>
<td>933</td>
</tr>
<tr>
<td>Water supply (wells and drainage pipes)</td>
<td>32,150</td>
</tr>
<tr>
<td>Feeding (feeder and bulk storage)</td>
<td>6,020</td>
</tr>
<tr>
<td>Disease, parasite, and weed control</td>
<td>2,564</td>
</tr>
<tr>
<td>Harvesting</td>
<td>12,068</td>
</tr>
<tr>
<td>Miscellaneous equipment</td>
<td>85,130</td>
</tr>
<tr>
<td>Tractors (90-100 h.p.)</td>
<td>42,500</td>
</tr>
<tr>
<td>1½ ton truck</td>
<td>7,000</td>
</tr>
<tr>
<td>½ ton truck</td>
<td>4,800</td>
</tr>
<tr>
<td>18' x 42' service building</td>
<td>16,000</td>
</tr>
<tr>
<td>16' p.t.o. driven high lift pump</td>
<td>7,905</td>
</tr>
<tr>
<td>6' side-mount mower</td>
<td>2,100</td>
</tr>
<tr>
<td>Farm shop equipment</td>
<td>4,000</td>
</tr>
<tr>
<td>Fiberglass transport tank</td>
<td>400</td>
</tr>
<tr>
<td>Waders</td>
<td>425</td>
</tr>
<tr>
<td>TOTAL</td>
<td>291,334</td>
</tr>
<tr>
<td>Investment per surface acre of water</td>
<td>2,057</td>
</tr>
<tr>
<td>Investment per acre of land</td>
<td>1,787</td>
</tr>
</tbody>
</table>

Depreciation of water supply facilities was calculated by summing the depreciation of separate components of the system and is $2,923, $5,846 and $11,693 for Farm Situations I, II, and III respectively.

Depreciation of the feeding system includes a charge for feeders and feed bins and is estimated to be $602 for Farm Situation I, $792 for Farm Situation II, and $1,394 for Farm Situation III.
Investment in harvesting equipment is the same for each Farm Situation and depreciation is $1,827.

Depreciation of miscellaneous equipment is a major portion of annual ownership cost and is $8,157 for Farm Situation I, $9,836 for Farm Situation II, and $13,371 for Farm Situation III.

Interest on Investment—Interest costs are the sum of interest charged on investment items and were computed at a rate of 9% of the full value of land and chemicals on hand, 9% on pond construction and 10% of one-half the investment in other depreciable items.

Interest on land was $7,658 for Farm Situation I, $15,175 for Farm Situation II, and $30,208 for Farm Situation III.

Interest charges for ponds were $3,074 for Farm Situation I, $5,840 for Farm Situation II, and $11,657 for Farm Situation III.

Interest charges for miscellaneous equipment were calculated in a similar manner for each and ranged from $3,830 for Farm Situation I to $6,792 for Farm Situation III.

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.

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

**Repairs and Maintenance**—Repair and maintenance costs were based on dealers’ estimates, manufacturers’ specifications and other published material as to expected repairs over the life of the item, and 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. 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

---

**Table 6. Estimated annual ownership costs, three farm situations, Delta of Mississippi, 1977.**

<table>
<thead>
<tr>
<th>Item</th>
<th>Farm Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
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<tr>
<td>Annual Ownership Costs:</td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td></td>
</tr>
<tr>
<td>Ponds</td>
<td>3,417</td>
</tr>
<tr>
<td>Water supply (wells and discharge pipe)</td>
<td>2,923</td>
</tr>
<tr>
<td>Feeding (feeder and storage)</td>
<td>602</td>
</tr>
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<td>Harvesting equipment</td>
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<tr>
<td>Disease, parasite and weed control equipment</td>
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<tr>
<td>Interest on Investment</td>
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</tr>
<tr>
<td>Land</td>
<td>7,658</td>
</tr>
<tr>
<td>Pond construction (drainage structures, gravel and vegetative cover)</td>
<td>3,074</td>
</tr>
<tr>
<td>Water supply (wells and discharge pipe)</td>
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</tr>
<tr>
<td>Feed equipment (feeder and storage)</td>
<td>301</td>
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<tr>
<td>Disease, parasite and weed control equipment</td>
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<tr>
<td>Chemicals on hand</td>
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<tr>
<td>Harvesting equipment</td>
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</tr>
<tr>
<td>Taxes and Insurance</td>
<td>2,671</td>
</tr>
<tr>
<td>TOTAL</td>
<td>36,771</td>
</tr>
</tbody>
</table>

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5Mr. Rhodes is a Teaching Research Assistant with the Department of Agricultural and Biological Engineering, at Mississippi State University.
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, 6-inch fingerlings per acre, priced at $0.06 each.

Feed—The price used in estimating total feed cost for each situation was $263.78 per ton—the weighted average weekly price of the major supplier in the area during 1977. An additional charge of $75 per ton was included for medicated feed used in the disease program.

Labor—Labor costs for the three farm situations include costs of full-time and part-time (harvest labor) labor. 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.

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.

Each cost component was converted to a percentage of total costs to facilitate comprehension of the relative contribution of the many cost components that comprise total annual costs. These data are presented in Table 9.

Feed and fingerling costs make up a larger percentage of total costs than do all other cost components combined.

Annual ownership costs, as a percentage of total costs, decreased from 12.83% to 10.33% as farm size increased from 163 acres to 643 acres. Annual operating costs, as a percentage of total costs, increased from 87.17% to 89.67% as farm size

<table>
<thead>
<tr>
<th>Table 7. Estimated annual operating costs, three farm situations, Delta of Mississippi, 1977.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Annual Operating Costs:</td>
</tr>
<tr>
<td>Repairs and maintenance</td>
</tr>
<tr>
<td>Vegetative cover</td>
</tr>
<tr>
<td>Water supply (wells and discharge pipe)</td>
</tr>
<tr>
<td>Feeding equipment (feeder and storage)</td>
</tr>
<tr>
<td>Disease, parasite and weed control</td>
</tr>
<tr>
<td>Harvesting equipment</td>
</tr>
<tr>
<td>Miscellaneous equipment</td>
</tr>
<tr>
<td>Fuel</td>
</tr>
<tr>
<td>Pumping</td>
</tr>
<tr>
<td>Power, transportation, feeding, harvest, etc.</td>
</tr>
<tr>
<td>Chemicals</td>
</tr>
<tr>
<td>Fingerlings</td>
</tr>
<tr>
<td>Feed (35% protein floating)</td>
</tr>
<tr>
<td>Labor</td>
</tr>
<tr>
<td>Management</td>
</tr>
<tr>
<td>Hired labor (full time)</td>
</tr>
<tr>
<td>Hired labor (for harvest)</td>
</tr>
<tr>
<td>Interest on operating capital</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

1 An additional charge of $75/ton was made for medicated feed used for disease treatment.
increased from 163 acres to 643 acres.

