Integrating Biofloc Systems with Organic Plant Production and Renewable Energy at KSU's High Tunnel Complex

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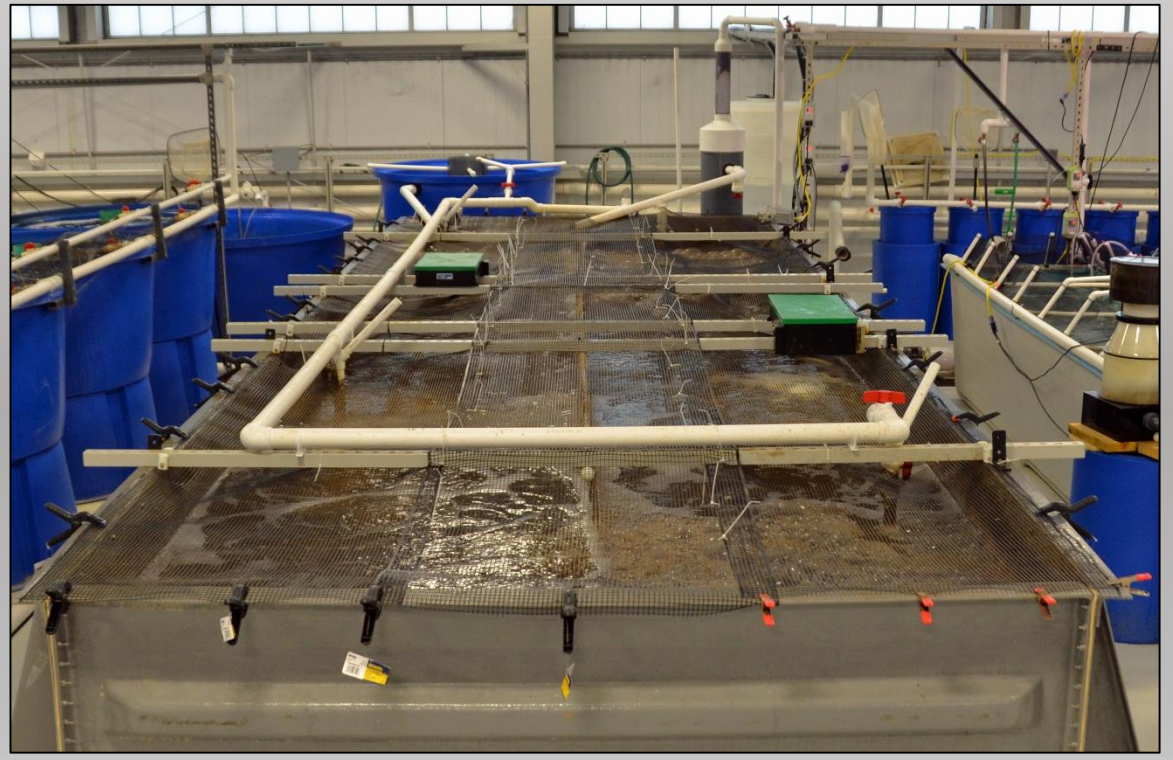
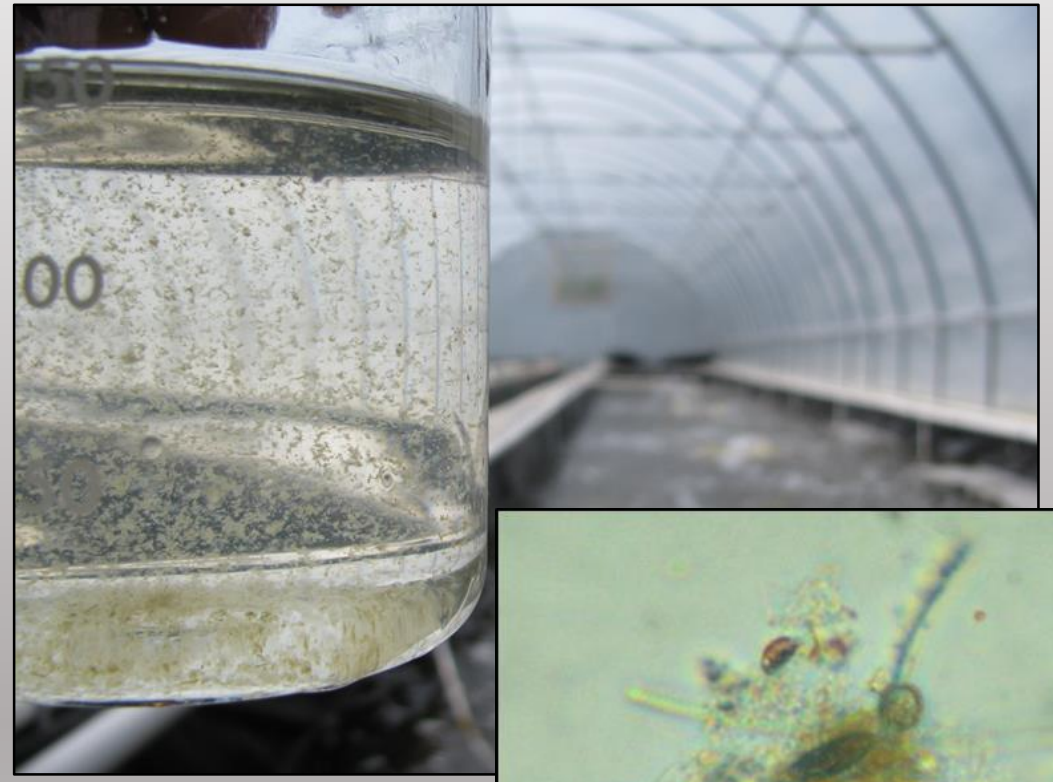
Biofloc Aquaculture Systems

