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9. ABSTRACT
Delineatesa step-by-step procedure for estimating costs and returns of a prospective catfish operation. The bases for all assumptions used are clearly expressed. Section topics include: Land Charge; Pond Construction; Water Supply; Production Items; Capital Costs; Loans for Capital Investment; Production Systems; Cash Flow of Operating Costs; Budget Analysis; Costs and Returns; and Summary of Alternate Unit Sizes and Production Schemes. Significant strides have been made in catfish production techniques during the last 20 years. Following recommended production practices, a knowledgeable producer faces no more risk in catfish than in other livestock production. Specialized training is needed in disease and parasite control, water quality measurements and production techniques. Numerous data tables and an extensive bibliography are included. Appendices are entitles: Calculating Principal and Interest on Loans; Estimating Growth Rates for Production Schemes; Estimating Input requirements and Operating Costs; Estimating Labor Requirements; and Harvest Costs.

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Preparation of FINANCIAL BUDGET for FISH PRODUCTION

Catfish Production in areas with Level Land & Adequate Ground Water

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Preparation of Financial Budget for Fish Production, Catfish Production in areas with Level Land & Adequate Ground Water[1]

E. W. McCoy and J. L. Boutwell[2]

INTRODUCTION

MORE THAN 50,000 acres of land, mostly in the Lower Mississippi Valley, were devoted to production of commercial catfish in 1975. In the major production area catfish are complementary to other enterprises and are raised on farms with cotton, rice, and soybeans. Some producers have shifted substantial acreage into catfish production because of higher profit opportunities.

Unlike traditional crop and livestock enterprises, catfish production has represented an almost intangible product for lending agencies. Since catfish are grown in water, the precise numbers and weight are difficult to determine until harvest. Inventories can be estimated only within a growing season. Further, due to the relatively brief period of production, lending agencies have been unable to establish a repayment history for the crop.

Without increased activity by lending agencies, catfish production will be restricted to operators who can provide internal financing from other enterprises. Without adequate financing, growth of the industry will be curtailed and catfish will remain a specialty crop produced on a seasonal basis.

Significant strides have been made in catfish production techniques during the last 20 years. Production has advanced from an art to a

[1]This study was conducted as a contributing portion to Hatch 630(S-83) "Processing and Marketing Technology of Commercially Cultured Catfish".

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science. Following recommended production practices, a knowledgeable producer faces no more risk in catfish than in other livestock production. A livestock producer, however, is not automatically knowledgeable about producing catfish. He needs specialized training in disease and parasite control, water quality measurements, and production techniques before attempting to grow fish. Equally important, the prospective producer must be assured of a market for the fish before undertaking any investments.

A step-by-step procedure for estimating costs and returns of a prospective catfish operation is delineated in this report. The basis for all assumptions used are clearly expressed. Prospective producers should modify the data to fit individual situations.

LAND CHARGE

Relatively level land underlain within a 100-foot depth by a fully charged aquifer was assumed for the study. The land could be somewhat swampy and difficult to work for conventional crop production. The per acre price was held constant for the three levels of land purchase. Land units of 80, 160, and 320 acres are traditional parts of the rectangular survey system of land measurement. The land was assumed to be available for purchase in the size units specified, and pond construction was varied to fit within the available land units.

Price of land varies. Farmland value normally is a function of the amortized net returns of the crops that can be produced upon the land. Other factors, including location, can modify land value. An average value of $350 per acre was used for land in the analysis. Potential producers should modify the price to closely approximate actual land prices for specific areas. Once established, however, the land cost will remain the same for whatever type of agricultural production contemplated. Many other capital costs are dependent upon the type of enterprise under consideration.

Once committed to catfish production, the producer incurs several long term capital costs which differ from those faced in crop production. In addition, the physical conversion of cropland to ponds limits the farmer's ability to rapidly adjust to changing market conditions. Before committing resources to pond construction the farmer should carefully weigh alternative uses of his land and financial resources.

POND CONSTRUCTION

With relatively level land and adequate ground water, pond size can be determined by the producer. Earlier research has indicated cost per

surface acre of water decreases with increases in pond size. Experienced producers, however, recommend building rectangular ponds of about 20 acres. Application of feed to the ponds is easier and harvesting problems and costs are reduced when 20-acre ponds are used. Until harvesting techniques are improved, ponds with a width of about 650 feet are recommended. A 20-acre pond stocked with 2,500 catfish per acre would contain approximately 50,000 pounds of fish at harvest. Using customary hauling equipment, one pond could be harvested in 2 days. Larger ponds would extend the harvest period and increase the risk of death loss among live hauled fish.

In the proposed system, ponds were set up in blocks of four to minimize earth moving. The levees were 5.5 feet high with two crown widths: 14 feet for the outside levees and 16 feet for the internal levees, Figure 1. The interior 16-foot levees allow sufficient space for feeding and harvesting equipment to operate. The slope was 3:1, although some producers feel a 4:1 slope would reduce maintenance and extend the life of the levees. A 4:1 slope would increase earth moving by 0.9 cubic yards per linear foot of levee. In addition the water surface area would be reduced. There is insufficient data to compare the reduction in maintenance cost with increased construction costs and reduced production returns for levees with a 4:1 slope.

When ponds are constructed, a certain amount of land area is lost to production. For example, only about 71 acres of water can be developed on 80 acres of land when four ponds are constructed. Because of levee sharing, about 145 acres are available from 160 acres of land and 292 from 320 acres of land, Table 1. The trade-off between fixed capital costs for pond construction and variable costs in feeding and harvesting favors larger units.

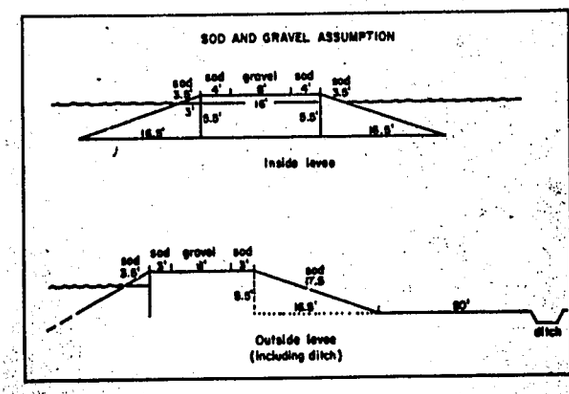

Fig. 1. Inside and outside levee dimensions for ponds on level land with adequate ground water.

Earth moving requirements for building various size units was determined by levee type. Producers planning alternative types of production units can modify the appropriate levee figures. For example, if 14-foot levees are considered adequate, the earth moving for inside levees can be reduced accordingly.

Because water covers a portion of all interior levees the relationship between earth moved and water acreage is not proportional. The 320-acre operation has 4.1 times as much water area as the 80-acre unit, but only 3.4 times as much earth moving is required. A schematic diagram of the pond units is shown in Figure 2. With the 80-acre basic unit each pond contains approximately 17.7 surface acres of water when filled to a 4.5-foot depth. The ditch levees are set on the short side of the acreage in the example; however, drainage is determined by the slope of the terrain. Generally, it is preferable to have independent drainage and filling for each pond to simplify management and disease control.

In planning a 160-acre catfish farm, four additional ponds would be built. Because of water on both sides of the levee the center ponds have greater water surface. (In the schematic diagram, an 80-acre unit occupies the four exterior ponds while each of the four center ponds are 0.65 acre larger.) The proportionally larger surface area and pro-

TABLE 1. EARTH MOVING REQUIREMENTS FOR POND CONSTRUCTION ON LEVEL LAND WITH ADEQUATE GROUND WATER BY LAND ACREAGE, 1976

Levees	Soil/ levees	Land acreage: 80		160		320	
		Levees	Soil total	Levees	Soil total	Levees	Soil total
	Cu. yd.	*No.*	*Cu. yd.*	*No.*	*Cu. yd.*	*No.*	*Cu. yd.*
Ditch levee[1]	8,197.20	2	16,394.40	4	32,788.80	8	65,577.60
Outside long levee[2]	15,729.93	2	31,459.86	2	31,459.86	2	31,459.86
Inside long levee[3]	16,768.46	1	16,768.46	3	50,305.38	7	117,379.22
Outside short levee[4]	4,074.61	2	8,149.22	2	8,149.22	2	8,149.22
Inside short levee[5]	4,223.56	0	0	2	8,447.12	6	25,341.36
Total yd³ soil			72,771.94		131,150.38		247,907.26
Total water acreage			70.96		144.52		291.64
Total acreage (water, sod & gravel)			80.35		160.60		321.08

	Top width	Length	Soil yd³/ linear foot	Total soil yd³/ levee
	Ft.	*Ft.*	*Cu. yd.*	*Cu. yd.*
[1] Ditch levee	14	1,320	6.21	8,197.2
[2] Outside long levee	14	2,533	6.21	15,729.93
[3] Inside long levee	16	2,533	6.62	16,768.46
[4] Outside short levee	16	615.5	6.62	4,074.61
[5] Inside short levee	16	638	6.62	4,223.56

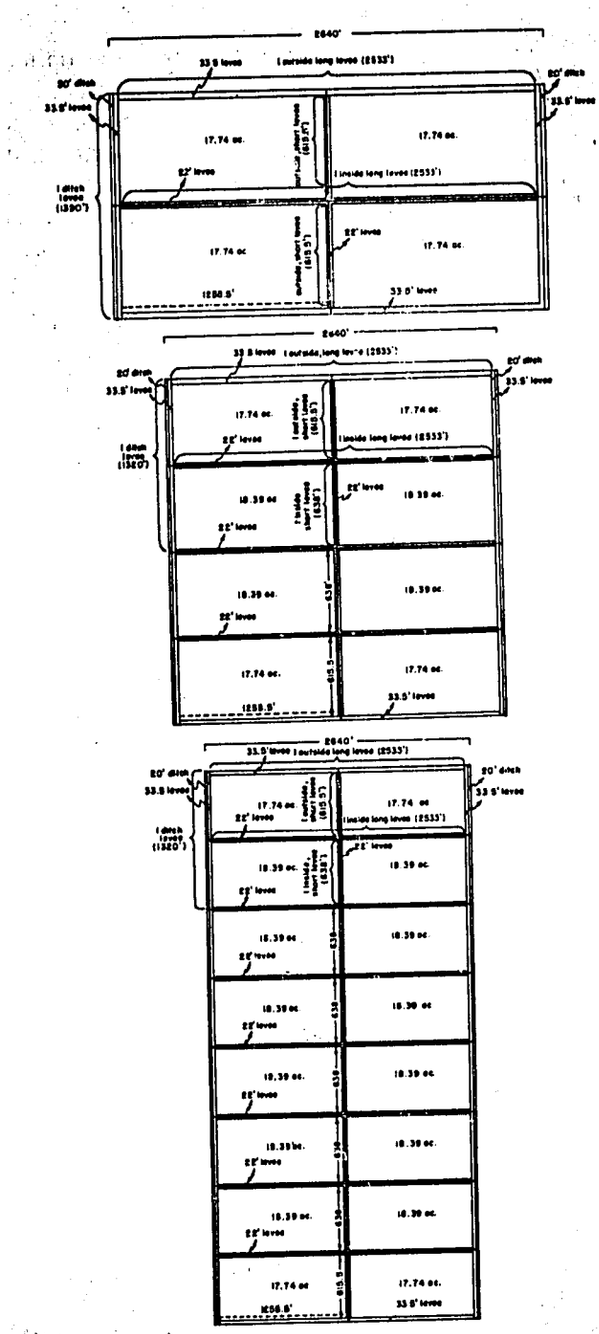

Fig. 2. Pond configuration for level land with adequate ground water by land acreage.

portionally smaller earth moving requirements increase the water surface per land acre and decrease the capital cost per unit.

