Cooperative Extension Service

Economics of Aeration

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Dr. Carole R. Engle
Coordinator of Aquaculture/ Fisheries, 1890 Research and Extension

Aeration, or the addition of dissolved oxygen to a fishpond, represents an input into the production process similar to fertilizer or other inputs. The acquisition of an aeration device by a fish farmer represents a capital investment for which an annual charge (fixed cost) must be calculated and operating expenses (variable cost) incurred. Fixed costs (depreciation, for example) are often omitted from cost comparisons. Yet capital goods, such as aeration devices, entail significant fixed cost.

Annual depreciation charges are an accounting device to allocate revenue towards replacing a capital good when it no longer functions. If a catfish farm does not generate sufficient revenue to replace an aerator when it fails, then the farmer will not continue to aerate. In that case, aeration in the long run would not be feasible.

Capital investment and annual depreciation cost per unit vary widely for different aeration systems, from $450 to $3,500, and $183 to $1,426, respectively. Floating electric paddlewheels have the highest mean capital cost (Table 1). However, on a per horsepower basis, the diffuser aerators were twice as expensive as the next highest, floating vertical pumps. Per horsepower, the least expensive was the floating pump sprayer followed by floating electric paddlewheels, propeller-aspirator-pump, diffusers and vertical pumps.

Variation in depreciation cost is a significant consideration. Farmers should carefully evaluate materials used in the construction of a particular aerator. Sturdily built aerators with fewer movable parts may last two or three times as long as other aerators. This would result, over time, in the purchase of fewer replacement aerators and a significantly lower long-run cost to the firm.

Table 1. Capital Investment and Operating Cost for Aeration Devices Used in Catfish Ponds

Aerator	Capital Investment[a]	Annual Deprec.[a]	Oper. Cost[a] /hr	Oper. Cost[a] /hp-hr	Oper. Cost ($/lb O_2)
Electric Floating					
Floating paddlewheels	2,558	661	.570	.0678	.0183
Propeller-aspirator-pump	650	217	.105	.0700	.0267
Floating vertical pump	1,619	801	.245	.0726	.0314
Floating pump sprayer	2,525	660	1.040	.0620	.0360
Diffuser	2,212	412	.085	.0690	.0430
Tractor-Powered					
Paddlewheel	2,650	265	12.000	--	.1830
Pump sprayer	2,683	268	12.000	--	.5170

[a]Values represent mean cost for type of aeration cost.

Repair cost of electric motors vary with the horsepower of the motor. Larger horsepower motors entail greater repair cost than smaller horsepower motors. More complex systems with more moving parts have a greater likelihood of mechanical failure and have greater repair cost.

Table 1 presents operating cost (calculated at $.075 per kw-hr) for the aerators studied. Cost per hour ranged from $.085 to $1.04 per hour for electric aerators. Per horsepower-hour, all aerators had similar cost; larger horsepower motors had greater cost per hour. Operating cost per pound of oxygen transferred was lowest for floating paddlewheels.

The operating cost of tractor-powered aerators was substantially greater than that of electric aerators. This cost represents tractor cost that includes fuel, oil and depreciation of the tractor. Tractor cost, however, varies with use of the tractor. Fixed cost varies as well as fuel and oil cost. The $12 cost in Table 1 is a representative cost based on an average amount of aeration.

The major cost of tractor-powered aerators is operating cost, while the cost of operating an electric aerator is a much lower percentage of total cost. Operating costs for tractor-powered aerators were 75 percent of total cost at 250h (per year) of aeration and 86 percent of total cost at 1250h (per year) of aeration. Electric aerators, however, had operating costs that were 4 to 20 percent of total cost at 250h of aeration and 11 to 49 percent of total cost at 1250h of aeration.

Depreciation cost, expressed as a percentage of total cost, was higher for electric aerators. At 250h of operation, depreciation cost comprised 50 to 80 percent of total cost. This percent declined to 25 to 52 percent of total cost at 1250h of aeration. Tractor-powered aerators, on the other hand, had depreciation cost of only 11 percent of total cost at 250h and 1 percent of total cost at 1250h of aeration. Depreciation on the tractor is not included in the calculation. The difference in depreciation cost reflects greater capital investment and shorter useful life of electric aerators.

