Thesis Journal

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Introduction

This is a series of entries chronicling the Thesis 1 Studio and Writing & Research Fall 2011. This document is supplementary to the Fall Thesis Proposal Document found at http://thesis.piuggi.com. This document is an outline of experiments within a course methodology for Thesis Studio 1, created by Professor Scott Pobiner. Using this methodology a series of predetermined Modules were used to provide support to research and prototyping. The enclosed Journals follow Scott Pobiner's 5 Modules: Social, Conceptual, Methodological, Technical and Evaluative through the ups and downs of the Fall Thesis Semester.

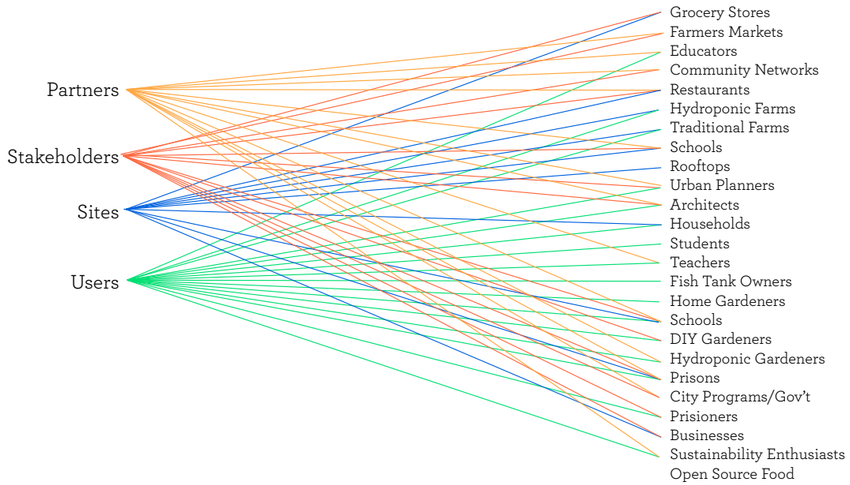

Figure 2.a *Initial User Identification Chart*

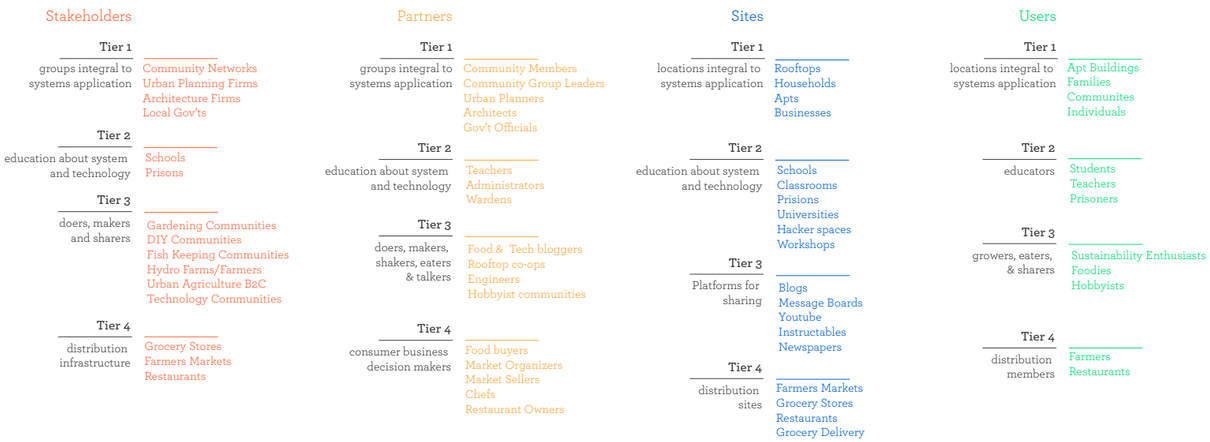

Figure 2.b *Update User Identification Chart*

Figure 2.d *User Prototype Cards*

Figure 2.e *Sample User Layout*

Date
09. 18.2011

Module
Social

Prototype
Identifying User Perceptions

Focus

Starting with the Social Module it was important to quickly acknowledge the path of people's meals, as well as their perceptions about where their food came from. In doing this, a direction was fostered, and a greater outline of participants was acknowledged. An initial user chart was created to understand who might be involved with the process (*Figure 2.a*). With this information, a simple prototype was executed on fellow graduate students. The purpose was to understand their perceptions of the 'food chain' and how their recent meals fit into it.

Objective

Students were given a stack of cards with images (*Figure 2.d*) of organizations and locations from the list (Figure 2.a). Participants were asked to arrange the cards according to their last meal eaten (*Figure 2.e*), to gauge their understanding of the path that meal took to get to them. While admittedly a very menial prototype, it served a unique purpose in facilitating the creative process and brainstorming the social scenarios around food.

Guiding Questions

What are people's perceptions about food? Do people know where their food comes from? How involved are people in their meals production? What are paths which meals take to get to individuals?

Results

The sampled demographic, consisted of 15 young adults, living in an urban setting. All participants were students and therefore of similar economic status, with limited finances, time and means for food preparation. The beginning and end of each path were all slightly different and no two meals were the same. One common thread emerged; the repetition of stores and markets. This in turn lead to an analysis of the network we purchase food from, and how we, as consumers can potentially offset and supplement said network, as producers.

Analysis

It became apparent that the initial user chart(*Figure 2.a*) was not robust enough to outline the different levels at which all of these organizations interacted. In acknowledging this an updated user chart was created (*Figure 2.b*) identifying the different user types into a tiered system to better visualize, illustrate and understand their broader connections related to food production and distribution.

Next Steps

Moving forward, it is important to examine more closely the relationship of distribution and the current issues involved in this chain, in the New York City area.

