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by

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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.

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TABLE OF CONTENTS

	Page
	vii
Summary and Conclusions	vii
The Problem	1
Objectives	1
Procedure	1
Sources of Data	2
Synthesized Firms	2
The Basic Production System	2
Land	3
Pond Construction	3
Pond Size	3
Water Supply	3
Feeding	4
Harvesting	4
Disease, Parasite and Weed Control	4
Miscellaneous	4
Estimated Investment Requirements and Annual Production Cost	4
Investment Requirements	4
Land	4
Pond Construction	4
Water Supply	5
Feeding	5
Disease, Parasite and Weed Control	5
Harvesting	5
Miscellaneous Equipment	5
Annual Ownership Costs	5
Depreciation	5
Interest on Investment	6
Taxes and Insurance	6
Annual Operating Costs	6
Repairs and Maintenance	6
Fuel	6
Chemicals	7
Fingerlings	7
Feed	7
Labor	7
Cost Summary	7
Cash Flow Analysis	8
Monthly Cash Flows	8
Annual Cash Flows	8
Equity Situation I	8
Equity Situation II	8
Equity Situation III	8
Cost Sensitivity	11
Feed	12
Fingerlings	12
Stocking Rates	13

Appendix 15
Production System 15
Pond Construction 15
Water Supply 16
Feeding 18
Disease, Parasite and Weed Control 18
Harvesting 19
Miscellaneous 23
Selected References 25

LIST OF TABLES

Number		Page
1	Estimated total production and production per pond and per acre, three farm situations, Delta of Mississippi, 1977	3
2	Total acres of land, surface acres of water, number of ponds, and surface acres per pond, three farm situations, Delta of Mississippi, 1977	3
3	Number of wells and feet of pipe required, three farm situations, Delta of Mississippi, 1977	3
4	Estimated annual feed requirements, three farm situations, Delta of Mississippi, 1977	4
5	Estimated total investment, three farm situations, Delta of Mississippi, 1977	5
6	Estimated annual ownership costs, three farm situations, Delta of Mississippi, 1977	6
7	Estimated annual operating costs, three farm situations, Delta of Mississippi, 1977	7
8	Catfish Production: Summary of total annual cost and cost per pound, three farm situations, Delta of Mississippi, 1977	8
9	Estimated annual cost components expressed as a percent of total cost, three farm situations, Delta of Mississippi, 1977	9
10	Monthly cash expenses, Farm Situation I, Delta of Mississippi, 1977	10
11	Monthly cash expenses, Farm Situation II, Delta of Mississippi, 1977	10
12	Monthly cash expenses, Farm Situation III, Delta of Mississippi, 1977	10
13	Costs and returns from producing catfish with investment financed for five years, Farm Situation I, Delta of Mississippi, 1977	11
14	Cost and returns from producing catfish with 75% of investment financed for five years, Farm Situation I, Delta of Mississippi, 1977	11

15 Costs and returns from producing catfish with investment financed for three lengths of loans, Farm Situation I, Delta of Mississippi, 1977 12

16 Total cost per pound of harvested catfish for selected feed prices, three farm situations, Delta of Mississippi, 1977 12

17 Total cost per pound of harvested catfish at selected fingerling prices, three farm situations, Delta of Mississippi, 1977 13

18 Total cost and cost per pound of harvested catfish at selected stocking rates, three farm situations, Delta of Mississippi, 1977 13

Appendix Figure 1 17

Appendix Tables

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 16

2 Linear feet of levee requiring all-weather surfacing and total cubic yards of gravel, three farm situations, Delta of Mississippi, 1977 16

