

Aquaponics

Module 4



Growing more fish and plants for human consumption and enjoyment

Module 3 - Filters, Feed and Fish

What are the filter types?

- Bacci tower
- Vortex
- Ebb and Flow
- Flow through
- NFT Nutrient Film Technique
- DWC Deep water culture

What ways can we aerate?

- Venturi
- Sheeting
- Air stones
- Dropping, manual stirring, wind

Name Plants for feed?

Name Plants for Profit?

What are some of the best fish for culture?

- Tilapia, Gurami, Carp, Catfish, mudfish
- Trout, Perch, Blue gill

Bed types for plant types

1. **Soil based Plants get soil**
2. **Water based plants get gravel**
3. **Floating Plants get to Float**



First Prototype

Develop safe reliable system using one pump

- ✓ Utilize gravity
- ✓ Understand head, hp to watts to kwh to cost
- ✓ GFIC required

Understanding dissolved oxygen

- ✓ Venturi
- ✓ Sheeting
- ✓ Use Flow form aeration where ever possible

Understanding filtration

- ✓ Gravel beds for trapping solids and also for additional biofiltration
- ✓ Ebb and flow – Build simple bell siphon prototype
- ✓ Flow through beds
- ✓ NFT- Nutrient film technique
- ✓ Low cost main biofilter

Plants are for

- ✓ Nitrate removal
- ✓ Ammonia removal
- ✓ CO₂ / carbonic acid production

Meet plant fertilizer needs

- ✓ Grow plants in soil if not aquatic
- ✓ Soil based plants - vermicast, cocopeat
- ✓ Dependant on capillary action of potting soil – we have ideal materials

Vegetables

Potting soil wicks moisture

NFT



Vegetables



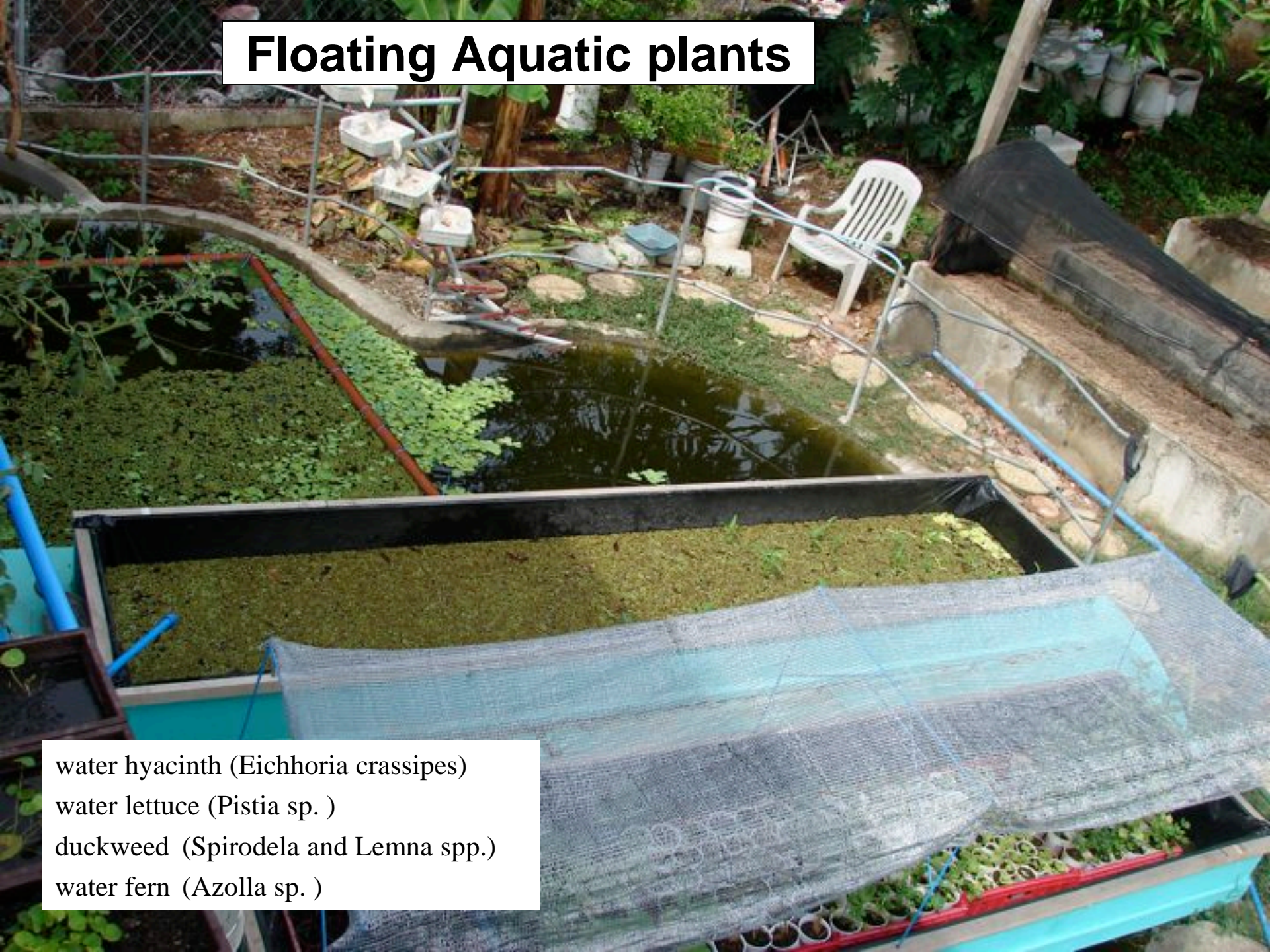
Potting soil provides the soil food web

NFT

Batchoy, celery, lettuce



Floating Aquatic plants



water hyacinth (*Eichhoria crassipes*)
water lettuce (*Pistia* sp.)
duckweed (*Spirodela* and *Lemna* spp.)
water fern (*Azolla* sp.)

Emergent plants

Semi submerged aquatic plants

Bed types for plant types

1. **Soil based Plants get soil**
2. **Water based plants get gravel**
3. **Floating Plants get to Float**



watercress (*Nasturtium officinale*)
water chestnut (*Eleocharis dulcis*)
water spinach (*Ipomoea aquatica*)



Water Loving Plants

Gotu kola (*Centella asiatica*)

Viola

All of the Mints

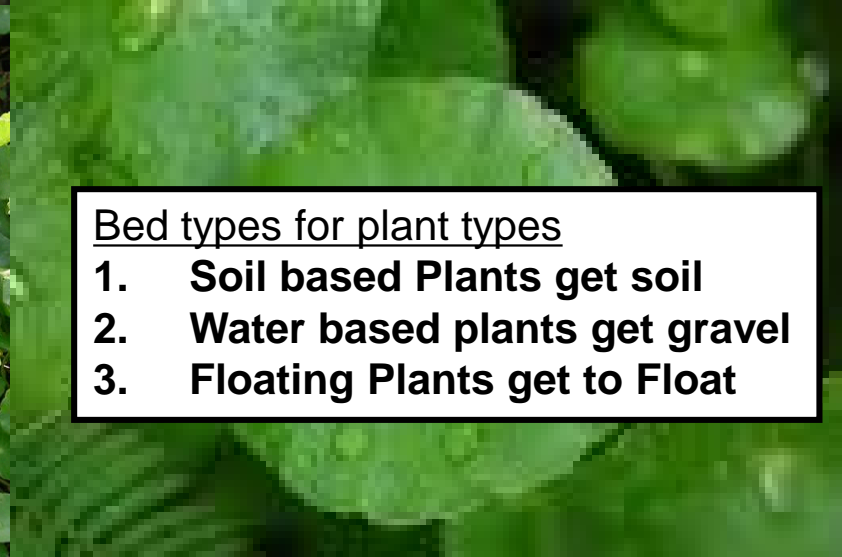
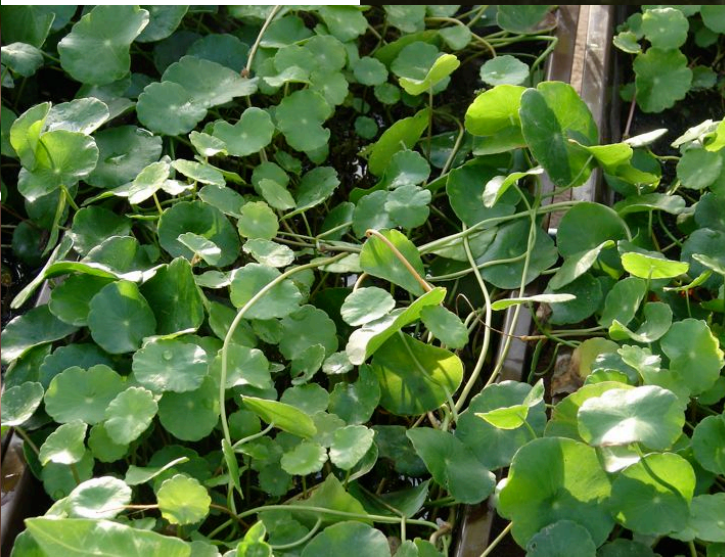
Wasabe (*Wasabia japonica*, *Cochlearia wasabi*, or *Eutrema japonica*)

Dandelion (*Taraxacum officinale*)

Nasturtium

Equisetum hyemale

[Horsetail, Scouring Rush]



Bed types for plant types

1. **Soil based Plants** get soil
2. **Water based plants** get gravel
3. **Floating Plants** get to Float

Nitrate loving leafy greens

Simulated river bed

CONTROL



Soil based

S.R.BED 4



Aquaponics

Gotocola



Water LILY

Salvinia molesta
[Giant Salvinia, Water Fern, Kariba Weed]



Water Loving Plants
Gabi, Poi, taro

A photograph of a Nasturtium plant with numerous bright green, round leaves and several bright orange flowers. The plant is growing in front of a dark red wooden fence. A white text box with a black border is overlaid on the center of the image.

