COVER PAGE

Commercial Aquaponics Case Study #2: Economic Analysis of Traders Hill Farms

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This case study is the second of a series of case studies with analyses of different commercial aquaponics systems. Each case study will be released in this draft form to make the information available as quickly as possible. These case studies will simply summarize the economics behind different commercial aquaponics production systems. The final report for this project will include the summary information from these case studies, an overall analysis of the respective systems, and a summary of data collected through a worldwide survey of the commercial aquaponics industry.

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Introduction to Traders Hill Farms & Background Info

Traders Hill Farms (THF) began with the Blaudow family, who had a vision for something great, and Angela TenBroeck, who had a matching idea. The Blaudows' 100 acre farm in Florida had 2 former Tyson hen houses that had not been used in 10 years, which was a common sight in their Northern Florida community. The Blaudows wanted to start something sustainable that could foster economic development within their community, and provide kids in the community with opportunities beyond high school. Angela found out through some experimentation that fish emulsion is an effective fertilizer, and began immersing herself in the world of aquaponics. She had a passion for sustainability and helping the community, and she is a 4th generation farmer, which made her transition from education and research into sustainable farming an easy one.

Traders Hill Farms was launched in December of 2012, and their Center for Sustainable Agricultural Excellence & Conservation was launched in November of 2013. Traders Hills Farms' Center for Sustainable Agricultural Excellence & Conservation was developed to be an institute for education and outreach for individuals to learn about sustainable agricultural practices and techniques, and resource conservation. Through this center, they work with local farmers to help them plan, build, and operate their own aquaponics systems, providing assistance throughout the process.

Traders Hill Farms thoroughly researched and experimented with a few different aquaponics systems until they created one that worked well and was easily replicable and adaptable. The system they currently use is similar to the University of the Virgin Islands' well known Deep Water Culture aquaponics system, but has quite a few differences. The THF system is also unique in that it is built inside of one of the 2 former Tyson hen houses on the Blaudows' property.

The aquaponic system at THF is inside of a hen house that has many clear roof panels, allowing for natural sunlight to nurture the plants. They only use artificial lighting in the winter months, and do so sparingly. Their hen house also hosts a handmade clay rocket stove, which is fueled by timber harvested from the farm property. This stove can be used for supplemental heating during cooler months.

Traders Hill Farms markets a few systems to producers in their community, and they have been able to replicate them in different settings. They work with local farmers to help them plan, build, and operate their own systems. They also provide assistance throughout the startup process, which includes providing producers with a maintenance schedule to follow.

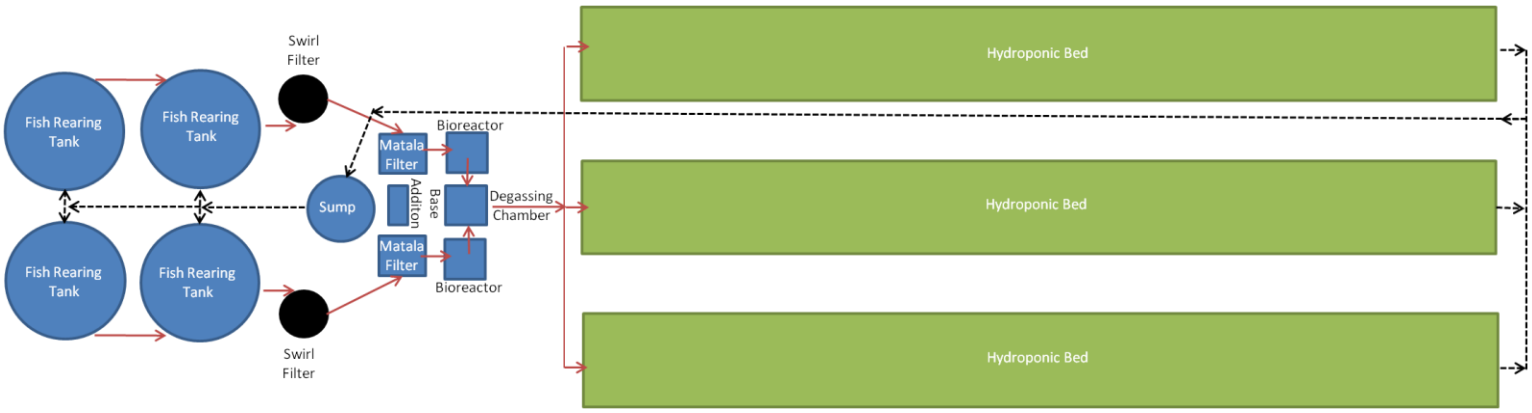
The following economic analysis pertains to the commercial aquaponics system developed by THF that is currently operating on their farm, and it includes figures producers will experience if they work with THF to replicate their system. This analysis does not include costs associated with land or infrastructure (rent/mortgage, greenhouse or hen house construction, other buildings, etc.) because THF was able to access land at no cost and the hen houses and structures were already on the property, which is owned by the Blaudow family. However, this analysis does include figures for building and operating THF's commercial aquaponics system and retrofitting a hen house into a commercial aquaponics facility. This information has been developed by THF over the past few years, and it is being provided to educate readers about the economics behind the Traders Hill Farms' commercial aquaponics system.

