WATER USE FOR AQUACULTURE

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BACKGROUND

The most prime consideration for any aquaculture facility is a plentiful supply of high -quality water. This is true whether the organisms to be grown are fish or shellfish. In addition to having a plentiful supply of suitable quality water, it is an economic necessity that the water be relatively inexpensive. A secondary consideration is whether the soil in the area will hold water. If such is not the case, suitable alternatives can be found but costs will be proportionately higher.

WATER NEEDS

For crawfish and shrimp the depth of water required is usually 1.5 to 3 feet while for finfish the depths recommended are from 3.5 to 5 feet. Because there are over 326,000 gallons of water per acre foot, a one acre pond 5 foot deep would require over 1.6 million gallons for a single filling. Some flushing of the pond is usually desirable and practiced which means an additional 0.4 million gallons per acre per year.

EVAPORATION AND RAINFALL

In most of the state of Texas, evaporation from a pond surface exceeds the amount of rainfall which enters the pond directly. And as most aquaculture ponds are not constructed to receive water from an outside drainage area, additional water is required for maintenance of the desired depth of water in the aquaculture ponds. The amount of water required to make up for the deficit has been depicted in several publications. Table 1 presents the evaporation rate and rainfall for selected counties in various locations in the state. Depicted here are average rainfall deficits and worst case scenarios reported over a 25 year period by the Texas Water Development Board on both an annual basis and during the summer months.

SEEPAGE

Many locations in Texas are blessed with soils of sufficiently high clay content that hold water well. This is not true for many other areas. Table 2 indicates some of the expected losses through permeability of subsoils.

From this table it is apparent that proper pond construction in addition to a careful selection of the pond site is imperative.

PUMPING COSTS

Because the final decision maker in any aquaculture production facility is operating cost, it is wise to calculate the pumping cost. Table 3 presents information which can be used to estimate the cost of pumping water. For this table, pumping plant efficiency is assumed to be equal to the performance standard for turbine irrigation pumps.

From Table 3 it can be determined that fuel costs to pump an acre foot of water 200 feet using a diesel-powered unit (diesel fuel at $1.00 per gallon) would be $25.00. The total cost of water would include depreciation, interest and maintenance costs of the well and pumping equipment. Cost of wells is extremely variable and impossible to relate to pumping lift or the amount of fuel required to pump a given quantity of water. Well costs must be estimated on an individual basis.

These can be estimated from the cost of fuel for a given amount of water. The cost of fuel for a diesel powered pumping unit is about 75% of the total cost of operation; for an electric-powered pumping unit fuel accounts for about 90% of the total cost and for a natural gas-powered pumping unit, fuel cost is about 65% of the total cost of operation.

Based on the example given above where fuel costs were $25.00 per acre foot of water, the total operating cost (not including ell costs) would be $35.00 per acre foot of water. Remember these figures for pumping cost are for purposes only.

EFFECTS OF THSE FACTORS ON COST OF PRODUCING A POUND OF FISH

Using the worst case scenario given above for evaporation (Table 1), it will require 4 acre feet of water to fill the average one acre pond for finfish production. In Young County it will require an additional 6.2 acre feet of water to make up for the evaporation. It will require an additional 7.3 acre feet of water (Table 2) to make up for seepage losses if the pond is built in uncompacted heavy clay. This means that a total of 17.5 acre feet of water (4 + 6.2 + 7.3) would be required for a one acre pond at an estimated water cost of $586. If 1,500 pounds of fish were harvested per acre this would mean that the water costs would be $0.39 per pound. This would compare to Orange County where a total of only 13.6 acre feet of water (7.19, if well compacted) would be required for the same installation at a cost of $456 ($241.00 if the soil was compacted) or about $0.30 (0.16) per pound of fish at the same production level. Higher production levels would result in a lower water cost per pound.

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TABLE 1. Net evaporation loss over fainfall from standing water reservoirs for selected counties in Texas.(All values are in feet of water lost.)

COUNTY	ANNUAL AVERAGE	25 YEAR RECORD				
		ANNUAL	JUNE	JULY	AUGUST	SEPTEMBER
Swisher	4.6	7.2	0.97	1.07	1.08	1.06
Young	4.0	6.2	0.90	1.05	1.38	1.06
Kaufman	2.5	4.6	0.64	0.93	1.00	0.81
Bowie	2.0	2.9	0.50	0.63	0.59	0.60
Upton	6.0	7.7	1.05	1.06	1.11	0.85
Mills	4.1	6.3	0.75	1.06	1.07	0.96
Anderson	1.5	2.7	0.40	0.66	0.78	0.68
Hays	3.0	6.0	0.75	0.94	1.08	0.77
Goliad	2.5	4.9	0.59	0.75	0.83	0.62
Orange	0.5	2.3	0.32	0.43	0.44	0.45
Wharton	1.7	4.4	0.47	0.95	0.65	0.72
Frio	4.0	6.6	0.96	1.18	1.21	0.92
Hidalgo	4.06	6.4	0.75	1.05	1.09	0.76

Excerpts from "Monthly Evaporation Rates For Texas 1940-1965". by John W. Cane. 1967 Report Number 64. Texas Water Development Board. 111pp.

TABLE 2. Expected water losses

SOIL CLASSIFICATION	INCHES/HR	INCHES/DAY	INCHES/YR
Fine sandy loam or Sandy clay loam	0.6	14.4	5,256
Clay or clay loam	0.06	1.44	526
Very tight or heavy clay	0.01	0.24	87.6
Compacted heavy clay	0.0001	0.0024	0.88

TABLE 3. Fuel required per acre foot of water

PUMPING LIFT OR HEAD FEET	DIESEL GALLONS	ELECTRIC KWH	NATURAL GAS MCF
10	1.2	15.48	0.204
20	2.5	30.96	0.408
50	6.2	77.52	1/032
100	12.5	155.04	2.064
150	18.8	232.56	3.084
200	25.0	310.20	4.116

This information prepared cooperatively with Dr. John Sweeten and Mr. Wayne Keese, Extension Agricultural Engineers.