The 160-acre unit envisioned in the study is a square quarter section. A unit with a different configuration results in slightly different water surface. The major point, however, is that a 160-acre unit of ponds is not simply a doubling of an 80-acre unit. Even if an additional 50- or 80-acre unit were added to an existing unit, there would be construction benefits from levee sharing by adjoining ponds.

Additional gains in earth moving would be derived in construction of a 320-acre unit of ponds. The unit consisted of 4 ponds, each 17.7 acres, and 12 ponds, each 18.4 acres. Almost one-quarter million cubic yards of soil must be moved to construct the 320-acre unit. No productive use of the land resource can be made during construction; producers should consider cash flow opportunities before beginning land changes. Depending on the nature of the construction process a producer may elect to begin construction on an 80-acre unit and add to the units over time. Alternative time spans for construction are not considered in this report.

In order for production to meet proposed levels it is necessary for feeding and harvesting equipment to have access to the ponds under all weather conditions. Soil that is conducive to pond construction often retains water for a relatively long time. To ensure access to the ponds, levees are graveled for an 8-foot width. A cubic yard of gravel is used for 10 linear feet of levee run, Table 2. In some areas gravel would not be available and shell or some other type of material would be used.

The amount of gravel used for the various pond units does not increase proportionally, nor in the same amount, as earth moving. The 160-acre unit requires 1.78 times as much gravel as the 80-acre unit, while the 320-acre unit required 3.35 times as much. The amount of gravel used is a direct function of the length of the levees. The proportionally shorter levee length for larger units leads to efficiencies in feeding, maintenance, and other variable cost items.

Wind action deteriorates the levees, reduces the width of the levees, and changes the slope. Wider interior levees can reduce the problem. In addition, levees are seeded in areas not covered by gravel. The seeding is extended to a point below the high water line. Establishing sod immediately after the construction process minimizes maintenance problems. The exterior slopes of the outside levees are seeded to the drainage ditch. Since the amount of outside levee is not proportional to land acreage, the amount of seeding also varies. The 160-acre unit

TABLE 2. GRAVEL AND SOD REQUIREMENTS FOR PONDS ON LEVEL LAND WITH ADEQUATE GROUND WATER BY LAND ACREAGE, 1976

Levees	Yd³ gravel/levee	Sq. ft. sod/levee	Land acreage: 80 Levees	80 Total gravel	80 Total sod	160 Levees	160 Total gravel	160 Total sod	320 Levees	320 Total gravel	320 Total sod
	Cu. yd.	*Sq. ft.*	*No.*	*Cu. yd.*	*Sq. ft.*	*No.*	*Cu. yd.*	*Sq. ft.*	*No.*	*Cu. yd.*	*Sq. ft.*
Ditch levee[1]	132.00	62,040.00	2	264.0	124,080	4	528.0	248,160	8	1,056.0	496,320
Outside long levee[2]	253.30	68,391.00	2	506.6	136,782	2	506.6	136,782	2	506.6	136,782
Inside long levee[3]	253.30	37,995.00	1	253.3	37,995	3	759.9	113,985	7	1,773.1	265,965
Outside short levee[4]	61.55	9,232.50	2	123.1	18,465	2	123.1	18,465	2	123.1	18,465
Inside short levee[5]	63.80	9,570.00	0	0	0	2	127.6	19,140	6	382.8	57,420
Total yd³ gravel				1,147.0			2,045.2			3,841.6	
Total sq. ft. seeded					317,322			536,532			974,952
Total acres sod					7.28			12.32			22.38
Total acres gravel					2.11			3.76			7.06

	Length	Linear ft./yd³ gravel	Total yd³ gravel/levee	Total width levee to be seeded (excl. gravel)/ft. of levee	Total ft.² to be seeded (excl. gravel)/levee
	Ft.	*Ft.*	*Cu. yd.*	*Ft.*	*Ft.*
[1] Ditch levee	1,320	10	132.00	47	62,040.00
[2] Outside long levee	2,533	10	253.30	27	68,391.00
[3] Inside long levee	2,533	10	253.30	15	37,995.00
[4] Outside short levee	615.5	10	61.55	15	9,232.50
[5] Inside short levee	638	10	63.80	15	9,570.00

required 1.69 times as much, and the 320-acre unit 3.07 times as much, as the 80-acre unit.

In summary, the pond construction figures used in analysis are based on relatively level land in 80-, 160-, and 320-acre blocks. The pond configuration used requires neither the least nor the most earth moving, gravel, and sod. Pond construction depends on individual terrain features, and it is unlikely that any actual operation exactly meets the above specifications.

The proposed ponds are constrained by existing levels of harvesting and feeding technology. With improvement in one or both of these areas or with changes in pond management systems, an entirely different configuration of ponds could be feasible. Pond construction is a long range capital commitment and the producer should carefully evaluate alternatives before entering the catfish business.

WATER SUPPLY

Adequate water is a prime factor in catfish production. On relatively level land, water must be supplied by streams, springs, or wells. Streams provide a low-cost water source; however, they also represent a source for introduction of wild fish stocks and diseases. The proposed pond areas are assumed to have adequate ground water contained in an aquifer within 100 feet of the surface. Producers with water at a different depth would have to adjust the program accordingly. A 2,000-gallon per minute pump, powered by a 60-horsepower diesel engine, was proposed for each 80 acres of water, Table 3. The optimum amount of water delivery capability per acre has not been resolved through research, but the system proposed was the most common size encountered in the Mississippi Delta catfish producing areas during 1976. The system is capable of supplying 25 gallons per minute per acre, sufficient to replace evaporation loss for all ponds during the summer months.

A prospective producer must balance the risks associated with smaller water delivery systems against the costs of larger systems. In general, the pumping system will be used for filling the ponds and replacing evaporation loss. Some producers use wells for water exchange and to provide aeration.

PRODUCTION ITEMS

Certain items are required in catfish production that are not commonly available on a farm; others have dual use for both fish and crop or livestock production. Single purpose items not normally avail-

TABLE 3. QUANTITY AND COST OF INVESTMENT ITEMS FOR CATFISH PRODUCTION IN PONDS ON LEVEL LAND WITH ADEQUATE WATER BY LAND ACREAGE. 1976

Item	Unit	Year life	Cost/ unit	80 Acres No/ units	80 Acres Total	80 Acres Total	80 Acres Depreciation	160 Acres No/ units	160 Acres Total	160 Acres Total	160 Acres Depreciation	320 Acres No/ units	320 Acres Total	320 Acres Total	320 Acres Depreciation
Land	acre	—	350.00	80	28,000	28,000	—	160	56,000	56,000	—	320	112,000	112,000	—
Pond construction															
Earth moving	cubic yd.	—	.40	72,772	29,100	29,100	—	131,151	52,460	52,460	—	247,907	99,162	99,162	—
Drainage structures (12")	linear ft.	20	8.00	260	2,080		104	520	4,160		208	1,040	8,320		416
Gravel	cubic yd.	5	6.00	1,147	6,882		1,376	2,045	12,270		2,454	3,842	23,052		4,610
Vegetative cover	acre	5	45.00	7.3	328		66	12.3	554		111	22.3	1,007		202
Subtotal						9,290	1,546			16,984	2,773			32,379	5,228
Water supply															
Drilling (16")	ft.	—	10.00	100	1,000	1,000		200	2,000	2,000	—	400	4,000	4,000	—
Casing (16")	ft.	15	14.00	60	840		56	120	1,680		112	240	3,360		224
Screen (16")	ft.	15	21.00	40	840		56	80	1,680		112	160	3,360		224
Gravel	cubic yd.	15	17.00	20	340		23	40	680		46	80	1,360		92
Pump (2,000 G.P.M. with 60-H.P. diesel engine)	each	10	12,030.00	1	12,030		1,203	2	24,060		2,406	4	48,120		4,812
Fuel tank (500 gal.)	each	20	143.00	1	143		7	2	286		14	4	572		28
Subtotal						14,193	1,345			28,386	2,690			56,772	5,380
Production items															
Boat (16')	each	10	200.00	1	200		20	1	200		20	1	200		20
Motor (10 H.P.)	each	10	475.00	1	475		48	1	475		48	1	475		48
Boat trailer	each	10	150.00	1	150		15	1	150		15	1	150		15
Tractor (35 H.P.)	each	12	3,000.00	2	6,000		500	2	6,000		500	2	6,000		500
Service bldg.	each	20	1,800.00	1	1,800		90	1	1,800		90	1	1,800		90
Mower (7')	each	12	1,350.00	1	1,350		113	1	1,350		113	1	1,350		113
Pickup (½ ton)	each	8	3,200.00	1	3,200		400	1	3,200		400	1	3,200		400
Relift pump (P.T.O.)	each	10	1,500.00	2	3,000		300	2	3,000		300	2	3,000		300
Oxygen kit	each	2	130.00	1	130		65	1	130		65	1	130		65
Aeration attachment	each	10	90.00	2	180		18	2	180		18	2	180		18
Fuel tank (300 gal.)	each	20	86.00	1	86		4	1	86		4	1	86		4
Subtotal						16,571	1,573			16,571	1,573			16,571	1,573
Feeding items															
Feeder (1,600 lb. P.T.O.)	each	10	800.00	1	800		80	1	800		80	1	800		80
Feed storage (10 ton)	each	10	1,200.00	1	1,200		120	0	0		0	0	0		0
Feed storage (20 ton)	each	10	1,600.00	0	0		0	1	1,600		160	1	1,600		160
Subtotal						2,000	200			2,400	240			2,400	240
Total depreciable investment						42,054	4,664			64,341	7,276			108,122	12,421
Total investment						100,154				174,801				323,284	
Investment per land acre						1,252				1,093				1,010	
Investment per water acre						1,411				1,210				1,107	
Average capital						79,127				142,631				269,223	
Average own capital						10,511				20,016				38,870	

able are a boat, motor, boat trailer, oxygen kit, relift pump, and aeration attachment. Although the boat could be used for recreational fishing, it would not be suitable if modified to enhance applying chemicals.

Two tractors are required, even for an 80-acre unit. The primary use of the tractors is to provide mobile P.T.O. power for relift pumps with aeration attachment. These are necessary if stocking and feeding rates are high. Good quality used tractors will be adequate since they are used only as mobile power sources and for mowing levees.

None of the pond configurations include additional land for storage buildings. The feed storage is situated on the levee. It was also assumed that the drain does not fully extend the length of one head pond. An area of approximately 500 feet by 20 feet is available for equipment and a storage building.

CAPITAL COSTS

In addition to the quantity required, cost estimates are derived for each capital item. Item costs are for conditions in early 1976 and must be adjusted for changes that occur.

