Aquaculture without Frontiers - Farmer to Farmer
Volunteer Assignment
Tacotalpa, Tabasco, Mexico
Assignment Report
March 18 - 28, 2011

Submitted by:

Kelly Green, B.S., University of Hawaii Aquaculture Program
Fish Farmer from Colorado

Beneficiary Organization:

Lacadon Village farmers' cooperative

Location of Project:

Caridad Guerrero, Tacotalpa, Mexico

Description of Assignment:

Review and document project progress. Provide hands on training and recommendations to the farmers.

Dates of Assignment:

March 18 - 28, 2011

Brief Background on Beneficiary Organization:

A village of Lacadon farmers purchased tanks for fish culture and have received previous training on how to integrate the fish culture into the irrigation of their habaneras and other marketable crops.

At this time there are some problems with the continued cooperation of the neighbor who owns the property where the tilapia tanks are currently located. This neighbor has drained the necessary nutrient-rich water from the tilapia tanks that was to be used for the integrated habaneras plants. It should be noted that the approximately 900 tilapia growing in one of the three tanks are the property of Chon and Lupita, the project leaders. Arrangements have been made to construct a new tank directly on Chon and Lupita's fathers' property and then transfer the aforementioned tilapia to the new tank. Dr. Martinez feels that this new arrangement will greatly improve the overall success of this project.

Proposed Objectives of the Assignment:

The primary objective of this assignment is to document progress of the habaneras crop and to inspect the newly prepared tilapia tank site for adequacy and size. There will also be continued training and recommendations for the local farmers to help them improve their success with the integrated aquaculture/agriculture system.

Tasks to be carried out:

1. Measurements of the habaneras growth will be in cm.
2. Pictures will be taken of new tank site to show adequate preparation.
3. After site and crop review, volunteer will make recommendations for improvement and further progress.
4. Volunteer will work with only one family who will then relay information to remaining farmers.
5. Discuss the nutrient cycles and water quality issues of integrated farming system and how fish effluents will benefit vegetable and tree crops.

Expected Number of Persons involved:

Two farmers, one male and one female, will be directly involved with this visit. The working group consists of a total of seven farmers. The Chon and Lupita will relay information to the other farmers when they are available.

Required expertise of Volunteer:

Sustainable practices and certifications, tilapia, vegetable production

Summary of Volunteer Activities

March 18, 2011

Volunteer Kelly Green travels to Villahermosa, Mexico from her home in Fruita, Colorado. Ms. Green was met at the airport by Dr. Rafael Martinez Garcia and escorted to the hotel in Villahermosa. It was arranged that Dr. Martinez would pick up Ms. Green on the 19th of March and escort her to the Village of Tapijulapa in Tacotalpa, Mexico.

March 19, 2011

Dr. Martinez and two other students of the Universidad Juarez Autonoma de Tabasco picked up Ms. Green at her hotel and escorted her to Tapijulapa. Hotel accommodations were arranged in the village where Ms. Green would stay for three nights while working on this project.

Dr. Martinez then drove Ms. Green and the accompanying students to the Village of Caridad Guerrero where Ms. Green would be working with the local farmers on their integrated aquaculture/agriculture project. Upon arrival Ms. Green was introduced to Chon and Lupita the project property co-owners. Dr. Martinez, Ms. Green, Chon, and Lupita engaged in extensive discussion and observation of the site to explain the current situation and conditions and to describe Ms. Green's responsibilities on the project. It was agreed that Ms. Green would return on Monday the 21st of March to work with Chon and Lupita in performing her duties.

After visiting Caridad Guerrero the group returned to Tapijulapa where Dr. Martinez arranged a guide named Miguel to take Ms. Green to the project Village of Caridad Guerrero at 9:00 a.m. on Monday the 21st of March and pick her up in the afternoon at 3:00. Lupita would meet Miguel and Ms. Green and take her to the farm. Dr. Martinez dropped Ms. Green off at her hotel and returned to Villahermosa. He will pick her up on Tuesday the 22nd of March at noon.