3 Land requiring vegetative cover, and establishment cost, three farm situations, Delta of Mississippi, 1977 16

4 Estimated investment for a 3000 gallon per minute well, Delta of Mississippi, 1977 18

5 Estimated annual ownership and operating cost for a 3000 gallon per minute well, Delta of Mississippi, 1977 19

6 Estimated total hours pumping time and diesel fuel required, three farm situations, Delta of Mississippi, 1977 19

7 Basic disease, parasite, and weed control program, three farm situations, Delta of Mississippi, 1977 20

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

9 Estimated total labor requirements for harvesting a 160 acre farm, by operation, Delta of Mississippi, 1977 21

10 Estimated total labor requirements for harvesting a 320 acre farm, by operation, Delta of Mississippi, 1977 21

11 Estimated total labor requirements for harvesting a 640 acre farm, by operation, Delta of Mississippi, 1977 22

12 Prices of selected inputs used in producing catfish for food, Delta of Mississippi, 1977 22

13 Data used in estimating selected equipment and facility costs, Delta of Mississippi, 1977 23

14 Estimated annual ownership and operating cost of selected equipment and facilities, Delta of Mississippi, 1977 24

15 Cost of selected miscellaneous items used in producing catfish for food, Delta of Mississippi, 1977 24

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 were 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].[1] Each hypothetical firm reflects the combination of production resources and the production practices recommended in 1977. The

[1] *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

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.

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.[2] 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.

[2] *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 drainage to enhance the movement of water from the farm when ponds needed to be drained.

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 water depth of four feet with a two-foot freeboard.[3] 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 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.[4] 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 managment 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.

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

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.

Item	Farm Situation I	Farm Situation II	Farm Situation 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

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

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

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

[4] *This 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.

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

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 innner and outer levees. Construction costs were based on an estimated charge of 40 cents per cubic yard of earth moved (Appen-

dix Table 1).

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 the investment required 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 $12,068 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.

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

Item	Farm Situation I	II	III
	----------dollars----------		
Land	85,086	168,606	335,646
Pond construction	68,316	129,778	259,043
Earth moving	50,036	94,102	188,470
Drainage structures	10,800	21,600	43,200
Gravel	6,547	12,458	24,144
Vegetative cover	933	1,618	3,229
Water supply (wells and drainage pipes)	32,150	64,300	128,600
Feeding (feeder and bulk storage)	6,020	7,920	13,940
Disease, parasite, and weed control	2,564	2,564	2,564
Harvesting	12,068	12,068	12,068
Miscellaneous equipment	85,130	104,765	150,935
Tractors (90-100 h.p.)	42,500	59,500	93,500
1½ ton truck	7,000	7,000	7,000
½ ton truck	4,800	4,800	9,600
18′ x 42′ service building	16,000	16,000	16,000
16″ p.t.o. driven high lift pump	7,905	10,540	15,810
6′ side-mount mower	2,100	2,100	4,200
Farm shop equipment	4,000	4,000	4,000
Fiberglas transport tank	400	400	400
Waders	425	425	425
TOTAL	291,334	490,001	902,796
Investment per surface acre of water	2,057	1,714	1,576
Investment per acre of land	1,787	1,517	1,404

Annual Ownership Cost

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 [2].

Current knowledge of life expectance of ponds is not adequate for determining the "best" method of depreciation. We consulted many producers and decided that an expenditure of one-half of the original investment on pond construction would be required after ten years in production. This cost was converted to an annual rate for each farm situation. 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. Estimates of pond depreciation ranged from $3,417 for Farm Situation I to $12,952 for Farm Situation III (Table 6).

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.

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

Item	Farm Situation I	Farm Situation II	Farm Situation III
	---dollars---		
Annual Ownership Costs:			
Depreciation			
Ponds	3,417	6,489	12,952
Water supply (wells and discharge pipe)	2,923	5,846	11,693
Feeding (feeder and storage)	602	792	1,394
Harvesting equipment	1,827	1,827	1,827
Disease, parasite and weed control equipment	270	270	270
Miscellaneous equipment	8,157	9,836	13,371
Interest on Investment			
Land	7,658	15,175	30,208
Pond construction (drainage structures, gravel and vegetative cover)	3,074	5,840	11,657
Water supply (wells and discharge pipe)	1,462	2,924	5,847
Feed equipment (feeder and storage)	301	396	697
Disease, parasite and weed control equipment	105	105	105
Chemicals on hand	42	42	42
Harvesting equipment	432	432	432
Miscellaneous equipment	3,830	4,714	6,792
Taxes and Insurance	2,671	3,437	5,106
TOTAL	36,771	58,125	102,393

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.[5] 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

[5]*Mr. 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 $.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.

Table 7. Estimated annual operating costs, three farm situations, Delta of Mississippi, 1977.

