Design and Operation of the UVI Aquaponic System

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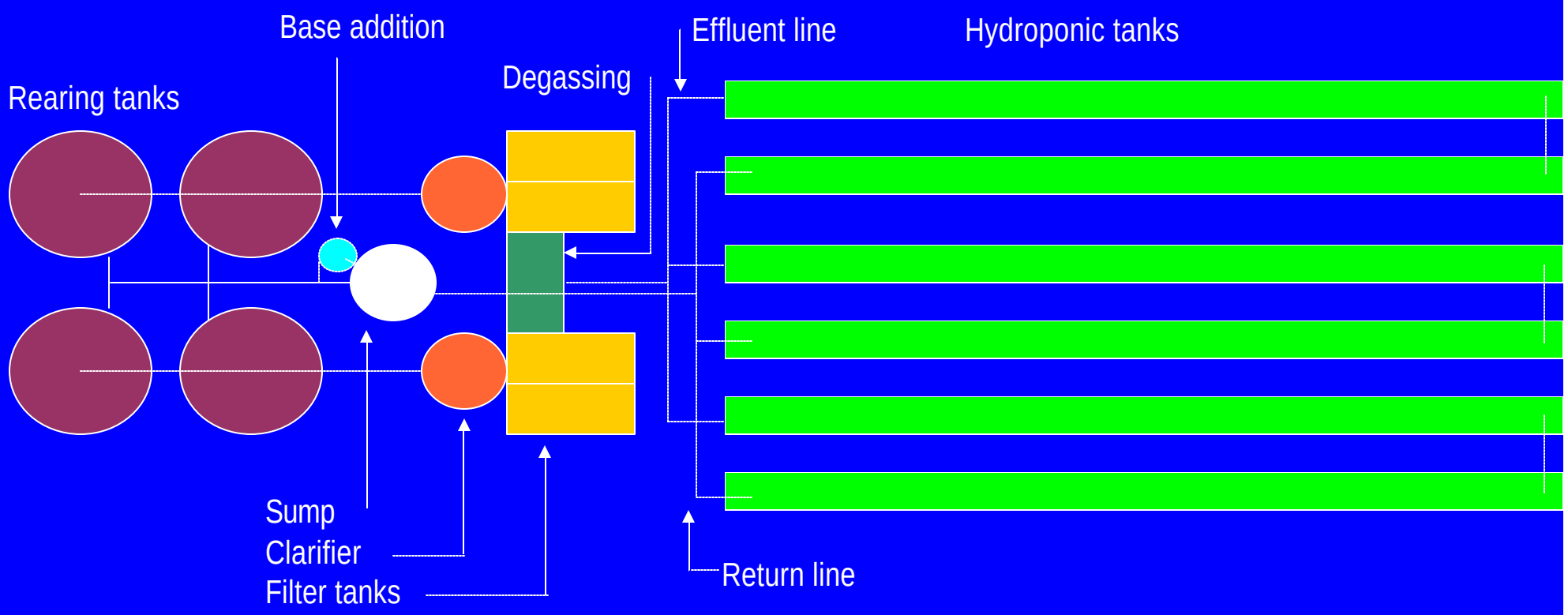
FARM STORE
FRESH PRODUCE