Annual operating costs make up 87.17%, 88.85%, and 89.67% of total cost for Farm Situations I, II, and III, respectively. Operating costs are such a large portion of total costs that significant changes in the annual supply of catfish would be expected if prices should fall appreciably below costs estimated in this study. Knowledgeable

CASH FLOW ANALYSIS

Cash flow analysis is a financial management tool for assisting in planning and managing business activities. The technique allows projections of expected cash expenditures and cash receipts over specified time periods [11]. These projections enable producers to foresee periods when operating costs are highest and to arrange for a line of credit in advance. Exercising the credit option reduces interest payments because the length of term of loans is shorter.

Monthly Cash Flows

Estimates of monthly cash expenditures (Tables 10-12) are based on the coefficients presented in earlier sections of this report. Monthly expenditures are highest in March when fingerlings are stocked and in September when the largest amount of feed is consumed.

Annual Cash Flows

Schedules of annual cash expenditures and receipts were constructed for different equity situations and for loans of different duration. The assumed equity situations and durations of repayment periods were:

Equity Situation I---No equity and fixed repayment periods; i.e., the entire investment in land, buildings, machinery and equipment is financed for five years at an annual interest rate of 10% and operating costs are financed for four months of each year at an annual interest rate of 10%.

Equity Situation II---A 25% equity and fixed repayment period; i.e., 75% of the investment in land, buildings, machinery, and equipment is financed for five years and operating costs are financed for four months of each year at an annual interest rate of 10%.

Equity Situation III---No equity and variable repayment periods; i.e., all necessary funds are borrowed but repayment schedules vary by cost component. The investment in land and the storage building is financed for 20 years at an annual interest rate of 9%.

Investment in depreciable machinery and equipment is financed at an annual interest rate of 10% but repayment schedules vary with expected life of the equipment---all items with a five-year depreciation schedule are financed for five years. All other depreciable items are financed for seven years. Operating costs are financed for four months of each year at an annual interest rate of 10%.

Table 8. Catfish Production: Summary of total annual cost and cost per pound, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Item</th>
<th>Farm Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>dollars</td>
</tr>
<tr>
<td>Total Annual Cost</td>
<td>286,192</td>
</tr>
<tr>
<td>Annual Ownership Cost</td>
<td>36,771</td>
</tr>
<tr>
<td>Annual Operating Cost</td>
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<tr>
<td>Total Cost per Pound(^1)</td>
<td>.436</td>
</tr>
<tr>
<td>Ownership Cost per Pound</td>
<td>.056</td>
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<tr>
<td>Operating Cost per Pound</td>
<td>.380</td>
</tr>
</tbody>
</table>

\(^1\)Total cost per pound was computed by dividing total annual cost by total pounds of production for each Farm Situation. Total production was 655,785, 1,323,611, and 2,653,243 pounds for Farm Situation I, II, and III, respectively.
Table 9. Estimated annual cost components expressed as a percent of total cost, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Item</th>
<th>Farm Situation</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td><strong>Annual Ownership Costs:</strong></td>
<td></td>
<td></td>
<td></td>
<td>-------</td>
</tr>
<tr>
<td>Depreciation:</td>
<td>12.83</td>
<td>11.15</td>
<td>10.33</td>
<td></td>
</tr>
<tr>
<td>Pond construction</td>
<td>6.00</td>
<td>4.82</td>
<td>4.18</td>
<td></td>
</tr>
<tr>
<td>Water supply</td>
<td>1.19</td>
<td>1.25</td>
<td>1.30</td>
<td></td>
</tr>
<tr>
<td>Feeding equipment</td>
<td>1.02</td>
<td>1.13</td>
<td>1.18</td>
<td></td>
</tr>
<tr>
<td>Harvesting equipment</td>
<td>.21</td>
<td>.15</td>
<td>.14</td>
<td></td>
</tr>
<tr>
<td>Disease, parasite and weed control equipment</td>
<td>.64</td>
<td>.35</td>
<td>.18</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous equipment</td>
<td>.09</td>
<td>.05</td>
<td>.03</td>
<td></td>
</tr>
<tr>
<td>Interest on investment:</td>
<td>2.85</td>
<td>1.89</td>
<td>1.35</td>
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<td>Land</td>
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<td>5.63</td>
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<td>Feeding equipment</td>
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<td>.59</td>
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<tr>
<td>Harvesting equipment</td>
<td>.11</td>
<td>.08</td>
<td>.07</td>
<td></td>
</tr>
<tr>
<td>Disease, parasite, and weed control equipment</td>
<td>.04</td>
<td>.02</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>.15</td>
<td>.08</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>Taxes and Insurance</td>
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<td>.91</td>
<td>.69</td>
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<td><strong>Annual Operating Costs:</strong></td>
<td>87.17</td>
<td>88.85</td>
<td>89.67</td>
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<td>Repairs and maintenance:</td>
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<td>2.12</td>
<td>1.63</td>
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<tr>
<td>Ponds</td>
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<td>Water supply</td>
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<td>.39</td>
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</tr>
<tr>
<td>Feeding equipment</td>
<td>.14</td>
<td>.10</td>
<td>.09</td>
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</tr>
<tr>
<td>Disease, parasite, and weed control equipment</td>
<td>.04</td>
<td>.02</td>
<td>.01</td>
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<tr>
<td>Harvesting equipment</td>
<td>.24</td>
<td>.14</td>
<td>.07</td>
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<td>Miscellaneous equipment</td>
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<td>1.25</td>
<td>.82</td>
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<tr>
<td>Fuel:</td>
<td></td>
<td></td>
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<tr>
<td>Pumping</td>
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<td>3.49</td>
<td>3.67</td>
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<td>Chemicals</td>
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<td>13.89</td>
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<td>Manager</td>
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<td>3.20</td>
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<td></td>
</tr>
<tr>
<td>Hired labor (for harvest)</td>
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<td>.75</td>
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<td>100.00</td>
<td>100.00</td>
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Table 10. Monthly cash expenses, Farm Situation I, Delta of Mississippi, 1977.