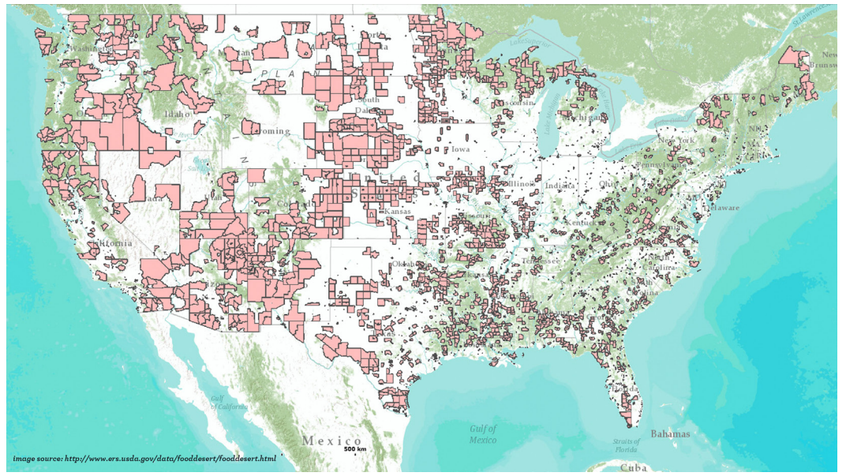

Figure 1.a *USDA Food Desert Locator Map*

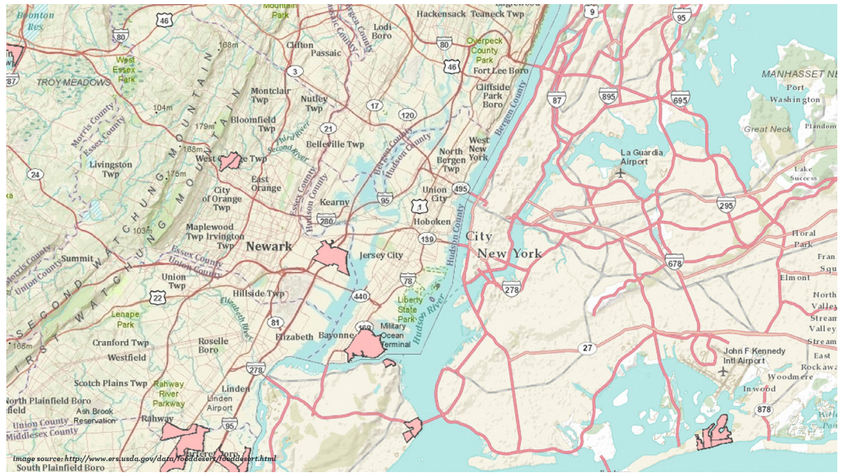

Figure 1.b *USDA Food Desert Locator Map*

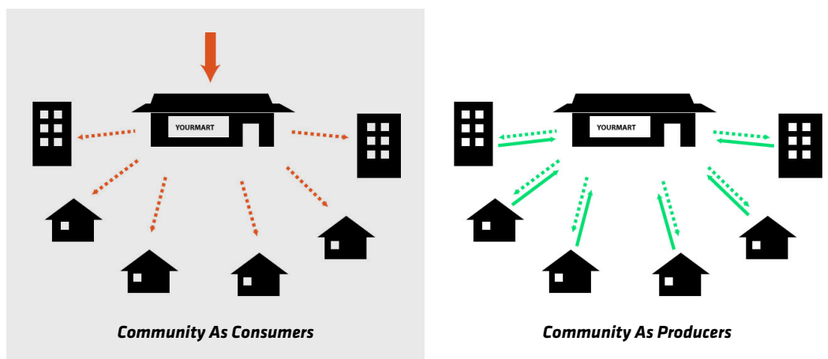

Figure 2.c *Alternative Model to Distribution*

Date
09. 21.2011

Module
Social

Prototype
Local Food Distribution Models

Focus

Food Deserts are described by the 2008 Farm Bill as, an area in the United States with limited access to affordable nutritious food, particularly such an area composed of pre-dominantly lower-income neighborhoods and communities.

Objective

Continuing the Social Module, it became important to find research and information about the current issues surround the topic of food distribution within America. This data will help develop a foundation for a more cohesive argument to validate the project, synthesize a specific problem with users that have real needs.

Guiding Questions

Who will need to participate in order to augment current food production? Who/What are the Stakeholders, Partners, Users and Sites needed to be involved with the project?

Results

Looking at the United States Department of Agriculture's Food Desert Locator (*Figure 1.a*) it is evident that there are many areas lacking access to nutritious food, at affordable prices. If we take a closer look at the data we see that the United States Department of Agriculture (USDA) deems food deserts in New York City to be almost non-existent (*Figure 1.b*).

Analysis

According to the New York Daily News, the USDA's map claims only 26,000 New Yorkers live in a food desert: while city officials estimate 3 million people within the New York live in food deserts.[1] Food desert data compiled into the map counts New York's bodegas, small corner stores that offer limited supplies, as grocery stores.[2] These bodegas generally provide unhealthy food options, and are not deemed by the public or the city of New York as an access to healthy food.

This highlights the fact that within this problem there is not support from the National Government. Solutions for this issue will not come from the top-down and therefore must come from the bottom-up. In order to begin to solve these problems the local communities who are afflicted by the problem must participate in the solution. Taking learnings from Identifying User Perceptions a conceptual model of new distribution and healthy food exchange was drafted. A document was created to show the juxtaposition of what communities as consumers vs. producers would look like, and how small New York shops *(Bodegas)* could integrate into this model (*Figure 2.c*).

Next Steps

Finishing the Social Module, it is now time to approach the Conceptual Model, and understand the avenues to begin to solve this now identified problem.

1 'Food desert' Status Denied to 3 million New Yorkers Without Grocery Stores, Lucadamo. *New York Daily News.* http://nydailynews.com
2 New Yorkers Question Federal Food Desert Maps, Eversely. *USA Today.* http://usatoday.com

Date
09. 28.2011

Module
Conceptual

Prototype
What is Urban Agriculture?

