

# **Aquaculture**

**in** *North Carolina*

## **Rainbow Trout**

*Inputs, Outputs and Economics*



*North Carolina Department  
of Agriculture and Consumer Services*

*Aquaculture and Natural Resources*

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**About this publication**

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The North Carolina Department of Agriculture and Consumer Services, Division of Aquaculture and Natural Resources, created this publication to assist individuals interested in the business of trout 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 trout 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 and Consumer Services. See *Sources of More Information* on page 15 for individuals to contact.

**North Carolina produces 7% of the trout grown in the U.S. Two-thirds of the U.S. harvest goes to processors, 5% is sold directed to restaurants and retailers, and the remaining is sold through recreational fee-fishing ponds.**

**U.S. Aquaculture & Trout Production**

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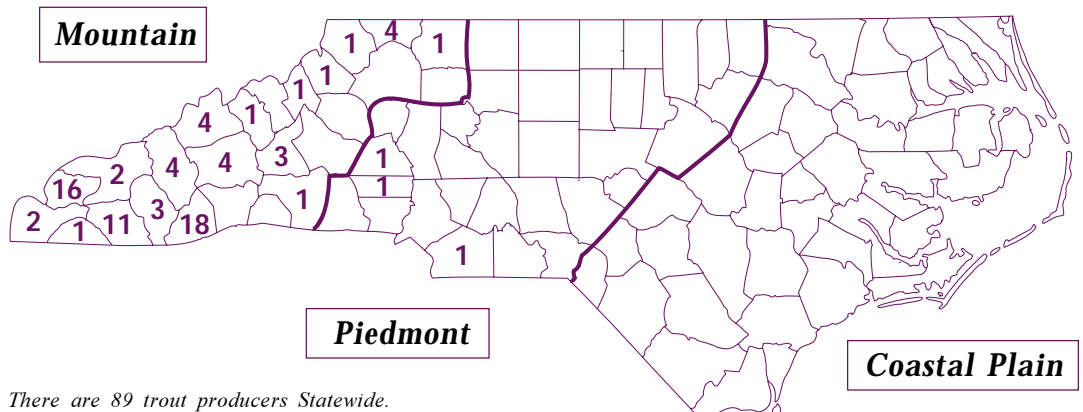
Aquaculture is the fastest growing segment of U.S. agriculture. The farm value of the U.S. aquaculture industry is estimated at nearly \$1 billion. Trout food fish production accounts for about 10% of the total value, and catfish for about 50% of the value.

Trout farming is the oldest form of commercial fish production in the U.S.; trout have been grown in culture systems for over 150 years. Rainbow trout is the predominant species raised. Trout are cultured in earthen or concrete raceways (rectangular tanks) supplied with flowing water. In 2000, an estimated 447 trout operations harvested and sold 59 million

pounds of trout valued at \$64 million. Idaho produces 58% of the total dollar production. North Carolina is the second largest producer, with about 7% of the production value. In 2000, U.S. trout farmers sold 70% of their harvest to processors, 18% through recreational fee fishing operations, 5% directly to restaurants and retailers, and the remainder to other outlets.

Production in the U.S. trout industry has remained stable over the last decade. Three reasons for limited expansion are: lack of suitable sites for new facilities; increasing costs associated with fish waste management; and difficulty in competing with the retail prices of imported trout or other seafood products.

**North Carolina Trout Farms, By County, 2000**



\* There are 89 trout producers Statewide. Sixty-five of these are active all year.

## North Carolina Trout Production

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North Carolina (NC) supplied about 7% of the U.S. trout market in 2000, with 89 producers harvesting an estimated 7.1 million pounds of food-size fish. Seventy percent of the harvest is sold to one of the three processing companies located within NC. Growers received an average of \$1.10 per pound over the past five years. Thirty percent of the harvest is sold through recreational fee-fishing ponds for \$1.50 to \$3.00+ per pound. Facilities range in size from 2,000 pounds annual production to greater than 500,000 pounds. The median size farm produces about 50,000 pounds per year.

Most farms purchase 3" trout fingerlings from hatcheries. Seventeen farms have their own hatcheries for growing fingerlings from purchased eggs, and there are three independent hatcheries. These hatching facilities produce about 7.5 million fingerlings annually for their own use and sale.

Many NC farms are located near the Great Smoky Mountains National Park and other mountain recreation areas. Thirty-one farms operate recreational fee-fishing ponds. Proximity to tourist activities and population centers largely determines the profitability of a fee-fishing operation.

## Inputs

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Following is a discussion of the production inputs used to raise rainbow trout in NC. 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 loaded per raceway—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 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 trout farming.

