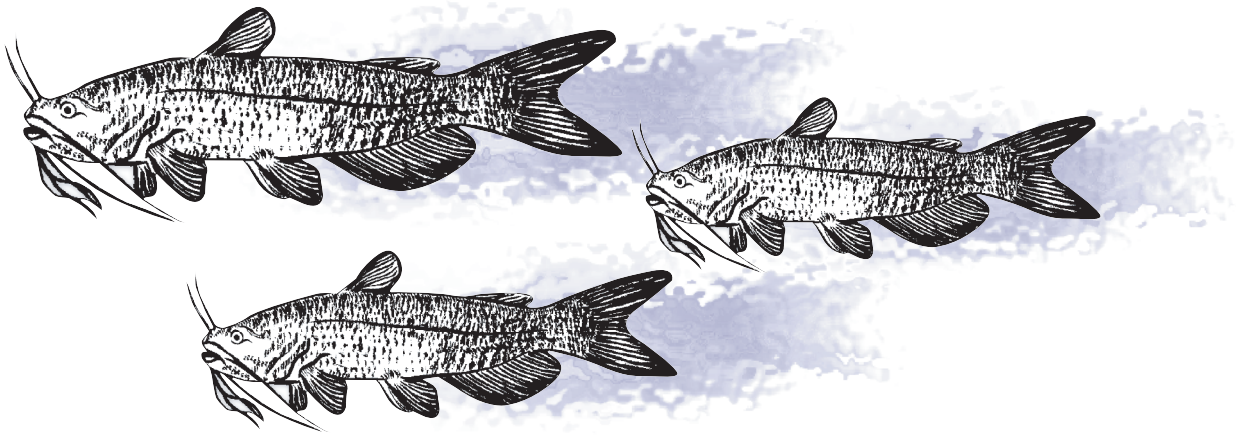
Aquaculture in North Carolina

Catfish

Inputs, Outputs and Economics



North Carolina Department of Agriculture and Consumer Services

Aquaculture and Natural Resources

Contents

About this publication

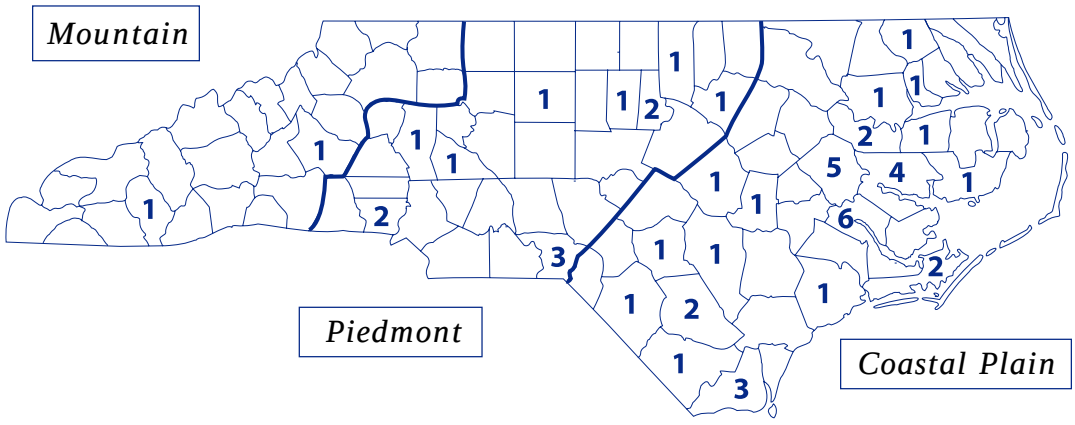
~~~

The North Carolina Department of Agriculture, Division of Aquaculture and Natural Resources, created this publication to assist individuals interested in the business of catfish farming. The publication was also designed for bank lenders who may need more information on the industry to evaluate loan proposals. A description of the inputs and outputs of North Carolina catfish farms, as well as an estimate of costs, returns, and resource requirements for an example farm are provided. For technical recommendations on building and operating a fish farm, individuals are encouraged to contact agents with the North Carolina Cooperative Extension Service. For information on state regulations governing aquaculture, or for help in preparing an aquaculture business plan, contact the North Carolina Department of Agriculture. See *Sources of More Information* for individuals to contact.

Catfish production accounts for 45% of U.S. aquaculture sales. In 2000 farmers sold 593 million pounds of catfish with a farm-gate value of $446 million.

U.S. Aquaculture and catfish production

~~~

Aquaculture is the fastest growing segment of U.S. agriculture. The farm-gate value of the U.S. aquaculture industry is estimated to be nearly $1 billion. Catfish production accounts for approximately 45% of total U.S. aquaculture sales: in 2000, U.S. catfish farmers sold 593 million pounds of catfish with a farm-gate value of $446 million.

Commercial catfish production began in Mississippi, Alabama, Arkansas and Louisiana in the late 1950's. These states continue to dominate the industry, producing about 96% of the annual U.S. catfish harvest. Farms average 300 acres in size and pond sizes typically range from 15 to 25 acres. Catfish farming is a major agricultural component in each state; for example, sales of catfish are one of the top five sources of income for Mississippi farmers.

Virtually all of U.S. farmed catfish are harvested by large processors which process and sell the fish. The high cost of equipment makes the economies of scale favor a smaller number of large processors. The processing company may be owned entirely by one farm, which processes its

North Carolina Catfish Farms, By County, 2000



own catfish and fish purchased from other farms, or it may be a cooperative effort owned by a number of farmers.

Catfish production continues to expand, with most growth concentrated in the Southeastern U.S. From 1995 to 2000, catfish acreage in the U.S. increased at about 2% annually, reaching an estimated 187,330 acres by 2000. The increase in production is also attributable to more efficient use of existing farms, with some farmers intensifying production to raise more catfish on the same water acreage.

Farmers may harvest anywhere from 1,000 to 10,000 pounds of catfish per water acre, depending upon a number of factors including farm location and water source, stocking rate, and the amount and type of feed used. Most commercial farmers harvest between 4,000 and 6,000 pounds per acre annually.