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<th>Labor</th>
<th>Fuel</th>
<th>Fingerlings</th>
<th>Repairs and Maintenance</th>
<th>Interest Paid</th>
<th>Taxes and Insurance</th>
<th>Total by Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
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<td></td>
<td></td>
<td>619</td>
<td></td>
<td>3,952</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>3,333</td>
<td></td>
<td></td>
<td>619</td>
<td></td>
<td>8,550</td>
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<tr>
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<td></td>
<td></td>
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</tr>
<tr>
<td>May</td>
<td>8,781</td>
<td>518</td>
<td>3,333</td>
<td></td>
<td></td>
<td>13,251</td>
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<tr>
<td>June</td>
<td>11,621</td>
<td>518</td>
<td>3,333</td>
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<td></td>
<td>16,091</td>
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<tr>
<td>July</td>
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<td>518</td>
<td>3,333</td>
<td>4,519</td>
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<td>25,752</td>
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<tr>
<td>August</td>
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<td></td>
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<tr>
<td>October</td>
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<td>518</td>
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<td></td>
<td></td>
<td>38,501</td>
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</tr>
<tr>
<td>November</td>
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<td></td>
<td>619</td>
<td></td>
<td>3,952</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>December</td>
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<td></td>
<td></td>
<td>619</td>
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<td>2,671</td>
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<td>41,818</td>
<td>13,636</td>
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<td>8,045</td>
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<td>252,092</td>
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<table>
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<th>Month</th>
<th>Feed</th>
<th>Chemicals</th>
<th>Labor</th>
<th>Fuel</th>
<th>Fingerlings</th>
<th>Repairs and Maintenance</th>
<th>Interest Paid</th>
<th>Taxes and Insurance</th>
<th>Total by Month</th>
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<td>January</td>
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<td></td>
<td>915</td>
<td></td>
<td>4,748</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>3,833</td>
<td></td>
<td></td>
<td>915</td>
<td></td>
<td>13,806</td>
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<td></td>
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</tr>
<tr>
<td>March</td>
<td>4,142</td>
<td>9,058</td>
<td>3,833</td>
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<td>915</td>
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<td>81,202</td>
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<tr>
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<td>14,234</td>
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<td>3,833</td>
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<td>3,833</td>
<td>8,209</td>
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<td>48,091</td>
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<td></td>
<td>86,887</td>
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<td>October</td>
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</tr>
<tr>
<td>November</td>
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<td></td>
<td></td>
<td>915</td>
<td></td>
<td>4,748</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>3,833</td>
<td></td>
<td></td>
<td>915</td>
<td></td>
<td>8,185</td>
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<td></td>
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<td>49,622</td>
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<td>68,592</td>
<td>10,980</td>
<td>14,869</td>
<td>464,592</td>
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Table 12. Monthly cash expenses, Farm Situation III, Delta of Mississippi, 1977.

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<th>Chemicals</th>
<th>Labor</th>
<th>Fuel</th>
<th>Fingerlings</th>
<th>Repairs and Maintenance</th>
<th>Interest Paid</th>
<th>Taxes and Insurance</th>
<th>Total by Month</th>
</tr>
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<td>January</td>
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<tr>
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<td>1,349</td>
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<td>24,835</td>
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<td>5,333</td>
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<td>159,733</td>
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<tr>
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<td>28,516</td>
<td>9,076</td>
<td>5,333</td>
<td></td>
<td></td>
<td>44,274</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>37,203</td>
<td>1,845</td>
<td>5,333</td>
<td></td>
<td></td>
<td>45,734</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>47,871</td>
<td>1,849</td>
<td>5,333</td>
<td></td>
<td></td>
<td>56,402</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>68,520</td>
<td>1,849</td>
<td>5,333</td>
<td>16,252</td>
<td>1,349</td>
<td>93,303</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>121,061</td>
<td>1,849</td>
<td>5,333</td>
<td></td>
<td></td>
<td>129,592</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>164,238</td>
<td>1,349</td>
<td>5,333</td>
<td></td>
<td>170,920</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>October</td>
<td>99,592</td>
<td>12,666</td>
<td>5,333</td>
<td></td>
<td>28,616</td>
<td>142,233</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>5,333</td>
<td></td>
<td></td>
<td>1,349</td>
<td></td>
<td>6,682</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>5,333</td>
<td></td>
<td></td>
<td>1,349</td>
<td></td>
<td>11,788</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>575,303</td>
<td>7,475</td>
<td>71,333</td>
<td>50,657</td>
<td>137,495</td>
<td>16,193</td>
<td>28,616</td>
<td>5,106</td>
<td>992,178</td>
</tr>
</tbody>
</table>
Gross revenue and the repayment potential for the different equity situations and repayment periods were computed at 58 cents \(^6\) per pound for catfish f.o.b. pond bank (the weighted average price paid by processors in 1977) and for prices decreased by 1-cent increments until revenues would not cover costs.

Costs and returns to Farm Situation I are presented for each equity situation and payback schedule (Tables 13, 14 and 15). The payback schedule presented in each table includes repayment of the initial investment in land, buildings and equipment and reinvestment in machinery and equipment at the end of their depreciable life. \(^7\)

The 163-acre unit was the highest-cost alternative considered in our study and payback schedules are more favorable for the larger operations. Most data required for determining costs and returns to the larger units are presented in this publication.

Returns above cost of production are positive for each equity situation if catfish sell for 58 cents (Tables 13, 14, and 15). Returns to a 63-acre operation with no equity and a five-year repayment schedule are negative if catfish are priced below 51 cents (Table 13). Returns to a 163-acre unit with a 25% equity and a five-year repayment schedule are negative if catfish sell or less than 38 cents (Table 14). Cumulative net returns to a 163-acre operation with no equity and a variable repayment schedule over a 20-year period are negative if catfish are priced as low as 44 cents (Table 15), positive if catfish are priced at 46 cents. However, revenue does not exceed cost in some years if catfish are priced as low as 46 cents.

### COST SENSITIVITY

Feed and fingerling costs comprise 62, 69 and 72% of total annual costs for Farm Situations I, II and III, respectively. The rate of initial stocking is the determining factor in quantity of feed and number of

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\(^6\)Price data obtained from Mr. James W. Ayres, Marketing Specialist, National Marine Fisheries Service, Little Rock, Arkansas.