Item	Farm Situation I	II	III
	----------dollars----------		
Annual Operating Costs:			
Repairs and maintenance	7,427	10,983	16,193
Vegetative cover	712	1,235	2,464
Water supply (wells and discharge pipe)	964	1,929	3,858
Feeding equipment (feeder and storage)	404	499	903
Disease, parasite and weed control	123	123	123
Harvesting equipment	703	703	703
Miscellaneous equipment	4,521	6,494	8,142
Fuel	13,635	25,475	50,657
Pumping	9,196	18,116	36,305
Power, transportation, feeding, harvest, etc.	4,439	7,359	14,352
Chemicals	2,093	4,135	7,475
Fingerlings	33,984	68,592	137,495
Feed (35% protein floating)[1]	142,419	287,479	575,303
Labor			
Management	20,000	20,000	32,000
Hired labor (full time)	20,000	26,000	32,000
Hired labor (for harvest)	1,818	3,622	7,333
Interest on operating capital	8,045	14,869	28,616
TOTAL	249,421	461,155	887,072

[1]An additional charge of $75/ton was made for medicated feed used for disease treatment.

Cost Summary

Total cost was $286,192, $519,280, and $989,465 for Farm Situation I, II, and III, respectively, Table 8. These costs convert to per pound costs of $.436 for Farm Situation I. $.392 for Farm Situation II, and $.373 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

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 producers will produce in the short run, if returns are greater than or equal to operating costs (variable costs) [10].

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. Producers also are in a position to arrange for at least a portion of their inputs before the production period starts and this gives the manager time to seek the best sources of inputs.

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.

Item	Farm Situation I	II	III
	----------dollars----------		
Total Annual Cost	286,192	519,280	989,465
Annual Ownership Cost	36,771	58,125	102,393
Annual Operating Cost	249,421	461,155	887,072
Total Cost per Pound[1]	.436	.392	.373
Ownership Cost per Pound	.056	.044	.039
Operating Cost per Pound	.380	.348	.334

[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.

Item	Farm Situation I	II	III
	-------% of total cost-----		
Annual Ownership Costs:	12.83	11.15	10.33
Depreciation:	6.00	4.82	4.18
Pond construction	1.19	1.25	1.30
Water supply	1.02	1.13	1.18
Feeding equipment	.21	.15	.14
Harvesting equipment	.64	.35	.18
Disease, parasite and weed control equipment	.09	.05	.03
Miscellaneous equipment	2.85	1.89	1.35
Interest on investment:	5.90	5.67	5.63
Land	2.68	2.90	3.05
Pond construction	1.07	1.12	1.18
Water supply	.51	.56	.59
Feeding equipment	.11	.08	.07
Harvesting equipment	.04	.02	.01
Disease, parasite, and weed control equipment	.15	.08	.04
Miscellaneous	1.34	.91	.69
Taxes and Insurance	.93	.66	.52
Annual Operating Costs:	87.17	88.85	89.67
Repairs and maintenance:	2.59	2.12	1.63
Ponds	.25	.24	.25
Water supply	.34	.37	.39
Feeding equipment	.14	.10	.09
Disease, parasite, and weed control equipment	.04	.02	.01
Harvesting equipment	.24	.14	.07
Miscellaneous equipment	1.58	1.25	.82
Fuel:			
Pumping	3.21	3.49	3.67
Power, transportation feeding, harvest, etc.	1.55	1.42	1.45
Chemicals	.73	.80	.76
Fingerlings	11.87	13.21	13.89
Feed	49.76	55.35	58.14
Labor:			
Manager	6.99	3.85	3.20
Hired labor (full time)	6.99	5.02	3.23
Hired labor (for harvest)	.64	.70	.75
Interest on operating capital	2.84	2.89	2.92
TOTAL	100.00	100.00	100.00

Table 10. Monthly cash expenses, Farm Situation I, Delta of Mississippi, 1977.

Month	Feed	Chemicals	Labor	Fuel	Fingerlings	Repairs and Maintenance	Interest Paid	Taxes and Insurance	Total by Month
	dollars								
January			3,333			619			3,952
February			3,333	4,598		619			8,550
March	1,996	20	3,333	2,220	33,984	619			42,172
April	6,538		3,333	2,299		619			12,789
May	8,781	518	3,333			619			13,251
June	11,621	518	3,333			619			16,091
July	16,763	518	3,333	4,519		619			25,752
August	30,418	518	3,333			619			34,888
September	41,615		3,333			619			45,567
October	24,686		5,151			619	8,045		38,501
November			3,333			619			3,952
December			3,333			619		2,671	6,623
TOTAL	142,419	2,092	41,818	13,636	33,984	7,427	8,045	2,671	252,092

Table 11. Monthly cash expenses, Farm Situation II, Delta of Mississippi, 1977.