Competition from overseas has intensified due to imports from Asia. To date, however, imports have not significantly impacted North Carolina farmers

North Carolina Catfish

In 2000, 51 North Carolina (NC) farmers raised an estimated 4.6 million pounds of catfish on 1,653 acres. Farms range in size from less than 10 to 270 water acres. The median farm size is 40 acres, and the average pond size is 10 acres. Nearly all NC catfish farms are located on the coastal plain. Most catfish enterprises are owned by either farmers who sought diversification, or individuals who already owned land and desired a supplemental source of income. Virtually all catfish raised in North Carolina are sold to one of two processors.

Inputs

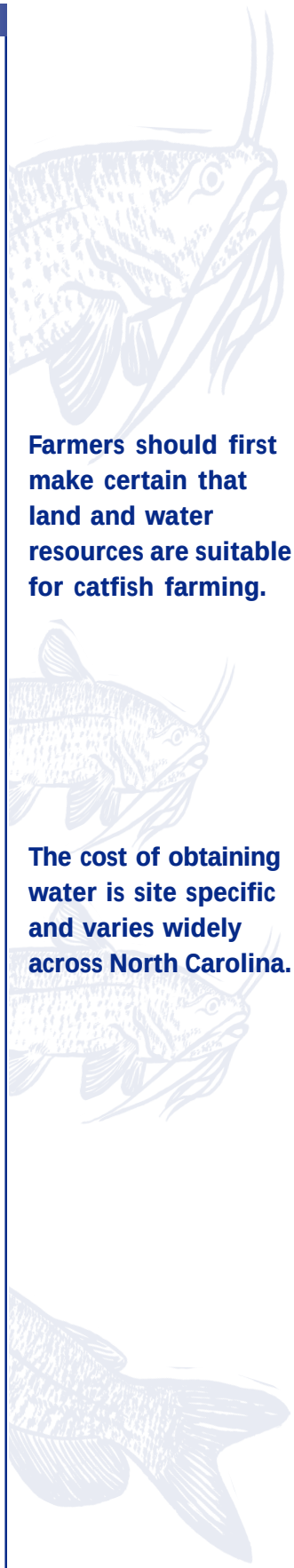
Following is a discussion of the production inputs used to raise catfish. These inputs—fingerlings, feed, water, etc.—determine yield and cost in both a direct and indirect way. When an input is used more intensively—for example, when more fish are stocked per acre—yield may rise enough to offset the increase in cost, resulting in a more profitable farm. As production intensity increases, however, the greater use of an input, such as feed, can have an indirect and negative effect on yield via changes in pond water quality. This can result in a lower yield and higher cost per pound harvested, *reducing* profits to the farm. The most successful farmers are those who efficiently use production inputs while maintaining a healthy water environment. Farmers are encouraged to work with agents and specialists of the NC Cooperative Extension service who can advise them on best management practices for catfish farming.

Water

Water is the growing environment for fish, so a reliable source of good quality water is vital to fish farming. Farmers choose between surface water (from streams, lakes, etc.) or well water. Nearly all catfish farms utilize well water because both the quality and quantity of surface water can be unpredictable. The major advantage of surface water is that it is usually much cheaper to obtain than water pumped from a well.

Water is used to fill ponds and compensate for evaporation and seepage. If ponds are constructed of high-clay soils, then seepage will be minimal. Catfish farming requires less water than other types of fish farming because ponds are not often drained; common practice is to drain ponds once every five to eight years to make needed levee repairs.

Catfish have a wide tolerance for environmental conditions and farmers can often remedy problems associated with an existing water source. For example, water



Farmers should first make certain that land and water resources are suitable for catfish farming.

The cost of obtaining water is site specific and varies widely across North Carolina.

Earth moving for pond construction is the major investment cost, and ranges from $1,200 to over $2,000 per pond acre depending upon soil type, pond size, topography, and other factors.

Farmers purchase catfish fingerlings from hatcheries and grow them to the minimum market size of about 1.5 pounds in 12 to 18 months.

with an abnormally high or low pH value can be corrected with the addition of lime or gypsum. In rare cases, however, water may be unsuitable for any type of aquaculture. Farmers determine the quality of water at a potential farm site by sending a water sample to the NC Cooperative Extension Service. When well water is to be used, existing wells near to the proposed site can be a source of water for testing.

Farmers should also determine the quantity of water available. NC Cooperative Extension agents recommend that a farm well supply a flow rate (the flow of water is measured in gallons per minute, or "gpm") capable of filling ponds to a depth of four to five feet within two weeks. Rapid filling of ponds prevents the establishment of pond-bottom weeds which negatively effect production. For a 10-acre pond, a flow rate of 15 gpm per water acre is sufficient. The cost to achieve this flow depends on the number of water acres in production and farm location. The cost of obtaining water is extremely site specific and varies tremendously across the state; it can make certain areas unprofitable for fish farming.

Well drillers that know the area around a potential site are a good source of information concerning water availability. They can also estimate the costs of obtaining suitable water.

Catfish Budgets estimates the cost for a well located on a farm in one of the eastern counties on NC's coastal plain. Pump size is estimated using the factor of 15 gpm per water acre, or a well capable of pumping 750 gpm for the example 50-acre farm. The estimated cost is $25,000 for the well and pump. Water is used to fill ponds, make-up for evaporation, and drain and refill the ponds every five years.

Land

Optimal land for pond fish culture is cleared land that is flat or has a slight gradient, with a clay content of at least 20%. Agents with the Natural Resource Conservation Service and North Carolina Department of Agriculture can determine the suitability of an area for fish farming. Agents can also test soil for pesticide residues which may rule out use of the land for any type of aquaculture.

The cost of land suitable for fish farming in rural NC typically ranges from $800 to $1200 per acre. About 80% of the total land area is used for ponds, and the remaining 20% for levees, roads, ditches, and support facilities.

Catfish ponds are of two general types: levee ponds or hill ponds. Hill ponds make use of a hilly topography where water is trapped in small valleys, or can be trapped with minimal construction. Levee ponds are built by constructing dikes. Hill ponds typically use only rainfall and runoff water, while levee ponds use well or diverted surface water. In North Carolina, nearly 100% of commercial catfish ponds are levee ponds with an average depth of four feet and size of 8-12 acres.

Catfish are also grown in cages suspended in lakes or other water bodies. Cage culture is more often used for small-scale or family production. Virtually all commercial-size operations (greater than 10,000 pounds harvested per year) use earthen ponds.