System Layout



Total water volume, 110 m^3

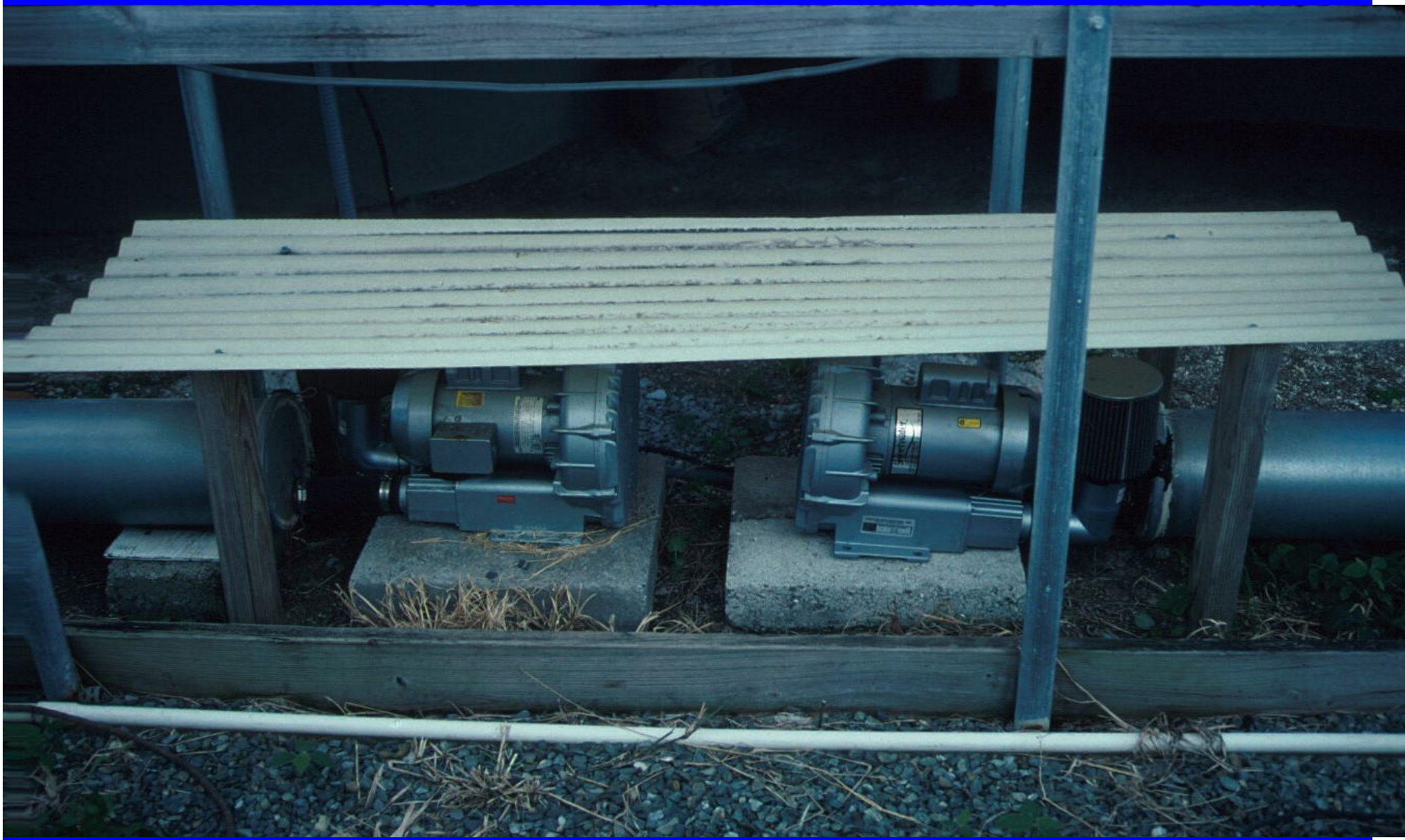
Land area - 0.05 ha

System Design

- Four fish rearing tanks, 7.8 m^3 each
- Two cylindro-conical clarifiers, 3.8 m^3 each
- Four filter tanks, 0.7 m^3 each
- One degassing tank, 0.7 m^3
- Six hydroponic tanks, 11.3 m^3 each
- Total plant growing area, 214 m^2
- One sump, 0.6 m^3
- Base addition tank, 0.2 m^3
- Total water volume, 110 m^3
- Land area - 0.05 ha

Treatment Processes

- Air stones, 22 per rearing tank, 24 per hydroponic tank
- Solids removal, three times daily from clarifier, filter tank cleaning one or two times weekly
- Denitrification in filter tanks
- Continuous degassing of methane, CO_2 , H_2S, N_2
- Direct uptake of ammonia and other nutrient by plants
- Nitrification in hydroponic tank
- Retention time: rearing tank, 1.37 h; clarifier, 20 min, hydroponic tanks, 3 h



Treatment Characteristics

Removal rates using romaine lettuce ($g/m^2/d$):

