Farmer to Farmer: New Caledonia
Trip Report June 2010

Aquaculture without Frontiers
Volunteer: Jason D. Licamele PhD

INTRODUCTION

New Caledonia is located in the Southwestern Pacific Ocean region and is one of the largest islands in the Pacific. The land area consists of 18,575 km^2, and 300 km^2 of ocean. New Caledonia has 2,254 km of coastline and experiences hot and humid tropical weather influenced by southeast trade winds. Cyclones are frequent from November to March. The population of New Caledonia is just under 230,000 people and is growing at a rate of 1.1%. The people of New Caledonia are primarily Melanesian and European. French is the official language but over 30 Melanesian-Polynesian dialects exist. Noumea is the capital city and hosts 65% of the population. The island of New Caledonia consists of coastal plains and interior mountains that supply 25% of the world's nickel, as well as chrome, gold, cobalt and iron. Only 0.32% of land is arable with approximately 100 km^2 equipped with irrigation. Food accounts for 20% of the imports. Vegetables, cattle, deer and swine are farmed and fish are plentiful. Approximately 20% of the employment is in agriculture.

Developing an aquaculture industry and bolstering agriculture production can relieve the need to import foods which is costly. New Caledonia has a history of shrimp aquaculture. However due to economic and technical constraints, shrimp aquaculture has not been able to proliferate. Competition with Asian production coupled with high labor and export costs have constrained the growth of the industry. New Caledonia is looking to bolster the shrimp aquaculture industry as well as diversify aquaculture production. The natural populations of sea cucumbers or "Bêche-de-Mer" have been over harvested for export to Asian markets. These natural populations of sandfish (*Holothuria scabra*) have diminished and fishery regulations have been implemented. Recent research on sea cucumber spawning and larval rearing conducted by the World Fish Center in Indonesia coupled with the high value of "Bêche-de-Mer" (reaching $500 per kilogram dry mass) has led to the interest in developing a sea cucumber aquaculture industry in New Caledonia. Funding has been secured by the Societe Elevage Aquacole de la Ouenghi (SEA) to develop an aquaculture hatchery and nursery system for the production of sea cucumbers for export to Asian markets and for restocking the natural indigenous populations. New Caledonia has a number of endemic fish and invertebrates that could potentially be good targets for aquaculture. Currently shrimp aquaculture is a major focus for New Caledonia but technical and economic hurdles must be overcome to be successful.

Due to the location and distance from markets, New Caledonia must import most of its goods and therefore life on the island can be expensive. Importation of vegetables drives the cost up, especially in the off season of growing. In the winter, vegetables such as

lettuce, herbs, tomatoes and cucumbers are grown on the island. However due to the warm humid summer climates, vegetables must be imported to meet the market demands. Most of the land is not farmable and methods such as hydroponics can provide a means to produce the necessary vegetables. Integrated farming and aquaponics can yield fish and vegetables with minimal environmental impacts. However, selecting a suitable fresh water fish species that can compete with wild fisheries on the island can be a challenge. Integrated sea water farming was proposed and yields promise for the aquaculture industry. The cultivation of macro-algae species and high valued invertebrates such as sea cucumbers and tridacnid clams integrated with fish aquaculture can increase the production from the farms with minimal additional labor and energy costs.

PROJECT SUMMARY

1) Institut Francais de Recherche Pour L'exploitation de la Mer (IFREMER)
French Research Institute for Exploration of the Sea
Shrimp Farm
Participants: 3 M:3 F:0
Dr. Robert Costa

The French Research Institute for Exploration of the Sea, or known locally as the Institut Francais de Recherche pour L'exploitation de la Mer (IFREMER) shrimp farm was visited and a tour was provided by local employees and Dr. Robert Costa. The challenges with water quality were addressed. One issue that was discussed was the location of the intake and discharge of water to and from the farm. The water discharge pipe was located close to the intake thus potentially posing water quality and contamination problems. One of the major bottlenecks for the shrimp industry in New Caledonia is the availability of viable post larvae. Farmers cannot stock the ponds at densities that would make shrimp farming economically viable.

