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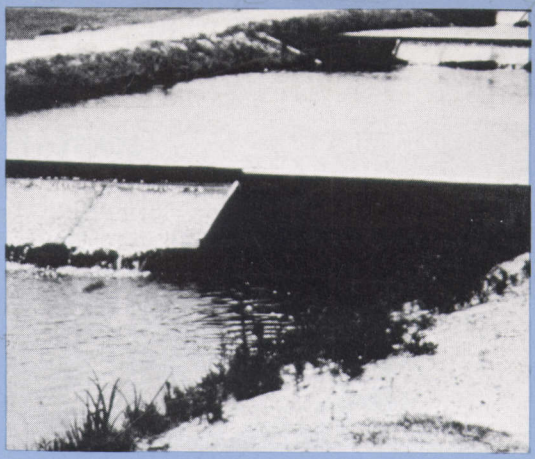
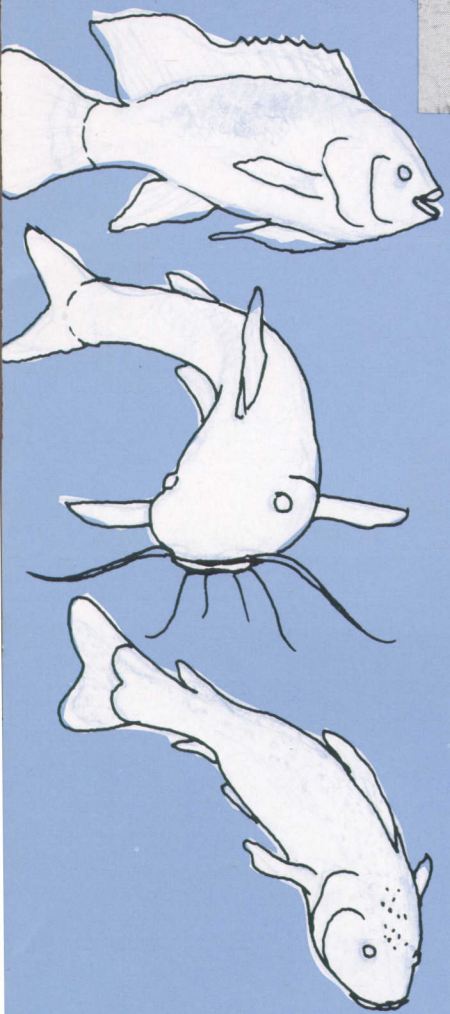
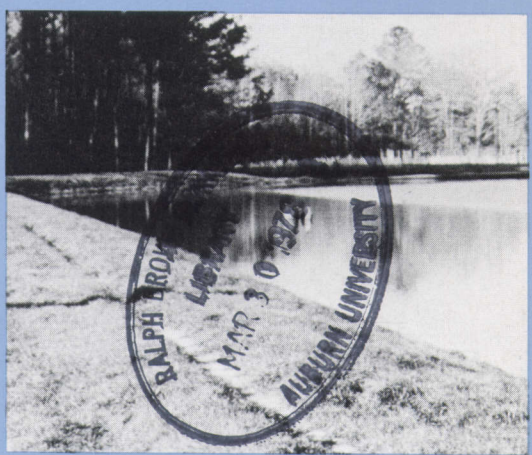




Budgeting For Selected Aquacultural Enterprises



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CONTENTS

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BUDGETING FOR SELECTED AQUACULTURAL ENTERPRISES*

KENNETH W. CRAWFORD and E. W. McCOY**

INTRODUCTION

THE CULTURE of catfish species in the U.S. has expanded greatly during the last 15 years. Essentially, there are three basic methods of production. First, many producers enjoy raising catfish for home consumption and mainly as a hobby. These people are generally very small scale operators, sometimes with only a single pond or less than a surface acre of water. The second method of production is for the recreational market. Catfish are produced for fee fishing ponds to satisfy this demand. If this type producer desires to minimize his marketing functions, the output will be sold to other operators, who may stock only catfish or a variety of species, depending upon the demand of their customers. The other production method is for commercial food fish processors. In these operations the producers perform either few or none of the marketing functions. Sometimes farmers harvest and deliver live fish to a processing plant, but often the processor provides a harvest crew and transportation (10).

Regardless of the distribution mode, catfish culture is capital intensive. Even if inputs are a minimum, fixed capital expenditures are high. In the U.S., some type of impoundment usually must be constructed using practically all machine labor. Production for recreational and food fish markets usually require relatively high amounts of variable capital expenditures, especially if formulated rations are fed to achieve a shorter growing period.

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*This report is derived from: K. W. Crawford, 1976, An Economic Analysis of Aquacultural Production in West-Central Alabama, 1973-74. Unpublished Master of Science thesis, Auburn University, Auburn, Alabama; presented as a contributing part of Hatch 630 (S-83), Develop and Improve Production and Management Systems for Freshwater Animals Cultured for Food.

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Few potential producers have enough liquid assets to build ponds, thus, some type of credit has to be used. Capital for land may be acquired through long-term financing arrangements. Equipment and other depreciable structures are often obtained with the use of borrowed capital for an intermediate length time period. Also, short-term loans are frequently needed to finance the day-to-day operations. Managers of financial institutions should look beyond an individual's character and collateral when deciding whether to lend money. Also, borrowers desire to succeed in their ventures and certainly do not wish to create financial burdens. Thus, both creditors and potential debtors want to carefully evaluate an innovative enterprise such as catfish production before any commitments are made.

The credit needs vary among individuals, thus, lenders must consider potential borrowers' applications separately. For example, one borrower may need only to finance the pond construction. Through careful planning and financial evaluation this individual expects to have adequate amounts of equity capital available for operating purposes. So, the expected returns would indicate the farmer's capability to repay the pond construction loan and a residual payment to his land, management, and equity capital.

The purpose of this report is to present a means of evaluating alternative fish farming enterprises from an economic standpoint. The examples are as generalized as possible, i.e., based upon "average" conditions. However, the basic procedures do not change, and any individual should be able to analyze fisheries enterprises for his situation in the same manner. Prior planning of this type should result in better decision-making.

A basic assumption for this analysis considers fish production as an auxiliary enterprise on an existing farm that already has row crops and/or livestock, as is often the case in catfish growing areas *(4)*. Such a farm should have some type of logical organization. The combinations of enterprises may have been determined by mathematical programming techniques often performed by economists, or simply by intuition, personal preferences, and goals of the individual farmer. For example, the farmer may have to minimize his losses in the immediate time period, while working toward a goal of maximized net farm income in the long run.

Using mathematical procedures called linear programming, the optimum combination of enterprises that would provide the maximum net farm income can be determined, based upon available resources and production constraints. Budgets for each enterprise considered are essential for this process. These consist of the expected costs and returns from the production of the enterprises considered; both those

currently being produced and others that are feasible. Enterprise budgets are also necessary for simplified programming, a less complicated form of linear programming, which achieves essentially the same results *(2)*. In addition, budgets can be used for comparative purposes in enterprise evaluation. Even if none of these organization techniques is employed, the most important thing is that prior planning is initiated.

The method of economic evaluation exemplified in this report is partial budgeting. Partial budgeting does not pertain directly to the overall farm organization, but considers only the economic effects of making changes within the present structure of operations. For example, if a farmer has a swine enterprise on his farm, there are several options that he can investigate in an attempt to improve net farm income. He can change the source of feed, build a feed mill, or change the design of the growing units, for example. All of these things are minor changes, and economic considerations should be made via partial budgeting to determine if it would be more profitable to implement any or all the options available.

The first step in the partial budgeting process is to carefully plan the desired changes. Next, the additional receipts and reduced costs, the net gain, all of which reflect the changes, are computed. Then, the reduced receipts and added costs, the net loss, are calculated. The difference between these two figures is the net change in returns, which is used to make a decision whether or not to implement the proposed modifications *(3)*.

BASIC ASSUMPTIONS AND PROCEDURES

A basic assumption for this analysis is that fish production is an auxiliary enterprise complementing row crops and livestock production on an existing farm. Other assumptions are that the fisheries enterprise is located on relatively rolling land with adequate watershed and favorable temperature and rainfall conditions for catfish, tilapia,[1] and trout production. Also, ground water would be available if needed. Each system considered was designed so that the physical plants were approximately the same, i.e., capable of producing about the same output under single cropping conditions for catfish.

The costs and returns presented are for the first year's operations, or the start-up period. It is desired to be as realistic as possible and to cover all expected costs. Thus, someone who knows relatively little about the economics of fish farming and wants to consider these enterprises as alternatives could use this example as a guide in his decision-

[1]Common name for *Sarotherodon* spp.

making process. In order not to present a "get-rich-over-night" picture, conservatism is used. If the results of the economic analysis are favorable under these conditions, then it is probable that an individual can make the venture even more profitable depending upon his available resources and managerial ability.

It is assumed that the necessary capital is available through local agricultural credit institutions. Loan repayment schedules are computed for all expenditures for fixed capital items. The length of loans depends upon the policies of the creditors, which is a function of the expected life of the various items *(19, 20)*. Even though it is assumed that the ponds are built on an existing farm, a loan for the portion of land required for fish production is computed. This also contributes to the conservatism of the analyses.

First, a budget is prepared for pond culture of catfish that involves cropping once per year. Next, partial budgeting is used to determine the economic feasibility of a multiple cropped system of management for the same ponds. Then a budget for a raceway system is calculated following a management program of harvesting a single crop of catfish each year. The next analysis consists of the effects of adding tilapia production to this system. Finally, the management is altered so that the facilities are fully utilized, yielding a crop each of catfish, tilapia, and trout in 1 year.

MANAGEMENT PLANS

Single cropped pond culture of catfish is the most common method of commercial catfish production in Alabama *(4)*. This technique results in a growing season during the months when climatic conditions are optimum for catfish production. The catfish would be growing at the best possible rate, other things being equal, due to the warm water temperatures, table 1 *(16)*. The ponds are drained and harvested in the fall. Then the winter rains are sufficient to refill the ponds via runoff prior to spring stocking for the next season.

The management program is changed to attain maximum utilization of existing facilities. By using a well to supplement runoff water, ponds are restocked relatively soon after harvest. Thus, three crops of catfish are grown in 2 years, table 1. The first crop is grown during essentially the same time period as the single cropped system. The other two crops have to be carried over winter during some part of the growing season. Compensation in the weight of marketable fish accounted for poorer growth during these periods *(8)*.

Polyculture in ponds was not considered in this study, although indications are that such fish culture systems are both biologically and

FIG. 1. Typical Alabama watershed catfish pond.

TABLE 1. PROPOSED TIME TABLE FOR POND CULTURES ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, 1976

System description	Date	Growing season	Activity
Ponds, 1 crop/year	April 1		Stock channel catfish
	Sept. 29-30	6 mo.	Harvest channel catfish
	Oct. 1-Mar. 31		Pond refilling & maintenance
Ponds, 3 crops/2 years	March 15		Stock channel catfish
	Sept. 15-16	6 mo.	Harvest channel catfish
	Sept. 16-30		Pond refilling (well) & maintenance
	Oct. 1		Stock channel catfish
	May 30-31	8 mo.	Harvest channel catfish
	June 1-15		Pond refilling (well) & maintenance
	June 16		Stock channel catfish
	Dec. 30-31	6½ mo.	Harvest channel catfish
	Jan. 1-Mar. 14		Pond refilling & maintenance

economically feasible (5, 18). At present, regulations are strict upon the use of exotic fish in many states, but attitudes are changing and soon this type of fish culture may be another viable alternative for farmers.