In eastern NC, several individuals have experience building aquaculture ponds, and can give estimates of construction for potential sites. The cost of pond construction depends upon a number of factors including soil type, topography, number and size of ponds, and whether or not roads and ditches already exist on the site. Cost can range from less than $1,200

per water acre to greater than $2,200 per water acre. Catfish Budgets assumes ponds are built on cleared farm-land at a cost of $1,600 per water acre.

Fingerlings

The catfish production cycle begins with broodfish that spawn in ponds in the spring and fall. Eggs are removed from hatching containers in the ponds and held indoors in commercial hatcheries. After about two weeks in the hatchery, catfish fry are stocked into ponds. There they are weaned from natural pond food—algae and zooplankton—to commercially produced catfish feed pellets. After 100 to 150 days, catfish fry reach the fingerling size of four to six inches, and are stocked into food fish ponds. Food fish production grows catfish from fingerling size, at a weight of about 1/ 50th of a pound, to a harvest size of 1.50 pounds, in 12 to 18 months.

Most farmers, both in North Carolina and in the "big three" producing states of Mississippi, Alabama, and Arkansas specialize in food fish production. Because of the level of expertise involved and economies of scale, it is more economical for most producers to purchase fingerlings from other farms that specialize in the broodfish-fry-fingerling portion of the production cycle. Farmers are encouraged to buy fingerlings that are six inches or larger.

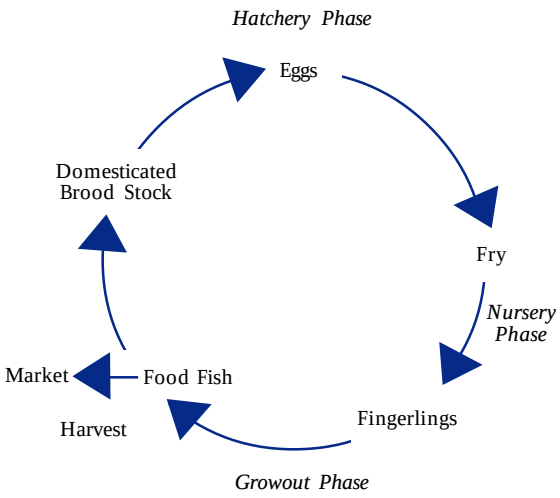
In 2001, two hatcheries were producing fingerlings for outside sales. North Carolina catfish producers can also purchase fingerlings from farms in other states. There are more than a dozen commercial hatcheries in the Southeast that sell fingerlings.

The price of six-inch fingerlings has remained stable over the past five years at 1.5 cents per inch, $0.08 each. The cost of fingerlings comprises about 15% of annual variable costs of food fish production.

The production parameter "stocking density" indicates the number of fish stocked per acre per production cycle. Generally, above stocking densities of about 6,000 catfish stocked per acre/year, the greater the density the less rapid the rate of growth; higher densities create greater competition for food and crowding which stress fish and inhibit growth. The greater amount of feed required for higher stocking densities can also cause water quality to deteriorate.

When catfish farming began in the 1950's, farmers stocked at rates of 2,000 fingerlings or less per acre. More recently, farmers have experimented with stocking rates of as high as 10,000 fish per acre. While researchers and innovative farmers continue to test higher stocking densities, the recommended density in NC is 5,000 - 6,000 fish per acre to harvest 1.50 pound

Catfish Production Cycle



Catfish fingerlings—fish that are about six inches in length, are purchased from hatcheries and stocked into ponds in the spring or fall.

The price of 32% averaged $240 per ton over the past five years. Feed accounts for about 50% of the variable operating cost for raising catfish.

Many fish farmers say that managing fish ponds is really managing water: water quality must remain high for fish to stay healthy and grow at a rapid rate.

catfish in 12 to 18 months. Catfish Budgets assume 6,000, six-inch fingerlings stocked per acre per year.

Feed

Catfish fry feed upon the natural food found in ponds. Farmers promote the growth of phytoplankton for fry by fertilizing pond water. As the fry mature, they are fed commercially produced catfish "crumble," and eventually a pelletted feed. Catfish feed is often described in terms of its protein content. Feed for food fish production varies from 28% to 32%. In North Carolina, most producers use 32% protein feed made by one of two catfish feed producers in North Carolina.

Catfish feed derives most of its protein content from soybean meal. Variation in the price of soybeans and corn, another key ingredient, over the past five years creates variability in the price of catfish feed, but generally lower prices for these inputs has meant a lower average price, at $225/ton. Farmers also pay a delivery charge of $10-$20 per ton. Catfish Budgets use an average feed price of $240 per ton.

The "feed conversion ratio," or FCR, is a critical parameter in fish production. FCR describes the number of pounds of feed fed per pound of fish harvested. Catfish Budgets assume an FCR of 2.0. Feed cost accounts for 50% to 60% of total variable cost.

Best management practices developed by fin fish researchers recommend feeding to "satiation," but no greater. Satiation refers to the point when fish stop actively feeding. If more feed is applied to the pond, the result is an increase in FCR, greater cost per pound of fish produced, and deterioration of pond water quality. Farmers determine the point of satiation by watching the fish feed just under the water surface.

Catfish grow faster and feed more during warmer months of the year. Feeding slows both in the winter and in mid-summer when water temperatures rise to the upper 80s. During months of heavy feeding, feed rates can reach 100 pounds of feed per acre per day. At this time, farmers are increasingly attentive to the effect of feed on the quality of the water environment.

Because fish are cold-blooded, their metabolic rate varies with the temperature of their surroundings. In cooler months, fish feed sparingly and larger fish can survive without feed for several months. In warmer months, catfish feed more heavily and may survive for only two to four weeks without feed, although this depends on the availability of natural food in the pond. Smaller fish are not able to survive without feed for as long a period as larger fish.

Oxygen

Like any other animal, fish require oxygen to live. Oxygen in natural waters comes from two sources: oxygen produced by algae, and oxygen transferred from the air into the water by wind action. In fish ponds, the churning action of diesel or electrically powered aerators speeds the transfer of oxygen into the water.

While a portion of the oxygen in the water is used by fish, algae both produce and use greater than 80% of the oxygen in the pond. Algae produce oxygen during the day and consume it at night. Algal growth is limited by the amount of nutrients in the pond. In commercial fish ponds, supplemental nutrients in the form of feed can result in an overabundance of phytoplankton. As algae use oxygen at night, oxygen can reach critically low levels. It is at this time that supplemental aeration is required.

