

BOOTSTRAPPING AQUACULTURE FROM PRODUCTION TO MARKETING IN DEVELOPING NATIONS

A Case Example from Liberia

by

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What do you do when you want to raise and sell fish, you have little money and there are few supplies/equipment you can buy even if you did?

- ~ 1. Pond?
- ~ 2. Species?
- ~ 3. Spawning?
- ~ 4. Feeding?
- ~ 5. Value added?

Building a Pond

- ~ US Peace Corps came to Liberia in the 1980's, taught fish farmers how to build fish ponds, but for tilapia, not catfish.

Tilapia Pond



African Catfish Pond



Species? Nile Tilapia?



Species? Blue Tilapia?

(not native but widely available in Liberia)



Spawning Tilapia?

- Spawning is easy, stopping them from spawning is hard.



Tilapia Birth Control

- ~ Hand sexing for all males can be tough, easier as the fish get bigger or as skill improves.



Paint, verify, practice until ink not required on increasingly smaller fish



Tilapia All-Male Hybrids - Male Blue x Female Nile

- ~ Can be effective, but requires separate gender, species broodstock ponds, etc.
- ~ Co-operatives allow some people to produce fingerlings, and some growout food fish.

Tilapia All-Male Hybrids Using Methyltestosterone

- ~ Too expensive for individual small scale farmers
- ~ Would have to be imported
- ~ A larger co-op could pull it off, with one farmer producing fingerlings and selling to grow-out farmers
- ~ Long range problem would be selling to EU, but local demand would put that in the distant future.

