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Shrimp study uses low-salinity groundwater in Sonora, Mexico

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Method uses a fraction of water needed for productive harvests

Shrimp farming offers a viable option for culture in areas with saline aquifers.

Projects involving low-salinity inland culture of Pacific white shrimp in the United States and Latin America in the 1990s showed that inland systems offer several advantages over other shrimp aquaculture approaches. These include the reduction of disease risks, elimination of escapes of non-native species, proximity to commercial markets and efficient use of water with a consequent decrease in environmental impacts. Today, inland shrimp culture at low salinity is practiced on a commercial scale in the coastal area of Colima, Mexico, where commercial farms operate intensive ponds.

In many areas of Mexico, including Sonora, salinization is affecting waters and soils. Sonora's Hermosillo coast, one of the main agricultural complexes of Mexico, comprises a 2,800-square-kilometer coastal plain fed by two aquifers, the Superior and Inferior. However, the Superior Aquifer has been classified as overexploited, with problems from saline intrusion in the southeastern and west zones, where occasionally the waters reach 10,000 mg/L total dissolved solids.

Mexico study

The authors evaluated a semi-intensive shrimp culture facility using zero water exchange and low-salinity groundwater. Survival, harvest volume and related shrimp parameters were examined during the summer culture season.

With support from Fundación Produce Sonora, the experiment was carried out over 77 days at the Ganadera Pocas Vacas fish farm in Sonora. Two 0.25-ha ponds with zero water exchange were stocked with Pacific white shrimp (*Litopenaeus vannamei)* at 13 postlarvae per square meter. The animals were fed manually from the pond edges, controlling the amounts through the use of feed trays. Ponds were filled and maintained with groundwater. Aeration was supplied from midnight to 7:00 a.m. at 2 hp/pond until shrimp reached 2 grams in weight.

Production, water use

The groundwater used to fill the ponds had low salinity – 2,118 mg/L of total dissolved solids dominated by carbonates, chloride and calcium – and a pH of 8.4 (Table 1). It was estimated that the aquifer that fed the ponds was influenced by seawater at 3.0 to 5.5 percent.

Mariscal-Lagarda, Chemical composition of the groundwater, Table 1

Variable	Units
pH	8.4
Chlorine	616 mg/L
Magnesium	29 mg/L
Potassium	7 mg/L
Calcium	319 mg/L
Sodium	94 mg/L
Alkalinity (as calcium carbonate)	923 mg/L
Sulfate	78 mg/L
Total dissolved solids	2,118 mg/L

Table 1. Chemical composition of the groundwater used to fill ponds.

Production parameters are summarized in Table 2. The harvests from the ponds were 1,123 and 1,358 kg/hectare (ha), with a feed-conversion ratio of about 1.0. Considering the short duration of the culture cycle, the feed-conversion ratio values obtained were less than or comparable to the 0.7 to 2.0 at commercial semi-intensive shrimp ponds using hypersaline, brackish or seawater and water exchanges of 4 to 8 percent in northwest Mexico.

Mariscal-Lagarda, Mean summary data, Table 2

Variable	Mean ± S.D.
Harvest size (g)	15.6 ± 2.6
Live-weight crop (kg/ha)	1,241.0 ± 166.0
Feed use (kg/ha/crop)	1,214.0 ± 26.0
Fertilizer (kg nitrogen/ha)	45.1 ± 5.6
(kg phosphorus/ha)	5.4 ± 0.7
Feed–conversion ratio	1.0 ± 0.1
Survival (%)	61.5 ± 2.1

Table 2. Mean summary data for experimental shrimp ponds.

Table 3 summarizes the mean data for the initial and final weeks of the trial. The temperatures of the pond water fluctuated between 20.2 and 32.2 degrees-C at 6 p.m. during the initial week. The pH ranged between 7.4 and 9.8, and the dissolved-oxygen concentrations varied between 4.0 and 8.9 mg/L. The concentrations of total suspended solids varied between 4.7 and 93 mg/L.

Mariscal-Lagarda, Mean data for water quality variables, Table 3

Variable	Week 1	Week 11
Temperature (° C)	31.5 ± 0.6	22.8 ± 0.6
pH	9.6 ± 0.2	8.2 ± 0.2
Dissolved oxygen (mg/L)	8.2 ± 0.6	7.8 ± 1.1
Total suspended solids (mg/L)*	9.3 ± 6.0	27.3 ± 5.3

Table 3. Mean data for water quality variables during initial and final weeks of the 77-day trial (14 samples each).

* Two samples

In terms of water usage, the trial utilized a minor amount of water in comparison to the commercial systems of the region. About 15.3 cubic meters per kg shrimp harvested were used, while the world range for shrimp culture is 100-200 cubic meters per kg shrimp. These results in general demonstrated that inland shrimp farming with Pacific white shrimp in low-salinity groundwater in Sonora, Mexico, was a viable alternative for the use of groundwater where agriculture has been eliminated by the salinity in the aquifer.

Dissolved solids in the ground water included carbonates, chloride and calcium.

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