Nasturtium Flowers

Water cress *Nasturtium officinale*



Gabi

CB3



**Kang
Kong**

CB4

Simulated river bed

CONTROL



Soil based

Simulated river bed

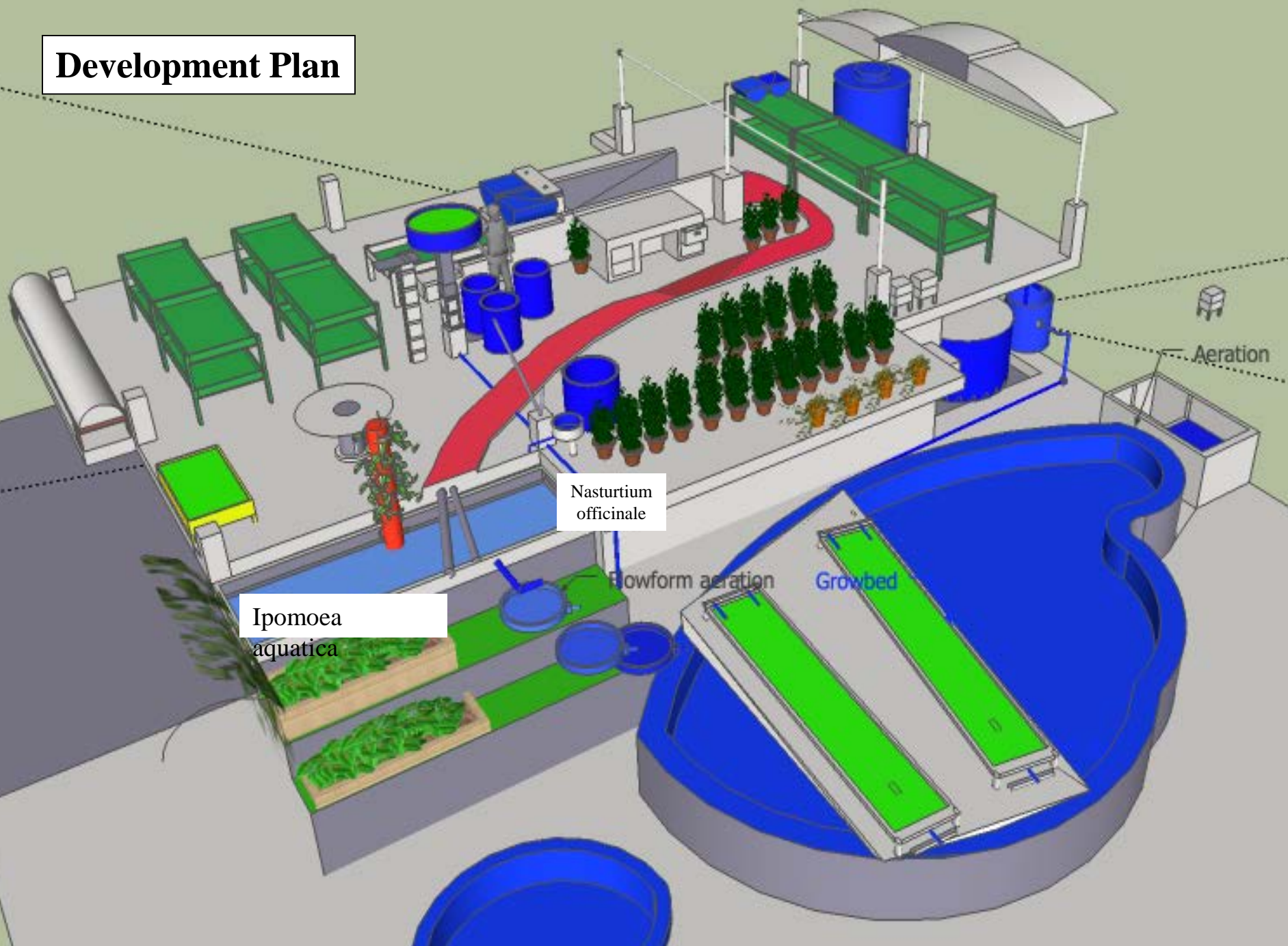


Aquaponics

Nitrate loving leafy greens

Kangkong

Development Plan



Ipomoea
aquatica

Nasturtium
officinale


Flowform aeration

Growbed

Aeration


Strawberry Tower
W/ *Centella asiatica*



A photograph of a pond densely populated with water hyacinth plants. The plants have bright green, rounded leaves and some small white flowers. A dark brown frog is perched on one of the larger leaves in the center of the frame. The water is dark and reflects the surrounding greenery.

Eichhornia crassipes
Water hyacinth

Non fish feed
Oxygen producing
Floating Plants

A close-up photograph of a dense patch of water hyacinth plants. The leaves are bright green, rounded, and have a distinctively wavy or scalloped edge. In the center-left of the frame, a dark brown dragonfly nymph is perched on a leaf. The nymph's body is segmented, and its legs are visible. The background is filled with more of the same plants, creating a textured, layered appearance.

Predator Insect Habitat
Oxygen producing
Floating Plants

Eichhornia crassipes
Water hyacinth

A group of five people are gathered around a concrete pond. A woman in a white shirt and pink pants stands on the left, holding a long wooden pole. A boy in a white and blue shirt stands next to her. In the center, a man in a white shirt and a woman in a yellow shirt are looking at something. On the right, a woman in a red shirt stands with her arms crossed. The pond is surrounded by a concrete wall and a metal railing. The background shows a building with a red roof and some plants. The text "Harvesting Fishes" is overlaid in a white box at the top center.

Harvesting Fishes

Selective harvest



Selective harvest

The maximum biomass of fish a system can support without restricting fish growth is called the critical standing crop.