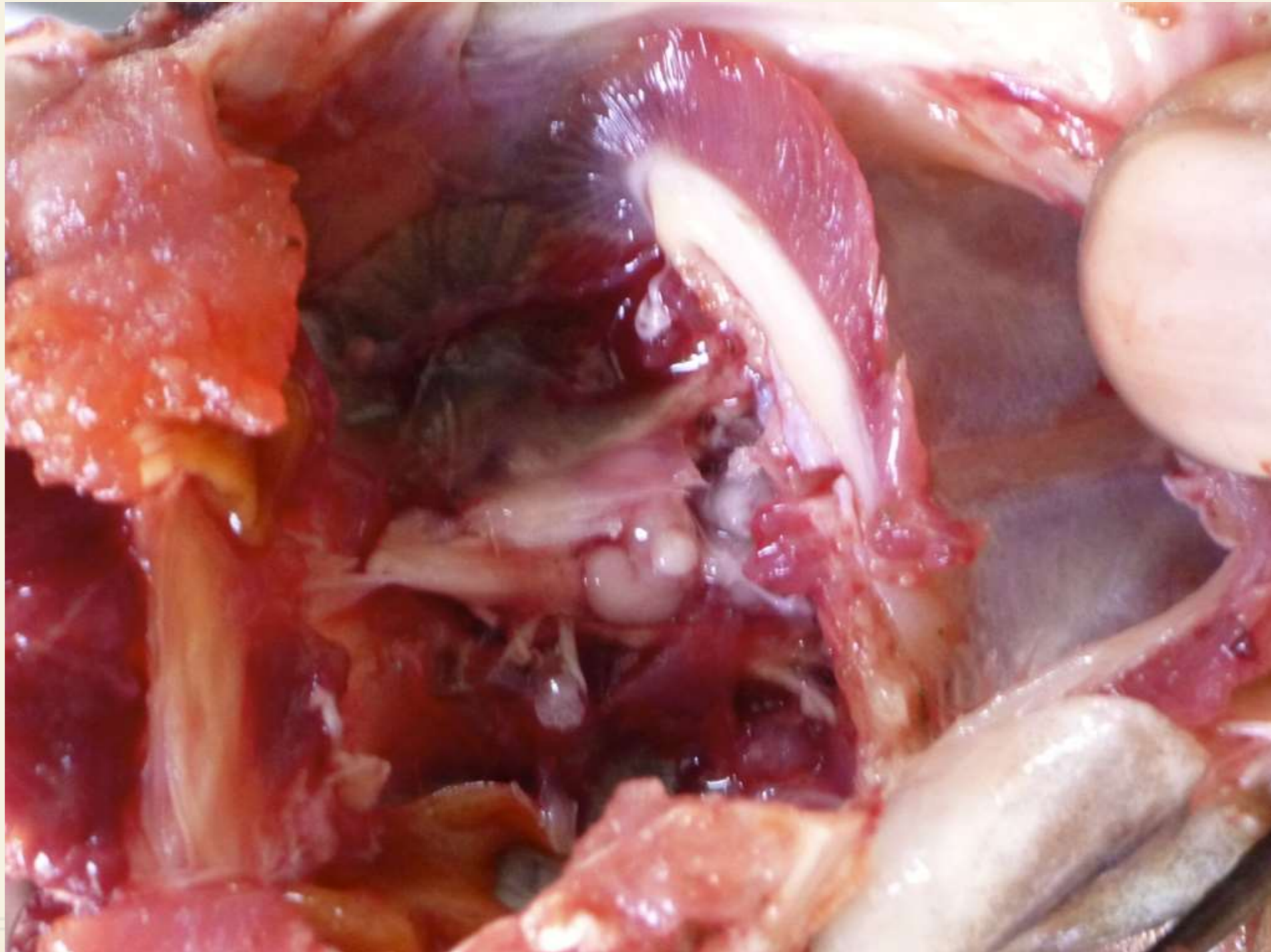
African Sharptooth Catfish

- ~ High demand = good.
- ~ Not interested in spawning in ponds without “encouragement” = bad.
- ~ Carnivores higher on the trophic scale demand higher quality feed = difficult.

Artificial Hormones

- ~ Not locally available in Liberia

**Not Too Hard to Find the Pituitary,
all needed materials are locally available**



Augustine Moore

- Went from \$50US to \$5,000 US annually from fish sales



Spawning Female



Cutting Testes for Sperm

(consider a garlic press if you can find it)



Adding Eggs to Incubation Tray



Water lettuce - floats fry swim away,
must be insect free



Catfish Larvae to Fingerling

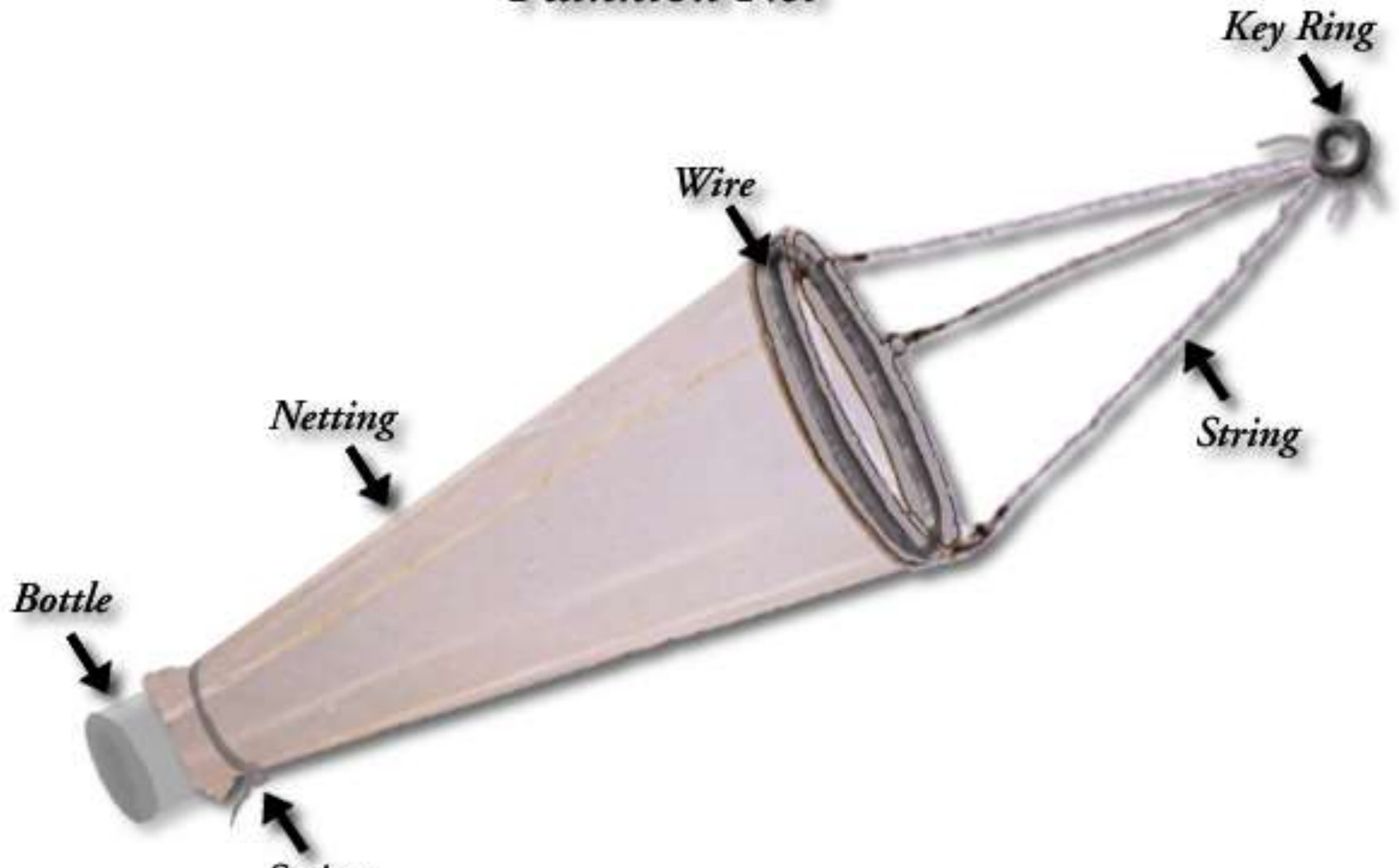
- ~ Trickier than tilapia fry to fingerling.
- ~ There are ways to concentrate and harvest rotifers and zooplankton from fertilized ponds (e.g. homemade plankton net) to supply nursery ponds
- ~ Concrete nursery tanks are better than earthen ponds, easier to feed chicken egg yolk, dried blood, brine shrimp (but these need to be imported)
- ~ Co-op divides farmers into fingerling producers and grow-out farmers