\(^7\)Results of this study should not be interpreted as recommendations. They are presented as a guide to producers and lending agencies interested in financing catfish production.
Table 15. Costs and returns from producing catfish with investment financed for three lengths of loans,1 Farm Situation I, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Item</th>
<th>1-5</th>
<th>6-7</th>
<th>8</th>
<th>9-10</th>
<th>11-12</th>
<th>13-15</th>
<th>16</th>
<th>17</th>
<th>18-19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating</td>
<td>252,092</td>
<td>252,092</td>
<td>252,092</td>
<td>252,092</td>
<td>252,092</td>
<td>252,092</td>
<td>252,092</td>
<td>252,092</td>
<td>252,092</td>
<td>252,092</td>
</tr>
<tr>
<td>7 year loan3</td>
<td>36,958</td>
<td>36,958</td>
<td>0</td>
<td>4,622</td>
<td>17,628</td>
<td>32,191</td>
<td>27,569</td>
<td>32,191</td>
<td>19,185</td>
<td>4,622</td>
</tr>
<tr>
<td>20 year loan4</td>
<td>11,069</td>
<td>11,069</td>
<td>11,069</td>
<td>11,069</td>
<td>11,069</td>
<td>11,069</td>
<td>11,069</td>
<td>11,069</td>
<td>11,069</td>
<td>11,069</td>
</tr>
<tr>
<td>Total Cost</td>
<td>302,841</td>
<td>302,841</td>
<td>265,883</td>
<td>270,505</td>
<td>283,511</td>
<td>298,074</td>
<td>293,452</td>
<td>298,074</td>
<td>285,068</td>
<td>270,505</td>
</tr>
<tr>
<td>Net Revenue</td>
<td>77,514</td>
<td>77,514</td>
<td>114,472</td>
<td>109,850</td>
<td>96,844</td>
<td>82,281</td>
<td>86,903</td>
<td>82,281</td>
<td>95,287</td>
<td>109,850</td>
</tr>
<tr>
<td>Total Revenue @ 46¢/lb.5</td>
<td>302,841</td>
<td>302,841</td>
<td>302,841</td>
<td>302,841</td>
<td>302,841</td>
<td>302,841</td>
<td>302,841</td>
<td>302,841</td>
<td>302,841</td>
<td>302,841</td>
</tr>
<tr>
<td>Net Revenue</td>
<td>0</td>
<td>0</td>
<td>37,048</td>
<td>32,426</td>
<td>19,425</td>
<td>4,862</td>
<td>9,484</td>
<td>4,862</td>
<td>17,868</td>
<td>32,431</td>
</tr>
<tr>
<td>Total Revenue @ 44¢/lb.6</td>
<td>288,545</td>
<td>288,545</td>
<td>288,545</td>
<td>288,545</td>
<td>288,545</td>
<td>288,545</td>
<td>288,545</td>
<td>288,545</td>
<td>288,545</td>
<td>288,545</td>
</tr>
<tr>
<td>Net Revenue</td>
<td>-14,296</td>
<td>-14,296</td>
<td>-22,662</td>
<td>-18,040</td>
<td>-5,034</td>
<td>-9,529</td>
<td>-4,907</td>
<td>-9,529</td>
<td>3,477</td>
<td>18,040</td>
</tr>
</tbody>
</table>

1Schedule includes repayment of initial investment of $291,334 and reinvestment in machinery and equipment as these items are replaced in the inventory.
2The cost of the 5 year loan remains constant for every year in the analysis.
3The cost of the 7 year loan differs from year to year because of the difference in length of loan and life of the depreciable items.
4The cost of the 20 year loan remains constant for each year in the analysis.
5A price of $0.44389 causes cumulative revenue over the 20 year period to equal cumulative cost over the 20 year period.

fingerlings used. Therefore, sensitivity analysis was performed to determine the effect of selected changes in the rate of initial stocking on total costs of production.

Feed
The price of feed was varied by about 10 and 20% both above and below the base price of $263.78 per ton. A 10% change in feed price results in less than a 3-cent change in total cost per pound of production (Table 16).

Fingerlings
The price of fingerlings was varied by 10, 20 and 30% above and below the base price of 6 cents. A 10% change in fingerling price results in a very small change in total cost per pound of production (Table 17).

Table 16. Total cost per pound of harvested catfish for selected feed prices, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Price per ton of feed</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>208.56</td>
<td>.3844</td>
<td>.3526</td>
<td>.3328</td>
</tr>
<tr>
<td>236.17</td>
<td>.4166</td>
<td>.3748</td>
<td>.3550</td>
</tr>
<tr>
<td>263.78</td>
<td>.4363</td>
<td>.3923</td>
<td>.3729</td>
</tr>
<tr>
<td>291.39</td>
<td>.4610</td>
<td>.4192</td>
<td>.3989</td>
</tr>
<tr>
<td>319.00</td>
<td>.4832</td>
<td>.4414</td>
<td>.4211</td>
</tr>
</tbody>
</table>

6The base price of feed was $263.78 per ton. Other prices are 1 and 2 standard deviations above and below the base price or about 10 and 20% above and below the base price.
Stocking Rates

Rates of initial stocking have a significant effect on per pound cost of production. The effects on costs of reducing the stocking rate from 4000 to 3500 and 3000 fish per surface acre were analyzed for each farm situation (Table 18). Feed and fingerling costs were the only major cost components that changed. Each change (500 fish per surface acre) in the stocking rate changed total costs about 7.7%.

Reducing the stocking rate reduces total cost but increases per pound costs. Conversely, an increase in stocking rate (e.g. from 3000 to 3500 per surface acre) increases total cost but reduces per pound cost.

Table 17. Total cost per pound of harvested catfish at selected fingerling prices, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Price per Fingerling</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>.042</td>
<td>.4232</td>
<td>.3815</td>
<td>.3614</td>
</tr>
<tr>
<td>.048</td>
<td>.4284</td>
<td>.3867</td>
<td>.3666</td>
</tr>
<tr>
<td>.054</td>
<td>.4336</td>
<td>.3919</td>
<td>.3718</td>
</tr>
<tr>
<td>.060(^1)</td>
<td>.4363</td>
<td>.3923</td>
<td>.3729</td>
</tr>
<tr>
<td>.066</td>
<td>.4439</td>
<td>.4022</td>
<td>.3821</td>
</tr>
<tr>
<td>.072</td>
<td>.4491</td>
<td>.4074</td>
<td>.3873</td>
</tr>
<tr>
<td>.078</td>
<td>.4543</td>
<td>.4126</td>
<td>.3925</td>
</tr>
</tbody>
</table>

\(^1\)The base price of fingerlings was $.06 each. Other prices are 10, 20, and 30\% changes above and below the base price.

Table 18. Total cost and cost per pound of harvested catfish at selected stocking rates, three farm situations, Delta of Mississippi, 1977.\(^1\)

<table>
<thead>
<tr>
<th>Stocking Rate</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000 fingerlings per surface acre</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost</td>
<td>286,192</td>
<td>519,280</td>
<td>989,465</td>
</tr>
<tr>
<td>Cost per pound</td>
<td>.4363</td>
<td>.3923</td>
<td>.3729</td>
</tr>
<tr>
<td>3500 fingerlings per surface acre</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost</td>
<td>264,250</td>
<td>474,974</td>
<td>900,621</td>
</tr>
<tr>
<td>Cost per pound</td>
<td>.4605</td>
<td>.4101</td>
<td>.3879</td>
</tr>
<tr>
<td>3000 fingerlings per surface acre</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost</td>
<td>242,259</td>
<td>430,590</td>
<td>811,649</td>
</tr>
<tr>
<td>Cost per pound</td>
<td>.4926</td>
<td>.4338</td>
<td>.4079</td>
</tr>
</tbody>
</table>

\(^1\)Cost changes include changes in feed and fingerling costs only.
APPENDIX

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 insure 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.