Capital items are divided into depreciable and non-depreciable. A depreciable item has a definable useful life. The item "wears out" with use. In the proposed system all depreciable items are assumed to have a zero value at the end of useful life. Because of recapture provisions of the income tax, producers should adjust the method of depreciation, years of life, and salvage value to conform to the actual value of each equipment item used in production. For example, if a pickup declines more in value in the first years of life and has a expected salvage value of 50 dollars at the end of 8 years, the double declining balance or sum of the year-digits method of depreciation might be more appropriate. Straight-line depreciation is used for the proposed systems.

Total depreciable investment is $42,054 for the 80-acre unit and comprises 42 percent of total investment. Total investment per land acre was $1,252 for the 80-acre unit. Non-depreciable items include land, earth moving, and well drilling. With proper maintenance these items do not have an identifiable life. Non-depreciable items are capitalized into the value of the property and recovered without tax liability when the property is transferred.

When larger size units are considered, additional savings besides pond construction are realized. The 160- and 320-acre units are operated with essentially the same production items as the 80-acre unit.

Due to increased feed requirements, the larger units require two 10-ton feed storage facilities or one 20-ton facility. Depreciable assets comprise 37 percent of total investment for the 160-acre unit, and 33 percent of the 320-acre unit.

Pond construction can sometimes qualify as a current cost under the soil and water provision of 1976 tax law. Prospective producers should closely examine tax provisions to determine any factors that might influence short or long range after tax income.

LOANS FOR CAPITAL INVESTMENTS

Capital for investment items can be acquired from personal savings or by borrowing. If savings are used, the interest that the savings would have drawn must be charged against the fish operation. Such charges are referred to as opportunity costs, which are real. The fish operation must return at least as much to capital as investment in a savings account, or the producer would be better off leaving his money in the bank or savings and loan association.

It was assumed the producer borrowed the maximum allowable amount to finance capital items. Loan terms and interest rates for 1976 are used. Interest rates are 8 percent for land and 9 percent for other items. Interest rates were very volatile during 1974-76 and the rates quoted at the time of the study were the lowest in 2 years. The 80-acre unit is used for an example of capital loans and repayment. Total capital investment is $100,154, Table 4. The loan amount varies by items ranging from 75 percent on the pickup to 95 percent for construction. The total yearly amount, principal and interest, for capital items is $17,880. The payments fluctuate after 7 years, depending upon the means used to replace worn out equipment. For the first crucial years of operation, however, substantial principal payments are required. Interest payments are included as current expenses on a production budget but principal payments must be repaid from net

TABLE 4. LOANS FOR CAPITAL INVESTMENT ITEMS FOR AN 80 ACRE CATFISH FARM ON LEVEL LAND WITH ADEQUATE GROUND WATER, 1976

Item	Total cost	Loan amount	Interest rate	Repayment period	Yearly payment
	Dol.	*Dol.*	*Pct.*	*Yr.*	*Dol.*
Land	28,000.00	22,400.00	8	20	2,281.50
Construction	38,390.00	30,470.50	9	7	7,246.34
Water supply	15,193.00	13,198.35	9	7	2,622.39
Equipment	15,241.00	15,048.95	9	4	4,645.14
Pickup truck	3,200.00	2,400.00	9	3	948.13
Oxygen meter	130.00	125.40	9	1	136.69
Total	100,154.00	89,643.20			17,880.19

income. The repayment schedules for land, construction, water supply, production items, pickup, and oxygen meter as well as total principal payments for the first 7 years are in Appendix A.

PRODUCTION SYSTEMS

Two basic production schemes are simulated for the proposed units: multiple and single cropping. Multiple cropping includes year round production, utilizing three basic production systems. An initial start up production is incorporated to generate first year income. The 80-acre unit is used for illustration.

During the first year, land purchase and pond construction occupies the early months. Two ponds are available for filling by April. With rainy weather during the winter months, pond construction may not be possible within the assumed time period. Under optimum conditions, the ponds might be available by February.

The first two ponds are stocked in April with 9-inch fingerlings at a rate of approximately 2,500 per acre, System 1. The fish are fed at 3 percent of body weight 6 days a week. Feeding is adjusted every 2 weeks according to the weight of the fish. The amount offered per water acre is not restricted as the fish grow in size. Water quality is maintained by mechanical aeration as needed. Disease and parasite control is conducted when applicable. The producer must recognize common disease and parasite problems to apply treatment at the proper time. The fish are harvested in September, after attaining a weight in excess of 1 pound.

The assumed growth rates for fish within each system are in Appendix B. An extended harvest period is built in for each system. For example, the fish in System 1 weigh over ¾ of a pound in August and can be harvested any time during the final 2-month period.

In June the remaining two ponds are completed and stocked with 7-inch fingerlings at a rate of 2,500 per acre, System 3. The June stocking constitutes the first repeatable system. The fish stocked in June are also fed at 3 percent of body weight 6 days a week until November 1. At the onset of cold weather catfish reduce their feed intake. In November, the June stocked fish weigh less than ¾ of a pound.

A partial harvest of larger fish can be made at this time to reduce risk and carrying charges for overwintering, although this is not budgeted in the report. The fish are overwintered until March with a reduced feeding schedule. The fish are fed at 1 percent of body weight

every other day or on warm days until March. In March the feed is increased to 2 percent until harvest.

Once begun, the production process is continuous over a three crop system. Fish are stocked in June and harvested by seining in March, restocked in April and harvested in September, System 4, restocked in October and harvested in May, System 2. For each unit, half of the ponds are beginning production as the other half near harvest. Every 2 years the ponds are drained following the April-September crop and winter rains are utilized to help in refilling. After the unit is in full operation, half of the ponds are drained every year. Draining the ponds at 2-year intervals will minimize wild spawning that might occur from fish which escaped seine harvest.

The multiple crop system fully utilizes the production unit and labor resources throughout the year. The system does include two production periods with overwintering fish, with added cost and risk factors. To properly appraise the multiple crop system, a single crop system was also considered.

In the single crop scheme, 5-inch fingerlings are stocked in all ponds in March, System 5. The fish are fed at 3 percent of body weight, adjusted biweekly until harvest in November. The ponds are drained for harvest and winter rains are used to reduce pumping costs in filling the ponds. Partial budget analysis could determine the economic feasibility of restocking smaller fingerlings in December and reducing fingerling cost. With existing biological knowledge, the cost and risk associated with overwintering fingerlings for a single crop was not economically justified.

The quantity of inputs varies for each system, Table 5. All systems are assumed to attain the same conversion ratio; thus feed requirements differed because of stocking size and harvest weight. The length of feeding period increased carrying charges for operating costs. Other input costs vary with the length of time and season the fish are in the pond. Pumping costs are lower for fish which are overwintered. The monthly operating costs by input item and system are in Appendix C. The pickup, boat, and labor charges are prorated to each system on a monthly basis. Although full-time labor is assumed for the production units, labor is not fully used. Labor coefficients for catfish production have not been clearly determined. With full-time labor, duties such as maintenance, feeding, and oxygen reading can be conducted more thoroughly, possibly improving production. Labor requirements by month and task are estimated in Appendix D. The actual time required in other operations may differ for some tasks.

TABLE 5. NUMBER OF INPUT UNITS FOR AN 80-ACRE CATFISH FARM ON LEVEL LAND WITH ADEQUATE GROUND WATER BY SYSTEMS OF PRODUCTION, 1976

Item	Description	Unit	Cost/unit	System 1	System 2	System 3	System 4	System 5
			Dol.	*No.*	*No.*	*No.*	*No.*	*No.*
Fingerlings								
	9-inch	each	0.135	88,750.00	88,750.00			
	7-inch	each	0.105			88,750.00	88,750.00	
	5-inch	each	0.050					177,500.00
Feed	32% protein	ton	215	74.95	68.18	79.46	75.13	152.61
Fuel								
Pumping	2,000-G.P.M. pump with 60-H.P. diesel engine	hr.	1.35	1,451.30	203.25	1,014.00	1,016.52	3,102.93
Tractor	30-H.P. gasoline	hr.	1.00	139.20	87.25	135.00	127.00	314.40
Pickup truck	½-ton (gas & oil)	mile	0.036	2,384.20	2,727.70	3,410.00	2,045.83	8,000.00
Boat motor	10-H.P. gasoline (gas & oil)	hr.	0.275	82.73	94.55	118.18	70.91	283.64
Labor	Full-time	month	450.00	4.06	4.00	6.11	3.60	12.00

CASH FLOW OF OPERATING COSTS

In many agricultural enterprises, input costs are incurred throughout the production period and cash receipts are concentrated at the end of the process. When a new producer begins operation, consideration must be given to means of providing daily living expenses until funds are available from the farm operation. An enterprise that is economically feasible in the long run may not be viable for an individual because of cash flow shortages in the short run.

For the proposed units it is assumed that operating expenses are borrowed under a drawing account type of loan. Under the loan arrangement available at Production Credit Associations and some banks, a loan amount is set aside in an account. The borrower draws upon the account as needed during the production process. Interest is charged on the funds only for the period that the money is used.

For the multiple crop scheme it is further assumed that cash expenses for the system harvested, plus accumulated interest for other systems simultaneously under production, are paid at each harvest. The net cash available after harvest can be used or accumulated to meet expenses. Since management and labor are incorporated into one person, only a wage for operator's labor was included in the drawing account. Daily living expenses can be met from this amount.

For the multiple crop scheme, cash expenses accrue from April through September. During this period System 1 is in operation in half the ponds and System 3 is in the remaining ponds. In September, System 1 is harvested and production is sold to processors at $0.45 per pound. The gross proceeds are used to pay operating expenses for System 1, plus accumulated interest for both System 1 and System 3. The net cash over operating expenses is $10,328, Table 6. During the initial 26 months of operation cash expenses approach $181 thousand, interest is over $7,000, and net cash is about $86.5 thousand. Costs for the following 2 years would not be exactly the same.

After the initial period, production will continue, utilizing systems 2, 3, and 4. Pumping for refilling will be offset by 1 year, during winter months on System 2. Approximately 2.7 hours per acre-foot of pumping time is required with a 2,000 G.P.M. pump, so about 866 hours of pumping would be required to fill the ponds in the 80-acre unit. With diesel fuel at $0.45 per gallon and a use rate of 3 gallons per hour, refilling ponds would cost approximately $1,169. Pumping costs could be spread over the winter months in order to evaluate cash flow for future years.