Harvesting Fishes



Complete harvest

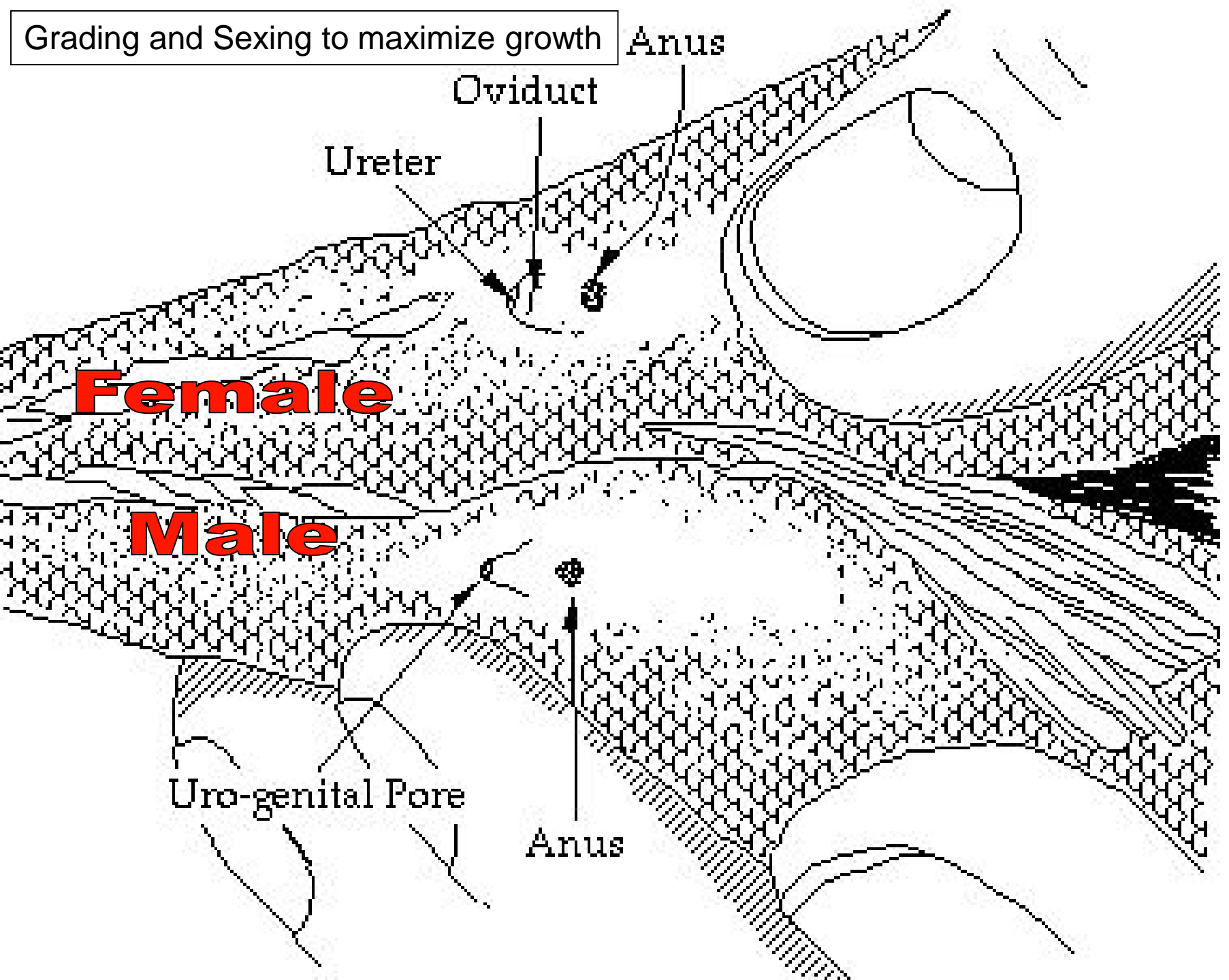


Complete harvest



Selective harvest

Grading and Sexing to maximize growth



Grading and Sexing to maximize growth



Consumption



Water Quality Testing

Secci disk

Turbidity
30 + cm Secci
"Safe" level



Turbidity
30 + cm Secchi
"Safe" level

60 cm

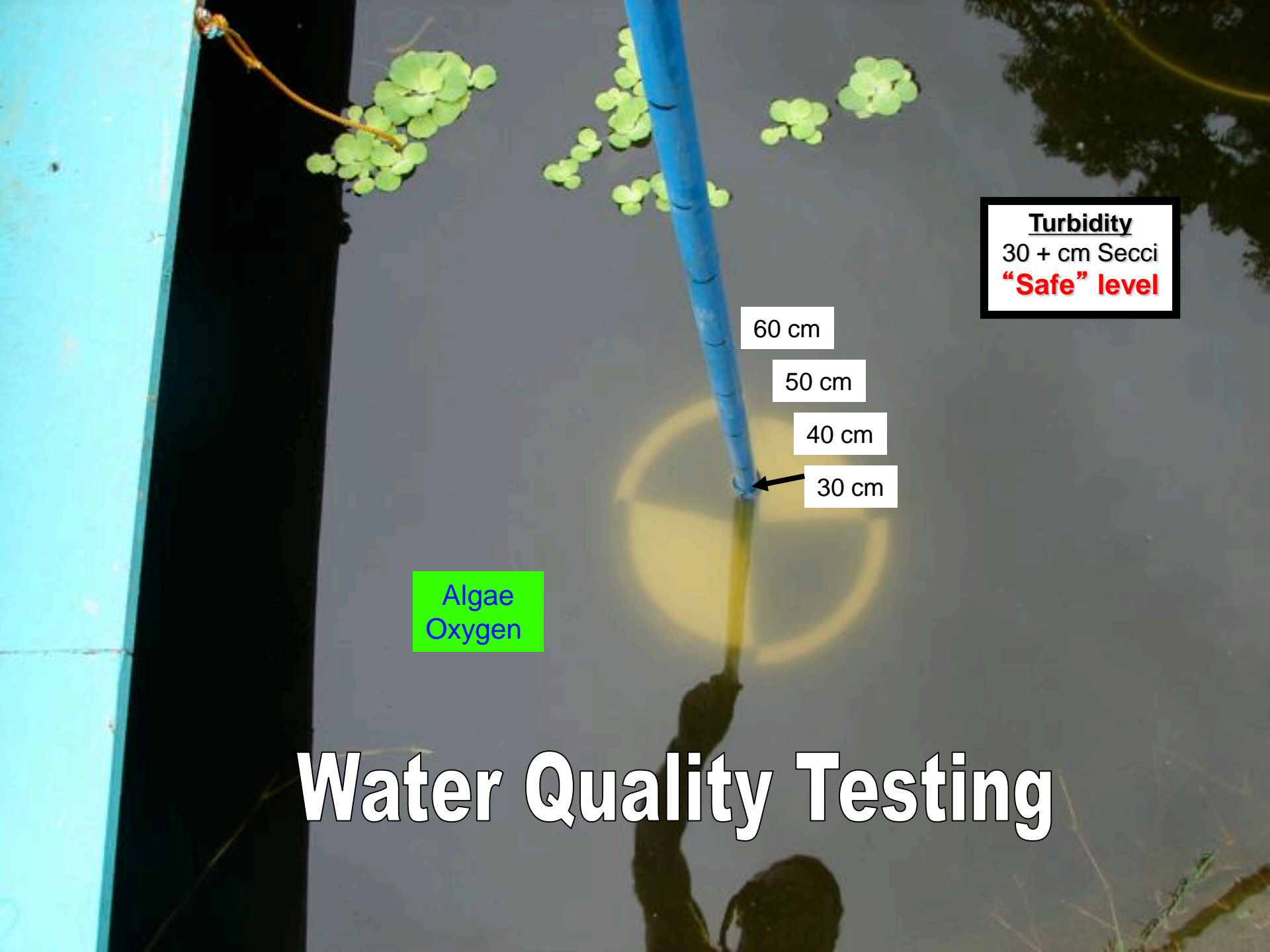
50 cm

40 cm

30 cm

Algae
Oxygen

Water Quality Testing





Turbidity is established when contrast is lost between white and black

60 cm

50 cm

40 cm

30 cm

Turbidity
60 + cm Secci

Turbidity
30 + cm Secci
“Safe” level

Water Quality Testing

A rooftop garden setup featuring numerous white bags of soil arranged on a concrete surface. In the background, there is a blue metal table. The scene is brightly lit, suggesting an outdoor or well-lit indoor environment. The bags are filled with dark, rich soil, and some have text printed on them, including 'PHILIPPINE TUFF CEMENT' and 'WHITENED CEMENT TYPE II'.

The City Farmer

Rooftop Plantation
Herbal Production

A photograph of a rooftop herb garden. The plants are growing in white sacks, some labeled 'APO', arranged in rows on a concrete surface. The garden is covered by a transparent polytunnel structure. In the background, there is a building with a blue tarp and a red roof, and a view of a green landscape under a blue sky.

The City Farmer

Rooftop Plantation
Herbal Production

A rooftop greenhouse structure with a white plastic covering and a metal frame. Inside, numerous plants are growing in white and brown fabric bags and pots. The plants include large-leafed green herbs and tall, thin stalks. In the background, a blue tarp is draped over a structure, and a red-tiled roof is visible. The scene is set on a rooftop with a view of a city and hills in the distance.

The City Farmer

Rooftop Plantation
Herbal Production

A photograph of a rooftop garden. In the foreground, several rows of hanging pots are suspended from a metal frame. The pots are filled with lush green herbs, including leafy greens and what appears to be basil. The pots are in shades of red, orange, and teal. In the background, more plants are visible, and a view of a city or landscape can be seen through the railing. The overall scene is bright and green, suggesting a healthy and productive urban farming environment.

The City Farmer

Hanging plants
Maximize space

Rooftop Plantation
Hanging Plants
Herbal Production



The City Farmer

**Aloha Garden
Tower**

Vertical Food Production

A vertical garden tower constructed from blue plastic barrels. The barrels are stacked and have multiple holes cut into their sides. Various types of lettuce, including green and purple varieties, are growing out of these holes. The tower is situated on a concrete surface, and a white corrugated metal structure is visible in the background.

