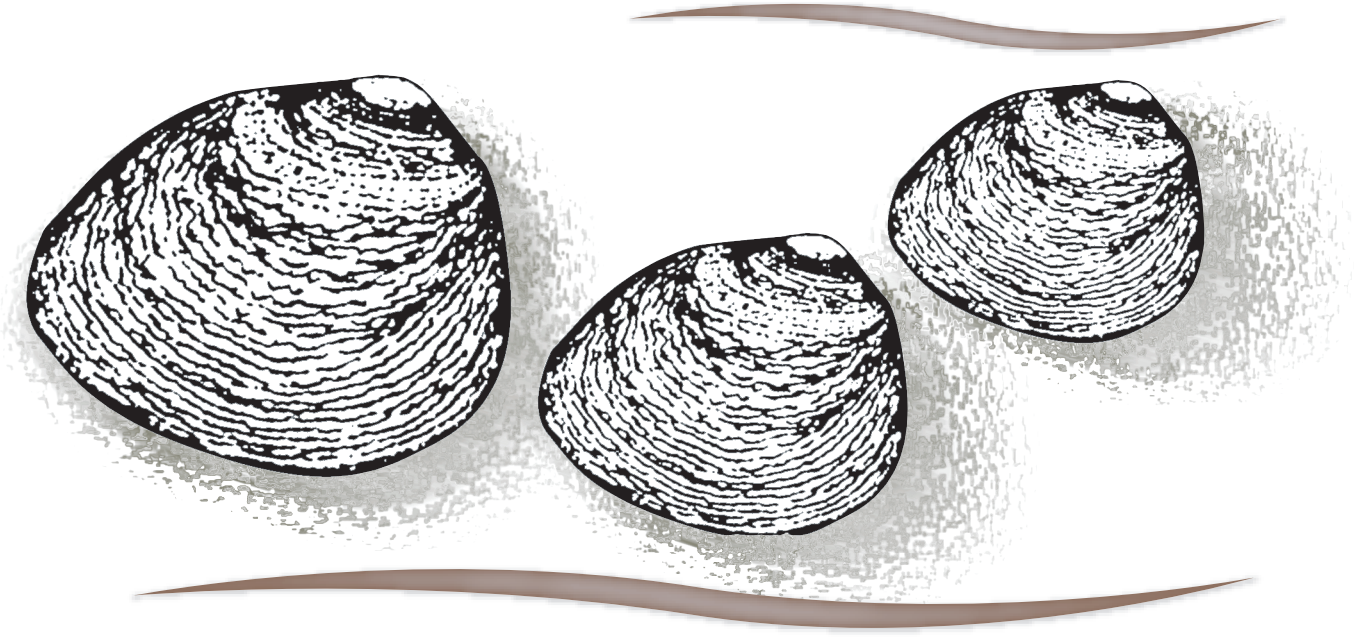
Aquaculture in North Carolina

Clams

Inputs, Outputs and Economics



North Carolina Department of Agriculture and Consumer Services

Aquaculture and Natural Resources

Contents

About this publication

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The North Carolina Department of Agriculture, Division of Aquaculture and Natural Resources, created this publication to assist individuals interested in the business of clam 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 clam 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 shellfish farm, individuals are encouraged to contact agents with the North Carolina Sea Grant Program. 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 Information* for individuals to contact.

Introduction

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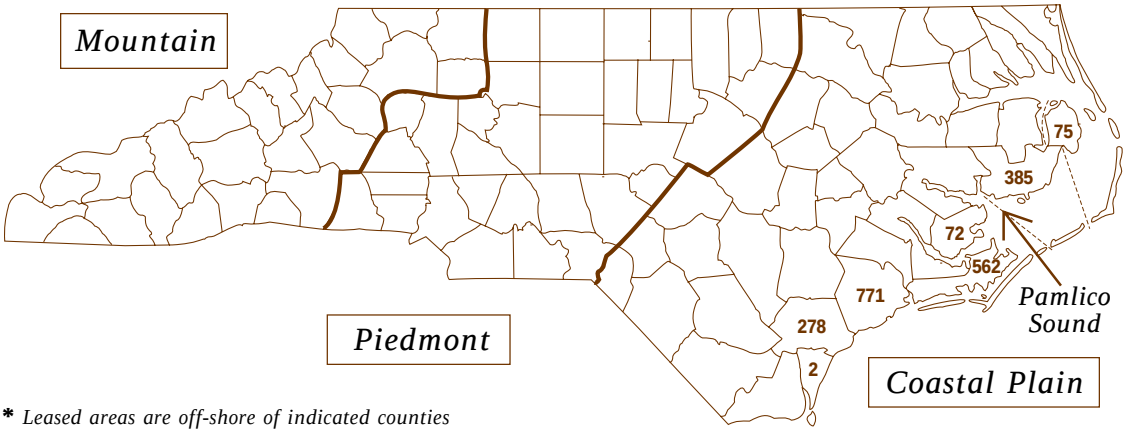
Aquaculture is the fastest growing segment of U.S. agriculture. The farm value of the U.S. aquaculture industry is estimated at nearly $1 billion. Catfish and trout production account for approximately 60% of total sales. Clam aquaculture accounts for about 2% of total sales.

Finfish in the U.S. are raised in ponds, cages, tanks, or raceways on private land. Shellfish are primarily grown on estuarine bottom leased from the state. "Shellfish aquaculture" is a term that has come to include not only shellfish hatched in a nursery, stocked onto leases, and then harvested; the term also includes "wild" shellfish that are moved from public bottom to a private lease for grow-out and harvest. This is a practice referred to as "relaying." Thousands of acres of near-shore ocean bottom are currently leased for shellfish aquaculture activities. Louisiana and Connecticut have the largest amount of leased area. Louisiana alone has 360,000 leased acres, almost all of which are used for the relaying and subsequent harvest of oysters.