2) Shrimp Farmer's Meeting
Participants: 12 M:12 F:0
Dr. Robert Costa, David Kawahigashi, Jacques Patrois
Bruno, Regis, Thomas, Dominque

The current challenge to the local shrimp farmers is to develop viable and consistent production of shrimp nauplii and post-larvae. There are two options for the industry to take: 1) develop a breeding program on the island or 2) import nauplii from Hawaii. The development of a shrimp consortium to house the shrimp broodstock and develop a breeding program for the island's shrimp industry is the best option in the long run for New Caledonia. A meeting to discuss the approach to be taken by the government to help support the farmers was held at the Establishment de Regulation des Prix Agricoles (ERPA). The shrimp industry in New Caledonia consists of 18 farmers and 4 hatcheries. This meeting consisted of eight local farm representatives, a shrimp consultant David Kawahigashi from Vannamei 101, Robert Costa (General Manager of ERPA). The meeting focused on the directions the shrimp industry must take to improve upon the current production. The goal of the meeting was to convince ERPA and the local shrimp

farmers that establishing a breeding program specific for New Caledonia will be beneficial in the long run to the industry. It was concluded that the shrimp industry will need a total of approximately 250,000 nauplii per year to sustain itself. Currently most farmers are using natural breeding methods to stock their ponds which yields less reproductive output compared to a biosecure stringent breeding program. After a presentation given by David Kawahigashi on the potential directions the shrimp farmers should take, it was concluded that a system should be constructed to house the broodstock. Designs and considerations for a recirculating biosecure broodstock system were discussed. New Caledonia has targeted a locally developed strain, SPR43, in which they are intending to use for the breeding program. It was also concluded from the meeting that in order to stay competitive the shrimp farmers must adopt innovate methods and technologies to compete with Asian production.

3) Aquaponics Meeting
Participants: 2 M:2 F:0
Jacques Patrois, Dr. Robert Costa

A meeting between Jacques Patrois from IFREMER and Robert Costa was held to discuss the potential of aquaponic systems for island population. I gave a presentation as well as supplemental information to Jacques Patrois to be distributed amongst the groups he will be meeting with, which included members from local island tribes and the South Pacific Commission (SPC). The feasibility of an aquaponics system was evaluated and it was concluded that production of vegetables and fish is a primary concern for the SPC and island populations. The fish production was not targeted as a primary revenue source due to competition with wild stocks. However the sustainable and low maintenance production of vegetables on the main island of New Caledonia, as well as the surrounding islands seemed to be a promising idea. Jacques Patrois was in favor of developing aquaponic systems on the surrounding islands to produce fruits and vegetables for local consumption. Currently there are some aquaponic systems being constructed on the surrounding islands. A second meeting with Jacques Patrois focused on the design of recirculating aquaculture systems and filtration designs for larval rearing of sea cucumbers and marine fish species. I gave a presentation to him and we conversed about the filtration components needed to provide sufficient water quality for larval rearing and algae production. We discussed the costs associated with such systems and the benefits that can be achieved. I also provided him with supplemental information in regards to a recirculating aquaculture system.

4) Le Jardin Caledonien Hydroponics Farm
Participants: 6 M:6 F:0
Dr. Robert Costa, Manuel Bianchi, J-Louis Bossard, Herve Mazurais, Christoph Gas

I was given a tour of Le Jardin Caledonien Hydroponics Farm located in the Dumbea region of New Caledonia. I met with Manuel Bianchi, J-Louis Bossard, Herve Mazurais and Christoph Gas. Manuel is the owner of the 50 hectare farm which consists of approximately 20 hectares of greenhouse. They primarily grow lettuce varieties, basil, parsley, bok choy, tomatoes, peppers, cucumbers, and strawberries. I spoke about nutrient