Month	Feed	Chemicals	Labor	Fuel	Fingerlings	Repairs and Maintenance	Interest Paid	Taxes and Insurance	Total by Month
	dollars								
January			3,833			915			4,748
February			3,833	9,058		915			13,806
March	4,142	39	3,833	3,680	68,592	915			81,202
April	14,234		3,833	4,529		915			23,511
May	18,578	1,024	3,833			915			24,350
June	24,178	1,024	3,833			915			29,950
July	34,110	1,024	3,833	8,209		915			48,091
August	60,936	1,024	3,833			915			66,708
September	82,139		3,833			915			86,887
October	46,162		7,455			915	14,869		72,403
November			3,833			915			4,748
December			3,833			915		3,437	8,185
TOTAL	287,479	4,135	49,622	25,476	68,592	10,980	14,869	3,437	464,592

Table 12. Monthly cash expenses, Farm Situation III, Delta of Mississippi, 1977.

Month	Feed	Chemicals	Labor	Fuel	Fingerlings	Repairs and Maintenance	Interest Paid	Taxes and Insurance	Total by Month
	dollars								
January			5,333			1,349			6,682
February			5,333	18,153		1,349			24,835
March	8,301	79	5,333	7,176	137,495	1,349			159,733
April	28,516		5,333	9,076		1,349			44,274
May	37,203	1,849	5,333			1,349			45,734
June	47,871	1,849	5,333			1,349			56,402
July	68,520	1,849	5,333	16,252		1,349			93,303
August	121,061	1,849	5,333			1,349			129,592
September	164,238		5,333			1,349			170,920
October	99,592		12,666			1,349	28,616		142,233
November			5,333			1,349			6,682
December			5,333			1,349		5,106	11,788
TOTAL	575,303	7,475	71,333	50,657	137,495	16,193	28,616	5,106	892,178

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 for less than 38 cents (Table 14). Cumulative net returns to a 163-acre operation with no equity and a variable repayment schedule over 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.

Table 13. Costs and returns from producing catfish with investment financed for five years,[1] Farm Situation I, Delta of Mississippi, 1977.

Item	1	2	3	4	5
	----------dollars----------				
Principal and Interest[2]	76,853	76,853	76,853	76,853	76,853
Annual Operating Cost	252,092	252,092	252,092	252,092	252,092
Total Annual Cost	328,945	328,945	328,945	328,945	328,945
Revenue @ .58 per pound	380,355	380,355	380,355	380,355	380,355
Net Revenue	51,410	51,410	51,410	51,410	51,410
Revenue @ .50 per pound[3]	327,893	327,893	327,893	327,893	327,893
Net Revenue	-1,052	-1,052	-1,052	-1,052	-1,052

[1]The $291,334 investment requirement is financed for 5 years. The entire annual operating cost is financed annually.

[2]All loans were assumed to have a 10% annual interest rate.

[3]A price of $0.5016 causes revenue to equal cost.

Table 14. Cost and returns from producing catfish with 75% of investment financed for five years,[1] Farm Situation I, Delta of Mississippi, 1977.

Item	1	2	3	4	5
	----------dollars----------				
Principal and Interest[2]	57,641	57,641	57,641	57,641	57,641
Operating Cost	189,069	189,069	189,069	189,069	189,069
Total Cost	246,710	246,710	246,710	246,710	246,710
Revenue @ 58¢/lb.	380,355	380,355	380,355	380,355	380,355
Net Revenue	133,645	133,645	133,645	133,645	133,645
Revenue @ 37¢/lb.[3]	242,640	242,640	242,640	242,640	242,640
Net Revenue	-4,070	-4,070	-4,070	-4,070	-4,070

[1]Seventy-five % of the $291,334 investment requirement is financed for 5 years. Seventy-five % of the annual operating cost is financed annually.

[2]All loans were assumed to have a 10% annual interest rate.

[3]A price of $0.3762 causes revenue to equal cost.

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

[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.

