Aquaponics
Campus Sustainability Grant Report – Coral Frederick

Project Description
We used variety of methods to expand, experiment with, and publicize aquaponics, a simple, elegant, sustainable food production system that integrates vegetable production with fish production. The aquaponics system formed a symbiotic environment between hydroponics (cultivation of plants in the absence of soil) and aquaculture (farming of aquatic animals) by allowing nutrient rich waste effluent from the fish tank to provide food for plants. This approach emphasized sustainability by maximizing outputs (vegetables, fish) and minimizing inputs (feed, nutrients) by using the waste products from the fish to fertilize the plants. This 'double-cropping' approach is desirable because of the reduced environmental impacts for both fish and vegetable production.

Nutrient-rich waste water from the fish culture tank is discharged from the culture tank into a solids filter where large particulate material such as uneaten food and excrements are filtered out. The water then flows into the hydroponic system where the toxic ammonia is converted into nitrate by bacteria that grow on the substrate (e.g., pea gravel). Nitrate is readily absorbed by plants as food from the water, which is then recirculated back into the culture tank (Fig. 1).

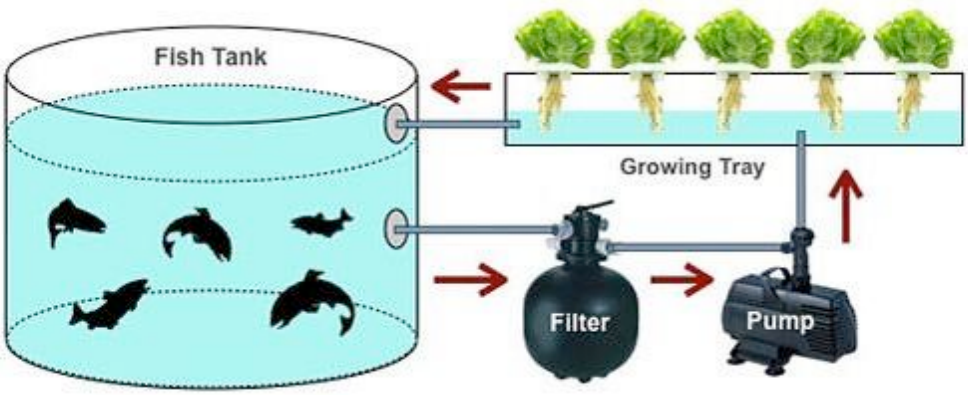

Fig. 1. Example of aquaponics system showing integration of fish culture with vegetable production.

We constructed an aquaponics system in June 2011 in a small greenhouse at the UGArden (on South Milledge Ave). Our system was designed with the intention of addressing all three components of UGA's mission: research, teaching and outreach, as well as an emphasis on the sustainability portion of the 2020 strategic plan. The system has been used for undergraduate research projects, classroom and lab use, and as a demonstration system for community members interested in building their own aquaponics systems. We have hosted a number of tours for individuals and groups in the Athens, GA area and we are working to set up a webcam and website to report our findings and further promote the use of aquaponics.

Project Expenses

Personnel:
Employed 2 undergraduate students and 2 volunteers on an hourly basis

Employee 1	-	75 hrs	-	$135.94
Employee 2	-	53.5 hrs	-	$535.00
Employee 3	-	48 hrs	-	$576.00
Employee 4	-	57.2 hrs	-	$572.00

Equipment:

Surge protector for tilapia feeding	-	$67.42
Heater and bulkheads	-	$751.26
Tank heater	-	$554.99
Webcam	-	$136.31
Thermocouple for tank feeder	-	$53.99

Supplies/General expenses:

Net cups	-	$5.40
Bricks for tilapia bath	-	$19.72
Azolla	-	$62.20
Azolla	-	$81.70
Lamp supplies for shrimp	-	$27.66
Tilapia feed	-	$148.43
Tilapia	-	$250.00
Bricks and PVC connectors	-	$45.74
Filter bags	-	$125.63
Cinder blocks and PVC	-	$55.98
PVC connectors	-	$15.43

Academic Impact

Courses:

FISH 4550/6550	Conservation Aquaculture	Drs. J. Shelton & R. Bringolf
HORT 4030	Community Food Production	Drs. D. Bailey & D. Burley
FANR 4500	Senior Project (3 Students)	Dr. Bringolf
FANR 4600	Senior Project (3 Students)	Dr. Bringolf

We also employed two undergraduate students who gained firsthand experience with the operation of an aquaponics system.

Research Value

Aquaponics, while growing in popularity, is still a relatively new and cosists mostly small-scale amateur projects. Our research concentrated on the creation of a larger system, and developing a more standardized, accessible process that can be promoted and available for others who wish to set up their own system. We evaluated ways to reduce input of supplies like water and feed, and ways to maximize the output of produce and fish. Some questions we researched involved finding the most sustainable and efficient planting material, how to optimize various parts of the system, and testing alternate fish diets to find more environmentally friendly and efficient use of fish feed.

Engagement

A) Partnerships:

We have been approached to partner with a number of groups for local, regional and international projects related to aquaponics. Locally, we have partnered with Hillsman Middle School (Athens) to build an aquaponics system for integration into their Science and Math curriculum. Warnell School students are working with the teachers and administrators to construct the system and create activities that introduce or reinforce a variety of topics in biology, chemistry, math, economics, etc. On a regional scale we have partnered with the Georgia Department of Agriculture to provide technical assistance with construction of an aquaponics system at the Dept. of Ag building in Atlanta. Internationally, we were visited by Emelisa Callejas, the Honduras Consulate General, about potentially building aquaponics systems in urban areas of her country. We have also been communicating with several groups currently working to create sustainable food supplies in Romania, China, Burkina Faso and Costa Rica.

B) Outreach

Our project has been featured as part of the UGA Fisheries Society annual fundraiser event (~200 attendees) and the UGA Office of Sustainability event for Campus Sustainability and National Food Day (~50 attendees). We hosted tours for elementary, middle and high school groups (~150 attendees) as well as many other various groups including the Honduras Consulate General (see above), Director of the UGA Costa Rica campus (Dr. Quint Newcomer), and the President of Georgia REAL Enterprises (Paul DeLargy) among many others (~100 attendees). We launched the Facebook page in February 2013 and we currently have 86 'Likes' with little or no promotion to date.

Project-Specific Metrics

This year we produced 300 tilapia (avg. wt 1 lb) and hundreds of pounds of vegetables and herbs including tomatoes, cucumbers, lettuce, basil, and squash among others. We have not attempted to maximize production of fish or vegetables but instead thus far we have focused on using the system to convey basic principles of sustainable food production, biology, chemistry, economics, etc. The three undergraduate research projects have focused on optimizing various components of the system and testing alternative fish diets to maximize sustainability.

More photos can be found at https://www.facebook.com/UGAquaponics?fref=ts

Our video can be found at http://www.youtube.com/watch?v=413UaHHtkGk