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Regional Land for Food

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Regional Land for Food

Project Goals and Overview

Our goal this semester was to provide measuring tools, or benchmarks, for the community to better understand the amount of land needed to feed our area on an all local diet based on USDA food pyramid standards. Though we understand that an all local diet may be difficult, and some might argue impractical, it is an idealistic goal that helped simplify our data collection. We hope this information, presented to local planning officials, will help to discourage future farmland loss and increase awareness about the value of having local, sustainable food sources. We also engaged the community through a survey about garden use administered during the Saturday farmer's market. By making information available to the community through this report, citizens of the area can make informed choices when buying food, and planning officials can attempt to promote more land to be used for food production in the TJPDC through a stronger understanding of how much land is needed.

Through this research we aimed to determine:

a) The amount of land available for farming in the Thomas Jefferson Planning District Commission area

b) The amount of land needed to feed our area based on a balanced diet, crop yields and population

c) Limitations of current farmland use in feeding the TJPDC.

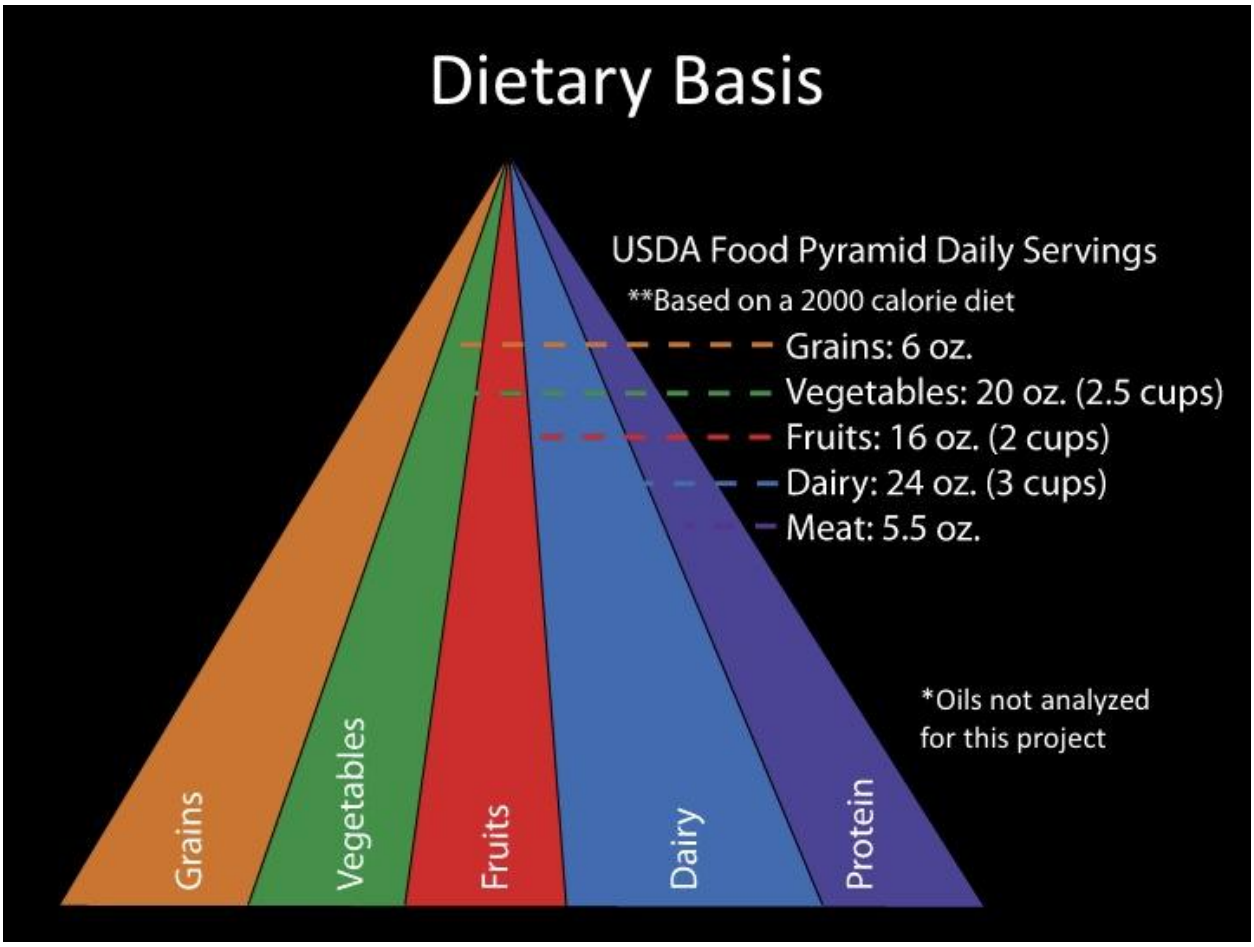
d) Current and changing urban farming (gardening) trends