TABLE 6. CASH FLOW AND CUMULATIVE INTEREST ON AN 80-ACRE MULTIPLE CROP CATFISH FARM ON LEVEL LAND WITH ADEQUATE GROUND WATER, BY MONTH, 1976

Month	80 Acres					
	Cash expense	Cumulative expense	Interest	Cumulative interest	Returns	Net cash[1]
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
April	785.65	785.65	35.30	35.30		
May	14,413.40	15,199.05	540.50	575.80		
June	13,538.48	28,737.53	406.15	981.95		
July	6,054.81	34,792.34	136.20	1,118.15		
August	8,040.05	42,832.39	120.60	1,238.75		
September	7,857.43	50,689.82	58.90	1,297.65	44,705.70	10,328.41
Carryover		17,610.18	792.45			
October	18,234.00	35,844.18	820.50	1,612.95		
November	1,913.07	37,757.25	71.70	1,684.65		
December	2,070.38	39,827.63	62.10	1,746.75		
January	2,208.30	42,035.93	49.70	1,796.45		
February	2,171.67	44,207.60	32.60	1,829.05		
March	4,934.95	49,142.55	37.00	1,866.05	48,304.50	14,922.20
Carryover		17,626.25	264.40	264.40		
April	15,205.58	32,831.83	228.10	492.50		
May	7,468.12	40,299.95	56.00	548.50	45,909.50	17,397.00
Carryover		12,335.85	370.10			
June	13,176.25	25,512.10	395.30	765.40		
July	5,760.05	31,272.15	129.60	895.00		
August	7,680.16	38,952.31	115.20	1,010.20		
September	6,822.57	45,774.88	51.20	1,061.40	41,335.20	11,377.31
Carryover		16,878.39	759.50			
October	18,662.05	35,540.44	839.80	1,599.30		
November	1,986.12	37,526.61	74.50	1,673.80		
December	2,143.48	39,670.09	64.30	1,738.10		
January	2,281.40	41,951.49	51.30	1,789.40		
February	2,208.27	44,159.76	33.10	1,822.50		
March	4,979.45	49,139.21	37.30	1,859.80	48,304.50	15,652.19
Carryover		18,346.70	275.20			
April	4,794.73	23,141.43	71.90	347.10		
May	5,542.02	28,683.45	41.60	388.70	45,909.50	16,837.35
Total	180,932.49	—	7,022.10	—	274,468.90	86,514.46

[1] Cash return above operating costs.

By the end of the first 26-month period unharvested fish are in half the ponds. To indicate a round turn of production, the cost of stocking and feeding the System 4 fish is not included in the table. To continue the cash flow analysis, System 4 would be the initial stocking and the costs would be added to the April total in the table. Total costs from Appendix C would be used to derive the continued table.

Cash flow analysis for the single crop, System 5, is much less complex than the multiple crop scheme. The ponds are filled in March and April of the first year, drained for harvest in November, and refilled during the winter months. For the first year's budget two pumping costs are included. All subsequent years would have only one such charge.

The single crop scheme could be conducted similarly. Ponds would be harvested by seining and refilled only every 2 years. With 2-year draining the second year budget would be reduced by the amount of the pumping costs. Harvest could be spread over October, November, and December with only slight changes in the costs and returns.

The single crop system returned about $27 thousand more than the included operating costs, Table 7. A wage for the operator was included in the cash expenses.

Cash flow analysis is crucial in determining the feasibility of entering a business. As indicated in the comparative analysis, the single crop scheme has lower initial operating cost requirements and first returns are comparatively close to those from the multiple crop scheme. The single crop scheme requires relatively rapid completion of the production unit in order for stocking to occur in March. With the same assumption for multiple crop, System 4 could be included as the initial unit with consequent reductions in cost.

The multiple crop scheme specified is only one of numerous biologically feasible alternatives. Adjustments of fingerling size can be used to shorten or lengthen the growing season. The availability of larger sized fingerlings will be a constraint for some systems.

After the first year, the multiple cropping scheme exhibits a substantial advantage with respect to cash flow. Over a 26-month period the multiple scheme contains six harvests. The longest period between harvests after fish are first stocked is 6 months. For single crops, of course, cash income is available only once per year. The single crop

TABLE 7. CASH FLOW AND CUMULATIVE INTEREST ON AN 80-ACRE SINGLE CROP CATFISH FARM ON LEVEL LAND WITH ADEQUATE GROUND WATER, BY MONTH, 1976

Month	Cash expense	Cumulative expense	Interest	Cumulative interest	Returns	Net cash[1]
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
March	10,205.39	10,205.39	688.80	688.80		
April	1,873.45	12,078.84	112.40	801.20		
May	2,266.12	14,344.96	119.00	920.20		
June	2,872.82	17,217.78	129.20	1,049.40		
July	4,147.66	21,365.44	155.50	1,204.90		
August	5,736.02	27,101.46	172.10	1,377.00		
September	7,761.16	34,862.62	174.60	1,551.60		
October	10,889.82	45,752.44	163.30	1,714.90		
November	4,140.25	49,892.69	51.10	1,746.00	78,762.60	27,123.91
Carryover						
December	638.84	638.84	57.40	57.40		
January	638.84	1,277.68	52.70	110.10		
February	785.18	2,062.86	58.90	169.00		
Total	51,955.55	—	1,915.00	—		

[1] Cash return above operating costs.

ponds could be partially seined or topped at an earlier date, improving cash flow. Topping would reduce total feed requirements for the remaining fish and might decrease aeration required to maintain adequate oxygen of the proposed feeding levels. Since harvesting would be done on an individual pond basis, any economic benefit available to the single crop scheme would also be available for the multiple crop. Harvesting costs are estimated in Appendix E.

BUDGET ANALYSIS

After compiling capital and operating costs for the alternative catfish production units, budgets should be prepared to indicate the relative profitability of each. This report examines two schemes of cropping: multiple and single. Three sizes of production units: 80, 160, and 320 acres, are examined. For comparative purposes each budget is placed on a biennial basis.

A budget systematically lists the expenses that producers expect to encounter when entering business at the stated level. While the previous examples are based only on the 80-acre unit, budgets were prepared for each size of operation.

The biennial ownership costs of production include interest on fixed capital items and depreciation. Interest may be a cash cost if the money is borrowed, or an opportunity cost if owners capital is used. In the analysis the budgets represent the first 2 years of operation. The interest included accrues if capital is borrowed under the previously defined assumptions. Biennial interest on 80 acres of land is $3,544.84 when land is purchased at $350 per acre and 80 percent of the purchase price is borrowed at 8 percent interest, Table 8. The interest amount was derived from Appendix A. Depreciation of capital items is listed in Table 3.

During the first 2 years, interest payments are larger than depreciation. Interest payments are reduced while the non-cash depreciation remains relatively constant. Depreciation as a budget charge is formal recognition of and accounting for a portion of the capital costs. A budget charge is made during the life of the depreciable capital asset. This can smooth wide fluctuations in net returns. If the entire asset value were charged off when purchased, the total costs would be substantially increased in that year. The amount charged for depreciation is available to meet principal payments on depreciable assets.

Under normal lending procedures the length of the repayment period is shorter than the depreciable life of the asset. Total depreciation over the first 2 years was $9,328 while total principal repayment

TABLE 8. BIENNIAL OPERATING BUDGET FOR A MULTIPLE CROP SYSTEM FOR CATFISH FARMS ON LEVEL LAND WITH ADEQUATE GROUND WATER BY LAND ACREAGE, 1976

Item	80 Acres Cost	160 Acres Cost	320 Acres Cost
	Dol.	*Dol.*	*Dol.*
Biennial ownership cost			
Interest			
Land	3,544.84	7,089.70	14,179.36
Construction	6,207.94	11,216.96	21,243.85
Water supply	2,246.59	4,493.18	8,986.36
Production items	2,801.34	2,804.91	2,804.91
Subtotal	14,800.71	25,604.75	47,214.48
Depreciation			
Construction	3,092.00	5,546.00	10,456.00
Water supply	2,690.00	5,380.00	10,760.00
Production items	3,546.00	3,624.00	3,626.00
Subtotal	9,328.00	14,550.00	24,842.00
Total biennial ownership cost	24,128.71	40,154.75	72,056.48
Biennial operating cost			
Fingerlings	63,900.00	127,800.00	255,600.00
Feed	95,743.26	191,504.80	383,009.60
Fuel			
pumping	8,065.40	16,414.80	33,125.00
tractor	719.13	1,463.60	2,953.50
pickup	635.70	1,293.80	2,610.90
boat	169.00	343.95	694.10
Subtotal	9,589.23	19,516.15	39,383.50
Labor	11,700.00	11,700.00	11,700.00
Chemicals	926.93	1,886.50	3,806.90
Repairs and maintenance			
ponds	6,344.21	12,911.80	26,055.90
water supply	1,003.50	2,007.00	4,014.00
production equipment	2,884.00	2,884.00	2,884.00
Subtotal	10,231.71	17,802.80	32,953.90
Taxes and insurance	1,990.40	2,018.80	4,037.60
Subtotal	193,100.53	372,229.05	730,491.50
Operating cost			
Interest on operating cost	8,117.31	15,642.30	30,697.70
Total operating cost	201,217.84	387,871.35	761,189.20
Total cost	225,346.55	428,026.10	833,245.68

was about $21,000. The difference was created by length of life of depreciable assets and the repayment of non-depreciable assets including land, earth moving, and well drilling. Ownership costs represented only 11 percent of total costs for the 80-acre unit with a multiple production scheme.

Operating costs include items that are necessary only if production is carried out. Operating costs are often termed variable costs since they change according to the specified level of production. Ownership

or fixed costs are incurred even if no production takes place. Taxes and insurance listed under operating costs would be fixed if no ad valorem taxes were charged on the value of the fish, and no insurance was carried specifically pertaining to the fish. Operating costs become fixed after they are incurred. In effect, once fingerlings are purchased for a crop the fingerling cost is fixed. The decision to continue production is always based on the remaining variable costs. Once the production process is started producers should evaluate expected returns against remaining variable costs. Before entering production, an 80-acre unit must have expected returns greater than $226 thousand for 2 years. After building the production unit the decision income becomes $202 thousand or will the unit return enough to cover operating costs and some amount of fixed costs?

Fingerling and feed costs made up 79 percent of operating costs. Fingerlings were priced at $0.015 per inch and feed at $215 per ton. A 1.8 feed conversion rate was assumed. Since feed and fingerlings contribute to operating and total costs it is extremely important that high quality is obtained when purchasing both items. Low priced fingerlings or feed may not be a bargain if the length of time to harvest and feed conversion are increased.

Considering both fixed and variable costs, an 80-acre unit requires expenditures of nearly one-quarter million dollars over a 2-year period. Clearly the scope of enterprise and expenditures involved requires full time management by someone knowledgeable in fish culture practices.

Costs increase with the size of unit. The 160-acre unit has total costs of almost $429 thousand, an increase of 90 percent above the 80-acre unit. Fixed and variable costs increased. The fixed cost increase was primarily in land, construction, and water supply. The same production items, excepting feed storage, were required for both units.

Thus the second 80-acre unit of fish could be produced for about $23 thousand less than the first 80-acre unit. When an additional 160 acres are added to make a 320-acre unit the per unit costs are further reduced. The biennial costs per land and water acre are reduced as unit size is increased to 320 acres as shown below. The rate of cost saving decreased from 160 to 320 acres and will disappear as unit size

Size of unit	*Cost/land acre*	*Cost/water acre*
A.	*Dol.*	*Dol.*
80	2,834	3,181
160	2,681	2,979
320	2,609	2,859

is further increased. When unit size increases beyond the size where essentially all labor can be performed by the owner-manager, the quantity of production per unit decreases. Numerous studies of other types of production indicate that owner-manager labor is more productive than either other family labor or hired labor.