Bottom leases are used for the culture of hard clams. Hard clams of the genus *Mercenaria* grow near-shore from Maine to Florida. Clam aquaculturists raise "littlenecks," clams approximately one-inch in thickness, which are typically served raw

Acres of Shellfish Leases, by county, North Carolina 2000 *



* *Leased areas are off-shore of indicated counties*

or steamed in the shell. Wild harvesters collect not only littlenecks but the larger "topnecks," "cherrystones," and "chowders," which are often processed for stews or clam strips. Littlenecks are more valuable than clams of larger size.

All states with wild clam harvests have some provision for aquaculturists to raise clams and other shellfish on private leases. The particulars of each program, (the number of acres and duration of the lease, management requirements, the government agency that issues the lease, etc.) differ widely. North Carolina's lease program is discussed below in *Permits and Licenses*.

North Carolina (NC) reported 10,087 bushels (about 1.0 million pounds with shell) of clams harvested and sold from leases in 2000. Assuming an average price of $0.16 per cultured littleneck clam, and 500 clams per bushel, gross returns to the state's clam farmers in 2000 is estimated at nearly $806,960. Over the past decade, the number of clams harvested from leases has averaged 8% of the total state harvest.

In 2000, there were 2,186 acres leased to 301 individuals. About half of these acres are used for clam production, while the other half are primarily used for the relay and harvest of oysters. State officials estimate that about one-half of the 1,100 acres used for clam production are actually planted with seed clams. On the remainder, a few leaseholders encourage the setting of clam larvae by providing a substrate, such as oyster shell. Other leaseholders take no action to promote clam production, and harvest only those clams that occur naturally. Of those that do actively farm their lease, it is estimated that 30 to 50 operations plant 50,000 to 100,000 seed per year, 12 plant 100,000 to 500,000 seed per year, and six operations plant greater than one million seed per year. Leases range in size from one to 35 acres. Eighty-percent of North Carolina clam farmers have their leases in Pender, Onslow, and Carteret counties.

Only three or four individuals in NC raise clams from their own hatchery seed. These growers periodically sell seed to other operations. Most clam growers, however, purchase seed from one of a half-dozen large hatcheries along the east coast. While NC does not have any large hatcheries, it does provide an over-wintering site for three northern hatcheries—juvenile seed are transported to the state to take advantage of NC's milder winter.

Habitat and Characteristics of the Hard Clam

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Clams prefer water with a relatively high and stable salinity, and grow best where waters have about two-thirds of the salt content of the ocean (about 25 ppt). For this reason, large clam populations are found in estuaries, but not near the influx of large streams and rivers. Clams also prefer an area with active tidal flushing; tides mix oxygen throughout the water column, wash away wastes and silt that can smother clams, and deliver supplies of microscopic algae upon which the clams feed. Clams grow from planting size (10-15 mm in length) to market size (45-50 mm in length, or one-inch in thickness) in two to four years, and the rate of growth is largely dependent upon temperature. Clams grow most rapidly at water temperatures between 68°F and 85°F. Growth is also influenced by the availability of food and how densely the clams are planted—that is, how close they are to one another as they grow.

Clams feed by filtering water (an adult clam can filter up to 24 gallons of water per day). As water passes over the clams' gills, the clam both breathes, by using the oxygen that is dissolved in the water, and feeds, by extracting the tiny algae that are suspended in the water. Because clams are virtually immobile and cannot escape areas of poor water quality, clams, like other shellfish, are susceptible to water-borne contaminants. These contaminants may come from surface runoff of agricultural pesticides or wild
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Clam growth and survival depends on temperature, planting density, availability of food, and water quality.

animal wastes, or discharges from industry and sewage treatment plants. To protect the shellfish consumer, states issue water-use classifications which restrict the areas in which wild harvesters and aquaculturists can harvest clams and other shellfish.

Although susceptible to pathogens carried in the water, clams do not have significant disease problems such as those that have decimated oyster populations (Dermo and MSX are the most notable of the oyster diseases). Also, because clams do not generally grow in abundance near freshwater sources, while oysters do, clams have not suffered as much from habitat degradation, which is often the result of upstream soil erosion (sediments can smother shellfish), or deterioration in water quality due to chemical contaminants or an overabundance of nutrients in the water.

Production Systems

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Hatchery

Clam culture begins in the hatchery, where broodstock—mature clams—are induced to spawn by a process which alternately exposes them to cold and warm water. Once spawned, eggs and larvae remain suspended in the water for 8 to 10 days, at which time they "set" and will sink to the bottom. The tiny clams are typically kept in downweller units for 30 to 50 days until they have reached 1 mm in length (about 1/20") and are ready for placement in a nursery system. A nursery system consists of one or more plastic, open-ended cylinders suspended in a water reservoir. Seawater enters through the bottom and circulates up through the clams, which are suspended on a screen near the bottom of the cylinder. Water exits through a pipe located near the top of the cylinder. As in the wild, clams feed upon microalgae and other organisms contained in the water. Most hatcheries supplement their food source by adding cultured algae.

While hatchery techniques are well defined, ownership requires an investment of time and money that is beyond the means of most small-scale culturists. Most clam farmers purchase seed from a commercial hatchery.

Nursery

The nursery system serves as an intermediate step in the production process, and provides the tiny clams with an adequate food supply and protection from predators until they are ready to be stocked in the ocean for grow-out. Farmers stock seed 4mm-12mm in length, with most stocking 10mm-12mm seed (about ½" in length).

