

I. Introduction

Through this paper, I hope to promote the practice of aquaponics as an inexpensive, sustainable and practical method of producing place-based heritage food for the five counties of the Thomas Jefferson Planning District (TJPD). Using two case studies from Milwaukee, Wisconsin and Chicago, Illinois, I will recommend two ways through which the TJPD can implement and promote aquaponics: (1) develop local planning and policies that provide for the practice and proliferation of aquaponics as an industry, and (2) provide the education and training resources that community members need to support and/or practice aquaponics.

A. *Virginia's Fishing Scene*

Seafood is one of Virginia's largest industries. Currently, Virginia is the nation's third largest producer of seafood, trailing Alaska and Louisiana. In 2010, Virginia generated an output of approximately 80.4 million pounds.¹

However, while Virginia may currently be the largest producer of seafood on the Atlantic Coast, it suffers from significant economic leakage. According to a joint study conducted by the Virginia Institute of Marine Science (VIMS) and the College of William and Mary's School of Marine Science, Virginia has been experiencing a decline in its direct economic impact of its seafood industry. In 2005, the Virginia's seafood industry generated a total of \$407.9 million in sales, \$239 million in value-added and 3,923 jobs. However, in 1994, it generated outputs of \$579 million in sales, \$406.4 million in value-added and 10,798 jobs. As

¹ Virginia Marine Products Board, *Virginia Seafood*, <http://www.virginiaseafood.org/dive-in/about/> (2012)

a result, between 1994 and 2004, the output for the seafood industry has decreased by nearly 30 percent.² The VIMS sites two primary reasons that are contributing to this reduction in direct economic impact for Virginia: (1) a rising dependency on seafood imported from other states and foreign nations, and (2) an increase in the distribution of Virginia seafood to other states and foreign nations. Between 1994 and 2004, the dollar value of seafood imports to Virginia increased by nearly 200 percent from \$90.4 million in 1994 to \$261.4 million in 2004.³ Further, according to the Virginia Department of Agriculture and Consumer Services (VDACS), in 2010, seafood exports totaled \$39.4 million to 27 foreign countries.⁴

B. *Virginia's Seafood Heritage and the Need to Reclaim It*

Seafood is one of Virginia's oldest industries that dates back to 1785, beginning with the enactment of the Potomac River Compact, which allowed Virginian fishermen to freely fish the entirety of the Potomac River. Throughout the 1800s, Virginians primarily relied on domestic fish markets in Virginia, and, in turn, most of the fish and shellfish harvested in Virginia waters were locally consumed. Virginians enjoyed a cornucopia of local oysters, American Shad, blue crabs, croaker, striped bass and catfish.⁵ By the late 1930s, however, Virginia was

² James, E. Kirkley, Thomas J. Murray and John Duberg, "Economic Contributions of Virginia's Commercial Seafood and Recreational Fishing Industries: A User's Manual for Assessing Economic Impacts," *VIMS Marine Resource*, Report No. 2005-9 (December, 2005), iii-iv.

³ *Ibid.* iv.

⁴ Virginia Marine Products Board.

⁵ James Kirkley, "Virginia's Commercial Fishing Industry: Its Economic Performance and Contributions," *VIMS Marine Resource* (1997), 5.

exporting approximately 75 percent of its seafood production in response to the nation's growing demand for seafood.⁶

According to the VIMS, by 1994, seafood consumption was exceeding 15.2 pounds per individual. In total, the United States consumed 13.7 billion pounds of seafood, 42.1% of which was supplied by imports. In response to this ever-increasing demand, fishermen began exploring the practice of aquaculture—fish farming. In 1993, aquaculture production of catfish, salmon, trout and selected shellfish exceeded 700 million pounds.⁷

While aquaculture continues to be practiced and supply Virginians with the fish and shellfish they demand, the practice requires a significant amount of land, making it unsuitable for urban environments, such as Charlottesville and the rest of the Thomas Jefferson Regional Planning District. In addition, aquaculture produces a significant amount of fish waste, which is eventually released into nearby bodies of water. Further, this fish waste is highly concentrated in nutrients that can lead to eutrophication, which can ultimately disrupt the other fishing industries. As a result, many urban areas have begun to explore a different system that requires less space, can be practiced indoors and has minimal impact on the surrounding environment—the system of aquaponics.

