# The Ploughshare
Institute for Sustainable Culture

www.sustainlife.org



# Introduction to Aquaponics

# What is Aquaponics?

Aquaculture + Hydroponics = Aquaponics

Combining aquaculture (raising fish) and hydroponics (raising vegetables without soil)

# What is Aquaponics?

Two novel concepts:

1. Combining aquatic animals and plants in a recirculating system would reduce nitrate in the water.
2. This combination would use much less water. (less waste due to removal of toxic nitrates)

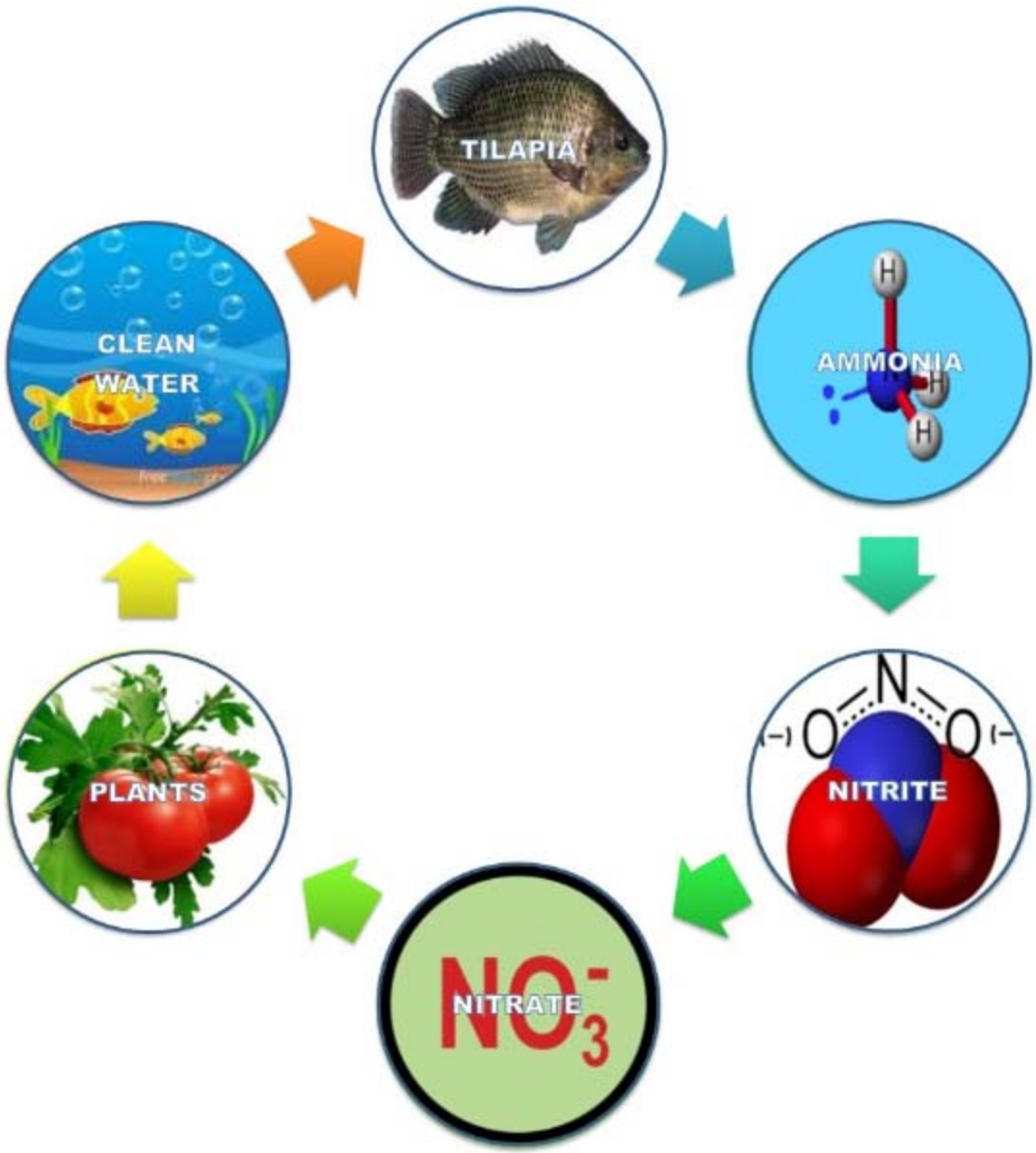
   There was one unforeseen benefit:

3. Aquaponically grown produce was found to be much richer in nutrients than hydroponically grown produce.

# The Nitrogen Cycle

1. Fish give off ammonia
2. Certain bacteria convert ammonia to nitrites
3. Other bacteria convert nitrites to nitrates
4. Nitrate feeds the plants
5. The nitrogen is removed by the plants and the cycle begins again with the fish.