Focus
Completing the Social Module it is now understood the different groups involved in urban food crisis prevention. The majority of these Stakeholders, Partners, Users and Sites previously outlined are directly related to or participate in agriculture in some facet. It became clear that a closer examination of Agriculture was necessary in order to understand the full grasp of the project.

Objective
When attempting to solve a problem it is important to clearly identify the problem. Fully understanding the context and definition of the issue at hand will facilitate a better understand of the conceptual approach of this project. The work now revolves around providing better access to food; in an attempt circumvent Food Deserts. It becomes important to define the term Agriculture, as well as Urban Agriculture, to understand what they truely represent and what that means to the project.

Guiding Questions
What are the roots of agriculture, and how do they relate to society? What is the link between culture and agriculture, where did this connect come from?

Results
Agriculture is defined as the active production of useful plants or animals in ecosystems that have been created by people.[3] The word comes from Latin, agricultura which means "cultivation of the land," a compound of agri, "a field" and cultura, "cultivation".[4] So how then did cultura become culture? And what does culture really mean. Culture is defined as "development or improvement of the mind by education or training." [5] The root of the word is from not only the Latin cultura, but also cited from late middle English to mean till.[6] So this word gained two connotations of development, and of society as first noted by German Philosophers[7], but also to care, improvement, and development. In the end its roots are tied to cultivation.

Understanding the full impetus of agriculture and society, a clear definition of Urban Agriculture must also be accessed as the solution relates to local communities and neighborhoods of New York. According to A.W Drescher:

> *"Urban Agriculture refers not only to food crops and fruit trees grown in cities but encompasses animals... The urban farming system is a composition of many different activities like gardening, staple food production, gathering, hunting... combined with food production."*[8]

Analysis
The definition of agriculture shows how ingrained cultivation became to budding societies. It led to the realization that societies must be studied to learn how agricultural technology has shaped them. In understanding agriculture and urban agriculture, it will be vital to examine the implementations of early cultures.

Next Steps
There is a deep seeded connection between the rise and support of societies through various agricultural techniques. If a full conceptual model is to be drawn up, it is important to take a step backward and examine the historical contexts of agriculture that have shaped and grown culture in unique ways.

3 Agriculture. Encyclopedia Brittanica.
4 5 6 Cultivation. Dictionary.com
7 "The Tension in the Beautiful", Velkley, 2002
8 Urban Food Security. Drescher, 2000

AGRICULTURAL TECHNOLOGY	*MECHANISM*	*MEANS*	*METHOD*	*TASK*	*BENEFIT*
Sumerian Agriculture	Systematically Planting Crops	Individuals Tasked With Care and Maintenance	Implementing Farms and Distribution	Care, Maintenance, Distribution and Billing	People can eat Without producing Or hunting
Egyptian Irrigation	Moving Water to arid Land	Creation of Dams and Canals	Planned systems of Water and land	Digging, Engineering, Planning and Maintenance	Non-fertile areas Can produce food
Mayan/Aztec Chinampas	Lakes as crop fields	Creation of floating Beds for planting crops	Mud, Williow trees, Combine to retain land And absorb lake nutrients	Digging, Engineering, Planning and Maintenance	Produce vegetables And proteins Simultaneously
Babylon Hanging Gardens	Brick, pumps and Asphalt building Housing plants	Structure/Building As a garden/oasis	A system of pumps to Move water into growing Beds for plants	Care, Engineering, Planning and Maintenance	Beauty and Enjoyment
Victory Gardens Movement	Call to arms to plant Gardens in public and Private spaces	1920's media, newspapers, Movies, posters and radio Broadcasts as War propaganda	Empowerment of families, And communities to Become food producers	Creating culture of Creators to supplement War-time food stocks	Self dependent Communities, Local commerce, Feeding armies

Figure 3.a *Agricultural Technology Chart*

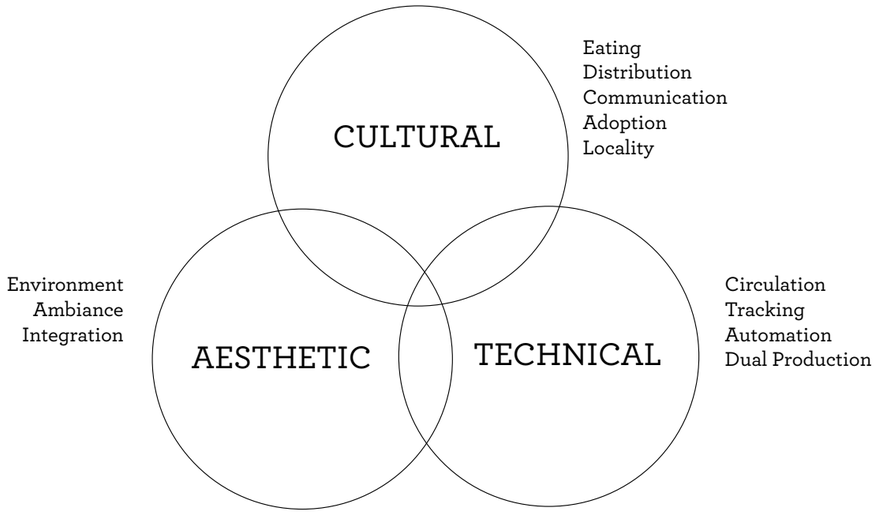

Figure 3.b *Conceptual Vienne Diagram*

Date
10. 06.2011

Module
Conceptual

Prototype
Roots of Agriculture

Focus
Building upon the research and investigation from the last entry, deeper insights about culture and agriculture can now be analyzed. In doing such, it is important examine prior successful models of agriculture and culture; as it seems this project must be deeply entwined with the two.

Objective
In order to examine the conceptual nature of the project, a research prototype was created as a way to understand agricultures role and benefits throughout societies. Five different scenarios throughout history were examined for their unique contributions related to agriculture and its way of creating, facilitating, or empowering a community of people.

Guiding Questions
What are historical instances of the use of agriculture? How have these instances shaped the landscape of society? How were the largest early civilizations/cities able to approach high output agriculture to support growing populations?