First Feeding

- *Artemia* may be purchased (not very practical for Liberia) - follow directions to hatch eggs OR
- Sieve green pond water through window screen to remove insects then add directly to rearing container or filter water through cloth and scrap filtrate into container - provides necessary zooplankton OR.
- Create bloom in earthen pond through fertilization.

supercharged Science

Plankton Net



Feeding Tilapia

- ~ Subsistence farmers fertilize ponds with garden wastes, high-nitrogen leaves, manure.
- ~ Better results with all males
- ~ Better results with stakes for periphyton
- ~ Better results with food.

Feeding Catfish

- ~ Predator fish, not worth it without food.
- ~ Higher protein needs than tilapia

Feed References

- ~ El-Sayed, A.-F. M. 2006. Tilapia Culture. CABI Publishing. Oxfordshire, UK/Cambridge, MA, USA.
- ~ Hertrampf, J. W. and F. Piedad-Pascual. 2000. Handbook on Ingredients for Aquaculture Feeds. Kluwer Academic Publishers. Dordrecht, The Netherlands.
- ~ Lim, C., C. D. Webster and C-S. Lee (Eds.). 2008. Alternative Protein Sources in Aquaculture Diets. The Haworth Press. New York and London.
- ~ **Stadlmyr, B. et al. 2012. West African Food Composition Table. Food and Agriculture Organization of the United Nations. Rome.**
- ~ Webster, C. D., and C. E. Lim (Eds.). 2002. Nutrient Requirements and Feeding of Finfish for Aquaculture. CABI Publishing. Oxon, UK/New York, USA.

No Feed Mills. What to Do?

- ~ A few commonly ingredients, like rice bran, are available in Liberia and wheat bran is fairly inexpensive to buy.
- ~ Some traditional ingredients of tilapia and catfish feeds are available, but more important for human food.

Get a Grinder

- ~ Locally available meat grinders are about \$25 US in Kakata, Liberia (avoid using rice bran as it ruins the die)

Focus on Unused but Valuable Wastes

- ~ Blood and other wastes from abbatoirs, co-ops help get for everyone.
- ~ Brewers grains available in Monrovia, co-ops can organize to get enough up-country for everyone.
- ~ Cooked chicken entrails
- ~ Some high-nitrogen (green finger) garden wastes

Blood Meal

- ~ Positive effects to 5%, pathological effects at 17.5% in salmon
- ~ Recommend 5% for juveniles, to 10% for adults Nile tilapia, no more than 50% of protein coming from blood.
- ~ 52% blood meal + 32% algae meal better for *Clarias lazera* than either alone

Brewer's Grains available in Monrovia, acquired through co-op

- ~ Dry-matter - 92.3%
- ~ Crude Protein - 25.9%
- ~ Crude fat - 7.0%
- ~ Ash - 4.3%
- ~ Crude fiber - 14.4%
- ~ N-free extract - 44.5%

Brewer's Grains in Diet

- ~ African catfish (*Clarias gariepinus*) 10%
- ~ *Tilapia discolor* 12 - 19%
- ~ Recommended 10 - 15%
- ~ **Pelletizing ability low, lessens water durability
- ~ **Cost/kg of tilapia produced better than for fish meal.