- Low Water Exchange
  - Biosecurity
  - Temperature Control
  - Salt Conservation = Inland Brackish Operation
- High Animal Density
  - (Intensive → Superintensive)
  - Indoor/Greenhouse Operation
    - Climate Control
    - Diverse Regions



Biofloc Systems

- Recirculating Systems
  - No External Biofilter
- Biofloc Particles in the Water
  - Microbes, Algae (in light), Protists, Zooplankton, Feed Particles, Feces, Detritus (eg. Exoskeletons), Exopolymeric Substances
  - Cycle Nitrogen in the System
  - May Provide Supplemental Nutrition
    - Recycling Nutrients



High Tunnel Greenhouses

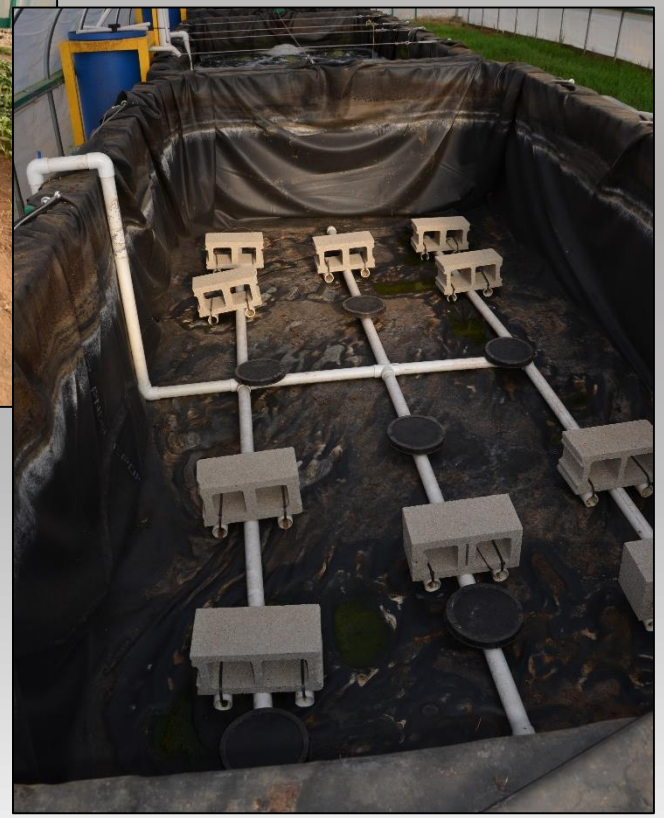
- Simple “Hoop Houses”
- Metal Ribs
- Wooden End Walls
- Plastic Sheeting
- No Heat
- No Automation Usually
- Extend the Growing Season
- Common for Fruits, Vegetables

Integrating Plant and Fish Production

- Diversify Products = Risk Mitigation
- Fish Nutrients → Soil Amendment
  - Sustainable Agriculture
- Fish Tanks = Heat Sinks
  - Diminish Temperature Swings
- Simple Fish Tanks
  - Low Cost Wood Frames
  - Rubber Liners
- Maximize Productivity of Tunnels
  - Warm/Cool Weather Crop Rotations

Simple, Wood-Framed Tanks

- ~ 2.7 x 5.5 m
- Plywood, insulation
- Steel Cables
  - Top and Bottom
- Sand Bottom
- Rubber Liner
- Rubber-faced Diffusers… up to 5 CFM
- 4 Tanks per High Tunnel
- Each High Tunnel ~ 30.5 x 10.0 m