Traders Hill Farms Aquaponic System Configuration

The aquaponic system that Traders Hill farms has developed consists of 4 fish rearing tanks (8 ft diameter by 4 ft height), 2 swirl filters, 2 Matala filters, 2 bioreactors with Kaldness media, a degassing tank, 3 hydroponic beds (100 ft long by 4 ft wide), a base addition tank, and a sump. Water flows from the fish rearing tanks to a swirl filter to begin the filtration of solids. Water leaving the swirl filter then flows through a Matala filter, and then a bioreactor filled with Kaldness media. From the bioreactor, water then accumulates in a degassing tank. The degassing tank is where filtered water from each pair of rearing tanks meets. Fully stocked, this system holds 50,000 gallons of water, 25,000 plants, and 2,500 fish.

From the degassing tank, water flows through the hydroponic beds then returns to the sump, which returns clean water into the fish rearing tanks via a 1 HP water pump. One 2.5 HP blower powers all aeration for the entire system. The base addition tank is used to add rarely needed nutrients into the system. The water pH and temperature are constantly monitored and measurements are visible on a mounted meter near the sump. A diagram of the THF commercial aquaponic system can be viewed below.

THF Commercial Aquaponic System Diagram



Aquaponic System Construction

Traders Hill Farms has established the following timeline for project construction and system acclimation. Although construction can be completed in as little as 1 month, it typically takes about 3 months to build the system and to make it fully operational. The construction phase length is dependent upon the characteristic of the proprietor, the system configuration and amenities (geothermal heating, rocket stove, etc.), and the construction site.

Plant propagation will begin taking place about a month and a half into the construction phase, or at least by the last month of construction. The nitrogen cycle will begin about 2 weeks into the propagation process. THF provides some “juice” to producers they build systems for. This “juice” comes from their own system, and it is provided in mesh bags filled with Kaldness media. This “juice” is used to inoculate the new systems with beneficial nitrifying bacteria. Its purpose is to help speed up the acclimation process.

In total, the system construction and acclimation processes are estimated to take about 3 months. This means that produce harvests will begin within about 3-4 months of breaking ground for construction. Fish are ready for harvesting and grading by month 7. The following figures display the construction costs necessary to build and stock a THF commercial aquaponic system in a modified hen house.

THF Construction Costs Table

	Cost / Sq Ft	Est. Sq Ft	**TOTAL**
Tanks & Grow Beds	$ 13.00	6500	$ 84,500
Barn Improvements	$ 2.00	6500	$ 13,000
Initial Agriculture Supplies			$ 5,000
Initial Tilapia Acquisition			$ 950
Co-op Membership			$ 1,000
Total Start Up			$ 104,450

As you can see, a significant amount (about 81%) of the construction cost can be attributed to the tanks and grow beds. The *Barn Improvements* category includes figures for retrofitting a hen house into an aquaponics facility. This involves removing old manure, pressure washing the barn, installing clear roof panels, and more. The *Barn Improvements* figure assumes that much of the labor will be completed by the proprietors. However, THF has typically been heavily involved in assisting in this process in their community.

The *Initial Agricultural Supplies* figure includes Grodan growing media, grow trays, seed starting trays, and all beginning seeds. The *Initial Tilapia Acquisition* figure includes the typical cost for the first batch of fingerlings, which vary in cost by size (typically ranging from $.30 to $1.75 per fish). The *Co-op Membership* fee allows access to the Traders Hill Farms' buyer co-op, which enables farmers to purchase items for their aquaponics systems at a discounted rate. Membership in this co-op also includes access to help with research and issues affecting aquaponics systems, and it grants access to a quarterly newsletter from Traders Hill Farms.

Aquaponic System Operating Costs

The produce cost of goods sold (*COGS Produce*) figure accounts for all costs associated with growing produce, which includes things like plant media, seeds, root bags, and rubber bands. The tilapia cost of goods sold (*COGS Tilapia*) figure includes the cost associated with raising fish, which is based on a feed cost of $.55 per pound of fish harvested. Traders Hill Farms has its own fish hatchery, which means they get their fingerlings for a very low cost. They also produce duckweed in their systems, which they use feed to their fingerlings.

