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Small-scale backyard integrated aquabioponics food production system and training program for Native Hawaiian working families in Hawai`i

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Introduction

After initial success from year one the project was expanded to include five additional families. Families and individuals were picked after extensive interviews and the participants were made aware of expectations. Initially, four families and a non-profit organization, The Paia Learning Center, were chosen for participation in the first year of the Aquabioponics project. Five Aquabioponics systems were built by the families selected. All families were trained in a week long "hands on" workshop. Year two expanded the project to include four more families and an educational institution, Kamehameha School.

In year one, Paia Learning Center (PLC) was chosen because of its mission; to work with "at risk" families and teenagers, teaching vocational- technical skills. Moreover, the PLC is located adjacent to a working class neighborhood making it an ideal demonstration site for the project. In addition, the PLC is committed to sustainable aquaculture and agriculture production as a high priority for the vocational-tech curriculum that will be offered. It was decided that this would be an ideal demonstration facility to be used for future Aquabioponics workshops.

A presentation about the project was given at the "Islands of the World Conference held on Maui July 29-August 3, 2006. There were almost thirty people in the audience and the presentation generated considerable interest especially with participants from tropical island regions. Initially, plans were made to expand the program by partnering

with American Samoa Community College. We are searching for possible funding sources to work with ASCC.

The following summarizes the status and results of the original five systems plus the five new systems.

Results - Selected Families

1) Family 1 Paia, HI

Family 1 is located in a working class neighborhood in Paia, a small former sugar plantation community on the North shore of Maui. This system has been very productive. The family has harvested four hundred and forty pounds of lettuce and tomatoes. They have also harvested bunches of green onions, cilantro and basil. They also use the organic bio-fertilizer to irrigate terrestrial plants and fruit trees located adjacent to the Aquabioponics system. It appears this system is more productive due to the rainfall and temperature differences relative to the location of the other families although this past summer lettuce production had curtailed due to the extremely hot weather. Their total fish production was approximately fifty pounds and all went for family consumption. They have recently restocked the tank with Chinese catfish fingerlings.

2) Paia Learning Center Paia, HI

The Paia Learning Center runs the "Teens on Call" Vocational work program. It was decided to set up a system at the PLC for a number of reasons. The school site is located next to a large working class neighborhood in the plantation town of Paia on the north shore of Maui. In addition, the PLC is committed to sustainable aquaculture and agriculture production as a high priority for the vocational-tech curriculum that will be offered. It was decided that this would be an ideal demonstration facility to be used for future Aquabioponics workshops.

After almost two years of production approximately three hundred pounds of lettuce and tomatoes have been produced and harvested. The vegetables have been distributed to some of the young adults working with the "Teens on Call" program used for home consumption and given away to neighbors. Moreover, approximately ninety pounds of fish have been harvested. Twenty pounds were given away and seventy pounds sold to a local fish market at \$6.50/ lb. The tank has recently been restocked with fingerlings. It is anticipated that these fish will be ready to harvest in another year.

3) Family 2 Haiku HI 96708

This family has two working parents and three children living at home. They are located in the upcountry area called Haiku on the North shore of Maui. After the initial set up

some challenges were identified. Due to excessive rainfall during the winter and spring, there was some overflow of the system and dilution of nutrient concentrations. Hydroponics plant production was changed to aquatic plants including water hyacinth. The water hyacinths were harvested and used as compost for fruit trees including avocados and papayas. After fish reached market size (3/4-1 lb) approximately sixty pounds of fish were harvested for home consumption.

4) Family 3
Haiku HI 96708

This family is also located in the upcountry region of Maui, Haiku. Both adults are employed and they have one child in the family. Aside from the commitment to the project, another reason for their selection was their interest in environmentally sustainable agriculture production and membership in a neighborhood food production co-op. They had agreed to allow their site to be used as a demonstration and training location to expand the project to other families who may be interested in setting up Aquabioponics systems. They started growing taro, a staple of the Native Hawaiian diet. New larger baskets and substrate were delivered and they have since had great success with the taro. The leaves are harvested weekly and consumed by the family or distributed to members of the farm cooperative. After almost two years, they have harvested approximately 600 lb of "luau" leaf. This amount of leaf is valued at almost \$ 1,800 retail. In addition, they have harvested approximately 200 lbs of tilapia over this time. Although all fish harvested were for home consumption, this species of fish are sold retail at \$ 4.50-5.00/lb making to total value of the fish production to date at \$900 to \$1000.

5) Family 4
Lahaina, HI

A system was set up with to this family located in Lahaina on the west side of Maui. The household has nine family members spanning four generations. They are a fishing family who has a small garden and a series of fruit trees including bananas and papayas in the backyard.

The system was stocked with Chinese catfish fingerlings and the hydroponics bed was planted with lettuce, herbs and tomato plants. The herbs include a number of special Filipino medicinal herbs. The patriarch of the family has been fishing Hawaii's waters for over 65 years. In that time he has developed many connections on Maui and Oahu for selling fish. He has sold his first crop of Chinese catfish (ninety lbs) for \$6.50/lb for a total of \$595. Approximately 250 lb of lettuce and 200 lb of cherry tomatoes have also been harvested and consumed by the family.