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.8 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 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

8Mr. Tom E. Blaylock, District Engineer, Soil Conservation Service, Greenwood, Mississippi.
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-five 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.

### 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. Estimated investment and ownership costs are presented in Appendix Tables 4 and 5.

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 the 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. Water requirements were converted to hours of pumping time (Appendix Table 6).

Water requirements for the

---

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, 1977.

<table>
<thead>
<tr>
<th>Farm Situation</th>
<th>Linear feet of levee run</th>
<th>Cubic yds. per linear ft.</th>
<th>Total volume of earth moved</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>--cubic yards--</td>
</tr>
<tr>
<td>I</td>
<td>20,176</td>
<td>6.2</td>
<td>125,091.2</td>
</tr>
<tr>
<td>II</td>
<td>37,944</td>
<td>6.2</td>
<td>235,252.8</td>
</tr>
<tr>
<td>III</td>
<td>75,996</td>
<td>6.2</td>
<td>471,175.2</td>
</tr>
</tbody>
</table>

Appendix Table 2. Linear feet of levee requiring all-weather surfacing and total cubic yards of gravel, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Farm Situation</th>
<th>Linear feet of levee</th>
<th>Total volume of gravel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>--cubic yards--</td>
</tr>
<tr>
<td>I</td>
<td>15,260</td>
<td>1,526</td>
</tr>
<tr>
<td>II</td>
<td>29,040</td>
<td>2,904</td>
</tr>
<tr>
<td>III</td>
<td>56,280</td>
<td>5,628</td>
</tr>
</tbody>
</table>

Appendix Table 3. Land requiring vegetative cover, and establishment cost, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Farm Situation</th>
<th>Land</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>acres</td>
<td>dollars</td>
</tr>
<tr>
<td>I</td>
<td>10.1</td>
<td>933.04</td>
</tr>
<tr>
<td>II</td>
<td>17.52</td>
<td>1618.50</td>
</tr>
<tr>
<td>III</td>
<td>34.96</td>
<td>3229.60</td>
</tr>
</tbody>
</table>

1Annual Maintenance costs is $70.50 per acre.

---

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

Appendix Figure 1. Schematics of farm designs, pond design and cross section of levee, berm and ditch.
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]. In those months in which evaporation exceeds precipitation the difference must be replaced. 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 unlike many actual operations.

Appendix Table 4. Estimated investment for a 3000 gallon per minute well, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well and casing</td>
<td></td>
</tr>
<tr>
<td>casing - 60' x 16'' @$15.11/ft.</td>
<td>900.00</td>
</tr>
<tr>
<td>screen - 40' x 16'' @$17.50/ft.</td>
<td>700.00</td>
</tr>
<tr>
<td>gravel - 20 yds. @$20.00/yd.</td>
<td>400.00</td>
</tr>
<tr>
<td>drilling and labor</td>
<td>1,500.00</td>
</tr>
<tr>
<td>Subtotal</td>
<td>3,500.00</td>
</tr>
<tr>
<td>Pump and Engine</td>
<td></td>
</tr>
<tr>
<td>pump assembly</td>
<td>4,800.00</td>
</tr>
<tr>
<td>suction and discharge pipe</td>
<td>225.00</td>
</tr>
<tr>
<td>right angle gear drive</td>
<td>1,200.00</td>
</tr>
<tr>
<td>diesel engine</td>
<td>4,500.00</td>
</tr>
<tr>
<td>Spicer shaft</td>
<td>150.00</td>
</tr>
<tr>
<td>fuel tank (500 gal.)</td>
<td>200.00</td>
</tr>
<tr>
<td>Subtotal</td>
<td>11,075.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td>14,575.00</td>
</tr>
</tbody>
</table>

'The wells are 100 feet deep. The depth to the screen is 60 feet. The pump is a two stage turbine driven by a 60 h.p. diesel engine. The rate of flow is 3000 gallons per minute, with 68 feet of head.
Source: Mr. Max Harper, Butane Gas Company of Greenwood, Mississippi.

Disease, Parasite and Weed Control

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

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 is 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 is powered by a 10 h.p. motor and a standard boat trailer is provided.

10 The recording station for these data is located at Scott, Mississippi.
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 7.

Harvesting

The harvesting technique incorporated into the cost estimates is 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, in 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

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownership cost</td>
<td></td>
</tr>
<tr>
<td>Depreciation¹</td>
<td></td>
</tr>
<tr>
<td>well and casing</td>
<td>233.33</td>
</tr>
<tr>
<td>pump assembly</td>
<td>400.00</td>
</tr>
<tr>
<td>suction and discharge pipe</td>
<td>18.75</td>
</tr>
<tr>
<td>right angle gear drive</td>
<td>100.00</td>
</tr>
<tr>
<td>spicer shaft and flanges</td>
<td>12.50</td>
</tr>
<tr>
<td>fuel tank</td>
<td>10.00</td>
</tr>
<tr>
<td>diesel engine</td>
<td>562.50</td>
</tr>
<tr>
<td>Interest</td>
<td></td>
</tr>
<tr>
<td>well and casing</td>
<td>157.50</td>
</tr>
<tr>
<td>pump assembly</td>
<td>216.00</td>
</tr>
<tr>
<td>suction and discharge pipe</td>
<td>10.13</td>
</tr>
<tr>
<td>right angle gear drive</td>
<td>54.00</td>
</tr>
<tr>
<td>spicer shaft and flanges</td>
<td>6.75</td>
</tr>
<tr>
<td>fuel tank</td>
<td>9.00</td>
</tr>
<tr>
<td>diesel engine</td>
<td>202.50</td>
</tr>
<tr>
<td>Operating Cost²</td>
<td></td>
</tr>
<tr>
<td>repairs and maintenance³</td>
<td>437.25</td>
</tr>
<tr>
<td>TOTAL SPECIFIED COST</td>
<td>2,430.21</td>
</tr>
</tbody>
</table>

¹Depreciation schedule was adopted from Foster and Waldrop, Cost-size Relationships in the Production of Pond-Raised Catfish for Food (Bulletin 792, Mississippi State University, Mississippi Agricultural and Forestry Experiment Station, January 1972). Wells and casing, 15 years; pump assembly, 12 years; suction and discharge pipe, 12 years; right angle gear, 12 years; spicer shaft and flanges, 12 years; fuel tank, 20 years; diesel engine, 8 years.