The biological feasibility of raising trout in the Southeast has been determined via several experiments (1,7,13,15). Rainbow trout were grown successfully in raceways during the winter months at Tifton, Georgia. Raceways typically are channel-like structures arranged in a stair-step configuration with water supplied from a watershed pond. Because of the design, there is adequate aeration to raise relatively large numbers of fish within a concentrated area. In most cases, water is recirculated through a reservoir after it passes through the raceways.

The first management plan for an economic evaluation of raceway culture is for singly cropped catfish. The management techniques are essentially the same as those for the singly cropped pond system. One crop of catfish is raised during the 6 months of warmest weather, table 2.

Next a modified program, which increases use of existing facilities, is developed, table 2. Channel catfish are grown in raceways following the spring stocking-fall harvesting technique. During the same time period, the reservoir is stocked with monosex tilapia, i.e., all male progeny resulting from a cross of *Sarotherodon niloticus* ♀ and *Sarotherodon hornorum* ♂. Although the species are unable to survive in water temperatures that remain below 54 F (12 C) for some length of time, the reservoir's temperature is suitable for 6 months of

FIG. 2. Aerial view of a typical raceway system.

TABLE 2. PROPOSED TIME TABLE FOR RACEWAY CULTURES ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, 1976

System description	Date	Length of growing season	Activity
Raceways, one crop per year	April 1		Stock channel catfish
	Sept. 30	6 mo.	Harvest channel catfish
	Oct. 1-March 31		Maintenance & refill reservoir
Raceways, two crops per year	April 1		Stock channel catfish
	April 2		Stock monosex tilapia
	Sept. 30	6 mo.	Harvest channel catfish
	Oct. 1	6 mo.	Harvest monosex tilapia
	Oct. 2-March 31		Maintenance & refill reservoir
Raceways, three crops per year	April 1		Stock channel catfish
	April 2		Stock monosex tilapia
	Sept. 30	6 mo.	Harvest channel catfish
	Oct. 1	6 mo.	Harvest monosex tilapia
	Oct. 2-Oct. 31		Maintenance refill raceways
	Oct. 2-March 31		Pond refilling & maintenance
	Nov. 1		Stock rainbow trout
	Feb. 28	4 mo.	Harvest rainbow trout
	March 1-March 31		Maintenance refill raceways

production *(22)*. Tilapia are filter feeders which can grow on natural food substances within the water, thus, no supplemental feed is necessary for the settling reservoir stock. Experiments conducted by Swingle during 1956-59 indicated that growth of Java tilapias was biologically feasible in Alabama, by using inorganic pond fertilization *(14)*. Monosex tilapia were successfully grown in organically fertilized earthen ponds in Northeast Brazil, as reported in 1975 *(9)*. Tilapias are excellent species for return reservoirs in raceway systems because they efficiently convert phytoplankton to flesh. Organic fertilization, in the form of non-utilized feed and metabolic wastes, of the reservoir from water recirculated through raceways provides nutrients for hybrid tilapia.

Finally, maximum use of raceway facilities is achieved by including a third species to the above plan. Approximately 1 month after the catfish harvest, rainbow trout are stocked in the raceways, table 2. Trout species require cooler water temperatures afforded by the winter months. Trout are harvested approximately 30 days before channel catfish are restocked in the raceways. Thus, the raceways are utilized year round.

DESCRIPTION OF FACILITIES

The conventional pond culture system in the analysis consists of two 5-acre production units, approximately 4 feet average depth and capable of producing about 2,500 liveweight pounds of catfish per acre. The average pond size in a recent sample of West-Central Alabama commercial catfish producers was 5.6 acres *(4)*. The pond size used in the example is convenient for processors and producers. A three-man crew provided by the processor plus three additional farm laborers can complete the harvest in a single day. The total pounds can be transported in a typical size live-haul fish truck. The producer does not have to be as concerned with oxygen problems that often occur when larger ponds are drawn down and harvesting is not completed in 1 day. The ponds for this analysis are typical watershed reservoirs. Construction is begun in September. This allows adequate time to complete the work before winter rains, which normally occur in the area, begin. In addition, runoff during the winter months completely fills the ponds, so that the first fingerlings can be stocked in the spring. Water from a drilled well is available, as required for the altered management plan in the partial budgeting analysis.

Design of the raceway system is patterned after the one currently in operation at the University of Georgia Coastal Plain Experiment Station near Tifton, Georgia, figure 3 *(7)*. Based on the general rule

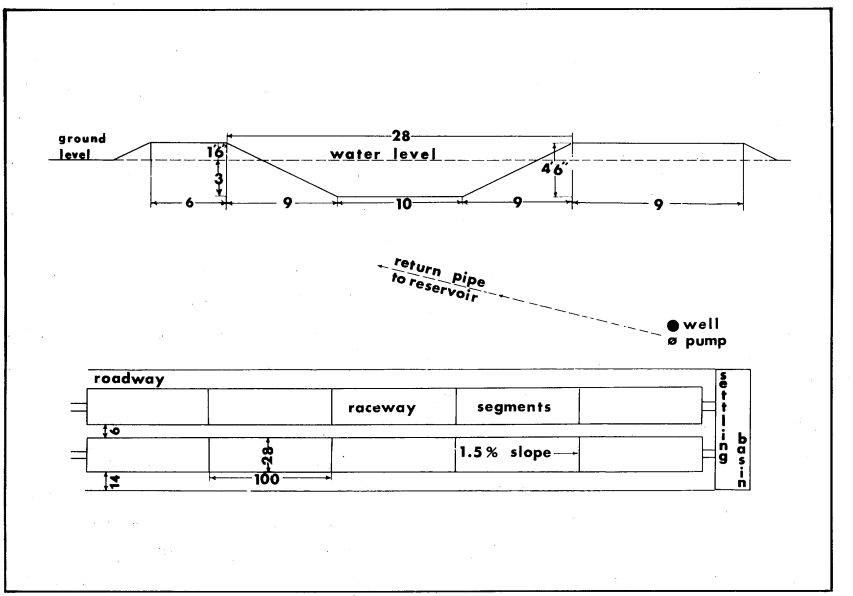

FIG. 3. Raceway system being used by Georgia's Agricultural Experiment Station.

that one segment in this type raceway system is capable of producing the equivalent poundage of a surface acre in a conventional pond, the scale of operation is approximately the same for both the pond culture system and raceway operation.

The raceway system in the analysis is closed, i.e., the water is recirculated. There are 10 raceway segments, each 100 feet in length with a 10-foot bottom width. The channel's bottom would slope about 18 inches per 100 feet, and the side slopes would be 1:2. It is assumed that the topography of the area is such that a 5-acre reservoir can be located above the head of the raceways. With this layout, in event of a power failure, an adequate supply of water would be maintained for necessary flow through raceway segments as electricity problems are rectified. The small settling basin may overflow during power failures or pump malfunctions. It is assumed that this water will not flow directly into any nearby streams. A 4 horsepower (hp) electric motor is sufficient to displace water from the settling basin back to the reservoir *(21)*. A well is located near the end of the raceway segments. The pumping system is capable of pumping either from the settling basin or from the well in the event that the reservoir needs additional water. There are many different designs and layouts for raceway systems, each depending upon the topography of the site being considered.

Construction of the raceway system would probably require a slightly longer time period than that needed for two 5-acre reservoirs. However, if work is begun in September, there should be adequate time to complete the job before winter. Utilizing the runoff during the rainy season, the reservoir and raceway segments can be filled, circumventing any pumping requirements prior to stocking in the spring for the initial crop.

MARKETING

The majority of producers in Alabama followed the management program of single cropped pond monoculture; thus, most of the catfish were harvested in the fall *(4)*.This pattern resulted in reduced inventories at processing plants during the spring and summer seasons. A practice followed by the processors was to pay higher prices for fish harvested during these low inventory periods. It is assumed that monosex tilapias could be marketed through the processors since one firm has marketed the species as a food fish from its Mississippi plant. The market demand for rainbow trout as a food fish is quite good. The manager of the plant marketing tilapias indicates trout can be sold through their outlets if supplies are available in the local area *(23)*. Since catfish numbers available for processing are low at the time of

harvest for rainbow trout, it is assumed that this species could be sold to nearby processors.

SINGLE CROPPED POND CULTURE

Table 3 has an itemized listing of the investments needed for the single cropped pond system. Pond construction costs, which include site preparation, soil moving, dam core, catch basin, pipe, valve, and fittings, were calculated to be $1,030 per acre (18). The land cost in the analysis is based on the average land value in Alabama of $300 per acre for general farm land in 1975 (17). A shed consisting of 1,000 square feet for storage is adequate for this situation. The construction cost on the structure is calculated using a rate of $0.60 per square foot. Purchase of a relift pump with attachments would be necessary for aeration (11). Most producers in a recent Alabama study attributed from 1 to 25 percent of the total use of their truck to the catfish enterprise. Thus, 12.5 percent of the cost of a one-half ton truck is used for the truck investment for the catfish enterprise (4). The total cost of $200 for the boat and electric motor is the other major investment for equipment items (18). The total capital requirement for the single cropping system is $16,315.00, table 4.

It is assumed that any capital needed for the operations can be financed through local agricultural lending agencies. Thus, the amount of the loans, the interest rates, and repayment periods are based on the current policies of such institutions (19,20). Such agencies usually do not finance the entire amount needed for these type investments. The loans for land, construction and equipment, and truck were 80 percent, 95 percent, and 75 percent, respectively, of the total cost. Thus, the total amount of loans needed for single cropped catfish pond culture was $14,924.25, table 4.

Loan repayment is computed using the declining balance method. This procedure involves charging interest on the amount of principal remaining after the previous year's principal payment has been deducted. The actual interest and principal payment on each loan is computed so that this cost can be included as an item in the budget. These repayment schedules are Appendix tables 1-4.

One of the assumptions for this report is that the net returns are representative of only the first year's operations. The reason for this is that in a realistic situation, which would involve using the declining balance procedure, the interest and principal payments vary from year to year. The amount of interest is greatest in the first year, since it is computed on the unpaid balance each year. Generally, interest on borrowed capital is deducted as an expense in an enterprise budget,

TABLE 3. INVESTMENTS AND DEPRECIATION FOR FIVE FISHERIES ENTERPRISES ON RELATIVELY ROLLING LAND, WITH ADEQUATE GROUND WATER, 1976

Item	Ponds						Raceways								
	Single cropped			Multiple cropped			One crop			Two crops			Three crops		
	Cost	Life	Depreciation	Cost	Life	Depreciation	Cost	Life	Depreciation	Cost	Life	Depreciation	Cost	Life	Depreciation
	Dol.	Yr.	Dol.	Dol.	Yr.	Dol.	Dol.	Yr.	Dol.	Dol.	Yr.	Dol.	Dol.	Yr.	Dol.
Non-depreciable															
Land	3,000	—	—	3,000	—	—	3,000	—	—	3,000	—	—	3,000	—	—
Site preparation	200	—	—	200	—	—	200	—	—	200	—	—	200	—	—
Soil moving	5,000	—	—	5,000	—	—	2,500	—	—	2,500	—	—	2,500	—	—
Dam core	200	—	—	200	—	—	100	—	—	100	—	—	100	—	—
Catch basin	2,500	—	—	2,500	—	—	1,250	—	—	1,250	—	—	1,250	—	—
Well	—			4,000	—	—	4,000	—	—	4,000	—	—	4,000	—	—
Raceways	—			—			7,000			7,000			7,000		
Total	10,900			14,900			18,050			18,050			18,050		
Depreciable															
Pipe, valve and fittings	2,400	20	120.00	2,400	20	240.00	1,200	20	60.00	1,200	20	60.00	1,200	20	60.00
Relift pump	1,500	10	150.00	—	—	—	—	—	—	—	—	—	—	—	—
Aerator attachments	90	10	9.00	—	—	—	—	—	—	—	—	—	—	—	—
Truck	625	10	62.50	1,875	10	375.00	625	10	62.50	625	10	62.50	1,250	10	125.00
Boat & electric motor	200	10	20.00	200	10	40.00	200	10	20.00	200	10	20.00	200	10	20.00
Storage shed	600	20	30.00	600	20	60.00	600	20	30.00	600	20	30.00	600	20	30.00
Pump & pipe	—		—	2,000	10	400.00	4,000	10	400.00	4,000	10	400.00	4,000	5	800.00
Corrugated aerators	—		—	—		—	270	10	27.00	270	10	27.00	270	10	27.00
Total	5,415		391.50	7,075		1,115.00	6,895		599.50	6,895		599.50	7,520		1,062.00
Total investment	16,315			21,975			24,945			24,945			25,570		

TABLE 4. LOANS FOR CAPITAL INVESTMENT ITEMS FOR TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Item	Total cost	Amount of loan	Interest rate	Repayment period	Yearly payment
	Dol.	Dol.	Pct.	Yr.	Dol.
Land	3,000.00	2,400.00	8	20	244.45
Construction	10,300.00	9,785.00	9	7	1,944.19
Equipment	2,390.00	2,270.50	9	4	700.83
Truck	625.00	468.75	9	3	185.18
Total	16,315.00	14,924.25			3,074.65

thereby affecting the net returns. The principal payments must be made from the remaining money available for family expenditures. Then, the residual represents the family's well being, before paying income taxes, since this is what is used to purchase goods and services whether they be necessities or luxuries.