Item	Years									
	1-5	6-7	8	9-10	11-12	13-15	16	17	18-19	20
	dollars									
Costs										
Operating	252,092	252,092	252,092	252,092	252,092	252,092	252,092	252,092	252,092	252,092
5 year loan[2]	2,722	2,722	2,722	2,722	2,722	2,722	2,722	2,722	2,722	2,722
7 year loan[3]	36,958	36,958	0	4,622	17,628	32,191	27,569	32,191	19,185	4,622
20 year loan[4]	11,069	11,069	11,069	11,069	11,069	11,069	11,069	11,069	11,069	11,069
Total Cost	302,841	302,841	265,883	270,505	283,511	298,074	293,452	298,074	285,068	270,505
Total Revenue @ 58¢/lb.	380,355	380,355	380,355	380,355	380,355	380,355	380,355	380,355	380,355	380,355
Net Revenue	77,514	77,514	114,472	109,850	96,844	82,281	86,903	82,281	95,287	109,850
Total Revenue @ 46¢/lb.	302,841	302,841	302,841	302,841	302,936	302,936	302,936	302,936	302,936	302,936
Net Revenue	0	0	37,048	32,426	19,425	4,862	9,484	4,862	17,868	32,431
Total Revenue @ 44¢/lb.[5]	288,545	288,545	288,545	288,545	288,545	288,545	288,545	288,545	288,545	288,545
Net Revenue	-14,296	-14,296	22,662	18,040	5,034	-9,529	-4,907	-9,529	3,477	18,040

[1]Schedule includes repayment of initial investment of $291,334 and reinvestment in machinery and equipment as these items are replaced in the inventory.

[2]The cost of the 5 year loan remains constant for every year in the analysis.

[3]The 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.

[4]The cost of the 20 year loan remains constant for each year in the analysis.

[5]A 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.

Price per ton of feed	Farm Situation		
	I	II	III
	dollars		
208.56	.3844	.3526	.3328
236.17	.4166	.3748	.3550
263.78[1]	.4363	.3923	.3729
291.39	.4610	.4192	.3989
319.00	.4832	.4414	.4211

[1]The 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.

Price per Fingerling	Farm Situation I	II	III
	----------dollars----------		
.042	.4232	.3815	.3614
.048	.4284	.3867	.3666
.054	.4336	.3919	.3718
.060[1]	.4363	.3923	.3729
.066	.4439	.4022	.3821
.072	.4491	.4074	.3873
.078	.4543	.4126	.3925

[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]

Stocking Rate	Farm Situation I	II	III
	----------dollars----------		
	4000 fingerlings per surface acre		
Total Cost	286,192	519,280	989,465
Cost per pound	.4363	.3923	.3729
	3500 fingerlings per surface acre		
Total Cost	264,250	474,974	900,621
Cost per pound	.4605	.4101	.3879
	3000 fingerlings per surface acre		
Total Cost	242,259	430,590	811,649
Cost per pound	.4926	.4338	.4079

[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

[8] *Mr. 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.

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.

Farm Situation	Linear feet of levee run	Cubic yds. per linear ft.	Total volume of earth moved
			--cubic yards--
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, 1977.

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, and establishment cost, three farm situations, Delta of Mississippi, 1977.

Farm Situation	Land	Cost
	acres	dollars
I	10.1	933.04
II	17.52	1618.50
III	34.96	3229.60

[1]Annual Maintenance costs is $70.50 per acre.

Water Supply

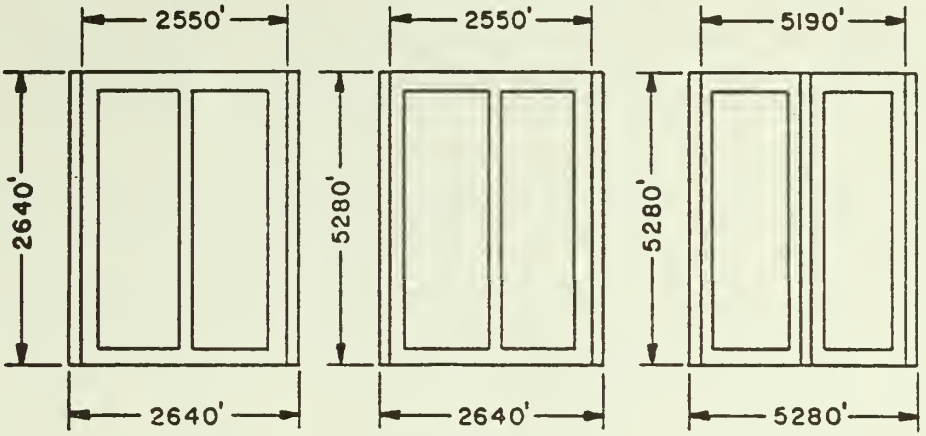
Wells were selected as the source of water. The operations are dependent on a supply of readily available water that is free of undesirable fish and other pollutants. After viewing the capacity of many on-going operations and determining requirements for water during stress periods it was concluded that 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 individuals after analysis of th particular situations.