USDA Organic

- KSU High Tunnel Complex is Certified
- “Natural” Farming
  - Conserve Natural Resources
  - Eliminate Synthetic Compounds
- Higher Value Plant Products
- No Standards for Aquaculture
- No Treated Wood
- Prevent Fish Water-Soil Contact

Photovoltaic Panels

- Photons → Electricity
- 8.4 kW System
- 30 Pole-Mounted Panels

- Should Produce Over 10,000 kWh/year
- Grid-Tied
  - Offsets Energy Usage at High Tunnels
  - Excess Energy Fed Into Grid

Teaching Tunnels

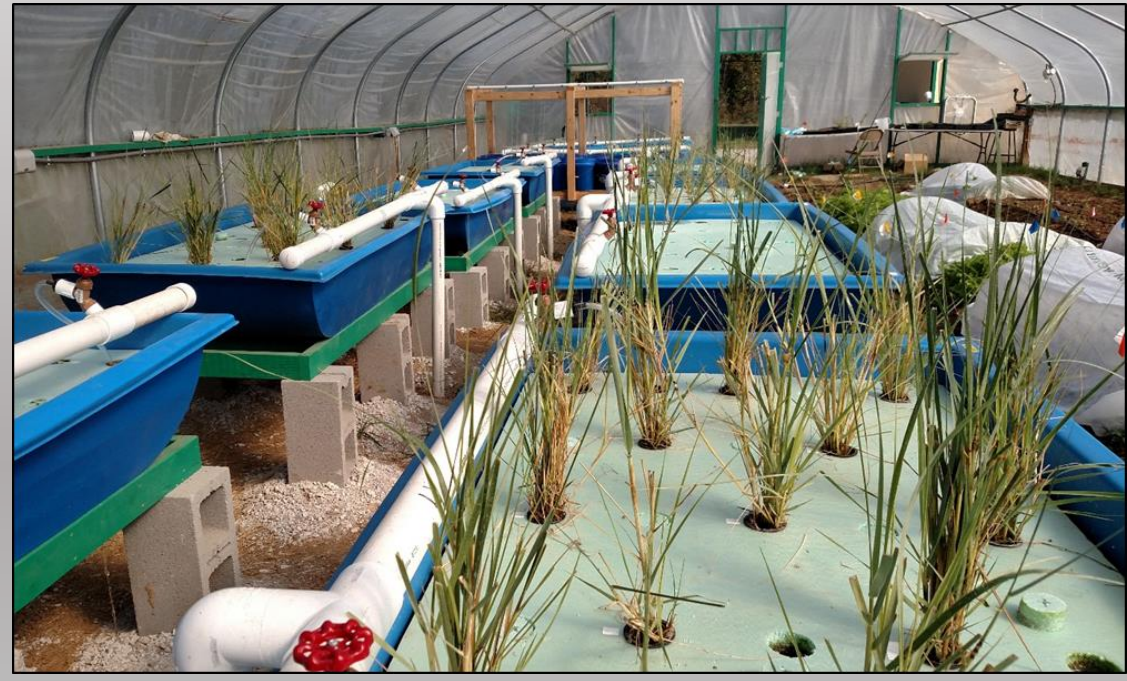
- At Two KY Schools
  - Versailles
    - 18 Months – 6th Grade
  - Lexington
    - 6th Grade – 12th Grade
- 8.5 x 12.2 m
- Solar Panel → Exhaust Fan
- Two RAS Inside
- Teaching Laboratories

Key Concepts (STEM)

- Physics/Technology
  - The Greenhouse Effect
  - PV Electricity
- Ecology
  - Photosynthesis
  - Fish Husbandry
  - Plant Propagation
  - Fish Effluent Fertilizer
- Integrated Food Production
  - Plants and Animals
  - Nutrient Efficiency

Additional/Future Work

- Warm/Cool Aquaculture Crops
- Maximize Production/Farmer Profits
  - Shrimp Growout
    = Late Spring – Early Fall
  - Large Mouth Bass *Micropterus salmoides*
    Nursery = Mid Fall – Mid Spring
- Decoupled Aquaponics
  - Seasonal Phytoremediation of Reused Aquaculture Effluent
  - Shrimp Biofloc Water
  - Salt-Tolerant Plants



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- Stay tuned to the KSU Aquaculture Facebook Page and Website: http://www.ksuaquaculture.org/

- YouTube Video on the High Tunnels Project (more coming soon): https://www.youtube.com/watch?v=HuJyqM719wE