A nursery system can be built for land or for the field. A field-based nursery system consists of trays made of various materials or mesh bags which are placed in a protected area of the lease, where wave action and siltation are minimized. Land-based upwellers, described above, or raceways, which consist of shallow indoor trays, provide more control over the environment and protection from predation and theft. Raceways can be constructed of a variety of materials—from PVC trays to resin-coated plywood, plastic, or concrete, and their construction will determine both the cost of investment and repair and maintenance.

Both upwellers and raceways provide a flow of oxygen and food-rich water; the upweller provides a vertical flow, and the raceway a horizontal flow. Most of the larger hatcheries with nursery systems use upwellers. A common practice is for seed less than 4 mm in size to be raised in upwellers, where their survival is thought to be higher than if they were raised at this size in raceways. At 4 mm or 5 mm, seed are often transferred to raceways, which generally require less labor to maintain. Some NC clam farmers who buy seed that is not yet of plantable size skip the upweller portion of the production cycle and purchase 4 mm or 5 mm seed to stock in
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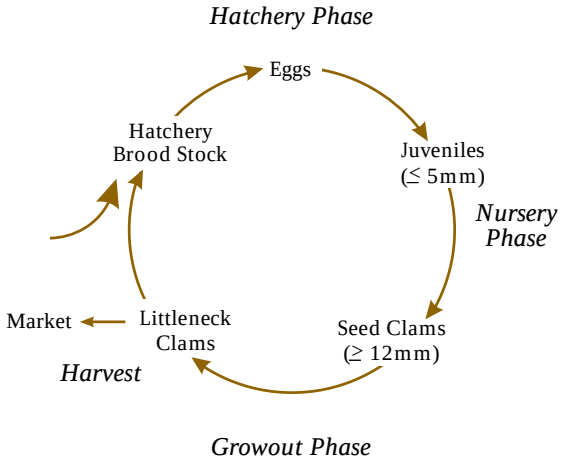
Clam Production Cycle



raceways. Growth from 4 mm to 12 mm requires 60 to 80 days in an indoor raceway. Growing clams from 1 mm to 4 mm requires an additional 30 to 40 days.

While nursery systems are standard for commercial hatcheries and clam farms with their own hatcheries, medium and large-scale clam growers without hatcheries are also attracted to the nursery option. Some farmers reduce their seed purchase costs by buying seed of a size smaller than the minimum planting size. The larger the seed, the higher the price, with the price of 12-15 mm seed typically ten times that of 1 mm seed. The farmer trades a lower initial seed cost for the additional costs of nursery equipment, and the cost of electricity and labor incurred during the operation of the nursery.

Field Grow-out

Grow-out systems are designed to protect clams from predators and allow water to circulate freely around the clams to supply both oxygen and food. Most grow-out systems use some form of pen, tray, or bottom net. Pens are cage-like containers made of a rigid frame with netting on the sides and top. Trays can be "soft," where the tray is actually a mesh bag in which clams are placed and the bag is staked to the bottom, or "hard" trays of wood, PVC or plastic, which are covered with a mesh netting and placed directly on estuarine bottom or on stands above the bottom floor.

Most NC producers use bottom nets. This method requires the lowest up-front capital investment, and clams are not as easily accessible to poachers as they are when held in trays. Clams are placed directly on the sea bottom, then nylon mesh netting is positioned over the clams and the sides of the net are held in place by sand bags, rebar, a weighted line, or other objects. Clam beds in NC typically have a width of 10 to 14 feet, dictated by the width of the mesh that is sold, and vary in length from 10 to 25 feet.

Grow-out time depends upon the size stocked, planting density, and location of the clam farm. Location determines temperature, salinity, and water quality, and the degree of water circulation around the clams. For NC clams planted at 12 mm, estimated grow-out time to 1" market size is two to four years.

The nursery provides an intermediate step between the hatchery and field grow-out. The protected environment allows the clams to grow to a larger size so that they are better able to survive the harsher condition in the wild.

Inputs

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Following is a discussion of the production inputs used to raise clams from the nursery through grow-out. While there are many nursery and grow-out options, this booklet present inputs for two example farms which use bottom nets. The smaller farm produces 220,000 little neck clams per year, the larger farm produces three times this amount. Both farms buy seed from a hatchery, but the larger farm buys smaller seed and uses a raceway nursery. Estimates of input usage, planting density, and survival are based on discussions with NC clam growers and NC Sea Grant Extension Specialists.

Enterprise Location

Site location has the greatest bearing upon potential clam production. Unlike pond culture of finfish, growers cannot influence
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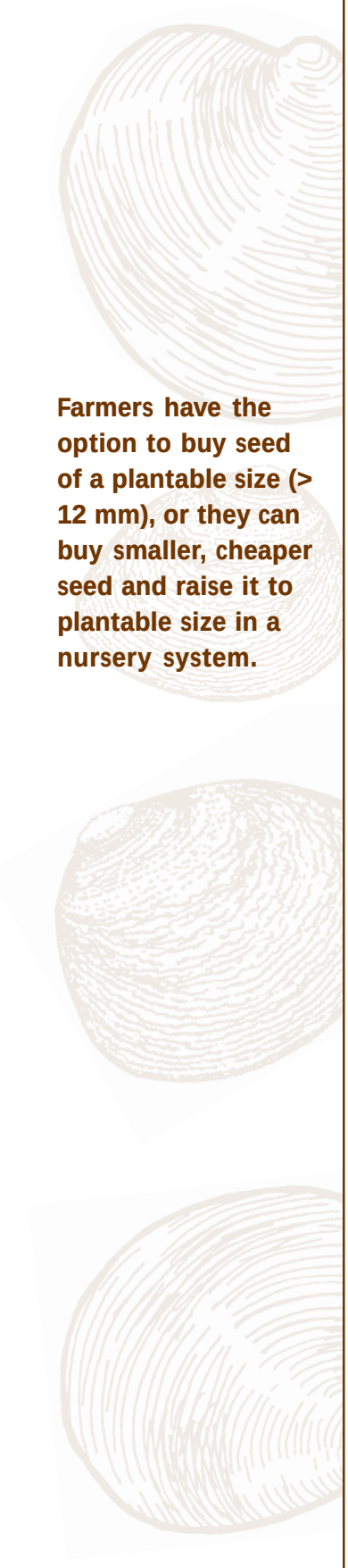

