WESTERN WASHINGTON FOODSHED STUDY:

Evaluating the potential for Western Washington to meet its food needs based on locally produced foods

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EXECUTIVE SUMMARY

The following report outlines the objectives, methods, and results of the Western Washington Foodshed Study which was undertaken in an effort to establish the potential for Western Washington to meet its food needs based on locally produced foods. The study was Part I of a broader study and sought to identify the types and amounts of food being produced in the region, the types and amounts of food consumed in the region, and the potential of the region's land resources for production. A mass balance was performed to compare the amount of food produced in Western Washington to the amount of those same foods consumed in order to identify surpluses and deficits. Several additional sub-questions were investigated regarding production and consumption of organic foods, consumption of locally sourced foods, and the consumption behaviour of Western Washington residents as compared to National trends and USDA dietary guidelines. The study found that Western Washington residents consume roughly 1.47 - 3.16 times the amount of food that is currently being produced in the region. The land resource analysis identified 665,000 acres of fallow and low-density lands (generally in non-urban areas) as having high potential to bring into food production. These findings are placed in the larger context of their relevance to the current food system, to future work, and to Part II of this analysis which will analyze food pathways and identify potential opportunities to re-localize the Western Washington food system.

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INTRODUCTION

Washington State is home to 6.7 million residents, and has grown by 14% in the past decade.[1] In the same decade, Washington State has lost 805,817 acres of farmland[2] to development, conversion to non-agricultural uses, and non-cultivation.[3] As the population continues to grow, and farmland continues to shrink, rising fuel prices and climate change raise concerns with long-distance transportation of food.[4] Eating locally is a concept that has arisen to combat these concerns, but raises a pressing concern of its own: is there enough farmland to feed our population locally?

The Western Washington Foodshed Study seeks to answer this question by identifying the food that is being produced in the region, the food that is consumed in the region, and the potential of the region's land resources for production. The study is funded by American Farmland Trust, with the intent of using study findings to inform policy discussions about the potential to develop a local food system by reconnecting local farmers to local consumers. The study will culminate in examining the food supply chain between local producers and consumers, and recommendations on how to relocalize these connections.

This foodshed study follows the precedent set by other foodshed studies conducted in San Francisco, New York, the Midwest, and British Columbia. The purpose of this foodshed study, like others, is to determine the potential for a population to be fed locally. Supporting local food promotes agricultural sustainability that ensures food security, improves nutrition, and reduces greenhouse gases.[5] When discussing local food systems, a foodshed study is useful in determining what the current production of a region is, and what potential the region holds to meet local food demand.[6]

What is a Foodshed?

The term "foodshed" is thought to be first used by Walter Hedden in his 1929 book *How Great Cities are Fed*. He described a foodshed as "the dikes and dams guiding the flow of food from the producer to consumer". Hedden differentiated foodsheds from watersheds in that "the barriers which deflect raindrops into one river basin rather than into another are natural land elevations, while the barriers which guide and control movements of foodstuffs are more often economic than physical."

Since Hedden first wrote about foodsheds in 1929, local food movements have adopted the phrase to identify food that is locally grown and processed. We are using the term in the same vein: to identify the food that is produced and consumed in Western Washington and the pathways by which food is moved through the supply chain.

The Western Washington Foodshed

Deciding what area is included in a foodshed is a difficult process. The San Francisco study chose to focus on a 100 mile radius of the city based on trends with the local food movement encouraging a 100 mile diet.[7] For this study, American Farmland Trust (AFT) and the Advisory Board helped define the geographical region of the foodshed as Western Washington. The Western Washington region is comprised of the 19 counties west of the Cascade Mountain Range.

This area was chosen because it seemed to be the most applicable to a foodshed study geographically, since county boundaries follow the mountain range, and a 100 mile radius would have included portions of these counties. Including areas east of the Cascades would have meant conducting a statewide study, which seemed less relevant in encouraging re-localization of the food system. Additionally, the land and population characteristics of Eastern and Western Washington vary greatly. Western Washington has 78%[8] of the State's population,[9] and higher pressure to convert agricultural land for development.[10] Additionally, the agricultural landscape of Eastern Washington is very different than Western Washington. The east side has larger farms, and the primary crops include small grains such as wheat and barley, potatoes, fruit, and vegetables. In the west, farms tend to be small, and dairy products, poultry, and berries are the primary products.[11]

THE STUDY

The study has been undertaken in two parts. Part I analyzes the types and quantities of food produced and consumed in the region, and examines all of the land resources there are for potentially increasing food production. All of the food that is consumed and produced in the region is compared side-by-side in a Mass Balance, to identify the surpluses and deficits in each item produced. Part II will further identify the pathways food travels, following individual items through the food supply chain, and make recommendations regarding how to re-localize the food system.

I. CONSUMPTION

INTRODUCTION

Containing over 5 million residents, *Western Washington's population consumes nearly 4.9 billion pounds (2.4 million tons) of food per year.* In addition, the following findings are notable about the region's consumption patterns:

- By weight, residents consume more protein and dairy items than they do grains, fruits, or vegetables.
- Added sugars account for 10 percent of the annual food weight eaten per person.
- Between 27 and 57 percent of food weight is lost between the farm and the table, depending on the food group.
- Residents' food expenditures in this region are roughly proportional to food expenditures nationwide; there is likely little difference in overall consumption patterns of this region and elsewhere.
- Estimated consumption levels do not meet the USDA's dietary guidelines—only 15 percent of recommended vegetable consumption is being met, while nearly double the amount of recommended protein is consumed.
- While it is difficult to determine how much of Western Washington consumers' food purchases are locally sourced, a recent national study found that locally marketed foods sold through intermediate channels (such as regional distributors and grocery stores, restaurants, other local retailers) account for anywhere from 50 to 66% of the total value of local food sales.
- Residents consume approximately 90 million pounds of organic produce per year, roughly equivalent to 17 pounds of organic produce per person.
- Residents consume approximately 218.3 million pounds of organic foods each year, roughly equivalent to 34.5 pounds of per person.

The following report expands upon these findings and outlines the objectives, methodology, and results of the Consumption Analysis portion of the Western Washington Foodshed Study. Previously published foodshed analyses were reviewed to determine various approaches to determining food consumption in a given region. The San Francisco Foodshed analysis, completed via partnership of the American Farmland Trust and the San Francisco Foundation, was the model from which the methodology for this analysis was derived. In addition to

estimating total food consumption within the Western Washington study boundary, this analysis also sought to determine the amounts of local and organic foods consumed, with the ultimate goal of performing a mass balance comparison, which compare food consumption with current and potential food production. (*See Chapter 3 for the Mass Balance comparison findings.)* Finally, a discussion of challenges encountered and future work is provided.

OBJECTIVES

The main objective for the Consumption analysis is to estimate the amount and types of food consumed by the study area population by answering the question:

> *What is the amount of food consumed, in terms of specific foods and overall food groups, by residents in Western Washington?*

To that end, this chapter of the report has seven objectives:

1. To identify the foods consumed by specific foods and overall food groups.
2. To estimate the weight of foods consumed (in pounds).
3. To investigate whether there is a difference in Western Washington food consumption patterns compared to national data; if so, use these findings to adjust consumption calculations based on United States Department of Agriculture data.
4. To estimate what portion of food consumed comes from local sources.
5. To estimate what portion of food consumed are Washington State Department of Agriculture or United States Department of Agriculture certified organic.
6. To estimate the amount (in pounds) of food necessary to feed the population of Western Washington according to the United States Department of Agriculture's standard Dietary Guidelines for Americans 2010 (preliminary analysis).
7. To compare the volumes of foods produced in Western Washington with the amounts of those same foods estimated to be consumed by Western Washington residents, in order to understand whether local production is capable of meeting the consumption demands of local residents.

FOOD CONSUMPTION

With over five million residents, Western Washington consumes no small amount of food. From a foodshed analysis perspective, the challenges lay in acquiring region-specific data on the food consumed by residents of this region, information on local and organic foods consumption

habits, and knowing the proportion of foods consumed here that are also produced within Western Washington. This remainder of this report contains sub-sections that respond to one of the following questions:

1. *How much food is consumed by the region's residents?*
2. *Do Western Washington residents' diets differ from national averages?*
3. *How much of all food consumed is sourced locally from Western Washington producers?*
4. *How much of all food consumed is certified organic?*
5. *Could Western Washington farms supply enough foods for residents to eat according to the Dietary Guidelines for Americans 2010? (preliminary analysis)*

How much food is consumed by the region's residents?

To estimate the volume of foods consumed by Western Washington residents, we used food consumption data from the Loss Adjusted Food Availability (Per Capita) Data System, published by the United States Department of Agriculture's Economic Research Service.[12] This data set is commonly used to estimate over 250 foods consumed on a national scale, and is the primary data source for many other foodshed analyses.[13] The foods include a wide variety of products including products like bananas and oranges that are not produced in Western Washington. It does not include beverages other than milk or juice. This data set has been updated every few years since 1970, and was last released in 2009. *Appendix A contains a detailed explanation of the methodology, including information on the data set, its limitations, and how it was categorized and used in this study.*

The numbers used to estimate consumption are reported in different ways, because the data set accounts for food losses that happen between the farm and retail outlets, between retailers and consumers' homes, and during the cooking process. As a result, this Foodshed study reports two different amounts:

> **Primary weights**: This number either equals or is as close as possible to original farm or raw product weight of each product. This number represents the amount that needs to be produced in order to feed the population given current food handling, storage, processing, and home preparation practices. *It is used here when comparing the amounts produced with the amounts consumed in the mass balance comparisons. It is also compared with loss-adjusted numbers in order to discussing food waste.*

Loss-adjusted availability: This number is the closest approximation of what a person actually eats. It is the primary weight *minus* all of the spoilage and loss that happened from the farm to the table. *It is used here in the Consumption section because it is closest to the amount consumed.*

Reporting the data in these ways represents the most accurate view of consumption and the most accurate comparison to Western Washington production volumes. As a result, the totals in different sections may appear to be different numbers, but they are linked according to the definitions above.

Findings

Overall Food Groups

In total, the 5,229,486 residents of Western Washington[14] are estimated to consume nearly *4.9 billion pounds (2.4 million tons) of food per year.*

Table 1, "Consumption estimates by food group, in pounds," summarizes the loss-adjusted weights per person, as well as displaying the loss-adjusted weights multiplied by the populations of the 19 Western Washington counties.

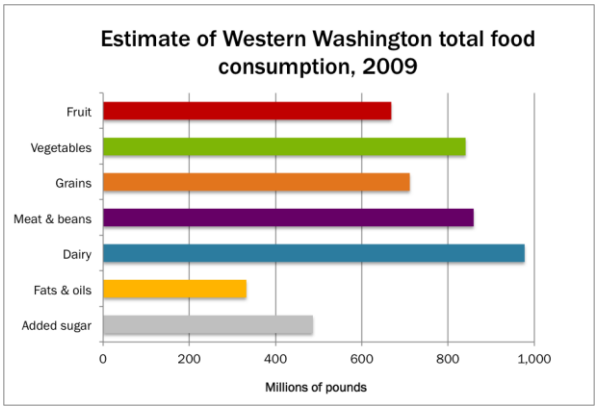
Table 1: Consumption estimates by food group

Consumption estimates by food group, in pounds		
	Consumption estimate per person*	Western Washington Consumption*
Fruits	128	668,170,318
Vegetables	161	840,952,320
Grains	136	711,058,019
Meat, beans, and nuts	164	859,173,495
Dairy	187	977,385,704
Fats and oils	63	332,004,035
Added sugars	93	486,324,994
Total	932	4,875,068,885

*Loss-adjusted availability per capita

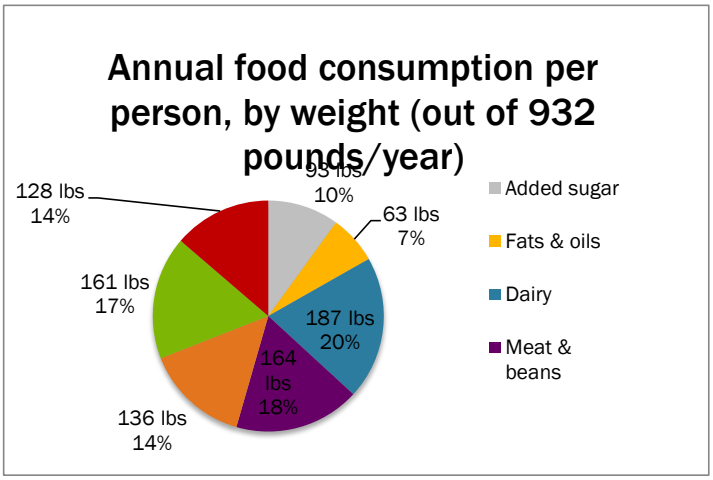
Image 1, “Estimate of Western Washington total food consumption, 2009” displays these consumption estimates by food group, calculated for the population of the 19 counties in the region.

Image 1: Estimates of Western Washington total food consumption, 2009



These estimates suggest there are 1,662 pounds of food available per year for every person, though after that amount is adjusted for food loss. By weight, dairy products and “protein” items (meat, beans, seafood, nuts) are consumed in greater quantities than other food groups. These categories are followed by vegetables, grains, fruits, added sugars, and fats and oils. Image 2, “Annual food consumption per person, by weight,” displays these percentages.

Image 2: Annual food consumption per person, by weight



Specific Food Items

The top 20 food items consumed, by weight, include the following items in Table 2. Notably, it is possible to grow or produce the majority of these items in Western Washington's climate (with the exception of cane sugar, oranges, bananas, rice, and some salad or cooking oils).

In addition, this diet mirrors current national trends of insufficient dietary patterns. The recent MyPlate (formerly MyPyramid and the Food Guide Pyramid) guidance includes messages emphasizing dark orange vegetables (such as sweet potatoes and carrots) and dark leafy greens (such as spinach, kale, chard, or collard greens), none of which rise to the top of this list. Moreover, while it is not possible to determine which cuts of chicken, pork, or beef are commonly eaten, no lean protein in the form of seafood appears at the top of this list. Also, four of the top items consumed include sweeteners, dairy fats, and oils.

Table 2: Top 20 food items consumed, by weight

	Top items consumed[15]	Top items consumed before adjusting for loss[16]
1	Milk	Milk
2	Wheat flour	Wheat flour
3	Corn sweeteners	Potatoes
4	Cane and beet sugar	Chicken
5	Potatoes	Tomatoes
6	Beef and veal	Beef and veal
7	Tomatoes	Corn sweeteners
8	Oranges	Pork
9	Salad and cooking oil	Cane and beet sugar
10	Chicken	Oranges
11	Apples	Salad and cooking oils
12	Pork	Apples
13	Cheese	Corn products (corn flour, meal, starch, grits, hominy)
14	Corn products (corn flour, meal, starch, grits, hominy)	Eggs
15	Eggs	Cheese
16	Cottage cheese	Lettuce
17	Legumes and dried beans	Corn
18	Rice	Bananas
19	Lettuce	Cottage cheese
20	Dairy fat	Rice

The following table lists the top items consumed in each food group. While many top items do grow in Western Washington, three top fruit items (oranges, bananas, pineapple) are not produced here. Similarly, two top vegetable crops (tomatoes, peppers) are less well-suited to the region's climate. *For specific estimates of how many pounds of each food item are consumed per person and across Western Washington as a whole, see Appendix B.*

Table 3: Top five items consumed in each food group by Western Washington population

Top five items consumed in each food group by Western Washington population (in pounds)

Fruit		Vegetables	
Oranges	177,694,909	Potatoes	228,994,200
Apples	150,078,376	Tomatoes	180,225,971
Bananas	52,362,251	Lettuce	75,876,485
Grapes and raisins	46,995,721	Onions	47,903,796
Pineapple	27,922,512	Bell and chile peppers	47,076,622
Meat, beans, seafood, and nuts		**Grains**	
Beef and veal	198,484,776	Wheat flour	495,337,955
Chicken	168,864,291	Corn products (flour, meal, hominy, grits, starch)	121,319,435
Pork	142,045,876	Rice	77,972,956
Eggs	110,195,906	Oat products	12,783,918
Legumes and dried beans	84,713,962	Barley products	1,881,443
Dairy		**Fats and oils**	
Fluid milk	699,694,768	Salad and cooking oils	171,660,805
Cheese	129,701,712	Dairy fats	74,320,934
Cottage cheese	89,889,635	Shortening	55,919,082
Frozen dairy products	26,283,397	Margarine	15,109,783
Evaporated and condensed milk	22,575,691	Other edible fats and oils	8,355,920
Added sugars*			
Corn sweeteners	244,769,182		
Cane and beet sugar	236,596,709		
Honey	3,390,256		
Other edible syrups	1,568,846		