The City Farmer

**Aloha Garden
Tower**

Vertical Food Production

The City Farmer

**Aloha Garden
Tower**

Vertical Food Production





The City Farmer

**Aloha Garden
Tower**

Vertical Food Production

The City Farmer



**Aloha Garden
Tower**

Vertical Food Production

Aloha Garden Tower ©

The City Farmer



**Aloha Garden
Tower**

Vertical Food Production



Aloha Garden Tower

Vertical Food Production



**Aloha Garden
Tower**



Aloha Garden Tower

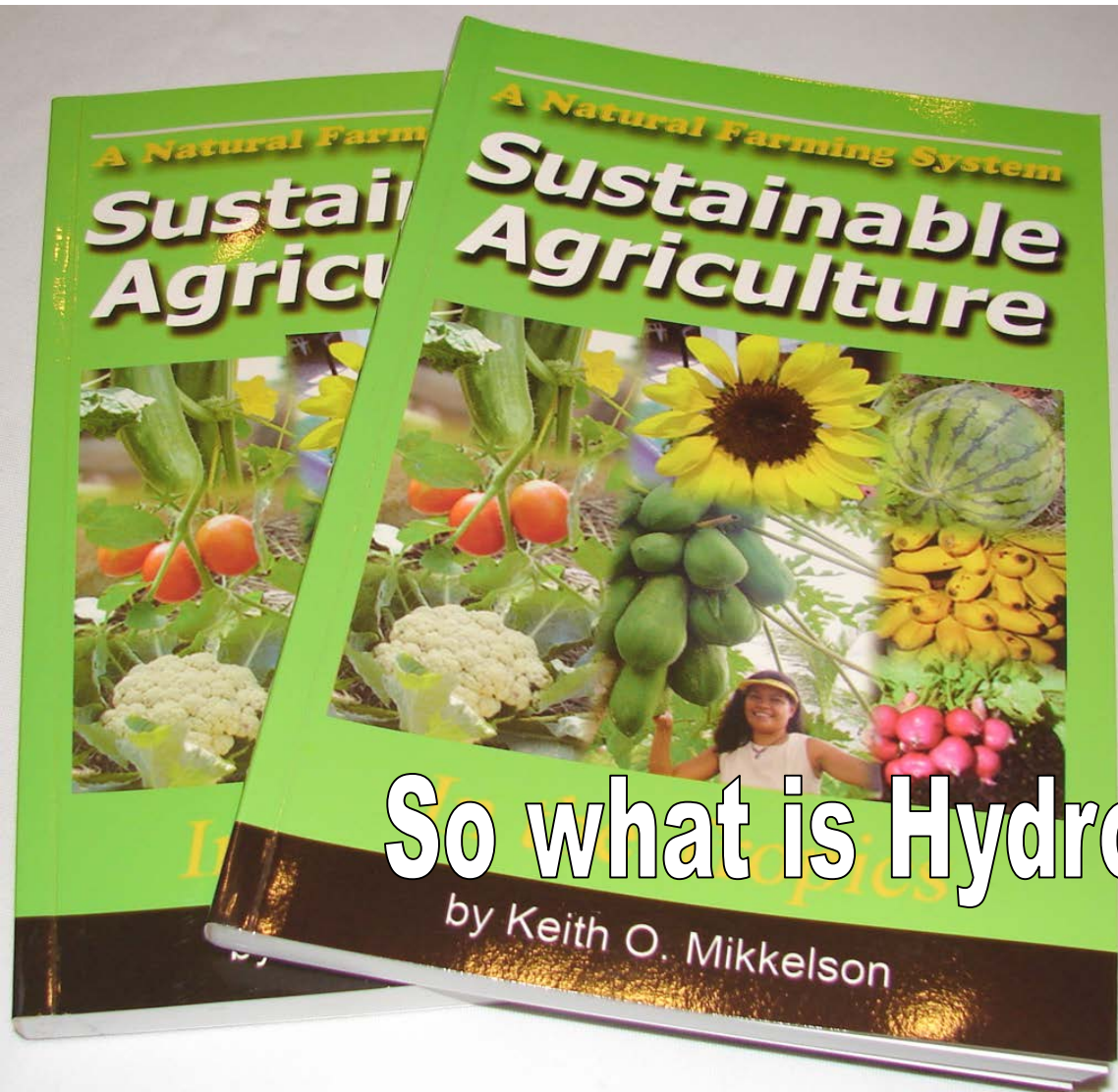
Vertical Food Production



Aloha Garden Tower

Vertical Food Production

RESOURCE RECOVERY FOR THE PRODUCTION OF HIGH QUALITY NUTRIENT DENSE FOOD AND MAXIMUM HEALTH



**A Natural Farming Method for
Sustainable Agriculture
in the Tropics**

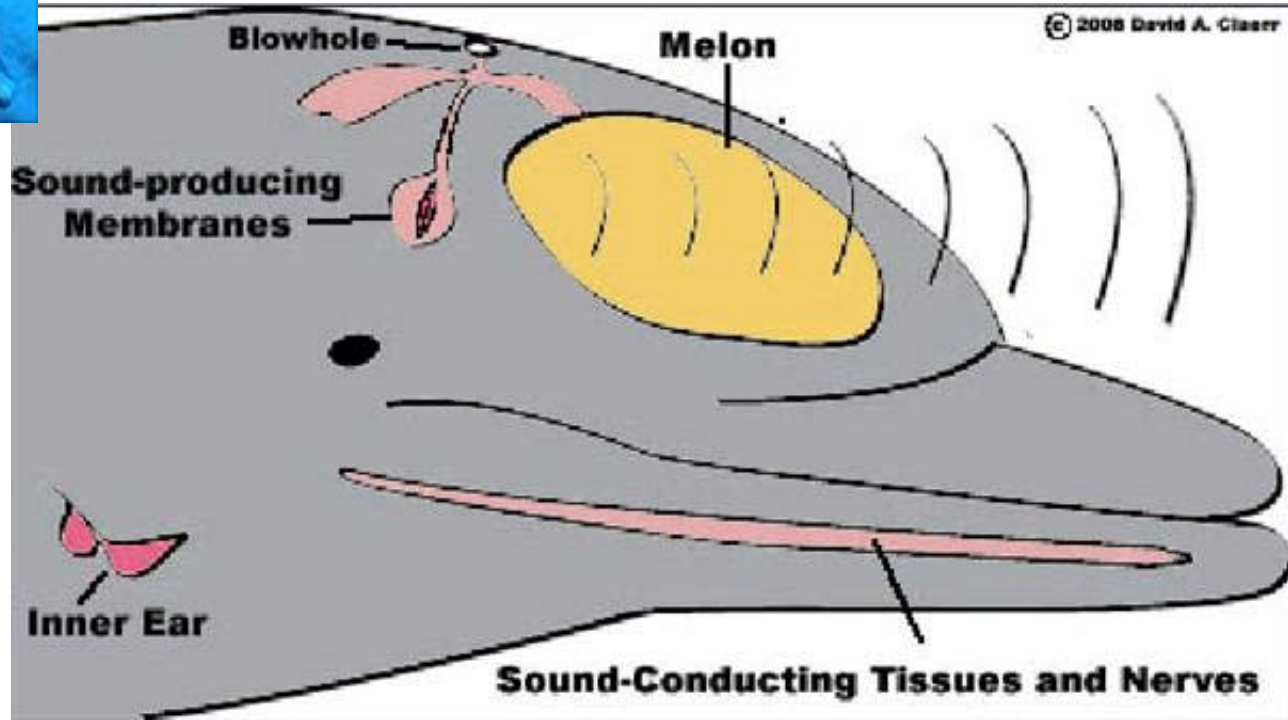
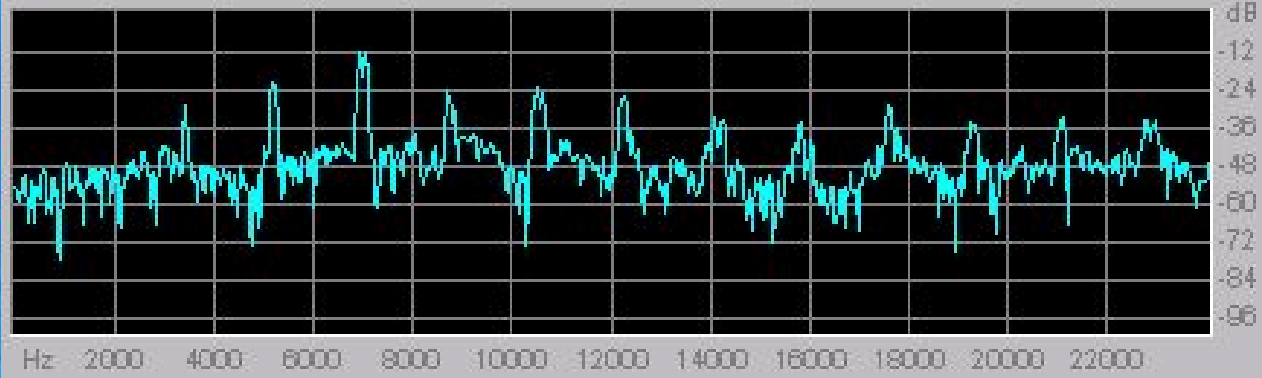
By Keith O. Mikkelson

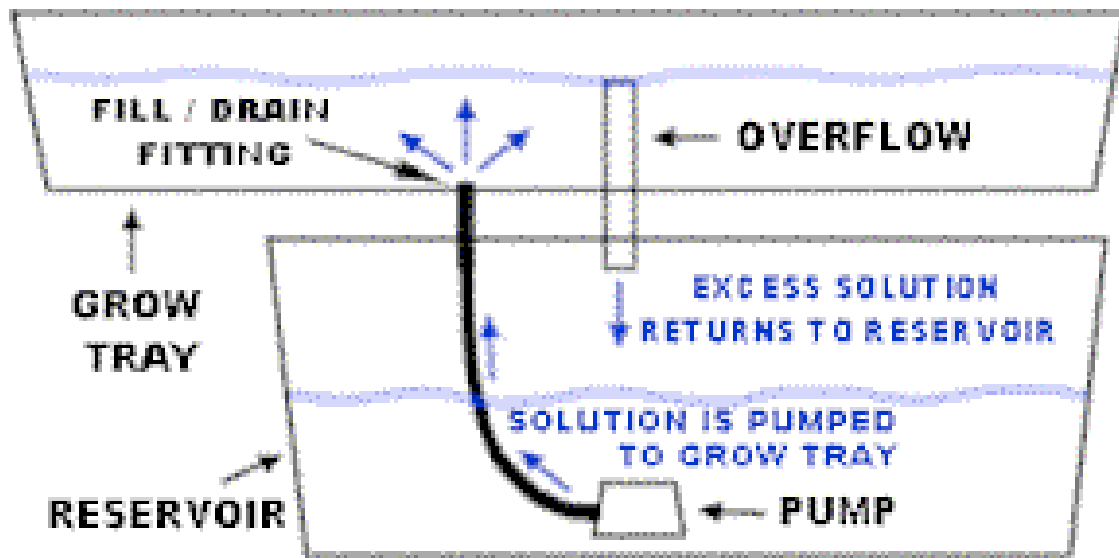
mik@mozcom.com

So what is Hydroponics?

by Keith O. Mikkelson

Hydrophonics





FLOOD / FLOW CYCLE (PUMP ON)



Hydroponics usually is a soil-less growing technology for fruits and vegetables using water and soluble fertilizers