II. Aquaponics

Aquaponics is a hybrid between aquaculture—the farming of fish and shellfish—and hydroponics—the production of plants in water and nutrient solutions instead of soil. More specifically, it is the method of growing plants and fish together in a

⁶ Ibid. 6.

⁷ Ibid. 8.

symbiotic environment through the use of a recirculating system. In this system, the fish waste serves as a fertilizer for the plants. In turn, the plant roots filtrate and clean the water, which re-circulates back to the fish tanks. To view a diagram that outlines the aquaponics process in more detail, refer to Figure 1 in the appendix.

Aquaponics has four primary benefits that make it an appealing option for urban communities. First, it eliminates the risk of mercury accumulation and that of pathogens that plague plants of traditional agricultural methods, such as *E. coli*. Second, it allows for the year-round production of fish, vegetables and herbs. Third, it is extremely water-efficient, using less than 5% of the water quantity that is used for conventional agricultural practices. In turn, this allows for the faster production of a higher crop yield, as there is a constant flow of nutrients. Finally, as stated before, it is achievable in relatively small spaces. Aquaponics is essentially a natural system in a controlled environment. This controlled environment eliminates the concerns of unpredictable frosts, pathogens, pests and other curveballs that nature has to throw at those who practice conventional farming techniques. Most importantly, aquaponics can serve as the most viable option in the face of climate change.⁸ As a result of these benefits, there are a number of cities, including Milwaukee and Chicago, that are exploring the opportunities that aquaponics has to offer.

While aquaponics is clearly not a heritage method of production, it provides communities with the opportunity to reclaim fish, vegetables and herbs that were

⁸ Genevieve Roberts, "Fish Farms, With a Side of Greens," *New York Times*, September 27, 2010, accessed May 6, 2012, <http://www.nytimes.com/2010/09/28/business/energy-environment/28iht-rbofish.html>

once a part of their heritage. It is important that cities reclaim foods that were once characteristic of their community because these foods instill a sense of place, strengthening the communal bonds between the residents. In addition, these foods can generate jobs and revenue for the community. One city that is exploring and championing this innovative method of aquaponics in order to reclaim its food heritage is Milwaukee, Wisconsin.

III. Case Study #1: Milwaukee

A. Milwaukee's Background

Milwaukee, Wisconsin has a rich heritage rooted in food production. In fact, Milwaukee was once known to the world as the city that “feeds and supplies the world”.⁹

One particular food product that was once enjoyed by the Milwaukee community is yellow perch. Yellow perch was a staple for Friday night fish fries. Batter and fry it, serve it with a side of German potato salad, rye bread and beer—a traditional Milwaukee Friday night fish fry. As reported by Milwaukee's Journal Sentinel, Community Member Fred Binkowski insists that “Perch were born to be fried...Perch is the best-tasting fish we have access to in Wisconsin.” However, since 1990, the population of Yellow Perch in Wisconsin lakes has decreased significantly by 80 percent. As a result, Milwaukee is importing the majority of its yellow perch from Canada and a few states bordering Lake Erie and Lake Winnipeg at a price of \$14 to \$16 per pound. This is much more expensive than

⁹ IBM, “Milwaukee”, IBM's Smarter Cities Challenge Report (July, 2011), 5.

cod and haddock, priced at around \$12 per pound, and, as a result, cod has now replaced yellow perch as the fish fry staple.¹⁰

In response to this significant decline and in efforts to reignite the traditional Friday night yellow perch fries, there are several ventures exploring the possibilities of aquaponics. Sweet Water Organics is one of these cases.