The area of examination was the Thomas Jefferson Planning District (planning district 10 within the State of Virginia). This includes the counties of Nelson, Albemarle, Fluvanna, Greene, Louisa, and the city of Charlottesville. The TJPD has a long history and tradition of farming. Our community shows its support of this heritage of locally grown food by patronizing farmers markets, and local food businesses. Our community has expressed a desire to have more local food and be able to support themselves on a more sustainable and nutritious diet. While our primary research concerned assessing the farmland available and potential farmland use, we also considered problems such as willingness to eat local food, costs, and distribution limitations. Eventually these concerns will also need to be addressed to complete the goal of an all local diet for our community. By identifying key benchmarks in the land for food equation, advising and educating planners and the community about how they can help, the resources and involvement will be achieved to overcome these hurdles and to progress to a sustainable, locally grown diet for all of our community members.

Project Methods

The first part of our research was to establish what diet would be used to formulate our calculations. Meeting with Lynda Fanning, nutritionist for the University of Virginia Health System provided a USDA 2,000 calorie a day diet was chosen for this project. Individuals and groups may require different servings, such as children, the elderly, or those with illnesses, but

the 2,000 calorie diet was based on an average healthy man, and provided slightly larger serving sizes than all citizens may require. For this research we did not analyze land needed for oil consumption, so here is an altered USDA food pyramid without oils included.



Ultimately the goal for the calculations was to arrive at a final number with units in the amount of acres per person for the five different food groups. This meant creating an equation for each section to multiply how many servings our population required and then divide that figure by the amount of land required to produce that volume. Several resources were used in order to find realistic numbers for agricultural production in Virginia. The two main resources used were The USDA agricultural census and the Virginia Cooperative Extension. The basis for

using these sources was that they represent the amount of production that is possible on average in Virginia using existing agricultural practices and the resources that are available to novice farmers. The sections following describe how calculations were made for each of the food groups.

Dairy

Using the USDA 2008 State Agricultural Overview it was found that last year 98,000 cows produced 1,725,976,000 lbs of milk. This equates to each cow yielded an average 17,612 lbs of milk throughout the course of the year (USDA 2008). Using the common liquid conversion factor of 8.6 lbs per gallon it was possible to convert production rate from 17,612 lbs of milk per cow per year to 2047.9 gallons per cow per year. Again 2047.9 gallons was converted to 32766.4 cups of milk per cow per year using the common conversion factor of 16 cups per gallon.

The food pyramid recommends that each person have 3 cups of dairy a day (USDA 2005), thus with a population of 219,557 consuming 3 cups a day for 365 days a year, it was found that the Charlottesville area will need to produce 240,414,915 cups of milk each year to feed its population. When the number of cups of milk needed each year was divided by 32766.4, or the number of cups produced per cow per year, it was found that 7337.2 cows are necessary to supply dairy to Charlottesville. According to the Virginia Cooperative Extension, each cow requires 0.04 acres of living space and hay from about .75 acres of land (VA Cooperative Ext. 1996). In addition to that, a cow needs at least 2.82 bushels of corn each year (VA Cooperative Ext. 2000), which can be grown on 0.026 acres a year (USDA 2008). In total, each dairy cow requires 0.816 acres a year. Therefore, 5987.2 acres of land are required to provide dairy to

planning district 10. By dividing 5987.2 by the population, it was found that each individual person requires 0.027 acres acre of land for their yearly dairy intake to be produced. Only milk from cows was analyzed for the purposes of this research.