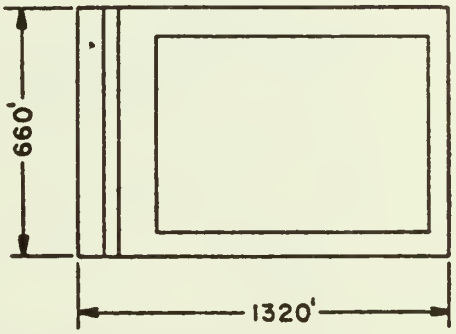
The fuel consumption rate for t 3000 g.p.m. well was estimated 3.698 gallons per hour of pumpi time. This estimate was develop in consultation with Mr. Francis Rhodes.[9] Water requirements w converted to hours of pumping ti (Appendix Table 6).

Water requirements for t

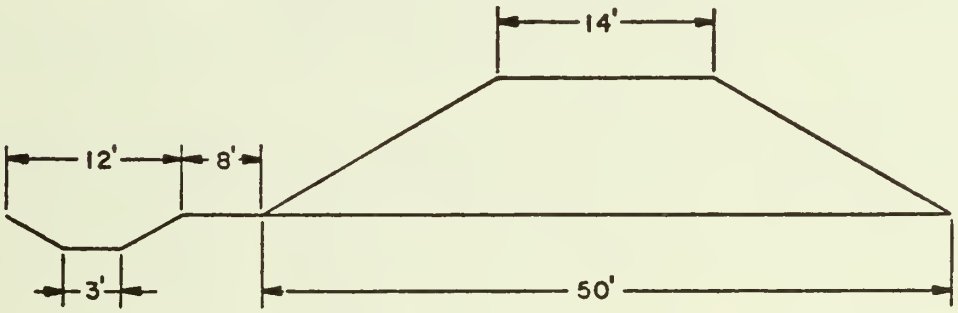
[9]*Francis E. Rhodes is a Teaching Research Assistant in the Department of Agricultural and Biologi Engineering, Mississippi State University.*



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].[10] 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 not unlike many actual operations.

Appendix Table 4. Estimated investment for a 3000 gallon per minute well,[1] Delta of Mississippi, 1977.

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

[1]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 ontrol program includes: (1) *Fingerling treatment using for-nalin.* Treatment is accomplished y placing fingerlings in a vat ontaining 250 p.p.m. formalin for ne hour. The amount of formalin equired was 3.89 gallons, 7.88 allons, and 15.79 gallons for ituations I, II, and III, respective-y. (2) *Parasite treatment.* This reatment was administered twice nnually on 20% of the ponds. otassium permanganate was sed at rates of 1922.4 pounds, 3888 ounds, and 6819.2 pounds for arm Situations I, II and III, espectively. Treatment of acterial infections was ac-omplished using Terramycin (TM-00) added to the feed. (3) *Weed ontrol.* This treatment was ad-ministered once annually on 75% of he ponds. Copper sulfate and armex both were incorporated nto the program. Quantities of opper sulfate used were 720.9 ounds, 1396.4 pounds, and 2922.48 ounds for Farm Situations I, II nd III respectively. Karmex was sed at a rate of 26.7 pounds for arm Situation I, 54 pounds for arm Situation II, and 108.24 ounds for Farm Situation III. etails of these programs are eported in Appendix Table 7.

arvesting

The harvesting technique incor-orated into the cost estimates is ne in use by many producers in the ississippi Delta area. The system mployes two tractors, one pulling seine reel and the other anchor-ng the free end of the seine, position and haul the seine. This ystem adapts well to the overall peration in that it does not violate ny of the restrictions placed on bor or equipment availability.