The summations of the interest payments and principal payments for each year are in Appendix table 5. These figures can be substituted into the budget to compute the net returns for subsequent years after the first year. If the returns for year one are low or negative, the principal payments for the catfish enterprise have to come from other income sources, such as savings, off-farm employment, or income from the other enterprises on the farm. By computing the returns for several years, more information is available to help an individual make the decision whether or not fish farming would be profitable in the long run. For example, possibly after 3 or 4 years of production, the net returns would be high enough to offset the low returns or losses in the first 2 years.

Depreciation is a technique used to spread the cost of certain capital items over the expected life of the item. Since such items are used for several years, it would not be equitable to charge all of this fixed expense to the operations in the same years that various capital items are purchased.

Some capital investments, those associated with real property and without an estimated life, are not depreciable. Land does not wear out, thus it does not depreciate. Similarly, land improvements or structures involving changes in the land itself, such as terraces or ponds, are not depreciable, because after they are built, there may be little deterioration. In addition, the length of useful life of such real property

cannot be estimated because of the difference in management practices by individuals.

An example to explain the difference between non-depreciable and depreciable capital investments is a water well facility. The well itself is a hole bored into the ground. It neither wears out nor has an estimated useful life, therefore, it cannot be depreciated. The well actually changes the value of the real property. So, if the land is sold to another party, the well will not be filled in, but will remain as a part of the land. On the other hand, the pumping equipment and pipe used in the facility definitely will deteriorate over a period of years and has an expected life, so this investment can be depreciated.

Depreciation expense often is intangible in that it is computed only for income tax deductions. So, most of the time there is never any money in a depreciation account that can be physically accessed. However, if depreciation expense is put into a savings account, it can be used to replace capital items when their useful life has expired. Otherwise, this money is available to use on the principal payments for various loans, and worn out items have to be refinanced or purchased from the accumulated disposable family income.

In the examples, all depreciation is calculated using the straight line method, table 3. The annual depreciation expense is equal to the difference of the cost minus the salvage value, i.e., what the item would be worth at the end of its useful life, divided by the expected years of life. A salvage value of zero was used for the depreciable items in the fisheries budgets presented.

The figure used for land tax is based on an average land value of $300 per acre in Alabama, 1975. The rate was 15 percent of the assessed value times a millage rate of 30, i.e., $0.03, table 5 *(17)*.

The growing season for the single cropped pond culture occurs in those months during which conditions are optimal for growth of channel catfish. Therefore, within 6 months these fish average 1 pound.

Catfish fingerlings are available in adequate supply by various producers within the region *(10)*. The stocker fish are delivered by the fingerling producer at no extra cost. Eight-inch fingerlings are budgeted at a cost of 1 cent per inch. Approximately 2,500 fingerlings are stocked per acre plus an additional 1 percent to account for death losses *(16)*.

A floating ration of 32 percent crude protein is adequate in the feeding program. An average price for 1973-74 of $235.00 per ton is used. The feed conversion ratio for this situation is assumed to be approximately 1.7:1.0 *(, 4)*.

TABLE 5. COSTS AND RETURNS FOR TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Item	Description	Unit	Quantity	Rate	Amount
Receipts					
Marketable catfish	1.0 lb. ea.	lbs.	25,000	.45	$11,250.00
Variable costs					
Fingerlings	8" (1% mortality)	ea.	25,250	.08	2,020.00
Feed	floating, 32% CP	ton	21.25	235.00	4,993.75
Truck	½ ton	mi.	1,250	.12	150.00
Disease control	terramycin, 50 mg./cc.	cc.	5,000	.02	100.00
Algae/weed control	algaecide	gal.	.50	12.00	6.00
Parasite control	potassium permanganate	lbs.	20.0	.80	16.00
Maintenance	labor and tractor	hr.	6.0	3.20	19.20
Aeration	12,000 gpm relift pump	hr.	10.0	1.00	10.00
Seasonal labor	processor provides equipment	hr.	36.0	2.20	79.20
Misc. expenses					15.00
Interest on operating capital	9% per annum ($7,409.15)				333.41
Operator's labor		hr.	170.75	2.20	375.65
Total cash expenses					8,118.21
Fixed costs					
Land tax	$300/ac. @ 15% @ 30 mills	ac.	10.0	1.35	13.50
Depreciation	straight line method (Table 3)				391.50
Loan cost	interest				1,319.19
Total fixed costs					1,724.19
Total variable and fixed costs					9,842.40
Net returns to land, management, and equity capital					1,407.60
Principal payments (less depreciation)					1,363.97
Disposable family income					$ 43.63

The truck expense is determined on a percentage of mileage basis. An annual total of 10,000 miles is assumed to be appropriate for farm vehicles of this type. For the single cropped pond cultures, 12.5 percent of the annual mileage, the same percentage allocation as was for the truck investment, is allocated to the catfish operation at a rate of 12 cents per mile *(4)*.

Ordinarily, control of diseases, parasites, algae, and weeds would not be major cost items in a budget for catfish culture, but are considered risks. Possibly, none of these problems would occur. However, such an allocation should not be ignored. Adding these costs in a budget can be considered insurance. Terramycin is included to treat for diseases. The rate is 2.5 grams per 100 pounds of body weight for 10 days *(16)*. Based on a 10 percent probability of occurrence, the cost is 1/10 of the total expense required for one treatment. An algaecide is budgeted for control of weeds and algae *(18)*. Potassium

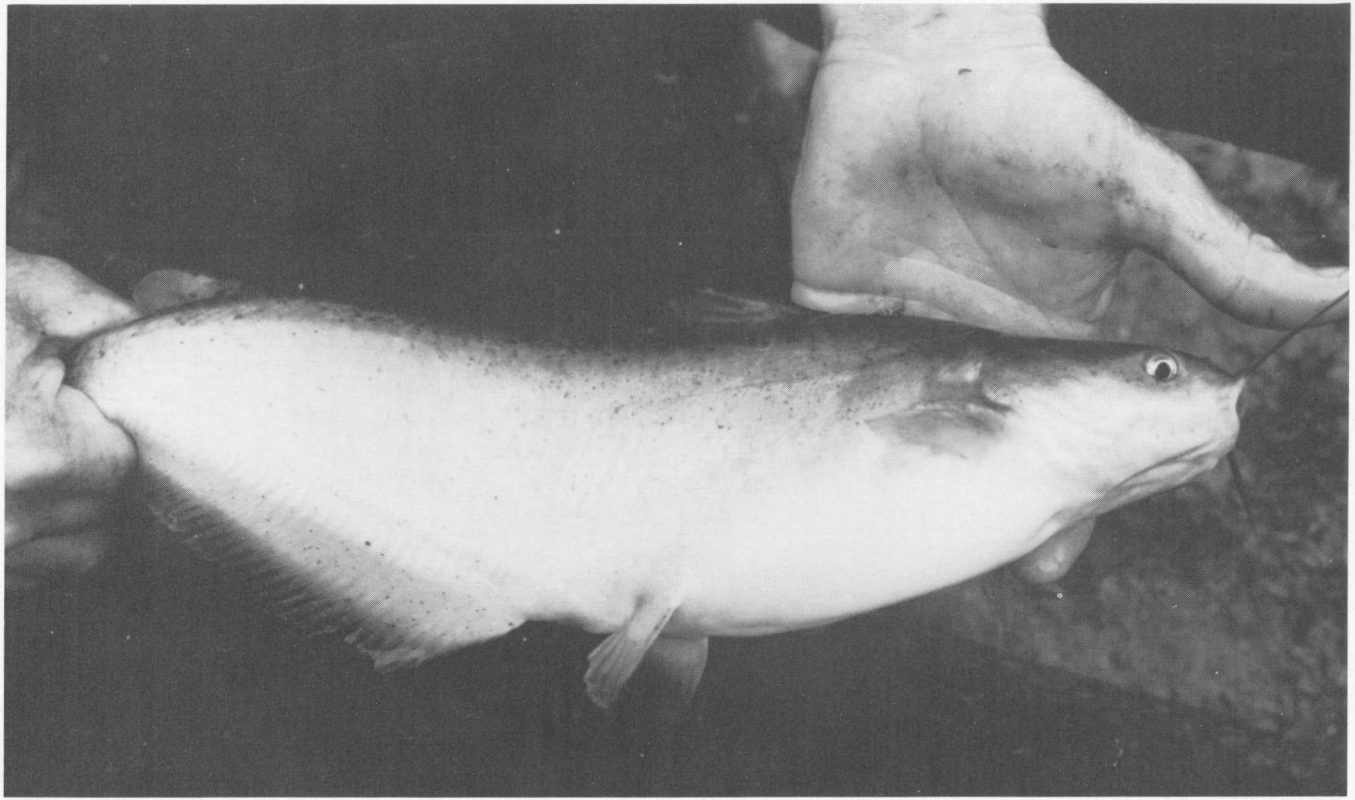

FIG. 4. Market-sized channel catfish.

permanganate is included for treatment of parasites at a rate of 2 ppm, based on the same 10 percent probability of occurrence *(6)*.

Another minor cost item in the budget is maintenance. This is allocated on an hourly basis at the minimum wage rate for farm labor, $2.20 per hour, and includes the general upkeep of the area such as mowing, and fence repairs. An additional $1.00 per hour is necessary to operate an average size farm tractor. This is calculated using a gasoline consumption rate of 2 gallons per hour and current gasoline prices *(18)*.

Aeration costs are allocated using the same tractor operation figures as shown above. The relift pump has a capacity of 12,000 gallons per minute (gpm), thus, 1 hour of pumping per surface acre of pond water provides adequate aeration when needed *(11)*.

Seasonal labor involves only that required during harvest. Although processors provide the necessary harvesting equipment and transportation,the producer is required to provide some farm labor. Based on requirements determined from the sample data, labor for three men was used in the budget. Each man has to work about 6 hours per pond, thus 36 hours are needed for the two 5-acre units. Again, the current minimum wage rate for farm labor is used *(4)*.

