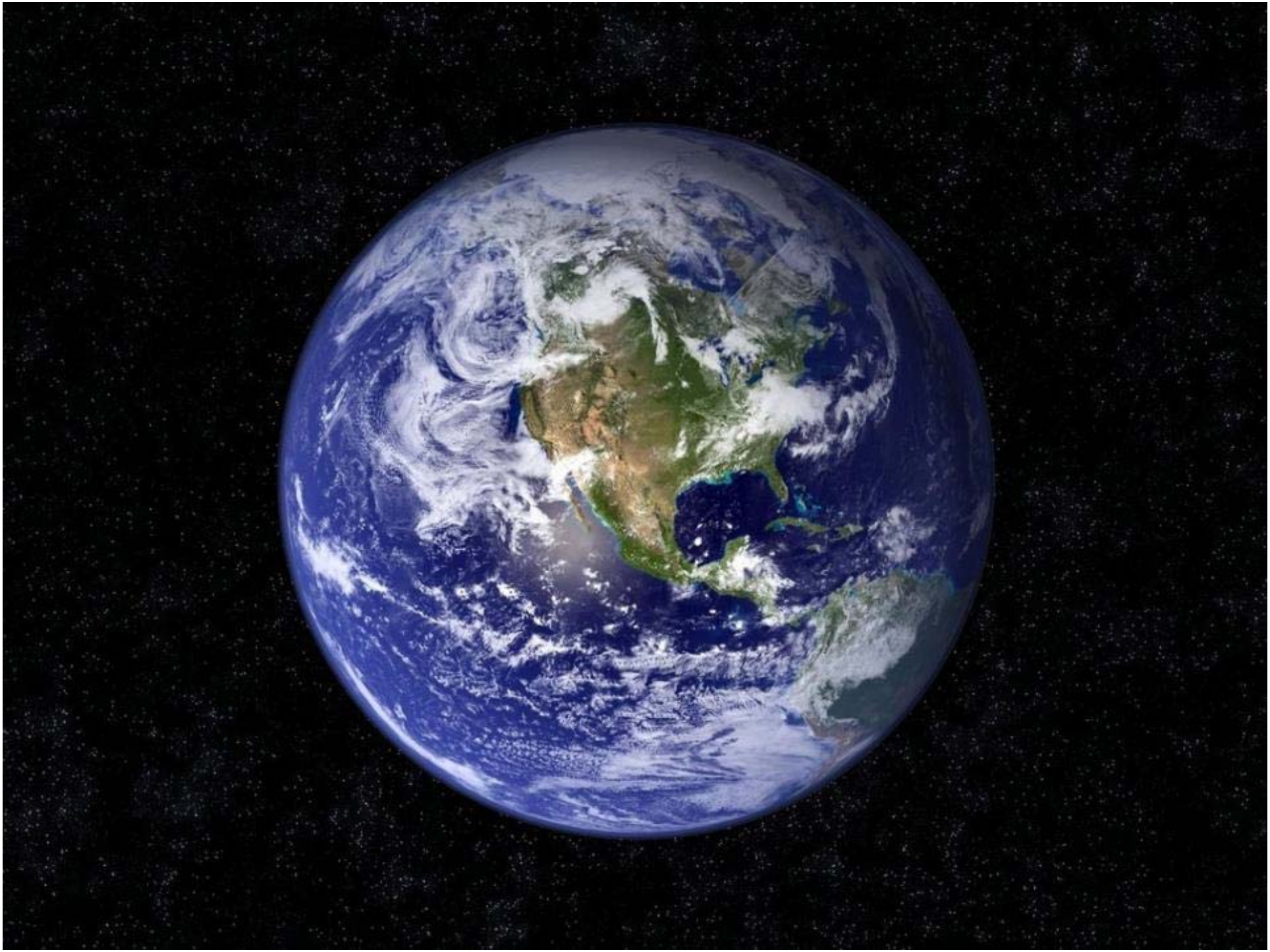
Ohio Aquaculture Association Annual Meeting

Aquaponics Session I
Feb 9, 2013 – 9am
Barry Adler

RainFresh Harvests -- Introduction to Aquaponics



Population is expected to grow by 50% in next 50 years

Resulting in increased demand for limited natural resources to manufacture goods, provide energy and produce food

Climate extremes will continue to disrupt traditional agricultural practices and yields

Aquaculture will be an important part of the solution for growing food more efficiently

moving forward

Aquaculture

Aquaculture or “fish farming” is one of the fastest growing segments within the agricultural sector worldwide. Aquaculture sales in Ohio have tripled from $1.8 million to $6.6 million in recent years.