Vegetables

The Virginia Cooperative Extension provides data on yield in pounds per 10 ft of a row and standard distance between rows for vegetables being grown in Virginia. From these two numbers it was possible to find the yield per 100 square feet planted of certain types of vegetables. In order to find an average yield per square feet for vegetables in general for Virginia, a list of standard vegetables that would provide various different nutrients was chosen. The list included asparagus, pole beans, broccoli, carrots, cucumbers, eggplant, leaf lettuce, bibb lettuce, potatoes, southern peas, sweet corn, spinach, sweet potatoes, summer squash, winter squash, tomatoes, watermelons, and peppers. Pounds of yield per square feet was found for each vegetable using the data provided (VA Cooperative Ext. 2006), and then an overall average of 83lbs/100sqft was found. Using the conversion that 1 pound is equal to 16 ounces, and that 16 ounces is approximately equivalent to 2 cups, it was possible to convert yield from pounds per 100 square feet to 664 cups per 100 square feet. There are 43,560 square feet in one acre, and with this equation, it was possible to calculate that each acre used for vegetable farming could potentially produce 289,238.4 cups of vegetables each year.

The food pyramid recommends that each person eat 3 cups a day of vegetables (USDA 2005). If the 219,557 residents of TJPD eat the recommended amount for 365 days the area will need to produce 160,276,610 cups per year. When that number was divided by the amount of cups of vegetables that can be produced on one acre, it was found that the region would need

554.1 acres of land for vegetable production to supply its population with the recommended amount of vegetables each year. When that number is divided by the population it is found that each person requires only 0.0025 acres of land to provide them with their yearly vegetables.

Grain

The USDA provides data for wheat and barley production in the form of pounds per acre produced within the five counties that make up Charlottesville (USDA, 2008). The two values were averaged to find that it is possible to produce 3,648 lbs of grain per acre in the region. Since 16 ounces are equivalent to one pound, then each acre could potentially yield 58,368 ounces of grain per year. The USDA food pyramid recommends that each person consume 6 ounces of grain each day (USDA 2005). In order to provide 219,557 people with 6 ounces 365 days a year, the region will need to produce 481,000,000 ounces of grain each year. When that number was divided by the amount of ounces of grain produced per acre, it was found that 8,237.9 acres would be needed to supply grain to the residents of district 10. The number of acres needed was then divided by the population equaling 0.038 acres needed to provide the grain needed for one person per year.

Fruit

The Virginia Cooperative Extension provides data about the spacing between fruit bushes and trees and on the average yield of each plant in Virginia. Using this information, the yield in quarts per acre was found for blueberries, blackberries, grapes, strawberries, and apples and an average was taken. It was found that an acre planted with fruit in Virginia will yield

approximately 19,732.7 quarts of fruit.

According to the USDA Food Pyramid each person should eat 2 cups of fruit per day, which is equivalent to 0.5 quarts (USDA 2005). Using the population number 219,557, it was calculated that the Charlottesville region needs approximately 40,000,000 quarts of fruit each year. If each acre yields 19,732.7 quarts, then the region needs to have 2,030.6 acres in production of fruit in order to sustain its population. This is equivalent to 0.0092 acres per person.

Meat and Protein

According to the USDA food pyramid, each person should eat 6 ounces of meat or some sort of protein source each day. If 16 ounces is equivalent to 1 pound, then each person requires 0.375 pounds of meat per day. When 0.375 pounds is multiplied by 219,557, the population of the five counties, then it is found that the region requires 82,334 pounds per day and 30,051,864 pounds of meat per year

Beef

According to the Virginia Cooperative Extension, a beef cow requires about 2.5 acres of pasture and hay from about .75 acres of land, totaling to 3.25 acres of land per cow (VA Cooperative Ext. 2000). In addition to that, a cow eats at least 2.82 bushels of corn each year (VA Cooperative Ext. 2000), which can be grown on 0.026 acres a year (USDA 2008). Therefore, each cow requires 3.276 acres to live on and to be fed. Based on a USDA census, it

was found that the average weight of meat produced by each cow was 778 pounds (USDA 2008). If the population of the Charlottesville region requires 30,051,864 pounds of meat each year, then the region will need to raise 38,627 cattle each year, which will require 126,542 acres or 0.576 acres per person.

Pork

There are many different techniques for raising pork and rarely are modern pigs kept on pastures. Twenty square feet per pig was chosen as the most reasonable number for this study based on the fact that it was the optimal "low risk" spacing for health and environmental issues according to the Virginia Cooperative Extension (VA Cooperative Ext. 1996). If each pig requires 20 square feet then it is possible to keep 2,178 pigs on each acre. According to the 2008 USDA census, the average pig slaughtered in Virginia yielded 203 pounds of meat (USDA 2008); therefore an acre could potentially produce 442,134 pounds of meat. The Charlottesville region needs 30,051,864 pounds of meat, which if supplied solely by pork would require 68 acres or 0.0003 acres per person. Better, more environmentally sound and humane methods for pig farming are available, and would require more land usage, but data on yields for these methods may be difficult to interpret for the purposes of this project.