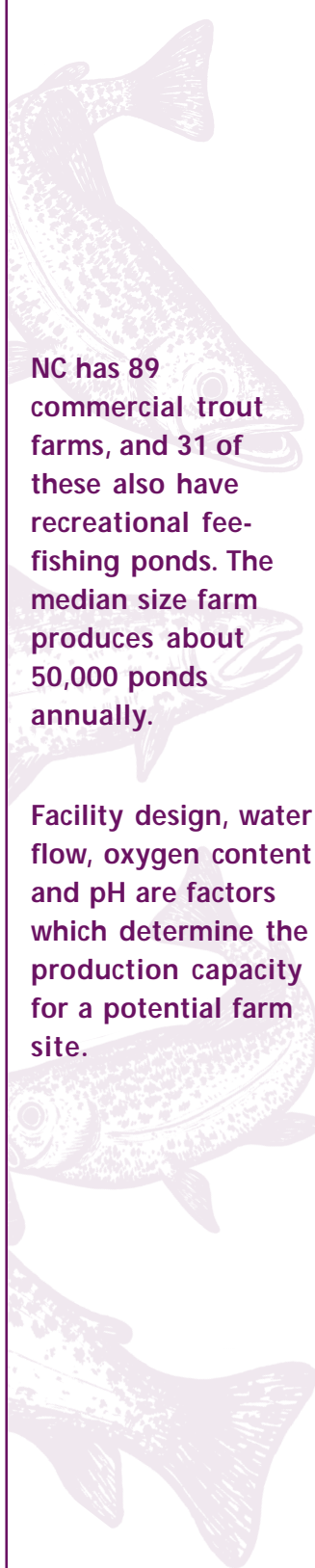
## Water

The quality and quantity of water determine the production capacity of a facility. Farmers choose between surface water (from streams, lakes, etc.) or groundwater from springs or wells. All NC trout farms utilize surface water because the cost to achieve high flows of well water would be cost prohibitive. The raceways in which trout are grown typically require at least 500 gallons per minute of water flow. Surface water is temporarily diverted from a stream to which it returns after flowing through a series of earthen ponds or rectangular-shaped concrete tanks called "raceways."

Trout grow in an environment of constantly moving fresh water. As water cascades down a series of raceways, it is reused by fish in lower raceways. Water progressively loses the oxygen that it contained when it entered the system (because the fish consume that oxygen), while the amount of uneaten feed or fish waste increases.

Oxygen content, facility design, pH, and water flow are critical parameters which determine both the number of contiguous raceway tanks that a particular site will support, as well as the density of fish that can be loaded in each tank. Most NC farms have incoming water that is saturated with oxygen; it is holding the maximum possible amount of oxygen.

The design of a facility also affects the amount of oxygen in the water. A well-designed facility allows at least a 3-foot fall between raceways. Splashing in the fall area adds oxygen back to the water, making it available to fish in the next tank. Some farmers add oxygen to the water to either compensate for temporarily low levels of



NC has 89 commercial trout farms, and 31 of these also have recreational fee-fishing ponds. The median size farm produces about 50,000 pounds annually.

Facility design, water flow, oxygen content and pH are factors which determine the production capacity for a potential farm site.

oxygen (especially during summer months when stream flow is lower), or they may use oxygen on a continuous basis so that raceways can be used more intensively. The use of supplemental oxygen is discussed in *Oxygen*, below.

A higher pH of incoming water limits reuse of the water because water with a high pH value converts ammonia (a by-product of feed and fish waste) into a form which is toxic to fish. The pH level of water used in most NC farms is optimum, at a level between 6.5 and 7.0.

Water flow should be sufficient to fill a raceway within 10 to 15 minutes. The rate of water flow is measured in terms of gallons per minute (gpm). Stream flow rates are slower during the summer months, and potential farm sites should be judged based on the minimum flow. A general rule of thumb is that one gpm of flow is required for each 50 to 100 pounds of annual production capacity. The 60,000 pound facility in Trout Budgets requires a stream flow of 600 gpm or greater.

Water temperature also has an effect on the production capacity of a facility. The optimal temperature range for growing trout is 55-65°F. Warmer water holds less oxygen, and trout convert feed less efficiently at temperatures above 68°F. Trout also grow slowly and do not actively feed at temperatures below 38°F.

Water temperature, oxygen content, pH, and flow rate all limit the locations suitable for trout operations. High-quality water is typically associated with a vegetated watershed; if the land in the watershed is cleared cropland, water quality has a greater potential to vary and fall below optimal levels and the increased sediment load from runoff increases maintenance costs for the raceways. Shade that vegetation provides also results in a lower temperature that is better for trout growth.

### **Land and Facilities**

The example farm in Trout Budgets requires a land area of one to two acres.

Cost of suitable, streamside land in NC's western mountains sells in excess of \$10,000 per acre. Land with a 3-10% slope and access to a year-round supply of rapidly flowing, high-quality water is an ideal spot for a trout farm.

Raceway tanks in NC are typically 3.0 feet deep, 8 feet wide, and 40 to 60 feet long. Nearly all commercial facilities use concrete raceways. Earthen ponds usually have lower production because it is more difficult to control water quality and manage the fish.

A water intake structure diverts a percentage of stream water into raceways via underground pipes. Water returns to the stream after flowing through the raceways.

Agents with the North Carolina Cooperative Extension Service help prospective trout farmers evaluate sites and plan construction. Farmers can contract all construction work, but many do much of the work themselves to reduce costs.

The U.S. Army Corps of Engineers determines if potential sites are part of wetlands. In almost all cases, wetland areas can not be used for raceway construction.