Traders Hill Farms only had one full-time operator and one part-time employee in the first 2 years, but they doubled the number of both full-time and part-time employees in the third year. This is because they set the goal to double production in year 3. The *full-time* and *part-time* figures listed below reflect a $10 per hour wage for full-time employees working 40 hours per week and for part-time employees working 20 hours per week.

The *Credit Card Fees* figure accounts for fees paid on sales for using a credit card machine, which in this case is the Square Credit Card Reader. The *office expense* figure includes things like paper, pens, etc. The *water and sewer* are a minimal cost for Traders Hill Farms because they use well water and a septic system. The *Fuel / Gasoline* cost is primarily associated with the delivery of products, but also includes

fuel costs for generators. THF is about 55 miles from their distributor, which means transportation of products accounts for majority of their fuel cost. *Professional services* typically include some type of consultant fees; for example, an electrician or an architect assisting with retrofitting the barn is typical. The *Contingency* figure amounts to 3.5% of income, which is recommended by THF to be held as an emergency fund of sorts. All of these figures can be viewed in the table below.

THF System Operating Costs Table

Item	Annual Cost Year 1	Annual Cost Year 2	Annual Cost Year 3	Annual Cost Year 4	Annual Cost Year 5
COGS Produce	$31,920	$35,910	$71,820	$71,820	$71,820
COGS Tilapia	$2,200	$6,600	$6,600	$6,600	$6,600
Full-time ($10/hr, 40 hrs/wk)	$19,200	$19,200	$38,400	$38,400	$38,400
Part-time ($10/hr, 20 hrs/wk)	$9,600	$9,600	$19,200	$19,200	$19,200
FICA Tax (7.65%)	$2,203	$2,203	$4,406	$4,406	$4,406
Credit Card Fees (2.5%)	$1,884	$2,325	$4,321	$4,321	$4,321
Office Expense	$1,200	$1,200	$1,200	$1,200	$1,200
Utilities: Water / Sewer	$0	$0	$0	$0	$0
Utilities: Electric	$4,444	$5,157	$9,342	$9,342	$9,342
Fuel / Gasoline	$5,984	$6,927	$12,462	$12,462	$12,462
Insurance: Liability	$600	$600	$600	$600	$600
Professional Services	$1,000	$0	$0	$0	$0
Contingency (3.5%)	$4,795	$5,919	$10,999	$10,999	$10,999
Total Variable Costs	**$85,030**	**$95,642**	**$179,350**	**$179,350**	**$179,350**

Aquaponic System Revenue

The Traders Hill Farms' aquaponic system required about 3 months of construction, acclimation, and preparation before production was possible. Therefore, revenue generated in the first year was a bit lower than estimates for subsequent years of production. Revenue generated during the first 3 years can be viewed in the tables below. Produce level 1 and 2 simply represent different types of products grown in the system. The following values are based on the experiences specific to Traders Hill Farms in building and operating their on-site commercial aquaponics system.

THF Year 1 Revenue Table

		Months 1-3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Total/Year
Produce Level 1	Units Sold	0	7500	7500	7500	3750	7500	7500	7500	3750	7500	60000
	Income	$0	$6,750	$6,750	$6,750	$3,375	$6,750	$6,750	$6,750	$3,375	$6,750	**$ 54,000**
Produce Level 2	Units Sold	0	7500	7500	7500	3750	7500	7500	7500	3750	7500	60000
	Income	$0	$9,375	$9,375	$9,375	$4,688	$9,375	$9,375	$9,375	$4,688	$9,375	**$ 75,000**
Tilapia	Pounds Sold	0	0	0	0	2000	0	0	0	2000	0	4000
	Income	$0	$0	$0	$0	$4,000	$0	$0	$0	$4,000	$0	**$ 8,000**
	Total Revenue	$0	$16,125	$16,125	$16,125	$12,063	$16,125	$16,125	$16,125	$12,063	$16,125	**$ 137,000**

Gross annual revenue generated in year one for the THF system is estimated to have been $137,000. It took about 3 months for the system to be built, and for sufficient nutrients to become available in the water for plant production. Production of produce began in months 4-6, but no fish were harvested until month 7.

THF typically sold 15,000 units of produce per month at this time, but the amount of production fluctuated during some months. By the 7th month, or July, it is too hot for many varieties of produce to grow in this part of Florida, so THF will grow only what it has agreed to sell to its core customers. Therefore, THF cut back harvests of produce by 50% during this month, but they were able to harvest 2,000 pounds of fish.