An electrical aerator supplying one horsepower per acre of water is a standard feature in commercial catfish ponds. Timers, some costing less than $100 each, can be installed to automatically turn aerators on and off at specified times. In addition to electrical aeration, one portable

emergency aerator powered by a tractor is on hand for every two or three ponds.

In months of heavy feeding, farmers take oxygen readings at sunset, near midnight, and near sunrise. By tracking the change in oxygen, the farmer can make the determination if mechanical aeration is required. Dissolved oxygen is a manageable phenomena, and losses due to oxygen deficiency in a pond are generally the result of inexperienced management or lack of sufficient aeration equipment.

Research in recent years indicates that mechanical aeration of catfish ponds on a regular basis, not just in response to low oxygen levels, can improve feed conversion rates, production, and profit. Some catfish farmers in NC now use aerators for about six hours per night during the warmer months, and the additional yield of catfish more than offsets the increase in electrical cost. Catfish Budgets assume nightly aeration during the summer months.

Medication and Chemicals

Like any crop or livestock, catfish are susceptible to disease. The most common diseases of food fish-size catfish are ESC (enteric septicemia of catfish) and columnaris. Both are bacterial infections and most often occur during the seasonal change of spring and fall. Ponds must be closely monitored during these times for the appearance of sick fish. A decrease in feeding activity is one of the first signs of a disease problem. Farmers can take sick fish to one of the seven NC Department of Agriculture's veterinary diagnostic labs for analysis.

ESC, columnaris, and other bacterial infections can be treated with feed that contains antibiotics. The Food and Drug Administration has approved two antibiotics for catfish. The typical treatment is to feed infected ponds with medicated feed for seven to ten days. The cost of medicated feed is approximately 70% greater than non-medicated. As an alternative to medicated feed, some farmers have been able to head-off a burgeoning disease problem by not feeding for several days.

Copper sulfate is a chemical approved for control of algal growth in food fish ponds. It is used on a very limited basis, and is applied directly to pond water.

Lime and gypsum are used to improve the pH of pond water, just as they are used for soils. Both are applied infrequently, once every several years as needed. Salt is also used to mitigate nitrate toxicity (nitrate is a naturally occurring by-product of feed).

The costs of all medication and chemicals constitute about 3% of the total costs of growing catfish. Catfish Budgets assume a per acre annual cost of $80.

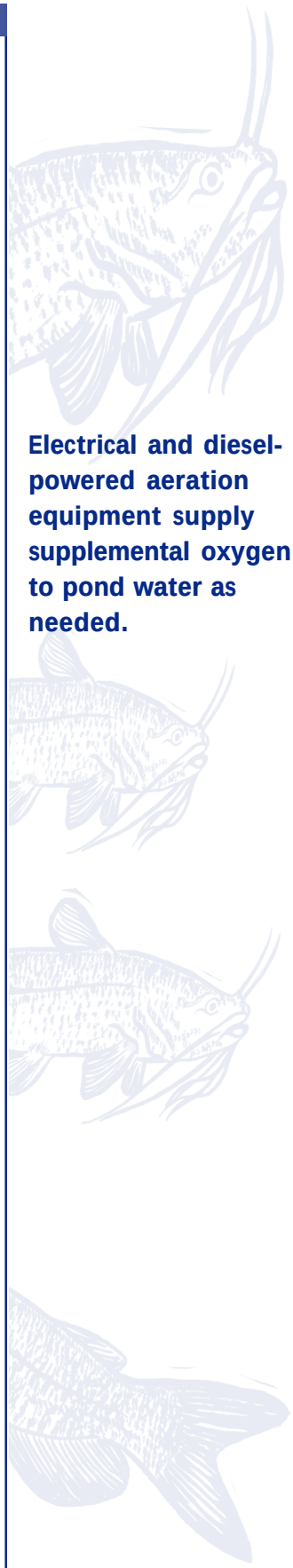
Electricity & Fuel

The cost of installing electrical lines is site specific, ranging from zero to tens of thousands of dollars depending on the distance to existing electrical lines. Farmers should contact their local electrical utility office for help in determining the cost.

Electricity and diesel fuel are used for aeration, water supply, feeding, and mowing of levees. Costs of electricity and fuel make-up about 4% of total variable costs. About 50% of the electrical and fuel costs for the year are expended during the three warmest months of the year, July - September, when aerators are often run nightly.

Loss of electrical power is rare in most areas. While a back-up generator could be used if power were lost, the tractor-driven emergency aerators which can be moved from pond to pond as needed are a cheaper option.

To reduce electrical costs, fish farmers in many areas can take advantage of off-peak demand programs offered by the electrical



Electrical and diesel-powered aeration equipment supply supplemental oxygen to pond water as needed.

Catfish are harvested year-round using seine nets that are pulled the length of the pond.

authority. The programs can reduce electrical costs by as much as 50%, and work well for fish farms since most power is used to run aerators between off-peak hours of 10 p.m. to dawn.

Labor

Catfish farming is not labor intensive, but the timing of labor use is critical. Summer months are the busiest, with more time spent feeding and evaluating water quality. During summer months, "D-O's,"—dissolved oxygen readings—are taken three or more times per day. These readings help determine if electrical aeration is required. Labor requirements during the coldest months are minimal, and many farmers use the extra time for routine repair and maintenance of equipment.

Labor is used in the following daily activities and varies by season: feeding (during warmer months one to two times per day, but may be once or twice weekly or less during cooler months), oxygen measurement (one to three times per day during warmer months and once or twice weekly in cooler months), water quality testing (two to three times per week and less frequently in cooler months), and maintenance of equipment and levees as required. If ponds are custom-harvested by a processor, little or no farm labor is needed for harvest. The total labor requirement for tasks other than harvest is estimated to average two to three hours per day per four, 10-acre catfish ponds. Catfish Budgets do not include any cost for the owner's labor, which is estimated at 20 hours or less for most weeks of the year.

Equipment Use

Greater than 80% of the equipment value used on the farm is specialized aquaculture equipment. A feed blower and aerators are collectively the most costly specialized equipment needed. Some equipment, such as tractors needed for feeding and to operate emergency aerators, is the same as that used for other farm enterprises. In Catfish Budgets, the 50-acre enterprise is an addition to an existing farm, and land and some equipment—a tractor, pickup truck, mower, and repair equipment—is already owned.