Types of Hydroponics



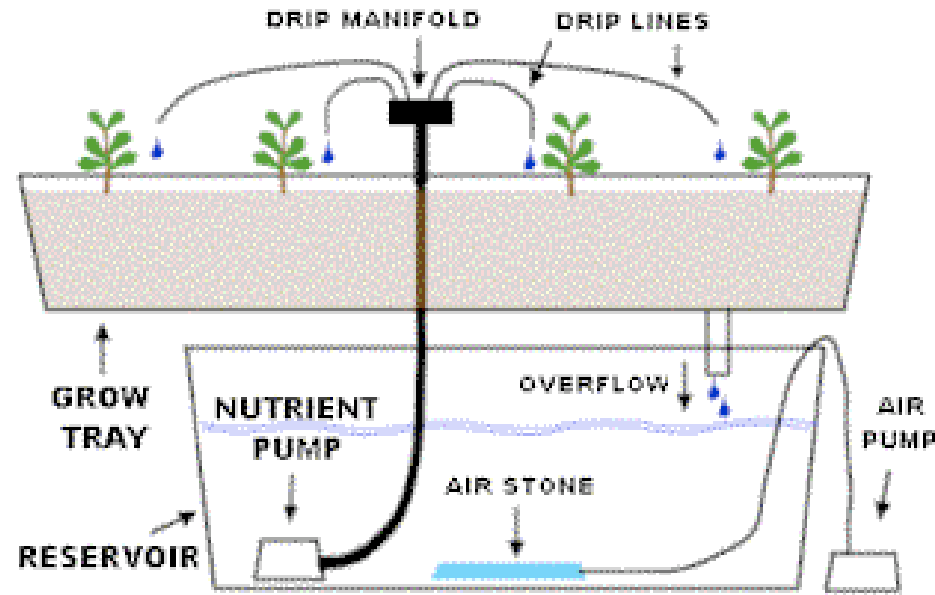
WICK SYSTEM

WATER CULTURE

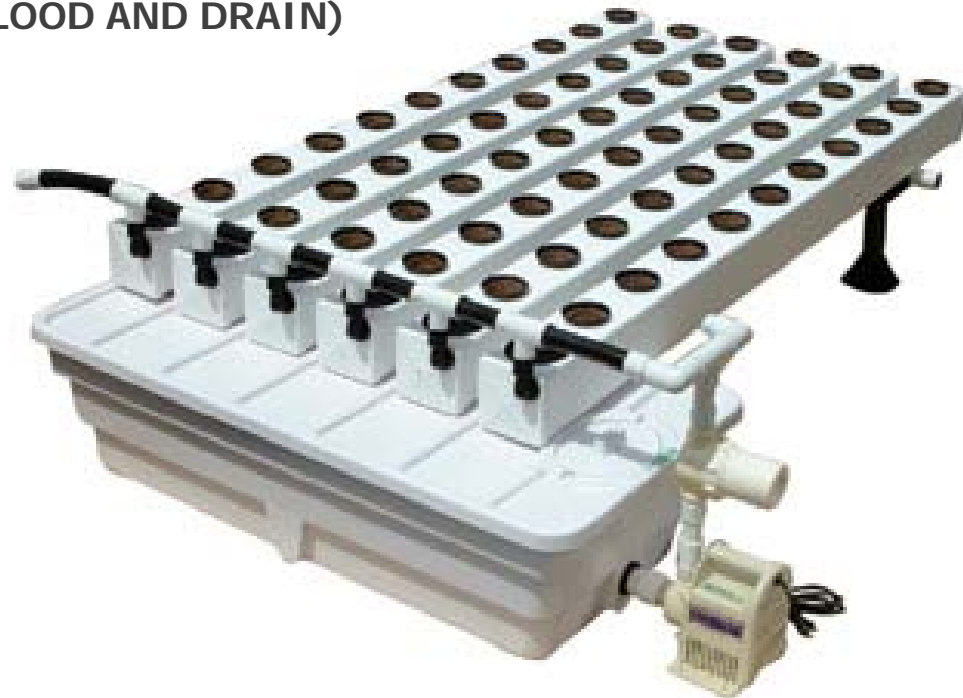
AEROPONIC

DRIP SYSTEMS
RECOVERY / NON-RECOVERY

N.F.T.
(Nutrient Film Technique)



EBB & FLOW - (FLOOD AND DRAIN)



Criticism of Hydroponics

1. Technologically Advanced
2. Management Intensive
3. Can you find a system in operation for over 1 year?
4. How about 5 years old?
5. Often Exotic Imported Mediums
6. Nutritionally lacking...



MEDIUMS: The seedling / plants are not placed into the soil. Instead alternative natural medium from mother earth is used as described below. The medium once used can be returned back into the recycling system of nature. and after the medium is returned back into the earth recycling system it also becomes environmentally friendly.

Rock Wool: This is made from Basalt rock (volcanic rock) which when **heated to over 1600 deg** it goes back to its original formation as volcanic lava. It is then **spun in a chamber** that creates fine light weight fibers. Rock wool is ideal for hydroponics as it retains excellent water as well as helping towards supplying oxygen to the roots of the plants via their loose fiber. Rock wool is also recyclable.

Organic Potting Mix: This potting mix is **imported in from Europe**. The P.H level has been adjusted to a neutral level with limestone. 98% certified as Organic. This potting mix is widely used throughout their herb range.

Coco Coir: Friendly Coco Coir Peat is the coir fiber pith **produced as a bi-product** when coconut husks are processed for the extraction of long fibers from the husk. Coco Coir Peat is the binding material that comes from the fiber fraction of the coconut husk. It can hold up to 8 times its own weight in water.

Perlite: is a naturally occurring siliceous rock when **heated** to an appropriate temperature it expands up to 20 times its original size. It is light weight, sterile non-toxic.

Criticism of Hydroponics

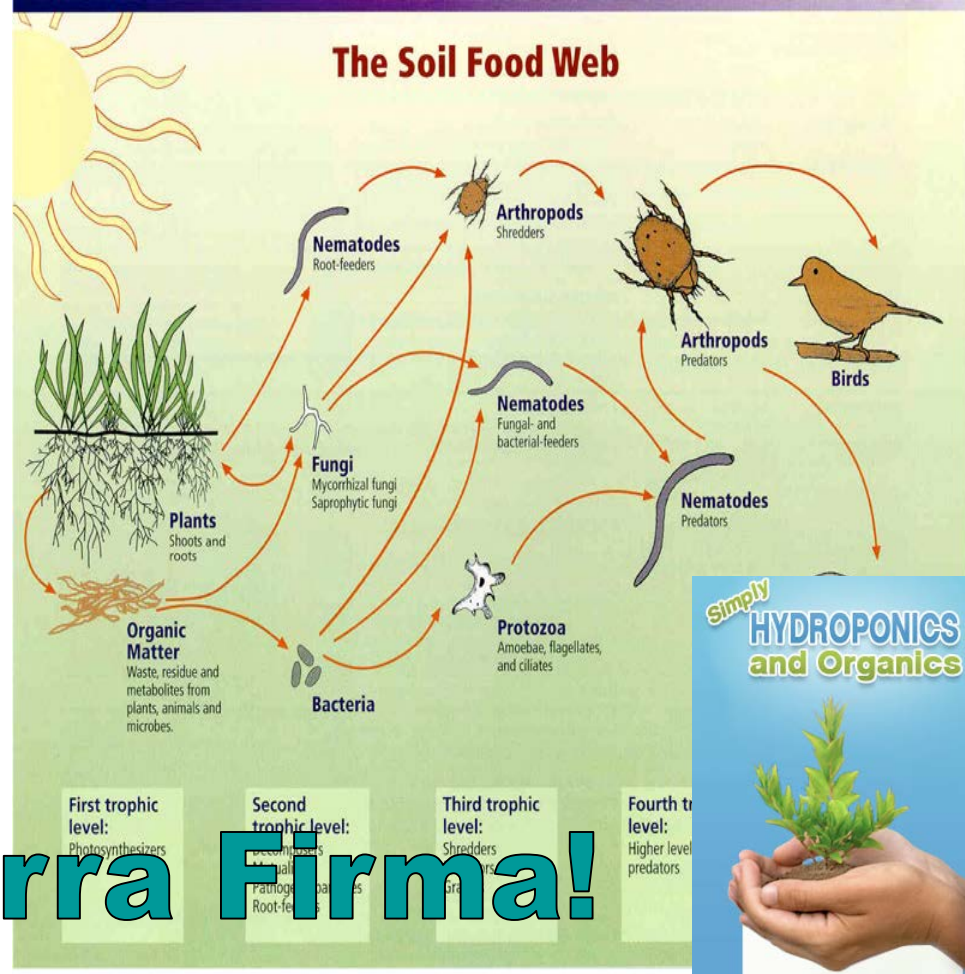
1. Technologically Advanced
2. Management Intensive
3. Can you find a system in operation over 1 year?
4. How about 5 years old?
5. Often Exotic Imported Mediums
6. Nutritionally lacking...

Nutritional proof lacking: Claims only

With intensive use:

Water gets worse not better...