NH_3-N, 0.56

NO_2-N, 0.62

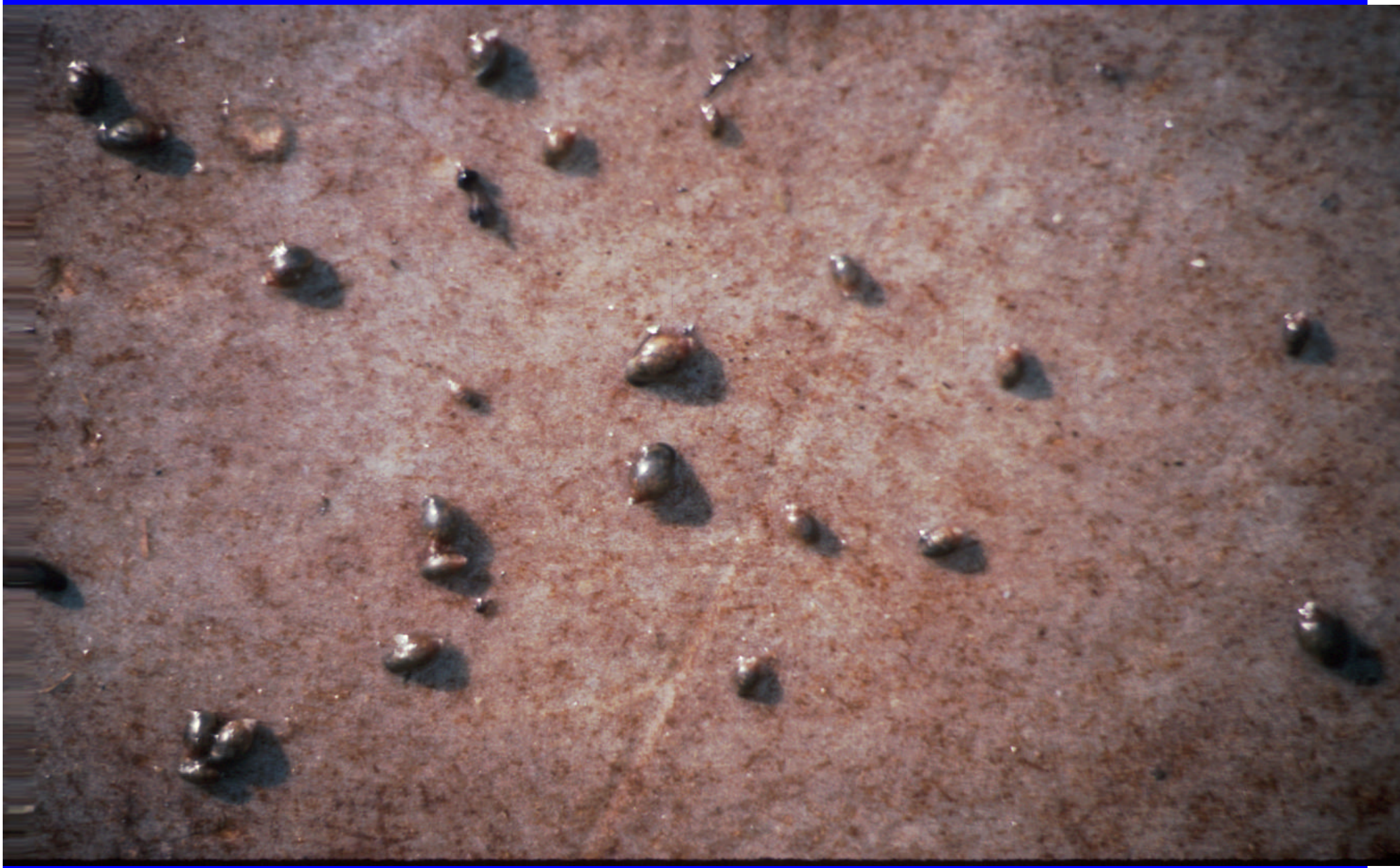
COD, 30.3

Total nitrogen, 0.83

Total phosphorous, 0.17

Raft Hydroponics

- Advantages: no tank size limitation, no root clogging, maximum exposure of roots to water, sheets shade and cool water, plants not affected when water pump stops, easy to harvest
- Disadvantages: roots vulnerable to damage by zooplankton, snails and other organisms (use tetras to control zooplankton and red ear sunfish to control snails)