The example farm is located on 1.5 acres of owned land valued at \$15,000. Trout Budgets assume that land and water resources are ideal. The farm consists of twenty 8' x 40' tanks.

### ***Fingerlings & Inventory Management***

Trout farmers stock raceway tanks with 3-inch fish (about 100 fish to the pound). The number of fish which can be stocked into a system depends on the quality and velocity of the incoming water. The number of pounds of fish that a given volume of water will support is its "carrying capacity."

Fingerlings are purchased from one of the dozen hatching facilities within NC, or from facilities in other States. There are dozens of sources of fingerlings in the U.S. Most hatching facilities in the U.S. do not

Nearly all NC Trout farms consist of a parallel series of concrete tanks called raceways. Stream water is temporarily diverted into these raceways.

Trout farmers stock 3" fingerlings into tanks several times a year. Market size fish weighing approximately one pound are grown in about one year.

spawn their own trout; trout eggs are purchased from spawning facilities located in the Pacific Northwest. The price of trout fingerlings has varied little, and averaged \$0.09 per fish over the past five years.

Three-inch fingerlings can be grown to a market size of about 1 pound in approximately one year. As the fish grow from an initial three inches to market size, they are stocked at successively lower numbers. Farmers calculate the appropriate carrying capacity and density by multiplying the fish length by 0.5 and by 1.0 to determine the number of pounds of fish per cubic foot of water. For example, 3-inch fish can be stocked at a rate of 1.5 to three pounds of fish per cubic foot of water, while 10 inch fish could be stocked at a rate of five to 10 pounds of fish per cubic foot of water. Since 3" fish weigh 1/100<sup>th</sup> of a pound, or 0.16 ounces, each cubic foot of water will support 150 to 300 fingerling fish.

Trout are typically graded by size and restocked three to five times per year. Grading and re-stocking fish makes the best

use of tank space, helps farmers determine the amount of fish ready for harvest, and improves feeding efficiency. If there is great variability in the size of fish in a raceway, the larger fish tend to eat all of the food, leaving little for the smaller fish. Cannibalism of smaller fish by larger fish is another unwanted result of poorly graded fish.

Trout Budgets assume an initial stocking rate of 24,000 three-inch fish. This is a stocking density of 300 fish per cubic foot of water. The farm is stocked in March of Year 1. After about six weeks, this initial lot of fish are graded and restocked into a total of three tanks. After six to eight more weeks, the fish are again graded and restocked into a total of five tanks. Over the next year, this lot will be graded and restocked two to five more times. New lots of fingerlings are stocked four to six times per year.

**Feed**

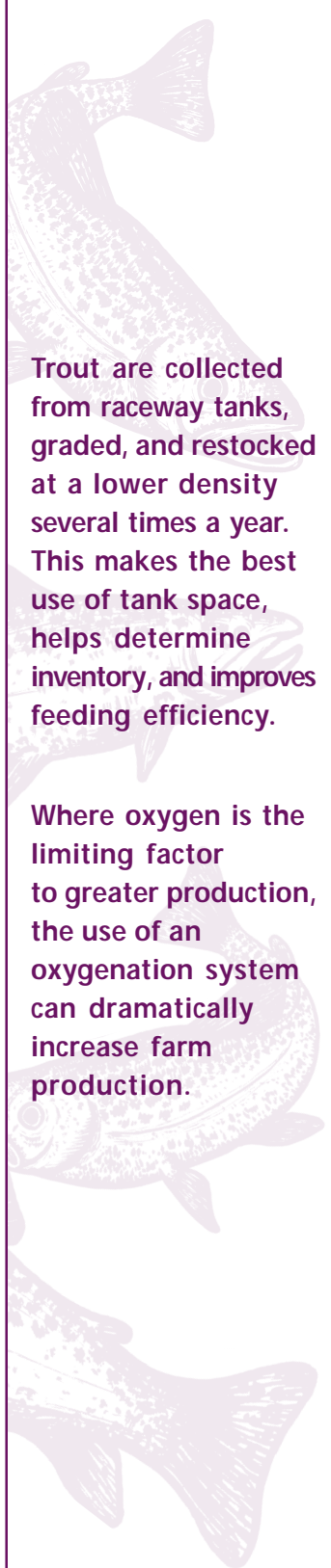
Trout eat commercially manufactured feed pellets that are made by a half-dozen mills in the U.S. Most NC trout farmers purchase feed made by a feed manufacturer in NC who also owns a farm and processing facility.

Fish feed is described in terms of its protein and fat content. Trout fingerlings require feed with a higher protein (50%) and fat (18%) content than larger fish (42% protein and 15% fat). Trout feed derives most of its protein content from fish and soybean meal. Over the past five years the price of fingerling feed has steadily risen to \$900 per ton for fingerling feed and \$600/ton for food fish feed.