March 20, 2011

Ms. Green spent the day exploring the local area with Miguel, the guide arranged by Dr. Martinez. She took a boat up the Tapijulapa River to a popular park named Parque de Tomas Garrido. The park is a local favorite where families and schools can go to swim in the waterfalls and sulfur pools, they can explore caves and historical buildings, and they can observe local plants and wildlife. The local guide spoke minimal English but was able to share some basic information. The exposure to the local activities and culture was very enlightening and helpful for Ms. Green. It was also helping her improve her Spanish language skills.

March 21, 2011

Upon arriving at the project farm Ms. Green and Lupita began by measuring and documenting the heights of each habaneras plant in bed #3. Only the plants in the third bed were measured because growth was the most noticeable in this bed, although still very minimal. Growth in beds 1 and 2 were zero. There were also a significant number of dead plants in Bed #3 which was indicated with a 0 on the spreadsheet. The obvious lack of overall growth was due to the lack of nutrients from the water supply. As mentioned in the background section, the tilapia tank water had been drained of nutrients by the adjacent neighbor forcing Chon and Lupita to use only the spring water with minimal nutrients.

Habaneras Plant Measurements from Bed #3

Rows	Plant Heights in cm																								Avg.
1	5	5	4	5	6	0	0	0	0	4	4	0	3	3	6	5	5	0	0	0	0	0	0	0	2.20
2	6	6	0	0	3	6	5	2	5	0	2	0	0	0	0	0	4	0	0	0	0	0	0	0	1.56
3	4	4	3	5	3	6	0	0	0	1	2	4	5	0	0	4	4	5	4	4	5	5	0	0	2.72
4	0	4	4	0	3	3	3	0	0	1	0	2	2	0	0	2	0	3	0	3	0	4	3	2	1.56
5	6	5	0	5	0	5	0	0	5	0	5	0	2	4	0	3	0	0	0	4	5	0	3	0	2.08
																									2.02

Integrated System Bed #3 – Sand & Gravel Only

After making the necessary measurements Ms. Green sat with Lupita, Chon, their mother, and their three daughters to discuss the situation and possible solutions. Lupita understood some English and Ms. Green had brought a dictionary to help with communication. The following information was gathered and recommendations made regarding the project.

General Conditions and Pertinent History

1. The names of working group of villagers are: Flavio, Trina, Chon, Maria del Rosa, Lupita, Indalecio, and Mariano.
2. The working group property is located on Flavio and Trina's farm.
3. There was a major flood event that caused substantial damage to the village and delays to the project. (see attached PowerPoint)
4. The project has also been delayed due to internal organizational and communication problems involving the neighbor adjacent to the working group property where the existing tanks are located. This has forced the working group to start over on the farm of Flavio and Trina in an attempt to create a more cohesive, compatible, and successful operation.
5. Current working group members are well educated and motivated.
6. The habaneras plants were grown from seeds at the Universidad facility and placed outside in the integrated system on December 20th, 2010.
7. The three beds were constructed of different substrates to determine effectiveness and because the existing soil is of poor quality. Bed #1 & #2 used coconut fibers only; Bed #3 used sand and gravel only.
8. The adjacent neighbor cleared the tilapia tank water of the necessary effluent and nutrients soon after the plants were planted and consequently prevented any nutrients from reaching the new habanera sprouts.
9. Chon is currently watering the plants every 3rd day using only the spring water.

Valve that was used to drain effluent from fish tanks

10. During December, 2010 and January, 2011 the ambient temperature had dropped to 15°C and the spring water had dropped to 14°C, too cold and too long for the habaneras plants.
11. For the approximate three months that the plants have been in the integrated system there should have been at least 60 cm of growth. As the data shows, there is an average of 2.02cm growth.
12. The existing tanks are 9 meters in diameter with a water depth of 1.5 meters, 95 cubic meters.
13. The existing tanks contain approximately 900 tilapia per tank that are 3 months old.
14. The new tank material for the new Working Group Property is scheduled to arrive on March 30, 2011 from the Universidad Juarez.
15. The new tank will be 4 meters in diameter and 1.5 meters deep, 18 cubic meters.
16. The existing tilapia will be sampled and approximately 180 fish will be transferred to the new tank to maintain a density of 10 fish/cubic meter.
17. It will take approximately 15 days before sufficient effluent and nutrients have accumulated to provide adequate supply to plants.
18. The tilapia are being feed a high protein processed food from Silver Cup.
19. New plants are being grown in Villahermosa at the Universidad facility and will be available for transplanting to the integrated system when necessary.
20. New tank site is close to completion. Area has been cleared and just needs to be leveled and compacted.