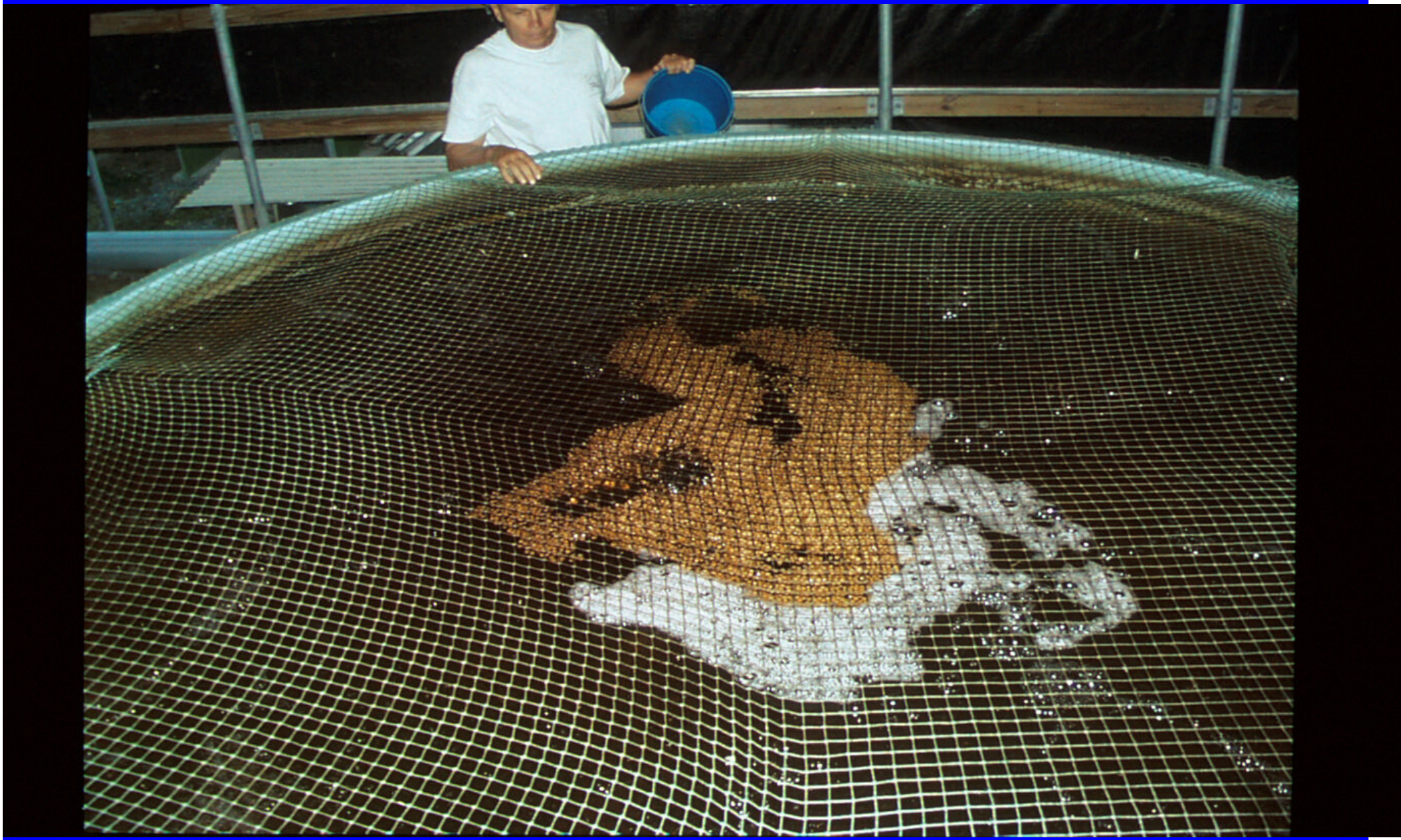


Important Principles

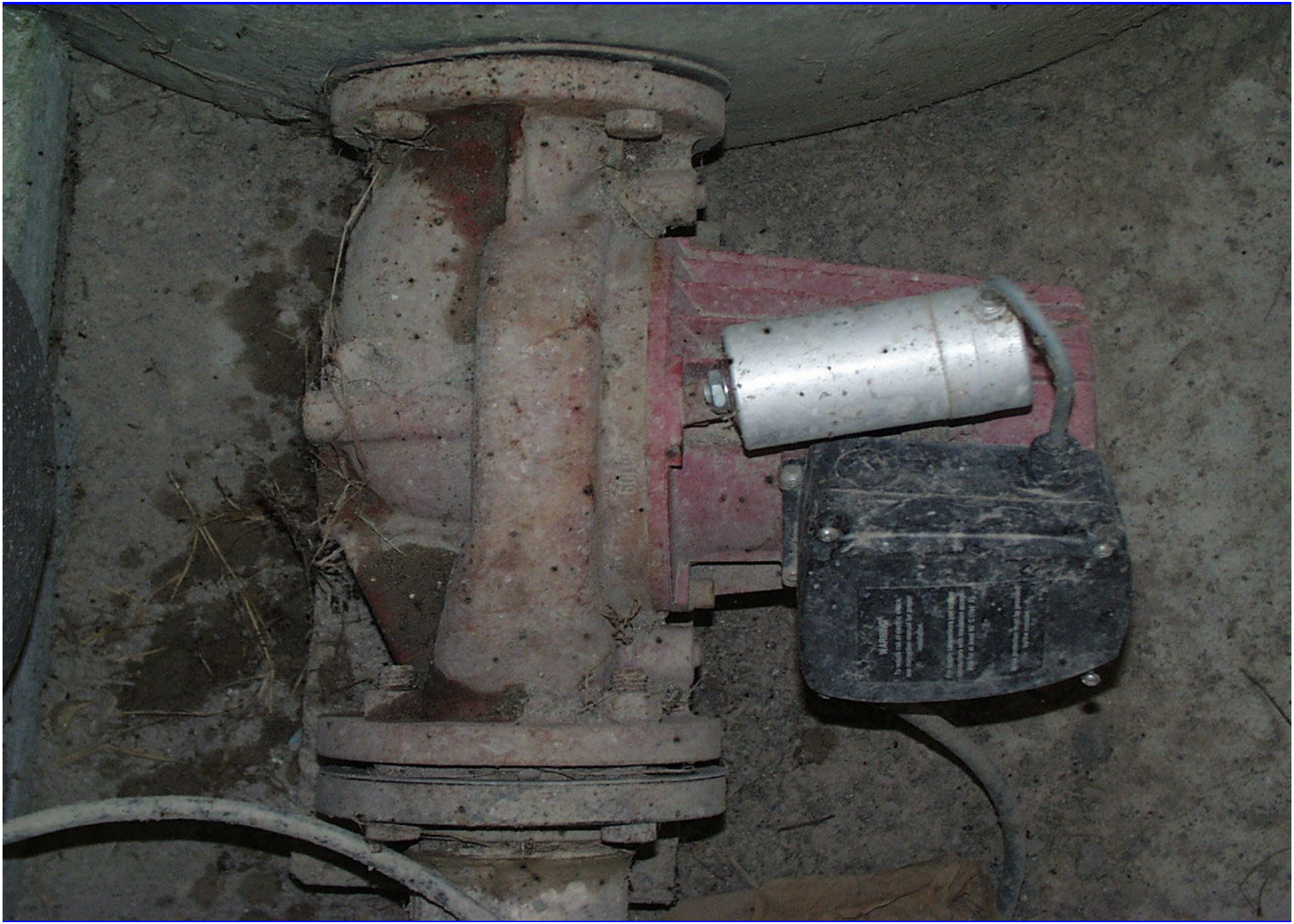
- Optimum feeding rate, 60 - 100 g/m^2 plant area/day prevents nutrient accumulation or deficiency
- Slow removal of solids increases mineralization
- Frequency of filter tank cleaning controls nitrate levels through denitrification
- Treatment capacity of hydroponic tanks is equivalent to 180 g of feed/day/m^2 of plant area

Production Management

- Feeding: three times daily *ad libitum*
  32% protein, floating, complete diet
- Stagger fish production, 24 week cycle, harvest every 6 weeks
- Stagger plant production
- Use biological insect control
- Monitor pH daily, maintain pH 7.0 by alternate and equal additions $Ca(OH)_2$ and KOH
- Add chelated iron (2 mg/L) every 3 weeks
- Add makeup water daily, about 1.5% of system volume
- Purge fish for 4-5 days before sale




pHTestr 2
WATERPROOF



Energy Consumption

- One blower for fish and degassing, 1.5 hp
- One blower for hydroponics, 1 hp
- One water pump, ½ hp
- Total energy consumption 3.0 hp

Production

- Tilapia - 5 mt annually , 580 kg every 6 weeks, 160 kg/m^3/yr
- Stocking rate: Niles, 77 fish/m^3; reds, 154 fish/m^3
- Leaf lettuce - 1,404 cases annually, 24-30 heads/case, 27 cases/week
- Basil – 5 mt annually
- Okra – 2.9 mt annually


Leafy
Leafy

Advantages of Aquaponics

- Fish provide most nutrients required by plants
- Plants use nutrients to produce a valuable by-product
- Hydroponic component serves as a biofilter
- Hydroponic plants extend water use and reduce discharge to the environment
- Integrated systems require less water quality monitoring than individual systems
- Profit potential increased due to free nutrients for plants, lower water requirement, elimination of separate biofilter, less water quality monitoring and shared costs for operation and infrastructure.

Perspective on UVI Aquaponic System

- The system represents appropriate or intermediate technology
- It conserves water and reuses nutrients
- The technology can be applied at a subsistence level or commercial scale
- Production is continuous and sustainable
- The system is simple, reliable and robust
- Management is easy if guidelines are followed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