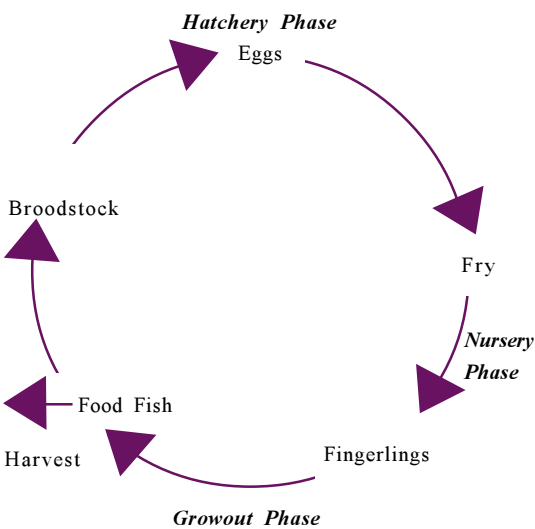
The “feed conversion ratio,” or FCR, is a critical parameter in fish production. FCR describes the number of pounds of feed fed per pound of fish harvested. The ratio is typically lower the smaller the fish size: larger fish convert feed less efficiently. Trout Budgets assume a feed conversion rate of 1.1 for fingerlings (from 3” to 5” in size) and 1.3 for food fish. Feed is the major variable cost in fish production,

Trout are collected from raceway tanks, graded, and restocked at a lower density several times a year. This makes the best use of tank space, helps determine inventory, and improves feeding efficiency.

Where oxygen is the limiting factor to greater production, the use of an oxygenation system can dramatically increase farm production.



**Rainbow Trout Production Cycle**



**Trout farmers stock and harvest fish throughout the year.**

accounting for about 70% of total variable cost.

Trout farmers rely on feed tables which are provided by the Cooperative Extension Service or feed manufacturers. These tables indicate the amount to feed based on the fish size and water temperature. Trout feed actively and convert feed most efficiently at water temperatures between 55°F and 65°F. Feeding in excess of what the fish are able to metabolize increases the costs of production, and leads to deterioration of water quality and disease.

Most farms in NC use a combination of hand feeding and feed distributed by demand feeders. Demand feeders consist of plastic cylinders suspended over each tank, with a rod hanging from the bottom of the cylinder into the water. Fish quickly become adept at moving the rod, which causes feed to fall from the cylinder. A few farmers use automatic feeders, which dispense feed from a hopper at preset intervals rather than in response to movement by the fish.

### Oxygen

As discussed above in *Water*, the amount of oxygen in water limits the production capacity of a farm in two ways: by limiting the number of raceway tanks that can be used in a series, and by limiting the density at which fish can be stocked.

One in five of NC trout farmers use some means of supplemental oxygen. Some use oxygen on an emergency basis, renting oxygen tanks only during the summer months when feeding rates are higher and flow rates lower, both of which can lower the oxygen content in raceway water. Successful use of oxygen assumes that oxygen is the factor which limits raceway loading and production for a given site and set of raceways. Often other elements—water temperature, accumulation of solids, level of carbon dioxide or ammonia—may be the limiting factor to production, and in this case an oxygenation system would not be the means by which the farmer could increase production. When oxygen is

limiting, the use of an oxygenation system is a means of more intensively using tank space and increasing farm production, sometimes by as much as 50% or more. Although supplemental oxygen is a proven means of increasing profits, the high initial investment deters farmers. Initial investment in equipment is estimated to be \$4,000 to \$6,000 per pair of tanks, or \$40,000 to \$60,000 for the example farm in Trout Budgets.

It is assumed that the farm in Trout Budgets is located in a site with a year-round supply of high quality water, and does not use supplemental oxygen.

### Medication

Like any crop or livestock, trout are susceptible to disease. Stress increases the probability that an animal will not be able to effectively stave off the onset of an infectious disease. Crowding, improper handling, low dissolved oxygen, and sudden changes in temperature are factors which create stress and can lead to disease problems. The best method of disease prevention is to protect trout from exposure to sources of stress.

Trout are affected by bacterial, parasitic, and viral pathogens. Bacterial infections are treated with feed containing antibiotics. Parasites are typically treated with chemicals applied directly to tank water. No medication is effective against viral pathogens. The most common viral infection is pancreatic necrosis, which affects fish less than 3" in size, and is confined to hatchery facilities.

The costs of all medication and chemicals constitute less than 1% of the variable costs of growing trout. Trout Budgets assume that 5% of feed is medicated feed and that \$100 annually is spent on chemical treatments.

### Electricity

The use of electricity is typically confined to lighting of the raceways. The cost of installing electrical lines is very site specific, ranging from zero to tens of thousands of

Much of the labor on the farm is used to stock, grade, transfer and harvest fish, all of which occur year-round.

Trout Budgets estimate costs and return to a facility consisting of 20 tanks, producing 60,480 pounds of fish annually.

dollars depending on the distance to existing lines. Farmers should contact their local electrical utility office for help in determining the cost. Trout Budgets assume that the site has electrical lines and spends \$50/month for lighting the raceways.

Some farmers also use electrically-powered pumps to recirculate water from the bottom of raceways to the top, to make up for low stream flow during the summer. Trout Budgets assume that the farm has sufficient natural water flow throughout the year.

**Labor**

Labor is used in the following daily activities and varies by season: hand feeding and filling of demand feeders (daily during the prime growing season of spring and fall and less frequently in midsummer and winter); stocking, grading, transferring and harvesting fish (fish are moved more frequently in spring and fall and less in midsummer and winter); monitoring water quality and use of oxygen systems; and maintenance of equipment as required.