B. Sweet Water Organics

Sweet Water Organics, an urban aquaponics company, was founded in 2009 by James Godsil and Josh Fraudorf. Godsil and Fraudorf started the venture using \$40,000 that was leftover from their original business—Community Roofing & Restoration.

This venture is unique in that it operates inside an abandoned warehouse that was once owned by Harnischfeger Industries—a mining crane manufacturer. This location was the prime spot for the headquarters of an urban agriculture venture because the warehouse was already in an industrial zone. As a result, no special zoning or policy revisions were required.¹¹ In addition, Milwaukee has always allowed agriculture uses across the city. In this particular case, even minor revisions were unnecessary.

Sweet Water Organics utilizes the re-circulating system, inspired by Will Allen's three-tiered, bio-intensive simulated wetland model, to farm yellow perch, blue gill—another Milwaukee favorite indigenous to Wisconsin lakes, tilapia, watercress, sprouts, wheatgrass, lettuce, basil, swiss chard and oyster mushrooms

¹⁰ Karen Herzog, "Perch return to local waters—in an old factory," *Journal Sentinel*, February 5, 2010, accessed May 6, 2012, <http://www.jsonline.com/news/milwaukee/83610787.html>

¹¹ Yves S. LaPierre, email message, April 12, 2010.

year-round. In addition, during the warmer season, Sweet Water Organics grows tomatoes, peppers, cucumbers, squash and an array of herbs.

The operation has been selling approximately 150 pounds of greens per week and sold 3,000 yellow perch during its second spring. Godsil and Fraundorf have big expansion plans for Sweet Water Organics.¹²

In addition, following Will Allen's model, Sweet Water Organics is not just focusing on providing urban consumers with local fresh fish and greens. It aims to create jobs as well. What started out as a six-employee business has now expanded to employ 11 people.

This success of Sweet Water Organics can be greatly attributed to the partnerships it has formed with the greater community of Milwaukee. The venture has received support from local restaurants and various institutions, such as the University of Wisconsin and the Milwaukee School of Engineering. In addition, through its partnership with the University of Wisconsin, Sweet Water Organics has received extensive support from the Sea Grant Program—a university-based program that seeks to utilize scientific information in order to support a vibrant economy while ensuring ecological sustainability.

Despite its success, however, Sweet Water Organics has encountered several obstacles that have the potential to continue to serve as setbacks in the future.

For example, it has had difficulty primarily with technical glitches. During its first

¹² Joe Barrett, "Fish Are Jumping—Off Assembly Line," *The Wall Street Journal*, May 14, 2010, Accessed May 6, 2012, <http://online.wsj.com/article/SB10001424052748703950804575242594125593702.html>

fall, an automatic fish feeder dumped four times as much food as needed into a tank housing 5,000 perch. 2,000 fish were killed and added to the compost pile.¹³

However, through continuous innovation and strong partnerships, Sweet Water Organics has the potential to overcome these adversities, expand and provide Milwaukee with the opportunity to reclaim its food heritage rooted in yellow perch and blue gill.

C. IBM Smarter City Challenge

In addition to the support that it has received from the greater Milwaukee community, Sweet Water Organics and Milwaukee's other aquaponic ventures received one of the 24 IBM Smarter Cities Challenge grants in March 2011. The IBM Smarter Cities Challenge aims to help cities improve one aspect of city life by providing \$400,000 and a team of IBM experts, researchers and consultants "who will study the role that intelligent technology can play to analyze and strategize project goals".¹⁴ The specific aspect of Milwaukee city life that IBM will focus on is urban agriculture—specifically, aquaponics. IBM will support Milwaukee's greater aquaponics and urban agriculture initiative and analyze whether ventures, such as Sweet Water Organics, can serve as sustainable economic models.