Source: 2010 Executive Summary Ohio Aquaculture Industry Analysis, Ohio Department of Agriculture, The Ohio State University South Centers

Aquaculture

In the last 20 years, the production of fish through aquaculture has grown exponentially, while marine fish catches have leveled off.

Unless it's an extraordinary year for marine fishing, in 2013 the lines will cross, and **the majority of the fish we eat will come from aquaculture rather than oceans.**

Source: New York Times, January 24, 2013
Green Blog Energy and the Environment

Aquaculture Opportunity

Feed conversion rates for several aquaculture fish species are approaching 1:1, meaning that for every pound of feed, a fish gains one pound.

By comparison, the most efficient farmed animals on land are broiler chickens with a 1.6:1 feed conversion ratio.

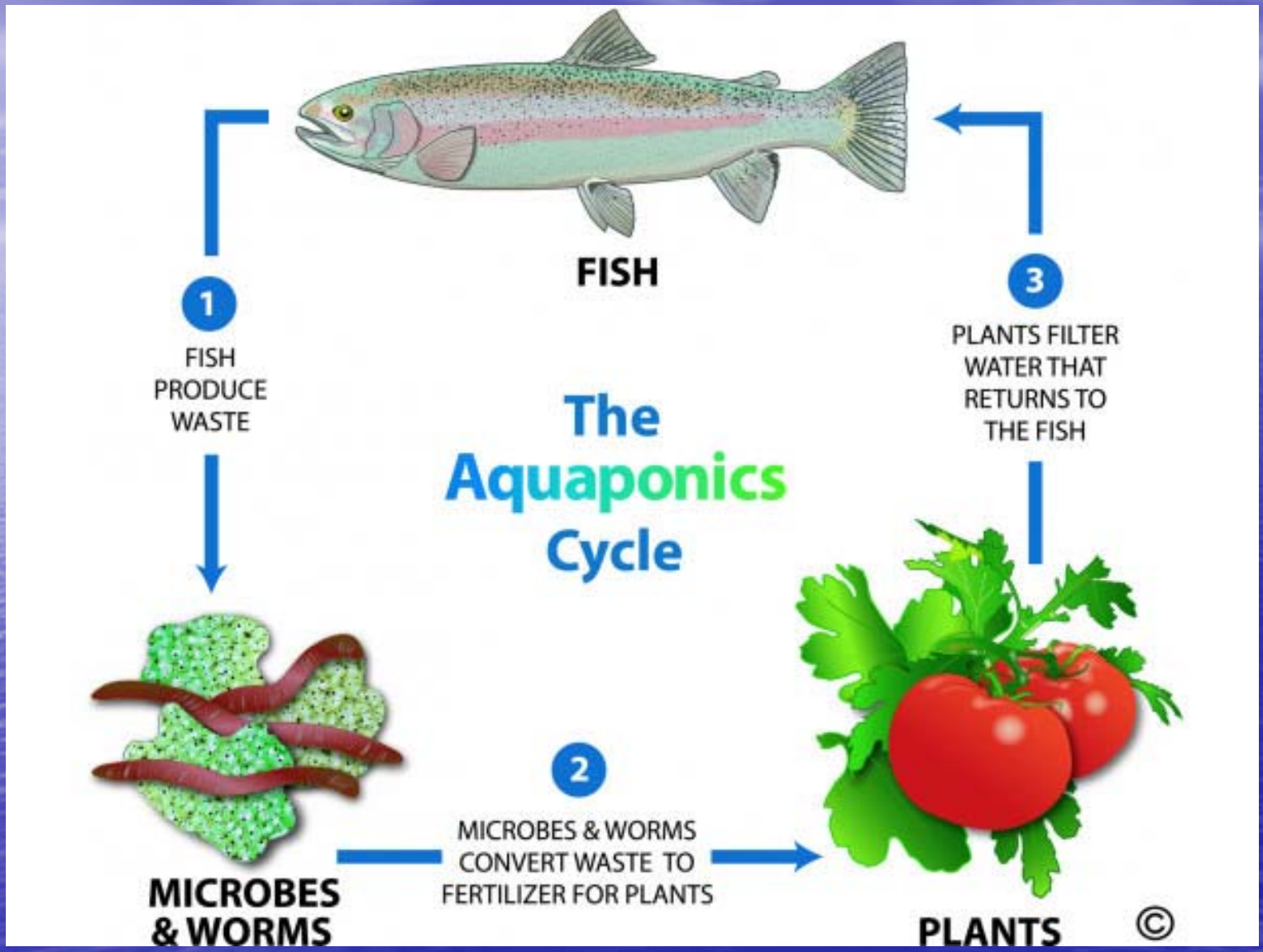
Source: New York Times, January 24, 2013
Green Blog Energy and the Environment