Results
A document was created outlining the advancements. For each item, the Mechanism, Means, Method, Task and Benefit were recorded and began to shape the key areas in which the project would need to be grounded (*Figure 3.a*).

Analysis
In the end, this prototype led to the understanding of three main conceptual areas, in which the project must focus as an agricultural advancement. These three areas - the Aesthetic, the Cultural and the Technological emerged to showcase a balanced focus for the work. The Aesthetic is the opportunity to create beautiful spaces with agricultural techniques, as seen in the Gardens of Babylon. The Cultural, is prevalent in each section (Figure 3.b). It is highlighted in the need for people to be involved through labor, distribution and planning. Last is the Technical. In this sphere there was a realization that the dual production of Aztec Chinampas is actually a technical advancement. This advancement in turn allowed the Aztec and Mayan civilization to record the largest cities of their time.

Next Steps
These findings helped to conceptually frame the projects major needs in order to design an agricultural advancement, similar to five key adaptations outlined (Figure 3.a). The results also helped to identify areas of further growth specifically as related to the technical requirements of the project, completing the Social Module. The distinction of Chinampas leads to the integration of the modern dual production method of Aquaponics.

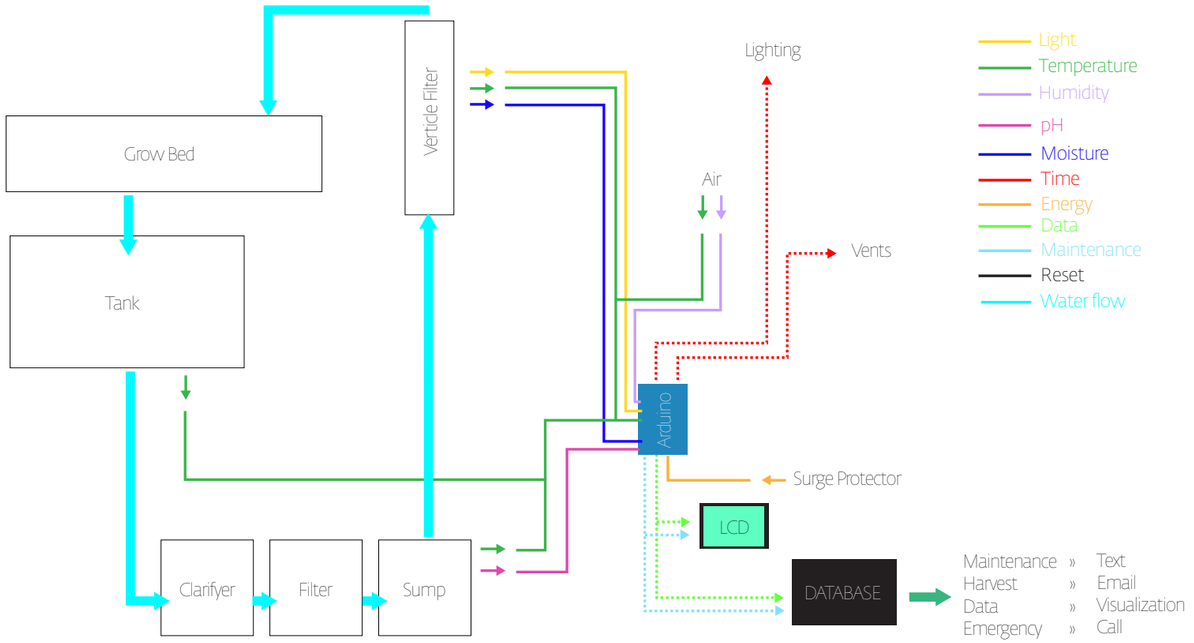

Figure 4.a *Technical Controls and Sensing*

Data		Use
Light	»	Health, Harvest & Lighting Control
Temperature	»	Health & Vent Control
Humidity	»	Health & Vent Control
pH	»	Health, Harvest
Energy	»	Efficiency
Moisture	»	Health, Harvest & Valve Control
Time	»	Harvest & Valve Control

Figure 4.b *Proposed Networked Garden*

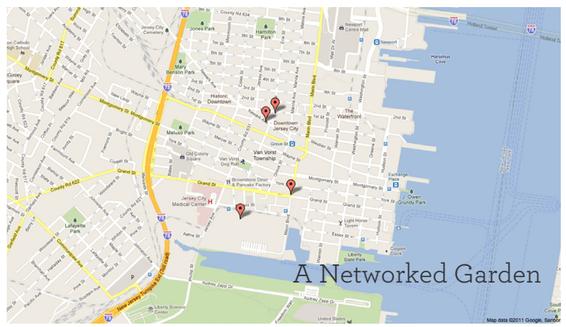

Figure 4.c *Proposed Networked Garden*

Date
10. 13.2011

Module
Technical

Prototype
Scalability, Modularity and Affordability

Focus
Entering the technical module the project had a framing from the conceptual examination. The result was that the solution was to create a dual producing, integrated environment, with cultural support. The technical module provided the opportunity to understand how these 'concepts' could be implemented into working solutions.

Objective
In order to approach this module in digestible manner, the technical module was divided into three key areas to examine, Scalability, Modularity and Affordability. These areas were identified through the synthesis of previous module examinations, of the social and conceptual. Once the general idea of who would use this system, and how it would need to be implemented; the technology behind the these systems needed to be thought out.

Guiding Questions
What are the technical hurdles associated with Aquaponics, semi-autonomous systems and recirculating systems? Which techniques and methods are the most efficient for users to capitalize upon? How can we plan effective modular systems, at various scales?

Results
Scalability became apparent for users to be able to manage a system of any size using the tools provided. Whatever the implementation a user needs the same system of control over its technology to manage it. Modularity arose as a need for individuals and communities to implement things within their unique spaces. Finally, Affordability was identified as a need for individuals to be able to be able to build and pay for their own systems.

Analysis
In the hope to create a scalable and manageable system, a series of sensors and controls (*Figure 4.a*) were proposed to support users in their aquaculture endeavor. According to the F1-Recirculating System by Family Farms, this type of Aquaponics unit is capable of producing a pound of fish and a pound of fresh vegetables for each gallon of clean water used. This proved the promise of dual farming as a key method for solving the problems of Food Deserts. It provides the ability to grow both fresh vegetables and healthy proteins, creating a well rounded meal. In order to justify the use of sensors and their needs, a document was created outlining their role within the proposed system(Figure 4.b).

The items within the scalable section fostered the ability for these systems to become modular, due to their connection to the internet as a data means. Once networked, these gardens possess the ability to then become hubs for one farmer to visit as needed. A system of alerts and real time information to users, micromanages the focus making system maintenance to be theoretically easier. If the sensor network can provide that for users, than an individual or community can capitalize on a variety of locations for their garden in a close region (*Figure 4.c*) as a way to stagger crop harvests and take advantage of limited urban spaces.

Next Steps
The last section of Affordability proved itself to be its own prototype sections entitled Filtration Part 1, and Part 2. This led to the Filtration Module which needed to be specifically added because of this projects special requirements.

Figure 6.a *Prototype v00.0*

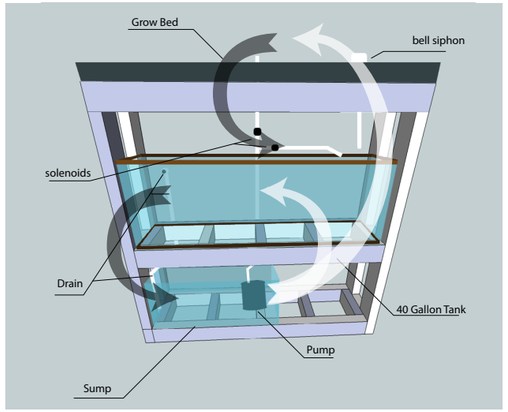

Figure 6.b *Prototype v00.1*

Figure 6.c *Sump Filter Constructed*

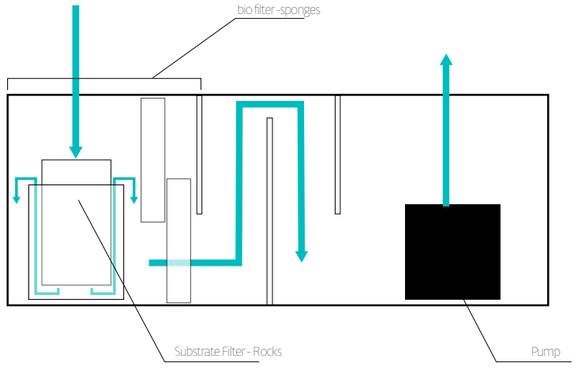

Figure 6.d *Sump Filter Flow Diagram*

Date
10.15.2011

Module
Filtration

Prototype
Part 1

Focus

This section serves to acknowledge the filtration specific needs of this project. Specifically it is important to note the integral needs to develop filtration for small scale aquaculture, using only accessible inexpensive materials as highlighted by the affordability section of the Technical Module.

Objective

The initial prototype v00.0 was created based off the fore mentioned mini-thesis project from the semester prior, Spring 2011(*Figure 6.a*). This prototype, a 10 gallon tank with a plant filter, used a method of Aquaponics known as an ebb and flow[9] system. Re-entering a new semester, it became apparent through research that the larger an aquaculture system, the more stable and dependable it becomes - this is common knowledge in the fish rearing and aquaculture communities.

Guiding Questions

What are the filtration specific hurdles associated with semi-autonomous Aquaponics recirculating systems? Which techniques and methods are the most efficient for users to capitalize upon? How can we plan effective modular systems, at various scales?

Results

Prototype v00.0 had shown a need for more water clarification, filtration, and oxygenation in order to provide a healthy aquatic environment for fish. A more technically enhanced prototype v00.1 of the initial ebb and flow system created was proposed to cycle watering and create constant flow of water for aquatic life (*Figure 6.b*). In order to execute the prototype two pieces of hardware needed to be created, a control using solenoids to regulate flow to location, and a sump/filter(*Figure 6.c & 6.d*). This filter used a bio filter[10], of sponges along with a substrate filter of rocks.

Analysis

Prototype v00.1(Figure 6.b) also had a variety of failures which are important to point out. In this prototype organizational flaws and a push for the use of technology caused a drastic and dangerous prototype. Leaking water caught above solenoids prompted circuit malfunction. The prototype was eventually scrapped for an alternative direction in which filtration hardware could replace electrical hardware. In addition to the electrical issues, the custom sump created eventually broke and leaked. Thirty gallons wound up on the floor on a Monday morning, after a previous week of successful leak testing. Construction was done the previous night on the prototype which must have caused the enormous leak.

Next Steps

The combination of dangerous electronics and failed filtration led to the realization that alternative methods needed to be explored to create a small scale Aquaponics system. This prototype will be readdressed in the Filtration Part 2 and Evaluative Sections.

9 A system where the plant grow-bed fills with water, until it reaches a cut off point of a syphon. Once the syphon is engaged all the water is pulled out of the grow bed. This cycle runs multiple times an hour.

10 The area within an aquatic ecosystem where good bacteria grows. This bacteria feeds on harmful ammonia, created via fish waste, and created nitrites and nitrates, or plant food. This by-product is then safely removed from the system by fertilizing the plants.