IBM sent its expert team to begin working with Milwaukee in June 2011. The ultimate goal of this collaboration was to transform the food system of Milwaukee from a Milwaukee that "feeds and supplies the world" to one that feeds itself. IBM established four main criteria that indicate a "smart city"—one that has a high quality of life for its residents: (1) sustainable economic growth and job creation; (2)

¹³ Barrett, "Fish are Jumping."

¹⁴ IBM, 3.

minimal inhibitors to economic growth; (3) the presence of cost-effective and easily implementable solutions; and (4) broad community support and engagement.¹⁵

IBM firmly believes that aquaponics and urban agriculture has the potential to address these four issues and promote Milwaukee's economic vitality. The expert team devised four key recommendations that will allow Milwaukee to foster the growth of aquaponics:

- (1) Establish an Urban Agriculture and Aquaponics Council, using the Milwaukee Water Council as a model. This entity will contribute to the success of the aquaponics industry through collaboration and sharing of knowledge between various stakeholders, including for-profit, nonprofit and public agencies.
- (2) Establish an Aquaponics Innovation Center that will: evaluate new aquaponics technologies; support business development through both analysis and documentation of smart/best practices and research of the industry's economic impact; serve as an incubator for new companies; and educate the public about the benefits of aquaponics.
- (3) Develop a market analysis of aquaponics production to guide industry expansion.
- (4) Expand Milwaukee's Office of Environmental Sustainability to serve as an advocate for aquaponics.

¹⁵ Ibid. 3.

IV. Case Study #2: Chicago

A. *Chicago's Background*

Chicago, Illinois is also a city that is pioneering the practice of aquaponics. Similarly to Milwaukee, Chicago was also a city whose economy was heavily reliant on its food industry. However, Chicago was infamous primarily for its meatpacking industry, ultimately serving as the setting for Upton Sinclair's The Jungle.

Using Milwaukee as a model, Chicago has been able to introduce and support aquaponics as a method for producing local food for the city. However, Chicago adapted Milwaukee's model to fit its own parameters and has developed its own unique system that can serve as another model for other communities, such as the TJPD.

B. *The Plant*

As mentioned before, Chicago was once the meatpacking capital of the nation. However, as it no longer is, the city is littered with many vacant factories that once belonged to meatpacking companies. There are various entrepreneurs who are taking advantage of these vacant buildings, including Chicago's innovative vertical farm and small business incubator, The Plant.

The Plant is the brainchild of Entrepreneur John Edel and is a former meatpacking plant and slaughterhouse in Union Stock Yards. Edel's vision was to turn the dilapidated and abandoned factory into Chicago's first vertical farm and food business incubator. As of today, The Plant is home to two aquaponics ventures—312 Aquaponics and Skyygreens Aquaponics, a Kombucha brewery—

Thrive Kombucha, and Peerless Bread and Jam—a small bakery that also sells small-batch jams. The Plant, however, is no ordinary vertical farm. It has carefully selected the various ventures to ensure that the wastes of one will serve as the raw materials for another. In addition, the wastes of the ventures will serve to help the building self-sustain itself, ultimately turning The Plant into a closed-loop system. More specifically, The Plant will produce all of its own electricity and heat on site through the use of an anaerobic digester and a combined heat and power (CHP) system. The food waste from the various ventures, such as the distilleries' grains and the aquaponics' vegetables, will feed the anaerobic digester, which will then digest the wastes and release the resulting methane into the CHP system. The CHP system will in turn supply the building with the heat and electricity it needs to function. Edel's ultimate goal for The Plant is for it to be net-zero energy and net-zero waste.¹⁶ Refer to Figure 2 in the appendix for a detailed diagram that outlines the process through which The Plant will be a self-sustaining, closed-loop ecosystem.

While the various ventures are currently in operation, The Plant as a whole will not be a completed project until 2016, as it is in the process of securing a partnership with a distillery venture, building a commercial kitchen and designing the renewable energy system. In addition, The Plant is still in the process of securing the myriad of permits and licenses it needs in order to operate.