requirements for lettuce, tomatoes and other target crops, the use of environmental controls to increase yields, the use of biological controls for pest management and the integration of fish as a nutrient generation source for the existing hydroponic farm. The hydroponic farm was interested in reusing the nutrient solution from the tomato hydroponic greenhouse for outdoor production of hydroponic lettuce and bok choy. I spoke to them about the nutrient requirements of lettuce and the nutrient assimilation rate of tomatoes and concluded that the reuse of the fertilizer could suffice with the addition of some nutrients such as calcium, magnesium, iron and other micro nutrients. Tip burn caused by calcium deficiency in new leaves was observed in the lettuce but this could also be attributed to the high humid temperatures in the summer which inhibits the translocation of calcium in the plant. It was suggested that the use of shade netting or fans could help alleviate the tip burn in the lettuce. Currently they are spraying the lettuce with foliar fertilizers to reduce the problem which has had some positive results. Pest issues that the hydroponic group had to keep in check included whiteflies, leaf miners and thrips which are controlled via bio-controls that are currently available on the market. It was concluded that the reuse of the fertilizer from the tomato greenhouses could be used to produce hydroponic lettuce with the addition of some added nutrients. The possibility of setting up a pilot demonstration aquaponics system at the hydroponic farm was discussed and could be implemented upon a return trip to New Caledonia.

Manuel Bianchi, J-Louis Bossard, Herve Mazurais and Christoph Gas

Tomato Greenhouse at Jardin Caledonien Hydroponics Farm

Nutrient solution and injection system

Lettuce crops at the farm

Parsley

Bok Choy

5) Societe Elevage Aquacole De La Ouenghi (SEA)
Participants: 4 M:3 F:1
Dr. Robert Costa, Dr. Sophie Costa, Roger Galliot

I was given a tour of the Societe Elevage Aquacole de La Ouenghi (SEA) aquaculture farm by the owners Dr. Sophie Costa and Roger Galliot. Roger Galliot also gave me a tour of his 2,300 hectare cattle farm that is located adjacent to the SEA. He also grows corn and raises horses. The SEA is focusing on spawning and producing sea cucumbers (*H. scabra*) for stock enhancement and export to Asia. Designs for a recirculating aquaculture system for the hatchery and for the nursery were drawn up. During cyclone season, water runoff and disturbance creates poor water quality at the intake site of the pumping station. The cyclone season coincides with the spawning season of *H. scabra* and it was therefore in the interest of SEA to construct a recirculating system for the hatchery and nursery. Filtration components that were onsite at the farm were observed and utilized into the filtration designs where applicable. The aquaculture system was designed with the ability to raise fish and other invertebrate species in the down season of sea cucumber production. Algae production protocols were discussed for the production of phytoplankton feeds for raising *H. scabra*. The SEA intends on producing over 750,000 sea cucumber juveniles to be stocked into ponds and lagoons around New Caledonia. Multiple dive trips were taken to collect broodstock and scout potential sites where sea cucumbers can be located. Because of the over-fishing, finding large populations of a few hundred or more for broodstock was not a simple feat. The target number of broodstock was 300-500 adults.

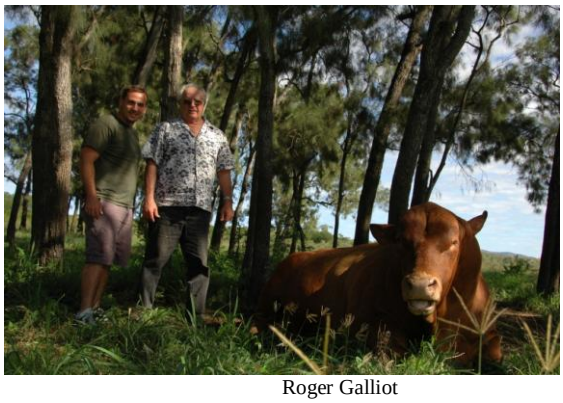
I gave a presentation to Dr. Robert Costa and Roger Galliot that outlined the potential target crops, system design considerations and protocols for aquaponics and recirculating aquaculture systems. It was concluded that producing vegetables locally could be profitable since a majority of foods are imported. The hurdle for the aquaponics system was to locate an endemic fish that could still yield revenue. Vegetables are of high value on the island. Drawings for an aquaponic greenhouse system and the associated costs were given to SEA. Drawings of a recirculating hatchery and nursery aquaculture system were also given to SEA.