Farmers have the option to buy seed of a plantable size (> 12 mm), or they can buy smaller, cheaper seed and raise it to plantable size in a nursery system.

the nature of the water—by applying lime, fertilizer, or additional aeration, for example. They must make do with the given conditions of the site. Optimally, the clam farm should be in an area with strong enough tidal flow to replenish waters with food while removing clam waste, but not strong enough to disturb bottom nets. Farmers note that clams grow faster farther from shore and closer to tidal channels that create a current.

The farm must be located near enough to a freshwater inlet to provide water of a salinity diluted from seawater, but not so close that salinity is variable or falls below 20 ppt. Clam beds that are closer to shore are also more vulnerable to siltation that can smother clams, or pollutants from industries or population centers. The closer the clam farm is to shore, however, the easier it is for the clam farmer to access the beds for maintenance and harvest. The farmer can also more easily guard beds from theft, which is, along with predation, the most costly threat to the farmer's crop. A bushel of clams can bring $50 to $100 or more, and is a tempting target for poachers. If the farm can be located within site of the owner's property, surveillance is simplified, but adds a major investment expense if land is not already owned.

Water depth is also a consideration. Beds located in an intertidal area (where nets are exposed for some portion of the day), have an advantage because the sun can burn-off algae and grasses that grow on the nets and restrict the movement of water. A disadvantage is that the longer the clams are exposed to the air, the less time there is for them to feed.

Most of the areas suitable for clam culture in NC are subtidal; there is not a great deal of tidal change. In subtidal areas, fouling will be more serious where clam beds are planted at shallow depths and algae have access to more sunlight. Deeper water lessens the fouling problem, but makes it more difficult to maintain beds and harvest.

Seed

Clam growers can purchase seed from one of a half-dozen hatcheries located along the eastern seaboard. Seed prices vary greatly based on size and hatchery, with 1 mm seed costing $3 - $5 per 1000 and 12 mm seed costing $20-$30 per 1000. Some larger farms supply a hatchery with brood clams from their own stock. For a fee, the hatchery spawns the broodstock and supplies seed back to the farm.

Most small-scale NC clam growers, who plant less than 100,000 seed per year, as well as some medium-size operations, planting 100,000 to 500,000 seed annually, purchase 10 mm to 15 mm seed and plant these directly on ocean bottom. Larger growers typically buy 1 mm to 5 mm seed and raise it to the 10-15 mm planting size in land-based nurseries.

In NC, grow-out planting densities range from 20 to 60 clams per square foot (sq ft) of sea bottom. Survival can range from 0% to greater than 90% depending upon seed quality, enterprise location, planting density, predation and weather conditions. Survival in the nursery is also variable, and depends largely on seed quality and the management and experience of the operator.

Clam Budgets use a planting density of 60 clams per sq ft, grow-out survival of 55%, and nursery survival of 75%. These are considered to be averages for medium-to-large NC growers. The smaller farm purchases 12 mm seed at $25.00/1000; the larger farm purchases 4 mm seed at $10.50/1000 and raises it to 12 mm in a raceway system.

Equipment

Virtually all clam producers in NC utilize bottom nets made of plastic mesh and rebar or sandbags to anchor these nets. Clam Budgets use a standard bed size of 10'X20', which is small enough for one producer to single-handedly remove. Edges of the net

are buried in the sand, and the net is allowed to "tent" slightly. This increases the required square footage to 220 sq ft of mesh per bed.

Few producers use mechanical harvesting machines. Clam Budgets assume the use of clam rakes. Clams are bagged in onion sacks for sale. The larger farm uses a mechanical grader, while the smaller farm uses wooden grading boxes to grade-out clams of market size.

Bed nets, rebar, sandbags, harvest equipment, etc., must be replaced at some point. The charge *Depreciation* takes into account the average annual replacement costs for equipment.

Electricity & Fuel

Fuel is used for the boat during maintenance and harvest. Travel time is estimated at 1/4 hour between the shore and the lease site. The larger farm requires electricity for water pumping (for the nursery), and for the mechanical grader, which separates harvested clams by size.

Labor

Labor and seed are by far the greatest operating costs in clam farming, and combined account for 65-75% of annual operating costs. Enterprise location largely determines the amount of maintenance required. Maintenance includes checking the nets for tears and predators, and clearing algae and grasses from the surface of the nets. Bed maintenance is estimated at 1/4 to 1/3 hour per 10'×20' bed per week. An additional 3/4 hour is required for preparation and travel time to and from the lease. Clams can be hand-harvested at the rate of about 1000 clams per hour, and planted at 20 times that rate.

Nursery Component

The larger of the example famers in Clam Budgets uses a land-based raceway system to raise purchased 4 mm seed to the planting size of 12 mm. Over a six-month period (May-October), the raceway is stocked with 1.6 million seed. With a 75% survival, an average of 1.2 million seed are planted for grow-out. Seed are purchased in three batches. Each batch requires approximately 70 days of growth in the nursery.