Meat Chickens

When raising "Free Range Chickens," 4,033 chickens can be kept on one acre (Fanatico 2006), and based on the USDA 2008 Census of Agriculture, chickens from Virginia yield on average 5.2 pounds of meat each year (VPF 2007). Therefore, it is possible to produce 20,972 pounds of chicken meat per acre. If the Charlottesville region requires 30,051,864 pounds of

meat per year then the region would need 1432.9 acres total for chicken production or 0.0065 acres per person

Laying Chickens

"Free Range" layers require more space than meat chickens. They must be kept with only 1,000 hens on each acre (Fanatico 2006). On average, hens in Virginia lay 245 eggs per year. If each egg weighs approximately 58 grams (USDA 2008), then it is possible for hens to produce 31,360 pounds per acre. If the Charlottesville region requires 30,051,864 pounds of protein per year, then the region would need to allocate 958.3 acres to egg production or 0.0044 acres per person.

Findings

ACTUAL

	Acres per	Total Acres	Acres in Production
Grains	0.038	8,237.9	1,877
Vegetables	0.0025	554.1	489
Fruit	0.0092	2,020	2,543
Dairy	0.027	5987.2	*** (not available)
Total	0.0767	16,799.1	

ACTUAL PROTEIN

	Pound per Acre	Acres per Person	Total Acres	Total Acres in Production
Chicken (eggs)	31,360	0.0044	958.3	6.3 (6,322 animals)
Chicken (meat)	20,972	0.0065	1,432.9	*** (numbers not available)
Beef	237.5	0.576	126,542	28,151 (36,000 animals)
Pork	442,134	0.0003	68	0.4 (850 animals)
Average	123,676	0.1468	32,250.3	

IDEAL

	Acres per person	Total
Dairy	0.12	26346.84
Fruit	0.0092	2019.9
Grain	0.038	8237.9
Vegetables	0.0025	554.1
Total	0.1697	37158.74

IDEAL MEAT

	Pounds per Acre	**Acres per Person**	**Total Acres**
Chickens (eggs)	31360	0.0044	958.3
Chickens (Meat)	20972	0.0065	1432.9
Cattle	237.5	0.576	126542
Pork	442134	0.0003	68
Average	123675.875	0.1468	32250.3

	Acres per Person	**Total Acres**
Overall Total	**0.3165**	**69409.04**

Discussion and Analysis

When our research began, it was understood that agriculture in the Charlottesville region would have to expand if food was to be sourced locally. The acres-per-person analysis was done using data from the most accessible resources for farmers. However, the purpose of the project ultimately is to promote food sustainability in the Charlottesville region. There are far more sustainable agricultural practices that could potentially increase production while at the same time promote environmental health in the region. Ultimately, if the land in production is increased, the goal should also be to introduce more sustainable agricultural practices as well.

Discussion of our data and its limitations

Grain is not a logical local product because the Charlottesville region does not have the vast spaces required for local wheat prices to compete with industrial mid-western grain prices. It has been a long time since grains have been produced locally on a large scale for this region. However, Thomas Jefferson claimed that Albemarle was one of the best counties in Virginia for growing wheat…. (Jefferson, 1810)

Discussion of sustainable farming methods

There are several innovative farmers in the Charlottesville region and Virginia who have developed ways to increase production per area, while at the same time reducing their use of

inputs, like fertilizers and pesticides that cause water and soil pollution and require large amounts of fossil fuels for their production. Joel Salatin in particular has successfully developed a farming ecosystem based practices for meat production. His "Pastured Poultry Technique" allows him to produce beef, chicken meat, and eggs on a single pasture. He keeps about 1,000 chickens per 5 acres in a moveable cage in his cow pasture. The advantage of this is that the chickens fertilize and trim the pasture to make the grass more nutritious for the cattle. In addition, since the chickens eat insects they require 30% less feed but still have a more nutritious diet than industrially raised chickens and are capable of producing around 21 dozen eggs each year. The system makes producing organic poultry and organic grass fed beef much less expensive by negating the need for inputs and expensive organic chicken feed (Nation 2008).