New Tank Site with Chon and his two daughters, Vivianna and Marlene

New Habaneras Plants at the Universidad Lab

Recommendations:

1. Provide farmers with a secchi disk to help them determine and maintain proper turbidity.
2. Provide some basic Hach water testing kits to help famers maintain and understand the basic chemistry of water. Will help improve recordkeeping and is something the children could help with as teachable moments.

3. After project is operational, increase densities of fish and add a small pump to circulate water and increase oxygen.
4. When installing inlet pipe at the tank, use some kind of a splash board or small paddle wheel to increase oxygen.
5. Site area needs more leveling and compacting to create the strong foundation.
6. Encourage the use of tank water for all the plants and trees on the property; create basins around the base of trees and bucket water from the tank to the tree basins or other native plants they are trying to grow.
7. Teach farmers how to research their market for the proper size of fish and habaneras to aid in the proper timing of the harvest.
8. Include the children in as much planning, installing, growing, recordkeeping, and harvesting as possible. The children will be responsible for carrying these skills on for the next generation.
9. Offer opportunities for the older children to attend the Universidad as liaisons for their project.
10. Keep fish food secure and dry to prevent infestation and rot.

Ms. Green returned to Tapijulapa with Miguel. Dr. Martinez will pick her up tomorrow around noon and they will return to Villahermosa.

Chon's daughters playing in the spring that feeds the tilapia tank

March 22, 2011

Ms. Green spent the morning walking around Tapijulapa, observing the local villagers and their traditions. It was market day and there were many people in town. Dr. Martinez arrived at noon and they drove back to the Universidad in Villahermosa. Ms. Green was introduced to Dr. Contreras and they spoke of the projects and duties to be observed and documented for the next six days. Dr. Martinez showed Ms. Green the aquaculture facility and introduced her to the other students and technicians who would be escorting her to the various projects. Arrangements were made for the following day's trip to the Marine Facility in Jalapita (city) near Centla (municipality), Tabasco where they would collect fertilized snook sp. *Centropomus parallelus* eggs and bring them back to the lab in Villahermosa to be hatched and cultured with rotifers. Dr. Martinez took Ms. Green to the

Quality Inn where arrangements had been made for her to stay for the duration of her trip.

March 23, 2011

Jalapita Marine Facility
Jalapita, Centla, Tabasco
Spawning Snook sp. *Centropomus parallelus*

Mari' and Alejandro Contreras arrived at 8:30 to pick up Ms. Green for the trip to Jalapita. The trip took approximately 2 hours and was located about 42 miles or 90 km to the north of Villahermosa along the coast. Upon arrival they began working with the facility manager, Manuel and his two sons, Luis Roberto and Jorge. Water from the site was put into four heavy duty plastic bags and approximately 120,000 fertilized eggs were collected for transport. Each bag was filled with air and closed tightly with a rubber band.

Mari, Jorge, Manuel, Roberto, Alejandro at the Jalapita Marine Facility

Mari' had implanted 4 female and 8 male snook sp. *Centropomus parallelus* with a homemade mixture of GNRH-a hormone, cholesterol, and cocoa oil to induce spawning. The hormone mixture was a part of her Master's thesis project and seemed to be very effective at delivering the hormones slowly over a longer period of time to ensure successful spawning. Each of those females were then placed in separate tanks with two males. The spawning process has been successful at the Jalapita site.

These species of snook sp. *Centropomus parallelus* are a local favorite and the fishermen have been helping with the capture of wild stock from the nearby lagoon to use in the culture environment. Alejandro brought several bottles of algae culture for Manuel to begin growing on site. These algae will help feed the rotifers that will eventually feed

the adolescent snook. As soon as the snook eggs were collected we returned to the lab in Villahermosa to begin the culture experiment.
Upon arrival at the lab with the eggs, technicians Isabella and Rachel were ready to perform water quality tests to compare and equalize transport water and culture water. Transport water was higher in temperature and needed to cool. Salinity levels were fine because the culture water was brought from Jalapita and stored at the lab for this purpose. Once the eggs were tempered they were transferred to the 500 ml culture tank and oxygen was added. Final biomass measurements showed that of the 120,000 eggs collected, 70,000 hatched and food production would be based on that quantity. The lab technicians will begin with 2250000 ml of rotifers and increase to 450000 ml and then to 6150000 ml every five days. If they are successful Artemia will replace rotifers after 30 days.

Snook eggs collected from spawning tank at Jalapita Marine Facility

The primary problem with this project has been getting the snook larvae to eat the rotifers. It is the general opinion that the rotifers are too big for the larvae and getting the appropriate size rotifers to the snook at the right time has been difficult. The other challenge with this project is synchronizing the algae and rotifer culture so there is adequate food for the rotifers. There have been many attempts at this with no success.

Snook is a marine species that will enter freshwater. They can grow to 24 kg and 140 cm, but the species in this experiment is of a smaller variety. They have a distinguishing black lateral line with yellow pelvic and caudal fins. It is thought that the fins will turn a brighter yellow when they are spawning. As carnivores their primary diet consists of small fish and crustaceans. This fish is popular with recreational fishermen because of its fighting tendencies and the locals like it for the taste and availability.

Recommendations:

I have minimal experience with marine species so can not offer many recommendations. I do understand the importance of offering the appropriate food that is of the appropriate size and nutritional value at the time of larval swim-up. My experience raising trout, also

a carnivore, was using a very fine powdered food. After participating in this project I realized how much smaller the marine snook larvae are than the freshwater trout. I can only offer recommendations in the form of questions.

1. Could you try a processed powdered feed? At least until they grew to accept the rotifers. Rafael thought they needed a live feed because they are a carnivore, but the carnivorous trout took the non-living powdered food. I am not sure if the powdered larvae feed is even available in a small enough size, which is the primary problem.
2. Could you analyze the water of the lagoons where these larvae would hatch naturally and use that information to try other diets?
3. Could you raise the snook larvae in hapas in the lagoon until they reached a more manageable size? I believe that nature has figured things out and can be a very efficient farmer.

Alejandro and Roberto collecting Snook eggs

March 24, 2011

Division Academica de Ciencias Agropecurias
Professor Mario Fernandez
Native Cichlid Selection
Teapa, Tabasco

Ms. Green and four other students, Fernanda, Elias, Rachel, and Alejandro, left Villahermosa at 8:00 a.m. to meet with Professor Fernandez at the Division Academica de Ciencias Agropecurias near the municipality of Teapa. Professor Fernandez was conducting a selection experiment on a population of native Cichlids. He needed to weigh and measure each individual in the population. Then using the data he could determine the conditional factor with which to make his final selection of the healthiest individuals for his broodstock.

Rachel, Carmen, Elias measuring Cichlids

Upon arrival we joined Prof. Fernandez and two other students to discuss the activities and objectives for the project. We broke into two teams of three to measure the cichlids contained in 17 hapas holding between 300 and 600 juveniles. The hapas were located in a small pond near the building. Elias and Alejandro got into the water to remove the fish from each individual hapa. The other students stayed on the bank and placed the fish into a small holding tank with a temporary supply of oxygen to reduce stress. Once all of the fish were transferred to the holding tank Elias and Alejandro helped measure each fish. One student recorded the measurements while the other two students performed the measuring in cm. The final results were not available at the time of this report. General results showed average lengths between 5.0 and 9.0 cm. Weights would be taken at another time in the near future.

I had the opportunity to speak with Prof. Fernandez during lunch, with Fernanda's help as a translator. He is very interested in aquaponics and integrated systems. We spoke of a very successful project that he helped establish in the state of Puebla where they are raising tilapia and cilantro. He said the people have created a cooperative of local farmers who are very ambitious and sensible businessmen. He was very proud of their success and of his involvement as an instructor. It was obvious he really cared about the people.

I mentioned my interest and research in aquaponics and recommended he contact Dr. James Rakocy from the Virgin Islands who is now working with Nelson and Pade in the United States. Prof. Fernandez knew of him and had actually been in contact with him trying to get some aquaponics training here in Mexico. Unfortunately there is no money to fund the project. We also spoke of my experience with trout and concrete raceways and the difference between pond cultures and flow-thru systems. Fernanda was extremely helpful and interested in helping us understand each other with some technical and scientific terminology. I could tell she was learning as she translated and that she was gaining more confidence in her English skills. Our conversation at lunch was as rewarding and educational as the work we did with the cichlids. Prof. Fernandez is a very

enthusiastic and animated educator. I would have enjoyed taking classes from him. It was obvious the students enjoyed his teaching style.

Professor Fernandez and Fernanda talking shop

Alejandro and Elias gathering the Cichlid hapas

March 25, 2011

Oxiacaque, Nacujuca Project
Dr. Rafael Garcia Martinez
Backyard Integrated Aquaculture/Agriculture System (IAAS)

I accompanied Dr. Martinez to the Oxiacaque Project, located just outside Villahermosa, to assess the site and meet the family members who will be responsible for the IAAS using tilapia, habanera, and cilantro. The family members include: Father-Felix, Mother-Apolonia May, 4 Daughters-Conchi, Lucy, Daisy, Laura, 2 Sons-Poncho, Pedro, Son-in-Laws-Mauricio, Ferdinand, Daughter-in-Laws-Elizabeta, Paula. This project will involve a total of 12 related adults and 8 children. It is Dr. Martinez's opinion that this type of organization has the potential to be more successful because of the family dynamic and the hierarchy.

The site is a small residential lot of less than 1 acre within the city limits of Oxiacaque. The primary water supply will be an on-site private well. The water quality is being tested by son-in-law Mauricio, who works at the Universidad. It is expected that the water will be of adequate quality with no contamination. The soil conditions are poor but the slope will be adequate for the gravity flow requirements. There are some small trees that could provide some shade but shade cloth may be necessary for plants during the hotter months. There is electricity available with occasional times of interruption so a backup generator will be necessary. Dr. Martinez mentioned that a security fence has been planned because the property is located directly adjacent to the street with easy access for possible trespassing and injury. General conditions seem adequate for a successful operation.

Dr. Martinez speaking with the women at the site of the Oxiacaque project

The IAAS will pump fresh well water up to the fish tank where the water will collect nutrients from the fish and feed waste for the plants and then will slowly be released into the hydroponic plant system. The hydroponic beds will contain a planting media of organic mulch to help capture the nitrogen from the fish water to be delivered to the plant roots. The water from the hydroponic beds will slowly drain into the settling tank at the lower end of the system where the solids will settle out and the water will be pumped back into the fish tank. Water levels can be regulated manually by turning the pumps off and on and by opening the valves from the fish tank to the hydroponic beds and from the hydroponics bed to the settling tank. The solids from the settling tank can be removed and used in the hydroponic system or on other plants around the property for fertilizer.

Materials List:

2 plastic tanks – 1 large tank for fish,
1 small tank for holding water to recirculate back to fish tank and to settle out the solids
Raised Planting Beds framed with wood and lined with plastic to catch and drain water to settling tank
2 small submersible pumps-one for the well and one to recirculate the water
1 small gasoline generator for electricity back-up
PVC pipes from well to fish tank to hydroponic beds to settling tank
Flexible poly pipe from settling tank to fish tank
Various PVC and poly pipe fittings and brackets
Glue and primer
Gear clamps for poly pipe
2 valves for the fish tank outlet and hydroponic beds outlet
Tools-hack saw, pipe cutters, drill, tape measure, heavy duty staple gun, level, hammer, Skill saw, screwdriver, pliers, wire cutters, nails or screws, razor knife, shovel, rake
Electrical cords preferably buried to prevent injury
6-8mm black plastic liner for planting beds
Corner brackets to reinforce bed frames
Concrete blocks to raise beds to a comfortable height (ergonomic)
Organic Mulch to fill beds
Plant materials
Fish
Predator covers for fish and plants-nets and pvc pipe frames or stronger material if available
Nets for harvesting fish
Cool, dry, secure storage area for fish food
Security fencing for property perimeter

Construction will begin as soon as possible. Fish and plant stock will be grown and provided by the Universidad Juarez Autonoma de Tabasco. Mauricio is performing the water quality tests at the Universidad and final results will be reported to Dr. Martinez. Density levels of the tilapia will be extensive at 8 fish/cubic meter to prevent oxygen depletion. Dr. Martinez will be available for regular project monitoring of water quality, fish health, and plant health. Mauricio will be a valuable liaison between his family members and the university staff to ensure timely problem solving and project success. After meeting most of the family members it seems highly likely that this will be a successful project. The conversations I observed between Dr. Martinez and the women indicated enthusiasm and a genuine desire for success.

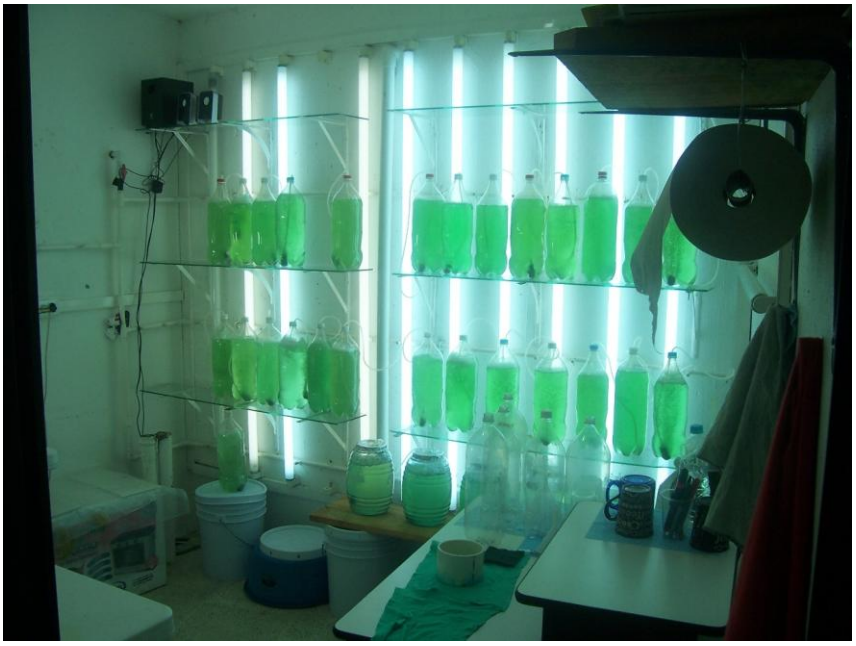
Recommendations:

1. Safety-proof the entire project. There will be easy access for small children and ample opportunity for serious drowning and electrocution hazards.
2. Teach the family how to research the market. Give them the skills to determine what to grow and how big to grow it. Give them the skills to make business decisions based on market demands. Is there any way to include a business student to talk to them about the business end of this project? Maybe this could be an integrated piece for all these projects, if necessary.
3. Allow the family member's ample opportunity to learn the math and science behind these projects, even if it is basic. Calculating areas and volumes, profit returns, fish density, measuring lengths and weights, fish biology, healthy diet components for people, plants, and fish.
4. Work with the family members to make the actual drawings or designs. Show them how to take the site measurements and put them on paper and then how to use the drawing to lay out the construction.

5. Include the older children as much as possible with all phases of planning, construction, implementation, and education.
6. Provide any reading material for future reference and problem-solving so they can become more proactive and self-sufficient as soon as possible. It will also help improve everyone's reading and math skills.
7. Encourage the use of the tank water and solids from the settling tank for all plants around the property, particularly the fruit trees, to enhance growth. The water could be bucketed by hand very easily and the solids worked into the soil or the hydroponic beds. The water and solids could be shared with neighbors, too.
8. Let me come back to help with construction. Haha

March 26, 2011

Ms. Green spent the morning with Dr. Martinez in the lab working on the rotifer and snook project. She took pictures of the lab and surrounding areas. Discussions between key individuals on the various projects helped provide valuable and missing information for her final report to be submitted to Dr. Fitzsimmons, Dr. Martinez, and Dr. Contreras. Ms. Green returned to the hotel to finish her report. A rough draft was submitted to Dr. Fitzsimmons for comments.



Algae production for rotifers in the lab

Rotifer production for the Snook

March 27, 2011

Ms. Green will relax and visit some local parks and museums. Once she receives the rough draft back from Dr. Fitzsimmons she will make the necessary changes and submit the final draft.

Men Ms. Green interacted with	16
Women Ms. Green interacted with	21
Families directly involved in the projects	7
Family Members involved in the projects	30
Community Members affected	367
Recommendations Ms. Green made to participants	19

March 28, 2011

Ms. Green returns to Colorado.

Dominquez Canyon in western Colorado