# The Nitrogen Cycle



# Why Do Aquaponics?

Its not about the fish

Its about vegetables

# Why Do Aquaponics?

Its not about the fish

Its about vegetables

3 times the crop yield

Only 2% of the water

needed for a soil garden

# Why Do Aquaponics?

Major benefits:

1. Increased crop yield
2. Decreased water use
3. Better use of space
4. Rich, clean protein source in the fish
5. Total control of the system inputs
6. Easy to certify organic if desired
7. No weeding
8. No stooping
9. The elderly or disabled can garden
10. Very relaxing to most people

# And Why Not?

Cons:

1. This is not a lark– it takes research and planning
2. It takes commitment for the long haul
3. You must obey the principles of Aquaponics or lose all your fish and plants
4. You must have some power source to move water and air
5. Temperature may need to be controlled
6. Someone knowledgeable must check it every day
7. The initial set up is more expensive than soil gardening
8. A greenhouse may be necessary

# Types of Systems

The types of Aquaponics are broken down by the type of plant growing system and the type of fish tank used

Plant Growing Systems

- Raft or Nutrient Film Technique (NTF)
- Media Grow Beds
- Barrelponics™
- Growing Power
- Integrated Aquaponics (Earthan Group of Australia)

# Comparison of small-scale and commercial systems

Most small-scale aquaponics gardens use the media bed growing system.

Most commercial facilities use the raft or NFT systems.

The Ploughshare Institute is using Integrated Aquaponics

# Basics of Raft and NFT Systems

Raft and NFT systems use constantly flowing nutrient water looping in the system with the plant roots hanging down into the water. There is no growing media around the roots.

Since the water is flowing around the roots, it is important to filter to water to prevent too much bio-film from clogging the roots. Filtering wastes the nutrients.

# Example of a Raft System

This is a raft system where the plants are held by little cups and the roots grow down into the water.

These systems require constant care and maintenance

# Media Grow Beds

Media Grow Beds are filled with soilless media. You can't use soil because an anaerobic condition will result in the soil and produce toxins.

The media filters the water and provides a substrate for the bacteria, worms and support for the plants.

There is a variety of media used. Normally one of the following are used:

- Gravel
- Expanded clay
- Expanded shale

# Two Major Types of Media Beds

There are two major divisions of media bed systems:

1. Ebb and Flow (also called Flood and Drain

   This filling and draining is accomplished by one of two ways:

   * Timed pump
   * Auto siphon

2. Constant Flood (also called Constant Flow).

# Example of Ebb and Flow

This was my 12” deep ebb and flow grow bed with autosiphon

# Constant Flow Bed

This was my constant flow grow bed being used as a seedling starting bed

This was my constant flow bed growing watercress and tomato cuttings

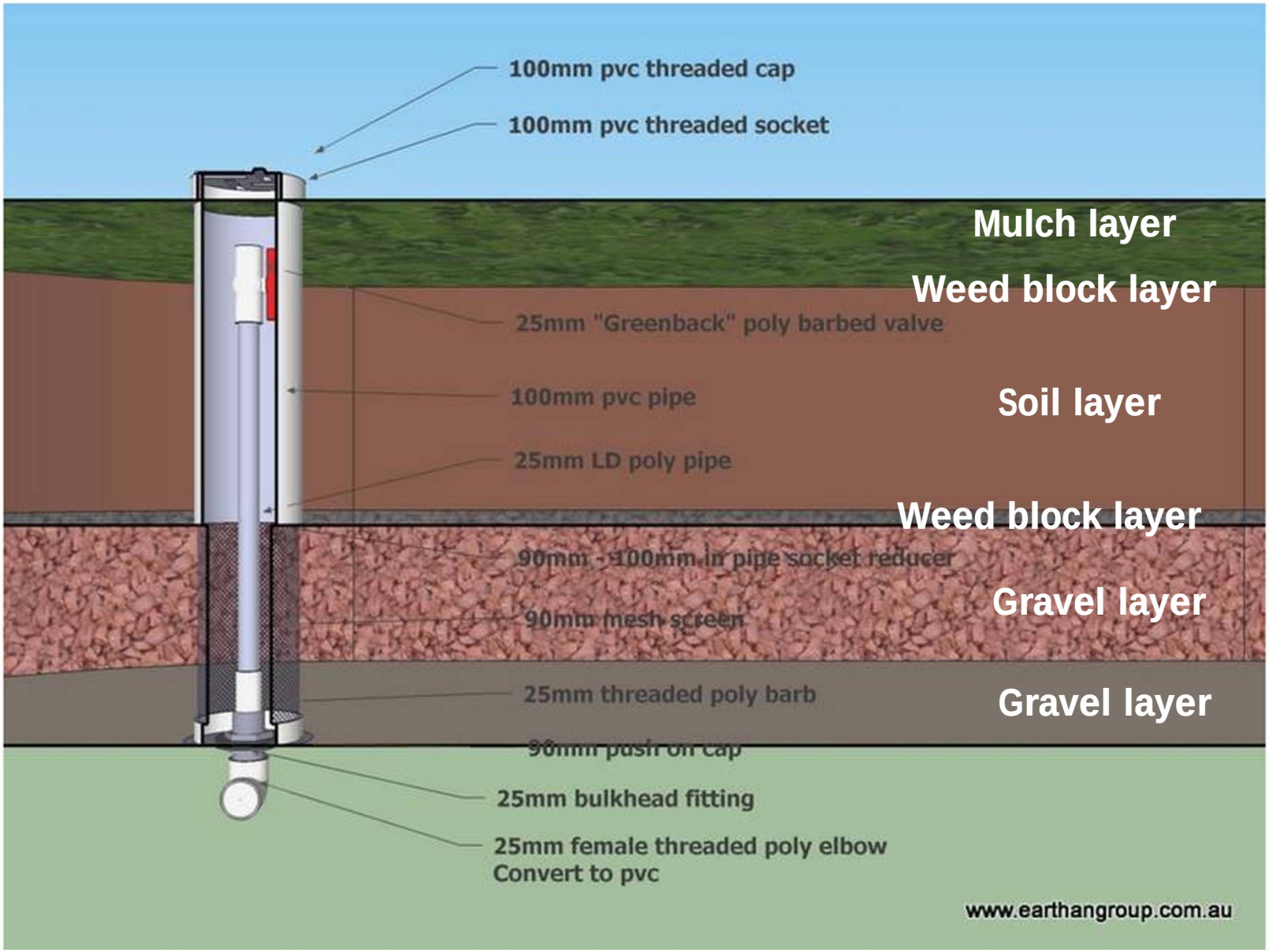
# Integrated Aquaponics

Integrating soil into Aquaponics

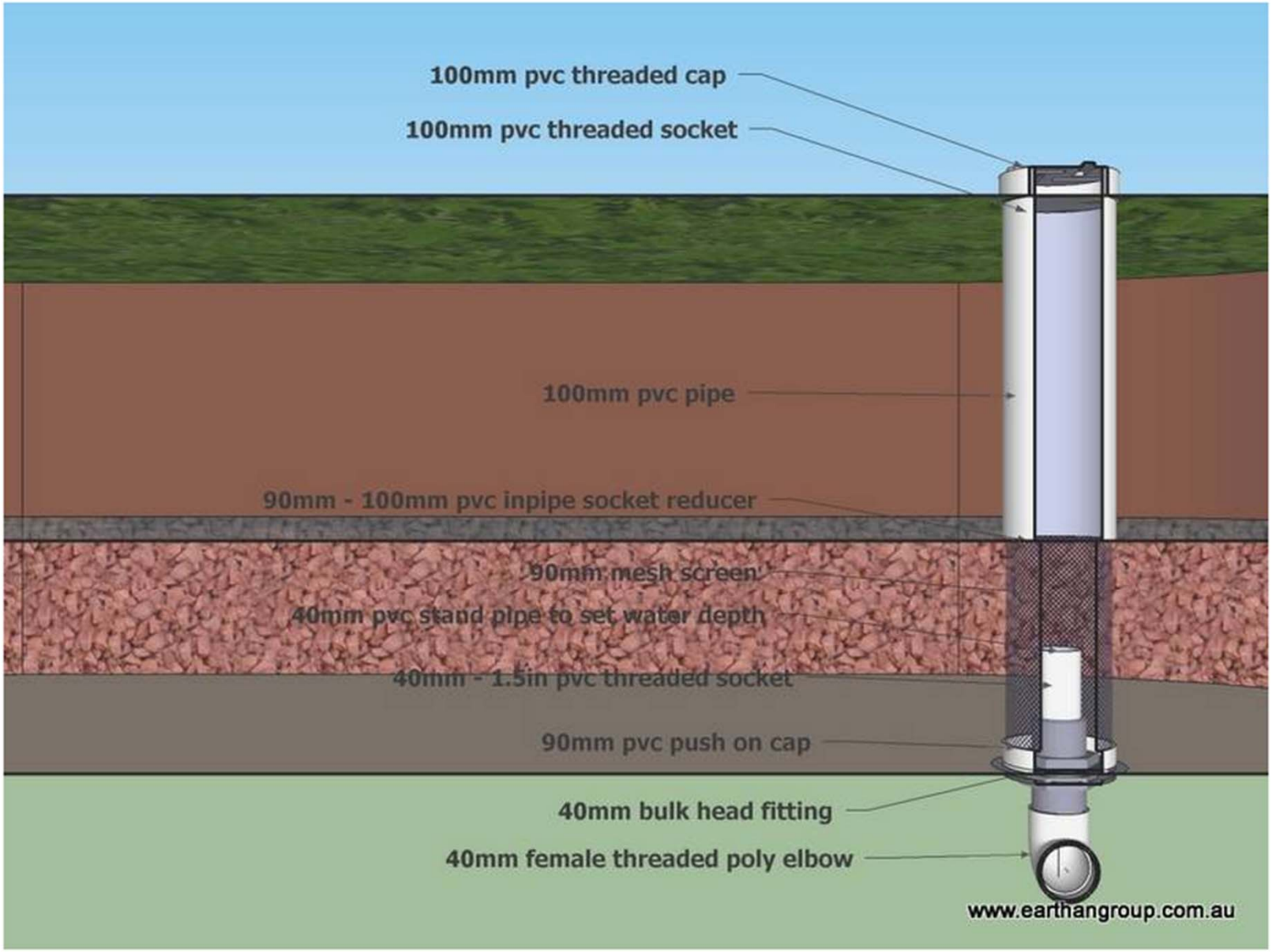
Based on the principles of a wicking bed garden

The water only moves up by capillary action and soil does not enter into the circulating water flow.

# Water Inlet Assembly



# Exit Assembly



# Examples of my Integrated Beds

Photos taken 11/28/2013

# General Guidelines for Aquaponics

1. Determine how much room you have for grow beds.
2. You need equal volumes for fish tanks and grow beds.
3. You need 1 lb of fish for every cubic foot of grow bed.
4. You need about 1 lb of fish for every gallon of fish tank. (when the fish are small cut back on the number of plants or plan to harvest fish as they grow)
5. 250 gallons or larger is the most stable system. You need a minimum of a 50 gallon fish tank.
6. Grow bed media
   * Must be inert and not affect pH
   * Must not decompose
   * Must be the proper size (½ to ¾ inch in diameter)

# General Guidelines for Aquaponics

7. Water
   * Must not have chlorine or chloramine
   * The temperature must match the fish and plants
   * You must keep enough oxygen dissolved in the water by bubblers or agitation or both
   * pH should between 6.8 and 7.0

# General Guidelines for Aquaponics

8. Fish
   * Stocking density
     - 1 pound of fish to 5-7 gallons of tank water
     - Fish selection
   * When introducing new fish into the system
     - Be sure your system is fully cycled (nitrogen cycle)
     - Match the pH
     - Match the temperature

# General Guidelines for Aquaponics

* Feeding Rate

9. Plants
   * Avoid plants that prefer an acidic environment or a very high pH
   * Plants can be started in all the same ways as a soil garden– by seed, cuttings or transplanting
   * If you plants look unhealthy after a few months it is most likely caused by:
     - A nutrient imbalance
     - Insect

# Starting Your System

Starting the system is called “Cycling”

There are two main ways to cycle your system:

1. Cycling with fish
    * Add only ½ of the fish that the system will take
    * Test daily for ammonia and nitrite levels. If too high, do a partial water exchange
    * Feed only once a day or less to control the ammonia level
    * Some people add nitrogen cycle bacteria
        - From an established system
        - From an stable aquarium
        - From bottled starter kits from aquarium store

# Starting Your System

2. Fishless Cycling
   - Add bacteria starter as we discussed above
   - Add ammonia
     - Synthetic—pure ammonia, ammonium chloride, not with soap
     - Organic—urine or animal flesh
   - Follow this process
     - Add ammonia a little at a time until you see a reading from the test kit of 5 ppm
     - Record the amount this took and add that amount daily until the nitrite appears at 0.5 ppm. If the ammonia level exceed 5 ppm stop and let it go back to 5 ppm
     - Once **nitrites** appear, cut back the ammonia to half the dose. If the nitrite exceed .5 ppm stop adding ammonia until it drops to 2.0 ppm
     - Once **nitrates** appear at 5-10 ppm and both the ammonia and nitrites drop to near zero, you can add the fish

# Murray Hallam's Technique

1. Add liquid seaweed to the system
2. Add plants
3. Wait for two weeks
4. Add fish
5. pH should be between 6.8 to 7.0

Adding bacteria as discussed above will dramatically speed up the cycling process. Keeping the temperature above $70^0$ will help as well

# System Maintenance

1. Ammonia, Nitrites and Nitrates after cycling
   - Ammonia and Nitrite levels should be less than .75 ppm.
2. Nitrates can rise as high as 150 ppm without causing stress. Above that—consider harvesting some fish and/or adding more plants or another grow bed

# Contact Information

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Aquaponics is much more detailed that we can cover in this introduction. Please let us know if you have an interest in further seminars on aquaponics in the future.