According to Edel, the renewable energy system alone will require at least eight permits for air, water, waste and zoning. Additionally, the building itself requires all

¹⁶ Melanie Hoekstra, *Frequently Asked Questions about The Plant*, Accessed May 6, 2012, <http://www.plantchicago.com/about-the-plant/frequently-asked-questions/>

of the standard construction permits.¹⁷ In September 2011, Chicago enacted a new zoning code that would benefit The Plant by promoting the expansion of urban agriculture within the city's boundaries. In addition, Chicago and its various aquaponics and urban agriculture ventures have been very fortunate to receive the undying support of their new mayor, Rahm Emanuel, and the state of Illinois. In 2011, the Illinois Department of Commerce and Economic Opportunity (DCEO) awarded The Plant two grants, totaling \$1.5 million, to support its renewable energy system. 45 percent of the funds came from DCEO's Large Customer Energy Efficiency grant, which in turn is supported with funds from the American Recovery and Reinvestment Act—a federally mandated policy. DCEO's Food Scrap Composting Revitalization and Advancement Program provided the remaining 55 percent. According to Warren Ribley, Director of DCEO, The Plant has the potential to "become a regional model for sustainability as well as a route to building out this part of the economy."¹⁸

In addition to providing fresh, local food for the community members of Chicago, The Plant will provide jobs as well. Using the DCEO grants, The Plant strives to create 125 green-collar jobs for the economically distressed community.

Aquaponics serves as one of the key steps to completing The Plant's closed-loop system. Because it requires very little input and generates zero to little waste, Edel essentially built the entire system off of the aquaponics system, as it is an almost fully closed system itself. As explained before, The Plant currently houses two aquaponics ventures—312 Aquaponics LLC and SkyyGreens.

¹⁷ Ibid.

¹⁸ Melanie Koekstra, "The Plant Wins \$1.5M for Renewable Energy System!", September 15, 2011, accessed May 6, 2012, <http://www.plantchicago.com/the-plant-wins-1-5m-for-renewable-energy-system/>,

Local, fresher, better. This is the premise of 312 Aquaponics. This innovative venture is a social startup that aims to “market the most comprehensive solution to current and future global agricultural needs.”¹⁹ While providing The Plant with the fish waste it needs to be self-sustaining, it also serves as The Plant’s central educational and training resource. The focus of 312 Aquaponics is to provide startup packages and supplementary training services that can help turn other urban farms “more efficient, scalable and sustainable.” The venture essentially serves as a consulting firm that specializes in the field of aquaponics. They hope to facilitate a network in which members share best growing practices and provide management guidance and other tools for food compliance, safety and security regulations. The primary goal for the systems that 312 Aquaponics hopes to provide is to have a payback period of less than three years. Farmers who employ traditional agricultural practices generally have an equipment payoff term as high as 15 years.²⁰ 312 Aquaponics ultimately hopes to allow farmers to have one as low as one.

While 312 Aquaponics focuses more on providing aquaponics systems and training, Skygreens—The Plant’s other aquaponics venture—focuses on providing Chicago community members with local and organic produce year-round.

Another aquaponics venture that hopes to find a home in The Plant is Greens and Gills LLC. This enterprise will specialize in raising tilapia and an array of leafy greens. Greens and Gills LLC aspires to be a part of The Plant system because it

¹⁹ 312 Aquaponics, *About Us*, Accessed May 6, 2012, <http://www.312ap.com/home/index.php/team/>

²⁰ Gabriel, Silverman, “Aquaponics redefines ‘locally grown’ while aiming for profit,” *Medill Reports Chicago*, May 12, 2011, Accessed May 6, 2012, <http://news.medill.northwestern.edu/chicago/news.aspx?id=186175>

is a low-cost alternative to greenhouses. Greens and Gills originally envisioned having \$1.5 million to start. However, after only being able to secure \$600,000, it had to turn to low-cost alternatives, such as those offered by The Plant.