Outputs

~~~

Catfish

At one time, catfish producers in the U.S. stocked in the fall and harvested the entire pond before restocking the following fall. Today, most catfish producers follow a harvest practice of "multiple-cropping," in which a seine with a certain size mesh is pulled the length of the pond to extract fish of a target size.

The primary advantage of multiple cropping is that it provides harvest-size fish year-round. This steady supply has helped to establish markets for catfish. Multiple-cropping also uses less water than single-batch harvest, since ponds are infrequently drained.

A disadvantage of multiple cropping is that an inventory of fish is maintained, and some of these fish are large and poor converters of feed. Also, after one or two seasons it is very difficult to determine the population of fish in the pond. Survival on average is also lower in multiple cropping, perhaps because of cannibalism of new fingerlings by larger fish.

Catfish production in NC varies widely, ranging from less than 3,000 to over 6,000 pounds harvested per acre per year. Producers who stock consistently every year, and manage ponds actively should expect harvests of 5,000 pounds/acre/year. In Catfish Budgets, fish are stocked each October at a density of 6,000 fish/acre, and harvested when they reach 1.50 pounds. The estimated survival rate is 50%, with
~~~

mortality attributed to bird predation, cannibalism of smaller fish by larger fish, and loss of weaker fish to disease. The farm harvests 247,500 pounds (4,950 lbs/acre) during the first 15-18 months of operation and the same amount annually thereafter.

Larger farms can reasonably expect frequent harvests, and a steady cash flow. Smaller farms will have less frequent harvests because the number of food-size, harvestable fish must be great enough to justify the time and labor involved in harvesting. From the farmer's standpoint it is desirable to harvest fish of 1.00 to 1.5 pounds, because larger fish are poorer converters of feed and costlier to grow.

While a few NC fish farms process and sell their own fish, or sell fish through a fee-fishing operation (where individuals pay a flat fee to fish ponds and/or a fee per pound of fish caught), most NC catfish are sold to one of two independent processors. The processor brings harvest equipment to the farm, harvests market size fish, and hauls them back live to the processing plant. Catfish Budgets assume the farm sells all fish to a processor, and the farm pays a fee of $0.05 for harvest and delivery to the processing plant.

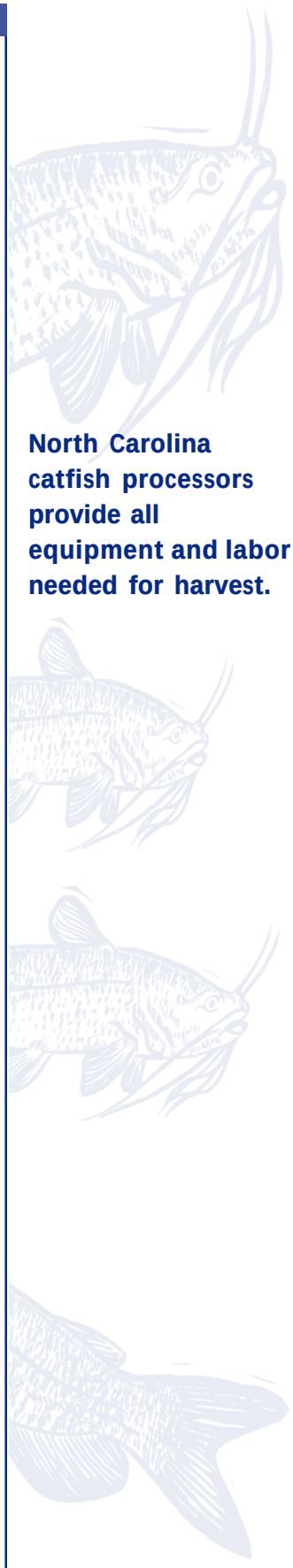
Effluent

Catfish ponds release water in periods of heavy rainfall or when ponds are drained. Research on catfish ponds has revealed that the natural biological activity in the pond acts to breakdown much of the organic matter in feed and fish wastes. The pond acts as a "digester" of organic matter.

Although ponds can act as their own treatment units for excess feed and fish waste, pond water normally contains more algae than natural water bodies such as nearby streams and estuaries. During months of heavy feeding, draining is best avoided; during these months pond water has the most potential to differ in quality from surface water. Discharge of excessive levels of ammonia (a by-product of the breakdown of organic matter in the pond) and algae can normally be avoided by draining ponds during winter months.

In North Carolina, effluent from aquaculture operations is monitored if the farm discharges greater than 30 days per year and has annual production of greater than 100,000 pounds.

Economics

~~~

Catfish Budgets estimate initial investment, operating costs, and annual returns for a 50-acre catfish enterprise. The enterprise consists of five, 10-acre ponds, and is an addition to an existing farm. The budgets assume that land and some equipment (a tractor, pickup, mower, and repair equipment) are already owned, and that the farm has another source of income to pay for debt service associated with year 1.

Stocking density (6,000 fish/acre) and production/year (4,950 lbs/acre) are averages for experienced North Carolina commercial catfish farmers following best management practices. Catfish are custom-harvested by a processor.

Initial Investment

The 50-acre farm requires an initial investment of $200,197 for pond construction, the well, and new equipment. In addition, the owner supplies the land (valued at $75,000) and some equipment (valued at $24,500) that is already owned. The budget assumes that the farmer purchases $35,702 in new equipment, pays for $14,647 worth of other start-up expenses, and borrows the remaining $149,849. Thus, the farmer invests 50% of the total initial investment by investing owned land, owned equipment, and cash. The borrowed amount is financed by a bank



North Carolina catfish processors provide all equipment and labor needed for harvest.
~~~

Catfish Budgets assume the catfish enterprise is an addition to an existing farm.

at 10% over 10 years. Operating funds (for feed, fingerlings, fuel, etc.) are financed with a credit lines from the feed mill and the bank at an interest rate of 10%.

Initial Investment - Table

	value($)	% of total
land (owned)	75,000	25
equipment (owned)	24,500	8
new equipment	56,800	19
pond construction	96,250	32
well and piping	32,500	11
other	14,647	5
Total	**299,697**	**100**

. . . . . .