Trout Budgets do not include any cost for the owner’s labor, which is estimated to average 25 to 40 hours per week.

**Equipment Use**

The cost of facilities—water intake structure, underground piping, and raceways—is the major investment cost of a trout facility. The only types of equipment used are the loading nets for transfer and harvest, tanks for moving fish, demand feeders for each raceway, and graders. Trout Budgets assume that the owner already owns shop equipment for minor repairs, a pickup truck, and a mower. The farmer purchases \$2,610 in new equipment.

**Outputs**

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**Trout**

Trout grow from 3” fingerlings to average market size, 12-14 ounces, in about 12 months. Fish are harvested year-round.

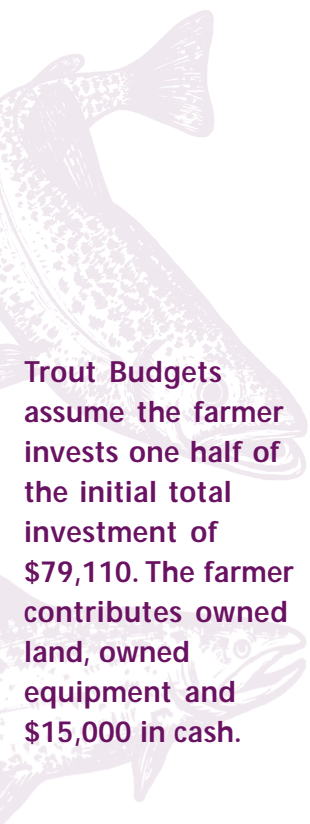
Trout production in NC varies widely depending on site conditions which limit the amount of fish that can be loaded per raceway. Well constructed facilities with a year-round source of high-flow, high quality water typically have a loading rate of three pounds of fish per cubic foot of water. As discussed above, oxygen systems can increase this loading rate if no other factors are limiting.

The estimated survival rate is 80%. Mortality is attributed to loss of weaker fish to disease, low dissolved oxygen levels resulting from high feeding rates and/or low water flow, theft, flooding, and bird predation. The farm stocks in March of Year 1, and begins harvesting in March of Year 2. In Year 2 and thereafter the farm has an annual harvest of 60,480 pounds.

Processing plants typically transport fish in trucks which haul about 3,000 pounds of fish per load. 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. Most NC trout farmers sell fish to one of the three processors in NC, who harvest and transport the fish. Farmers usually assist in harvesting.

**Effluent**

Farms which harvest more than 20,000 pounds annually and also use more than 5,000 pounds of feed in any one month must obtain an effluent discharge permit (NPDES permit) from the NC Department of Environment Health and Natural Resources. The permit is free and takes four to six months to process. Most trout farms qualify for a general permit, which takes about one month to obtain. Farms are required to have a waste management plan, which typically consists of a settling pond.



**Trout Budgets assume the farmer invests one half of the initial total investment of \$79,110. The farmer contributes owned land, owned equipment and \$15,000 in cash.**



**Economics**

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The tables below estimate initial investment, operating costs, and annual returns for a facility with 20 tanks. Total water volume per tank is 800 cubic feet (tank dimensions are 8' X 40' X 3'). The owner purchases 3" fingerlings from a NC hatchery. Twenty-four thousand fish are initially stocked in March of Year 1. Additional fish are stocked every few months, and each batch of existing fish are graded and transferred several times during the year. Harvest of food fish begins in March of Year 2, and the farm is harvested on 10 to 20 occasions annually. The average harvest weight is 14 ounces and survival is 80%. In Year 2 and thereafter, the farm harvests 60,480 pounds of fish per year. The farm sells all fish to a processor.

The budgets assume that land and some equipment (a tractor, shed, mower, and repair equipment) are already owned. Summaries of the investment and operating costs and returns for Years One and Two are given below. A detailed investment budget and costs and returns for an average year (year 2 and thereafter) appears on pages 11-13.

**Initial Investment**

The trout facility requires an initial investment of \$62,340: \$59,500 for site preparation, raceway and water intake construction; and \$2,840 for new equipment. In addition, the owner supplies the land (1.5 acres valued at \$15,000), and some equipment that is already owned (valued at \$14,500). Budgets assume that the farmer purchases the \$2,840 of new equipment, and funds 23% of the construction (23% of \$59,500 or \$13,685), and borrows the remaining \$46,695. 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 at 10% over 10 years.

**Initial Investment**

|                   | Value(\$)     | % of total |
|-------------------|---------------|------------|
| land (owned)      | 15,000        | 16         |
| equipment (owned) | 14,500        | 16         |
| new equipment     | 2,840         | 3          |
| construction      | 59,500        | 65         |
| <b>Total</b>      | <b>92,720</b> | <b>100</b> |

**Operating Costs and Returns**

Sales are based on a price of \$1.10 per pound, the five year average price paid by NC trout processors. Net returns are calculated before income tax and do not include the costs of owner labor or use of owner funds.