Miscellaneous expenses simply are costs incurred throughout the production period for small items specifically related to the operation of the catfish production units. Some examples might include telephone expenses, minor medical bills, and various supplies *(18)*.

All of the above expenses account for the total operating capital necessary for the catfish enterprise. It is important to calculate an interest charge on this money, because if the funds are not actually borrowed from some lending agency, then this item must be considered an opportunity cost. The interest rate used is 9 percent per annum. But, the loan or opportunity cost would be only for 6 months, since the amount could be paid at the end of the growing season.

The last variable cost item is operator's labor. As was determined earlier, the majority of pond owners in a recent Alabama study provided all necessary labor for feeding and management of the catfish enterprise *(4)*. Usually, this was actually unpaid labor, so it was not included in the operating capital subtotal, and subsequently, no interest was charged on this item. The labor requirements by months for single cropping catfish culture in ponds are estimated in table 6 *(18)*.

After all the fixed and variable costs are accounted for, the net returns are computed. The latter figure, a residual to land, management, and equity capital, is calculated by deducting the sum of the variable and fixed costs from the total receipts. In effect, these net

TABLE 6. LABOR REQUIREMENTS FOR TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Month	Daily requirements	Other monthly requirements	Monthly total
		Hours	
April	0.50	8.00	23.00
May	0.50	—	15.50
June	0.50	—	15.00
July	0.75	5.00	28.25
August	1.00	2.00	33.00
September	1.00	12.00	42.00
October	—	3.00	3.00
November	—	3.00	3.00
December	—	2.00	2.00
January	—	2.00	2.00
February	—	2.00	2.00
March	—	2.00	2.00
TOTAL	—	—	170.75

returns are payments to the land where the catfish enterprise is located, payments to the manager for his entrepreneurship and fish culture skills, and payments to his money used for investment.

To be realistic, it is assumed that the depreciation expense is not put into a savings account. Thus, this money is available to apply to the principal payments on the borrowed capital. After deducting the net principal payment, total principal payments less depreciation, from net returns to land, management, and equity capital, the residual is the amount of disposable family income for year one, table 5. This figure, $43.63, represents the money provided by the catfish enterprise which is available to purchase the market basket of goods and services desired by the individual and his family, and to pay income taxes.

Often farmers do not pay themselves actual wages for their labor, so the value of the operator's labor in the budget could be added to the above figure. Thus, disposable family income would increase to $419.28.

MULTIPLE CROPPED POND CULTURE

Management of the pond cultures is organized so that three crops of catfish can be harvested within a 2-year period. The same basic items are budgeted, but the calculations are different from those in the previous section because of the biennial time period involved.

The investments for the multiple cropped pond cultures are slightly different due to the alterations in management, table 3. A drilled well is necessary to supplement runoff water for pond refilling. The cost of

this water supply system is $4,000. The well and pumping system is available to transfer water for aeration purposes as needed. With no special aeration equipment required, capital costs are reduced by $1,590. The truck is used over three times as much for the year-round production as it is in the single crop per year situation, so 37.5 percent of the total vehicle cost, $1,875, is allocated as the truck investment *(4)*. The remaining necessary investments are the same as for single cropped conditions. The total amount of capital needed for the multiple cropped system is $21,975.00, of which $20,051.25 can be financed through local lending agencies *(20)*. The land cost is the same as in the previous analysis, so the loan amount and repayment schedule for land does not change. The cost of construction changes to $16,300, due to the addition of the well, standpipe, valve, and fittings, and pump with pipe. The amount of this loan is $15,485. The truck allocation increases capital costs for this item to $1,875. The loan for this item is $1,406.25 for 3 years. The capital needed for production items is $800, for a boat with an electric motor and storage shed, of which $760 is financed for 4 years. The loan repayment schedules for the above changes are in Appendix tables 6-8.

The interest and principal calculations by various years of operation are necessary in order to recompute the costs and returns for operation after the first year, Appendix table 9. The first 2 years' interest is $3,351.97. Expressed annually this is $1,675.99 which is an added cost of $356.80 per year for the multiple cropped system.

Depreciation is calculated on a biennial basis, table 3. The average life figure remains unchanged from those presented in the previous analysis. These biennial figures are actually what is required in the 2-year production period involved. However, since the analysis is comparing the difference in costs of operating a single versus a multiple cropped system, the total biennial depreciation should be expressed on an annual basis. The latter figure is $557.50, an increase of $166 per year.

Each of the three crops harvested is raised during a different growing season. The first season is the traditional period of spring stocking through fall harvest. This is the time when environmental conditions are such that optimum growth occurs, i.e., water temperatures 60-95 F (15-35 C) (16). Thus, these fish reach an average of 1 pound each in 6 months. The liveweight price of $0.45 per pound is assumed for these catfish. The second growing season is such that the fish overwintered. Biological growth is retarded during the months of cool and cold water temperatures, below 54 F (12 C) (8,12). Even though feeding is done on the days having a water temperature greater than

54 F (12 C), the fish are smaller when harvested, 0.75 pounds on the average, and require a slightly longer growing period of 8 months. Since this crop of fish is harvested when processor inventories are low and the supply of market size catfish also relatively short, an additional 5 cents per pound is paid for these catfish. Thus, the liveweight price is $0.50 per pound. The final crop is harvested at the end of December, a 6½-month growing season. The growing season is one-half month longer to compensate for slowed growth in the latter part of the season due to cooler water temperatures. These fish average about 1 pound each. The market price used was $0.45 per pound, liveweight. The added production via the multiple cropping would in effect be the second crop, 18,750 pounds, liveweight. The reason is that within the 2 years involved, the other fish produced would be exactly the same, when expressed in annual terms, as would be harvested from the single cropped system, i.e., 50,000 pounds for 2 years' production equals 25,000 pounds for 1 year's production. The additional 18,750 pounds would be grown during a 2-year period, so the value added would be $4,687.50, 9,375 pounds per year, at $0.50 per pound, liveweight.

As in the previous analysis, 8-inch fingerlings are purchased at a price of 1 cent per inch, including delivery costs. A 1 percent mortality rate is assumed *(16)*. The total number of fingerlings needed is 75,750 for the biennial period, 25,250 fingerlings for each crop. This cost is $3,030 per year for fingerlings, an added cost of $1,010 per year.

Again a 32 percent crude protein floating ration is used. The same feed conversion ratio of 1.7 pounds of feed required to produce 1.0 pound of fish flesh is appropriate *(4)*. Total feed requirements are 7.97 tons more per year. The annual cost of this is $1,872.95.

Since the catfish enterprise is operated on a year-round basis, the mileage allocated to truck expense increases. The allocation is 37.5 percent, since a 12.5 percent allocation is required for a single crop system *(4)*. The annual cost would be $225, an increase of $75 over the allocation for the single cropped system.

Terramycin is used for disease control. The rate of 2.5 grams per 100 pounds body weight for 10 days is used. Based on a 10 percent probability of occurrence, one-tenth of the total cost of one treatment is included in the budget *(16)*. Three applications, one per crop, would be required. Thus, a total of 15,000 cubic centimeters (cc) is charged at $0.02 per cc. for this item. The same algaecide is used in the multiple cropped budget. However, the second growing season is such that no algaecide is needed, so 1 gallon is allocated for the other two crops *(18)*. Also, three applications of potassium permanganate, one per crop, would be necessary for control of parasites. As in the first

analysis, a 10 percent probability of occurrence and a rate of 2 ppm is adequate *(6)*. The total biennial cost for these controls is $360, $180 per year. The increased annual cost over the single cropped pond culture is $58.

The maintenance requirements for the three crop system is only twice the amount needed for the single cropping, because no mowing is necessary during the winter months. Thus, the annual cost is the same; there are no increased costs for maintenance.

Pumping is required for 30 days to refill the ponds between harvests. An additional 10 days is needed to pump an adequate volume of water for aeration purposes. A 4 horsepower motor provides enough power to pump about 1,200 gallons per minute. A daily electricity cost for the motor was calculated based on kilowatt demand and Alabama Power Company rates *(21)*. This cost includes pumping for pond

TABLE 7. COSTS AND RETURNS FOR TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, MULTIPLE CROPPING, 1976

Item	Description	Unit	Quantity	Rate	Amount
Receipts					Dollars
Marketable catfish...	1.0 lb. ea.	lb.	50,000	.45	22,500.00
Marketable catfish...	.75 lb. ea.	lb.	18,750	.50	9,375.00
Total receipts					31,875.00
Variable costs					
Fingerlings.....	8" (1% mortality)	ea.	75,750	.08	6,060.00
Feed.....	floating, 32% CP	ton	58.44	235.00	13,733.40
Truck.....	½ ton	mi.	3,750	.12	450.00
Disease control.....	terramycin, 50 mg./cc.	cc.	15,000	.02	300.00
Algae/weed control..	algaecide	gal.	1.0	12.00	12.00
Parasite control.....	potassium permanganate	lb.	60.0	.80	48.00
Maintenance.....	labor and tractor	hr.	12.0	3.20	38.40
Aeration/pumping ..	600 gpm, 4 hp motor	days	40.0	2.92	116.80
Seasonal labor.....	processor provided equipment	hr.	108.0	2.20	237.60
Misc. expenses					45.00
Interest on operating capital	9% per annum ($7,200.40)				999.46
Operator's labor			479.5	2.20	1,054.90
Total variable cost					23,095.56
Fixed costs					
Land tax.....	$300/ac. @ 15% @ 30 mills for 2 yr. ac.		10.0	1.35	27.00
Depreciation.....	straight line method for 2 years				1,115.00
Loan cost	interest for 2 years				3,351.97
Total fixed costs					4,493.97
Total variable and fixed costs					27,589.53
Net returns to land, management, and equity capital					4,285.47
Principal payments (less depreciation)					3,755.65
Disposable family income, biennial					529.82

refilling as well as aeration, so the amount is much greater than that required in the previous analysis. Annual pumping costs are $58.40 total, an increase of $48.40 for the multiple cropped system.

Seasonal labor is an increased cost to the multiple cropped system. Three men per pond are needed for 6 hours for each of the three harvests, 36 hours per harvest. There are two more harvests than in the single cropped system, so the annual costs are $118.80. The additional cost per year is $39.60.

Total miscellaneous expenses are $45 for the multiple cropped system. This is $22.50 annually, an increase of $7.50 over the single cropped system. The items for such expenses might include telephone bills, special trips to laboratories, books, etc.

Interest on the above operating capital items must be applied whether it is actual or an opportunity cost. The annual rate of 9 percent is used. Since the system produces fish in three growing periods, the interest was computed first for 6 months, then for 8 months for the second growing period, and finally for 6½ months. The total interest charged for the multiple cropped system is $999.46 or $499.73 expressed on an annual basis. The increased interest expense for the system is $166.32 per year.

It is assumed that the farm operator has adequate time to carry on other farming activities and has time remaining to provide the management for the catfish operation, including the feeding responsibilities. During the colder months, no feeding is required when water temperatures are below 54 F (12 C) *(8)*. Thus, the average daily labor requirements are less during these months. The second growing season was the only one in which the fish were overwintered. The total amount of labor needed for the biennial period is 479.5 hours, table 8 *(18)*. The labor for the first year is 250.25 hours and the second year's labor requirements are 229.25. The total labor expense is $1,054.90 for the biennial period, or $527.45 annually. The extra labor cost for this system is $151.80 per year. Since the manager provides the necessary time, this is unpaid labor, and there is no interest charged on this amount.

