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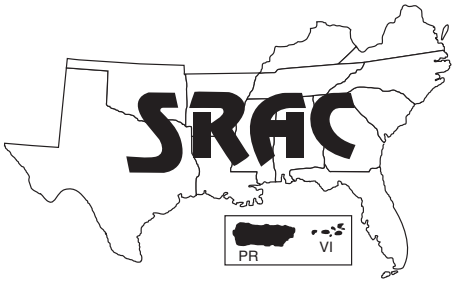

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Cage Culture: Harvesting and Economics

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Successful fish culture, whether it is done in cages, open ponds, or in some other manner, is more than just harvesting a few fish at the end of the growing season. Having a successful and profitable harvest requires that the producer understand the variables that influence success. Most of these variables are discussed in other SRAC publications (numbers 160-165). This publication focuses on harvesting, a "post-production" activity, and economics, which determines how production can be improved. Attention to detail, good record keeping, and an understanding of how various input costs affect the bottom line will help the producer analyze the overall operation and formulate a plan for next year.

Harvesting

The ease of harvesting caged fish is one of the reasons people choose cage culture. Basically, all that is required is a dip net to capture the fish and containers in which to place the fish until they can be sold or processed.

Harvesting can begin when a significant portion of the fish reach a size the market is willing to accept. As a rule, the value of fish per pound does not increase once they have reached the minimum market size. Although the size of the individual fish and the total pounds of fish in the cage should be increasing over time (assuming that growing conditions are favorable), risk exposure continues as long as the fish are in the water. The culture of fish, like any crop or commodity, carries risk that must be kept to an acceptable level. Therefore, it is advisable to harvest fish as soon as is practical after they reach a marketable size. The culture period—the time between stocking and harvest—is quite variable and depends upon factors such as species, size and density of fingerlings stocked, time of year stocked, climate and weather. Overall culture conditions such as water quality, disease incidence, and other possible stressors also affect the length of the culture period.

When warm-water fish such as catfish are cultured in the warmer parts of the southern region, fish stocked in the spring often can be harvested in the fall or winter of the first growing season, assuming that they have grown large enough. In cooler areas fish may have to be overwintered and finished the second or even the third season because there are fewer optimal temperature days per growing season when higher feeding rates are possible. Although overwintering fish may extend the period that the producer can offer fish to his customers, the unnecessary holding of marketable fish is risky at best.

The culture of what might be called "non-temperate climate" fish requires different production strategies and harvest seasons. For example, in the warmer parts of the southern region, the stocking of rainbow trout and other cold-water species usually occurs in the fall, with grow-out during the cooler months. These species' poor tolerance of warm water means that they must then be harvested before water temperatures rise above 65 to 70 °F (18 to 21 °C) in the spring. Because the fish must reach market size quickly, culturing them is difficult in all but the more northern or higher elevation parts of the region. The culture of tilapia, which require consistent water temperatures above 60 °F (15 °C), is challenging in all but the most southerly parts of the country. Such climate challenges give the producer added incentive to produce fish quickly, but limit the culture of both trout and tilapia.

No matter how carefully fingerlings are graded before stocking, the fish will not all reach market size at the same time. Differences in growth rate are caused by a variety of factors, including genetics and social structure. Some fish may simply grow faster in the production culture conditions and, therefore, have a genetic

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advantage. Some may dominate the feeding area and get more of the available feed. In any case, it may be possible to do a partial harvest by removing only the fish that have reached market size. However, this can cause considerable stress for fish, especially if done while water temperatures and, thus, the metabolic rates of the fish are high. Physical injuries caused by fish-to-fish and fish-to-equipment contact can lead to disease. After a partial harvest, fish density in cages is lower, which may lead to aggressive behaviors and injuries.

Before harvesting, it is important to test a few of the fish for off-flavor. (See SRAC publications 192 and 431 for more information on off-flavor and testing.) If the fish taste muddy, musty, oily, or have any strange flavor, they should not be harvested. While off-flavor is most common during the warmer months when water conditions are most stable, it can occur at any time of year. Off-flavor can be very persistent, lasting from a few days to several months. Fish that exhibit off-flavor in the fall when water temperatures cool may still have off-flavor in the spring. Some consider off-flavor to be the most serious challenge in the catfish industry; it causes greater financial losses than diseases because it delays harvest. Buyers, especially first-time consumers, will be reluctant to purchase fish again if their first experience was unpleasant.

The producer should stop feeding the fish at least 2 days before harvest in warm weather and up to a week before harvest in cool weather. This gives the fish time to empty their digestive systems and it reduces hauling, holding and processing problems. Excessive waste fouls the water in hauling and holding tanks and may stress the fish sufficiently to cause disease or death. Although fish destined for a processor will not have enough time to develop a disease, fish being sold to a live market or fish-out may. Fish that are dead-on-arrival (at the processor or fish-out) or that die soon after delivery (at a fish-out) can cost the producer considerable money and possibly future sales. Food in the gut of fish reaching the processing plant means the processor has paid for unmarketable weight.

At harvest, the producer should record the number of fish harvested and their total weight (length records could also be useful). These records are necessary for analyzing an operation and improving its efficiency. A financial analysis should include a profit and loss statement and the cost of production per unit (a pound of fish). The cost of producing a pound of fish is calculated by adding all input costs (accounts payable) and dividing the sum by the units (pounds of fish) marketed. Do not forget to include your labor as an input, as it certainly has value, too!

Marketing

All commercial ventures require marketing strategies, and caged-fish farming is no different. Ideally, you should identify your market(s) before you stock, but always plan your marketing before you harvest. Having market-size fish and no marketing plan will cause frustration and reduce your chances of having a successful venture.

Fish can be sold either dressed (processed) or live. If you plan to process your fish, you must be in compliance with your state's health laws, including HACCP (see SRAC publication 4900, "The HACCP Seafood Program and Aquaculture"). Compliance with the food safety laws and regulations are, of course, in addition to the state licensing and permitting that may be necessary to operate a fish farm and to transport fish on public roadways. Contact your state department of health and/or an Extension fisheries (or aquaculture) specialist for more information and assistance regarding these regulations.

The markets available for cage-cultured fish are virtually the same as for any other farm-raised fish, though some markets may be easier to enter than others. For example, the total numbers and pounds of fish harvested from a cage operation are often smaller than the production from an open pond operation, which might limit one's options to markets not requiring large volumes. Also, smaller operations must often transport their own fish to market, and finding an economical way to do that may prove difficult. However, those small numbers and low total weights lend themselves well to other markets from which open pond fish farmers may feel excluded because of the volume they produce.

Here are some possible markets for cage operations:

- sales to processing plants
- live sales direct to consumers
- live sales to fish-out lakes, ethnic markets or live-haulers
- sales to local restaurants or grocery stores, if able to process
- sales to caterers, if able to process
- farmers' markets
- local volunteer, religious and charitable organizations for fund-raisers

Producers with only a few hundred fish to sell at one time will probably realize their greatest profits selling directly to the consumer. Direct sales of live fish or fish processed on-site reduce middleman costs and return all the revenue to the fish farmer. Although direct sales markets may take some time to develop, they tend to be the most profitable. Live sales at the pond bank and at local farmers' markets also eliminate the need to process the fish. Sales to processing plants, while they are much simpler and involve the least time, effort and risk, usually return the least amount of revenue to the farmer. When selling to a processor, the producer has little or no control of the sales price. Therefore, this option should be avoided if maximizing profit is your goal. Unexpected surplus may be disposed of in this manner, however.

Fee-fishing, fish-out or pay lakes are good markets for live fish. Fish-out lakes usually buy fish regularly throughout the spring and summer, and they pay premium prices for good quality fish. However, selling fish to these markets at other times of the year can be difficult because fewer people enjoy angling during

the colder months. Also, it may be necessary for the producer to haul small loads of fish relatively frequently to fish-out lakes. If you do not have the ability or desire to haul your fish, you will have to hire a live-hauler. A live-hauler may charge you by the load, may buy the fish from you to resell, or may want a percentage of the sale price.

Finally, if your volume is large enough, you may decide to start your own processing operation if you can commit the necessary financial and physical resources. State and local regulations often require complete, stand-alone structures designed to guarantee a sanitary product (see SRAC publication 442, "Small-Scale On-farm Fish Processing"). To obtain an operating permit, processing facilities often must have design features that ensure flying insect control, surfaces that can be thoroughly washed and sanitized, and waste water disposal systems. Although the caged culture of fish does allow the producer considerable flexibility as to harvest dates, it should be remembered that on-site processing facilities will be used relatively infrequently.

When marketing farm-raised fish, you should stress quality and freshness. Many producers and consumers believe that cage-cultured fish taste better than those raised free in ponds. In marketing cage-cultured fish, you should emphasize that the fish have been raised off of the pond bottom; have been fed a nutritionally complete, plant-based diet; that they are free of chemicals and antibiotics (if that is the case); and that they were grown in a controlled, pollution-free environment. This last point assumes that the pond in which the cages are located is, in fact, free of contamination from all outside sources.