The system is indoor, and uses 10, 4'×10' fiberglass raceways. Two 3-hp pumps bring water from a dock pumphouse to the raceway building. Total investment for the system is $27,620, which is 60% of the initial investment for the clam enterprise. Additional annual operating costs of electricity, labor, repair and maintenance, and depreciation are also incurred. The partial budget at the bottom of the 300-bed farm's Operating Budget summarizes the operating costs for the nursery component. The additional costs of the nursery component plus the cost of 4 mm seed result in an estimated cost of $22.85 per 1000, 12 mm clams produced. Therefore, at this size of operation, a nursery system is justified, and saves the farm about 10% in seed costs. Adding a nursery component to the smaller farm was not justified—costs of producing 12 mm seed were greater than the price of purchased 12 mm seed.

Outputs

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Because clam production depends so heavily on the enterprise location, it is very difficult to generalize survival and the growth rate, which determine both the quantity produced and how quickly clams reach harvestable size. A 55% survival rate and grow-out cycle length of three years are the assumptions used in clam budgets. With NC clams requiring an average of three years to reach market size, at a "steady-state" the farm on average should harvest about 1/3 of the lease per year.

Economics

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Clam Budgets provide information on estimated investment, operating costs, and

The location of the clam farm has more influence on production than any other factor.

Larger farms can justify the extra expense of operating a nursery; smaller farms find it more economical to buy seed of plantable size.

average annual returns to two example clam farms. Both use 10'×20' beds planted with 60, 12 mm clams per sq ft of bottom. The smaller farm has 100, 10'×20' beds; the larger farm has 300, 10'×20' beds. Bed nets are held in place with rebar and sand bags. One-third of the lease is harvested and replanted each year once established. The smaller farm buys 12 mm seed and the larger farm buys 4 mm seed and raises it to 12 mm in land-based raceways. Clams are harvested by hand. The smaller farm grades clams in wooden grading boxes; the larger farm uses a mechanical grader.

Once established (years 3+), the smaller farm plants an average of 400,000 and harvests 220,000 clams per year. The larger farm purchases 1.6 million clams, plants 1.2 million, and harvests 660,000 clams in an average year. (Note that the farmer may harvest greater than 1/3 of the lease, replanting the clams that have not reached marketable size. But on average, 1/3 of the lease is harvested and replanted per year).

The economics of clam farming presented in Clam Budgets is based on information obtained from NC clam farmers. The budgets should be used as a guide for prospective clam farmers, who should construct a business plan with supporting budgets and financial projections before any investment decision is made.

Costs

The Investment Costs tables give costs for items that are purchased initially. Clam Budgets assume that both operations are already located shore side and have access to a boat and motor. Each operation also has use of a pickup for delivering product, and the larger farm uses owned shop equipment for repairs made to the nursery component. Both use an in-home office—no provision is made for any land structure other than the nursery building.

Unlike land-based aquaculture in fish ponds, clam farming does not require a large investment in facilities. Assuming that waterfront land is owned, or the clam enterprise is readily accessible from land, the out-of-pocket initial investment for equipment for someone already owning a boat and motor is less than $6,500 for the 100-bed farm. Because most of the equipment has a relatively short life, however, (nets, for example, are replaced every two years), the annual charge for *Depreciation*, which accounts for the average annual cost of replacing materials and equipment, is about one-third of the initial investment, at $2,196/year.

The Operating Budgets give annual costs for an average year (years 3 and onward, when harvests begin). The costs of clam seed and labor make up 65% to 75% of these annual costs. Fixed Costs include *depreciation; insurance, permit & lease fees*; and *interest on investment*. *Interest on investment* accounts for the use of the owner's capital in clam farming as opposed to some other potential investment opportunity.

Returns

NC clam producers report that local wholesale prices have fluctuated between 15 and 20 cents per littleneck clam over the past five years. An average sale price of 16 cents per clam is used for clam budgets. Farmers can often sell at a higher price if they bypass local wholesalers and ship to more distant wholesale markets on the east coast. Some producers that sell to local retail markets also report higher prices—20-22 cents to restaurants and seafood markets, and 25-30 cents if sold directly to consumers.

Taking into account costs for an average year, the smaller operation has net returns of $11,926 in an average year, and the larger farm earns $44,882/year. The larger operation earns $6.91 per bushel more than the smaller operation. In general, larger farms can reduce the cost per clam produced because they make more efficient

use of labor. Larger farms can also justify a nursery component, producing seed clams for a lower price. As with larger farms, larger nurseries generally result in a lower cost per seed clam produced.

Both labor and interest on investment are considered costs, and are subtracted from Gross Receipts to calculate net returns to the owner. If the clam farmer supplies all of the labor and the investment and operating capital used in the clam operation, these costs are actually "paid" to the farmer. For this reason, Annual Net Returns are given with these costs added back to returns. For example, for the 100-bed farm, when the costs of labor and interest are added back to Net Returns, the farmer makes a total return of $20,775 during the average year (this is *Annual Net Returns to Owner's Labor, Management, & Capital* in the Operating Budget). This is the return to the owner's labor of 17 hours per week, and use of his or her money to finance all of the investment and operating costs.

The return to each of the example farms is given for an average year only. The budget does not include costs paid in the first two years after start-up, when no harvests are made. During these years, however, the following costs are incurred: cost of labor to maintain beds; cost of net and boat repair and maintenance; fuel and oil for the boat; insurance, permit and lease fees; and interest on the original investment and on yearly operating costs. Because clams are not harvested or planted during this time, costs associated with the nursery and planting would not occur in year two, and costs associated with harvest would not occur in years one or two.

Potential clam farmers should take into consideration the effect of the long production cycle on their overall income (see *Length of the Production Cycle* below), and the lost opportunity or "opportunity cost" associated with capital used to fund the clam enterprise. Opportunity cost refers to the next best alternative for use of the clam farmer's money (for example, investment of funds in a CD or Treasury Bill). For the smaller operation, taking a simple 6% opportunity cost of money, the interest cost on all equipment plus seed cost is about $2,600 over the two-year period leading to the first harvest. For the larger farm, the interest cost is about $8,500.