Next, partial budgeting is performed to analyze the economic effects of the proposed changes. The sum of the reduced receipts and the added costs are deducted from the sum of the added receipts and the reduced costs, yielding an increase of $735.13 in net returns to land, management, and capital, table 9. The total net returns available for debt payments, $2,142.73, is the sum of the single cropped net returns to land, management, and equity capital, $1,407.60, and the net change in returns resulting from multiple cropping management.

TABLE 8. LABOR REQUIREMENTS FOR TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, MULTIPLE CROPPING, 1976

Month	Daily requirements	Other monthly requirements	Monthly total
		Hours	
April	0.50	8.00	23.00
May	0.50	—	15.50
June	0.50	2.00	17.00
July	0.75	5.00	28.25
August	1.00	2.00	33.00
September	1.00	12.00	27.00
September	0.25	4.00	17.75
October	0.50	8.00	23.00
November	0.50	—	15.00
December	0.25	—	7.75
January	0.25	—	7.75
February	0.25	—	7.00
March	0.50	5.00	28.25
April	0.75	—	22.50
May	1.00	14.00	43.00
June	0.25	4.00	7.75
June	0.50	8.00	23.00
July	0.50	—	7.00
August	0.50	2.00	17.50
September	0.75	5.00	27.50
October	1.00	2.00	33.00
November	1.00	12.00	40.00
December	—	2.00	2.00
January	—	2.00	2.00
February	—	2.00	2.00
March	—	2.00	2.00
Total			479.50

It is assumed that the annual depreciation, $557.50, is available to apply toward paying the principal on the borrowed capital. After deducting depreciation, the average debt for the first 2 years is $1,877.82. Deducting this from the total net returns to land, management, and equity capital, $2,142.73, the annual disposable family income is $264.91. The biennial disposable family income in table 7 is twice this amount. During the first 2 years, the principal payments and all possible costs are covered with the funds left over for farm family expenditures. Again the value of the operator's labor could be added to the disposable family income. This would increase the annual disposable income to $792.36. Computation of disposable income for years following the start-up period can be made by substituting into table 7 the proper interest payments and principal payments for Appendix table 9.

TABLE 9. PARTIAL BUDGET ANALYSIS FOR TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, MULTIPLE CROPPING, COMPARED TO SINGLE CROPPING, 1976

Item	Added receipts	Reduced costs	Reduced receipts	Added costs	Net change
			Dollars		
Marketable catfish	4,687.50				
Variable costs				3,429.57	
Well depreciation				522.80	
Totals	4,687.50			3,952.37	735.13

SINGLE CROPPED RACEWAY CULTURE

As was discussed earlier, the biological feasibility of raising channel catfish in raceways has been established in the Southeast *(1,7)*. The next budget analysis involves the management of a closed raceway system under single cropping conditions for channel catfish. It is desired to determine the economic feasibility of such a system for areas with relatively rolling terrain and fairly easily accessible ground water. As in the previous analysis, the fish production system is auxiliary to the others on the farm. The raceways occupy relatively little space per pound of output capability. However, economic considerations are important in determining the feasibility of such progressive fish culture systems.

Land cost is again computed using the 1975 value of $300 per acre. The other investments are considerably different than for the pond production system, table 3. The reservoir construction costs are computed the same as for the two previous analyses. Thus, the cost per acre for pond construction is $1,030 *(18)*. The actual building of the raceway segments cost about $700 each, which includes all necessary grading and the concrete bulkheads with weirs. Corrugated fiberglass roofing material supported by steel frames are used for the inclined plane aeration structures *(1)*. Each aerator costs approximately $27. Including site preparation, $200, the total construction cost per raceway segment is $747. Other necessary capital items in the physical plant are a drilled well, with pump and pipe.

The truck investment is 12.5 percent of the total cost of a new one-half ton pickup. This is appropriate, since the truck is used from 1 to 25 percent of its total use in work relative to the catfish enterprise *(4)*.

Investment in a boat and electric motor is included because this equipment might be helpful in management of the reservoir, specifically in the control of weeds and algae. Also included in the

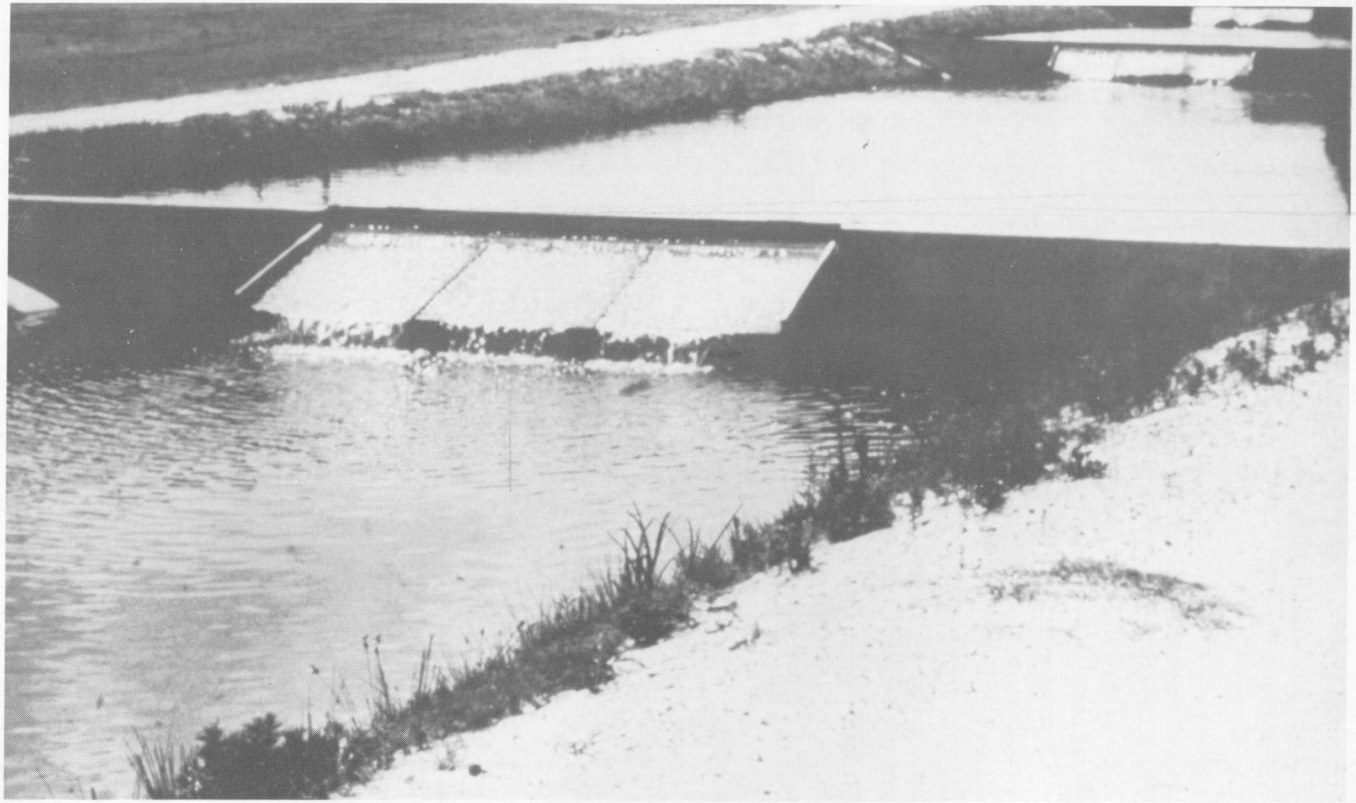

FIG. 5. Ground level view of a typical raceway system.

equipment investment is a storage shed of approximately 1,000 square feet. The construction cost of such a structure is calculated at a rate of $0.60 per square foot.

All depreciation is computed using the straight line method. Zero salvage value is used in these calculations, because the items cannot be sold for other uses at the end of their useful lives, table 3.

The loans are financed through local lending agencies, table 10. The amount of the land loan is 80 percent of the cost, while 95 percent of the capital needed for construction and equipment items is borrowed, and 75 percent of the truck allocation is financed. The interest rates and repayment periods are based on the policies of private lending agencies *(19,20)*.

Repayment schedules are computed for each of the capital groups in table 10. The actual interest payment and principal payments over the life of each loan have been calculated, Appendix tables 10-12. The repayment schedule for land is the same as for the pond cultures presented earlier, Appendix table 1.

In order to recalculate the costs and returns for years beyond the first year, the total interest and principal payments during the repayment periods can be substituted, Appendix table 13.

As mentioned previously, the raceway system occupies about the same amount of land area as the production units for the pond cultures previously discussed. Thus, the land tax is calculated for 10 acres using the average 1975 Alabama farm land value and 15 percent of the assessed value at a millage rate of 30, table 11 *(17)*.

The annual depreciation costs are presented in table 3 under single cropping for raceways. The straight line method using zero salvage value is used. However, individuals may compute depreciation by other methods as permitted by the Internal Revenue Service, U. S. Department of the Treasury.

TABLE 10. LOANS FOR CAPITAL INVESTMENT ITEMS FOR A TEN-SEGMENT RACEWAY SYSTEM ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Item	Total cost	Amount of loan	Interest rate	Repayment period	Yearly payment
	Dol.	Dol.	Pct.	Yr.	Dol.
Land	3,000.00	2,400.00	8	20	244.45
Construction	20,520.00	19,494.00	9	7	3,873.27
Equipment	800.00	760.00	9	4	234.59
Truck	625.00	468.75	9	3	185.18
Total	24,945.00	23,122.75			4,537.49

TABLE 11. COSTS AND RETURNS FOR A TEN-SEGMENT RACEWAY SYSTEM ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Item	Description	Unit	Quantity	Rate	Amount
Receipts					Dollars
Marketable catfish	1.0 lb. ea.	lb.	25,000	.45	11,250.00
Variable costs					
Fingerlings	8″ (1% mortality)	ea.	25,250	.08	2,020.00
Feed	floating, 32% CP	ton	21.25	235.00	4,993.75
Truck	½ ton	mi.	1,250	.12	150.00
Disease control	terramycin, 50 mg./cc.	cc.	5,000	.02	100.00
Parasite control	potassium permanganate	lb.	20.00	.80	16.00
Algae/weed control	algaecide	gal.	.25	12.00	3.00
Mowing	labor and tractor	hr.	6.00	3.20	19.20
Maintenance	labor	hr.	6.00	2.20	13.20
Pumping	600 gpm, 4 hp motor	day	180	2.92	525.60
Misc. expenses					30.00
Interest on operating capital	9% per annum ($7,870.75)				354.18
Operator's labor		hr.	164.75	2.20	362.45
Total variable costs					8,587.38
Fixed costs					
Land tax	$300/ac. @ 15% @ 30 mills	ac.	10.0	1.35	13.50
Depreciation	straight line method (table 3)				599.50
Loan cost	interest				2,057.05
Total fixed costs					2,670.05
Total variable and fixed costs					11,257.05
Net returns to land, management, and equity capital					−7.43
Principal payments (less depreciation)					1,880.94
Disposable family income					−1,888.37

The timetable for this operation is essentially the same as for the single cropped pond culture system. Therefore, the catfish reach marketable size within a 6 month growing season from April through September. The average weight is approximately 1 pound each.

The fingerlings are obtained from nearby producers at a cost of 1 cent per inch *(4)*. Eight-inch fingerlings are stocked at a rate of 2,500 per raceway segment. An additional 250 fingerlings are stocked to account for the assumed mortality rate of 1 percent *(16)*.

A floating ration of 32 percent crude protein, which is a widely used formulation for catfish production, is used. The feed conversion ratio for this system is assumed to be 1.7:1.0, and the average 1973-74 price per ton, $235.00, is used to calculate total feed cost *(4)*.