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, medication, etc.), repair and maintenance, and an interest cost on operating capital. Trout Budgets assume that the farm finances variable costs with a credit line from the 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, economic depreciation (replacement of worn-out equipment and repairs to raceways) and the costs of financing. Note that the cost of financing includes both principal and interest.

In Year 1, the farm spends \$36,029, primarily for fingerlings, feed, and a \$7,769 debt payment. Harvest begins in March of Year 2. The farm harvests 60,480 pounds of trout in this and succeeding years. The Summary Budget, below, does not make an allowance for carrying over the costs of the first year; if the owner is not able to pay operating costs and the debt payment from

**Feed and fingerlings make up greater than 70% of the total cost of raising trout. Assuming a sales price of \$1.10 per pound, and total cost of production of \$0.76, the farm nets \$21,452 per year on 60,480 pounds harvested.**

**Rainbow Trout Production Summary Budget, Years 1-2**

|                                              | Year 1    |               | Year 2    |               |
|----------------------------------------------|-----------|---------------|-----------|---------------|
| Pounds Harvested                             | lbs.      | -             | \$        | 60,480        |
| Income                                       | \$        | -             | \$        | 66,528        |
| Expenses                                     |           |               |           |               |
| fingerlings                                  | \$        | 6,480         | \$        | 8,640         |
| feed                                         | \$        | 17,963        | \$        | 23,950        |
| medication                                   | \$        | 478           | \$        | 608           |
| electricity & fuel                           | \$        | 450           | \$        | 600           |
| repair & maint. of equip                     | \$        | 568           | \$        | 757           |
| monitor water quality                        | \$        | 500           | \$        | 500           |
| interest on operating funds                  | \$        | 1,322         | \$        | 1,753         |
| debt payment                                 | \$        | 7,769         | \$        | 7,769         |
| property taxes & insurance                   | \$        | 500           | \$        | 500           |
| <b>Total Expenses</b>                        | <b>\$</b> | <b>36,029</b> | <b>\$</b> | <b>45,076</b> |
| Returns to Owner's Labor,<br>Land, & Capital | \$        | (36,029)      | \$        | 21,452        |

some other source of funds, additional interest cost will be incurred.

From Year Two onward, the farm harvests 60,480 pounds of fish annually with gross sales of \$66,528. Variable Operating Costs are \$36,807, or \$0.61 per pound sold. The cost of feed and fingerlings makes up 89% of the variable operating cost. Annual debt payment is \$7,769. The farm has an annual net profit of \$21,452 or \$0.35 per pound produced. This is what the owner earns for his or her management skills, labor, and any capital invested in the farm.

The breakeven price for Year Two and subsequent years is \$0.75. This means that the farmer must receive a price of \$0.75 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 rise of 10% in the cost of feed, net returns fall by \$2,500 (\$0.04 per pound produced).

A change in feed conversion has a similar effect on farm profits. If poor management results in a higher feed conversion (more pounds of feed required to produce one pound of fish), annual profit falls. If the FCR increases by 10%, farm profits fall by \$2,500.

**Other Topics**


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**Financing**

The farm in Trout Budgets requires an initial investment of over \$90,000 if land and no equipment are owned. Operating costs are \$35,000 for the first year, and approach \$50,000 thereafter. For this reason, most individuals with an interest in trout farming hope to gain lender financing.

Lenders generally consider fish farming to be riskier than other farm ventures. Fish farms are specialized facilities which cannot readily be converted to other uses. The time delay between first stocking and first harvest (12 months) and the uncertainty as to the movement in price over that time period is also a source of concern. While





aquaculture is considered a form of agriculture, it differs in that fish are sold through seafood marketing channels with which agricultural lenders are usually unfamiliar. Lenders are unsure where trout will be sold, and wonder how the bank would be able to sell the fish (and manage the farm) if the fish farm were to fail. Also, unlike the production of some other types of livestock—hogs, turkeys, chickens—the NC trout industry does not have integrator companies which contract with growers for quantity and price.

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 on a fish farm. Many individuals who have built trout farms spent time working on other farms to gain valuable experience.

### **Insurance**

Government programs provide subsidized insurance for some agricultural products. No programs exist for livestock or aquaculture. However, fish farmers can participate in the Federal Crop Insurance Program's Non-insured Assistance Program, which provides disaster payments. Liability insurance is available from private insurers for fee-fishing operations.

### **Permits & Licenses**

The North Carolina Department of Agriculture and Consumer Services grants an aquaculture license for a period of five years. The license is free. The U.S. Army Corps of Engineers requires a permit (404 permit) for construction of the water intake structure. This permit takes about six months to process and the cost is \$100. The Corps also evaluates sites to determine if they are in a wetland. The NC Division of Environment Health and Natural Resources, Division of Water Quality, requires an Effluent Discharge Permit (NPDES permit)

for trout farms meeting both of the following criteria: production of more than 20,000 pounds annually and use of greater than 5,000 pounds of feed in any one month. Farms that do not meet these criteria qualify for a general permit, which is free and takes one to three months to process. Prospective trout farmers should check with the local County Planning Department to see if other permits are needed. Potential producers are also encouraged to contact the NC Department of Agriculture and Consumer Services (see *Sources of More Information*) for help on obtaining permits and to learn about situations when other permits may be required.