Aquaculture Challenges

- **Fish wastes, effluents and pollution**
- High capital investment /production costs
- Need for infrastructure and technical support

Aquaponics

The combined culture of fish and plants in a closed, recirculating system



Aquaponics Cycle *Credit: Radio Netherlands Worldwide*

Basic Aquaponics Goal

Optimize growing conditions and yields for both plants and fish

- Water quality
  - Oxygen
  - Fish wastes -- bio-solids and NH_4-N
- Fish density and feeding rates
- Water, nutrients, proper temperatures and lighting for plants
- Control pests in plants and fish tanks

Harvest fish and plants in a manner that preserves quality and food safety

Some Examples of Aquaponic Systems

- ❖Continuous flow or
- ❖Ebb and flow
  - ➢Floating Rafts
  - ➢Troughs
  - ➢Gravel or inert substrate beds
  - ➢Multi-level vertically integrated systems

Aquaponic Systems can be innovative

Aquaponics:
The new urban agricultural revolution

The recent focus on local, sustainably grown foods, along with improved profitability and innovative production systems have resulted in a number of new projects just over the past 5 years or so in colder regions:

Milwaukee, Wisconsin and Chicago, Illinois (Growing Power)

Racine, Wisc (Natural Green Farms)

Chicago, Illinois (Greens and Gills)

New York (Aqua Vita Farm)

Boulder, Colorado (Green Acres Aquaponics)

Aquaponics:
The new urban agricultural revolution

New projects (continued):

Glasco, Kansas (Survival Condo in an Atlas Missile Silo)

Boulder, Colorado (Green Acres Aquaponics)

North Freedom, Wisconsin (KP Simply Fresh)

Milwaukee, Wisconsin (Sweet Water Organics)

Mount Kisco, New York (Cabbage Hill Farm)

Richwood, Ohio (Fresh Harvest Farm)

Aquaponics Advantage

Environmental

- Up to 98% less water than conventional farming
- Can be designed for zero waste water discharge
- Up to 75% less energy use than conventional crops
- Chemical free crops with no hazardous pesticides introduced into the food supply chain
- Soilless production located on un-farmable land sites
- Less methane emission. In the U.S., cows account for 20% of methane emissions, fish don't pass gas like other meat animals and also have a better feed conversion to protein ratio

Aquaponics Advantage

Production

- Vertically integrated growing systems can have up to 10 times the yields with ½ the labor of conventional agricultural production
- Energy costs can be reduced by combining 2 food production systems in the same space
- Systems can be designed for scalable sized production units to supply local or even regional markets
- Crops can be grown in controlled environments not subject to outdoor pests and climate extremes

Aquaponics Advantage

Marketing

- Year-round production to get premium winter pricing on crops
- Specialty local markets for perishable items and live fish or other aquatic species can result in added value pricing
- Strong demand in most of the mid-west region for chemical free, locally grown, fresh food items

Top Trends for 2013
National Restaurant Association

1. Locally sourced meats and seafood
2. Locally grown produce
3. Healthful kids' meals
4. Environmental sustainability
5. Children's nutrition
6. New cuts of meat (such as Denver steak, pork flat iron, etc.)
7. Hyper – local sourcing (such as restaurant gardens)
8. Gluten-free cuisine
9. Sustainable seafood
10. Whole-grain items in kids' meals

So why isn't everybody growing aquaponically?

Aquaponic Challenges

Economic

- Higher initial capital investment makes the return on investment dependent on keeping production costs down, maximizing yields and getting premium market prices
- Intensive production systems require higher operating expense for energy, labor, materials such as plants and aquatic stock and feed supplies. Future costs are difficult to predict and likely will increase
- Selecting the right plants and aquatic species that are capable of being grown in your facility, that also will be marketable and provide you with a reasonable profit margin

Aquaponics Challenges

Technical

- Operating a “poly-culture” system requires expertise in both horticulture and aquaculture
- Management of environmental parameters is critical including temperature, water quality (oxygenation, filtration, pH, etc.), nutrient balance, disease and pests
- Multiple 'single points of failure' where problems such as an electrical failure or a pipe blockage can lead to a complete loss of aquatic or plant stock
- Harvesting, quality control and processing of fresh and sometimes live products for delivery to markets can also be technically challenging

Aquaponics – Growing Sustainably

Blending technology with nature

Growing wholesome, nutritious food

www.rainfreshharvests.com

Location: Near Plain City, 25 miles Northwest of Downtown Columbus in Central Ohio

Farm Description:

- Family farm growing herbs, specialty vegetables, fruit and fish
- Production on 1.5 acres of the 9 acre farm
  - **Bio-intensive raised beds and small fruit orchard**
  - **Passive solar greenhouse**
  - **Aquaculture pond**
  - **Bio-integrated renewable energy greenhouse with aquaponics**

Marketing locally for 9 years:

- Started with just one customer in 2004 and added 2 greenhouses in 2005
- By 2012, delivering fresh produce to 3 Grocers (including 2 Whole Foods locations), 2 Caterers, 9 Restaurants , 1 college cafeteria and also selling Koi and Mosquitoefish on the farm

Bio-Intensive Field Crops

Raised Beds

BioIntensive Matrix Planting

Compost and Manure Incorporated

Winter Rye Cover Crop

Reusable landscape fabric mulch for reduced weed growth with drip irrigation

Passive Solar Greenhouse

- Gothic Style
- Below Ground Insulation
- Inflatable Double Walled Roof
- Roll-Up Sides
- Twin-Wall Polycarbonate ends
- Thermal activated end vents

Raised beds with bio-intensive matrix planting of annuals. Perennial plantings include red raspberries, oregano, thyme, rosemary, garlic chives and sage

Passive Solar Greenhouse

No supplemental heating

Row covers for winter heat retention

Winter harvests of Lettuce, Arugula, Mizuna, Spearmint, Oregano and Thyme

Row cover over early winter arugula crop (December)

Aquaculture Pond

4 ft deep for freshwater shrimp

Designed for freshwater shrimp

Stocked with Yellow Perch in 2005

Restocked with mosquitoefish in 2010

Currently breeding mosquitoefish and too many cattails

Renewable Energy Working in Ohio
Bio-Integrated Greenhouse

Innovative Design

Solar
Wind
Aquaponics
Vermiculture

Powered by 1 kW wind turbine and 2.1 kW solar array

Heated by a solar thermal drain-back, closed-loop radiant floor system

Bio-Integrated Greenhouse Containers

Standard pots in trays and larger containers

Herbs

Vermicompost

Solar Thermal Mass

Herbs growing in containers filled with vermicompost above water-filled barrels that provide solar thermal mass storage

Bio-Integrated Greenhouse Aquaponics

Recirculation
Trough
Culture

Herbs
Baby Greens
Koi and
Mosquitoefish
Grass Filters
Biofiltration Tanks
Vermicompost

Herbs growing in 3” pots filled with vermicompost in troughs above fish tanks that overflow into a 5 step biofiltration before recirculating back to plants

Winter Harvest

Harvesting lettuce, parsley, arugula, rosemary, oregano, and thyme with 12” of snow on the ground and winter night temperatures of -5 degrees F

RainFresh Harvests Aquaponics Components

- Rainwater collection
- Growing Troughs
- Fish Tanks
- Biofiltration – Grass Trays and Barrels
- Vermicompost Growing Media

RainFresh Harvests Aquaponics Components

- Rainwater collection

RainFresh Harvests Aquaponics Components

- Growing Troughs
  - Gutter troughs for 3” pots
  - 6 troughs with a total of 174 pots over fish tanks
  - Vermicompost growing media

RainFresh Harvests Aquaponics Components

- Fish Tanks
  - 8 tanks/100 gallons water each
  - 4 sets of 2 interconnected
  - Koi and mosquitoefish
  - Bottom overflow to bio-filtration with recirculation to troughs

RainFresh Harvests Aquaponics Components

- Biofiltration
  - Grass trays in gravel troughs
  - Bottom flushing
  - Barrels with gravel, duckweed, cattails