Sensitivity analysis

The sale price for clams and clam survival are the factors most likely to change the economic picture for the clam farm.

While wholesale clam prices have remained within the $0.15 to $0.20 range over the past several years, even a small change in price has a great impact on returns. For example, if the smaller farm is able to sell clams to a local restaurant for $0.20/each, Net Returns to Owner's Management increase by $8,800, to $20,726/yr. Note that this does not account for any additional costs associated with sales to a retail market.

Survival of clams on the lease is a function of seed quality, planting density, and farmer diligence in maintaining beds, which keeps silt, predators, and net fouling to a minimum. A storm which disrupts nets, allowing predators to enter, or which covers nets in silt, can devastate a bed. Successful clam farmers carefully choose the site location, move the location if it does not prove favorable, and maintain their beds regularly. If better management or a more favorable site increase survival by 10%, *Net Returns to Owners Management* for the smaller farm increases by $3,500 to $15,421; for the larger, the increase is $10,499 to $44,882.

Length of the Production Cycle

Clams require the longest growing cycle of any aquaculture species raised in North Carolina. For example, crawfish can be

If the clam farmer uses his or her own labor and money to finance the farm, these "costs" can be included as part of the farmer's profit.

Net returns are most influenced by the sale price for clams and clam survival.

raised to market size in a matter of months, catfish in one year, and hybrid striped bass in about 18 months. Clams require two to four years to reach market size. Potential clam farmers should take this factor into consideration when planning for the clam operation, especially if the culturist has no other income source or plans to rely on a lending institution for financing. A clam farmer will likely need another source of income to service the loan until harvest. Experienced clam farmers also caution beginners that they should prepare for the worst possible circumstance—a catastrophic loss, perhaps due to a hurricane or poorly sited farm, which may destroy the first year's crop.

Other Topics

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Permits & Licenses

The NC Division of Marine Fisheries administers the shellfish lease program. All of the permits and licenses discussed below are obtained from Marine Fisheries unless otherwise noted.

Once a site has been selected, and before filing the lease application form, the applicant should contact Marine Fisheries for a preliminary site check; areas with significant amounts of sea grasses or those with natural shellfish productivity of greater than 10 bushels per acre cannot be leased. If the owner plans to construct a dock or water intake structure, such as that needed for a nursery system, also contact the Division of Coastal Management to ensure that these structures can be placed on the chosen site.

A $100 one-time fee is collected at the time of the lease application. If the lease is approved (time for approval averages 6 months), a registered land survey of the site—typically costing from $200 to $400, depending on the location and size of the lease—must be completed. Guidelines allow one individual to lease from ½ to five acres of bottom for clam culture, unless the applicant proves that more lease area is needed. The lease term is 10 years and can be renewed at a cost of $50 for additional 10-year periods if standards are met. Once aquaculture equipment is in place, the applicant can apply for an Aquaculture Operation Permit (no charge).

The lease owner must submit an Annual Production Report with the number of clams planted and harvested on the lease. A minimum of 25 bushels of clams (Marine Fisheries considers 400 clams of any size to be a bushel) or 50 bushels of cultch (material placed on the seabottom to enhance the population of oysters), or an equivalent combination of clams and cultch must be planted on the lease per acre/year. In addition, 10 bushels of clams must be harvested and sold per acre from the lease each year. A rental fee of $5 per lease acre/yr is collected. Lease rental fees are expected to increase to $10 per leased acre per year in the near future. Additional reports on the quantity of clams harvested are required if the grower sells to anyone other than an in-state wholesaler.

All growers must obtain a Shellfish License ($25.00/year) or a Standard Commercial Fishing License ($200.00/year) with a shellfish endorsement (free) to be eligible for permits to manage the lease. If the grower uses a boat in conjunction with the harvest of the lease, the grower must also obtain a Commercial Fishing Vessel Registration, the cost of which is based on the size of the boat (costing about $1.00 per foot per year). If no boat is used, the grower can harvest from the lease with just a Shellfish License. Growers that do not have these license have the option of hiring license-holding individuals to plant and harvest their lease. All persons working on the lease must have one of the required licenses.

If the owner sells to retail markets or directly to the public, the grower must obtain a Dealer's License ($50/year). Additional permits are required if the owner
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cold-stores clams before shipping, delivers clams in his or her own vehicle, or harvests using mechanical means.

Financing

Clam aquaculture is considered a relatively new and risky enterprise by NC bank lenders. Lenders are most concerned with the following three factors associated with clam farming: (1) production risk, largely due to the clam farm's vulnerability to the weather, a factor out of control of the owner, (2) price risk, because most clams are not sold based on contractual arrangements, so the price is determined at the time of sale, and (3) the long time period between planting and harvest, which accentuates both production and price risk.

Some clam farmers have obtained operating capital from bank lenders. These operations, however, had sufficient assets outside of the clam farm (coastal real estate or bank accounts, for example) to serve as collateral for the loans.

Insurance

Most small clam farmers do not carry insurance on their operations. It is advisable for farmers to purchase general liability insurance. Insurance on equipment (boats, dock, pumps) can also be obtained. Aquaculture operations are eligible to participate in the Federal Crop Insurance Program's non-insurance assistance program which provides disaster payments.

Markets

Smaller NC clam growers typically sell to local fish and shellfish wholesalers, who ship product to northern markets. A very few producers sell to local retail markets such as seafood stores and restaurants. Over the past three years, the price in the local wholesale market has varied between $0.15 and $0.20 per clam. Retail market prices are reported to range from $0.24 to $0.30 per clam.