### **Markets**

Seventy-five percent of NC grown trout are sold to NC processors. Nearly all of this is sold fresh to wholesalers along the east coast of the U.S. To compete with less expensive trout from Idaho and imports of fresh and frozen fish, some NC processors are trying to capitalize on niche markets for fresh fish and value-added products such as smoked trout.

Farmers also engage in fee fishing and some sell smaller fish to stock privately owned recreational ponds. In most cases, well-located fee-fishing operations are more profitable than farms which produce fish for processing.

### **Research**

USDA, the Commerce Department, and a number of public and private institutions support research in trout aquaculture. Research is currently being conducted on trout nutrition and disease prevention which should lead to more intensive production in existing facilities and to lower operating costs. Research into genetically selected trout that better convert feed and grow faster in colder weather could lead to the construction of new facilities in areas which are currently considered marginal for trout farming.

**Rainbow Trout Budgets**

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NOTE: 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.

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|                                    |          |
|------------------------------------|----------|
| number of raceway pairs            | 10.0     |
| raceway length                     | 40.0     |
| raceway width                      | 8.0      |
| raceway depth                      | 3.0      |
| area in cubic feet                 | 960.0    |
| stocking density per batch         |          |
| (initial no. stocked per batch)    | 24,000.0 |
| avg. size @ harvest, ounces        | 14.0     |
| survival, 3" to 5"                 | 90%      |
| survival, 5" to harvest            | 80%      |
| total farm harvest per year        | 60,480.0 |
| feed conversion ratio, fingerlings | 1.1      |
| feed conversion ratio, food fish   | 1.3      |

|                                                        |        |
|--------------------------------------------------------|--------|
| bank credit line interest rate for yearly op. expenses | 10%    |
| percent of construction financed by owner              | 23%    |
| percent of new equipment financed by owner             | 100%   |
| bank interest rate for construction (10 year loan)     | 10%    |
| bank interest rate for equipment (5 year loan)         | 10%    |
| sale price per lb                                      | \$1.10 |

.....

**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 25 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 cover debt payments until sales begin, then additional interest costs will be incurred.
- (3) The owner funds 1/2 of the total initial investment in land, equipment & facilities. For this example, the owner contributes 1.5 acres of land, \$14,500 in existing equipment, and \$2,840 for new equipment, and \$13,685 for construction. A total of \$46,695 is borrowed.



**INVESTMENT COSTS**

*Land is owned and some equipment shared*

**New Construction & Equipment**

|                                       | UNIT             | PRICE/UNIT(\$) | # OF UNITS | TOTAL(\$)     |
|---------------------------------------|------------------|----------------|------------|---------------|
| <b>Pond Construction</b>              |                  |                |            |               |
| site preparation .....                | dol.             | -              | -          | 2,500         |
| water intake assembly .....           | dol.             | -              | -          | 10,000        |
| raceway construction .....            | pair of raecways | 3,100.00       | 10         | 31,000        |
| labor .....                           | hours            | 8.00           | 2000       | 16,000        |
| <b>SUBTOTAL</b> .....                 | -                | -              | -          | <b>59,500</b> |
| <b>Equipment</b>                      |                  |                |            |               |
| demand feeders and mounting .....     | unit             | 135.00         | 10         | 1,350         |
| tanks for transfer and harvest .....  | unit             | 1,000          | 1          | 1,000         |
| loading nets .....                    | unit             | 50.00          | 3          | 150           |
| graders .....                         | unit             | 80.00          | 3          | 240           |
| waders .....                          | unit             | 100.00         | 1          | 100           |
| <b>SUBTOTAL</b> .....                 | -                | -              | -          | <b>2,840</b>  |
| <b>TOTAL INITIAL INVESTMENT</b> ..... | -                | -              | -          | <b>62,340</b> |

| <b>Shared Farm Equipment, Owned</b>      |      |           |   |               |
|------------------------------------------|------|-----------|---|---------------|
| <b>shared with other farm activities</b> |      |           |   |               |
| shop equipment                           | unit | 2,000.00  | 1 | 2,000         |
| mower                                    | unit | 500.00    | 1 | 500           |
| pickup                                   | unit | 12,000.00 | 1 | 12,000        |
| <b>TOTAL</b>                             | -    | -         | - | <b>14,500</b> |