In months 8 through 10, THF sold 15,000 units of produce per month, but sold no fish. In month 11, plant production again gets cut by 50% and no fish are harvested. This is partially due to lower temperatures and reduced sunlight, but mainly due to the seasonality of demand from their customers. Finally, in the last month of the first year, THF sold about 15,000 units of produce and 2,000 pounds of fish. This amounts to a total annual production of 120,000 units of produce and 4,000 pounds of fish in the first year of production.

The second year of production of the THF commercial system is estimated to have generated approximately $169,125 in gross annual revenue. This is more than a 23% increase in revenue from the first year of production. Much of this difference is due to the fact that 3 months of potential production were lost in the first year due to construction and system acclimation. Improved knowledge, operational efficiencies, and buyer relationships also contributed to THF experiencing this growth in revenue.

THF Year 2 Annual Revenue Table

		Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	**Total/Year**
Produce Level 1	Units Sold	6250	6250	3750	6250	6250	6250	3750	6250	6250	6250	3750	6250	67500
	Income	$5,625	$5,625	$3,375	$5,625	$5,625	$5,625	$3,375	$5,625	$5,625	$5,625	$3,375	$5,625	**$ 60,750**
Produce Level 2	Units Sold	6250	6250	3750	6250	6250	6250	3750	6250	6250	6250	3750	6250	67500
	Income	$7,813	$7,813	$4,688	$7,813	$7,813	$7,813	$4,688	$7,813	$7,813	$7,813	$4,688	$7,813	**$ 84,375**
Tilapia	Pounds Sold	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	12000
	Income	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	**$ 24,000**
	Total Revenue	$15,438	$15,438	$10,063	$15,438	$15,438	$15,438	$10,063	$15,438	$15,438	$15,438	$10,063	$15,438	**$ 169,125**

By their third year of production, Traders Hill Farm had overcome much of the learning curve they faced in figuring out how to efficiently operate their system. They estimated they could double production to 25,000 units of produce per month, while maintaining the same fish harvesting schedule. This would require more employees, but would increase revenues by 85.81%; which would amount to a total annual revenue of $314,250.

THF Year 3 Annual Revenue Table

		Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	**TOTAL/YR**
Produce Level 1	Units Sold	12500	12500	7500	12500	12500	12500	7500	12500	12500	12500	7500	12500	135000
	Income	$11,250	$11,250	$6,750	$11,250	$11,250	$11,250	$6,750	$11,250	$11,250	$11,250	$6,750	$11,250	**$ 121,500**
Produce Level 2	Units Sold	12500	12500	7500	12500	12500	12500	7500	12500	12500	12500	7500	12500	135000
	Income	$15,625	$15,625	$9,375	$15,625	$15,625	$15,625	$9,375	$15,625	$15,625	$15,625	$9,375	$15,625	**$ 168,750**
Tilapia	Pounds Sold	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	12000
	Income	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	**$ 24,000**
	Total Revenue	$28,875	$28,875	$18,125	$28,875	$28,875	$28,875	$18,125	$28,875	$28,875	$28,875	$18,125	$28,875	**$ 314,250**

Scaling back production in July and December makes sense operationally for THF, given their climate and consumer demand. During the month of July, THF cuts back on plantings to avoid losing too much product to the summer heat. Furthermore, the demand for their products tends to decrease around the months of November and December. However, they take advantage of the extra time they have during these months by performing rigorous preventative maintenance activities.

These activities include cleaning tanks, pipes, and other equipment. This practice decreases the likelihood of running into problems with their aquaponics system during months of full scale production. Shutting down a system in the height of the production season to perform troubleshooting and maintenance has the potential to cause serious problems and financial losses. Producers should seriously consider having a preventative maintenance schedule in place for this reason. It is economically efficient for producers to perform these activities during slower periods of the growing season.

Traders Hill Farms 5 year Pro Forma Income Statements

Based on the information described above, 5 years of estimated pro forma income statements have been created for the commercial aquaponics system at Traders Hill Farms. In the first year of production, producers may experience a negative net income. This is due to the large fixed cost associated with building the system, and the fact that fewer months of production are possible in the first year. However, this is based on the assumption that the producer would pay in full for the cost of the system in the first year. This may not be the case for many producers, especially considering the recent growth in alternative methods of funding and financing available to food production enterprises (investment clubs, angel investors, crowdfunding, grants, tax credits, etc.). THF offers assistance with accessing financing for producers purchasing their systems, but there are also many other ways producers can access capital. All of the estimated net income figures can be viewed in the income statement table below.