Medium and larger growers usually ship directly to northern markets. These markets pay $0.01 to $0.03 more than their local counterparts. Additional costs—of marketing and shipping the clams as well as the investment in facilities and required permits—must be deducted from this margin.

In addition to sales to local retail markets such as seafood stores and restaurants, NC clam farmers may sell directly to consumers. The closer the clam grower is to the retail market, the higher the sale price. The major drawback is the time involved in making these sales and the smaller volume as compared to sales to a wholesaler.

Most clams are sold on the "spot" market—pricing is arranged at the time of sale. It is possible to contract a price in advance for a specified amount of product, but spot market sales are the norm. Larger growers with a consistent supply are in the best position to contract sale quantities and prices.

Clam prices vary during the year and depend largely on the amount of clams harvested from the wild. Unlike other fish and shellfish, there is no distinct season for wild clams. If clam prices are temporarily down due to clams "coming in" from a particular state or area, clam growers will usually hold their clams until prices rebound.

Some clam growers are able to command a $0.01 premium for cultured product, but this seems to be atypical. Growers report that most of their sales are made during the summer months and around holidays (Christmas, Easter, 4th of July, etc.), when prices are higher.

CLAM BUDGETS

One-hundred, 10×20-foot beds
Buys 12 mm seed
INVESTMENT COSTS

Land and some equipment owned

New Equipment	Unit	Price/Unit	# Unit	Total	% Of Total	Estimated Life	Annual Depreciation
Nets	sq ft	$0.04	28,600	$1,195	19.1%	2	$598
Rebar*	ft	$0.20	3,600	$713	11.4%	5	$143
Sand bags*	unit	$2.20	1,250	$2,750	44.0%	4	$688
Hand graders	unit	$110.00	1	$110	1.8%	3	$37
Site survey, application fees	unit	$550.00	1	$550	8.8%	10	$55
Harvest rakes	unit	$385.00	1	$385	6.2%	6	$64
Misc (waders, hip boots, buckets, etc.)	unit	$550.00	1	$550	8.8%	5	$110
TOTAL INVESTMENT				**$6,253**	**100.00%**		**$1,694**

Shared equipment, OWNED	Current Value	% Used By Aquaculture	Value Used By Aquaculture	Estimated Life	Annual Depreciation
Pickup	$12,000	15%	$1,800	8	$225
Office equipment	$2,500	15%	$375	10	$38
Boat (wooden skiff or metal jon boat)	$3,000	30%	$900	15	$60
Motor	$3,000	30%	$900	5	$180
TOTAL	**$20,500**		**$3,975**		**$503**

* *The farm uses sand bags for 1/2 of the nets and a line of rebar for the other 1/2.*

CLAM BUDGETS

One-hundred, 10×20-foot beds
Operating Budget for an Average Year (years 3+)
One-third of the lease is harvested and replanted each year

	Unit	Price/Unit	# Unit	Total	% Of Total	$/Bushel***
GROSS RECEIPTS						
clams	per 50 mm clam	$0.16	220,000	$35,200	—	$80.00
VARIABLE COSTS						
clam seed	per 1000 12 mm	$25.00	400	$10,000	43.63%	$22.73
labor:						
grow-out, bed maintenance	hours	$8.50	660	$5,610	24.47%	$12.75
harvest & replanting	hours	$8.50	230	$1,955	8.53%	$4.44
fuel & oil:						
boat	dol.			$400	1.75%	$1.09
truck	dol.			$250	1.09%	$0.68
repair & maintenance of equipment	dol.			$241	1.05%	$0.57
office overhead	dol./mo.	$50.00	12	$600	2.62%	$1.36
harvest bags, tags	per 250 clams	$0.22	880	$194	0.77%	$0.44
interest on var. costs (10% for 1/2 year)				$962	4.20%	$2.20
Subtotal, variable costs				$20,364	88.10%	$46.28
FIXED COSTS						
depreciation	dol.			$2,196	8.91%	$4.99
insurance, permit & lease fees	dol.			$400	1.75%	$0.90
interest on investment*	dol.			$314	1.24%	$0.71
Subtotal, fixed costs				$2,910	11.90%	$6.61
TOTAL COSTS				**$23,276**	**100.00%**	**$52.90**
ANNUAL NET RETURNS**						
to owner's management				**$11,926**		**$27.10**
to owner's management and labor (avg 17 hrs/week)				**$19,491**		**$44.30**
to owner's labor, management, & capital				**$20,775**		**$47.22**

** Computed for depreciable items at 11% of one-half of the investment. ** See page 9 for an explanation of the differing categories of Net Returns. *** One bushel = 500 Clams*

Assumptions

leased water bottom, acres = 1.0
stocking density = 60 per ft2
planting size = 12 mm
size @ harvest = 45-50 mm
grow-out survival = 55%
grow-out cycle averages 3 years

CLAM BUDGETS

Three-hundred, 10×20-foot beds
Buys 4 mm seed, uses raceway nursery system
INVESTMENT COSTS