Single cropping has essentially the same fixed costs as the multiple crop scheme, Table 9. Variable expenses are reduced since production costs are incurred for two crops instead of three. Single crop produc-

TABLE 9. BIENNIAL OPERATING BUDGET FOR A SINGLE CROP SYSTEM FOR CATFISH FARMS ON LEVEL LAND WITH ADEQUATE GROUND WATER BY LAND ACREAGE, 1976

	80 Acres	160 Acres	320 Acres
Item	Cost	Cost	Cost
	Dol.	*Dol.*	*Dol.*
Biennial ownership cost			
Interest			
Land	3,544.84	7,089.70	14,179.36
Construction	6,207.94	11,216.96	21,243.85
Water supply	2,246.59	4,493.18	8,986.36
Production items	2,801.34	2,804.91	2,804.91
Subtotal	14,800.71	25,604.75	47,214.48
Depreciation			
Construction	3,092.00	5,546.00	10,456.00
Water supply	2,690.00	5,380.00	10,760.00
Production items	3,546.00	3,624.00	3,626.00
Subtotal	9,328.00	14,550.00	24,842.00
Total biennial ownership cost	24,128.71	40,154.75	72,056.48
Biennial operating cost			
Fingerlings	17,750.00	35,500.00	71,000.00
Feed	65,622.30	131,244.60	262,489.20
Fuel			
pumping	8,377.96	17,007.26	34,433.42
tractor	628.80	1,282.75	2,584.37
pickup	576.00	635.70	635.70
boat	156.00	318.24	641.16
Subtotal	9,738.76	19,243.95	38,294.65
Labor	10,800.00	10,243.95	10,800.00
Chemicals	308.98	630.32	1,269.91
Repairs and maintenance			
ponds	6,344.21	12,911.80	26,055.90
water supply	1,003.50	2,007.00	4,014.00
production equipment	2,884.00	2,884.00	2,884.00
Subtotal	10,231.71	17,802.80	32,953.90
Taxes and insurance	1,009.40	2,018.80	4,037.60
Subtotal	115,461.15	216,684.42	420,845.26
Operating cost			
Interest on operating cost	4,736.64	8,620.68	17,274.07
Total operating cost	120,197.79	225,305.10	438,119.33
Total cost	144,326.50	265,459.85	510,175.81

tion does not require the management level of multiple crop production. The scheme requires one stocking in the spring and one harvest in the fall. A large amount of slack is present in the scheme; stocking and/or harvest can be delayed or advanced by a few months without substantially altering decisions for the ponds for the following year. Each production period is independent of all previous or following production periods. Unlike multiple cropping, the biennial single crop costs can be divided by two to derive annual budget figures. Only the interest on capital items would be incorrect in the annual budget, but the precise interest figures can be obtained from Appendix A.

Since fingerlings are stocked at a smaller size and fed for a longer period for single cropping, the feed cost is a higher proportion of total cost. Management of feed purchases becomes relatively more important than management of fixed costs. During early months of growth, feed purchases were programmed on a 1 ton reserve basis for the 80-acre unit and 2-ton basis for the larger operations. Feed was reordered whenever the supply reached the reserve level. As the fish approached ½ pound in weight they required approximately 2½ tons of feed per day for each 80-acre unit. Feed reserves thus were raised to ensure at least a 1-day supply on hand.

In the case of the 320-acre unit, feed deliveries would be required daily during the last month of growth. If feed dealers cannot guarantee rapid delivery, additional storage facilities would be required with increased cost for interest, depreciation, and repairs and maintenance. The multiple production system more fully utilized storage facilities. Total costs per land and surface acre were lower for single cropping than multiple cropping. To evaluate the efficiency of a production system, costs must be considered in relationship to returns.

COSTS AND RETURNS

Essentially the same level of fixed costs are required for single and multiple crop schemes. Ponds, wells, and production equipment are necessary whether fish are in the pond for 1 or 12 months. Biennial cost and return budgets were prepared for each size of production unit. Within each budget, both single and multiple crop schemes are listed. For the 80-acre unit, operating cost for the single crop is 64 percent of the cost for multiple cropping. Returns are only 57 percent of those for multiple crops, Table 10. Returns are based on prices that existed in 1976.

During the fall an overabundance of fish are available for processors and prices are at the seasonal low. During spring and summer

TABLE 10. BIENNIAL COSTS AND RETURNS FOR SINGLE AND MULTIPLE CROP CATFISH PRODUCTION SYSTEMS ON LEVEL LAND WITH ADEQUATE GROUND WATER, 80 ACRES, 1976

Item	80 Acres			
	Single crop		Multiple crop	
	Cost	Total	Cost	Total
	Dol.	*Dol.*	*Dol.*	*Dol.*
Cost				
Ownership	24,128.71		24,128.71	
Operating	120,197.79		201,217.84	
Total		144,326.50		225,346.55
Returns				
Sales @ $0.45 per lb.	157,525.20		86,040.90	
Sales @ $0.50 per lb.			188,428.00	
Total		157,525.20		274,458.90
Net returns		13,198.70		49,122.35
Net returns on annual basis		6,599.35		22,671.85
Percentage return on average investment		8.3		28.4
Percentage return on ownership capital		62.8		215.8
Principal Payment (less depreciation)		5,753.14		5,753.14
Cash spendable income		846.21		16,918.71
Net annual return per land acre		82.49		283.39

supplies are reduced and alternate sales outlets are available to live haulers. During the spring and summer, prices normally rise at least $0.05 per pound above the fall low. Production from the multiple crop system has two of three crops available for harvest during the spring and summer. Increased net returns are thus due to increased quantity of fish and higher prices for two-thirds of the crop.

Net returns represent the difference between total costs and total returns. On an annual basis, $6,599.35 was available from single crop on 80 acres. Net returns, which theoretically can be withdrawn without altering the scope of the business, are a payment to land, unpaid family labor, capital, and management used in production. In the present analysis, interest on investments in land and capital items is included in the budget. Principal payments on these items must be withdrawn from net returns to determine cash spendable income.

Under normal budget conditions a percentage return to average capital is computed. Average capital investment is a theoretical value and does not precisely apply to any production year. Average capital for depreciable items is computed by summing original value and the salvage value and dividing by two. Since none of the investment items had a salvage value, the value of non-depreciable items was added to one-half of the value of the depreciable items to derive average capital.

The single crop system had an 8 percent return on average capital. Only a small proportion of average capital represented ownership capital.

Interest on borrowed capital is repaid in the cost sector, thus returns to ownership capital are 62.8 percent for the single crop. The principle of using borrowed capital to increase returns on ownership capital is called "leverage." Only 10 percent of the average capital is provided by the owner the first year. In subsequent years the proportion of ownership capital increases while interest payments decrease.

Cash spendable income is computed by subtracting the principal payment on loans (less depreciation) from the net annual returns. Depreciation, which is included as a non-cash fixed expense, is available for partial loan repayment on capital items. Cash spendable income is the amount the owner has available for living expenses. In the budget analysis, an additional $5,400 per year or $450 per month was included to pay for labor. Since the owner-operator also performs the labor functions, the net cash return to labor and management would be $6,264.21 or about $535 per month for the labor and risk in managing the operation.

Net returns per land acre were also computed. In evaluating alternative enterprises, each must be placed on a comparable basis. Standard measurements are returns, capital, and labor requirements per acre. The $82.49 returns per acre are relatively low on a capital investment of $1,252 per acre.

Because of higher gross returns to the same fixed costs, multiple cropping is more feasible. Since the multiple cropping system initially occupied 26 months, the annual returns are adjusted accordingly. The multiple cropping scheme pays back principal and returns almost $17,000 in cash spendable income. With the included wages, the intensified scheme yields income sufficient to attract capable personnel.

When unit size is doubled to 160 acres, net annual returns for both the single and multiple crop systems are more than doubled, Table 11. All ponds are stocked in March and harvested in November in the single crop system. The system included eight ponds with about 145 acres of water. Eight harvests have to be scheduled to coincide with the needs of processors. Under existing processing conditions each pond would nearly satisfy 1 week's needs.

The eight ponds supply processing capacity of one plant for over 1 month. Since other producers also desire to harvest in the fall, the harvest period would be longer than specified. For the multiple crop production, only one-half of the ponds are available for harvest at any

TABLE 11. BIENNIAL COSTS AND RETURNS FOR SINGLE AND MULTIPLE CROP CATFISH PRODUCTION SYSTEMS ON LEVEL LAND WITH ADEQUATE GROUND WATER, 160 ACRES, 1976

Item	160 Acres			
	Single crop		Multiple crop	
	Cost	Total	Cost	Total
	Dol.	*Dol.*	*Dol.*	*Dol.*
Cost				
Ownership	40,159.75		40,159.75	
Operating	225,593.53		387,871.35	
Total		265,753.28		428,031.10
Returns				
Sales @ $0.45 per lb.	315,050.40		172,081.80	
Sales @ $0.50 per lb.			376,856.00	
Total		315,050.40		548,937.80
Net returns		49,297.12		120,906.70
Net returns on annual basis		24,648.56		55,803.10
Percentage return on average investment		17.3		39.2
Percentage return on ownership capital		123.1		278.8
Principal Payment (less depreciation)		10,831.81		10,831.81
Cash spendable income		13,816.75		44,971.28
Net annual return per land acre		154.1		348.76

one time period. Two harvest periods are in short supply months, March and May, while the remaining one is in October. Until many producers shift to spring and summer harvest, processor capacity will not be fully used and scheduling of harvest will be simplified.

The relatively close spread between costs and returns indicates the feedlot nature of catfish production. Basically the producer is purchasing a feeder catfish, providing a water feedlot environment, and attempting to add flesh for less than the cost of production. The fingerling catfish used as feeders cost over $1.00 per pound. Ultimately these fish are sold for between $0.45 to $0.50 per pound. The pounds of fingerlings stocked cost twice as much as these pounds will return. Feed conversion thus becomes a crucial issue. With feed at $215 per ton, a feed conversion rate of 4.2 will just cover feed costs. As feed conversion is lowered, other costs are covered until ultimately all economic costs are covered and profits are derived.

Once a profit per unit is gained, additional production adds to profits until diseconomies of scale are reached. The 160-acre unit exhibited economies of scale over the 80-acre unit. Net returns were approximately the same for 160 acres of single crop or 80 acres of multiple crop. In terms of investment capital, the 80-acre unit would be preferred. In terms of risk and level of management required, the 160-acre

single crop would be preferred. The 160-acre multiple crop has cash spendable income almost three times as high as single crop on the same acreage. A very high level of management and risk bearing ability is necessary to attain the production levels and profits specified for either scheme. The manager would have to arrange in advance for fingerlings and feed in the desired quantity, and of the desired quality. Marketing and harvesting would have to be coordinated with the needs of processors and live haulers.

The 320-acre unit represents the maximum size that can be operated with the production equipment and labor specified. Beyond this size unit, partial budgeting would be necessary to determine if additional returns would warrant the increased costs. The single crop system on 320 acres probably is not realistic with the proposed cost structure. Very close managerial supervision would be required since all the ponds would simultaneously receive a relatively high feeding rate. All 16 ponds would also be ready for harvest at the same time.

Total annual cost for the single crop system is about one-half million dollars with cash spendable income of about $39 thousand, Table 12. By increasing costs about $323 thousand, and multiple cropping, cash spendable income is increased by $62 thousand. Multiple cropping for the 320-acre unit utilizes labor and equipment more efficiently.