Salatin has also developed a way to naturally raise pork on land that is otherwise unproductive for agriculture. Most pigs in Virginia are raised in pens and are kept in close quarters. This concentrates waste causing point source water and air pollution, makes disease outbreak among the animals more likely, and is a less ethical practice of animal husbandry. Salatin has begun to pasture his pork in forested land in the mountainous parts of his farm. These pastures provide a natural setting where the pigs can root and forage. At the same time, they are clearing the land so that one day it may be able to be converted to pasture. This method, along with some of his other practices has brought Salatin success. He is one of the first strictly local farmers to successfully sell meat to a corporate food chain. He claims that the secret to his success is that “the unfair advantage of grazing pigs is that after 200 pounds they can get more of their feed from the grass. I figure I get a 350 pounder on about the same feed as a commercial finisher gets his to 250 pounds. It’s in those last 50 to 100 pounds where your advantage lies" (The Stockman Grass Farmer 2008). The Salatin methods discussed are just two of the many

practices used on his Polyface Farm that are based on natural ideals. However, they are two that could be easily implemented on pasture and forested land in the Charlottesville region.

Dave and Leigh O'Neill are another pair of farmers in the Charlottesville region who have managed to increase their fruit and vegetable yields using natural Permaculture methods. Their farm, Radical Roots, is a model of sustainable agriculture in mountainous regions like Charlottesville. Though they have just 4 acres of hilly land in production, they are able to produce 1 to 2 tons a week during the growing season. They are capable of such production because of their use of Swales and Berms. Swales and Berms are a series of trenches and beds along the contours of their land that catch water reducing the need for irrigation. In addition to that they co-crop to enhance fertility.

Discussion of our community engagement project

Another way to increase the sustainability of the Charlottesville food system is to increase urban agriculture. It was found that there are 690 acres of vacant urban land in Charlottesville (Comprehensive Plan, 2007), where individual citizens could potentially grow their own food. Furthermore, by promoting the use of biointensive methods, such as those discussed by John Jeavons, it is possible to make even small yards extremely productive. Jeavons claims that a single person can be sustained on just 4000 square feet.

Urban Agriculture will address sustainability on several levels. First it will encourage land use inwards rather than forcing agriculture out into natural ecosystems. Equally as important, increasing urban organic agriculture will allow citizens of the region to reduce their carbon footprint. The agriculture industry is one of the largest consumers of fossil fuel energy in the US. Fertilizers, machinery, and food transport all use large amounts of petroleum. Organic

gardening at home produces food without relying on any of these. Moreover, when a garden is planted in an urban yard instead of a lawn, there is no need to use gas powered lawn care machinery or lawn fertilizers. Furthermore, gardening makes fresh fruits and vegetables seem exciting while also making them physically more accessible. By enabling more members of the community to have access to gardens, it is possible to promote healthier eating habits and ultimately a healthier community. Teaching young people about sustainable farm practices, training the next generation of farmers to be stewards of the land, and by increasing the amount of farmers in our generation, it is possible that one day there may be enough farmers to provide more local food sources to America's different cities. Bringing agriculture into urban areas will also teach people about sustainability, the impact they have on the environment, and ways to improve their carbon footprint. Regular citizens would be able to learn more about the environment by gardening, and using the space available to them. By using their land in sustainable ways, they would be able to save money and promote healthy lifestyles to their children and neighbors.

Community Engagement

In order to transfer these sustainable ideas to our community, we created a community engagement project for the Charlottesville area. The method of sustainable urban gardening struck our group as an ideal way to promote local food, as well as a way to gage how much urban land in Charlottesville is being used for gardening. For our community engagement aspect, we composed a survey that questions home garden patterns. The survey asked questions

concerning the size of garden, types of vegetables and fruits planted, where produce other than home grown is purchased, why do you choose to grow foods at home, what would encourage you to grow more, how much money do you spend on your garden, and do you own chickens. We also asked for the participant's zip code and email address. The survey was placed on surveymonkey.com, and we also took the survey to the Charlottesville Farmer's Market for two consecutive Saturdays. At the market, 50 gardeners took the survey and explained to us many benefits and issues they had with gardening.