THF 5 Year Projected Income Statements

		Year 1	Year 2	Year 3	Year 4	Year 5
Income						
	Produce	$ 129,000	$ 145,125	$ 290,250	$ 290,250	$ 290,250
	Tilapia	$ 8,000	$ 24,000	$ 24,000	$ 24,000	$ 24,000
	Total Sales	**$ 137,000**	**$ 169,125**	**$314,250**	**$ 314,250**	**$ 314,250**
Fixed Costs						
	System Construction	$104,450	$0	$0	$0	$0
	Rent	$0	$0	$0	$0	$0
	Total Fixed Costs	**$104,450**	**$0**	**$0**	**$0**	**$0**
Variable Costs						
	COGS Produce	$31,920	$35,910	$71,820	$71,820	$71,820
	COGS Tilapia	$2,200	$6,600	$6,600	$6,600	$6,600
	Full Time ($10/hr, 40 hrs/wk)	$19,200	$19,200	$38,400	$38,400	$38,400
	Part Time ($10/hr, 20 hrs/wk)	$9,600	$9,600	$19,200	$19,200	$19,200
	FICA Tax (7.65%)	$2,203	$2,203	$4,406	$4,406	$4,406
	Credit Card Fees (2.5%)	$1,884	$2,325	$4,321	$4,321	$4,321
	Office Expense	$1,200	$1,200	$1,200	$1,200	$1,200
	Utilities: Water / Sewer	$0	$0	$0	$0	$0
	Utilities: Electric	$4,444	$5,157	$9,342	$9,342	$9,342
	Fuel / Gasoline	$5,984	$6,927	$12,462	$12,462	$12,462
	Insurance: Liability	$600	$600	$600	$600	$600
	Professional Services	$1,000	$0	$0	$0	$0
	Contingency (3.5%)	$4,795	$5,919	$10,999	$10,999	$10,999
	Total Variable Costs	**$85,030**	**$95,642**	**$179,350**	**$179,350**	**$179,350**
Net Income		**($52,480)**	**$73,483**	**$134,900**	**$134,900**	**$134,900**

In the second and third years of production, Traders Hill Farm's commercial aquaponics system increased total annual revenues. This is because at least 3 more months of production were possible in year 2 compared to the first year. In the third year of production, THF was able to double the production of produce from year 2, but maintain the same fish harvesting schedule. This was possible because their operation became more efficient as they learned over time, and they were able to create more profitable relationships with buyers over time.

The above information was used to calculate the Net Present Value (NPV) and Internal Rate of Return (IRR) for this operation. NPV is the sum of the present values of cash flows experienced in a project over a period of time. IRR is the rate of return that makes the NPV of cash flows equal to zero. A conservative approach was taken towards estimating NPV and IRR for this operation. Typically, NPV is estimated over the lifetime of a project and includes figures for asset depreciation. However, NPV was estimated for just 5 years of time and it was assumed assets would have no value at the end of the project.

Therefore, the true NPV and IRR of this project would be higher because the aquaponics system is likely to still be operational for much longer than 5 years. The NPV of this operation has been estimated to equal $181,972. This assumes a tax rate of 30% on net income and an interest rate of 8%. The IRR for this operation was then estimated to be 50.9%. Again, these values are likely to be higher when the entire lifetime of the investment is taken into account.

Aquaponic production involves a fairly steep learning curve and some significant risks. Aquaponics, after all, is still farming; which means that producers are at the mercy of their own capabilities, Mother Nature, and the supply and demand of their commercial markets. It is important for those considering diving into commercial aquaponics to fully understand the costs associated with the construction and operation of these systems, and to adequately prepare for these costs as well as the inherent risks involved in aquaponics. It is also vital to expect and to prepare for the challenges facing producers who are new to aquaponics production.

Having access to experienced producers and a legitimate educational entity, such as the Center for Sustainable Agricultural Excellence & Conservation offered through Traders Hill Farms, can be very beneficial to new aquaponics producers. The assistance offered by Traders Hill Farms in getting producers started from the ground up can increase the likelihood of success in this industry. Furthermore, membership in cooperatives that can lower the costs of distribution, packaging, and other key business requirements can be very beneficial.

Finally, it is important to note that Traders Hill Farm did not have to purchase the structure housing their aquaponics system. This could be a significant additional cost for other producers. Furthermore, THF didn't have a significant cost to access the land they operate on, and heating costs are minimal for this operation because they are located in Northern Florida. These are some unique advantages that must be taken into account.