Coefficients for the system were eveloped in consultation with ersonnel of the U. S. Fish and ildlife Service, Fish Farming xperiment Station, Stuttgart, rkansas, and were tested for

Appendix Table 5. Estimated annual ownership and operating cost for a 3000 gallon per minute well, Delta of Mississippi, 1977.

Item	Cost
	dollars
Ownership cost	
Depreciation[1]	
well and casing	233.33
pump assembly	400.00
suction and discharge pipe	18.75
right angle gear drive	100.00
spicer shaft and flanges	12.50
fuel tank	10.00
diesel engine	562.50
Interest	
well and casing	157.50
pump assembly	216.00
suction and discharge pipe	10.13
right angle gear drive	54.00
spicer shaft and flanges	6.75
fuel tank	9.00
diesel engine	202.50
Operating Cost[2]	
repairs and maintenance[3]	437.25
TOTAL SPECIFIED COST	2,430.21

[1]Depreciation 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.

[2]Charges for fuel are presented in Table 7.

[3]Estimated 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.

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

Appendix Table 7. Basic disease, parasite, and weed control program, three farm situations, Delta of Mississippi, 1977.

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.

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.

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. Loan fish/1000#	.085	5
10. Cleanup, gear maintenance, and storage/100 ft. of seine	1	2

Appendix Table 9. Estimated total labor requirements for harvesting a 160 acre farm, by operation, Delta of Mississippi, 1977.

Operation	Hours Per Operation	Number in Crew	Total Man Hours
1. Preliminary equipment check	8	1	8.0
2. Lower seine into water and prepare to pull	8	5	40.0
3. Attach live car	.664	2	1.328
4. Pull seine	14	5	70
5. Detach live car & attach second live car	1.336	2	2.672
6. Load fish (40,000 lbs./pond)	27.2	5	136.0
7. Maintenance of fish overnight (eight nights)	64.00	1	64.0
8. Second seine pull (sum of 2-5)	23.6242	5	118.0
9. Load fish (335,785 lbs.)	29.97	5	149.86
10. Cleanup, gear maintenance and storage	8	2	16.0
TOTAL	194.79	---	605.86

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

Operation	Hours Per Operation	Number in Crew	Total Hours
1. Preliminary equipment check	16	1	16.0
2. Lower seine into water and prepare to pull	16	5	80.0
3. Attach live car	1.328	2	2.656
4. Pull seine	28.0	5	140.0
5. Detach live car and attach second live car	2.672	2	5.344
6. Load fish (40,000 lbs/pond)	54.4	5	272.0
7. Maintenance of fish overnight (16 nights)	128.0	1	128.0
8. Second seine pull (sum of items 2-4)	45.328	5	226.64
9. Load fish (683,611 lbs.)	60.98	5	304.89
10. Cleanup, gear maintenance and storage	16	2	32.0
TOTAL	368.708	---	1207.53

Appendix Table 11. Estimated total labor requirements for harvesting a 640 acre farm, by operation, Delta of Mississippi, 1977.

Operation	Time per Operation	Number in Crew	Total Man Hours
1. Preliminary equipment check	32	1	32.0
2. Lower seine into water and prepare to pull	32	5	160.0
3. Attach live car	2.656	2	5.312
4. Pull seine	56.0	5	280.0
5. Detach live car and attach second live car	5.344	2	10.688
6. Load fish (40,000 lbs/pond)	108.8	5	544.0
7. Maintenance of fish overnight (32 nights)	256	1	256.0
8. Second seine pull (sum of items 2-4 above)	96.0	5	480.0
9. Load fish (1,373,243 lbs.)	122.47	5	612.34
10. Cleanup, gear maintenance and storage	32	2	64.0
TOTAL	743.27	---	2444.34

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

Item	Unit	Price Dollars
Fingerlings	each	.06
Feed	ton	263.78
Gravel	cubic yards	4.29
Pipe		
Water Supply	linear foot installed	10.00
Drainage	linear foot installed	16.00
Chemicals		
Formalin	gallon	5.00
Potassium permanganate		
550 lb. drum	each	397.00
110 lb. drum	each	85.00
Copper Sulfate	100 lb. bag	53.00
Karmex	pound	2.30
Hired labor (part-time)	hour	3.00
Diesel	gallon	.55
Earth Moving	cubic yard	.40
Vegetative Cover		
Establishment cost	acre	92.38
Annual maintenance	acre	70.50
Tractors	each	17,000.00
½ ton truck	each	4,800.00
1½ ton truck	each	7,000.00
Relift pumps	each	2,635.00
Gate and screen	each	150.00

Appendix Table 13. Data used in estimating selected equipment and facility costs, Delta of Mississippi, 1977.