The truck expense again is based on an annual mileage of 10,000 for a farm vehicle of this type. Twelve and one half percent of the mileage is an adequate allocation for this variable cost item, figured at the rate of 12 cents per mile *(4)*.

Diseases and parasites present no more of a problem in raceways than in pond culture, so the same assumptions are made for control. The rate of 2.5 grams per 100 pounds of body weight for 10 days, based on a 10 percent probability of occurrence is adequate for disease control. Terramycin in a solution of 50 mg./cc. is used *(16)*. For parasite control, the same probability of occurrence is used. Potassium permanganate, a good oxidizing agent, again is adequate for treatment at a rate of 2 ppm *(6)*. The annual cost in the budget is 1/10 of the total cost of one treatment.

No problematic algae growth is expected within the raceway segments, since the water is pumped back to the reservoir after it goes through the entire raceway system. Thus, the majority of the waste materials from the catfish is transferred to the reservoir. This organic fertilization creates some algae and weed growth in the pond. In order to maintain water quality, an algaecide is necessary. Since 1 gallon will treat about 20 surface acres of water, 0.25 gallons provides the necessary control for the water storage pond *(18)*.

The raceway system occupies about the same amount of land area as the pond culture, so general maintenance time is 6 hours. But, 6 more hours of maintenance is required for small jobs, as cleaning the corrugated inclined plane aerators, replacing fuses, and making minor repairs on pumps or other equipment. The minimum farm labor rate, $2.20 per hour, is applied to derive this variable cost item.

Pumping is a major variable cost item in the budget for the single cropped raceway culture. The rate of flow through each raceway segment is about 600 gpm, (gallons per minute) for 24 hours per day during the growing season. The reservoir provides an inflow of 1,200

gpm, 600 gpm for each of the two parallel sides, figure 3. This amount has to be displaced to the storage pond when it reaches the end of the raceway segments. A 4 horsepower motor is required for this transfer of water. The daily cost is $2.92, based on the kilowatt demand for a 4 horsepower motor and using Alabama Power Company rates *(21)*.

The processor's crew of three men provides adequate labor for harvesting the raceway segments, so no extra farm labor has to be provided. Even though the raceway system produces the same poundage as the single cropped pond culture, the reduced labor requirements for harvest are possible due to the construction of the segments. One segment at a time is harvested simply by seining or catching the fish in a cage as water drains by gravity flow.

Miscellaneous expenses include more items than those discussed previously for the pond cultures. Replacement parts and minor repairs account for these increases, because of the increased amount of equipment used in operations of the raceways. Twice the allocation used in the single cropped pond culture should cover these expenses.

The above items constitute the necessary operating capital for catfish culture in raceways. At this point, interest expense on this money is allocated in the budget. Again this amount is an opportunity cost if it is not actually incurred. The annual rate of 9 percent is used for the 6 months in the growing season.

The last variable cost item is operator's labor. The operator provided all the time required to properly manage the system, including feeding time. Since this is unpaid labor, it is not included in calculation of interest on operating capital. The labor requirements are calculated on a monthly basis for the single cropped raceway system, table 12 *(18)*.

The net returns to land, management, and equity capital are calculated by deducting the sum of total variable costs and total fixed costs from gross returns. For this management plan the net returns to land, management, and equity capital are negative for the first year of operation, -$7.43. It is assumed that the depreciation is available to apply toward the payment of the principals, so this money is deducted from the total amount of principal payments. However, negative disposable family income results when the above payments, $1,880.94, are deducted, so other income would have to amount to $1,888.37 to support the raceway operations in the first year. The farmer's labor expense could be added to the disposable family income if it is not an actual paid wage. This would reduce the negative family income to -$1,525.92. Using the actual interest payments and principal payments for the various loans, Appendix table 31, the net

TABLE 12. LABOR REQUIREMENTS FOR A TEN-SEGMENT RACEWAY SYSTEM ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Month	Daily requirements	Other monthly requirements	Monthly total
		Hours	
April	0.50	8.00	23.00
May	0.50	—	15.50
June	0.50	—	15.00
July	0.75	5.00	28.25
August	1.00	2.00	33.00
September	1.00	2.00	31.00
October	—	3.00	3.00
November	—	2.00	2.00
December	—	2.00	2.00
January	—	2.00	2.00
February	—	2.00	2.00
March	—	8.00	8.00
Total			164.75

returns for subsequent years can be computed for the single cropped raceway system.

DOUBLE CROPPED RACEWAY CULTURE

An additional crop of fish can easily be produced in this system simultaneously with the growth of catfish in the raceways. The reservoir is constructed as a commercial catfish pond, i.e., with an improved bottom, catch basin, and drainage structures. A less expensive pond could be built if it will not be used for anything except a supply of water for the raceways. The costs of renovating such a reservoir into a production pond are tremendous. Thus, the reservoir is built so that it can be used as a production unit if so desired at any future date.

As discussed previously, the biological feasibility of raising monosex or hybrid tilapia in ponds organically fertilized has been established *(9)*. Climatic conditions allow a crop of hybrid tilapia to be grown in the pond supplying water for the raceway segments. Tilapia convert to fish flesh the unutilized nutrients pumped into the reservoir from the raceway segments. This second crop of fish reduces average fixed costs per unit of output for the operation.

There are few changes required to implement the above proposals. No capital investments change. The same assumptions relative to financial arrangements are made, Appendix tables 10-12. All of the fixed costs, land tax, depreciation, and interest, are the same.

It is assumed that tilapia fingerlings are obtained from producers in Florida. The monosex tilapia are stocked at a size of 20 grams each, about 4 inches, in the 5-acre reservoir. The stocking rate is 2,000 per

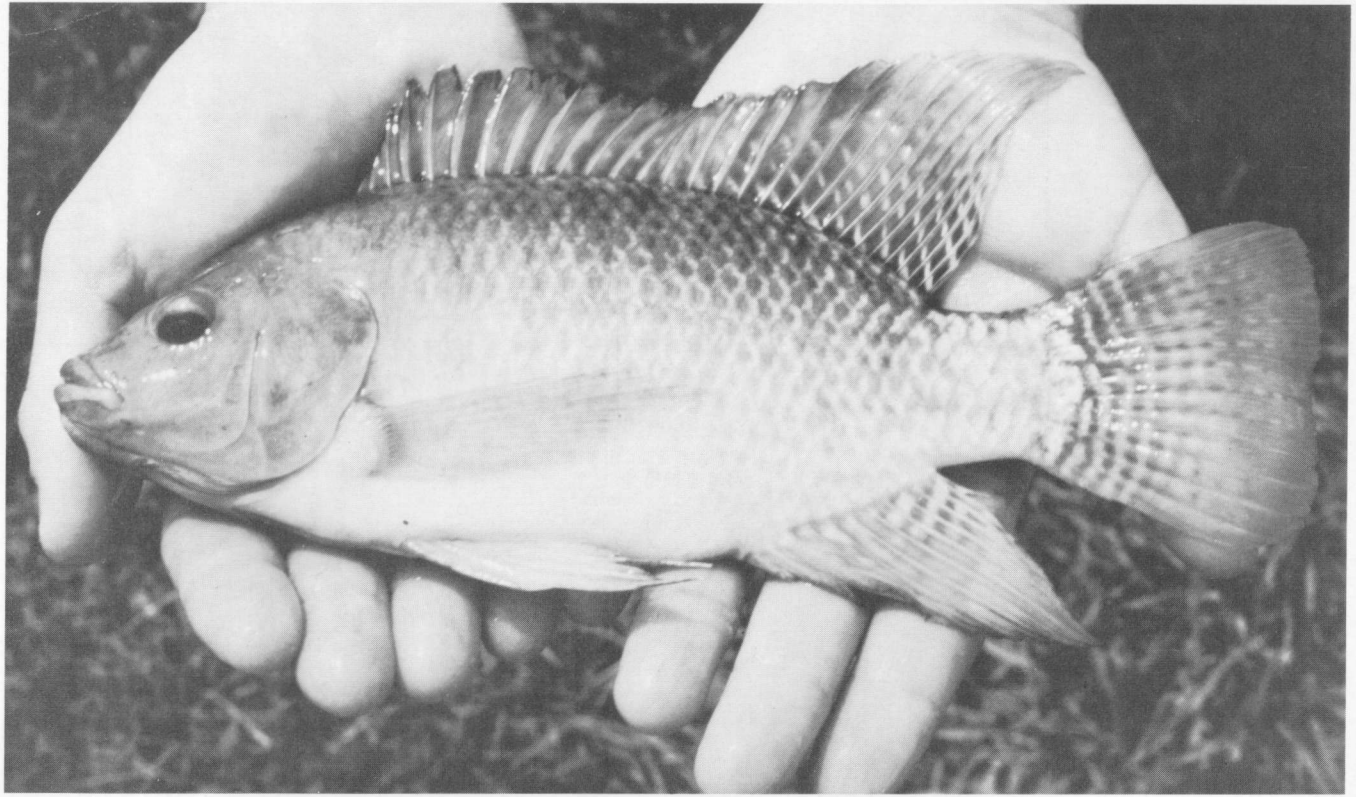

FIG. 6. Market-sized tilapia.

acre, with an extra 100 to cover any death loss. At a cost of $0.05 each, the additional total costs of these fingerlings are $505, table 13. With no supplemental feeding the tilapia are about one-half pound each (200 grams), a good market size, by the end of September. Based on the approximate growth rate of 1.0 gram per day, 6 months of production yields 2.5 tons *(22)*. The price per pound paid by the processors on a liveweight basis is $0.40[2]. The increased revenue from tilapia is $2,000.

The feed, truck, mowing, maintenance, pumping, miscellaneous, and operator's labor expenses are the same as for the single cropped raceway system. The only changes in chemical costs are a reduction of $3 because no algae and weed controls are necessary. Seasonal labor is an added cost, since three men are needed for about 6 hours to harvest the tilapia. Using the wage rate for farm labor, $2.20 per hour, the harvest cost is $39.60. The interest on operating capital changes due to the above modifications. Total operating capital is $8,412.35. The interest charge, 9 percent per annum for 6 months, is $378.56, an increased cost of $24.38.

The partial budgeting determined that the crop of tilapia effects a net positive change in net returns to land, management, and equity capital, table 13. This figure added to the net returns for single cropping, -$7.43, results in $1,426.59 net returns to land, management, and equity capital. Again depreciation, $599.50, is applied toward the payment of principals, but still $454.35 is needed from other sources for the first year's operations, table 14. The principal and interest payments in Appendix table 13 can be used to recompute the disposable family income for years beyond the first one.

MULTIPLE CROPPED RACEWAY CULTURE

The same physical plant discussed in the previous section is theoretically operated year round for the next analysis. In warm weather, the raceways are used for channel catfish production and the reservoir is used for growth of monosex tilapia. Rainbow trout are raised in the raceways during the months of cooler water temperatures, November through February. It is expected that such a year-round production schedule would increase the returns above the double cropped system by distributing the fixed costs among three crops of fish rather than two.

No changes are made in the non-depreciable investment items for the multiple cropped raceway system. Under depreciable items, the truck investment is doubled, 25 percent of the total cost of a new

[2]Supported by current market research at Auburn University.