6) Kamehameha High School
Pukalani, HI

The Kamehameha School Maui campus is located in Pukalani at the 1,600 foot elevation. The Maui campus is one of three campuses located on Maui, Oahu, and the island of Hawaii. The Kamehameha Schools were founded to educate Native Hawaiian children and are funded through Bishop Estate. Founded in 1996, the Maui campus enrolls 1,100 students in its K-12 program. The academy (9-12) started an aquascience program in 2005 and the instructor contacted the Maui County Aquaculture Specialist in

early 2006 with the intention of developing an aquaculture component to the program. Materials and supplies were purchased over the summer and when the fall semester began an integrated SAAR system was set up with the students assisting in its construction. Fingerling Chinese catfish were stocked and vegetables and herbs planted in the hydroponics bed in early September. The students weighed the fish weekly and adjust feed rates accordingly. Weekly water quality tests were also carried out. Unfortunately this data was not passed on to the principal investigator prior to the instructor leaving for the summer. The students learned math, chemistry, biology and ecology concepts and principles through "hands on" learning. At the end of the school year, the students harvested forty lbs of catfish and harvested lettuce and tomatoes for a luncheon. They prepared the fish and a large salad. There was enough food for 25 students and teachers. Throughout the semester, the students harvested and distributed 271 lb of lettuce, 192 lb of various species of tomatoes and 32 lb of a variety of herbs including cilantro, green onions, basil, and oregano. Chili pepper, an island favorite was also grown and harvested. The majority of plant production was taken home by the students and also distributed to the landscaping staff at Kamehameha School.

7) Family 5
Kahakuloa, HI

A system was transported and set up with this family. Kahakuloa is an isolated rural area on the North side of Maui. It is primarily farming and ranching community. They wanted a source of fresh fish and had observed the system at the Paia Learning Center and shown considerable interest in participating in the program. The system was set up in March and was stocked with 75 Chinese catfish fingerlings. The hydroponics bed was also stocked with lettuce, tomatoes and a variety of herbs. It is anticipated that the fish will not reach market size until at least March of 2008. They have been consistently harvesting the tomatoes, lettuce and herbs and have harvested approximately thirty lb of lettuce and 7-10 lb of tomatoes. All of the vegetable harvest has been consumed by the family. The nutrient rich effluent is used as fertilizer for the bananas and avocados near the SAAR system.

8) Family 6
Wailuku, HI

This family consists of husband and his wife. They also care for their parents, an elderly couple who live nearby. This system was set up in a backyard in a subdivision in Wailuku, the capital of Maui County. This system was also set up in March of 2007 and was stocked with 75 Chinese catfish fingerlings. These fish may reach market size a month or so earlier due to higher average water temperatures. The hydroponics bed was planted with different varieties of lettuce and tomatoes as well as a variety of herbs. This family has also kept fairly accurate harvest records and has harvested approximately 35-40 lb of lettuce and 12-15 lb of tomatoes. The effluent from the system is currently being used to water a large mango tree in the yard.

9) Family 7
Olomalu, HI

This family has two working adults and two young children with three families from the extended family living on nearby parcels. They have 3 ½ acres of farm land where they

raise goats, chickens and occasionally pigs. They also have a small vegetable garden used to raise items for their family and elderly members of the extended family. A system was set up in April 2007 and stocked with 80 catfish fingerlings. The hydroponics bed was planted with a variety of lettuce, tomatoes, herbs and some small Chinese peas that they had planned to plant in the garden. They have harvested approximately 30 lb of lettuce and about 15 lb of cherry tomatoes. They also frequently harvest herbs for meals but have not kept good records of that. The produce is used either for home consumption or given to extended family members, also for home consumption.

10) Family 8
Upper Kula, HI

This family consists of two working adults and two young children. Again there are extended family members living close by with a number of elderly family members. Their SAAR system was completed in May 2007 and was stocked with approximately 50 ½ lb Chinese catfish. These catfish were remaining animals from the Kamehameha School project and were transferred to the SAAR tank near the end of the school year. They have had considerable success with their hydroponic production and have harvested approximately 60 lb of lettuce 25 lb of tomatoes and 10-12 lb of green onions and other herbs. They have also used the hydroponic bed for starting avocado seeds. After 6-8 weeks the young plants are sold for \$5-10.00. They have sold about twenty avocado plants and also planted a few in their yard.

Conclusion

These SAAR have provided the basis for the development of an organic sustainable healthy diet self food supply to these families. It has also provided an excellent opportunity to train students and working families in natural food production system. We have fulfilled our main objective; to have families producing their own food and increase consumption of natural-organic raised food in their diets as well as selling production not consumed, as an additional sustainable income source.