Item	Description	Estimated New Cost	Repairs as Percentage of New Costs	Estimated Life	Average Investment
Seine storage reel	2000′ capacity	$ 750.00	50	10	$ 375.00
Boat & motor	Standard capacity	1,230.00	75	10	615.00
Boat trailer	Standard capacity	270.00	40	10	135.00
Crane (backbone)	17′ reach	6,000.00	100	10	3,000.00
Feeder	2000# capacity	4,120.00	75	10	2,060.00
Feed storage service	23 ton capacity	1,900.00	50	10	950.00
Building	18′ x 42′	16,000.00	100	20	8,000.00
Relift pump	pto driven 16″ highlift	2,630.00	50	10	1,315.00
Tractor	90-100 hp	17,000.00	65	12	8,500.00
Mowing machine	6′ side mount	2,100.00	40	12	1,050.00
Haul seine with funnel & hoop	2000 section of 10′ seine w/ 1″ mesh	4,700.00	dollars per unit 120.00	5	2,350.00
Cutting seine	50′ section of 6′ seine w/ ½″ mesh	138.00	dollars per unit 7.00	5	69.00
Live car	20,000# capacity	250.00	dollars per unit 16.00 per car	5	125.00
Live car	10,000# capacity	170.00	dollars per unit 11.00 per car	5	85.00
Brailing basket	450 capacity	60.00	dollars per unit 3.00	5	30.00
Truck	½ ton	4,500.00	70	8	2,250.00
Truck	1½ ton	7,000.00	70	10	3,500.00
Oxygen meter and probe		600.00	5	5	300.00
Fiberglas transport tank	275 gal. capacity	400.00	10	5	200.00
Shop equipment		4,000.00	50	5	2,000.00

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 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 and 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. 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.

Item	Size or Description	Depreciation	Interest	Fuel	Repairs and Maintenance	Total
		----------	dollars	----------		
Seine storage reel	2000′ capacity	75	34		38	146
Boat and motor	16′ boat-10 h.p. motor	123	62	30	92	307
Boat trailer	std. commercial	27	14		11	51
Crane	17′ reach	600	300		600	1,500
Cutting seine	50′ section of 6′ seine with ½″ mesh	28	7		7	42
Live car	20,000 lb capacity	50	13		16	79
Live car	10,000 lb capacity	34	9		11	54
Brailing basket	450 lb capacity	11	3		4	18
Feeder	2000 lb capacity	412	206		309	927
Feed storage	bulk 23 ton capacity	190	95		95	380
Service building	18′ x 42′	800	800		800	2,400
Relift pump	p.t.o. driven-16″ high lift	263	132		132	526
Tractors	90-100 h.p.	1,417	850		921	3,185
Truck	1½ ton	700	350	325	490	1,865
Truck	½ ton	563	225	346	316	1,510
Mowing machine	6′ side mount	175	105		219	499
Haul seine and funnel hoop	2000′ section of 10′ seine with 1″ mesh	940	212		190	1,342
Oxygen meter and probe		120	30		30	180
Scales	1000# capacity	90	45		45	180
Fiberglas transport tank	275 gal. capacity	80	18		8	106
Shop Equipment		800	180		400	1,380

and interest charges for each item of equipment are presented in Appendix Table 14.

The costs of selected miscellaneous items needed to adjust cost estimates to correspond to individual situations, and no reported elsewhere in the study, a presented in Appendix Table 15

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

Item	Farm Situation I	II	III
	----------	dollars	----------
Insurance	2296	2694	3627
Fuel for relift pumps	362	844	2351
Formalin (@ $25/5 gal cont.)	25	50	100
Potassium permanganate	1448	2855	4938
Copper sulfate	530	1060	2067
Karmex	90	170	370

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