Pounds Catfish Harvested For Processing and Prices Paid to Farmers

Year	Round weight processed (1000s of lbs)	Average Prices paid by processors
1990	360,435	$0.76
1991	390,870	$0.63
1992	457,367	$0.60
1993	459,013	$0.71
1994	439,269	$0.78
1995	446,886	$0.79
1996	472,123	$0.77
1997	524,949	$0.71
1998	564,355	$0.74
1999	596,628	$0.74
2000	593,603	$0.75
1996-2000 Average Price $0.74		

Operating Costs & Returns

Sales are based on a price of $0.75 per pound, the average five-year (1992-1996) farm-gate price for whole catfish as reported by the U.S. Department of Agriculture plus a 1¢ premium that the largest processor in North Carolina has typically paid producers. Returns are calculated before income tax and do not include the costs of owner labor or use of owner funds. Costs and returns are calculated for year one, when 2000 pounds per acre are harvested, and for year two and succeeding years, when an average of 4,950 pounds are harvested per acre.

Costs are split into the categories of variable costs and fixed costs. Variable costs vary directly with the volume of output; if nothing is produced, variable costs are zero. Variable costs include the inputs described in *Inputs* (fingerlings, feed, electricity & fuel, etc.), repair and maintenance, and an interest cost on operating capital. Catfish Budgets assume that the farm finances variable costs with credit lines from the feed mill and bank at an annual interest rate of 10%.

Fixed costs must be paid whether or not the farm produces, and tend to remain constant regardless of the volume of output. Fixed costs include property taxes, insurance, and the costs of financing. Note that the cost of financing includes both principal and interest, and that no equipment is replaced in Year One.

From Year Two onward, the farm harvests 247,500 pounds of fish annually with sales of $185,625. Variable Operating Costs are $119,623, or $0.48 per pound sold. The cost of feed and fingerlings makes up 70% of the variable operating cost. Annual debt payment is $20,357. The farm has an annual net profit of $42,520 or $850 per water acre (or $0.17 per pound produced). This is what the owner earns for his or her management skills, labor, and any capital invested in the farm.

Catfish Production Summary Budget, Years 1-2,

	Year 1	Year 2 & thereafter
Pounds Harvested	**100,000**	**247,500**
Income	**$75,000**	**$185,625**
Expenses		
fingerlings	$24,000	$24,000
feed	$24,000	$59,400
electricity & fuel	$1,433	$9,339
repair & maintenance	$2,130	$4,260
chemicals	$4,000	$4,000
harvest expenses	$5,000	$12,375
interest on op funds	$1,389	$6,234
debt payment	$20,357	$20,357
other	$3,125	$3,125
Total Expenses	**$85,433**	**$143,105**
Returns to Owner's Labor, Land, & Capital	$(10,433)	$42,520

By Year 2, net returns before tax to the farmer's labor, land, and capital is $42,520, or $850 per water acre.

Net returns are most sensitive to a change in feed price: a 10% rise in the cost of feed lowers net returns per acre by $125. Changes in feed conversion ratio have the same effect.

The breakeven price for Year two and subsequent years is $0.58. This means that the farmer must receive a price of $0.58 or higher per pound to pay all of the costs associated with raising the fish. Since feed is the major operating cost, the breakeven price is quite sensitive to a change in feed price. For every fall (rise) of 10% in the cost of feed, net returns rise (fall) by about $125 per acre (or $0.03 per pound produced).

A change in feed conversion has an almost identical effect. If the farmer improves feed conversion by 10%, annual profit rises by $125 per acre; if poor management results in a higher feed conversion (more pounds of feed required to produce one pound of fish), annual profit falls by the same amount.

Other Topics

~~~

Financing

Catfish farming is capital intensive. Construction and equipment costs of $3,000 - $4,000 per acre plus operating costs of nearly the same amount are required before the first harvest is made. For this reason, most individuals with an interest in catfish farming hope to gain lender financing.

While the climate for aquaculture loans is improving in NC, lenders still consider fish farming to be riskier than other farm ventures. Unlike farm land which can be used for many different crops, fish farms are specialized (and capital-intensive) facilities which cannot readily be converted to other uses. The time delay between first stocking and the first full harvest (15 - 18 months) and the uncertainty as to the
~~~

When North Carolina lenders have more exposure to successful fish farming operations the opportunity for financing increases.

Most catfish farms in NC range from 20 to 40 acres in size and are part of a larger farm.

movement in price over that time period is also a source of concern. Another concern is that, in comparison to livestock and other crops, lenders can not see the fish to exactly determine the amount in the pond, or gauge the management success of the farmer prior to harvest.

North Carolina has a small industry with a much shorter history (about 15 years) than some other states. In states with larger industries, such as the catfish industry in Mississippi and Alabama or the tropical fish industry in Florida, lenders are familiar with the industry. Construction and equipment loans, as well as operating loans based on pond inventory, are commonplace. As NC lenders have more experience with successful fish farming operations, the opportunities for lender financing should increase.

Those who have been able to gain financing have had a combination of owned assets, either land, equipment, or cash, typically making up 50% or more of the total investment amount; a good credit history and good relations with a banker; and experience with raising other types of livestock.

Farm Size

Like farming of traditional agricultural crops or livestock, aquaculture operations must be of a certain size to create returns to justify the large initial investment in facilities. Investment on a per acre basis varies greatly depending on the size of the farm.

Larger farms allow savings in per acre pond construction and equipment costs, just as larger cotton or peanut farms are less costly to develop on a per acre basis the larger the total size of the farm. The relatively low level of labor required also justifies a larger farm size if catfish farming is the sole income source of the owner.

Pond construction and the equipment cost per acre are lower for larger farms and farms with larger size ponds. Small farms can be profitable, however, if they are additions to existing farming operations. Both labor and equipment are shared, lowering investment and operating costs.

Alternative Uses of Aquaculture Ponds

Ponds constructed for raising catfish can also be used for other aquaculture species. Hybrid striped bass, and to a lesser extent largemouth bass, brim, baitfish, ornamental fish, and yellow perch are also raised in eastern North Carolina. However, these species are considered to be more difficult to culture than catfish, and for this reason a smaller pond size—two to four acres— is recommended. A potential catfish farmer interested in raising more than one species may want to initially build smaller ponds. Large ponds can also be divided into smaller ponds.

Catfish farming requires less water than other types of fish farming because ponds are not often drained. Changing to other species may require additional water-pumping capacity.

