AQUACULTURE EXTENSION
Illinois - Indiana Sea Grant Program

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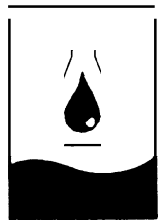

WATER QUALITY

Water Quality Water Sources Used in Aquaculture

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The source and quantity of water available are the most important factors to consider when choosing a site for an aquaculture facility. Many undesirable chemical and environmental factors associated with certain fish farms can be traced to a lack of background information on the source of water used. Before final site selection for a new farm is made a thorough investigation of the quality and quantity of water must be considered by the producer.

When choosing a good water source. it will be helpful to know what charactizes an "ideal" source and how the source my be affected in the future. First. the source must be uncontaminated from excessive nutrients, chemicals. or heavy metals. A source meeting this criteria should be further investigated to determine the threat of future contamination.

The second criteria of an "ideal" source is availability of the large volumes of water necessary for commercial fish farms. For example. the volume of water available can decrease after extensive timber harvests within the source's watershed, The water table may be lowered by the presence of multiple wells within the same aquafier.

Water Sources

There are six categories of water sources being used.

1. Springs
2. Wells
3. Rivers. streams or lakes
4. Surface runoff
5. Ground water
6. Municipal

Each source listed has advantages and disadvantages which should be carefully considered before a final selection is made. Table 1 on page 2 summarizes the advantages and disadvantages for each source.

In general springs and wells are considered to be the best sources of water to use for aquaculture. These two sources are the most commonly used sources and have few disadvantages. One common disadvantage of springs and wells is the occasional high concentrations of carbon dioxide and nitrogen gas that can result in gas super saturation. Both gases are easily removed through intense agitation. Under some circumstances the five other sources listed are acceptable.

Selecting any source without first determining its quality is very risky. Most water quality tests are very simple to use and inexpensive. Many private laboratories can conduct analyses for routine water quality parameters.

Tests kits may also be purchased to determine the concentrations of dissolved oxygen, carbon dioxide. nitrite. nitrate. ammonia. hardness, and alkalinity. Prices of tests kits may range from inexpensive aquaria kits to more expensive battery operated meters. The accuracy of these kits usually increses with price.

Determining the presence of pesticides or heavy metals can be very expensive if a comprehensive analysis is requested. Instead, laboratory analyses for three commonly found contaminates: DDT, lead, and mercury are usually sufficient. Concentrations as low as one part per billion (ppb) are cause for concern.

More specific analysis should be done if there is an indication that other contaminates are present. An example would be wells located in sandy soils where intensive agriculture is practiced. Water from drainage may have higher than normal levels of agriculture chemicals. Remember, some chemicals that are toxic to kill fish break down very quickly and their presence may be hard to detect.

Table 2 on page 2 provides a list of water quality parameters and suggested acceptable values. Names of laboratories offering water quality testing services can be obtained from either your local health office, county Cooperative Extension Service, or a university animal disease diagnostic laboratory,

Table 1. Comparisons of the advantages and disadvantages of commonlv used water sources. Sources are listed by overall rank according to the most desirable characteristics. Reference to contaminates may include pesticides, organic matter, sediments, metals, wild fish, or insects. Reference to dissolved gasses include carbon dioxide, nitrogen, methane, and hydrogen sulfide.

Source	Advantages	Disadvantages
Springs	•Constant temperature • May not require pumps • Few contaminates	• May require pumping •May contain dissolved gasses •Inexpensive
Wells	•Constant temperature •Few contaminates	• Requires pumping unless artesian wells •May contain dissolved gasses
Rivers, streams or lakes	•May be readily available •Inexpensive	• May contain contaminates • Excessive nutrients possible
Surface or runoff	•Inexpensive	•May contain contaminates • Susceptible to draughts or floods • Requires 5-7 acre watershed per surface acre of water
Ground water	•Inexpensive	• Ponds hard to drain •If wetland will require permit
Municipal	•High quality	• May contain toxic chlorine or chloramines • Expensive

Table 2. Suggested chemical values for water sources. Concentrations are in parts per million except for pH. Source for of information in this table is from *Fish Hatchery Management. 1982.* U.S. Department of Interior.

Parameter	Value
Dissolved oxygen	5-saturation
Carbon dioxide	o-1o
Total Alkalinity (as $CaC0^{3}$)	50-400
% as carbonate	0-40
% as bicarbonate	75-100
pH	6.5-8.0 (cold water species) 6.5-9.0 (warm water species)
Manganese	0-0.01
Iron (total)	0-0.15 (cold water species) 0-0.5 (warm water species)
Phosphorous	0.01-3.0
Nitrates	0-3.0
Nitrite	0-0.5
Un-ionized ammonia	0.-0.05
Zinc	0-0.05
Hydrogen sulfide	0.00
Mercury	0.000
Lead	0.000

From Table 2, it should be mentioned that parameters such as dissolved oxygen, carbon dioxide, chlorine, and chloramines will vary widely among water sources. Initial examinations for oxygen and carbon dioxide are normally meaningless because each can be easily manipulated through mechanical means. Nitrate levels are a combination of ammonia, nitrite, and nitrate. Chlorine and chloramines are used in municipal water supplies as disinfectants and are very toxic to fish. Each can be eliminated through additions of sodium thiosulfate (lppm sodium thiosulphate per ppm of chlorine) for chlorine or sodium thiosulfate and biological filtration for chloramines. Heavy metals, such as mercury and lead, and pesticides are two other groups of contaminates in water sources. If present, the source should not be used.

The quantity of water needed for a commercial aquaculture facility varies with the production method used, type of aquaculture chosen, scale of operation, and species being produced. For example, the water requirement for a trout farm using raceways will be different than the water required to produce yellow perch in ponds.

In general, most prospective producers grossly underestimate the quantities of water needed for a commercial operation. As a rule, the minimum recommended quantity for a commercial operation using ponds is 25 gals. /min./acre. For raceways the minimum quantity recommended for a commercial operation is 500 gals./min. Even production systems that recycle water use large volumes of water. For example, a commercial operation with tanks totaling 500,000 gals. and exchanges 10% per day requires 5,000 gals. /day.

In conclusion, selecting a good source of water that will provide large quantities of high-quality water is one of the first steps to a successful aquaculture enterprise. Fish require large quantities of unpolluted water to grow rapidly and maintain their state of well-being.

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