PROJECT TITLE	*APPROACH*	*MEDIUM*	*PLANNING*	*RESULT*
Edible Estates Frizt Haeg	Converting Lawns/public spaces into Edible Crop gardens. Crowd Sourced for Lawns to gain recognition	Land and Edible Plants	Acquiring sites, plant selection and layout	Becomes a 'show' and an exhibit. Creates buzz which generates interest
Window Farms Britta Riley	Converting Windows into Hydroponic gardens	recycled materials, nutrients, pumps	Make it yourself or purchase pre-made. Schematics, how-tos, community forums .	Community of window farmers is growing across the country
Farm Fountain Ken Rinaldo & Amy Youngs	Using Urban space for aquaponic garden as installation	plants, fish, recycled materials, bacteria, lights	Location, plant selection, fish selection, light identification	exhibition installation, diy system, no community

Figure 5.b *Methodology Charting Precedents*

Date
10.22.2011

Module
Methodological

Prototype
Interpreting Successful Methods

Focus
The methodological module provided the opportunity to examine successful projects, in order to understand the methodologies they implemented. During this time period a variety of precedent projects were researched. Three projects were highlighted as key precedents to the body of research being conducted. The rationale for their role as a precedent was articulated and then each project was examined by a framework, in order to best understand its approach and results.

Objective
Each precedent was outlined by its Approach, Medium, Planning and Result. The three projects analyzed were Fritz Haeg's Edible Estates, Britta Riley's Window Farms, and Ken Rinaldo and Amy Youngs', Farm Fountain. These projects showcased themselves as the most relevant to the work and their successes, warranted further analysis (*Figure 5.a*).

Guiding Questions
What are the methods others are using in approaching urban agriculture? Do the systems succeed or fail? What are the key learnings/take aways from these methods? How can these be implemented to benefit the project?

Results
This task facilitated a keen understanding of the competition's strengths and weaknesses, as well as avenues for adoption and an outline of what makes successful projects in Urban Agriculture. The four aspects, the approach, Medium, Planning and Result, were used as a framework to make an accurate comparison of the methods of each project.

Analysis
The exercise highlighted the need for community involvement, through the methodology of both Edible Estates and Window Farms, and their success being related directly to fostering communities of people. Farm Fountains inability to foster a community highlighted a disconnect and a potential area of growth for the project. Overall the methods for success were noted and are key to set the methodology for which this project must observe. At the same time this analysis facilitated the projects examination into the Evaluative Module.

Next Steps
In outlining the methods which the project can follow, a clear successful path arose in fostering community engagement. The last of the Modules set out to define is the Evaluated, however before this can be discussed a final prototype must be explained.

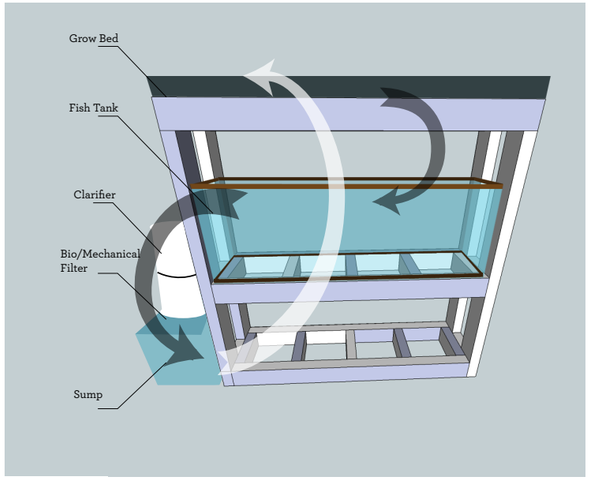

Figure 6.e *Prototype v00.2*

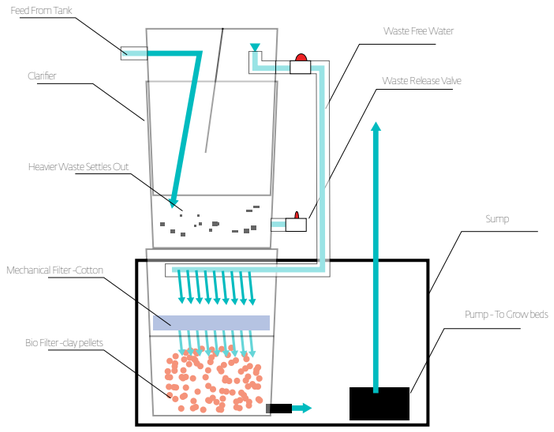

Figure 6.f *Prototype v00.2 Filtration Flow Diagram*

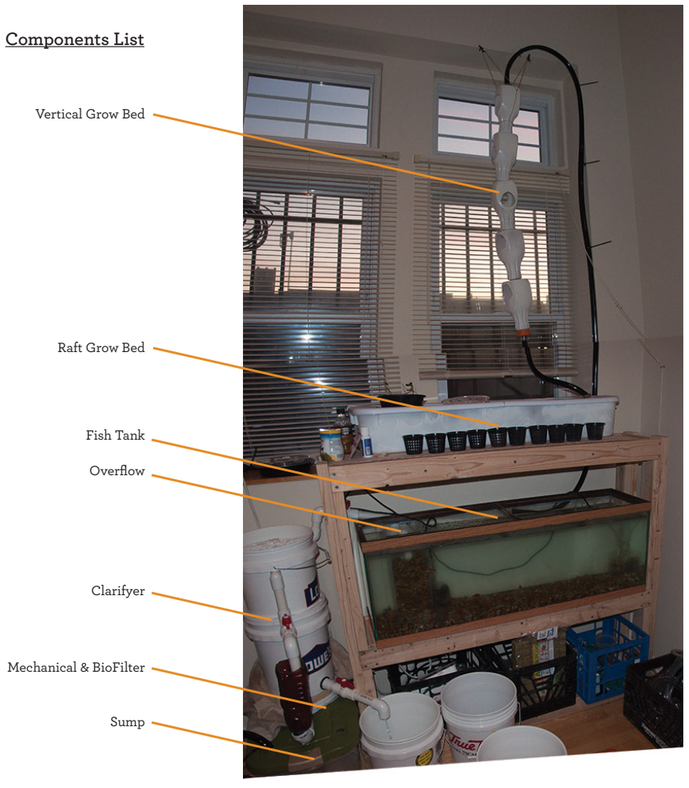

Figure 6.g *Prototype v00.2 Photo*

Date
11.15.2011

Module
Filtration

Prototype
Part 2

Focus

This section serves to acknowledge the filtration specific needs of this project. Specifically it is continuation of the section Filtration Part 1, material from this section will reference those pages, and images.

Objective

Prototype v00.2 focuses on a realization that alternative technical solutions to cleaning and flowing water can also be solved within the scientific methods of Aquaculture. Rather than continuing to pursue a means of continuous water, flow through added electricity and programmed intelligence devised and implemented, proved to be an alternative solution to the ebb and flow model (*Figure 6.e*).

Guiding Questions

What are the filtration specific hurdles associated with semi-autonomous Aquaponics recirculating systems? Which techniques and methods are the most efficient for users to capitalize upon? How can we overcome the shortcomings of prior prototypes?

Results

In order execute this model a new type of filtration was required. Including a new functional requirement known as a Clarifier[11] (*Figure 6.f*). Finally in addition to this system other elements were added to the growing environment for the plants, including a vertical grow bed[12] and a raft bed[13] (*Figure 6.g*).

Analysis

This new version of a prototype has great hopes for its ability to create cleaner and more sound scientific results; which will in turn foster more sustainable ecosystems, hopefully. As this prototype is still in progress, it is difficult to provide actual analysis about the implications of the choices and learnings. However it is important to note that this prototype facilitated the need to examine the evaluation of this project, as a means for better understanding of prototypes and decisions made.

Next Steps

Moving forward, it is important to provide a framework for true analysis of completed and in progress prototypes as a means for rapid decision making and reflection.

11 A piece of hardware which intakes water from a fish tank, the water is forced downward gently. The liquid is then forced to slowly rise in order to exit the device. During this process solids are settled out from the water, removing suspended solids, which cloud the water.
12 A hydroponic technique of growing plants vertically to save space. The plants are provided nutrient rich water to their roots, while in a soilless substrate container suspended in air.
13 A hydroponic technique where a plants roots sit directly in nutrient rich water that provides the roots nutrient rich water, using this method water must be extremely clean, continually moving and have a high oxygen content in order to maximize root intake and minimize root rot.

Date
11.20.2011

Module
Evaluative

Prototype
Ecological Design

Focus
Approaching the Evaluative Module last allowed for reflection upon the entire semester, as well as an analysis of the work completed to date. This facilitated reflection upon the all the previous modules, including the filtration specific module. This section allows for the evaluative frameworks to be applied.

Objective
The integration of design principles as a guiding structure to gauge success, and evaluation of the project, provides constraints to ensure the direction of the project is held to a set of higher standards. Research led to a set of design principles to frame the work.

Guiding Questions
How do we evaluate the success of the project? How can we determine the scales of success? What are the key elements needed to achieve in order to evaluate the project? Are there levels of success?

Results
In approaching the evaluation of the work completed during the Fall Thesis Section, it became important to find other frameworks to support the project. Realizing that the projects main goals were to support sustainable economies and communities, it became evident that the Five Principles of Ecological Design written by Sim Van der Ryn and Stuart Cowen[14] would provide strong framing for the examination and its potential success.

The Principles of Ecological Design are outlined as follows:

1. Solutions grow from place
2. Ecological accounting informs design
3. Design with nature
4. Everyone is a designer
5. Make nature visible

Analysis
Any prototypes or projects attempting to solve the Food Desert problem within New York, must fit within this framework to be deemed successful. In dictating that the proposed solution systems fit under the Principles of Ecological Design, we ensure that Sustainability and the environment are at the forefront of the solution.

Next Steps
Now that a greater design system and structure can be used to gauge success of the project it is necessary to outline ways in which current work can be evaluated and dissected. Similar to the historical agricultural technologies, and competitor methods analysis outlined in prior sections a framework must be developed to illustrate the strengths and weaknesses of prior and current prototypes.

14 Edwards, Andres R. 2006. The Sustainability Revolution: Portrait of a Paradigm Shift. Philadelphia, Pa: New Society. 103-104

PROTOTYPE VERSION	ENVIRONMENT			DOMAIN			
	MACRO	MICRO	SOCIAL	AQUACULTURE	HYDROCULTURE	HARDWARE	INTERACTION
v00.0	North Eastern United States	Apartment	No Social Interaction	10 Feeder Fish, Need more circulation & suspended matter removal	Minial plant growth, Needs more light and Grow Bedspace	Custom Ebb&Flow System with air pump	Flawed,/ Non-existant
v00.1	North Eastern United States	Apartment	thesis.piuggi.com	Cannot support fish life	Cannot support plant life	Dangerous electrical components mixing with water.	Flawed,/ Non-existant
v00.2	North Eastern United States	Apartment Temperature Instability	Data Visualization	Blue Gill fish, using clarifier	Vertical and raft grow beds to be provided natural and artificial lighting	Raft, Clarifier, BioFilter, Mechanical Filter, LED Light systems	Data Feedback

Figure 7.a *Prototype Evaluation Guide*

Date
11.26.2011

Module
Evaluative

Prototype
Evaluating Prototypes

Focus
Acknowledging the 5 Principles of Ecological Design provides an overarching framework. However it is necessary to provide a more finite comparison between these project specific prototypes.

Objective
To address this need an evaluative system was created to analyze past and future prototypes. As previously mentioned, past methods for analyzing projects and advancements became an influence for organizing and understanding the prototypes created during Fall 2011 Thesis Studio as well as future prototypes.

Guiding Questions
How do we evaluate the success of the project? How can we determine the scales of success? What are the key elements needed to achieve in order to evaluate the project? Are there levels of success?

Results
The evaluative system created utilizes two over arching classifications for the evaluation of prototypes. The first area is the environment a constructed system lives in; thinking of the Ecological Design Principle 2 - we must be aware of the environment we design within and its effects[15]. Each system must perform in unique areas, and accounting for fish and plant species correlates directly to these factors. The environment of the system is then analyzed by three sections, the micro, macro and social. The second area for evaluation is the prototypes domains; it is important to recognize that there are a variety of domains merging within this project. By stating the purpose and use of each domain for each prototype it is clear to see what is overlapping, and then make distinctions as to what is successful and unsuccessful(*Figure 7.a*).