²Charges for fuel are presented in Table 7.

³Estimated at 3 percent of investment per year.

Appendix Table 6. Estimated total hours pumping time and diesel fuel required, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Farm Situations</th>
<th>Hours of Pumping Time</th>
<th>Fuel Consumption gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>4,521</td>
<td>16,720</td>
</tr>
<tr>
<td>II</td>
<td>8,907</td>
<td>32,938</td>
</tr>
<tr>
<td>III</td>
<td>17,850</td>
<td>66,009</td>
</tr>
</tbody>
</table>
Appendix Table 7. Basic disease, parasite, and weed control program, three farm situations, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Item</th>
<th>Frequency of Occurrence</th>
<th>Ponds Requiring Treatment</th>
<th>Possible Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fingerling treatment</td>
<td>Annually at stocking</td>
<td>100</td>
<td>250 P.P.M. formalin for one hour</td>
</tr>
<tr>
<td>Parasite incidence</td>
<td>Twice annually</td>
<td>20</td>
<td>2 P.P.M. of potassium permanganate</td>
</tr>
<tr>
<td>Bacterial incidence</td>
<td>Twice annually</td>
<td>20</td>
<td>Maintain feeding schedule with feed treated with TM-100 for 10 days.</td>
</tr>
<tr>
<td>Weed control</td>
<td>Once annually</td>
<td>75</td>
<td>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.</td>
</tr>
</tbody>
</table>

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 from 40,000 to 50,000 pounds of fish a day through the plants. This allows the fish to be moved from one 20 land acre pond with only a portion of the fish held overnight in live cars.

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 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 Tables 8-11.

Appendix Table 8. Estimated labor requirements for harvesting a 20 acre pond, by operation, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Time per Operation</th>
<th>Number in Crew</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Preliminary Equipment Check</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2. Lower Seine into water and prepare to pull</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>3. Attach live car</td>
<td>.083</td>
<td>2</td>
</tr>
<tr>
<td>4. Pull Seine</td>
<td>1.75</td>
<td>5</td>
</tr>
<tr>
<td>5. Detach 1st live car and attach 2nd live car</td>
<td>.167</td>
<td>2</td>
</tr>
<tr>
<td>6. Load fish/1000#</td>
<td>.085</td>
<td>5</td>
</tr>
<tr>
<td>7. Maintenance of fish overnight</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>8. Second Seine pull (sum of items 2-4 above)</td>
<td>2.83</td>
<td>5</td>
</tr>
<tr>
<td>9. Loan fish/1000#</td>
<td>.085</td>
<td>5</td>
</tr>
<tr>
<td>10. Cleanup, gear maintenance, and storage/100 ft. of seine</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
### Appendix Table 9. Estimated total labor requirements for harvesting a 160 acre farm, by operation, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Hours Per Operation</th>
<th>Number in Crew</th>
<th>Total Man Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Preliminary equipment check</td>
<td>8</td>
<td>1</td>
<td>8.0</td>
</tr>
<tr>
<td>2. Lower seine into water and prepare to pull</td>
<td>8</td>
<td>5</td>
<td>40.0</td>
</tr>
<tr>
<td>3. Attach live car</td>
<td>0.664</td>
<td>2</td>
<td>1.328</td>
</tr>
<tr>
<td>4. Pull seine</td>
<td>14</td>
<td>5</td>
<td>70.0</td>
</tr>
<tr>
<td>5. Detach live car &amp; attach second live car</td>
<td>1.336</td>
<td>2</td>
<td>2.672</td>
</tr>
<tr>
<td>6. Load fish (40,000 lbs./pond)</td>
<td>27.2</td>
<td>5</td>
<td>136.0</td>
</tr>
<tr>
<td>7. Maintenance of fish overnight (eight nights)</td>
<td>64.00</td>
<td>1</td>
<td>64.0</td>
</tr>
<tr>
<td>8. Second seine pull (sum of 2-5)</td>
<td>23.6242</td>
<td>5</td>
<td>118.0</td>
</tr>
<tr>
<td>9. Load fish (335,785 lbs.)</td>
<td>29.97</td>
<td>5</td>
<td>149.86</td>
</tr>
<tr>
<td>10. Cleanup, gear maintenance and storage</td>
<td>8</td>
<td>2</td>
<td>16.0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>194.79</strong></td>
<td>---</td>
<td><strong>605.86</strong></td>
</tr>
</tbody>
</table>

### Appendix Table 10. Estimated total labor requirements for harvesting a 320 acre farm, by operation, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Hours Per Operation</th>
<th>Number in Crew</th>
<th>Total Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Preliminary equipment check</td>
<td>16</td>
<td>1</td>
<td>16.0</td>
</tr>
<tr>
<td>2. Lower seine into water and prepare to pull</td>
<td>16</td>
<td>5</td>
<td>80.0</td>
</tr>
<tr>
<td>3. Attach live car</td>
<td>1.328</td>
<td>2</td>
<td>2.656</td>
</tr>
<tr>
<td>4. Pull seine</td>
<td>28.0</td>
<td>5</td>
<td>140.0</td>
</tr>
<tr>
<td>5. Detach live car and attach second live car</td>
<td>2.672</td>
<td>2</td>
<td>5.344</td>
</tr>
<tr>
<td>6. Load fish (40,000 lbs./pond)</td>
<td>54.4</td>
<td>5</td>
<td>272.0</td>
</tr>
<tr>
<td>7. Maintenance of fish overnight (16 nights)</td>
<td>128.0</td>
<td>1</td>
<td>128.0</td>
</tr>
<tr>
<td>8. Second seine pull (sum of items 2-4)</td>
<td>45.328</td>
<td>5</td>
<td>226.64</td>
</tr>
<tr>
<td>9. Load fish (683,611 lbs.)</td>
<td>60.98</td>
<td>5</td>
<td>304.89</td>
</tr>
<tr>
<td>10. Cleanup, gear maintenance and storage</td>
<td>16</td>
<td>2</td>
<td>32.0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>368.708</strong></td>
<td>---</td>
<td><strong>1207.53</strong></td>
</tr>
</tbody>
</table>
Appendix Table 11. Estimated total labor requirements for harvesting a 640 acre farm, by operation, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Time per Operation</th>
<th>Number in Crew</th>
<th>Total Man Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Preliminary equipment check</td>
<td>32</td>
<td>1</td>
<td>32.0</td>
</tr>
<tr>
<td>2. Lower seine into water and prepare to pull</td>
<td>32</td>
<td>5</td>
<td>160.0</td>
</tr>
<tr>
<td>3. Attach live car</td>
<td>2,656</td>
<td>2</td>
<td>5,312</td>
</tr>
<tr>
<td>4. Pull seine</td>
<td>56.0</td>
<td>5</td>
<td>280.0</td>
</tr>
<tr>
<td>5. Detach live car and attach second live car</td>
<td>5.344</td>
<td>2</td>
<td>10.688</td>
</tr>
<tr>
<td>6. Load fish (40,000 lbs/pond)</td>
<td>108.8</td>
<td>5</td>
<td>544.0</td>
</tr>
<tr>
<td>7. Maintenance of fish overnight (32 nights)</td>
<td>256</td>
<td>1</td>
<td>256.0</td>
</tr>
<tr>
<td>8. Second seine pull (sum of items 2-4 above)</td>
<td>96.0</td>
<td>5</td>
<td>480.0</td>
</tr>
<tr>
<td>9. Load fish (1,373,243 lbs.)</td>
<td>122.47</td>
<td>5</td>
<td>612.34</td>
</tr>
<tr>
<td>10. Cleanup, gear maintenance and storage</td>
<td>32</td>
<td>2</td>
<td>64.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>743.27</td>
<td>---</td>
<td>2444.34</td>
</tr>
</tbody>
</table>