Nile Tilapia Supplemental Feeds

- ~ Rice bran
- ~ Maize meal
- ~ Copra meal
- ~ Coffee pulp
- ~ Brewery by-products

Palm Kernel Meal

- ~ 15 - 18% crude protein (20 - 25% if from Nigeria)
- ~ Deficient in lysine and methionine
- ~ Fiber high
- ~ Ca:P ration good
- ~ Good source of manganese
- ~ More suitable for extensive farming and herbivorous fish (5 - 10%) dt high fiber than carnivorous fish (3 - 8%)
- ~ Tilapia prefer dark or red feed, so should be attracted to it
- ~ Otherwise may be discarded from local oil production.

Palm Kernel Meal

- ~ Water - 13.5
- ~ Protein - 6.1
- ~ Fat - 55.3
- ~ Carbohydrate - 19.6
- ~ Fiber - 4.0
- ~ Ash - 1.5

Maize

- ~ Energy food
- ~ Maize meal has a high pelletizing ability
- ~ Reduces pH in pond
- ~ Extruding maize meal improves digestibility & optimizes protein use

Maize

- ~ *Clarias anguillaris* fingerlings fed maize bran, fish meal, blood meal and groundnut cake gave better growth and performance than other locally available feedstuffs, but maize bran alone (11.1% crude protein) gave poor results

Flying, Dried Ants

- ~ Water - 2.9
- ~ Protein - 38.8
- ~ Fat - 46.9
- ~ Carbohydrates - 5.5
- ~ Fiber -
- ~ Ash - 5.9

Bamboo Caterpillar, Deep Fried

- ~ Water - 4.5
- ~ Protein - 25.5
- ~ Fat - 55.3
- ~ Carbohydrate - 11.0
- ~ Fiber -
- ~ Ash - 3.7

Cattle Manure

- ~ Mixed with rice bran, good performance and early sexual maturity of herbivorous/omnivorous fish

Egg Powder

- ~ A complete food
- ~ High feeding value, particularly for fry
- ~ Often included at 1 - 3 % of fish feed.

Amaranth

- High in lysine, a limiting factor in many other plant feeds
- Use in fish culture?



Borbor John - weed related to Amaranth Civil War survival food



Types of Fish Preservation

- Refrigeration
- Canning
- Freezing
- Drying/Smoking
- Pickling
- Microwave

Fish Deteriorate Rapidly



Alive is Always Best



Alive is Always Best



Alive is Always Best



#1 Key to Success:

- Ice, Ice, Baby!!!!!!
- You need a co-op in Liberia,
- Propane, not electric

Smoking/Drying



Refrigeration (Co-op Required)

- 5° C still allows bacteria and molds to grow, but more slowly
- Safety of refrigerated foods depends upon the condition of the fish when it went into the refrigerator, conditions in refrigerator, and the length of time it has been in the refrigerator.
- If it smells bad, has obvious mold or bacterial growth, get rid of it.

Freezing (Co-op)

- Stops mold and bacterial growth
- Does not kill all bacteria
- Does not stop oxidation if still exposed to atmosphere - rancidity can still occur.
- Vacuum packing stops or severely slows oxidation
- Different species react differently to freezing.

Canning - Co-op orders equipment/supplies through household goods stores in Monrovia

- Canning is easy
- It is economical to can
- Canning allows storing in quantity
- Easy to keep
- Easy to see and identify in clear glass jars
- Freezers not always available
- Safe food
- No storage costs

Canner with Gauge

- \$100US



Canning Jars and Lids - Co-op (require deposit on jars)

About \$1US/
jar with ring
and lid



Reusable Ring

Lid about
\$0.50US



Canning Over Traditional Charcoal Fire



Conclusions

- Hand-sexing for all male-tilapia is doable with low labor costs, hybrids require area co-op fingerling producers
- Pituitary spawning of catfish is practical, but one catfish fingerling producer supplies growers in an area
- Focus on novel feed components that are nutritious but not in demand for human food
- Better fish quality = higher prices
- Co-ops help get the equipment/supplies individual farmer can't get.
- Co-ops create division of labor/sectors