Soil gets better, not worse

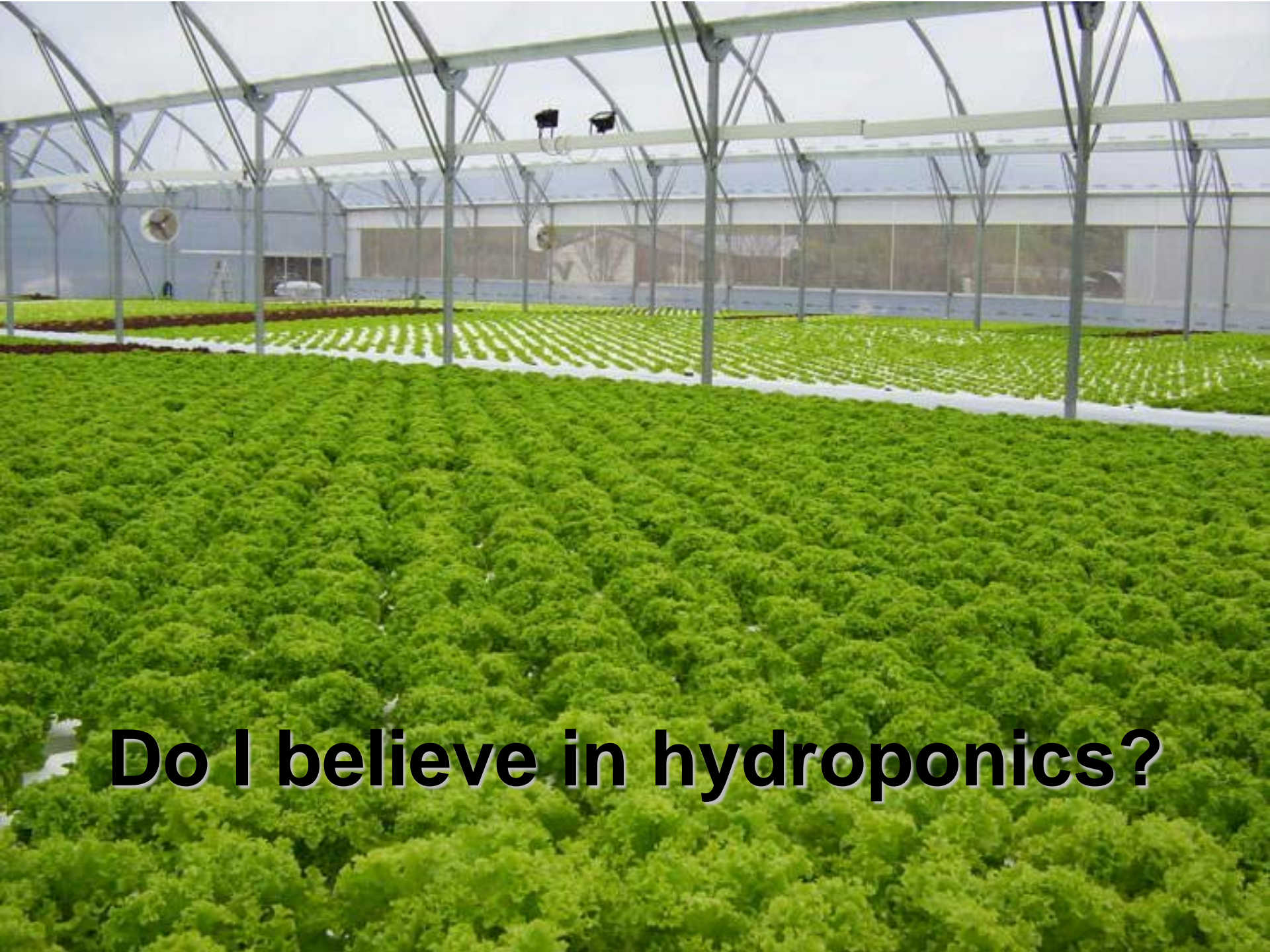


Terra Firma!

Hydroponic Farming Eliminates The Soil

	Traditional Farming	Emirates Hydroponics Farms	Water saving / kg yield
Lettuces	320 Gallons	10 Gallons	310 Gallons
Tomatoes	360 Gallons	12 gallons	348 Gallons
Strawberries	370 Gallons	54 Gallons	316 Gallons

Then God said, "**Let the land produce vegetation:** seed-bearing **plants and trees on the land** that bear fruit with seed in it, according to their various kinds." And it was so. **12 The land produced vegetation:** plants bearing seed according to their kinds and trees bearing fruit with seed in it according to their kinds. **And God saw that it was good. 13** And there was evening, and there was morning, the third day.



Do I believe in hydroponics?



Do I believe in hydroponics?

Why not?

God invented it...

...it's called seaweed, kelp and algae!

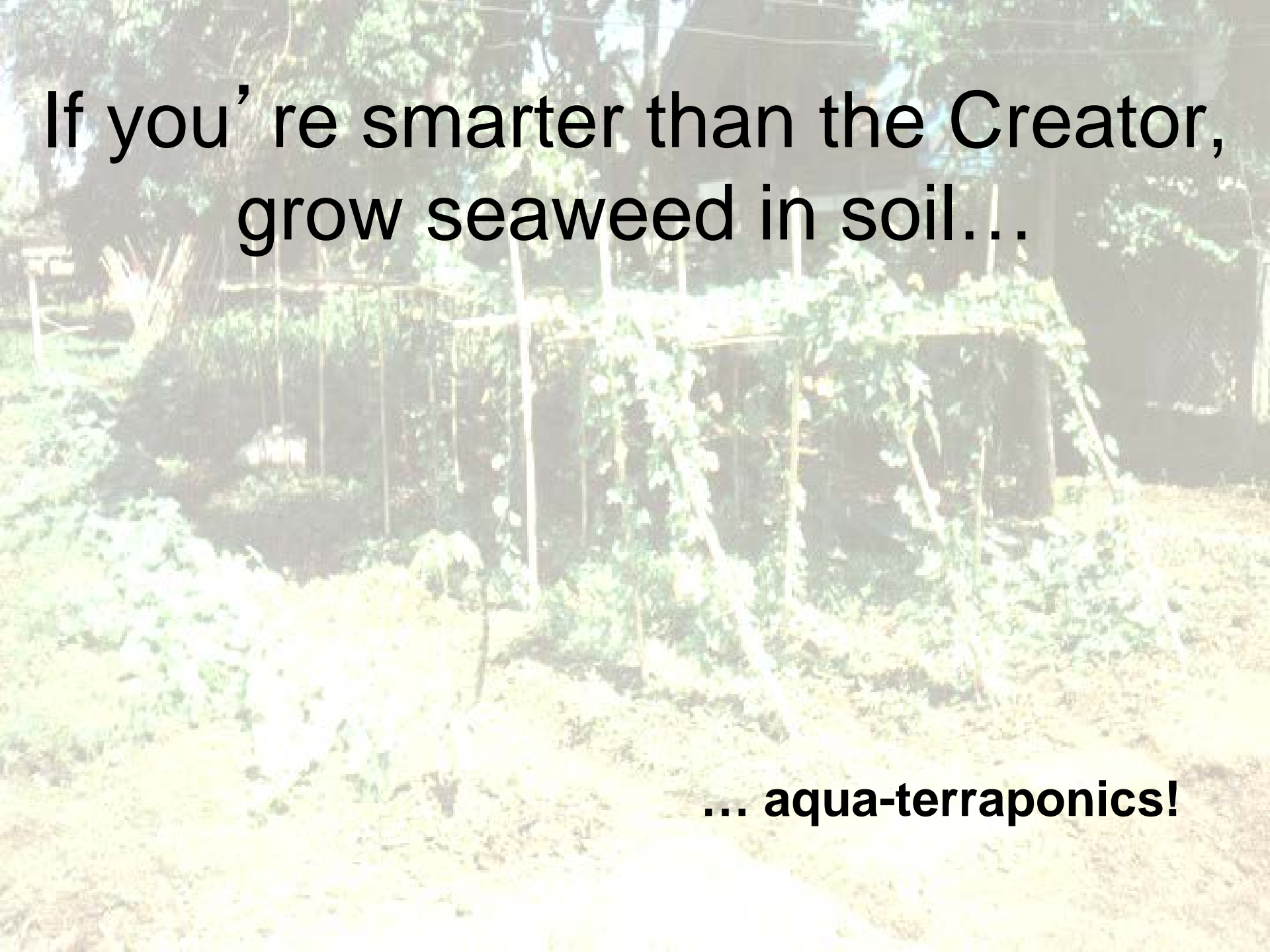


...Azolla, the floating fern, lotus, lily, hyacinth...

A large circular pond with a bamboo frame structure. The pond is filled with water and contains various aquatic plants, including a dense patch of bright green Azolla (floating fern) in the upper left, a large area of dark green hyacinth in the lower right, and a central area with lotus and lily plants. The pond is surrounded by a white tiled wall with a blue decorative border. The text "Designed to live in water!" is overlaid in the upper center.

**Designed to
live in water!**

...Azolla, the floating fern, lotus, lily, hyacinth...

A photograph of a garden with a trellis structure covered in green plants, likely seaweed, growing in soil. The background shows a dark building and trees.

If you're smarter than the Creator,
grow seaweed in soil...

... aqua-terraponics!

Commercial Systems

The image shows the interior of a large, arched commercial greenhouse. The structure is built with a metal frame and covered with a translucent material. The floor is covered with wooden planks. In the center, there are several long, narrow wooden grow beds arranged in rows. The beds are supported by wooden posts. In the background, there is a wooden wall with a door and some equipment, including a large white pipe and a fan. The overall appearance is that of a well-maintained, professional hydroponic growing facility.