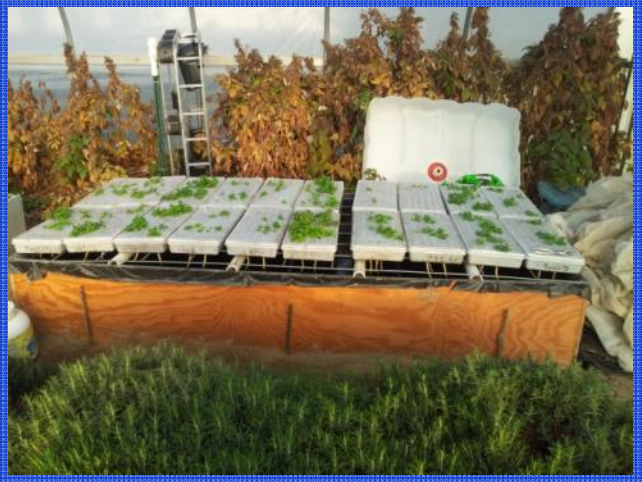
RainFresh Harvests Aquaponics Components

- Vermicomposting
  - Barrels with red wigglers
  - Plant residue and trimmings
  - Growing Mix
  - Compost Tea

Adapting aquaponics for unheated high tunnels using in-ground fish tanks

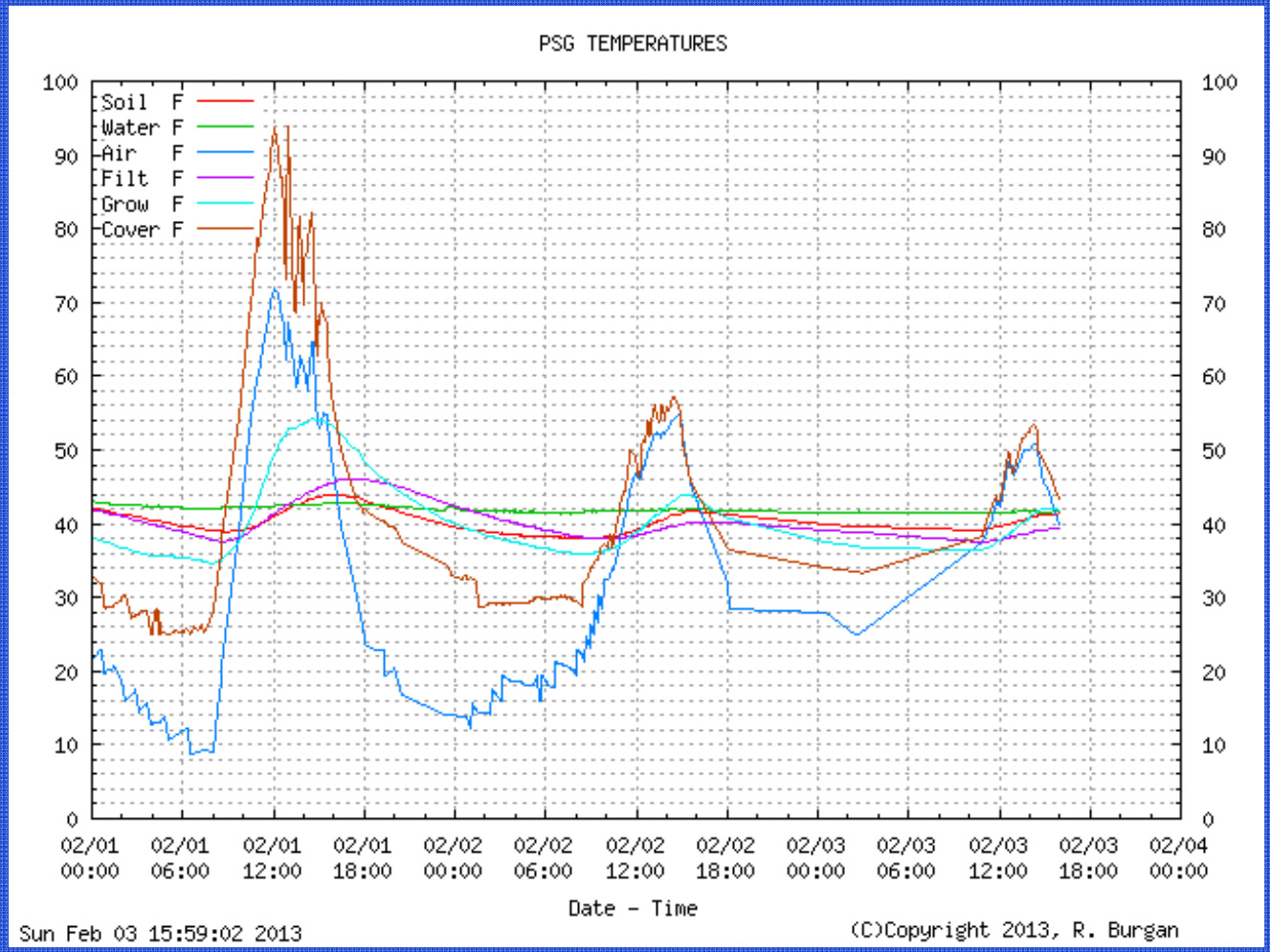
Warner Foundation Research Project 2012 -2013