Analysis
The evaluation document serves to showcase glaring flaws and potential directions for prototypes. As future prototypes are built they will be designed using successful elements while avoiding past pitfalls. This also provides opportunity for reflection and analysis in illustrating the components and advancements of the prototypes. Categorizing the sections serves as a checklist for each sequential examination. In doing so a greater understanding of choices, decisions and outcomes is fostered, as well as a concise metric for evaluation.

Next Steps
A variety of filter prototypes must be explored in order to finalize best scientific avenue to promote maximum production.

15 Edwards, Andres R. 2006. The Sustainability Revolution: Portrait of a Paradigm Shift. Philadelphia, Pa: New Society. 103

Glossary

Ammonia *A toxic chemical created when fish waste builds up in a tank water this can in turn create an unhealthy ecosystem.*

Agriculture *Defined by Encyclopedia Brittanica as the active production of useful plants or animals in ecosystems that have been created by people.*

Aquaculture *A method for farming fish in a commercial way to provide large quantities of fish to a given market.*

Aquaponics *Defined by The University of the Virgin Islands Agricultural Experiment Station as a recirculating system where nutrients, which are excreted directly by the fish or generated by the microbial breakdown of organic wastes, are absorbed by plants cultured hydroponically (without soil).*

Bio filter *The area within an aquatic ecosystem where good bacteria grows. This bacteria feeds on harmful ammonia, created via fish waste, and created nitrites and nitrates, or plant food. This by-product is then safely removed from the system by fertilizing the plants.*

Clarifier *A piece of hardware which intakes water from a fish tank, the water is forced downward gently. The liquid is then forced to slowly rise in order to exit the device. During this process solids are settled out from the water, removing suspended solids, which cloud the water.*

Culture *Development or improvement of the mind by education or training.*

Ebb and Flow System *A system where the plant grow-bed fills with water, until it reaches a cut off point of a syphon. Once the syphon is engaged all the water is pulled out of the grow bed. This cycle runs multiple times an hour.*

Food Desert *Described by the 2008 Farm Bill as, an area in the United States with limited access to affordable and nutritious food, particularly such an area composed of predominantly lower-income neighborhoods and communities.*

Hydroponics *Growing plants in soil less media, and providing nutrient rich water to fertilize plants via their roots.*

Nitrogen Cycle *The conversion of Ammonia into Nitrites and then Nitrates in order to remove them from the water for healthy fish.*

Raft Bed *A hydroponic technique where a plants roots sit directly in nutrient rich water that provides the roots nutrient rich water, using this method water must be extremely clean, continually moving and have a high oxygen content in order to maximize root intake and minimize root rot.*

Urban Agriculture *According to A.W. Drescher, Urban Agriculture refers not only to food crops and fruit trees grown in cities but encompasses animals... The urban farming system is a composition of many different activities like gardening, staple food production, gathering, hunting... combined with food production.*

Vertical Gardening *A hydroponic technique of growing plants vertically to save space. The plants are provided nutrient rich water to their roots, while in a soilless substrate container suspended in air.*

Victory Gardens *A movement during World War I and II to promote local agriculture to support a large mass of troops needing to be fed over seas.*

Annotated Bibliography

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An intriguing article written about the potentials of urban farming. The article showcases the amount of available unconventional rooftop spaces which can be used for local agricultural solutions.

Drescher et al. 2000. "Urban Food Security: Urban agriculture, a response to crisis?" *UA Magazine*, 2000 1.1.

A staple text outlining the use and needs of urban agriculture throughout the world. This texts serves to define the field as well as present it as a solution to various world food issues.

Diver, Steve and Lee Rinehart. *Aquaponics - Integration of Hydroponics with Aquaculture.* National Sustainable Agriculture Information Service, 2010.

A critical text outlining successful models of Aquaponics. This text also discusses the difficulties and opportunities within the research of Aquaponics. It does well to provide general and in-depth information about the business and scientific aspects of Aquaponics.

Edwards, Andres R. 2006. *The Sustainability Revolution: Portrait of a Paradigm Shift.* Philadelphia, Pa: New Society. 103-104

This book outlines the various methods and opportunities for Ecological and Sustainable Design as a framework for integration into current design and architecture projects. This is the route of the evaluative portion of the project.

"Food Desert Locator Documentation," *USDA Economic Research Service.* Accessed Oct 9, 2011. http://www.ers.usda.gov/data/fooddesert/fooddesert.html

The interactive showcase of Food Deserts in America provided by the USDA. Users can navigate to discover facts and data about the Food Desert they live in. This site features the data in question by the city of New York.

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A book dedicated to networked robotic devices. The book is a collection of essays discussing the telepresense of data, and creating interactive experiences from a distance through the internet.

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The initial news story that broke the information about New York City being under reported for Food Deserts, this article first addressed the issue to shed light on the efforts of the city to understand this growing issue.

Open Source Hardware Definition, accessed November 26, 2011. http://freedomdefined.org/OSHW

The working definition for Open Source Hardware, a process for sharing information about Hardware devices in a similar way to the Open Source Software Movement.

Rakocy, James "The Status Of Aquaponics, Part 1," *Aquaculture Magazine*; Jul/Aug99, Vol. 25 Issue 4, 83.

An overview text of Aquaculture by the expert from the University of the Virgin Islands, James Rakocy, developer of one of the first successful Aquaponics systems. The text provides an expert look at filtration and the biology of ecosystems.

Rakocy, James, Bailey, Donald S., Shultz, R. Charlie and Thoman, Eric S, "*Update on Tilapia and Vegetable Production in the UVI Aquaponic System.*" University of the Virgin Islands Agricultural Experiment Station, 2003.

One of the first Aquaponics Research systems to be set up, this paper serves as an update the to the progress happening within this system. As one of the first successful Aquaponics system in the world this group is touted as the experts in the field.

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