TABLE 12. BIENNIAL COSTS AND RETURNS FOR SINGLE AND MULTIPLE CROP CATFISH PRODUCTION SYSTEMS ON LEVEL LAND WITH ADEQUATE GROUND WATER, 320 ACRES, 1976

Item	320 Acres			
	Single crop		Multiple crop	
	Cost	Total	Cost	Total
	Dol.	*Dol.*	*Dol.*	*Dol.*
Cost				
Ownership	72,056.48		72,056.48	
Operating	438,119.33		761,189.20	
Total		510,175.81		833,245.68
Returns				
Sales @ $0.45 per lb.	630,100.80		344,163.60	
Sales @ $0.50 per lb.			753,712.00	
Total		630,100.80		1,097,875.6
Net returns		119,924.99		264,629.92
Net returns on annual basis		59,962.50		121,345.40
Percentage return on average investment		22.2		45.0
Percentage return on ownership capital		154.3		312.2
Principal Payment (less depreciation)		20,969.31		20,969.31
Returns to management		38,993.18		100,376.09
Net annual return per land acre		187.3		381.7

The 320-acre unit represents a substantial debt load for the operator. Total investment is over $300 thousand and the principal payments exceed $30 thousand per year. Some managers who would be physically and technically capable of operating a unit of this size may be psychologically unable to withstand the pressures of the debt.

Budgeting for use of own or borrowed capital is very similar. Prices and yields should be conservative and attainable with average levels of management. In addition, consideration should be given to risk factors, which include disease and parasites, climatic factors, and pump failures. Risk is minimized by considering contingency plans in the event of adverse conditions. The graveling of levees, incorporation of disease and parasite control practices, and purchase of aeration equipment are all features used to reduce risk. Insurance can also be used, but with relatively new types of production the premiums may be so high that risk is reduced in exchange for profits.

Sensitivity analysis is also necessary to indicate the stability of the profit level. The 320-acre multiple crop system includes two major assumptions that require sensitivity analysis. Price is assumed to be $0.45 for fall crops and $0.50 for spring and summer crops. Production was 2,272,224 pounds over 26 months. If production goals were reached, price could drop $0.10 per pound and all costs including the principal payment could still be met.

If price remained constant, production could decline by about 480 thousand pounds. The sensitivity analysis indicates that about 20 percent slack is built into the price and production figures. Increased input prices would cause the same results.

SUMMARY OF ALTERNATE UNIT SIZES AND PRODUCTION SCHEMES

Each of the production schemes within different unit sizes demonstrate positive net returns to management. The multiple crop scheme on 320 acres of land has the highest net returns. This unit also has the highest input requirements in terms of capital investment and variable costs.

For producers with existing units, decisions regarding changes in the production unit are based on marginal productivity. Two changes can be compared; shifting from single to multiple crop within the same unit, or addition of more production capacity. Both comparisons are made.

Producers with a single crop scheme on an existing 80-acre operation have three choices; continue to produce single crop, shift to multiple

crop, or increase size of unit and produce for either single or multiple crop. If the first alternative is chosen marginal analysis is not necessary. If the producer desires to shift to multiple crop no additional capital investment would be required. Costs would increase by $81 thousand and revenue by $117 thousand for a net revenue increase of $36 thousand, Table 13. Since no additional capital is required the cash spendable income would also increase by $36 thousand. The producer is able to spread fixed costs over more units of production.

The producer can also add an additional 80 acres to production. The alternative requires additions to land, construction, and water supply. No additional production items, beyond additional feed storage, are required. Thus, capital investment for an additional 80 acres is lower than that required for the initial 80-acre unit. Net revenue is increased by about $36 thousand or approximately 49 percent return on the additional capital investment.

If the producer simultaneously adds an additional 80-acre unit and shifts to multiple cropping, net returns are increased an additional $71 thousand with the same capital investment. Percentage return to investment increases to 145 percent. Again the economic benefits of fully utilizing fixed resources are shown. Once the fixed unit size has been established, the highest returns to capital investment can be gained by increasing net revenue from the unit.

TABLE 13. CHANGE IN CAPITAL REQUIREMENTS, COSTS, AND RETURNS FOR SINGLE CROP, MULTIPLE CROP, AND SINGLE TO MULTIPLE CROP AS UNIT SIZE IS INCREASED, 1976

Size of Unit	Single crop			Multiple crop			Single to multiple crop		
Acres	Capital	Cost	Revenue	Capital	Cost	Revenue	Capital	Cost	Revenue
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
80	—	—	—	—	—	—	—	81,010	116,943
160	74,659	121,426	157,525	74,659	202,694	274,469	—	162,277	233,887
320	148,471	244,423	315,050	148,471	405,214	548,938	—	323,070	467,775

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APPENDIX A

Calculating Principal and Interest on Loans

Whenever money is borrowed for an extended period of time, the loan is usually amortized or repaid with a series of equally spaced payments. These payments normally cover both principal and interest on the loan. For budget purposes the principal and interest must be separated. Principal payments represent a shift in ownership and an addition to net worth. Interest payments are a cost to the operation and must be repaid by the productive activity.

Individuals differ in their willingness to incur debt. The budget analysis presented in the report assumes money is borrowed to the maximum extent allowed by lending agencies. For any other level of borrowing, the principal and interest payments would be reduced.

Using the land purchase as an example: The land was valued at $350 per acre or $28,000 for 80 acres. The operator borrowed 80 percent of the assessed value of the property or $22,400 and paid the remaining $5,600 from savings. The loan was assumed to be obtained from the Federal Land Bank. Repayment was over 20 years with initial interest at 8 percent. The Federal Land Bank periodically adjusts interest rates based on the rates charged the Bank in its borrowing operations. During the first 7 years of loan repayment, interest is assumed to remain at 8 percent.

The bank or other lending agency will compute the equal payments for the borrower. The prospective operator needs to know, in advance of borrowing, the amount of principal and interest when considering alternate production plans.

When a debt is amortized, all liabilities with respect to both principal and interest are discharged by a series of equal payments. The payments are basically an annuity whose present value is the original principal of the debt. In formula form: An annuity whose present value equals $1 = \frac{1-(1+i)-n}{i}$ where i is the interest rate per period and n is the number of repayment periods. This value is also called a capital recovery factor. As it is very difficult to compute the annuity or capital recovery value, table values are available for this purpose. An example is included in Appendix Table A3. To use the table, first find the interest rate charged on the loan, in this case 8 percent. If the loan were repaid quarterly the 2 percent rate would be used. After finding the column headed by the interest rate go down the column to the number of years of repayment. The table figure for 8 percent

APPENDIX TABLE A1. REPAYMENT SCHEDULE FOR CAPITAL ITEM FOR AN 80-ACRE CATFISH FARM, 1976

Year	Interest	Principal	Total payment	Loan amount remaining
	Dol.	*Dol.*	*Dol.*	*Dol.*
		Land		
0				22,400.00
1	1,792.00	489.50	2,281.50	21,910.50
2	1,752.84	528.66	2,281.50	21,381.84
3	1,710.55	570.95	2,281.50	20,810.89
4	1,664.87	616.63	2,281.50	20,194.26
5	1,615.54	665.96	2,281.50	19,528.30
6	1,562.26	719.24	2,281.50	18,809.06
7	1,504.72	776.78	2,281.50	18,032.28
		Construction		
0				36,470.50
1	3,282.35	3,963.99	7,246.34	32,506.51
2	2,925.59	4,320.75	7,246.34	28,185.76
3	2,536.72	4,709.62	7,246.34	23,476.14
4	2,112.85	5,133.49	7,246.34	18,342.65
5	1,650.84	5,595.50	7,246.34	12,747.15
6	1,147.24	6,099.10	7,246.34	6,648.05
7	598.29	6,648.05	7,246.34	—0—
		Water supply		
0				13,198.35
1	1,187.85	1,434.54	2,622.39	11,763.81
2	1,058.74	1,563.65	2,622.39	10,200.16
3	918.01	1,704.38	2,622.39	8,495.78
4	764.62	1,857.77	2,622.39	6,638.01
5	597.42	2,024.97	2,622.39	4,613.04
6	415.17	2,207.22	2,622.39	2,405.82
7	216.57	2,405.82	2,622.39	—0—
		Production items		
0				15,048.95
1	1,354.41	3,290.73	4,645.14	11,758.22
2	1,058.24	3,586.90	4,645.14	8,171.32
3	735.42	3,909.72	4,645.14	4,261.60
4	383.54	4,261.60	4,645.14	—0—
		Pickup		
0				2,400.00
1	216.00	732.13	948.13	1,667.87
2	150.11	798.02	948.13	869.85
3	78.28	869.85	948.13	—0—
		Oxygen meter		
1	11.29	125.40	136.69	—0—

APPENDIX TABLE A2. TOTAL PRINCIPAL PAYMENT BY YEAR FOR 80 ACRE CATFISH FARM, 1976

Year	Total principal payment for the loan
	Dol.
1	10,036.29
2	10,797.98
3	11,889.92
4	11,869.49
5	8,411.83
6	9,025.56
7	9,956.05

APPENDIX TABLE A3. ANNUAL PAYMENT THAT WILL REPAY A $1.00 LOAN IN X YEARS WITH COMPOUND INTEREST AT 8 PERCENT ON THE UNPAID BALANCE[1]

Year	Capital recovery factor[2]
1	1.080
2	0.560
3	0.388
4	0.302
5	0.250
6	0.216
7	0.192
8	0.174
9	0.160
10	0.149
11	0.140
12	0.132
13	0.127
14	0.121
15	0.117
16	0.113
17	0.110
18	0.107
19	0.104
20	0.102

[1] World Bank, 1973. Compounding and Discounting Table for Project Evaluation. Gittinger, J. P. Ed. John Hopkins Press, Baltimore, Md., p. 17.
[2] Table figures rounded to three places.

and 20 periods is 0.10185. Multiply the loan amount by the table figure: $22,400 × 0.10185 = $2,281.50. The resultant amount is the total payment. Over a 20-year period, payments will equal $45,630 if interest remains at 8 percent. Total interest will exceed total principal payments by $830.

Having established the total yearly payment, $2,281.50 in our example, multiply the original loan amount by the interest payment: $22,400 × 0.08 = $1,792.00. The answer is the first year's interest. Subtract the interest from the total payment to derive the first year's principal payment: $2,281.50 — $1,792 = $489.50. Reduce the original loan amount by the principal payment: $22,400 — $489.50 = $21,910.50. For the second year the interest is charged for the reduced loan amount: $21,910.50 × 0.08 = $1,752.84. The procedure is continued as for the first year until the entire debt is retired.

Lending agencies often allow payments on the principal to be delayed under adverse conditions. In most cases, however, the interest payments must be made. In production procedures where principal payments cannot be met from first year's cash flow the producer should arrange for paying only interest with principal payments delayed until the second year.

APPENDIX B

Estimating Growth Rates for Production Schemes

Three production items strongly influence the schedule of production: the number and size of fingerlings stocked and the conversion ratio of feed to fish flesh. To produce marketable size fish within the specified production period, all three factors interact. Initial stocking weight is a function of the number and length of fingerlings stocked. A length-weight table for channel catfish is included as Appendix Table B1. The weights used are averages and will vary with the condition of the fingerlings stocked.