2: Upper grow beds

1: UVA grow beds

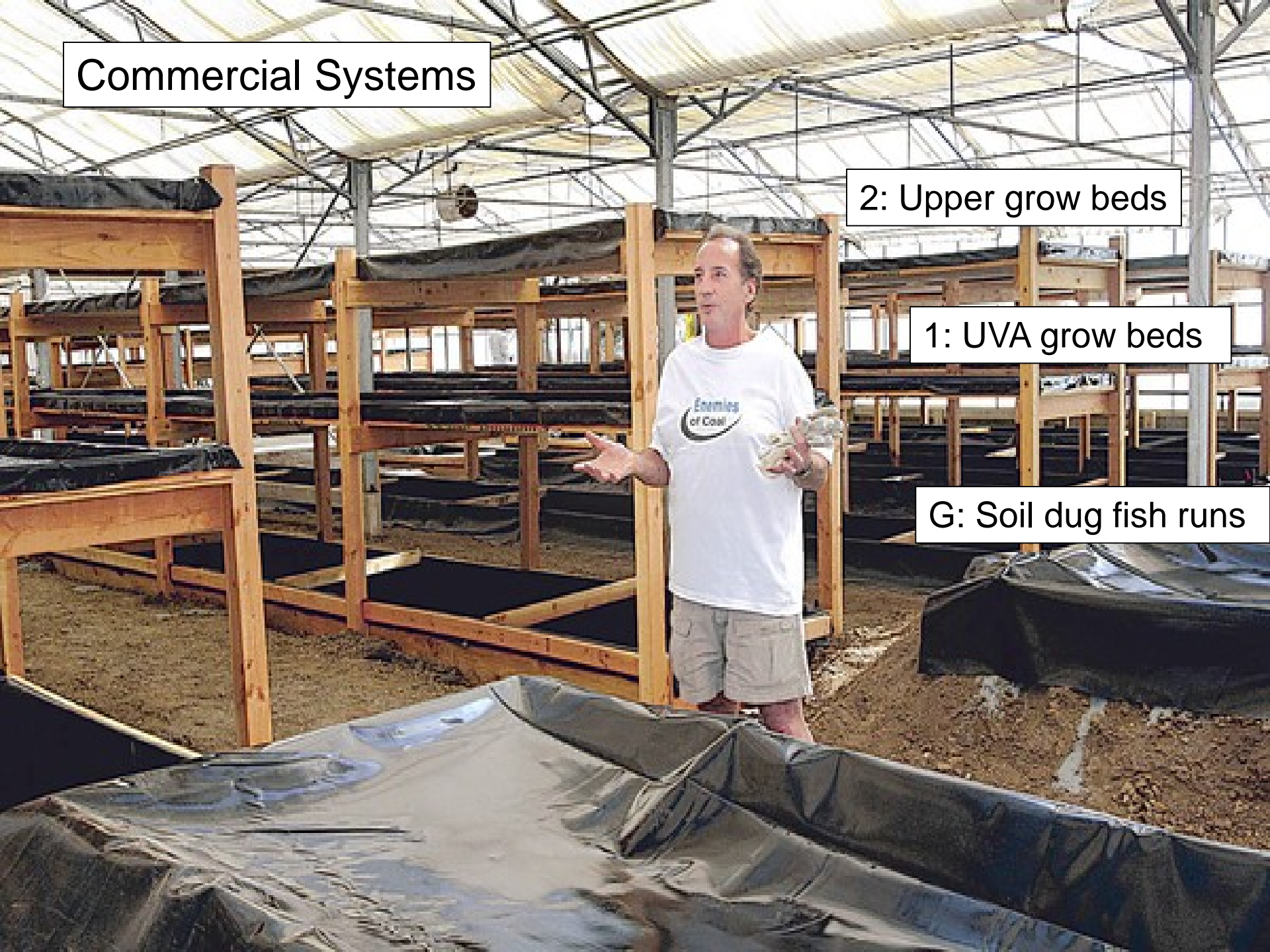
G: Soil dug fish runs

Commercial Systems

2: Upper grow beds

1: UVA grow beds

G: Soil dug fish runs



Commercial Systems



Commercial Systems



Commercial Systems



Low calorie Protein

Excellent source of Phosphorus,
Niacin, Selenium and Vit. B12

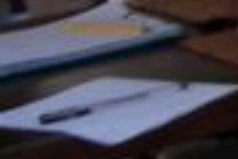
Good source of Potassium

Low in Fat

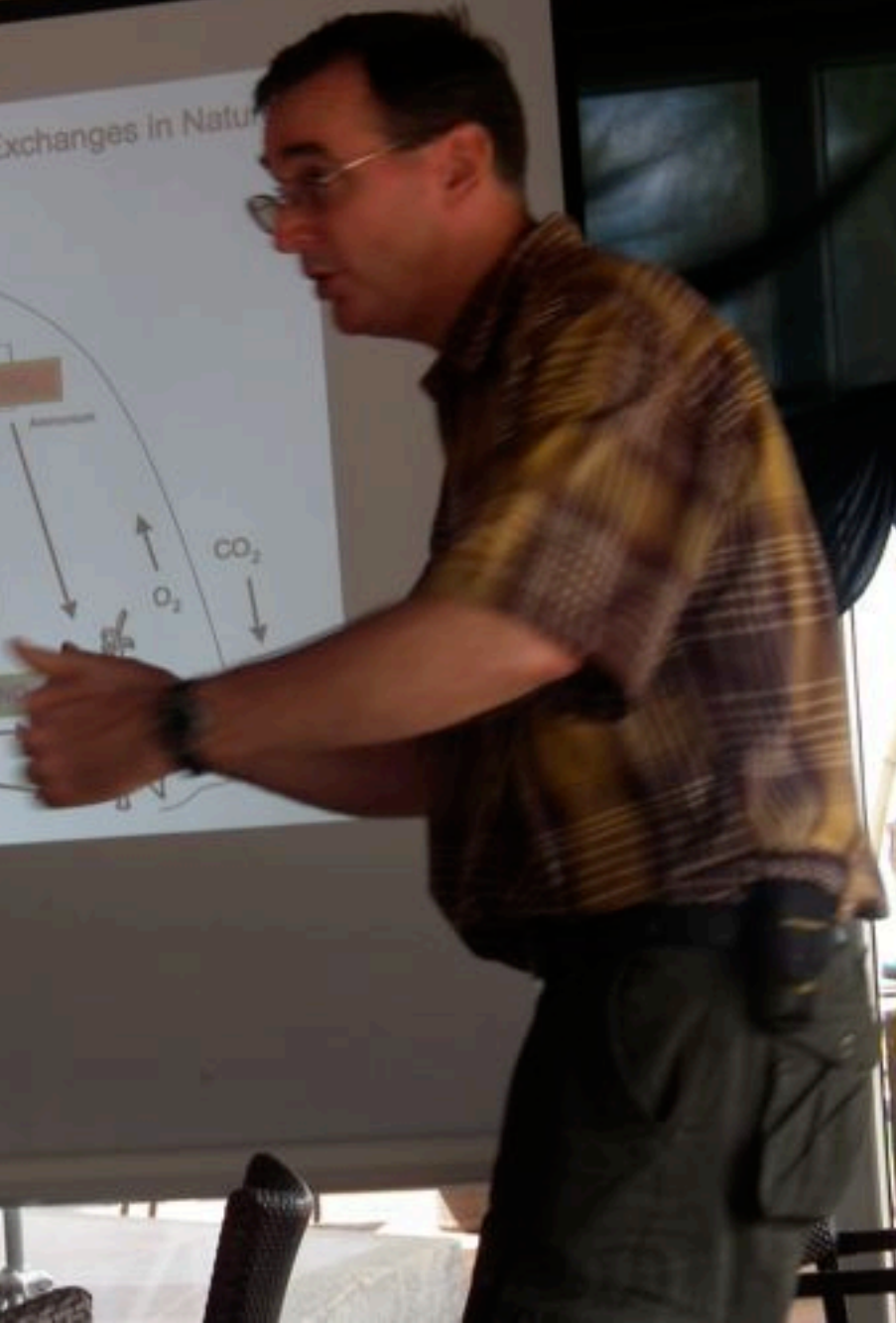
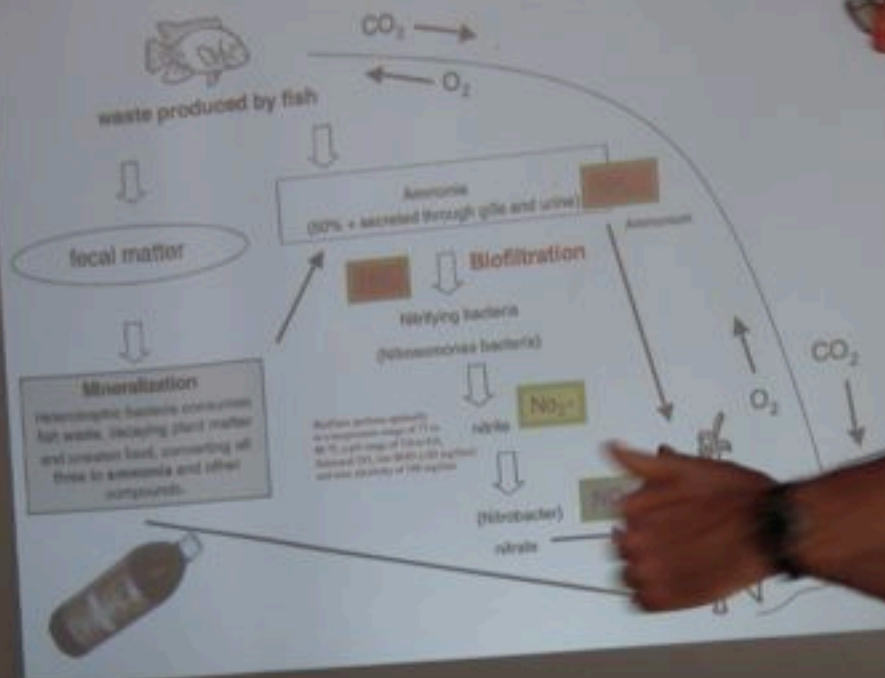
Toxin-free







Some Nutrient Exchanges in Nature





















Whoops...

Consultant

General Manager

Chief Engineer

Commercial Systems

Murray Hallams
Practical
Aquaponics



\$6,000.00

Grow Fish & Plants Together..

Practical
AQUAPONICS
for Everyone.



Single family size

- One lettuce tray (1.2 X 2.4 m)
- One fish tank (200 L)
- One small air pump
- Shade cloth

Other designs are permissible as long as the basic specifications are followed. In this instance fish are under the plants, water flows constantly, etc.



Specifications

- Water transfer, manual
- Fish biomass, about 2.5 kg
- Daily feed, 40-59 g
- Iron chelate, 0.25 g/week
- 1.4 heads lettuce/day; 1.8 kg tilapia/10 weeks
- Cost, 250 USD



Micro-farm size

Components

- 8 linked lettuce trays
- one 1600 L fish tank
- one air blower
- water pump
- Shade cloth (50%)

Specifications

- stock about 19.2 kg of fish
- feed 0.32-0.47 kg/day
- iron chelate 2 g/week
- annual production, 3300 heads of lettuce and 75 kg tilapia
- annual income about 8600 USD at Hawaii farm gate prices...**ratio of lettuce to fish income**
- cost of construction, 2500 USD



Small farm, 0.1 hectare

Components

- equivalent of 270 lettuce trays
- 54,000 L in tanks
- air blower
- recirculate water with a water pump

Specifications

- stock about 648 kg of fish
- daily feed, 11-16 kg
- annual production, 112,000 heads of lettuce, 2,500 kg tilapia
- Income 234,000 USD/year
- Cost, <80,000 USD

Cost: P40,000,000/h



Thai Style Systems



Above:-

The walls are going up under the strict supervision of the head brickie, also known as 'she who must be obeyed'.