Record keeping

All businesses must keep good records if the manager is to gauge its profitability, competitiveness and success, and caged-fish farming is no exception. By studying these records, the farmer can identify areas where money can be saved and profits can be increased, or determine what may have caused a disease outbreak. Records should include:

- infrastructure costs, including cage materials, boats, docks and ALL other equipment
- fingerling cost, including delivery
- feed cost, amount and date purchased
- miscellaneous items purchased (e.g., chemicals, nets, baskets, etc.)
- hauling/transporting expenses
- fingerling weight and length
- stocking and harvesting dates
- final weight of fish harvested per cage
- crop insurance premiums, if applicable
- chemical treatments/medications and the dates and rates applied (including treatments to the pond itself)
- water chemistry test results
- number and total weight of fish harvested
- revenue from the sale of fish
- daily observations of the pond and fish

Most of these records are self explanatory. Daily observations should include the amount of feed fed, weather conditions, pond conditions, fish appearance and fish behavior. This information will be invaluable in understanding why problems (if any) occurred in the past and in predicting or avoiding similar challenges in the future. The use of spreadsheets or databases could facilitate the analysis of data.

Economics

Fingerling prices, feed prices, materials and equipment prices, length of growing season, and general climate and weather conditions vary widely throughout the southern region of the U.S. This makes it very difficult to produce good regional budgets. Volatility in the food-fish market makes the situation more difficult still.

Fingerling prices for 6- to 8-inch channel catfish, for example, may range from $0.10 to $0.55, depending on the number purchased and proximity to the hatchery. Feed costs may vary by $100.00 per ton or more, depending on volume, manufacturer and location. Live weight price paid for channel catfish varies from about $0.55 per pound at large processing plants during periods of low demand to $1.50 or more per pound for live sales directly to consumers or to fee-fishing lakes. Contact your county Extension office or state fisheries (or aquaculture) specialist for budgets specific to your area.

Estimates of the fixed costs of cage materials and equipment are summarized in Table 1. Cage and equipment costs are usually depreciated over 5 years or more.

Approximate production costs calculated on fingerling and feed price

Table 1. Estimates of the fixed costs of materials and equipment for cage culture.

Item	Cost/cage	Cost/five cages
Cage materials[1]	75.00[2]	160.00
Dip nets	50.00	50.00
Scales[3]	250.00	250.00
Miscellaneous[4]	30.00	65.00
Total	$405.00	$525.00
Total/cage	$405.00	$105.00

[1] Calculated for a 4- x 4-foot cylindrical cage, purchasing the netting and hoops only.

[2] Calculated on buying an entire roll of netting (50 feet). Two rolls of netting will make five cages (second example).

[3] Used for weighing fish and feed.

[4] Includes chemicals, buckets, rope, etc. Cost for aerators is not included. Depending on pond size, stocking density, and the type of system used, costs for aeration could range from $300 to $1,800.

only, and based on a feed conversion ratio (FCR) of 1.8 (when it takes 1.8 pounds of feed to produce 1.0 pound of live fish), are summarized in Table 2. As with most enterprises, there are some economies of scale. Cage materials, fingerling costs, and time involved per activity all diminish (up to a point) with larger operations.

Feed costs associated with the production of 1 pound of fish are shown in Table 3. Obviously, feed management and feed price have a significant effect on the overall cost of production.

Any discussion of economics must emphasize the need to reduce risk exposure. Fish farming is a high-risk form of agriculture. At this time, few, if any, insurance options are available.

Table 2. Production costs based on various fingerling and feed prices.[1]

Cost per fingerling	Feed costs (per 50-pound bag) in dollars					
	8.00	10.00	12.00	14.00	16.00	18.00
0.10	0.39	0.46	0.53	0.60	0.68	0.75
0.15	0.44	0.51	0.58	0.65	0.73	0.80
0.20	0.49	0.56	0.63	0.70	0.78	0.85
0.25	0.54	0.61	0.68	0.75	0.83	0.90
0.30	0.59	0.66	0.73	0.80	0.88	0.95
0.35	0.64	0.71	0.78	0.85	0.93	1.00
0.40	0.69	0.76	0.83	0.90	0.98	1.05
0.50	0.79	0.86	0.93	1.00	1.08	1.15

[1] Calculated in cents/pound for producing a 1-pound fish with a feed conversion of 1.8:1 and no mortality.

Table 3. Feed cost per pound for fish produced with various feed conversion ratios and feed prices.

FCR	$320/ton	$400/ton	$500/ton	$600/ton
1.6:1	$.26	.32	.40	.48
1.8:1	$.29	.36	.45	.54
2.0:1	$.32	.30	.50	.60
2.2:1	$.35	.44	.55	.66
3.0:1	$.48	.60	.75	.90

Cage Culture
Record Keeping Sheet

Name ____________________ **County** ____________________

Stocking Date ____________________ **Stocking Size** ____________________

Week	Temperature							Total Feed Fed	Dead Fish	Weather Conditions
	S	M	T	W	T	F	S			

SRAC fact sheets are reviewed annually by the Publications, Videos and Computer Software Steering Committee. Fact sheets are revised as new knowledge becomes available. Fact sheets that have not been revised are considered to reflect the current state of knowledge.

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