The overall cost for all materials and supplies for a SAAR system is approximately \$1000 (see Appendix 1). This does not include labor, fish feed, or utilities (water and electricity). It is evident from the amount of production from one growth cycle (1-1 1/2 years) that these monies can be recouped from the sale of the commodities produced or the savings from having to purchase these items (see Table 1). For example, 270 lbs of lettuce produced at Kamehameha School was worth about \$900. An additional 190 lb of tomatoes at \$3.00/lb was worth \$570. Conservatively, the system can produce approximately 70-80 lb of fish per growth cycle. If sold wholesale at \$5.00/lb that could generate an additional \$350-400. One growth cycle could generate between \$1500-2000 in sales or savings on food expenses. This is a considerable amount of money for working families in Hawaii. It is important to keep in mind, this was the first exposure to aquaponics for all the participants and we were very conservative with initial fish stocking densities. It was important that all participants see some success with the first trial to encourage continued participation. It is believed that stocking densities can be increased by at least one fourth to a third (100-120 fish).

None of the participants found any noticeable increase in utility expenses. This is an important consideration in that Maui County has some of the highest electricity rates in the nation. It is estimated that, on average, water and electric expenses were 3-10 dollars/month.

One of the families has also agreed to find markets for all the fish produced. He has been selling fish for quite sometime on Maui and has stated that he will help out any participants wanting to market fish.

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SAAR has proven to be a valid method for improving native Hawaiians' food consumption lifestyle-- enhancing their diet with the production of their own organic food while at the same time providing an additional source of income. The SAAR objective is not just to study and identify the challenges facing the native Hawaiian community, but to deliver a practical solution by helping them to grow high quality organic food in their own backyards.

Projects like this are absolutely vital if we are to release native communities from the dependency of governmental assistance programs that only serve to cause greater harm by keeping these communities entrenched in the idea that "big brother" is obligated to care for their needs rather than they themselves. During the implementation of this project, one of the biggest challenges we faced was the concurrency of food stamp programs. When we approached low income families and explained SAAR to them, we overwhelmingly faced the same response from a majority of the families: They were confused as to why they would need to work when everything already came free to them from a US government that was obligated to take care of them. This was the predominant mentality among many low income families that we interviewed.

This mind set was one of the big obstacles that we needed to overcome. We needed to show these families that SAAR places a workable and accessible solution to change and improve their life conditions in a sustainable and environmentally-friendly way. We were proposing a radically different way to make them healthier, wealthier, and improve their self-esteem and purpose through their own food production. The SAAR families got the idea and developed a different approach to life. As a result, we still have these SAAR projects working and producing healthy food and additional income.

This project needed at least one more year to reach a wider circle of native Hawaiians to become completely sustainable and self-propagating. Unfortunately, the USDA-ERS discontinued the project. This was a major setback to every one of us who were seeing the daily progress and delivering workable solutions to the community. However, we hope that the participating families will not get the impression that solutions are not a strong point in governmental programs.

Tables

Table 1 Hawaiian Average Commercial Supermarket price of commodities grown in various SAAR systems

All prices on a per lb basis

	Foodland*	Star Market*	Farmers Market*
Butter lettuce	2.19/lb	1.99/lb	1.50-1.75/lb
Romaine lettuce	2.39	2.19	2.00
Green lettuce	2.19	2.19	1.75-2.00
Spinach	3.29	2.99	2-2.50
Manoa lettuce	2.99	2.99	2-2.50
Green onion	5.56	4.99	3-4.00
Chinese cabbage	2.19	1.99	1-1.50
Egg plant	3.49	2.99	2-3.00
Cherry tomatoes	6.25	4.99	3-4.00
Roma tomatoes	2.49	2.29	
Basil	4.99	3.49	
Cilantro	6.99	5.49	4-5.00
Parsley	5.99	5.4	
Chinese Catfish	8.50	7.50	7.00
Tilapia	5.00	4.50	4.50

*Local Food Stores

Appendix 1

SAAR Parts List

One	700 gallon tank
two	55 gallon barrels
one	4 x 8 grow bed
one	ten ft x 1 ¼" pvc pipe
four	1 ½" x 4 ft x 2 ft Styrofoam
one	ten ft ¾" pvc pipe
one	700 gallon/hr submersible pump
five	1 ¼ " bulkhead fittings
one	2 ft length 3" PVC
three	male thred 1 ¼" elbow
one	¾ " ss valve
one	1 ¼" ss valve
eighteen	hollow block
one	¾ male thread adapter
one	¾" cap
one	1 ¼" cap
four	L braces
sixteen	lag nuts
seventy-two	3" hydroponic baskets
two	8ft length 2 by 4
two	4ft3" length 2 by 4
two	¾" u clamps
9 ft x 9 ft	shade cloth
twenty four	small screws
biofilter medium	3 ft ³
one	1 ¼ "ss union
four	1 ¼ " male thread coupling
one	1 ¼-3/4" thread reducer
one	¾" thread adapter male
one	3/4 " hose adapter
one	15 ft garden hose