V. Application to the TJPDC/Policy Recommendations

Using these case studies of Milwaukee and Chicago as models, the Thomas Jefferson Planning District Commission (TJPDC) can support aquaponics as a way to produce heritage, local, inexpensive food for the five counties of the Thomas Jefferson Planning District—Albermarle/Charlottesville City, Greene, Nelson, Fluvanna and Louisa. Central Virginia once enjoyed a bounty of striped bass and catfish. However, with an increasing national demand for these fish and a resulting depletion in numbers, striped bass and catfish have been steadily disappearing from Virginian diets. I propose two primary ways in which the TJPDC can reclaim this heritage of seafood that the members of the five-county region once enjoyed—(1) ensuring that local planning and policies support and provide for urban agriculture and (2) providing the education and training resources that community members need to support and/or practice aquaponics.

A. Local Planning and Policy

Some of the greatest constraints that have limited the practice of urban agriculture are the municipal hard policies that restrict land use. In addition, the extensive startup costs required by these ventures have acted as a barrier to the expansion of urban agriculture. While aquaponics requires less startup capital and has a lower payback period than outdoor farms, it can still exceed the budgets of

some, especially those of younger population. As a result of these two major inhibitors, the TJPDC should consider supporting several initiatives that can minimize these barriers, including:

1. *Incorporating urban agriculture into city and/or county land use plans.*

Chicago has been championing this particular idea, and the TJPDC can follow its example. In 2010, Chicago’s Metropolitan Agency for Planning (CMAP)—Chicago’s equivalent to the TJPDC—developed *GO TO 2040*—its comprehensive regional planning campaign. *GO TO 2040* is unique in that it devotes an entire section to planning for a sustainable local food system with a specific nod to urban agriculture. CMAP proposes to “simplify and incentivize the conversion of vacant underutilized lots, spaces and rooftops into agriculture uses.”²¹

In reviewing the comprehensive plans of all five counties, there is no specific support for urban agriculture. Similarly to CMAP, the TJPDC should encourage the five counties to include guidelines for urban agriculture, such as establishing zoning ordinances that allow agricultural uses in various urban areas. For example, Chicago recently amended its ordinance to allow for more widespread urban agriculture. More specifically, the zoning code was amended to clearly define urban farm use, identify areas where it is permitted, establish regulations that serve to decrease potential impacts on surrounding property and help preserve the character of Chicago’s neighborhoods. Additionally, the amendment makes a specific reference to aquaponics, allowing for its

²¹ Chicago Metropolitan Agency for Planning, *GO TO 2040/Livable Communities* (May, 2010), 154.

operation and thus supporting it as a source of fresh, local and inexpensive food.

2. *Review and amend buildings to reflect the structural needs of aquaponics.*
3. *Expanding the counties' sustainability initiatives to include creating an Aquaponics Council.*

Both Milwaukee and Chicago have plans to establish an agency that will be responsible specifically for promoting the continuous development and innovation of aquaponics. These councils would serve to coordinate and facilitate a network between all stakeholders who are—or, potentially could be—involved in the growth of the aquaponics industry. These stakeholders traverse the public, private and nonprofit sectors—the City/County, educational institutions, community organizations, health institutes and partnering companies or corporations.

The TJPDC should consider promoting the establishment of a similar council that would serve as a vessel to facilitate collaboration and the sharing of ideas and knowledge between these various stakeholders. This council would advance both the science and business success of the aquaponics industry.

4. *“Leverage Existing City Systems and Data” to assess prime opportunities for aquaponics.*²²

Following Milwaukee’s lead, the TJPDC should utilize the existing applications and functions, such as GIS data, to support the development of aquaponics as a sustainable and lucrative industry. Using available GIS data, the TJPDC can identify the locations of vacant buildings that could serve as

²² IBM, 21.

potential locations for aquaponics ventures. In addition, GIS can provide the TJPDC with the option to establish specific criteria for the location of aquaponics ventures and ultimately locate sites that fit these criteria. For example, Milwaukee plans to use existing GIS data to identify vacant buildings that are close to the Milwaukee Public School facility and in neighborhoods that have low crime rates.