TABLE 13. PARTIAL BUDGET ANALYSIS FOR A TEN-SEGMENT RACEWAY SYSTEM ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, DOUBLE CROPPING, COMPARED TO SINGLE CROPPING, 1976

Item	Added receipts	Reduced costs	Reduced receipts	Added costs	Net change
			Dollars		
Marketable tilapia	2,000.00	—	—	—	—
Variable costs	—	3.00	—	568.98	—
Totals	2,000.00	3.00	—	—	1,434.02

vehicle, because it is used year round in fish production, table 3 *(4)*. As a result, depreciation increases by $62.50 per year. The truck loan now is $937.50, 75 percent of the truck investment allocation. So, for the first year the interest payment is $75.00, an increase of $32.81 and the principal payment increases by $145.79, Appendix table 14. Again the boat and electric motor are included in case these items are needed in the management of the reservoir. Having this equipment available is good insurance even if it is used for nothing more than recreational activities. The average life for pump and pipe is assumed to be only 5 years, since pumping is required 24 hours per day for 330 days each year. Due to the increased use of the pumping system, the additional annual depreciation is $400. The total interest and principal payments by years was computed for the borrowed capital, Appendix table 15.

The total acreage requirements for this operation are the same as for the other systems in the analysis. So, there are no additional costs for land purchases or taxes.

Rainbow trout fingerlings are available within a reasonable distance of the area. These fingerlings are somewhat more expensive than channel catfish, 2.5 cents per inch, an added cost of $4,725 each year, table 15. Six-inch trout fingerlings are stocked in November and reach marketable size by the end of February, a 4-month growing period. The mortality rate for trout, 5 percent, is assumed to be higher than for tilapia or catfish. These fish average 0.75 pounds each and are sold to the catfish processor for $0.75 per pound *(1)*. The additional revenue from trout production is $16,875 annually.[3]

A complete nutrient ration of 45 percent crude protein is used in the rainbow trout feeding program. The cost of this feed was $450 per ton in 1973-74. Based on this price, the increased cost of feed is $7,515 per year. The trout achieve a feed conversion ratio of 1.5:1.0 *(1)*.

[3]Current market research at Auburn University indicates that rainbow trout have a retail value of $2.39 and a farm price of $1.14, liveweight.

TABLE 14. COSTS AND RETURNS FOR A TEN-SEGMENT RACEWAY SYSTEM ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, DOUBLE CROPPING, 1976

Item	Description	Unit	Quantity	Rate	Amount
Receipts					Dollars
Marketable catfish	1.0 lb. ea.	lb.	25,000	.45	11,250.00
Marketable tilapia	.5 lb. ea.	lb.	5,000	.40	2,000.00
Total receipts					13,250.00
Variable costs					
Fingerlings					
catfish	8" (1% mortality)	ea.	25,250	.08	2,020.00
tilapia	20 g. (1% mortality)	ea.	10,100	.05	505.00
Feed	floating, 32% CP	ton	21.25	235.00	4,993.75
Truck	½ ton	me.	1,250	.12	150.00
Disease control	terramycin, 50 mg./cc.	cc.	5,000	.02	100.00
Parasite control	potassium permanganate	lb.	20.00	.80	16.00
Mowing	labor and tractor	hr.	6.00	3.20	19.20
Maintenance	labor	hr.	6.00	2.20	13.20
Pumping	600 gpm, 4 hp motor	day	180	2.92	525.60
Seasonal labor	processor provided equipment	hr.	18.0	2.20	39.60
Misc. expenses					30.00
Interest on operating capital	9% per annum ($8,412.35)				378.56
Operator's labor		hr.	164.75	2.20	362.45
Total variable costs					9,153.36
Fixed costs					
Land tax	$300/ac. @ 15% @ 30 mills	ac.	10.0	1.35	13.50
Depreciation	straight line method				599.50
Loan cost	interest				2,057.05
Total fixed costs					2,670.05
Total variable and fixed costs					11,823.41
Net returns to land, management, and equity capital					1,426.59
Principal payments (less depreciation)					1,880.94
Disposable family income					−454.35

FIG. 7. Market-sized rainbow trout.

TABLE 15. COSTS AND RETURNS FOR A TEN-SEGMENT RACEWAY SYSTEM ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, MULTIPLE CROPPING, 1976

Item	Description	Unit	Quantity	Rate	Amount
Receipts					Dollars
Marketable catfish	1.0 lb. ea.	lb.	25,000	.45	11,250.00
Marketable tilapia	.50 lb. ea.	lb.	5,000	.40	2,000.00
Marketable trout	.75	lb.	22,250	.75	16,875.00
Total receipts					30,125.00
Variable costs					
Fingerlings					
catfish	8" (1% mortality)	ea.	25,250	.08	2,020.00
tilapia	20 g. (1% mortality)	ea.	10,100	.05	505.00
trout	6" (5% mortality)	ea.	31,500	.15	4,725.00
Feed					
catfish	floating, 32% CP	ton	21.25	235.00	4,993.75
trout	floating, 45% CP	ton	16.70	450.00	7,515.00
Truck	½ ton	mi.	2,500	.12	300.00
Disease control	terramycin, 50 mg./cc.	cc.	10,000	.02	200.00
Parasite control	potassium permanganate	lb.	40.0	.80	32.00
Mowing	labor and tractor	hr.	6.0	3.20	19.20
Maintenance	labor	hr.	12.0	2.20	26.40
Pumping	600 gpm, 4 hp. motor	days	330.0	2.92	963.60
Seasonal labor	processor provided equip.	hr.	18.0	2.20	39.60
Misc. expenses					60.00
Interest on operating capital	9% per annum ($21,399.55)				1,925.96
Operator's labor		hr.	284.75	2.20	626.45
Total variable cost					23,951.96
Fixed costs					
Land tax	$300/ac. @ 15% @ 30 mills	ac.	10.00	1.35	13.50
Depreciation	straight line method				1,062.00
Loan cost	interest				2,089.86
Total fixed costs					3,165.36
Total variable and fixed costs					27,117.32
Net returns to land, management, and equity capital					3,007.68
Principal payments (less depreciation)					1,564.23
Disposable family income					1,443.45

The truck expense for the catfish and trout is 12.5 percent of the annual mileage, 1,250 miles, per crop. No truck expense is necessary for the tilapia crop. A standard rate of 12 cents per mile is used, increasing the truck variable cost by $150 annually.

For trout, the total amount of terramycin needed for disease control is about 5,000 cc. at a cost of $0.02 per cc., an increased cost of $100 (16). There is no allocation in the budget for weed and algae control,

because the tilapia stocked in the reservoir utilize the excess nutrients that otherwise create over-fertility and algal blooms. Two ppm potassium permanganate is used in control of parasites for the trout crop, an increased cost of $16 *(6)*. The total additional cost for chemicals is $116.

Mowing requirements for the raceway system operated on a year round basis are the same as for the single cropped system. However, general maintenance requirements are about twice that needed in the previous analysis, since the raceways are in operation nearly all year. Six additional hours of labor at a cost of $13.20 per year are needed.

The pumping cost in the multiple cropped budget is very important because of its magnitude. The only period when pumping is not required is after harvest of the trout and prior to stocking catfish, 30 days. During this time there is an adequate supply of water in the reservoir to refill the raceways. However, 150 extra days of pumping are required for the system. The increased total cost of this item is $438 *(21)*.

The same assumptions relative to harvest labor for the catfish and tilapia are used as in the previous section. In addition, the trout are harvested relatively easily by the processor's crew at no extra expense.

A miscellaneous expense allocation of $60.00, a $30 increase, is enough to cover any of these type costs for the entire production year. As in the previous budget, these are items necessary to keep all equipment functioning properly, as well as various supplies.

An interest rate of 9 percent per annum is charged on the operating capital and included in the budget as a cost. For the multiple cropped system, it is allocated for the entire year. The extra interest cost is $1,547.40 per year.

The labor required by the operator for year-round production in the raceway system is computed on a monthly basis, table 16. The operator's labor is 284.75 hours, an increase of 120 hours. The additional cost is $264 *(18)*.

According to the partial budget analysis, the net change in income from the double cropping to triple cropping is positive $1,581.09, table 17. Adding this additional revenue to the increased returns from double cropping $1,426.59, the net returns to land, management, and equity capital from the raceway system are $3,007.68, table 15. Depreciation increases greatly due to the shorter expected life of the items resulting from intensive use, table 3. Principal payments less depreciation for the first year leave a debt of $1,564.23, which can easily be paid from the net returns to land, management, and equity capital, with $1,443.45 remaining in disposable family income. This money can be used to pay income taxes, go into savings and

expenditures as desired by the operator and his family to improve their well-being. In addition the value of the operator's labor could be added to the above figure, if it is not an actual paid wage, increasing disposable income to $2,069.90.

TABLE 16. LABOR REQUIREMENTS FOR A TEN-SEGMENT RACEWAY SYSTEM ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, MULTIPLE CROPPING, 1976

Month	Daily requirements	Other monthly requirements	Monthly total
		Hours	
April	0.50	12.00	27.00
May	0.50	—	15.50
June	0.50	—	15.00
July	0.75	4.50	27.75
August	1.00	—	31.00
September	1.00	8.00	37.00
October	0.25	4.00	11.75
November	0.50	8.00	23.00
December	0.75	4.50	27.75
January	1.00	2.00	33.00
February	1.00	—	28.00
March	—	8.00	8.00
Total			284.75

TABLE 17. PARTIAL BUDGET ANALYSIS FOR A TEN-SEGMENT RACEWAY SYSTEM ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, MULTIPLE CROPPING, COMPARED TO DOUBLE CROPPING, 1976

Item	Receipts	Reduced costs	Reduced receipts	Added costs	Net change
			Dollars		
Marketable trout	16,875				
Depreciation and interest				495.31	
Variable costs				14,798.60	
Totals	16,875			15,293.91	1,581.09

SUMMARY

The net returns to land, management, and equity capital for the single cropped ponds are $1,407.60, which is more than enough to cover the principal payments for year one, table 18. Disposable family income is about $44, after the first year's principal payments are made.

The multiple cropped pond system is managed such that three crops of catfish are harvested within 2 years, i.e., a biennial time period. When expressed annually, the net returns to land, management, and equity capital were $2,142.73 for the multiple cropped system, table 18. After the payments are made on all of the borrowed capital, there is some $265 remaining for each of the first 2 years, which is over five times as great as the disposable family income from single cropped pond system.

Single cropped raceways do not appear to be very feasible because of negative net returns and negative disposable family income. The system is quite capital intensive. So, in this type analysis where all costs are to be paid for by returns from fish production, unfavorable conditions may result for the first year or two during which start-up capital is being repaid. Later, many of the capital items will have been paid for and still be in good condition for several more years use. Thus, refinancing would not have to be done immediately.

Adding hybrid tilapia to the raceway production system greatly improves the net returns, because of relatively few inputs required beyond those already committed for the single cropping system. However, there still has to be $454 supplied from other sources to make principal payments in year one.

Finally, complete utilization of all resources commited and/or available results in quite favorable net returns to land, management, and equity capital. The returns from multiple cropping are high

TABLE 18. FIRST YEAR ANNUAL NET RETURNS AND DISPOSABLE FAMILY INCOME FROM FISHERIES ENTERPRISES ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, 1976

Type system	Net returns to land management and equity capital	Disposable family income
	Dollars	
Single cropped ponds	1,407.60	43.63
Multiple cropped ponds	2,142.73	264.91
Single cropped raceways	−7.43	−1,888.37
Double cropped raceways	1,426.59	−454.35
Multiple cropped raceways	3,007.68	1,443.45

enough that all of the necessary loan payments can be easily made for the first year's operations. In addition there are over $1,400 in disposable family income for the operator and his family.

All of the budgets include a cost for the operator's labor. This amount is considered an opportunity cost if actual wage payments are not made. Farmers sometimes do not place a value on their labor, so the operator's labor figure could be added to the disposable family income in each budget. The complete interest and principal repayment schedules are presented in the Appendix for a period of 20 years, so that the disposable family income can be computed for the production years beyond the first. This can be done by substituting the loan cost, i.e., interest payments, into the costs and returns schedules resulting in new net returns to land, management, and equity capital. Then the total principal payment less depreciation for the desired year is deducted, leaving a new disposable family income figure.