In-ground fish tanks



Winter protection, biofiltration, wireless monitoring

Temperature Sensors Monitoring In-Ground Fish Tanks



It is still a work in progress, but after 8 years of greenhouse operation, lessons learned:

•**Managed to keep fish growing in a recirculating aquaponics system** that utilizes a biofiltration system that includes vermicomposting as a source of organic growing materials for growing fresh baby greens and herbs in a renewable energy powered greenhouse

•**Achieved zero net discharge of water and nutrients --** the only water and nutrients that leave the system are the fresh baby greens and fish sold or delivered to market

•**Working towards net zero energy –** all equipment is powered by renewable energy, however, during the coldest winter nights after days with no sunshine, some supplemental propane is needed for heating

•**Net positive operating costs –**
baby greens and herbs sold to local restaurants and sale of Koi and mosquitoefish covers labor and material costs, however, still working on net positive return on investment as the capital investment for the greenhouse, renewable energy equipment and growing infrastructure were significant

Tours are offered in the spring and fall

For more info: *www.rainfreshharvests.com*

RainFresh Harvests

Blending technology with nature

Growing wholesome, nutritious food

barry@rainfreshharvests.com

www.rainfreshharvests.com


Support your local growers
Rain Fresh
HARVESTS
Questions?
Thank you !

Aquaponics Online Resources

General Aquaponics:

http://aquaponicscommunity.com/

http://aquaponicsjournal.com/

http://www.enotes.com/topic/Aquaponics

http://www.aces.edu/dept/fisheries/aquaculture/documents/309884-SRAC454.pdf

https://attra.ncat.org/attra-pub/summaries/summary.php?pub=56

Alberta Canada CDC South study:
http://www.dfo-mpo.gc.ca/science/enviro/aquaculture/acrdp-pcrda/projects/reports-rapports/ca/CA-05-01-004.pdf

The Aquaponic Gardening Community:
http://aquaponicscommunity.com/page/what-is-aquaponics

Aquaponics Online Resources

Projects and Products:

Aqua Vita Farms: New York City https://www.facebook.com/aquavitafarms
http://www.aquavitafarms.com/index.php?option=com_content&view=featured&Itemid=435

Backyard Aquaponics: http://www.backyardaquaponics.com/

Black Soldier Fly Larvae (living food source): http://thebiopod.com/

Growing Power: Milwaukee, Wisc. http://www.growingpower.org/aquaponics.htm
http://www.growseed.org/growingpower.html

Greens and Gills: Chicago, Ill. http://greensandgills.wordpress.com/

Hawaiian Organic Aquaponics: http://www.olomanagardens.com/

Friendly Aquaponics: also in Hawaii http://www.friendlyaquaponics.com/

Green Acre Organics: Florida http://www.greenacreorganics.biz/

Natural Green Farms: Racine, Wisc. http://naturalgreenfarms.com/
http://www.journaltimes.com/business/local/article_cc791f8e-62f9-11e0-8278-001cc4c03286.html

Aquaponics Online Resources

Projects and Products (cont.):

Nelson and Pade: Wisc https://aquaponics.com/
https://aquaponics.com/see/currentprojects.php
https://aquaponics.com/articles/raftmethod.php

Norcal Aquaponics: Ukiah, Calif. http://norcalaquaponics.com/
http://www.youtube.com/watch?v=-pUo4g4rHYQ&feature=player_embedded

Ohio:

CropKing: http://www.cropking.com/aqua.shtml

Lake Farmpark Aquaponics: http://www.youtube.com/watch?v=fk9Z1gujhgA

RainFresh Harvests: www.rainfreshharvests.com

Portable Farms Aquaponics System: http://portablefarm.com/farm/

Sweetwater Organics: Milwaukee, Wisc. http://sweetwater-organic.com/

The Aquaponics Source: http://theaquaponicsource.com/

University of Virgin Islands:
http://www.uvi.edu/sites/uvi/Pages/AES-Aquaculture-Aquaponic_Systems.aspx
https://www.was.org/documents/MeetingPresentations/AA2011/AA2011_0386.pdf