To the left of the grow bed is the submersible pump that we will use temporarily to flood the beds. I am in the process building a bicycle powered pump, a solar pump and a Servonius rotor pump. We will try these out to see which option works best for us.

Home Systems



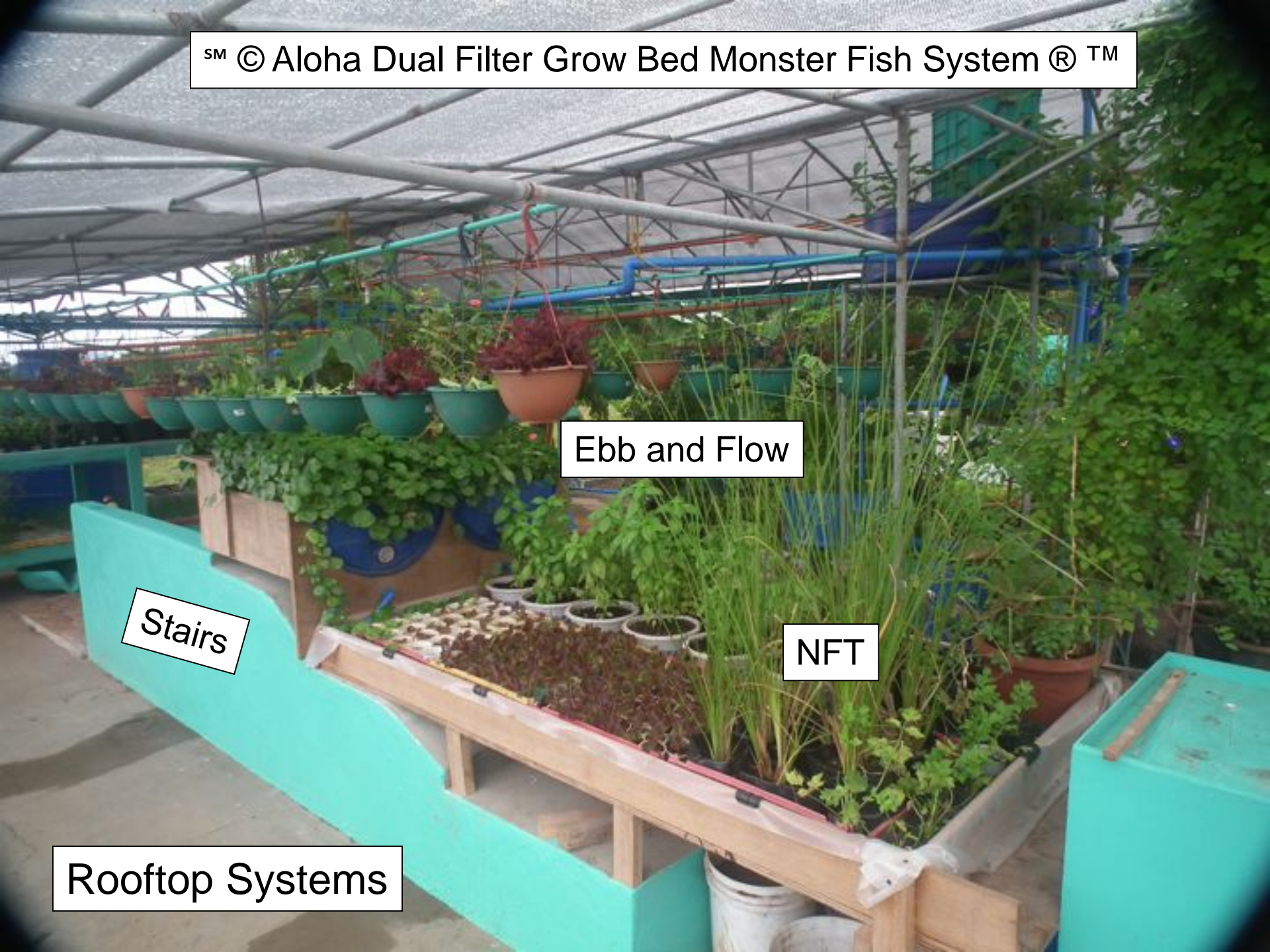
SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM

Ebb and Flow

Stairs

NFT

Rooftop Systems

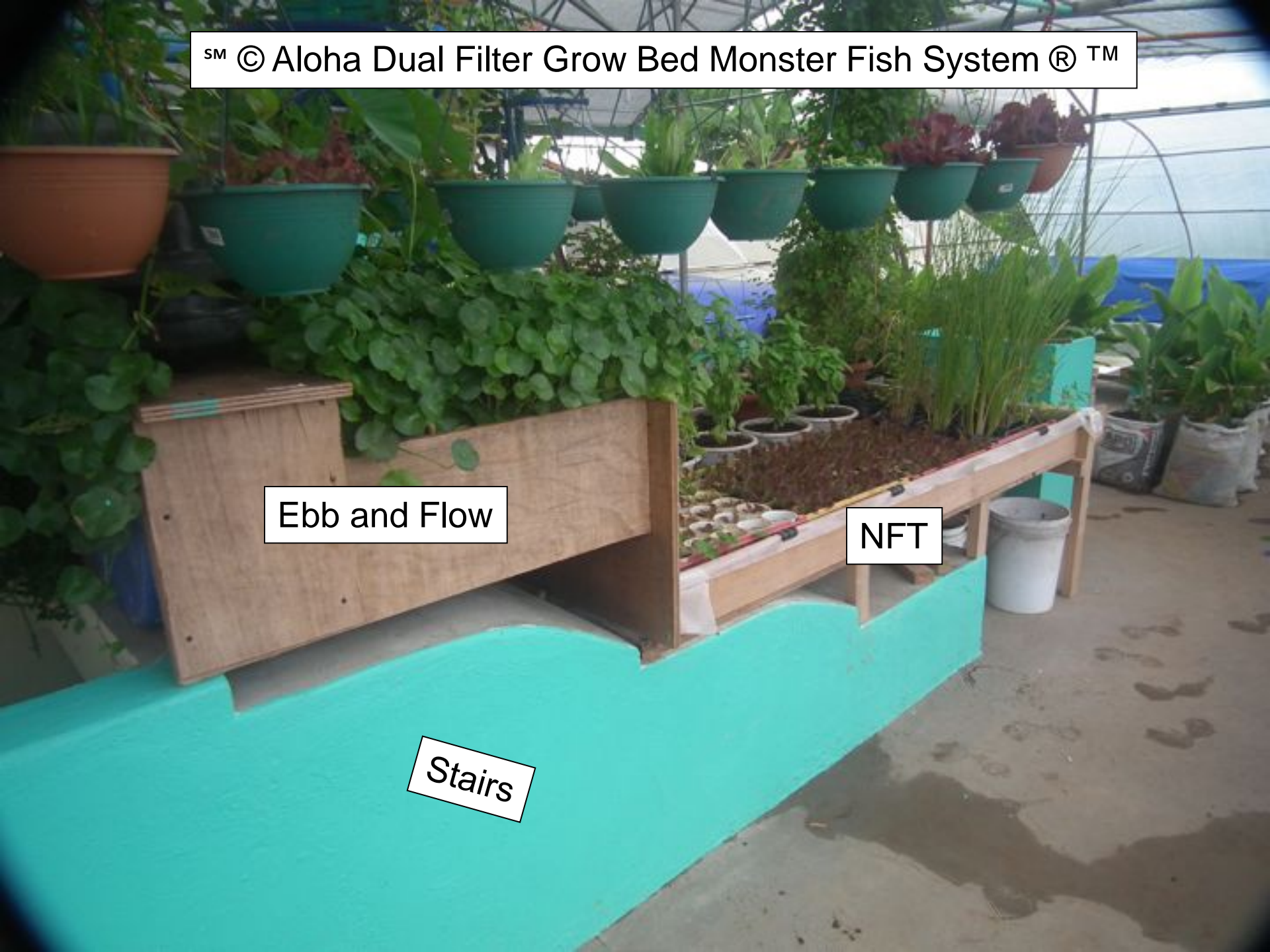


SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM

Ebb and Flow

NFT

Stairs



SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM

CHOPS
w/ venturi

Four 300 L grow out tanks
250 L water X 4 = 1,000 L
minimum

ENTER Stocking rate	plant grow area m ²	4' x 8' (3m ²) beds	pond volume in liters	Pump Size @ 10' in hp
260	5.9	2	988	0.04

Minimum system



SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM



SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM



SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM



SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM





SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM



SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM

SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM



SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM



SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM



SM © Aloha Dual Filter Grow Bed Monster Fish System ® TM



Don't start with tomatoes

A large yellow plastic tub is filled with a mix of green and red chili peppers. The green peppers are the majority, interspersed with several bright red ones. The tub is placed on a light blue tiled floor. In the background, there are some green plastic bowls and a wooden cutting board.

Thank You!

Planning your system

Location: _____ Climate: _____ Day length: _____ hrs

Farm Area: _____ ft² / m²

Fish supplier:

Water source:

Economical non toxic feed:

Staffing:

Bed construction:

Pump sizing:

Filter medium:

Cultivar selection:

Aeration:

Tank sources:

Plumbing:





