Local and Hydroponic Food Opportunities for Carolina Dining Services

ENEC 698 Preliminary Report
November 11, 2014

This report shows the preliminary results of the ENEC 698 local produce working group's decision support tool developed for Carolina Dining Services (CDS). The report highlights specific opportunities and useful information gleaned from the tool, as well as providing the full output tables for the client's consideration in the Appendix.

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Executive Summary

In the fall semester of 2014, a team of UNC students developed a new web-based decision support system to increase the availability of local food in North Carolina communities. Carolina Dining Services (CDS), the company who provides the food in campus dining halls, was asked to participate in a beta-test to demonstrate a UNC-focused application of the tool. CDS provided a year's worth (2013-2014) of order data of produce items used in campus dining halls, and they indicated an interest in sourcing more produce locally, including an on-campus hydroponic facility. Potential advantages of sourcing more produce locally include potential price savings, increased control over sourcing, and positive consumer perception surrounding local sourcing. A preliminary analysis of the order data provided by CDS shows that CDS is sourcing several high-production North Carolina crops locally, but could expand its local sourcing in crops such as strawberries and watermelon. Hydroponic or indoor production appears feasible in crops at a variety of demand levels. Many of CDS' highest demand items are relatively low in nutrition content, though the variation in pounds per unit may partially account for this. With additional data, the team could be more specific in showing where CDS might benefit economically by sourcing more produce locally throughout the year.

Potential Advantages of Local and Hydroponic Sourcing

A preliminary comparison of North Carolina prices to national prices indicate that crops produced in high volumes within the state, including sweet potatoes and blueberries, may be cheaper than those purchased from national distributors. In addition, the possibility of free or highly subsidized production and labor costs through existing university funding mechanisms and academic partnerships could dramatically lower the price of hydroponically grown items compared to current prices for items CDS purchases from its distributed. Thus, each of these changes in sourcing stand to benefit CDS economically.

If prices for local or hydroponically sourced items are equivalent or slightly higher than existing prices, studies have shown that consumers are willing to pay between 5%[1] and 27%[2] more for local food. Consumers are willing to pay more due to a perception that local foods are healthier, fresher, higher quality, support the local economy, and more sustainable than traditional foods[3]. Thus, CDS could improve student satisfaction and commitment by increasing local sourcing.

An additional benefit of on-site or closely-located hydroponic production is increased control and flexibility over supply. A nearby facility operated by another organization in partnership with CDS could use its produce to address anticipated shortages, supply small-scale events, or build relationships with other local organizations through tours and volunteer workdays. We do not envision CDS as the operator of the facility, but through this partnership, CDS could strengthen consumer buy-in and have a flexible supply at the ready at all times.

High Demand Items and Local Sourcing

Analysis of the current CDS dataset demonstrates which produce items CDS ordered in the highest quantities on a category level and whether or not they are purchased locally. This information also highlights where North Carolina specialty crops provide opportunities for increased local sourcing.

Produce Name	Local (Y/N)	Demand in Category
Sweet Potato	Y	23.9%
Purple Sweet Potato	Y	0.1%
White Sweet Potato	Y	0.1%
Red Potato	N	33.3%
Idaho Potato	N	19.5%
Yukon Gold Potato	N	14.1%
Fingerling Potato	N	9.0%
Potato (Unclassified)	N	0.2%
Jicama	N	0.1%
Sweet Potato	N	0.01%

Table 1: Percent demand and origin within the tuber vegetable category. Each category of fruit and vegetable can be similarly displayed and analyzed by origin or demand.

For example, in the tuber vegetable category displayed in Table 1, red potatoes had the highest demand*, at approximately 33%, whereas sweet potatoes came in at approximately 24%. The entire category of tubers totaled 10% of the produce ordered by weight. Almost 100% of the sweet potatoes were sourced locally**, while 0% of the red potatoes came from local sources. Idaho potatoes were in less demand than both red and sweet potatoes, coming in at approximately 20% and did not come from local sources. While the tuber category is a high demand category for CDS, currently only 24% of the category is sourced locally. A similar analysis can be performed on each produce category (see Figure 1) as done above to see which foods are in the highest demand and where they are coming from. In addition, analysis of the data across categories can show the most promising local produce items.

North Carolina is a top producer of fifteen major crops by pounds produced.[4] Comparing this data with the list of crops CDS sources locally reveals that CDS purchases nearly, if not all, sweet potatoes, peanuts, peaches and muscadine grapes from local sources. However, there are several crops heavily produced locally that CDS is not purchasing (see Figure 2). For example, red potatoes are the second highest produced food commodity in North Carolina and watermelons are the fourth, yet, CDS purchased 0% of their red potatoes or watermelons from local sources. Similarly, despite being North Carolina's thirteenth ranked top crop, less than 2% of the strawberries purchased were grown locally. Although CDS purchases the majority of their cucumbers and blueberries locally, 33% of cucumbers and 12.5% of blueberries were still sourced from out-of-state producers.

We understand that CDS is limited in the changes it can make in its purchasing agreements, and our analysis shows that CDS is already taking advantage of many crops that are abundant in North Carolina. With more comprehensive purchasing data, we could uncover additional situations in which it would be beneficial for CDS to purchase locally. If given monthly purchasing data, we could provide a more in depth analysis and potentially suggest more options to buy fresh, local produce that is only in season for a short period of time. With price data, we would also be able to determine the optimal buying time for local produce items. Based on the price difference between the local and national produce prices, our data on the seasonality of both sources, and anticipated demand needs as derived from monthly purchasing data, our tool could indicate to CDS the optimal buying time for local and national produce items. This has the potential to highlight sourcing changes that will save money or be cost neutral while enhancing CDS' reputation as a provider that is committed to local, sustainable sourcing.

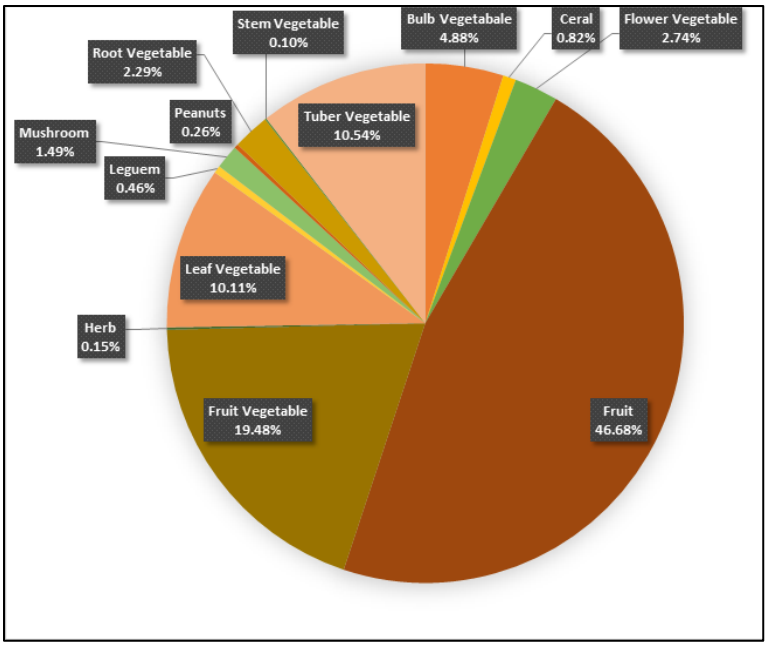

Figure 1: Percent total demand for each produce category.

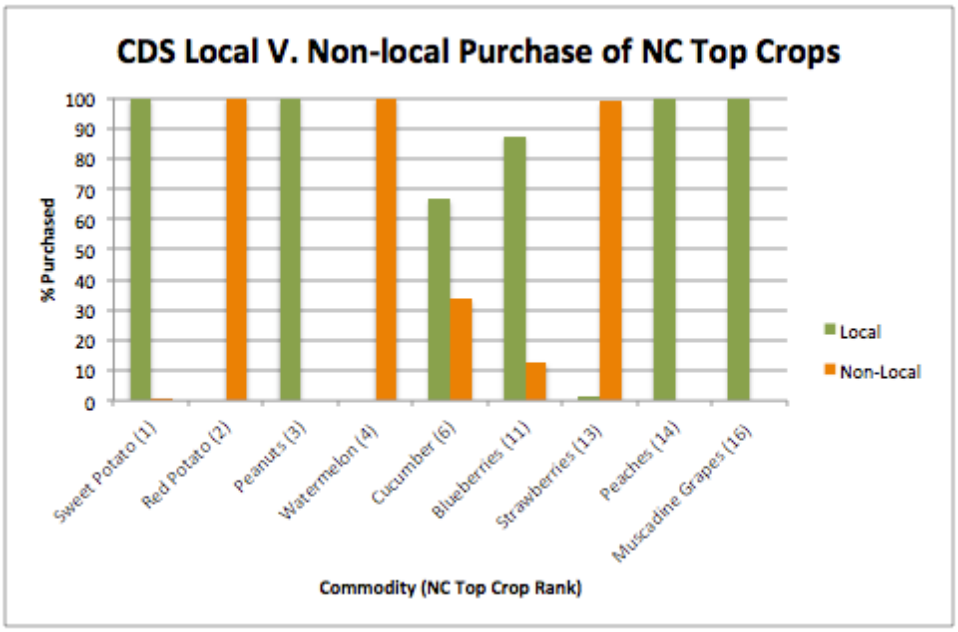

Figure 2: Local and non-local purchase of NC top crops. Those crops with the highest ranks, such as sweet potatoes and red potatoes, may be cheaper than the same items purchased on the national market.

**Demand is defined in this tool as total number of pounds ordered for a single produce item over the total number of pounds ordered within that produce item's category. Demand is separated by category because poundage alone would bias the tool towards produce items with high unit weights such as watermelons. This would eliminate lighter but still valuable produce items such as lettuce.*
***There is no universally accepted definition of "local", however, the 2008 farm bill defined "local" food as either being transported less than 400 miles or within the same state. For the purpose of this report, we will refer to food as "local" only when it has been sourced from within the state of North Carolina.*

Hydroponic Opportunities

We recognize that CDS is not interested in personally owning or operating an on-site hydroponic facility. However, given the wide range of student and academic groups within the region with interest or expertise in this particular technology, we have conducted an analysis of which produce items CDS could potentially source from an as-yet hypothetical nearby hydroponic facility.

Hydroponics is an agricultural technique where plants are grown in water infused with nutrients. The term "hydroponics" includes many applications and naming conventions, such as aquaponics, which integrates fish culture in a closed system, and aeroponics, which either mists or drips solution onto roots instead of submerging them. Various techniques are better suited to various produce items, but not all crops are well suited for the hydroponic method. Traditionally, the most important commercial hydroponic crops are tomatoes, cucumbers, peppers, lettuce, and flowers.[5] Although these crops are important commercially, other considerations like size, time to maturity, and pollination play an integral role in choosing which plants to produce in a hypothetical facility with limited space, money, and effort.

For the purposes of this analysis, all CDS-ordered produce items were categorized as either easy, medium, or hard to grow using these technologies (see Table 2). "Easy" items can be grown in close proximity, have relatively short times to harvest, or do not require external pollination. Though not grown hydroponically, mushrooms are also categorized as easy because they generate large amounts of biomass when grown indoors given marginal inputs. "Medium" items are economically viable within the confines of an indoor facility but require more inputs due to higher space requirements, external pollination needs, or longer times to harvest. "Hard" items use large swaths of land, depend on federal subsidies for their economic viability, or are time-intensive on the part of the grower. "N/A" items cannot be grown outside of traditional soil media or grow on trees.

Potential Classification	Produce Category	Prime Examples	Notable Exceptions
Easy	**Leafy Greens**, **Herbs**, Legumes, Bulb Vegetables, Mushrooms, Stem Vegetables	Bibb Lettuce, Arugula, Basil, Snow Peas, Bean Sprouts, Green Onions	Cucumbers
Medium	Fruit Vegetables	Tomatoes, Peppers, Eggplant, Squash	Carrots
Hard	Fruits, Root Vegetables, Tuber Vegetables	Beets, Radishes, Blueberries, Melons	Strawberries
N/A	Fruits, Tuber Vegetables, some Cereals	Apples, Potatoes, Corn	Barley

Table 2: Hydroponic potential across fruit and vegetable categories. CDS purchases produce items from each of these categories. Decision-making for items within a potential hydroponic facility may depend upon demand in addition to hydroponic potential.

Currently, with the data we have received from CDS, we are able to see which produce items are required in high quantities and can be grown hydroponically. We sorted the data first by produce category, percent demand within that category, and hydroponic feasibility in Table 3. CDS might want to grow crops that it uses in very high quantities because they could be assured that there would always be a need for that crop in the dining halls. Targeting produce items that CDS consumes in higher quantities, we select for produce items which are most cost-effective and have the quickest return on investment because these items theoretically represent a larger, or at least more consistent, cost-burden to CDS' budget. Alternatively, it is possible that CDS could supply all of the produce it needs for items that are ordered in much lower quantities while sourcing high-demand items through existing channels. The results of this analysis are displayed in Figure 3.

CDS is already purchasing 14,500 pounds of hydroponically grown bibb lettuce, indicating that this item is available at competitive prices and does not need to be grown on-site. Depending on CDS' preference for high or low demand crops, Table 3 and Figure 3 demonstrate the crops that might meet their needs in a hydroponic facility. By and large, crops within the high demand category had lower hydroponic potential ratings than crops within the low demand category. Thus, CDS may prefer to purchase low-demand crops such as green onions and basil rather than high-demand crops such as yellow onions from a hydroponic facility.

Produce Name	Produce Category	Total Pounds	% Demand in Category	Hydroponic Potential
Yellow Onion	Bulb Vegetable	21270	76.4	Easy
Carrot	Root Vegetable	9540	73.2	Medium
Snow Peas	Legume	2010	76.1	Easy
Anise/Fennel	Herb	388	46.1	Easy

Table 3: High demand items with easy or medium hydroponic potential. These items should be considered for a hydroponic facility if CDS would prefer to grow items for which there is always a need.

With additional data, we could provide better guidance on which items to produce on-site. Knowing the price information and anticipated monthly demand, we could combine our knowledge of seasonality and hydroponic growing capabilities for produce items to recommend which produce items would be optimal and cost-effective to grow onsite utilizing hydroponic growing systems. These recommendations could help CDS save money by purchasing crops that cost more when grown traditionally than hydroponically, improve CDS' reputation with students, and improve the nutritional value of CDS' meals through freshly harvested produce items.

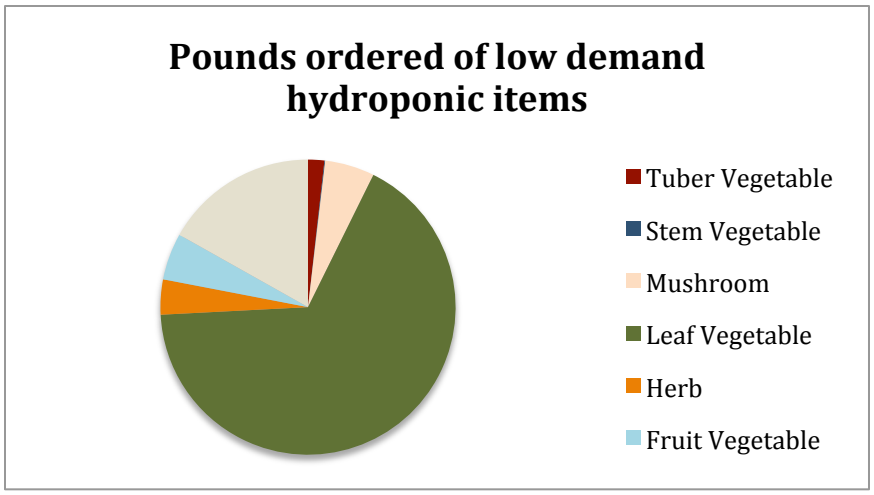

Figure 3: Distribution of low-demand items that are easy to grow hydroponically. The majority are leaf vegetables such as lettuce and spinach, but bulb vegetables such as green onions and herbs such as basil are also important in this category.

Nutrition

Nutrition is important for food providers such as CDS in order to maintain a good reputation within an academic and health-promoting institution. Such a reputation is convincing for parents, the primary purchasers of meal plans, who care to have healthy food available for their student children. CDS actively promotes better nutrition awareness through user access to an on-site nutritionist and providing nutritional information with screen displays by meal stations. The food tool can support CDS's efforts by assessing what foods are most nutritious and in high demand. This would be more valuable if price data were obtained as a third variable in determining which produce items are both affordable and nutritious. Another point to note is that the data included in this report is only part of the nutrition data collected, and more elaborate data with amounts of each vitamin, mineral and other specified attributes were recorded. These data could be manipulated into infographic visuals containing the array of daily essential nutrients to inform consumers at CDS of how complete a meal or self-made salad is.

In Table 4, produce items were ranked for nutrition completeness, which quantifies essential nutrient content.[6] The top three items in Table 4 --banana, pineapple, and honeydew-- are red

indicating lower nutritional value. Broccoli and bibb lettuce are exceptionally complete. Items with a higher nutritional completeness are encouraged to populate the demand graph. Replacing items with lower nutritional completeness scores with similar, more nutritious items within the same category may improve student diets and overall health. However, it is understood that other factors like price and individual preference contribute to demand outcomes.

Produce Name	Produce Category	Nutritional Completeness Score	Demand of Category	Demand of Total
Broccoli	Flower Vegetable	92	97.8	2.7
Lettuce Hydro Bibb	Leaf Vegetable	87	25.1	2.5
Cucumber	Fruit Vegetable	79	34.7	6.8
Cucumber	Fruit Vegetable	79	17.5	3.4
Cantaloupe	Fruit	62	11.9	5.5
Orange	Fruit	58	7	3.3
Sweet Potato	Tuber Vegetable	55	23.8	2.5
Pineapple	Fruit	49	16.4	7.6
Honeydew	Fruit	48	15.3	7.1
Banana	Fruit	42	26.8	12.5

Table 4. Shows the top 10 produce items with highest ranking of total demand in comparison to nutritional quality as measured by the Completeness Score™ from *Self Nutrition Data.*

Of the total produce items considered (96 analyzed), half had scores of 75 or higher. Despite half of items with higher scores, the majority of total demand was for items of lower nutritional completeness (Completeness Score™ < 50) as displayed in Figure 4. It is encouraged to have produce items of increased nutritional quality to appeal to parents who support a nutritious diet for their student child. This would entail shifting purchases for items with Completeness Scores™ 75+, or higher-end scores in general.

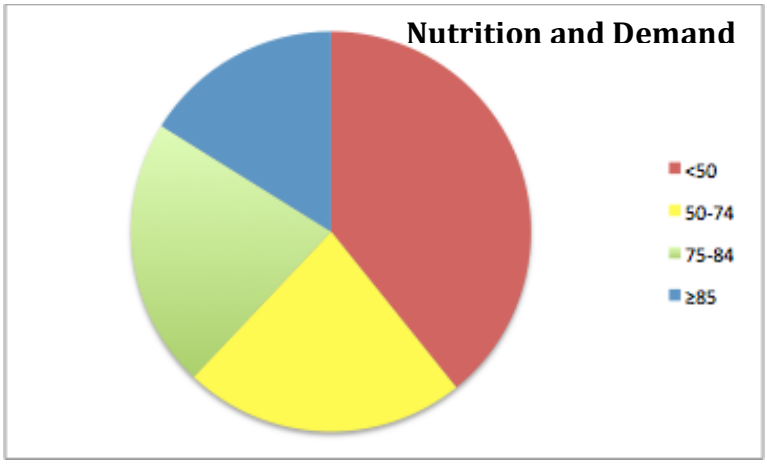

Figure 4: Displays the distribution of demand of Completeness Scores™ that are reflective of a produce item's nutrient content for all produce items evaluated. The sum of the % of total demand for intervals of the Completeness Score™ (blue is ≥ 85; green is 75-84; yellow is 50-74; red is < 50) was quantified to indicate the distribution of nutrition quality.

Next Steps and Recommendations

We derived the results described within this report from a prototype of the Food Tool we will continue building in the spring. This prototype demonstrated that there are several local fruits and vegetables which may be cheaper when sourced from North Carolina than from national producers. In light of those results and the specialized demand, hydroponic potential, and nutrition results from our analysis of CDS demand data, we offer short-term recommendations for sourcing local food, as well as middle- and long-term suggestions (see Figure 5).

Although North Carolina produces a variety of food items, CDS also purchases many produce items through a national and global supply chain. A large majority of the nation's fruits and vegetables are mass produced in California.[7] Water shortages and land degradation place increasing pressures on national food prices. Moreover, the crippling drought in California renders some produce items more vulnerable to price inflation than those sourced from North Carolina. The USDA warns that "With respect to fruits and vegetables...owing to higher production costs, insufficient water, or both, producers may opt to reduce total acreage, driving up prices not just this year but for years to come."[8] Short term, we recommend that CDS source from non-California suppliers, as they are likely to become more expensive.

As North Carolina is not immune to drought, resourcing locally is an immediate recommendation rather than a permanent solution. We could "drought proof" by using more detailed location data to more accurately identify which produce items are worth exploring. In the future, we plan to include environmental risks into our tool, and assess which foods are at higher risks based on their location. These suggestions would benefit CDS due to the current state of the drought crisis in California, for example, and represent "middle-term" next steps.

Another middle-term next step involves more actively engaging the nutritional information to help students eat balanced meals. CDS currently offers students nutritional information by LCD display and publishes useful health information online. Similarly, our tool engages users to explore nutritional information regarding produce. We are interested to learn how CDS provides nutritionally balanced meal options and communicates nutrition information to consumers. In the future, our web-based application which we will begin developing in the spring could benefit CDS by offering visual and hands-on knowledge aids about completeness and balance in nutrition. Moreover, we can offer CDS information about the completeness of their meals that is easy for all to digest.

Long-term, a hydroponic facility would be a joint collaboration with many actors for the benefit of all students and not merely an extension of CDS services. We envision a very minimal role for CDS outside of serving the food. The scale and products of the greenhouse will depend upon CDS's supply needs, but ultimately, the cost of constructing and operating such a facility would not be the responsibility of the client. The technical expertise to construct a hydroponic facility will initially

require a third party, but the funding and operation can be realized through grants, academic partnerships, volunteers, and student led-initiatives. Potential partners include the NC State Agroecology Department, Central Carolina Community College, TABLE, Nourish, CHEAP, The Sonder Market, FLO Food, Carolina Campus Community Gardens, HOPE Gardens, Sprout, NC Growing Together, and the Center for Environmental Farming Systems.

This project seeks to realize a more secure and sustainable food system on campus, but we still lack the information to perform a thorough cost-benefit analysis. The seasonal nature of crops results in dramatic price fluctuation for various foods at some geographies. A monthly breakdown of location data and more detailed price information would help us to determine the most costly food, not just the most in demand; furthermore, we could assess which foods are at highest risk based on their location. As this collaboration continues, our team will refine our output and work to provide the most detailed and informative analyses and recommendations possible.

Next Steps	Recommendations
Provide price data	Source from non-California suppliers
Provide source location data	Add more nutrition information to displays
Provide monthly data	Partner with a hydroponic facility

Table 5: Next steps and recommendations for CDS.

Appendix

Works Cited

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Demand Table

Produce Name	Local (Y/N)	Produce Category	Percentage Demand of Category	Percentage Demand of Total
Garlic	0	Bulb Vegetable	3.28569	0.160432
Yellow Onion	0	Bulb Vegetable	76.3789	3.72938
Red Onion	0	Bulb Vegetable	18.978	0.926648
Green Onion	0	Bulb Vegetable	1.35737	0.066277
Yellow Corn	0	Cereal	32.2581	0.263003
White Corn	0	Cereal	67.7419	0.552307
Broccoli	1	Flower Vegetable	1.28139	0.035067
Broccolini	0	Flower Vegetable	0	0

Broccoli	0	Flower Vegetable	97.7576	2.67527
Cauliflower	0	Flower Vegetable	0.961046	0.0263
Strawberries	1	Fruit	0.009015	0.004208
Watermelon Seedless	1	Fruit	0.811341	0.378724
Peach	1	Fruit	1.21138	0.565457
Muscadine Grapes	1	Fruit	0.060851	0.028404
White Peach	1	Fruit	0.067612	0.03156
Yellow Honeydew	1	Fruit	0.016903	0.00789
Blueberries	1	Fruit	0.013804	0.006444
Cantaloupe	1	Fruit	2.32885	1.08708
Gold Apple	0	Fruit	1.27711	0.59614
Gala Apple	0	Fruit	4.37223	2.0409
Fig	0	Fruit	0.002254	0.001052
Cantaloupe	0	Fruit	11.8659	5.53885
Honeydew	0	Fruit	15.3047	7.14404
Banana Organic	0	Fruit	0.210348	0.098188
Banana	0	Fruit	26.8043	12.5119
Asian Pear	0	Fruit	0.022537	0.01052
Blackberries	0	Fruit	0.006085	0.00284
Lemon	0	Fruit	0.861299	0.402044
Lime	0	Fruit	0.012771	0.005961
Granny Smith Apple	0	Fruit	1.47243	0.687315
Mango	0	Fruit	0.014274	0.006663
Orange	0	Fruit	6.97754	3.25703
Papaya	0	Fruit	0.003756	0.001753
Pear	0	Fruit	1.77143	0.826882
Pineapple	0	Fruit	16.3883	7.64988
Plum	0	Fruit	0.305004	0.142372
Raspberries	0	Fruit	0.006226	0.002906
Red Apple	0	Fruit	6.41561	2.99473
Red Seedless Grapes	0	Fruit	0.175791	0.082057
Strawberries	0	Fruit	0.772277	0.36049
Watermelon	0	Fruit	0.052587	0.024547

Blueberries	0	Fruit	0.001972	0.000921
Watermelon Seedless	0	Fruit	0.28735	0.134132
White Seedless Grapes	0	Fruit	0.006761	0.003156
Grapefruit Pink	0	Fruit	0.089398	0.04173
Sungold Tomato	1	Fruit Vegetable	0.011437	0.002236
Tomato	1	Fruit Vegetable	0.11213	0.021917
Tigrado Tomato	1	Fruit Vegetable	0.026911	0.00526
Pumpkin	1	Fruit Vegetable	0.107645	0.02104
Cucumber	1	Fruit Vegetable	34.536	6.75041
Gold Bell Pepper	0	Fruit Vegetable	0.255656	0.049971
Acorn Squash	0	Fruit Vegetable	0	0
Butternut Squash	0	Fruit Vegetable	0	0
Cucumber	0	Fruit Vegetable	17.416	3.40414
Eggplant	0	Fruit Vegetable	3.11721	0.60929
Green Beans	0	Fruit Vegetable	0.811819	0.158679
Green Bell Pepper	0	Fruit Vegetable	11.0515	2.16013
Heirloom Tomato	0	Fruit Vegetable	0.080733	0.01578
Okra	0	Fruit Vegetable	0.067278	0.01315
Red Bell Pepper	0	Fruit Vegetable	0.013456	0.00263
Roma Tomato	0	Fruit Vegetable	0.089704	0.017534
Sundried Tomato	0	Fruit Vegetable	0.004485	0.000877
Tomatillo	0	Fruit Vegetable	0.00897	0.001753
Tomato	0	Fruit Vegetable	8.49047	1.65955
Cherry Tomato	0	Fruit Vegetable	0.032966	0.006444
Grape Tomato	0	Fruit Vegetable	0.523422	0.102308
Ghost Pepper	0	Fruit Vegetable	0.000897	0.000175
Jalapeno Pepper	0	Fruit Vegetable	0.081631	0.015956
Pablano Pepper	0	Fruit Vegetable	0.246685	0.048217
Yellow Squash	0	Fruit Vegetable	11.2542	2.19976
Zucchini Squash	0	Fruit Vegetable	11.6579	2.27866
Habanero Chili Pepper	0	Fruit Vegetable	0.000897	0.000175
Dill	0	Herb	0.421719	0.000351
Mint	0	Herb	0.474433	0.000395

Thyme	0	Herb	0.632578	0.000526
Rosemary	0	Herb	1.0543	0.000877
Anise/Fennel	0	Herb	81.8134	0.06803
Chives	0	Herb	3.16289	0.00263
Sage	0	Herb	0.421719	0.000351
Cilantro	0	Herb	0	0
Basil	0	Herb	12.019	0.009994
Lettuce Hydro Bibb	1	Leaf Vegetable	25.1474	2.54236
Lettuce Baby Fancy	1	Leaf Vegetable	0.346861	0.035067
Spinach	1	Leaf Vegetable	0.015609	0.001578
Romaine	1	Leaf Vegetable	0.520291	0.052601
Pea Sprout	1	Leaf Vegetable	0.005203	0.000526
Collard Greens	1	Leaf Vegetable	8.70447	0.880008
Green Lettuce Leaf	1	Leaf Vegetable	0.520291	0.052601
Kale	1	Leaf Vegetable	3.29518	0.333137
Chard Red/Rainbow	0	Leaf Vegetable	1.52619	0.154295
Green Lettuce Leaf	0	Leaf Vegetable	0.763094	0.077148
Kale	0	Leaf Vegetable	2.12452	0.214786
Leeks	0	Leaf Vegetable	0	0
Leaf Cactus	0	Leaf Vegetable	0.242803	0.024547
Swiss Chard	0	Leaf Vegetable	0.554977	0.056107
Spinach	0	Leaf Vegetable	19.2161	1.94272
Romaine	0	Leaf Vegetable	5.05723	0.511278
Pea Shoot	0	Leaf Vegetable	0.005203	0.000526
Parsley	0	Leaf Vegetable	0.454388	0.045938
Mustard Greens	0	Leaf Vegetable	0.104058	0.01052
Mesclun Mix	0	Leaf Vegetable	7.58585	0.766917
Lettuce Butter	0	Leaf Vegetable	0.693722	0.070134
Lettuce	0	Leaf Vegetable	0.138744	0.014027
Arugula	0	Leaf Vegetable	0.041623	0.004208
Baby Spinach	0	Leaf Vegetable	0.041623	0.004208
Bok Choy	0	Leaf Vegetable	5.04683	0.510226
Cabbage Green	0	Leaf Vegetable	5.02948	0.508473

Cabbage Napa	0	Leaf Vegetable	1.64932	0.166744
Cabbage Red	0	Leaf Vegetable	0.190774	0.019287
Celery	0	Leaf Vegetable	10.9781	1.10987
Bean Sprout	1	Legume	11.355	0.052601
Sugar Snap Peas	0	Legume	12.112	0.056107
Ginger Root	0	Legume	0.454201	0.002104
Snow Peas	0	Legume	76.0787	0.352424
Mushroom Portabella	0	Mushroom	7.0161	0.104675
Mushroom Oyster	0	Mushroom	0.235045	0.003507
Mushroom Exotic	0	Mushroom	0.070514	0.001052
Mushroom Crimini	0	Mushroom	0.176284	0.00263
Mushroom Button	0	Mushroom	1.52779	0.022794
Mushroom	0	Mushroom	90.0223	1.34307
Mushroom Shitake	0	Mushroom	0.951933	0.014202
Peanuts	1	Nut	100	0.263003
Carrot	0	Root Vegetable	73.1525	1.6727
Parsnip	0	Root Vegetable	8.77983	0.200759
Radish	0	Root Vegetable	0.086265	0.001973
Red Beet	0	Root Vegetable	8.43477	0.192869
Root Celery	0	Root Vegetable	0.15336	0.003507
Rutabaga	0	Root Vegetable	0.383399	0.008767
Yucca	0	Root Vegetable	1.99367	0.045587
Turnip	0	Root Vegetable	7.0162	0.160432
Asparagus	0	Stem Vegetable	99.6448	0.098363
Lemon Grass	0	Stem Vegetable	0.35524	0.000351
Purple Sweet Potato	1	Tuber Vegetable	0.066516	0.007013
Sweet Potato	1	Tuber Vegetable	23.8458	2.51431
White Sweet Potato	1	Tuber Vegetable	0.066516	0.007013
Red Potato	0	Tuber Vegetable	33.2578	3.50671
Idaho Potato	0	Tuber Vegetable	19.4596	2.05182
Jicama	0	Tuber Vegetable	0.066516	0.007013
Potato	0	Tuber Vegetable	0.166289	0.017534
Yukon Gold Potato	0	Tuber Vegetable	14.0514	1.48158

Sweet Potato	0	Tuber Vegetable	0.008314	0.000877
Fingerling Potato	0	Tuber Vegetable	9.0112	0.950142

Hydroponic Potential Table

Produce Name	Produce Category	Produce Total Pounds	Percentage Demand of Category	Hydroponic Potential
Yellow Onion	Bulb Vegetable	21270	76.3789	Easy
Red Onion	Bulb Vegetable	5285	18.978	Easy
Garlic	Bulb Vegetable	915	3.28569	Easy
Green Onion	Bulb Vegetable	378	1.35737	Easy
White Corn	Cereal	3150	67.7419	Medium
Broccoli	Flower Vegetable	15258	97.7576	Medium
Broccoli	Flower Vegetable	200	1.28139	Medium
Cauliflower	Flower Vegetable	150	0.961046	Medium
Broccolini	Flower Vegetable	0	0	Medium
Lime	Fruit	34	0.012771	Easy
Cucumber	Fruit Vegetable	38500	34.536	Easy
Cucumber	Fruit Vegetable	19415	17.416	Easy
Zucchini Squash	Fruit Vegetable	12996	11.6579	Medium
Yellow Squash	Fruit Vegetable	12546	11.2542	Medium
Green Bell Pepper	Fruit Vegetable	12320	11.0515	Medium
Eggplant	Fruit Vegetable	3475	3.11721	Medium
Green Beans	Fruit Vegetable	905	0.811819	Medium
Grape Tomato	Fruit Vegetable	583.5	0.523422	Easy
Gold Bell Pepper	Fruit Vegetable	285	0.255656	Medium
Pablano Pepper	Fruit Vegetable	275	0.246685	Medium
Pumpkin	Fruit Vegetable	120	0.107645	Medium
Roma Tomato	Fruit Vegetable	100	0.089704	Medium
Jalapeno Pepper	Fruit Vegetable	91	0.081631	Medium
Heirloom Tomato	Fruit Vegetable	90	0.080733	Medium
Okra	Fruit Vegetable	75	0.067278	Medium
Cherry Tomato	Fruit Vegetable	36.75	0.032966	Medium
Tigrado Tomato	Fruit Vegetable	30	0.026911	Medium

Red Bell Pepper	Fruit Vegetable	15	0.013456	Medium
Sungold Tomato	Fruit Vegetable	12.75	0.011437	Medium
Tomatillo	Fruit Vegetable	10	0.00897	Medium
Sundried Tomato	Fruit Vegetable	5	0.004485	Medium
Habanero Chili Pepper	Fruit Vegetable	1	0.000897	Medium
Ghost Pepper	Fruit Vegetable	1	0.000897	Medium
Butternut Squash	Fruit Vegetable	0	0	Medium
Acorn Squash	Fruit Vegetable	0	0	Medium
Anise/Fennel	Herb	388	81.8134	Easy
Basil	Herb	57	12.019	Easy
Chives	Herb	15	3.16289	Easy
Rosemary	Herb	5	1.0543	Easy
Thyme	Herb	3	0.632578	Easy
Mint	Herb	2.25	0.474433	Easy
Sage	Herb	2	0.421719	Easy
Dill	Herb	2	0.421719	Easy
Cilantro	Herb	0	0	Easy
Lettuce Hydro Bibb	Leaf Vegetable	14500	25.1474	Easy
Spinach	Leaf Vegetable	11080	19.2161	Easy
Celery	Leaf Vegetable	6330	10.9781	Easy
Collard Greens	Leaf Vegetable	5019	8.70447	Easy
Romaine	Leaf Vegetable	2916	5.05723	Easy
Bok Choy	Leaf Vegetable	2910	5.04683	Easy
Cabbage Green	Leaf Vegetable	2900	5.02948	Easy
Kale	Leaf Vegetable	1900	3.29518	Easy
Kale	Leaf Vegetable	1225	2.12452	Easy
Cabbage Napa	Leaf Vegetable	951	1.64932	Easy
Chard Red/Rainbow	Leaf Vegetable	880	1.52619	Easy
Green Lettuce Leaf	Leaf Vegetable	440	0.763094	Easy
Lettuce Butter	Leaf Vegetable	400	0.693722	Easy
Swiss Chard	Leaf Vegetable	320	0.554977	Easy
Romaine	Leaf Vegetable	300	0.520291	Easy
Green Lettuce Leaf	Leaf Vegetable	300	0.520291	Easy

Parsley	Leaf Vegetable	262	0.454388	Easy
Lettuce Baby Fancy	Leaf Vegetable	200	0.346861	Easy
Cabbage Red	Leaf Vegetable	110	0.190774	Easy
Lettuce	Leaf Vegetable	80	0.138744	Easy
Mustard Greens	Leaf Vegetable	60	0.104058	Easy
Baby Spinach	Leaf Vegetable	24	0.041623	Easy
Arugula	Leaf Vegetable	24	0.041623	Easy
Spinach	Leaf Vegetable	9	0.015609	Easy
Pea Shoot	Leaf Vegetable	3	0.005203	Easy
Pea Sprout	Leaf Vegetable	3	0.005203	Easy
Leeks	Leaf Vegetable	0	0	Easy
Snow Peas	Legume	2010	76.0787	Easy
Sugar Snap Peas	Legume	320	12.112	Easy
Bean Sprout	Legume	300	11.355	Easy
Mushroom	Mushroom	7660	90.0223	Easy
Mushroom Portabella	Mushroom	597	7.0161	Easy
Mushroom Button	Mushroom	130	1.52779	Easy
Mushroom Shitake	Mushroom	81	0.951933	Easy
Mushroom Oyster	Mushroom	20	0.235045	Easy
Mushroom Crimini	Mushroom	15	0.176284	Easy
Mushroom Exotic	Mushroom	6	0.070514	Easy
Carrot	Root Vegetable	9540	73.1525	Medium
Root Celery	Root Vegetable	20	0.15336	Medium
Radish	Root Vegetable	11.25	0.086265	Medium
Lemon Grass	Stem Vegetable	2	0.35524	Easy
Jicama	Tuber Vegetable	40	0.066516	Easy

Nutrition

Produce Name	Produce Category	Nutritional Completeness Score	Demand of Category	Demand of Total
Asparagus	Stem Vegetable	94	99.6448	0.098363
Cilantro	Herb	93	0	0

Broccoli	Flower Vegetable	92	97.7576	2.67527
Broccoli	Flower Vegetable	92	1.28139	0.035067
Spinach	Leaf Vegetable	91	19.2161	1.94272
Parsley	Leaf Vegetable	91	0.454388	0.045938
Mustard Greens	Leaf Vegetable	91	0.104058	0.01052
Basil	Herb	91	6.76759	0.009994
Chives	Herb	91	1.78094	0.00263
Spinach	Leaf Vegetable	91	0.015609	0.001578
Okra	Fruit Vegetable	90	0.067501	0.01315
Arugula	Leaf Vegetable	90	0.041623	0.004208
Green Lettuce Leaf	Leaf Vegetable	89	0.763094	0.077148
Green Lettuce Leaf	Leaf Vegetable	89	0.520291	0.052601
Romaine	Leaf Vegetable	88	5.05723	0.511278
Snow Peas	Legume	88	76.0787	0.352424
Green Onion	Bulb Vegetable	88	1.35737	0.066277
Sugar Snap Peas	Legume	88	12.112	0.056107
Romaine	Leaf Vegetable	88	0.520291	0.052601
Lettuce Hydro Bibb	Leaf Vegetable	87	25.1474	2.54236
Green Beans	Fruit Vegetable	87	0.814508	0.158679
Lettuce Butter	Leaf Vegetable	87	0.693722	0.070134
Zucchini Squash	Fruit Vegetable	86	11.6965	2.27866
Bok Choy	Leaf Vegetable	85	5.04683	0.510226
Kale	Leaf Vegetable	85	3.29518	0.333137

Kale	Leaf Vegetable	85	2.12452	0.214786
Dill	Herb	85	0.237459	0.000351
Pumpkin	Fruit Vegetable	84	0.108001	0.02104
Mint	Herb	84	0.267142	0.000395
Green Bell Pepper	Fruit Vegetable	83	11.0881	2.16013
Jalapeno Pepper	Herb	83	10.8044	0.015956
Cabbage Red	Leaf Vegetable	82	0.190774	0.019287
Sage	Herb	82	0.237459	0.000351
Celery	Leaf Vegetable	81	10.9781	1.10987
Collard Greens	Leaf Vegetable	81	8.70447	0.880008
Cabbage Green	Leaf Vegetable	81	5.02948	0.508473
Gold Bell Pepper	Fruit Vegetable	81	0.256503	0.049971
Lettuce	Leaf Vegetable	81	0.138744	0.014027
Cauliflower	Flower Vegetable	80	0.961046	0.0263
Cucumber	Fruit Vegetable	79	34.6503	6.75041
Cucumber	Fruit Vegetable	79	17.4737	3.40414
Butternut Squash	Fruit Vegetable	78	0	0
Mushroom	Mushroom	77	90.0223	1.34307
Anise/Fennel	Herb	77	46.0671	0.06803
Red Bell Pepper	Fruit Vegetable	76	0.0135	0.00263
Radish	Root Vegetable	75	0.086265	0.001973
Leeks	Leaf Vegetable	75	0	0
Carrot	Root Vegetable	74	73.1525	1.6727
Blackberries	Fruit	74	0.006085	0.00284

Eggplant	Fruit Vegetable	73	3.12753	0.60929
Acorn Squash	Fruit Vegetable	73	0	0
Tomatillo	Fruit Vegetable	72	0.009	0.001753
Rosemary	Herb	72	0.593648	0.000877
Cabbage Napa	Leaf Vegetable	70	1.64932	0.166744
Rutabaga	Root Vegetable	70	0.383399	0.008767
Turnip	Root Vegetable	68	7.0162	0.160432
Mushroom Portabella	Mushroom	67	7.0161	0.104675
Mushroom Crimini	Mushroom	67	0.176284	0.00263
Mushroom Oyster	Mushroom	65	0.235045	0.003507
Lemon	Fruit	64	0.861299	0.402044
Red Beet	Root Vegetable	63	8.43477	0.192869
Lime	Fruit	63	0.012771	0.005961
Cantaloupe	Fruit	62	11.8659	5.53885
Cantaloupe	Fruit	62	2.32885	1.08708
Raspberries	Fruit	62	0.006226	0.002906
Parsnip	Root Vegetable	61	8.77983	0.200759
Strawberries	Fruit	60	0.772277	0.36049
Garlic	Bulb Vegetable	60	3.28569	0.160432
Strawberries	Fruit	60	0.009015	0.004208
Peach	Fruit	59	1.21138	0.565457
Orange	Fruit	58	6.97754	3.25703
Papaya	Fruit	56	0.003756	0.001753
Sweet Potato	Tuber Vegetable	55	23.8458	2.51431
Sweet Potato	Tuber Vegetable	55	0.008314	0.000877
Jicama	Tuber Vegetable	53	0.066516	0.007013

Watermelon	Fruit	52	0.052587	0.024547
Grapefruit Pink	Fruit	51	0.089398	0.04173
Potato	Tuber Vegetable	51	0.166289	0.017534
Mushroom Shitake	Mushroom	51	0.951933	0.014202
Mango	Fruit	50	0.014274	0.006663
Pineapple	Fruit	49	16.3883	7.64988
Plum	Fruit	49	0.305004	0.142372
Honeydew	Fruit	48	15.3047	7.14404
Lemon Grass	Stem Vegetable	48	0.35524	0.000351
Ginger Root	Legume	47	0.454201	0.002104
Peanuts	Nut	43	100	0.263003
Fig	Fruit	43	0.002254	0.001052
Banana	Fruit	42	26.8043	12.5119
Blueberries	Fruit	42	0.013804	0.006444
Blueberries	Fruit	42	0.001972	0.000921
White Seedless Grapes	Fruit	41	0.006761	0.003156
Yellow Corn	Cereal	37	32.2581	0.263003
Red Seedless Grapes	Fruit	37	0.175791	0.082057
Asian Pear	Fruit	36	0.022537	0.01052
Pear	Fruit	35	1.77143	0.826882
White Corn	Cereal	26	67.7419	0.552307
				75.09319