Fish do not have the same conversion rate throughout the growth cycle. Some experimental evidence indicates fish should be fed at a lower rate as body size increases. During the growing season the operator can adjust feeding rates depending upon the actual growth rate of the fish. If the precise conversion ratio that the fish would attain was known in advance it could be used to make precise estimates of feed requirements. Lacking precise data, the manager must use a conservative conversion ratio as an estimate. The method of estimating the growing system and feed requirements for System 1 are used as an example.

APPENDIX TABLE B1. LENGTHS AND AVERAGE WEIGHTS PER THOUSAND OF CHANNEL CATFISH GROWN IN PONDS

Total length	Average weight per thousand fish
In.	*Lb.*
1	1.3
2	3.5
3	10
4	20
5	32
6	60
7	93
8	112
9	180
10	328
11	395
12	509
13	656
14	850
15	1,090
16	1,290
17	1,432
18	1,750
19	2,200

APPENDIX TABLE B2. TOTAL POUNDS AND AVERAGE WEIGHT PER FISH BY MONTH FOR THE 80-ACRE UNIT BY PRODUCTION SYSTEMS, 1976

Month	System 1 Total	System 1 Lb./fish	Month	System 2 Total	System 2 Lb./fish
	Lb.	*Lb.*		*Lb.*	*Lb.*
Stocking	16,045	0.18	Stocking	16,045	0.18
May	23,105	0.26	October	24,099	0.27
June	34,697	0.39	November	26,218	0.29
July	52,017	0.59	December	28,559	0.32
August	77,856	0.88	January	31,055	0.35
September	99,346	1.12	February	33,517	0.37
			March	44,280	0.49
			April	76,515	0.86
			May	91,819	1.03

Month	System 3 Total	System 3 Lb./fish	Month	System 4 Total	System 4 Lb./fish
	Lb.	*Lb.*		*Lb.*	*Lb.*
Stocking	8,290	0.09	Stocking	8,290	0.09
June	15,006	0.17	April	13,816	0.16
July	18,663	0.21	May	22,889	0.26
August	27,935	0.31	June	33,839	0.38
September	40,736	0.46	July	50,626	0.57
October	60,860	0.68	August	76,547	0.86
November	66,049	0.74	September	91,856	1.03
December	71,878	0.80			
January	78,214	0.88			
February	84,416	0.95			
March	96,609	1.08			

Month	System 5 Total	System 5 Lb./fish
	Lb.	*Lb.*
Stocking	5,680	0.03
March	8,482	0.05
April	13,225	0.07
May	21,593	0.12
June	31,903	0.18
July	47,102	0.27
August	70,340	0.40
September	104,183	0.50
October	156,275	0.88
November	175,028	0.99

System 1 is stocked with 9-inch fingerlings weighing 180 pounds per thousand. The two ponds are stocked with 16,045 pounds of fish that are fed at 3 percent of body weight 6 days a week. Feeding is adjusted every 2 weeks. Thus the fish are initially fed about 480 pounds of feed a day or 5,760 pounds of feed over the 2-week period. The expected feed conversion is 1.8; therefore, the fish should weigh 19,245 pounds at the end of 2 weeks. Feeding is then adjusted to the increased weight. The process is continued until the fish reach harvestable size.

In order to reduce risk of low oxygen in a pond some researchers recommend feeding at 3 percent of body weight until 35 pounds an acre of feed is reached. The feeding is continued, holding feed constant at 35 pounds an acre a day until the fish reach harvestable size. That amount represents a pond weight of about 1,200 pounds an acre. Very close management and monitoring of water quality must be carried out at higher levels of feeding.

The prospective producer might initiate production with the single crop system and reduced feeding rates. As the operator gained experience in production he could change to multiple crop and higher feeding rates. The actual amount of feed used is the same under either system, only the length of the growing period and interest payments change with the reduced feeding levels.

APPENDIX C

Estimating Input Requirements and Operating Costs

Before budget analyses can be performed, estimates of both costs and returns must be made. While these estimates are theoretical, they should be based on data from existing operations or from Experiment Station research results. Data used in the study came from both sources.

The first step in establishing input requirements is to determine which inputs are necessary for production. To raise catfish on level land, all operations will require fingerlings, feed, pumping, some vehicle for transportation and feeding, and labor. Some operations will require inputs for disease and parasite control and all budgets should include this eventuality. After listing each input, the price per unit must be established. Some items have a seasonal price change which must be included.

Price estimation should include the trend over several years. Outlook reports are useful in estimating future changes in prices. General inflation must also be considered. The relationship of input to product prices also should be considered. Has the price of catfish moved in the same direction as feed, fingerling, and other input prices? Conservative price estimates should be used in the budget. For example, feed prices were declining during 1976 and were at about $190 per ton during the survey period. Prices had been much higher and the general trend would indicate an increase in the future. Thus a price of $215 per ton was used. The same basis was used for other input prices. The prices for input items are listed in Table 5.

APPENDIX TABLE C. OPERATING COSTS FOR AN 80-ACRE CATFISH UNIT ON LEVEL LAND WITH ADEQUATE GROUND WATER, BY SYSTEM BY MONTH, 1976

Month	Fingerling	Feed	Fuel				Labor	Total
			Pumping	Tractor	Pickup	Boat		
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
System 1								
April	—	—	292.70	12.00	24.45	6.50	450.00	785.65
May	11,981.25	1,365.25	285.40	9.15	12.28	3.25	275.00	13,931.58
June	—	2,242.45	336.60	11.18	12.27	3.25	275.00	2,880.75
July	—	3,349.70	347.60	25.74	12.28	3.25	275.00	4,013.57
August	—	5,000.90	356.70	41.56	12.27	3.25	275.00	5,689.68
September	—	4,155.95	340.20	39.61	12.28	3.25	275.00	4,826.29
Total	11,981.25	16,114.25	1,959.20	139.24	85.83	22.75	1,825.00	32,127.52
System 2								
October	11,981.25	1,558.75	135.40	9.60	12.27	3.25	275.00	13,975.52
November	—	412.80	—	6.95	12.28	3.25	275.00	710.28
December	—	447.20	—	7.03	12.27	3.25	275.00	744.75
January	—	485.90	—	7.12	12.28	3.25	275.00	783.55
February	—	475.15	—	7.10	12.27	3.25	275.00	772.77
March	—	2,081.20	—	10.80	12.28	3.25	275.00	2,382.53
April	—	4,297.85	—	15.93	12.27	3.25	275.00	4,604.30
May	—	4,899.85	139.00	23.32	12.28	3.25	275.00	5,352.70
Total	11,981.25	14,658.70	274.40	87.85	98.20	26.00	2,200.00	29,326.40
System 3								
June	9,318.75	804.10	190.20	7.85	12.27	3.25	275.00	10,611.42
July	—	1,201.85	347.60	8.77	12.28	3.25	275.00	1,848.75
August	—	1,793.10	356.70	10.14	12.27	3.25	275.00	2,450.46
September	—	2,476.80	338.80	23.72	12.28	3.25	275.00	3,129.85
October	—	3,893.65	135.40	39.00	12.27	3.25	275.00	4,358.57
November	—	1,004.05	—	8.32	12.28	3.25	275.00	1,302.90
December	—	1,126.60	—	8.60	12.27	3.25	275.00	1,425.72
January	—	1,225.50	—	8.83	12.28	3.25	275.00	1,524.86
February	—	1,199.70	—	8.77	12.27	3.25	275.00	1,498.99
March	—	2,358.55	—	11.45	12.28	3.25	275.00	2,660.53
Total	9,318.75	17,083.90	1,368.70	135.45	122.75	32.50	2,750.00	30,812.05

Continued

Appendix Table C, continued

Month	Fingerling	Feed	Fuel: Pumping	Fuel: Tractor	Fuel: Pickup	Fuel: Boat	Labor	Total
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
System 4								
April	9,318.75	1,083.60	—	8.50	12.27	3.25	275.00	10,701.37
May	—	1,775.90	139.00	10.10	12.28	3.25	275.00	2,215.53
June	—	2,167.20	190.20	17.00	12.27	3.25	275.00	2,664.92
July	—	3,347.55	347.60	25.73	12.28	3.25	275.00	4,011.41
August	—	4,641.85	356.70	40.72	12.27	3.25	275.00	5,329.79
September	—	3,136.85	338.80	25.24	12.28	3.25	275.00	3,791.42
Total	9,318.75	16,152.95	1,372.30	127.29	73.65	19.50	1,650.00	28,714.44
System 5								
March	8,875.00	543.95	292.68	13.26	24.00	6.50	450.00	10,205.39
April	—	1,085.75	292.68	14.52	24.00	6.50	450.00	1,873.45
May	—	1,492.10	278.05	15.47	24.00	6.50	450.00	2,266.12
June	—	1,995.20	380.48	16.64	24.00	6.50	450.00	2,872.82
July	—	2,941.20	695.12	30.84	24.00	6.50	450.00	4,147.66
August	—	4,495.65	713.41	46.46	24.00	6.50	450.00	5,736.02
September	—	6,548.90	680.54	51.22	24.00	6.50	450.00	7,761.16
October	—	10,079.20	270.68	59.44	24.00	6.50	450.00	10,889.82
November	—	3,629.20	—	30.55	24.00	6.50	450.00	4,140.25
December	—	—	146.34	12.00	24.00	6.50	450.00	638.84
January	—	—	146.34	12.00	24.00	6.50	450.00	638.84
February	—	—	292.68	12.00	24.00	6.50	450.00	785.18
Total	8,875.00	32,811.15	4,189.00	314.40	288.00	78.00	5,400.00	51,955.55

Apportioning costs on a monthly basis are based on biological and climatic factors. The growth rate of the fish determines the feed requirements. The weather determines pumping necessary to replace evaporation. Tractor use is based on feeding, maintenance, and an estimated quantity of aeration during times of heavy feeding. Other costs are equally apportioned to ponds.

One cash flow table in the text, Table 6, cannot be precisely derived from the appendix tables. The multiple production scheme begins with System 1 in April and is joined by System 3 in May. System 3, however, is repeatable, while System 1 was introduced only to improve cash flow in year 1. For this reason the pond filling costs for System 3 are included in cash flow but excluded from the appendix table.

The production could start with any of the systems by adding initial filling costs. Pumping costs were $1.35 per hour and 866 hours were required to fill an 80-acre unit at a cost of $1,169. This cost can be spread over several months since the ponds do not have to be full before stocking. The ponds should be filled during winter or spring when pumping to replace evaporation is reduced. If pond construction was completed in the summer, the ponds could be half filled in September and System 2 started. During the winter, the ponds could be gradually filled. Systems 3 and 4 would follow as shown in the appendix tables. The ponds would then be drained and restarted with System 2. The production could also start with System 3 or 4. Only systems 1 and 5 are nonrepeatable. System 1 is a one time start up production used to increase cash flow for the example in the text. System 5 is a single crop per year example.