The land used for ponds can be converted into farm land. Levees must be carefully pushed down so that original topsoil is replaced. Fertilization and liming may also be required.

Insurance

Farmers should contact their local USDA Farm Service Agency office for information on weather related insurance provided for aquaculture.

General liability policies are available for catfish farms as are policies covering equipment damage due to weather and fish loss from a power outage. The difficulty of determining the number of fish in a pond at any one time has impeded the development

of more inclusive policies to cover fish kills. Research is ongoing to develop techniques, such as ultrasound, to more accurately determine inventory.

Permits & Licenses

The North Carolina Department of Agriculture grants an aquaculture license for a period of five years. The license is free. A free capacity use permit is required for well-water withdrawals in some areas. If the proposed aquaculture operation is not in a wetland and does not meet the criteria of both (1) discharging water more than 30 days per year and (2) producing more than 100,000 pounds per year, it is likely that no other permits will be needed. Potential producers are encouraged to contact the NC Department of Agriculture (see *Sources of More Information*) to learn about situations when other permits may be required.

Markets

Catfish is the fifth most popular fish consumed in the U.S. Per capita consumption of catfish rose from 0.4 pounds per person annually in 1985 to 1.0 pounds in the 1990's. About 50% of farmed catfish is sold through retail grocery chains, and 50% is distributed by food service companies to restaurants and institutions. Advertising efforts by The Catfish Institute, a marketing and promotional organization supported by the industry, have helped to take catfish from a regional specialty into restaurants and retail markets across the U.S. The Institute has spent more than $18 million since 1986 for advertising and public relations. Their advertising strategy has taken cues from the generic advertising of beef and pork and encourages consumption of catfish as an alternative to other meats. Promotional efforts abroad have resulted in sales to Canada, Europe and Asia. Nearly 405,000 pounds were sold abroad in 2000.

Research

USDA, the Commerce Department, and a number of other government agencies support research in catfish aquaculture. Research is currently being conducted on catfish nutrition, water quality, and genetics which should lead to more intensive production and lower operating costs.

The most significant advances for farmers have been the development of a fingerling vaccine against ESC (a bacterial infection which can cause a high degree of mortality), and genetic selection. Ongoing research in the genetic selection of faster-growing and hardier catfish is leading to the sale of catfish that grow 25% faster.

~~~
~~~

Catfish Budgets

~~~

These worksheets provide only general costs and returns estimates to fish farming.

Investment costs in particular can vary greatly and are extremely site specific. Prospective fish farmers should use these worksheets as a guide to obtaining costs specific to their site.

acres water	50.0
acres land	62.5
number of ponds	5.0
acres foodfish	50.0
ponds foodfish	5.0

foodfish info:	Year 1	Year 2
stocking density/acre	6,000.0	6,000.0
size @ harvest, lbs	1.5	1.5
FCR	2.0	2.0
survival		55%
lbs harvested/acre/year	2,000.0	4,950.0

bank credit line interest rate for yearly op. expenses	10%
percent of construction financed by owner	0%
percent of new equipment financed by owner	70%
bank interest rate for construction (10 year loan)	10%
bank interest rate for equipment (5 year loan)	10%
sale price per lb	$0.75

For this set of worksheets:

(1) No cost is assumed for owner's labor or for the interest cost of using the owner's personal funds. Labor is estimated at 20 hours per week.

(2) Budgets assume that all construction and equipment purchases take place at the beginning of year 1. Loan payments begin in year 1, but sales sufficient to cover the full operating cost in a year are not realized until year 2. If the owner does not have another source of income to make the payment until sales begin, then additional interest cost will be incurred.

(3) The owner funds 1/2 of the total intital investment in land, equipment & facilities. For this example, the owner contributes 62.5 acres of land, $24,500 in existing equipment, and $50,349 in cash for the purchase of new equipment. A total of $149,849 is borrowed for the initial investment, plus about $100,000 annually to cover operating costs.
~~~

CATFISH BUDGETS
INVESTMENT COSTS

Addition to existing farm
Land is owned and some
equipment shared

New Construction & Equipment

	UNIT	PRICE ($)/UNIT	# OF UNITS	TOTAL($)
Pond Construction				
pond construction (varies widely by site)	acre	1,600.00	50	80,000
vegetative cover & levee gravel	pond	750,000	5	3,750
drainage structure & piping	pond	400.00	5	2,500
electrical equipment and installation	pond	2,000.00	5	10,000
SUBTOTAL	-	-	-	**96,250**
Water Supply				
well & motor (varies widely by site)	unit	12,500.00	2	25,000
water distribution system (installed)	pond	1,500.00	5	7,500
SUBTOTAL	-	-	-	**32,500**
Equipment				
feed blower	unit	5,000.00	1	5,000
feed storage	unit	4,200.00	1	4,200
electrical aerator	unit	3,900.00	5	19,500
emergency aerator	unit	4,300.00	2	8,600
tractor (50 HP)	unit	17,500.00	1	17,500
misc (waders, scale, test equip)	unit	2,000.00	1	2,000
SUBTOTAL	-	-	-	**56,800**
Other Startup expenses				
lime treatment	acre	80.00	50	4,000
installation of utilities (varies widely by site	dol.	-	-	2,500
fill ponds	hrs pumping	1.50	5,431	8,147
SUBTOTAL	-	-	-	**14,647**
TOTAL INITIAL INVESTMENT	-	-	-	**200,197**
Investment cost per water acre	-	-	-	4,004

Shared Farm Equipment, Owned

tractor	unit	7,000	1	7,000
shop equipment	unit	2,000	1	5,000
mower	unit	500	1	500
pickup	unit	12,000	1	12,000
TOTAL				**24,500**