New Equipment	Unit	Price/Unit	# Unit	Total	% Of Total	Estimated Life	Annual Depreciation
Nursery							
Building	sq. foot	$16.50	400	$6,600	14.2%	15	$440
Building, electrical	unit	$2,750.00	1	$2,750	5.9%	15	$183
Building, plumbing	unit	$2,200.00	1	$2,200	4.7%	15	$147
Raceways	unit	$275.00	10	$2,750	5.9%	15	$183
Dock (100 ft)/pump hse construction	unit	$4,950.00	1	$4,950	10.7%	15	$330
Pump suction line	unit	$330.00	1	$330	0.7%	15	$22
Pumps (3hp)	unit	$2,750.00	2	$5,500	11.8%	6	$917
PVC intake pipe (49)	ft	$3.30	400	$1,320	2.8%	15	$88
PVC materials	unit	$880.00	1	$880	1.9%	15	$59
Owner labor–raceways & plumbing	hour	$8.50	40	$340	0.8%	—	
SUBTOTAL				**$27,620**	**59.6%**		**$2,369**
Grow-out & Harvest							
Nets	sq ft	$0.04	85,800	$3,260	7.7%	2	$1,793
Rebar*	ft	$0.20	10.800	$2,138	4.6%	5	$428
Sand bags*	unit	$2.20	3,750	$8,250	17.8%	4	$2,063
Grader	unit	$3,300.00	1	$3,300	7.1%	8	$413
Site survey, application fees	unit	$550.00	1	$550	1.2%	10	$55
Harvest rakes	unit	$385.00	1	$385	0.8%	6	$64
Misc (waders, hip boots, buckets, etc.)	unit	$550.00	1	$550	1.2%	5	$110
SUBTOTAL				**$18,433**	**40.4%**		**$4,925**
TOTAL INVESTMENT				**$46,053**	**100.0%**		**$7,294**

Shared equipment, OWNED	Current Value	% Used By Aquaculture	Value Used By Aquaculture	Estimated Life	Annual Depreciation
Pickup	$12,000	15%	$1,800	8	$225
Office equipment	$2,500	30%	$750	10	$75
Shop equipment	$1,500	90%	$1,350	8	$169
Boat (wooden skiff or metal jon boat)	$3,000	50%	$1,500	15	$100
Motor	$3,000	50%	$1,500	5	$300
TOTAL	**$22,000**		**$6,900**		**$869**

** The farm uses sand bags for 1/2 of the nets and a line of rebar for the other 1/2.*

CLAM BUDGETS

Three-hundred, 10×20-foot beds
Operating Budget for an Average Year (years 3+)
One-third of the lease is harvested and replanted each year

	Unit	Price/Unit	# Unit	Total	% Of Total	$/Bushel***
GROSS RECEIPTS						
Clams	per 50 mm clam	$0.16	660,000	$105,600	—	—
VARIABLE COSTS						
Clam seed	per 1000 4 mm	$10.50	1,600	$16,800	28.47%	$12.73
Labor:						
Nursery (half-time, 6 mos.)	hours	$8.50	671	$5,702	7.43%	$4.32
Grow-out, bed maintenance	hours	$8.50	1,410	$11,985	20.31%	$9.08
Harvest & replanting	hours	$8.50	693	$5,891	9.98%	$4.46
Nursery cleaning supplies/freshwater	mo	$50.00	8	$400	0.51%	$0.30
Electricity (nursery):	mo	$300.00	8	$2,400	2.54%	$1.82
Fuel & oil:						
Boat	dol.			$960	1.36%	$0.73
Truck	dol.			$300	0.42%	$0.23
Repair & maintenance of equipment	dol.			$1,332	2.08%	$1.01
Office overhead	dol./mo.	$62.50	12	$750	1.02%	$0.57
Harvest bags, tags	per 250 clams	$0.22	2,640	$581	0.89%	$0.44
Interest on var. costs (10% for 1/2 year)				$2,355	3.75%	$1.78
Subtotal, variable costs				**$49,455**	**78.78%**	**$37.47**
FIXED COSTS						
Depreciation	dol.			$8,163	16.36%	$6.18
Insurance, permit & lease fees	dol.			$550	0.93%	$0.42
Interest on investment*	dol.			$2,551	3.93%	$1.93
Subtotal, fixed costs				**$11,624**	**21.22%**	**$8.53**
TOTAL COSTS				**$60,718**	**100.00%**	
ANNUAL NET RETURNS**						
to owner's management				**$44,882**		**34.01**
to owner's labor (avg 40 hrs/week) and management				**$62,562**		**47.40**
to owner's labor, management, & capital				**$67,467**		**51.11**

* *Computed for depreciable items at 11% of one-half of the investment.* ***See page 9 for an explanation of the differing categories of Net Returns.*

*** *One bushel = 500 Clams*

Assumptions

leased water bottom, acres = 3.0
stocking density = 60 per ft2
purchase size = 4 mm
planting size = 12 mm
size @ harvest = 45-50 mm
nursery survival = 75%
grow-out survival = 55%
grow-out cycle averages 3 years

Nursery Cost:

4 mm seed	$16,800
labor	$5,702
supplies	$400
electricity	$2,400
repairs	$691
int. on op.	$1,300
interest on investment	$130
TOTAL	**$27,422**

COST PER 1000 12 mm SEED PRODUCED = $22.85

SOURCES OF MORE INFORMATION

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

Business Planning

Rebecca Dunning
North Carolina Department of Agriculture and Consumer Services
3903 Inwood Road
Raleigh, NC 27603
(919) 513-0452
rebecca.dunning@ncmail.net

Marketing

North Carolina Department of Agriculture and Consumer Services
PO Box 27611
Raleigh, NC 27962
(919) 733-7125

A limited number of technical publications are available on clam culture methods. The most useful publication for NC clam farmers, "Clam Gardening, a Manual for the Small-Scale Clam Operation in North Carolina," can be obtained from Skip Kemp at the **NC Sea Grant College Program** (see address below). Skip can also be contacted to work one-on-one with potential clam farmers.

Skip Kemp
NC Sea Grant College Program
303 College Circle
Morehead City, NC 28557
(252) 222-6314

The **NC Division of Marine Fisheries** provides the clam farmer with information on leasing and other required permits. The Office of Coastal Management can be contacted at the same address for information on water-intake structures.

NC Division of Marine Fisheries
P.O. Box 769
Morehead City, NC 28557
(252) 726-7021

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