5. Providing low cost leases of City/County-owned property.
6. *“Investigating creative uses of financing to stimulate aquaponics development” and providing financial incentives.*²³

To make aquaponics more attractive as a profitable form of agricultural production to farmers and entrepreneurs, Milwaukee has been exploring the possibility of using existing financing methods, such as Tax Increment Financing (TIF), to promote the practice of aquaponics. TIF is a public financing method that Milwaukee—and many other cities—uses for subsidizing community-improvement projects. The method functions by using the revenue from property taxes around the area of redevelopment to subsidize the improvement projects. Each of the TJPDC’s five counties has used TIF to finance several projects, such as Charlottesville and the Waterhouse project, and should consider using a similar method to provide financial support for the development of an aquaponics industry in the TJPDC.

Additionally, in order to encourage more farmers and entrepreneurs to practice aquaponics, the TJPDC should consider providing tax incentives.

²³ Ibid. 22.

B. *Education and Training*

In addition to municipal hard policies and financial barriers, the TJPDC must address the lack of education and training resources available. Aquaponics is a new technique that many are unfamiliar with. As a result, the TJPDC should consider ways to both educate people about the benefits of aquaponics and train them how to practice it. This includes:

1. *Establishing an Aquaponics Innovation Center.*

Similar to Milwaukee, the TJPDC should propose creating an Aquaponics Innovation Center under the umbrella of the Aquaponics Council. The Aquaponics Innovation Center would serve as a hub for collaboration and innovation with the purpose of identifying, documenting and assessing the best aquaponic practices. It would essentially serve as a center of archived information to which new aquaponic ventures could turn to.

The key domain of the Aquaponics Innovation Center would be research. The center would facilitate research by creating partnerships between the private, public and university research sectors (IBM). In addition to the scientific and technological support, the Center would also provide support for business research by providing management mentorship and leadership skills development.

The other responsibility of the Center would be to focus on reaching out to the community and educating people about the benefits of aquaponics.

VI. Conclusion

The cities of Milwaukee and Chicago recognize the potential for aquaponics as a job creator and revenue creator. Using these cities as models and the proposed ideas, the TJPDC should highly consider promoting aquaponics as a source of heritage and inexpensive food, jobs and revenue for the economy of the TJPDC.