CATFISH BUDGETS
OPERATING COSTS AND RETURNS
Year 1

Addition to existing farm
Land is owned and some
equipment shared

	UNIT	PRICE/UNIT($)	# UNIT	TOTAL($)	% OF TOTAL
Gross Receipts					
catfish	lb	0.75	100,000	75,000	-
TOTAL GROSS RECEIPTS	**LB**	**0.75**	**100,000**	**75,000**	**-**
Variable Costs					
fingerlings (6,000/acre)	per	0.08	300,000	24,000	28.09%
feed (240/ton)	lb	0.12	200,000	24,000	28.09%
chemicals	acre	80.00	50	4,000	4.68%
electrical usage					
aeration	hr	0.85	400	340	0.40%
water supply	hr	1.50	23	35	0.03%
fuel					
aeration	hr	1.50	80	120	0.14%
misc.	acre	15.00	63	938	1.10%
repair & maint. of equip.	dol.	164.06	12	2,130	2.49%
interest on operating funds	dol.	-	-	1,389	1.62%
harvest (payment to processor)	lb	0.05	100,000	5,000	5.85%
SUBTOTAL, VARIABLE COSTS	**-**	**-**	**-**	**61,951**	**72.51%**
Fixed Costs					
payment on land and const. debt	dol.	-	-	15,976	18.70%
payment on equipment debt	dol.	-	36	4,381	5.13%
property taxes & insurance	acre	50	63	3,125	3.66%
SUBTOTAL, FIXED COSTS	**-**	**-**	**-**	**23,482**	**27.49%**
TOTAL COSTS	**-**	**-**	**-**	**85,433**	**100.00%**

** Excludes annual depreciation estimated at $13,520.00*

RETURNS SUMMARY
Returns to owner's management, labor, and capital

	LB	FARM	WATER ACRE
Returns above variable costs	$0.13	$13,049	$261
Returns above total costs	($0.10)	($10,433)	($209)
Breakeven price/lb above variable costs	$0.62		
Breakeven price/lb above all costs	$0.85		

CATFISH BUDGETS
OPERATING COSTS AND RETURNS
YEAR 2 AND AFTER

Addition to existing farm
Land is owned and some
equipment shared

	UNIT	PRICE/UNIT($)	# UNIT	TOTAL($)	% OF TOTAL	$/LB HARV
Gross Receipts						
catfish	lb	0.75	247,500	185,625	-	-
TOTAL GROSS RECEIPTS	**LB**	**0.75**	**247,500**	**185,625**		
Variable Costs						
fingerlings (stock 6,000 acre)	per	0.08	300,000	24,000	16.77%	0.10
feed	lb	0.12	495,000	59,400	41.57%	0.24
chemicals	acre	80.00	50	4,000	2.80%	0.02
electrical usage	-					
aeration	hr	0.85	6,120	5,202	3.64%	0.02
water supply	hr	1.50	908	1,363	0.95%	0.01
fuel	-					
aeration	hr	1.50	1,224	1,836	1.28%	0.01
misc.	acre	15.00	63	938	0.66%	0.00
repair & maint. of equip.	mo	355.00	12	4,260	2.98%	0.02
interest on operating funds	dol.	-	-	6,250	4.37%	0.03
harvest (payment to processor)	lb	0.05	247,500	12,375	8.65%	0.05
SUBTOTAL, VARIABLE COSTS	**-**	**-**	**-**	**119,623**	**83.45%**	**0.48**
Fixed Costs						
payment on land and const. debt	dol.	-	-	15,976	11.16%	0.06
payment on equipment debt	total	-	-	4,381	3.06%	0.01
property taxes and insurance	acre	50	63	3,125	2.18%	0.01
SUBTOTAL, FIXED COSTS	**-**	**-**	**-**	**23,482**	**16.41%**	**0.09**
TOTAL COSTS	**-**	**-**	**-**	**143,105**	**100.00%**	**0.58**

** Excludes annual depreciation estimated at $13,520.00*

RETURNS SUMMARY
Returns to owner's management, labor, and capital

	LB	FARM	WATER ACRE
Returns above variable costs	$0.27	$66,002	$1,320
Returns above total costs	$0.17	$42,520	$850
Breakeven price/lb above variable costs	$0.48		
Breakeven price/lb above all costs	$0.58		

SOURCES OF MORE INFORMATION

~~~

The **North Carolina Department of Agriculture and Consumer Services** provides assistance with permitting and helps individuals analyze the economics of proposed or existing aquaculture operations:

Permitting

Tom Ellis, Director
North Carolina Department of Agriculture
Division of Aquaculture & Natural Resources
P.O. Box 27647
Raleigh, NC 27611
(919) 733-7125
tom.ellis@ncmail.net

Business Planning

Rebecca Dunning
Agricultural Economist
North Carolina Department of Agriculture
P.O. Box 27647
Raleigh, NC 27611
(919) 733-7125

Marketing

North Carolina Department of Agriculture
Division of Marketing
P.O. Box 27647
Raleigh, NC 27611
(919) 733-7125

Many technical publications are available on catfish culture methods. As part of the **North Carolina Cooperative Extension Service**, the following aquaculture extension agents can be contacted to work one-on-one with prospective crawfish farmers in eastern and central North Carolina:

In the Northeast

Steve Gabel
Aquaculture Area Agent
NC Cooperative Extension Center
730 N. Granville St., Suite A
Edenton, NC 27932
(252) 482-6585
steve_gabel@ncsu.edu

Dr. Harry Daniels
Extension Aquaculture Specialist
Vernon G. James Research & Extension Center
Plymouth, NC 27962
(252) 793-4428 ext. 150
harry_daniels@ncsu.edu

In the Southeast

Mike Frinsko
Assistant Aquaculture Area Agent
NC Cooperative Extension Service
403 Government Circle
Greenville, NC 27834
(252) 757-2803
mike_frinsko@ncsu.edu

Marc Turano
NC Cooperative Extension Service
PO Box 109
Bolivia, NC 28422
(910) 253-2610
marc_turano@ncsu.edu

In the Piedmont (central NC)

Dr. Tom Losordo
Extension Aquaculture Specialist
North Carolina State University
Campus Box 7646
Raleigh, NC 27695-7646
(919) 515-7587
tlosordo@unity.ncsu.edu

Dennis DeLong
Recruiting Systems Specialist
NC State University
Campus Box 7646
Raleigh, NC 27695-7646
(919) 515-7587
dennis_delong@unc.edu

Prepared by

Rebecca Dunning
North Carolina Department of Agriculture
Division of Aquaculture and Natural Resources
P.O. Box 27647
Raleigh, NC 27611
(919) 733-7125

Graphic design and typesetting by:
Joey Fountain

Acknowledgments

The author wishes to express thanks to Dr. Harry Daniels of North Carolina State University for many helpful comments on this publication.
~~~

Notes

Notes

1200 copies of this public document were printed at a cost of $582.99 or $0.48 each.