Appendix Table 12. Prices of selected inputs used in producing catfish for food, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Price Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fingerlings</td>
<td>each</td>
<td>.06</td>
</tr>
<tr>
<td>Feed</td>
<td>ton</td>
<td>263.78</td>
</tr>
<tr>
<td>Gravel</td>
<td>cubic yards</td>
<td>4.29</td>
</tr>
<tr>
<td>Pipe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Supply</td>
<td>linear foot installed</td>
<td>10.00</td>
</tr>
<tr>
<td>Drainage</td>
<td>linear foot installed</td>
<td>16.00</td>
</tr>
<tr>
<td>Chemicals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formalin</td>
<td>gallon</td>
<td>5.00</td>
</tr>
<tr>
<td>Potassium permanganate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>550 lb. drum</td>
<td>each</td>
<td>397.00</td>
</tr>
<tr>
<td>110 lb. drum</td>
<td>each</td>
<td>85.00</td>
</tr>
<tr>
<td>Copper Sulfate</td>
<td>100 lb. bag</td>
<td>53.00</td>
</tr>
<tr>
<td>Karmex</td>
<td>pound</td>
<td>2.30</td>
</tr>
<tr>
<td>Hired labor (part-time)</td>
<td>hour</td>
<td>3.00</td>
</tr>
<tr>
<td>Diesel</td>
<td>gallon</td>
<td>.55</td>
</tr>
<tr>
<td>Earth Moving</td>
<td>cubic yard</td>
<td>.40</td>
</tr>
<tr>
<td>Vegetative Cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment cost</td>
<td>acre</td>
<td>92.38</td>
</tr>
<tr>
<td>Annual maintenance</td>
<td>acre</td>
<td>70.50</td>
</tr>
<tr>
<td>Tractors</td>
<td>each</td>
<td>17,000.00</td>
</tr>
<tr>
<td>½ ton truck</td>
<td>each</td>
<td>4,800.00</td>
</tr>
<tr>
<td>1½ ton truck</td>
<td>each</td>
<td>7,000.00</td>
</tr>
<tr>
<td>Relift pumps</td>
<td>each</td>
<td>2,635.00</td>
</tr>
<tr>
<td>Gate and screen</td>
<td>each</td>
<td>150.00</td>
</tr>
</tbody>
</table>
### Appendix Table 13. Data used in estimating selected equipment and facility costs, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Estimated New Cost</th>
<th>Repairs as Percentage of New Costs</th>
<th>Estimated Life</th>
<th>Average Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seine storage reel</td>
<td>2000' capacity</td>
<td>$ 750.00</td>
<td>50</td>
<td>10</td>
<td>$ 375.00</td>
</tr>
<tr>
<td>Boat &amp; motor</td>
<td>Standard capacity</td>
<td>1,230.00</td>
<td>75</td>
<td>10</td>
<td>615.00</td>
</tr>
<tr>
<td>Boat trailer</td>
<td>Standard capacity</td>
<td>270.00</td>
<td>40</td>
<td>10</td>
<td>135.00</td>
</tr>
<tr>
<td>Crane (backbone)</td>
<td>17' reach</td>
<td>6,000.00</td>
<td>100</td>
<td>10</td>
<td>3,000.00</td>
</tr>
<tr>
<td>Feeder</td>
<td>2000# capacity</td>
<td>4,120.00</td>
<td>75</td>
<td>10</td>
<td>2,060.00</td>
</tr>
<tr>
<td>Feed storage service</td>
<td>23 ton capacity</td>
<td>1,900.00</td>
<td>50</td>
<td>10</td>
<td>950.00</td>
</tr>
<tr>
<td>Building</td>
<td>18' x 42'</td>
<td>16,000.00</td>
<td>100</td>
<td>20</td>
<td>8,000.00</td>
</tr>
<tr>
<td>Relift pump</td>
<td>pto driven 16”</td>
<td>2,630.00</td>
<td>50</td>
<td>10</td>
<td>1,315.00</td>
</tr>
<tr>
<td>Tractor</td>
<td>90-100 hp</td>
<td>17,000.00</td>
<td>65</td>
<td>12</td>
<td>8,500.00</td>
</tr>
<tr>
<td>Mowing machine</td>
<td>6' side mount</td>
<td>2,100.00</td>
<td>40</td>
<td>12</td>
<td>1,050.00</td>
</tr>
<tr>
<td>Haul seine with funnel</td>
<td>2000 section of 10'</td>
<td></td>
<td>dollars per unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&amp; hoop</td>
<td>seine w/ 1” mesh</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutting seine</td>
<td>50' section of 6'</td>
<td></td>
<td>dollars per unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>seine w/ ½” mesh</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live car</td>
<td>20,000# capacity</td>
<td>250.00</td>
<td>120.00</td>
<td>5</td>
<td>2,350.00</td>
</tr>
<tr>
<td></td>
<td>dollars per unit</td>
<td></td>
<td></td>
<td></td>
<td>69.00</td>
</tr>
<tr>
<td></td>
<td>Live car</td>
<td>10,000# capacity</td>
<td>15.00 per car</td>
<td>5</td>
<td>125.00</td>
</tr>
<tr>
<td></td>
<td>dollars per unit</td>
<td></td>
<td></td>
<td></td>
<td>11.00 per car</td>
</tr>
<tr>
<td></td>
<td>Brailing basket</td>
<td>450.00</td>
<td>3.00</td>
<td>5</td>
<td>30.00</td>
</tr>
<tr>
<td></td>
<td>Truck</td>
<td>½ ton</td>
<td>4,500.00</td>
<td>70</td>
<td>2,250.00</td>
</tr>
<tr>
<td></td>
<td>Truck</td>
<td>1½ ton</td>
<td>7,000.00</td>
<td>70</td>
<td>3,500.00</td>
</tr>
<tr>
<td></td>
<td>Oxygen meter and probe</td>
<td>600.00</td>
<td>5</td>
<td>5</td>
<td>300.00</td>
</tr>
<tr>
<td></td>
<td>Fiberglas transport tank</td>
<td>275 gal. capacity</td>
<td>400.00</td>
<td>5</td>
<td>200.00</td>
</tr>
<tr>
<td></td>
<td>Shop equipment</td>
<td>4,000.00</td>
<td>50</td>
<td>5</td>
<td>2,000.00</td>
</tr>
</tbody>
</table>

**Miscellaneous**

Each of the farm situations requires a storage and service building. Design of the facility 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 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 pto-driven relift pumps. 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 Situations 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.