The survey results showed us interesting trends on gardening in the area and the gardeners' opinions. When asked why people grow a garden, the most common reason given was for personal enjoyment, followed by environmental concerns and the ability to provide healthy food for their family. When asked what would cause you to grow more food, the participants said concern for their health and concern for the environment as the top reasons. Also listed were a rise in fruit prices and more time to garden. We also asked about the willingness to have chickens, which many people were enthusiastic about; however, 40 of the 50 participants do not currently own chickens but out of this 40 over half were interested in having them. People also expressed interest in gardening classes, where they could learn more about basic gardening principles and sharing ideas. There were many concerns on soil qualities, such as where they could learn to grow more in a small space, repair their soil quality, and have access to soil testing locations and information on how to do this.

In regards to pests, one participant had many problems with groundhogs in her yard. City residents are not allowed to kill groundhogs and previously the city provided residents with free groundhog traps, but stopped the practice. The construction of the traps is apparently very difficult, and they are very expensive in gardening stores. It costs about $250 a year to remove

groundhogs, a cost the participant said she was not willing to spend. She explained to us many methods of trapping the groundhogs, and suggested that Charlottesville begin the program again, or someone should start a business to start building traps. Another pest issue in the area is deer. Many gardeners expressed a desire to exterminate the deer, but did not have a reliable method in doing so or the legal right to kill.

The desire to own chickens was a very positive response, but with many questions. Most residents were unclear about rules concerning chickens within the city limits. In response to this, we looked up the laws, which say that one can own chickens but no roosters, and they must be kept in a specific coop size. Whereas the city allows chicken ownership, certain homeowners associations do not, which was a clear obstacle for many possible owners. Also, chicken coops can be expensive and many participants asked where they could buy an economical chicken coop.

At the Charlottesville Farmer's Market, we also handed out fact sheets which contained information on where to learn more about sustainable farming methods such as John Jeavons' work and the Charlottesville urban chicken association called Cluck. It also contained links to the Piedmont Environmental Council website, the Edible Blue Ridge website, and other local food groups.

The survey is online and can potentially be used to collect data over time. The ideal would be for future classes to use the survey, its results, and the contacts we found to continue work on urban gardening and issues the Charlottesville community has with gardening.

Proposed Indicators and Benchmarks

Our research mostly centered around our one main indicator of land used for food production in the TJPD. What follows are sample optimal, passable and failing benchmarks for this indicator calculated based on our calculated land acreage requirements. In our findings section, the chart contains what could be considered the "ultimate" level benchmark - 100% local production acreage.

Indicator: Land available in the TJPD for food production.

Optimal Benchmark: There is enough land available, conserved, and in production to provide the people in the Charlottesville area with a full nutritional diet where there are:

4,942.74 acres for grain

332.46 acres for vegetables

1,212 acres for fruits

3,592.32 acres for milk/dairy

19,350.018 acres for meat including beef, poultry, fish, eggs, pork, and beans

(Based off of numbers where 60% of needs are met locally)

Passable Benchmark: There is enough land available/conserved and in production to provide the people in the Charlottesville area with a partially nutritional diet where there are:

1,647.58 acres for grain

110.82 acres for vegetables

404 acres for fruits

1,197.44 acres for milk/dairy

6,450.006 acres for meat including beef, poultry, fish, eggs, pork, and beans.

(Based off of 20% of needs met locally)

Failing Benchmark: There is minimal land available/conserved and in production to provide the people in the Charlottesville area with a poor nutritional diet where there are:

411.895 acres for grain

27.75acres for vegetables

101 acres for fruits

299.36 acres for milk/dairy

1612.5015 acres for meat including beef, poultry, fish, eggs, pork, and beans

(Based off of 5% or less of needs met locally)

The issue with all of our benchmarks for this indicator is that we are measuring only the possibility of production with little attention to where the food produced in this area is actually consumed. Unfortunately, this would require a great deal of market analysis that we could not accomplish in one semester (perhaps an idea for future work?). These benchmarks are theoretical ideals and in a sense assume that what is grown locally will be consumed locally.

We chose to present a 5% level as "failing" because, though admirable, 5% of food grown locally is a base level that we as a community already exceed for many crops. A 20%

level we presented as "passable" because it is the current goal met for local food sourcing for some ambitious agencies in the TJPD such as the Jefferson Area Board for Aging (JABA). JABA currently sources 25% of its daily food use locally (http://www.jabacares.org/news/full/gray-to-green1/). Sixty percent of food grown locally is an ambitious enough level to be "optimal" but accounts for some crops and foods that may actually be more efficient to grow elsewhere (such as grains).