For electric aerators the fixed cost of depreciation is a significant cost. In choosing an electric aerator, the catfish farmer should consider carefully the materials used in construction and the quality of construction to ensure a longer life. For tractor-powered aerators, operating costs are more significant and aerator selection should primarily consider operating efficiency.

Average total cost was calculated per kilogram of dissolved oxygen (AC/kg DO) produced. Average total cost indicated the efficiency of production; it measures cost per unit of output. The most efficient level of production is that which produces the lowest cost per unit of output. This implies the greatest production per unit of output. While average cost measures efficiency of input use, it should not be the sole criterion for selecting an aerator. Farmers are concerned with profits which are calculated from output price as well as input cost. Average cost does not consider output price and does not measure profitability. What it does indicate is the most efficient level of usage of that particular input.

Tractor-powered aerators had average total cost curves (ATC) that declined from 50 to 250 hours of aeration, but at aeration levels greater than 250 hours per season continued to increase with increasing amounts of aeration. Increasing ATC indicates the rapidly increasing tractor cost associated with long-term use of tractor-powered aerators.

A farmer utilizing less than 250 hours of aeration per season should continue to rely on tractor-powered aeration devices (Figure 1). A farmer who plans to aerate more often and for longer periods would plan to invest in electric aerators.

Average total cost per kilogram of O_2 (AC/kg DO) produced declined with greater output for all electric aerators (Figure 2).

Average cost declined most rapidly when aeration was increased from 50 hours to 250 hours (a quantity of 50 hours of aeration represents 10 nights of aerating 5 hours each). Electric paddlewheel and pump sprayer average cost were of similar magnitude. Vertical pump and propeller-aspirator-pump cost were slightly higher with diffuser aerators being substantially higher.

For the low-cost aerators, at high levels of aeration, the additional production required would be approximately 400 kg/ha/yr. For an average yield of 3,000 kg/ha/yr, this would represent a 13 percent increase in yield. Research suggests that continuous nightly aeration may increase production of catfish by 20 percent. Continuous nightly aeration would produce sufficient additional poundage of fish to more than compensate for the additional cost. Hence, continuous nightly aeration would increase farm income.