The economic feasibility of several differently managed aquacultural systems was examined. All possible costs were computed, based upon the physical and managerial constraints stated. Thus, the last figure computed for each system represents the amount of disposable family income that a particular aquacultural enterprise provides. This income, positive or negative, partially affects the social well-being of a farm family. Disposable family income is the amount available for the payment of income taxes, for living and leisure expenses, or savings.

Fish culture systems, like most agricultural operations, vary in design depending upon the area in which they are located. This report, as well as indicating the expected costs and returns, outlines a procedure which can be followed to help make decisions concerning the economic feasibility of aquacultural enterprises for individual farm situations.

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APPENDIX

APPENDIX TABLE 1. REPAYMENT SCHEDULE FOR LAND OF TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Year	Interest	Principal	Total payment	Loan amount remaining
		Dollars		
1	192.00	52.45	244.45	2,347.55
2	187.80	56.65	244.45	2,290.90
3	183.27	61.18	244.45	2,229.73
4	178.38	66.07	244.45	2,163.65
5	173.09	71.36	244.45	2,092.30
6	167.38	77.07	244.45	2,015.23
7	161.22	83.23	244.45	1,932.00
8	154.56	89.89	244.45	1,842.11
9	147.37	97.08	244.45	1,745.03
10	139.60	104.85	244.45	1,640.18
11	131.21	113.24	244.45	1,526.94
12	122.16	122.29	244.45	1,404.65
13	112.37	132.08	244.45	1,272.57
14	101.81	142.64	244.45	1,129.93
15	90.39	154.06	244.45	975.87
16	78.07	166.38	244.45	809.49
17	64.76	179.69	244.45	629.80
18	50.38	194.07	244.45	435.73
19	34.86	209.59	244.45	226.14
20	18.31	226.14	244.45	0.00

APPENDIX TABLE 2. REPAYMENT SCHEDULE FOR CONSTRUCTION OF TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Year	Interest	Principal	Total payment	Loan amount remaining
		Dollars		
1	880.65	1,063.54	1,944.19	8,721.46
2	784.93	1,159.26	1,944.19	7,562.20
3	680.60	1,263.59	1,944.19	6,298.61
4	566.87	1,377.32	1,944.19	4,921.29
5	442.92	1,501.27	1,944.19	3,420.02
6	307.80	1,636.39	1,944.19	1,783.63
7	160.56	1,783.63	1,944.19	0.00

APPENDIX TABLE 3. REPAYMENT SCHEDULE FOR EQUIPMENT ITEMS OF TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Year	Interest	Principal	Total payment	Loan amount remaining
		Dollars		
1	204.35	496.49	700.83	1,774.02
2	159.66	541.17	700.83	1,232.85
3	110.96	589.87	700.83	642.96
4	57.87	642.96	700.83	0.00

APPENDIX TABLE 4. REPAYMENT SCHEDULE FOR TRUCK FOR TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Year	Interest	Principal	Total payment	Loan amount remaining
		Dollars		
1	42.19	142.99	185.18	325.76
2	29.32	155.86	185.18	169.90
3	15.28	169.90	185.18	0.00

APPENDIX TABLE 5. TOTAL INTEREST AND PRINCIPAL PAYMENTS BY YEAR FOR TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Year	Total interest payment for the loans	Total principal payment for the loans
	Dollars	
1	1,319.19	1,755.47
2	1,161.71	1,912.94
3	990.28	2,084.55
4	803.12	2,086.35
5	616.01	1,572.63
6	475.18	1,713.46
7	321.78	1,866.86
8	154.56	89.89
9	147.37	97.08
10	139.60	104.85
11	131.21	113.24
12	122.16	122.29
13	112.37	132.08
14	101.81	142.64
15	90.39	154.06
16	78.07	166.38
17	64.76	179.69
18	50.38	194.07
19	34.86	209.59
20	18.31	226.14

APPENDIX TABLE 6. REPAYMENT SCHEDULE FOR CONSTRUCTION OF TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, MULTIPLE CROPPING, 1976

Year	Interest	Principal	Total payment	Loan amount remaining
		Dollars		
1	1,393.65	1,683.07	3,076.72	13,801.93
2	1,242.17	1,834.55	3,076.72	11,967.38
3	1,077.06	1,999.66	3,076.72	9,967.73
4	897.10	2,179.62	3,076.72	7,788.10
5	700.93	2,375.79	3,076.72	5,412.31
6	487.11	2,589.61	3,076.72	2,822.70
7	254.02	2,822.70	3,076.72	0.00

APPENDIX TABLE 7. REPAYMENT SCHEDULE FOR EQUIPMENT ITEMS OF TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, MULTIPLE CROPPING, 1976

Year	Interest	Principal	Total payment	Loan amount remaining
		Dollars		
1	68.40	166.19	234.59	593.81
2	53.44	181.15	234.59	412.66
3	37.14	197.45	234.59	215.21
4	19.38	215.21	234.59	0.00

APPENDIX TABLE 8. REPAYMENT SCHEDULE FOR TRUCK FOR TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, MULTIPLE CROPPING, 1976

Year	Interest	Principal	Total payment	Loan amount remaining
		Dollars		
1	126.56	428.99	555.55	977.26
2	87.95	467.60	555.55	509.67
3	45.88	509.67	555.55	0.00

APPENDIX TABLE 9. TOTAL INTEREST AND PRINCIPAL PAYMENTS BY YEAR FOR TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, MULTIPLE CROPPING, 1976

Year	Total interest payment for the loans	Total principal payment for the loans
	Dollars	
1	2,089.86	2,626.23
2	1,856.91	2,859.18
3	1,603.26	3,112.83
4	1,327.11	3,097.85
5	1,055.49	3,062.23
6	780.60	3,337.12
7	481.01	3,636.71
8	154.56	89.89
9	147.37	97.08
10	139.60	104.85
11	131.21	113.24
12	122.16	122.29
13	112.37	132.08
14	101.81	142.64
15	90.39	154.06
16	78.07	166.08
17	64.76	179.69
18	50.38	194.07
19	34.86	209.59
20	18.31	226.14

APPENDIX TABLE 10. REPAYMENT SCHEDULE FOR CONSTRUCTION OF A TEN-SEGMENT RACEWAY SYSTEM ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Year	Interest	Principal	Total payment	Loan amount remaining
		Dollars		
1	1,754.46	2,118.81	3,873.27	17,375.19
2	1,563.77	2,309.50	3,873.27	15,065.69
3	1,355.91	2,517.36	3,873.27	12,548.33
4	1,129.35	2,743.92	3,873.27	9,804.41
5	882.40	2,990.87	3,873.27	6,813.54
6	613.22	3,260.05	3,873.27	3,553.48
7	319.79	3,553.48	3,873.27	0.00

APPENDIX TABLE 11. REPAYMENT SCHEDULE FOR EQUIPMENT ITEMS OF A TEN-SEGMENT RACEWAY SYSTEM ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Year	Interest	Principal	Total payment	Loan amount remaining
		Dollars		
1	68.40	166.19	234.59	593.81
2	53.44	181.15	234.59	412.66
3	37.14	197.45	234.59	215.21
4	19.38	215.21	234.59	0.00

APPENDIX TABLE 12. REPAYMENT SCHEDULE FOR TRUCK FOR A TEN-SEGMENT RACEWAY SYSTEM ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Year	Interest	Principal	Total payment	Loan amount remaining
		Dollars		
1	42.19	142.99	185.18	325.76
2	29.32	155.86	185.18	169.90
3	15.28	169.90	185.18	0.00

APPENDIX TABLE 13. TOTAL INTEREST AND PRINCIPAL PAYMENTS BY YEAR FOR A TEN-SEGMENT RACEWAY SYSTEM, ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, SINGLE CROPPING, 1976

Year	Total interest payment for the loan	Total principal payment for the loan
	Dollars	
1	2,057.05	2,480.44
2	1,834.33	2,703.16
3	1,591.60	2,945.89
4	1,327.11	3,025.20
5	1,055.49	3,062.23
6	780.60	3,337.12
7	481.01	3,636.71
8	154.56	89.89
9	147.37	97.08
10	139.60	104.85
11	131.21	113.24
12	122.16	122.29
13	112.37	132.08
14	101.81	142.64
15	90.39	154.06
16	98.07	166.38
17	64.76	179.69
18	58.38	194.07
19	34.86	209.59
20	18.31	226.14

APPENDIX TABLE 14. REPAYMENT SCHEDULE FOR TRUCK FOR A TEN-SEGMENT RACEWAY SYSTEM ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, MULTIPLE CROPPING, 1976

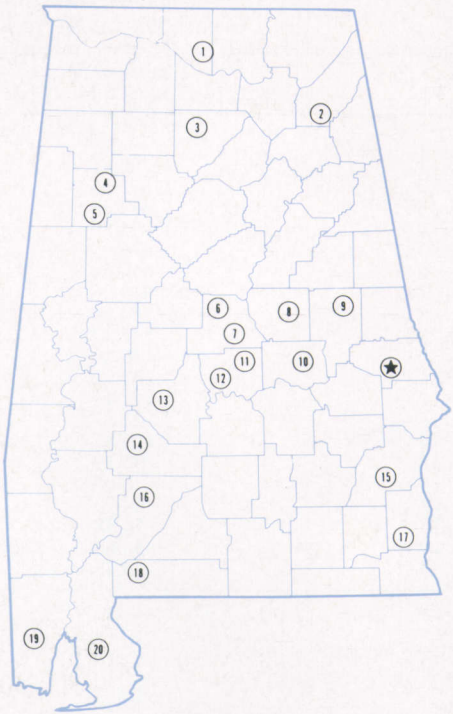
Year	Interest	Principal	Total payment	Loan amount remaining
		Dollars		
1	75.00	288.78	363.78	648.72
2	51.90	311.88	363.78	336.84
3	26.94	336.84	363.78	0.00

APPENDIX TABLE 15. TOTAL INTEREST AND PRINCIPAL PAYMENTS BY YEAR FOR TWO FIVE-ACRE WATERSHED PONDS ON RELATIVELY ROLLING LAND WITH ADEQUATE GROUND WATER, MULTIPLE CROPPING, 1976

Year	Total interest payment for the loan	Total principal payment for the loan
	Dollars	
1	1,780.61	2,330.70
2	1,571.36	2,539.95
3	1,343.36	2,767.95
4	1,094.86	2,460.90
5	874.02	2,447.15
6	654.49	2,666.68
7	415.24	2,905.93
8	154.56	89.89
9	147.37	97.08
10	139.60	104.85
11	131.21	113.24
12	122.16	122.29
13	122.37	132.08
14	101.87	142.64
15	90.39	154.06
16	78.07	166.38
17	64.76	179.69
18	50.38	194.07
19	34.86	209.59
20	18.31	266.14

Alabama's Agricultural Experiment Station System
AUBURN UNIVERSITY

With an agricultural research unit in every major soil area, Auburn University serves the needs of field crop, livestock, forestry, and horticultural producers in each region in Alabama. Every citizen of the State has a stake in this research program, since any advantage from new and more economical ways of producing and handling farm products directly benefits the consuming public.



Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. Lower Coastal Plain Substation, Camden.
15. Forestry Unit, Barbour County.
16. Monroeville Experiment Field, Monroeville.
17. Wiregrass Substation, Headland.
18. Brewton Experiment Field, Brewton.
19. Ornamental Horticulture Field Station, Spring Hill.
20. Gulf Coast Substation, Fairhope.