These benchmarks for food sourcing are based on a regional population of 219,557 and the crops that are hardy in the climate of central Virginia. Because of this, with some minor adjustment for population our acreage calculations (see methods section) for each part of the food pyramid could easily be used to set goal benchmarks for other communities in Virginia. The same model could be used to create benchmarks for use in other climates, but they would need to be based off of another source of local yields - not the VA Cooperative extension.

In our original work plan we proposed additional indicators and benchmarks, but the limited time available for this project prevented us from exploring them further. They could be used for future study. For example, one that we felt the community could benefit from immediately is the indicator "planning officials in the TJPD are aware of prime farmland and active in its conservation." Benchmarks for this indicator would allow planning officials and non-profits to measure their information access and monitoring tools in an attempt to consolidate the farmland preservation resources in our area.

Bibliography

VA data on US Census. http://quickfacts.census.gov/qfd/states/51000.html.2007.

"2008 State Agriculture Overview: Virginia." 2008. US Department of Agriculture. National Agricultural Statistics Service. http://www.nass.usda.gov/Statistics_by_State/Ag_Overview/AgOverview_VA.pdf. March, 2009.

"Chickens and Eggs 2007 Summary." February 2008. United States Department of Agriculture. National Agricultural Statistics Service.

http://usda.mannlib.cornell.edu/usda/nass/ChickEgg//2000s/2008/ChickEgg-02-28-2008.pdf. March, 2009.

"Fact Sheet No. 8 Livestock and Poultry Yard Management." 1996. Virginia Polytechnic Institute and State University. Virginia Cooperative Extension. http://www.ext.vt.edu/pubs/farmasyst/442-908/worksheet08.html**.** March 2009.

Fanatico, Ann. 2006. "Alternative Poultry Production Systems and Outdoor Access." National Sustainable Agriculture Information Service.

http://attra.ncat.org/attra-pub/poultryoverview.html#alternative. March, 2009.

"Getting Started in the Cattle Business in Virginia." 2000. Virginia Polytechnic Institute and State University. Virginia Cooperative Extension.

http://www.ext.vt.edu/pubs/beef/400-790/400-790.html. March, 2009.

"Gray to Green." 2009. Jefferson Area Board for Aging.

http://www.jabacares.org/news/full/gray-to-green1/. May, 2009.

"Livestock Slaughter." 2008. United States Department of Agriculture. National Agriculture Statistics Service. http://usda.mannlib.cornell.edu/usda/nass/LiveSlau//2000s/2008/LiveSlau-12-29-2008.pdf. March 2009.

Nation, Allan. 2008. "Salatin-Designed Pastured Egg Production System Lowers Labor Costs." *The Stockman Grass Farmer*.

http://www.stockmangrassfarmer.net/cgi-bin/page.cgi?id=545. March, 2009.

"Virginia Grazer Joel Salatin Finds Pigs Can Profitably Create Pasture from Cut-Over Forest Land." 2008. Staff Report. *The Stockman Grass Farmer.* http://www.stockmangrassfarmer.net/cgi-bin/page.cgi?id=663. March, 2009.

"Vegetable Planting Guide and Recommended Planting Dates." 2006. Virginia Polytechnic Institute and State University. Virginia Cooperative Extension. http://www.ext.vt.edu/pubs/envirohort/426-331/426-331guide.html. March, 2009.

" Virginia Poultry Industry Facts." 2007. Virginia Poultry Federation. http://www.vapoultry.com/facts.asp**.** March 2009.

"Small Fruit in the Home Garden." 2000. Virginia Polytechnic Institute and State University. Virginia Cooperative Extension.

http://www.ext.vt.edu/pubs/envirohort/426-840/table1.html. March, 2009.

"USDA Food Pyramid." 2005. United States Department of Agriculture. MyPyramid.gov. March, 2009.

"Yields per Acre of Vegetable Crops." 2000. NDSU Agriculture Department. http://www.ag.ndsu.edu/pubs/plantsci/hortcrop/h912w.htm. March 2009.

"Land Use and Urban Design." City of Charlottesville Comprehensive Plan. 2007. http://www.charlottesville.org/Index.aspx?page=1745

City of Charlottesville GIS data (courtesy of the scholars lab)

Soil data viewer – online at USDA website

Jefferson, Thomas. *Farm Book*. 1810