Several operating costs included in the budget are excluded from the tables; chemical costs, repairs and maintenance, and taxes and insurance. Each of these items have aspects of fixed costs. Chemicals are ordered in advance to be on hand if needed. The precise month of need will vary for different operators. Repairs and maintenance include tune-ups on motorized equipment, welding, replacement of worn or broken parts and other items. The occurrence of breakdowns is almost random and can only be assigned as an advance fixed charge that will occur during the year. These charges can be apportioned to each system, but it is easier to include them with ownership cost as a reduction from net cash returns.

APPENDIX D

Estimating Labor Requirements

Catfish production is not labor intensive. As with a cattle or swine feedlot, labor is used primarily for feeding, maintenance, and disease

APPENDIX TABLE D1. LABOR REQUIREMENTS FOR AN 80-ACRE CATFISH FARM WITH LEVEL LAND AND ADEQUATE GROUND WATER WITH MULTIPLE CROPPING, 1976

Month	Job description						Maintenance			
	Stocking	Harvest	Feeding	Aeration	Disease control	Oxygen reading	Pond	Equipment	Misc.[1]	Total
	Hr.	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*
April	—	—	—	—	—	—	12	8	12	32
May	24	—	34	—	13	60	15	10	20	176
June	24	—	38	—	13	60	15	10	22	182
July	—	11	—	16	13	60	15	10	31	156
August	—	—	26	12	13	60	15	10	24	160
September	—	96	26	12	13	60	15	10	22	254
October	24	—	22	6	13	60	15	10	11	161
November	—	—	14	—	13	60	15	8	4	114
December	—	—	14	—	13	60	15	8	4	114
January	—	—	14	—	13	60	15	8	4	114
February	—	—	14	—	13	60	15	8	4	114
March	—	96	41	—	13	60	15	8	4	237
April	24	—	43	—	13	60	15	10	4	169
May	—	96	46	3	13	60	15	10	11	254
June	24	—	27	3	13	60	15	10	14	166
July	—	—	41	6	13	60	15	10	23	168
August	—	—	45	12	13	60	15	10	24	179
September	—	96	44	12	13	60	15	10	22	272
October	24	—	23	6	13	60	15	10	19	170
November	—	—	14	—	13	60	15	10	6	118
December	—	—	14	—	13	60	15	10	6	118
January	—	—	14	—	13	60	15	10	6	118
February	—	—	14	—	13	60	15	10	5	117
March	—	96	41	—	13	60	15	10	5	240
April	—	—	40	—	13	60	15	10	4	142
May	—	96	42	—	13	60	15	10	11	247
Total	144		691		325	1,500	387		322	4,292

[1] Pumping, buying feed, supplies, etc.

APPENDIX TABLE D2. LABOR REQUIREMENTS FOR AN 80-ACRE CATFISH FARM WITH LEVEL LAND AND ADEQUATE GROUND WATER WITH SINGLE CROPPING, 1976

Month	Job description						Maintenance			Total
	Stocking	Harvest	Feeding	Aeration	Disease control	Oxygen reading	Pond	Equipment	Misc.	
	Hr.	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*
January	—	—	—	—	—	—	12	8	8	28
February	—	—	—	—	—	—	15	8	12	35
March	48	—	14	—	23	60	15	10	12	182
April	—	—	14	—	13	60	15	10	12	124
May	—	—	14	—	13	60	15	10	12	124
June	—	—	26	—	13	60	15	10	14	138
July	—	—	28	6	13	60	15	10	22	154
August	—	—	32	12	13	60	15	10	23	165
September	—	—	36	12	13	60	15	10	22	168
October	—	—	24	12	13	60	15	10	11	145
November	—	192	18	6	13	30	15	10	5	289
December	—	—	—	—	—	—	15	8	8	31
Total	48	192	206	48	127	510	177	114	161	1,583

control. Feed distribution can be controlled by the speed of the tractor when using a blower feeder powered by a tractor P.T.O. During the feeding operation, the manager can check for signs of disease and early signs of areas which need maintenance. The labor times used in the tables are derived from many sources, primarily personal communications with catfish producers.

As unit size increases, labor time does not increase proportionally. Oxygen reading, disease control, and equipment maintenance would increase only slightly. For the 320-acre unit, labor would approach or slightly exceed 200 hours per month during the summer.

The labor table presently contains 96 hours of labor for each harvest period. The harvest budget includes 83 hours per harvest per pond. The harvest budget does not include the manager's labor, however. The 96 hours represent the manager and one part-time laborer for 24 hours each per pond. The manager may hire more than one laborer since feeding must continue in the remaining ponds.

Basically, the labor estimates indicate one man can perform all labor required except harvest on a 320-acre unit. The budgets are constructed with payment for full-time labor, however, and managers may elect to operate larger units with additional help. Maintenance and other tasks often require more than one person, although the number of hours required would not justify hiring additional labor.

APPENDIX E

Harvest Costs

Catfish producers can contract for custom harvest or purchase harvesting equipment for their own operation. A third alternative is cooperative purchase of equipment by several producers. Essentially the same amount of equipment is required for harvesting one or numerous ponds. Labor costs, of course, vary with the size of pond, the amount harvested per pond, and the number of ponds harvested. Much research is underway to improve harvesting methods, but in 1976 the following method was used.

A seine approximately one-third longer than the width of the pond was set. Haul lines were run through snatch blocks and attached to a line hauler. A boat was used to keep the mud line from cutting into the pond bottom. After pulling the seine, smaller cutting seines were used to concentrate the fish. The fish were dipped into a brailing basket and transported by crane to the hauling truck. Two seine hauls

were normally required with a portion of the fish remaining overnight in a live car (floating net cage) when the pond harvest exceeded the capacity of the hauling truck.

The capital investment items required for harvesting ponds of the size specified in the budget are listed in Appendix Table E1. For ponds with different dimension, the seine length could change. The tractors in the farm budget could be used to pull the seine replacing the line hauler. Additional savings in capital, with corresponding increases in labor, could occur by eliminating the storage reel, snatch blocks, seine platform and motor, and seine platform trailer. The total saving of $6,500 would represent a decrease of $707 in yearly depreciation.

Fixed costs represent more than 50 percent of total cost for the 80-acre unit, Appendix Table E2. The labor requirement while low is intensified over a 2-day period for each harvest. In addition to labor, the pump and aerator are normally operated to reduce oxygen stress on the crowded fish. Operating costs are directly proportional to the number of harvests. For the 80-acre single crop, harvest costs per pound of fish harvested was about $0.03. Costs decreased for all other levels of production with a low of less than $0.01 per pound for the 320-acre multiple crop.

If partial harvesting was incorporated into the system, ownership costs would remain constant while operating costs would increase. The economic benefits from partial harvesting would have to exceed the additional harvesting costs. Benefits include improved cash flow and lower operating interest, a more uniform product, and improved feed conversion. The major benefits, however, would accrue by allowing a higher initial stocking density. Partial harvesting then would be used when pond capacity was reached. Overall harvest weight per acre would be increased.

Owning harvesting equipment allows harvest when the ponds are ready instead of scheduling with contract harvesters. In addition, sales to live haulers are expedited when the producer has his own equipment. Each producer should evaluate his own situation with respect to the quantity of fish and number of ponds he expects to harvest. Excluding repairs and maintenance, annual variable costs per pond are about $230. Annual ownership costs including repairs and maintenance are about $7600. More than 150,000 pounds of fish are required to reduce fixed costs below $0.05 per pound.

APPENDIX TABLE E1. CAPITAL INVESTMENT REQUIREMENTS FOR HARVESTING EQUIPMENT FOR PONDS ON LEVEL LAND WITH ADEQUATE GROUND WATER, 1976

	Unit	No/units	Cost/unit	Total cost	Yr/hr life	Salvage value	Depreciation year	Average capital
		No.	*Dol.*	*Dol.*	*No.*	*Dol.*	*Dol.*	*Dol.*
Harvesting								
Hand seine with (10 ft.	200 ft.	1	468.00	468.00	5	0	93.60	234.00
funnel and loop 1" mesh)			29.95	29.95	5	—	6.00	14.95
Hand seine without 10 ft.	200 ft.	7	468.00	3,276.00	5	—	655.20	1,638.00
funnel and loop 1" mesh)								
Hand line 3/4	linear ft.	600	.89	534.00	5	—	106.80	267.00
Storage reel (1,000 ft. capacity)	each	1	1,500.00	1,500.00	5	—	300.00	750.00
Line hauler (P.T.O.)	each	4	1,200.00	1,200.00	10	—	120.00	600.00
Snatch blocks	each	4	30.00	120.00	10	—	12.00	60.00
Cutting seine (6' with 1" mesh)	ft.	50	1.72	86.00	5	—	17.20	43.00
Seine supports	each	20	6.00	120.00	10	—	12.00	60.00
Live car (30,000 lb. capacity)	each	2	235.00	470.00	5	—	94.00	235.00
Brailing basket (450 lb. capacity)	each	1	55.50	55.50	5	—	11.10	27.75
Crane (25' reach 500 lb. capacity)[1]	each	1	2,500.00	2,500.00	10	—	250.00	1,250.00
Waders — chest high	pr.	4	79.25	317.00	3	—	105.67	158.50
Dip nets	each	4	4.95	19.80	3	—	6.60	9.90
Scales (500 lb. capacity)		1	375.00	375.00	10	—	37.50	187.50
Seine platform and motor 7' x 20' x 18' with 20 H.P. motor			2,000.00	2,000.00	8	—	250.00	1,000.00
Seine platform trailer			1,750.00	1,750.00	10	—	175.00	875.00
Total investment				14,821.25			2,252.67	7,410.60

[1] Trailer mounted

APPENDIX TABLE E2. HARVEST COSTS FOR SINGLE AND MULTIPLE CROPS FOR CATFISH FARMS ON LEVEL LAND WITH ADEQUATE GROUND WATER BY LAND ACREAGE, 1976

Item	80 Acres		160 Acres		320 Acres	
	Single cost	Multiple cost	Single cost	Multiple cost	Single cost	Multiple cost
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
Biennial ownership[1]						
Depreciation	4,505.34	4,880.79	4,505.34	4,880.79	4,505.34	4,880.79
Interest[2]	1,333.91	1,445.07	1,333.91	1,445.07	1,333.91	1,445.07
Total	5,839.25	6,325.86	5,839.25	6,325.86	5,839.25	6,325.86
Biennial operating						
Labor[3]	1,660.00	2,490.00	3,320.00	4,980.00	6,640.00	9,960.00
Fuel[4]	160.00	240.00	320.00	480.00	640.00	960.00
Repairs and maintenance	2,172.00	2,353.00	2,172.00	2,353.00	2,172.00	2,353.00
Interest[5]	30.00	38.15	43.60	58.60	70.90	99.50
Total	4,022.00	5,121.15	5,855.60	7,871.60	9,522.90	13,372.50
Total cost	9,861.25	11,447.01	11,694.85	14,197.46	15,362.15	19,698.36
Cost per pound	0.028	0.020	0.018	0.012	0.011	0.009

[1] 26 months for multiple cropping
[2] 9% on $7,410.60 average capital
[3] 83 hours per harvest per pond at $2.50 per hour
[4] fuel per harvest per pond
tractor — 16 hours pumping
3 hours seine hauler
1 hour seine reel
20 hours @ 2 gal./hr. @ $0.50 per gal.
[5] 9% for 1 month at each harvest.