Dr. Robert Costa collecting sea cucumbers

Sea Cucumber *Holothuria scabra*

Sea Cucumber *Holothuria scabra*

Ponds at the SEA Farm



Roger Galliot

Cattle at Roger Galliot's Farm

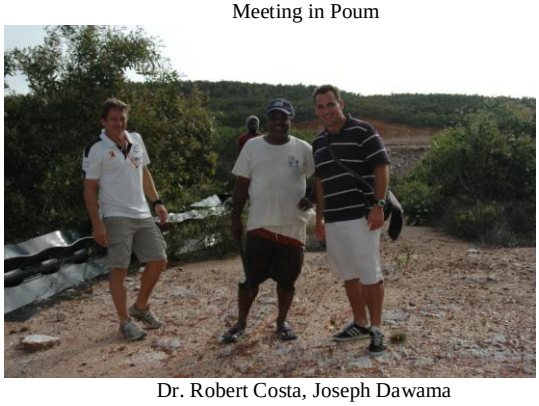
6) Meeting with Tribal Leaders in the Poum region of New Caledonia
Participants: 12 M:11 F:1
Dr. Robert Costa, Chief Willian Padome, Ronny Padome, Joseph Dawama, Colleen

A trip was made to Poum located on the North side of the island where we met with Chief Willian Padome of the Tiabet village, Ronny Padome, and Joseph Dawama. Other younger members of the tribe were also present which showed that they were interested in the opportunity for participating in the development of an aquaculture industry. Chief Willian was interested in the possibility to growout the sea cucumbers to generate income for the tribe. A presentation was given and discussions ensued about the potential profitability of growing sea cucumbers. When the meeting was over, the tribal members

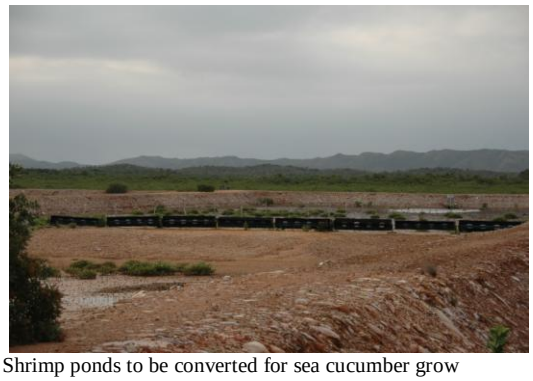
were interested in such a venture and we toured potential sites for growout of sea cucumbers. We toured lagoons in Tiabet and scouted an area for building a dyke to retain water in the lagoon at low tides. The primary lagoon that the tribe was focusing on was approximately 130,000 m^3 and was suitable for production of sea cucumbers. The lagoon can be flushed via the tidal cycles to maintain water quality. A trip was made to visit Joseph Dawama and his 5 hectares of abandoned shrimp ponds. The site was difficult to get to and required clearing of brush in order to get the truck there. The ponds were constructed for shrimp production but were never put into full production because of the lack of post larvae for stocking. Paddle wheels were used to aerate and move the water. Joseph also showed us two lagoons located near his village, one of which was suitable for grow out of sea cucumbers. The meeting with the tribal leaders was successful.

Meeting in Poum

Growout Lagoon for sea cucumbers



Dr. Robert Costa, Joseph Dawama



Shrimp ponds to be converted for sea cucumber grow

In conclusion New Caledonia has the potential to increase the productivity of aquacultured shrimp by developing a breeding program on the island. The construction of a commercial sea cucumber hatchery has the potential to be a successful operation. Aquaponic systems have great potential for providing vegetables to the local island markets. The sourcing of an economically viable local fresh water fish species that can compete with local fisheries is a hurdle for aquaponics that must be overcome. New Caledonia also has the potential to break into the marine ornamental market because of the availability of high valued local endemic species. The introduction of integrated farming methods, alternative energy production and innovated aquaculture technologies can bolster the success of aquaculture on the island.