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.

Prices of selected inputs are presented in Appendix Table 12.

The data used in calculating depreciation and interest on investment for each piece of machinery and each building are presented in Appendix Table 13. 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. Depreciation
### Appendix Table 14. Estimated annual ownership and operating cost of selected equipment and facilities, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Item</th>
<th>Size or Description</th>
<th>Depreciation</th>
<th>Interest</th>
<th>Fuel</th>
<th>Maintenance Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seine storage reel</td>
<td>2000' capacity</td>
<td>75</td>
<td>34</td>
<td>38</td>
<td>146</td>
</tr>
<tr>
<td>Boat and motor</td>
<td>16' boat-10 h.p.</td>
<td>123</td>
<td>62</td>
<td>30</td>
<td>92</td>
</tr>
<tr>
<td>Boat trailer</td>
<td>std. commercial</td>
<td>27</td>
<td>14</td>
<td>11</td>
<td>51</td>
</tr>
<tr>
<td>Crane</td>
<td>17' reach</td>
<td>600</td>
<td>300</td>
<td>600</td>
<td>1,500</td>
</tr>
<tr>
<td>Cutting seine</td>
<td>50' section of 6'</td>
<td>28</td>
<td>7</td>
<td>7</td>
<td>42</td>
</tr>
<tr>
<td>Live car</td>
<td>20,000 lb capacity</td>
<td>50</td>
<td>13</td>
<td>16</td>
<td>79</td>
</tr>
<tr>
<td>Live car</td>
<td>10,000 lb capacity</td>
<td>34</td>
<td>9</td>
<td>11</td>
<td>54</td>
</tr>
<tr>
<td>Brailing basket</td>
<td>450 lb capacity</td>
<td>11</td>
<td>3</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>Feeder</td>
<td>2000 lb capacity</td>
<td>412</td>
<td>206</td>
<td>309</td>
<td>927</td>
</tr>
<tr>
<td>Feed storage</td>
<td>bulk 23 ton capacity</td>
<td>190</td>
<td>95</td>
<td>95</td>
<td>380</td>
</tr>
<tr>
<td>Service building</td>
<td>18' x 42'</td>
<td>800</td>
<td>800</td>
<td>800</td>
<td>2,400</td>
</tr>
<tr>
<td>Relift pump</td>
<td>p.t.o. driven-16'</td>
<td>263</td>
<td>132</td>
<td>132</td>
<td>526</td>
</tr>
<tr>
<td>Tractors</td>
<td>90-100 h.p.</td>
<td>1,417</td>
<td>850</td>
<td>921</td>
<td>3,185</td>
</tr>
<tr>
<td>Truck</td>
<td>1½ ton</td>
<td>700</td>
<td>350</td>
<td>325</td>
<td>490</td>
</tr>
<tr>
<td>Truck</td>
<td>½ ton</td>
<td>563</td>
<td>225</td>
<td>346</td>
<td>316</td>
</tr>
<tr>
<td>Mowing machine</td>
<td>6' side mount</td>
<td>175</td>
<td>105</td>
<td>219</td>
<td>499</td>
</tr>
<tr>
<td>Haul seine and funnel hoop</td>
<td>2000' section of 10'</td>
<td>940</td>
<td>212</td>
<td>190</td>
<td>1,342</td>
</tr>
<tr>
<td>Oxygen meter and probe</td>
<td></td>
<td>120</td>
<td>30</td>
<td>30</td>
<td>180</td>
</tr>
<tr>
<td>Scales</td>
<td>1000# capacity</td>
<td>90</td>
<td>45</td>
<td>45</td>
<td>180</td>
</tr>
<tr>
<td>Fiberglas transport tank</td>
<td>275 gal. capacity</td>
<td>80</td>
<td>18</td>
<td>8</td>
<td>106</td>
</tr>
<tr>
<td>Shop Equipment</td>
<td></td>
<td>800</td>
<td>180</td>
<td>400</td>
<td>1,380</td>
</tr>
</tbody>
</table>

and interest charges for each item. The costs of selected miscellaneous items needed to adjust individual situations, and more cost estimates to correspond to reports elsewhere in the study, are presented in Appendix Table 15.

### Appendix Table 15. Cost of selected miscellaneous items used in producing catfish for food, Delta of Mississippi, 1977.

<table>
<thead>
<tr>
<th>Item</th>
<th>Farm Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>dollars</td>
</tr>
<tr>
<td>Insurance</td>
<td>2296</td>
</tr>
<tr>
<td>Fuel for relift pumps</td>
<td>362</td>
</tr>
<tr>
<td>Formalin (@ $25/5 gal cont.)</td>
<td>25</td>
</tr>
<tr>
<td>Potassium permanganate</td>
<td>1448</td>
</tr>
<tr>
<td>Copper sulfate</td>
<td>530</td>
</tr>
<tr>
<td>Karmex</td>
<td>90</td>
</tr>
</tbody>
</table>
SELECTED REFERENCES

15. McWhorter, J. C., Evaporation Data from Standard U. S. Weather Bureau Pan, Mississippi Agricultural Experiment Station, I.S. 777, September 1962.
18. Simpson, James H., Farm Values in Mississippi, Staff Paper No. 30, Mississippi Agricultural and Forestry Experiment Station, Mississippi State University, 1977.
21. Climatic Patterns of Mississippi, Mississippi Agricultural Experiment Station Bulletin 650, October 1962.
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In conformity with Title IX of the Education Amendments of 1972 and Section 504 of the Rehabilitation Act of 1973, Dr. T. K. Martin, Vice President, 610 Allen Hall, P. O. Drawer J, Mississippi State, Mississippi 39762, office telephone number 325-3221, has been designated as the responsible employee to coordinate efforts to carry out responsibilities and make investigation of complaints relating to nondiscrimination.