VII. Appendix

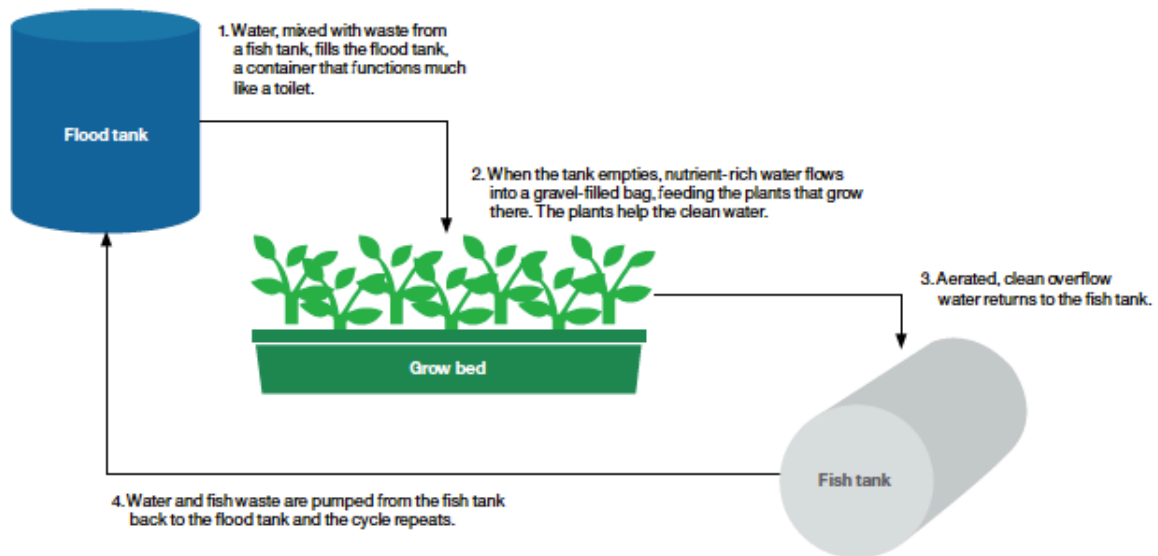


Figure 1—a detailed diagram outlining the three-tier system of aquaponics.

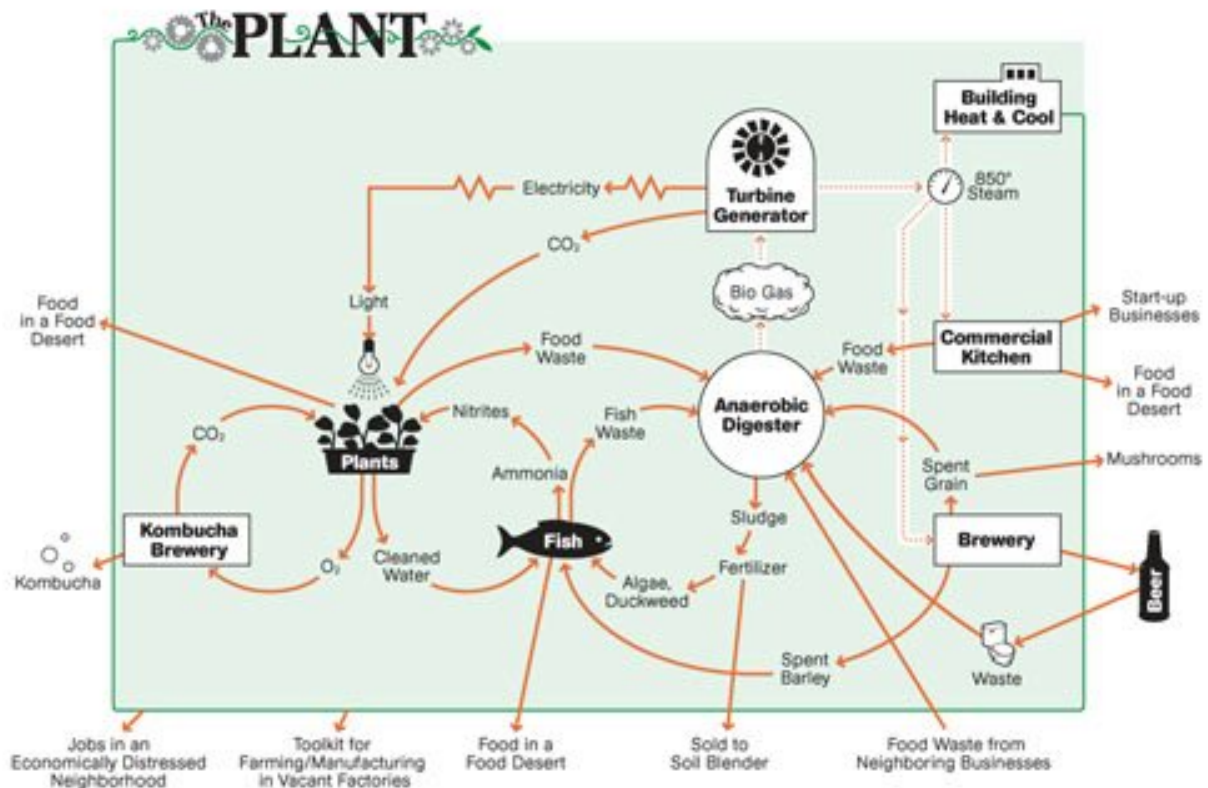


Figure 2 – a detailed diagram modeling The Plant's self-sufficient system.

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