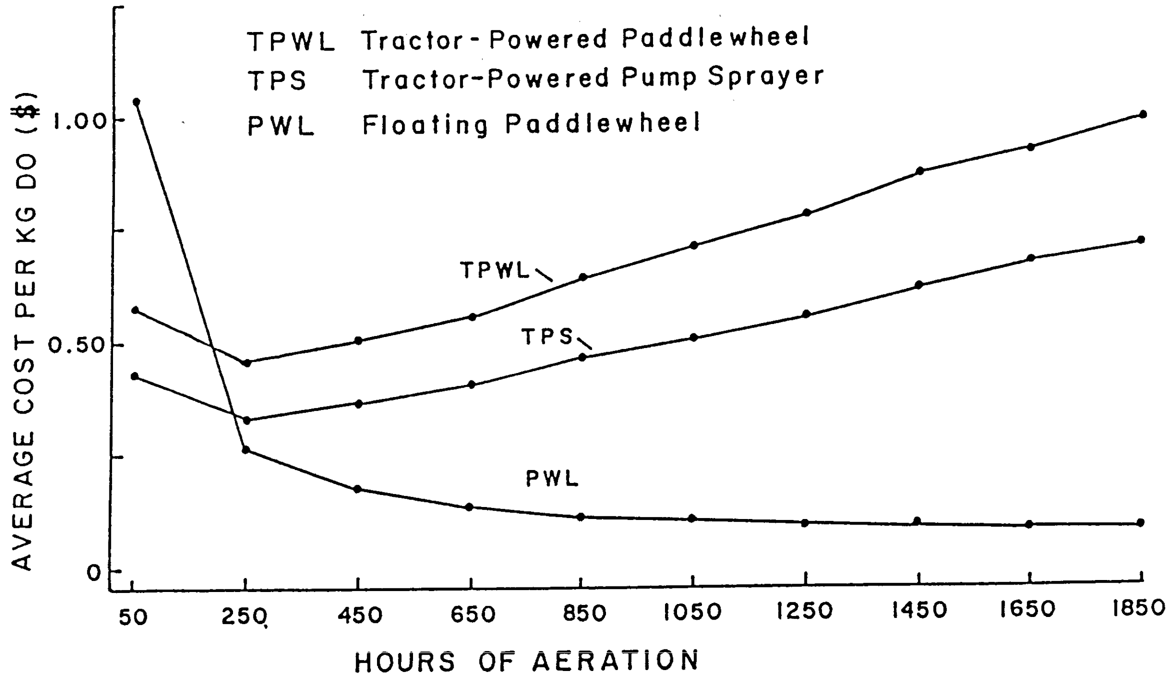

Figure 1. Average cost per kilogram dissolved oxygen for most efficient aerators of three types.

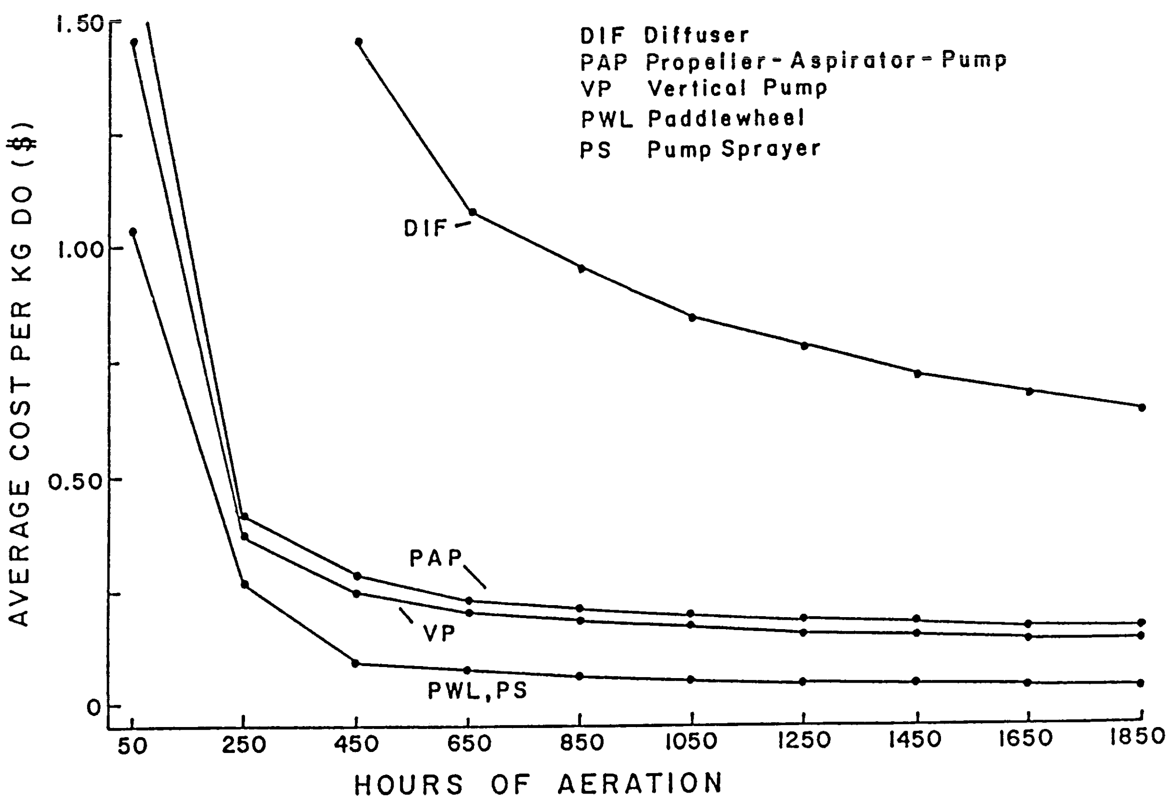

Figure 2. Average cost per kilogram dissolved oxygen for the most efficient unit of 4 types of aeration devices.

DR. ENGLE is coordinator of aquaculture/fisheries, 1890 Research and Extension, University of Arkansas at Pine Bluff.

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