**TROUT BUDGETS  
OPERATING COSTS,  
YEAR 1, MARCH-DECEMBER**

*Land is owned and some  
equipment shared*

|                                           | UNIT      | PRICE/UNIT(\$) | #UNIT  | TOTAL(\$)     | % OF TOTAL    |
|-------------------------------------------|-----------|----------------|--------|---------------|---------------|
| <b>Gross Receipts</b> .....               | -         | -              | -      | -             | -             |
| Trout .....                               | -         | -              | -      | -             | -             |
| <b>TOTAL GROSS RECEIPTS</b> .....         | -         | -              | -      | -             | -             |
| <b>Variable Costs</b>                     |           |                |        |               |               |
| fingerlings (length=3 ʒ) .....            | each      | 0.09           | 72,000 | 6,480         | 18%           |
| fingerling feed (1.1 FCR) .....           | lb        | 0.45           | 2,851  | 998           | 4%            |
| food fish feed (1.3 FCR) .....            | lb        | 0.30           | 55,598 | 16,680        | 46%           |
| medicated feed (cost of medication) ..... | lb        | 0.10           | 2,780  | 278           | 1%            |
| other medication .....                    | treatment | 50.00          | 4      | 200           | 1%            |
| electricity .....                         | month     | 50.00          | 9      | 450           | 1%            |
| repair & maint. of equip. ....            | mo        | 63.06          | 9      | 568           | 1%            |
| monitoring of water quality .....         | yr.       | 500.00         | 1      | 500           | 1%            |
| interest on above operating funds .....   | dol.      | -              | -      | 1,332         | 4%            |
| <b>SUBTOTAL, VARIABLE COSTS</b> .....     | -         | -              | -      | <b>27,936</b> | <b>77%</b>    |
| <b>Fixed Costs</b>                        |           |                |        |               |               |
| payment on const. debt .....              | dol.      | -              | -      | 7,769         | 22%           |
| property taxes and insurance .....        | dol       | -              | -      | 500           | 1%            |
| <b>SUBTOTAL, FIXED COSTS</b> .....        | -         | -              | -      | <b>8,269</b>  | <b>20.56%</b> |
| <b>TOTAL COSTS</b> .....                  | -         | -              | -      | <b>36,029</b> | <b>100%</b>   |

\* Excludes annual depreciation, estimated at \$2,729

**TROUT BUDGETS  
OPERATING COSTS, YEAR 2,**

*Land is owned and some  
equipment shared*

|                                    | UNIT      | PRICE/UNIT(\$) | #UNIT  | TOTAL(\$) | % OF TOTAL | \$/LB HARV |
|------------------------------------|-----------|----------------|--------|-----------|------------|------------|
| <b>Gross Receipts</b>              |           |                |        |           |            |            |
| Trout .....                        | lb        | 1.10           | 60,480 | 66,528    | -          | -          |
| <b>TOTAL GROSS RECEIPTS .....</b>  |           |                |        |           |            |            |
| <b>Variable Costs</b>              |           |                |        |           |            |            |
| fingerlings (length=3") .....      | each      | 0.09           | 96,000 | 8,640     | 14%        | 0.14       |
| fingerling feed (1.1 FCR) .....    | lb        | 0.45           | 3,802  | 1,711     | 3%         | 0.03       |
| food fish feed (1.3 FCR) .....     | lb        | 0.30           | 74,131 | 22,239    | 37%        | 0.37       |
| medicated feed (cost of medic.) .. | acre      | 0.11           | 3,707  | 408       | 1%         | 0.01       |
| other medication .....             | treatment | 50.00          | 4      | 200       | 1%         | 0.00       |
| electricity .....                  | month     | 50.00          | 12     | 600       | 1%         | 0.01       |
| repair & maint. of equip. ....     | mo        | 63.06          | 12     | 757       | 1%         | 0.01       |
| monitoring of water quality .....  | yr.       | 500.00         | 1      | 500       | 1%         | 0.01       |
| interest on operating funds .....  | dol.      | -              | -      | 1,753     | 2%         | 0.03       |
| <b>SUBTOTAL, VARIABLE COSTS -</b>  |           |                |        |           |            |            |
| <b>Fixed Costs</b>                 |           |                |        |           |            |            |
| payment on const. debt .....       | dol.      | -              | -      | 7,769     | 14.60%     | 0.15       |
| property taxes and insurance ..... | dol.      | -              | -      | 500       | 0.11%      | 0.01       |
| <b>SUBTOTAL, FIXED COSTS .....</b> |           |                |        |           |            |            |
| <b>TOTAL COSTS .....</b>           |           |                |        |           |            |            |

\* Excludes annual depreciation, estimated at \$2,729

| <b>RETURNS SUMMARY</b>                            |        |          |           |
|---------------------------------------------------|--------|----------|-----------|
| Returns to owner's management, labor, and capital |        |          |           |
|                                                   | LB     | FARM     | TANK PAIR |
| Returns above variable costs                      | \$0.49 | \$29,721 | \$2,972   |
| Returns above total costs                         | \$0.35 | \$21,452 | \$2,145   |
| Breakeven price/lb above variable costs           | \$0.61 |          |           |
| Breakeven price/lb above all costs                | \$0.75 |          |           |

**SOURCES OF MORE INFORMATION**

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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**

**Debra Sloan**

North Carolina Department of Agriculture  
Division of Aquaculture & Natural Resources  
Aquaculture Specialist  
PO Box 1475  
Franklin, NC 28734  
(828) 524-1264  
dsloan@primeline.com

**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 trout 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 trout farmers in western North Carolina:

**Skip Thompson**

Area Specialized Agent-Aquaculture  
NC Cooperative Extension Service  
PO Box 308  
Waynesville, NC 28786  
(828) 456-3575  
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Graphic design and typesetting by:  
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**Acknowledgments**

The authors wish to express thanks to Skip Thompson of the North Carolina Cooperative Extension Service and Dr. Jeff Hinshaw of North Carolina State University for many helpful comments on this publication.





**Notes**

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