*Only has four total categories

Food Waste

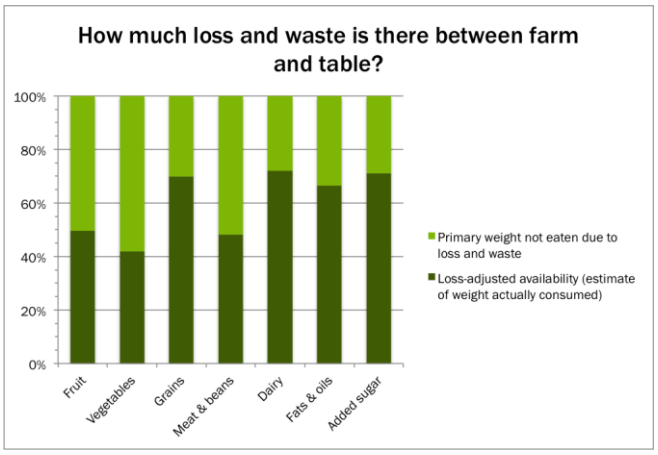
Food loss and waste accounts for the final "use" of a large portion of the food produced in this country. Losses range from between 27 and 57 percent of the food's weight, depending on food category. For example, as Table 3 indicates, "Consumption estimates by food group, in pounds," indicates that the average resident is likely to eat 128 pounds of fruit annually. However, for that amount to be consumed, 257 pounds of fruit were actually produced. This much needs to be produced because over the production, processing, transportation, storage,

and home preparation, nearly 50 percent of this fruit does not make it into the mouths of residents. This loss including waste, spoilage, and the parts we don't eat such as cores and stems. The same is true for other food groups.

Image 3, "How much loss and waste is there between farm and table?" compares the average percentage lost for each food group. Out of the whole of the primary (original) weight of each item, the dark green indicates amount most likely to actually be consumed per person after adjusting for losses along the food chain.

Developing a better understanding of food loss may be one key to balancing local production with local food consumption. If the goal of this foodshed analysis is to understand how regional production may be shifted to meet consumer needs, and how consumer behavior may be shifted to meet local product availability, then it would be worthwhile to examine whether food waste can be decreased so that the food production in Western Washington can reach the plates of more residents, rather than falling in the compost or garbage bin.

Image 3: How much loss and waste is there between farm and table?



Do Western Washington Residents' diets differ from national averages?

While the Loss-Adjusted Food Availability Data is frequently used as a proxy for food consumption and has been used in ways similar to our methodology in other studies[17], it reports National data and provides estimates of the consumption of an average U.S. citizen. Of course, it is possible that Western Washington residents may have different preferences and lifestyles

that these National averages do not take into account. Therefore, to paint the most accurate picture of the Western Washington foodshed, an attempt has been made to identify if these differences in habits actually exist and if so, use this information to adjust the national averages based on the specific preferences and habits of the people of Western Washington.

Several possible methods were considered in determining how to best identify any potential differences between Western Washington dietary habits and National averages (discussed further in Appendix A). The main data source this study utilizes is the Bureau of Labor Statistics Consumer Expenditure data from 2009 - 2010. This data provides information on the buying habits of U.S. citizens on both a national level as well as by metropolitan area, and includes information on spending for food for consumption at home and away from home. While this information has not been utilized to adjust consumption estimates in other foodshed studies, it has been used to provide secondary insights[18]. Because this information is decoupled from the actual consumption of these food items, both in that it is not loss-adjusted and also because it does not account for differences in the cost of food items between regions, it would be difficult to make accurate adjustments to the Loss-Adjusted Food Availability estimates using the data.

Other data sources by which to base any adjustments on could not be identified. Having spoken with contacts from local food distributors, grocery chains, and industry organizations including Charlie's Produce[19], Whole Foods Markets, PCC Farmland Trust, and Unified Grocers, no apparent industry reports or research that could guide such an adjustment seem to be available. Anecdotal evidence from several advisory board members seems to highlight the general opinion that more fresh produce and seafood is consumed in the Puget Sound region, however none of these insights have been able to be supported by data.

Using the Consumer Expenditure data from the Bureau of Labor Statistics, the percentage of total food dollars spent on specific food categories in several different Western metropolitan regions, New York City, and the National average[20] can be compared. As Image 4 shows, Seattle residents tend to spend a higher percentage (46.4% vs. 40%) on food away from home. Image 5 shows the relative expenditures of only food items for home consumption. Based on this data, Seattle residents spend a similar percentage of their overall food dollar on fruits and vegetables versus national average, while expenditures on dairy and meat are lower. Additionally, Seattle residents tend to spend more overall on cereals and bakery products and

"other" items. The "other" category encompasses sugars and sweets, fats and oils, miscellaneous items, and non-alcoholic beverages (coffee, tea, etc.).

While this data shows some variation between consumer expenditures on food items across the country, the percentage of spending on any one food category by Seattle residents differs by no more than 1.8% when compared to the national average. *Therefore, the major takeaway from this analysis is that food expenditures between categories are largely similar across the country.* With this in mind, using national data to measure the food consumption of the residents of Western Washington is likely to be accurate enough that we can be confident that doing so will not distort the study's overall findings.

Image 4: Food Expenditures – All

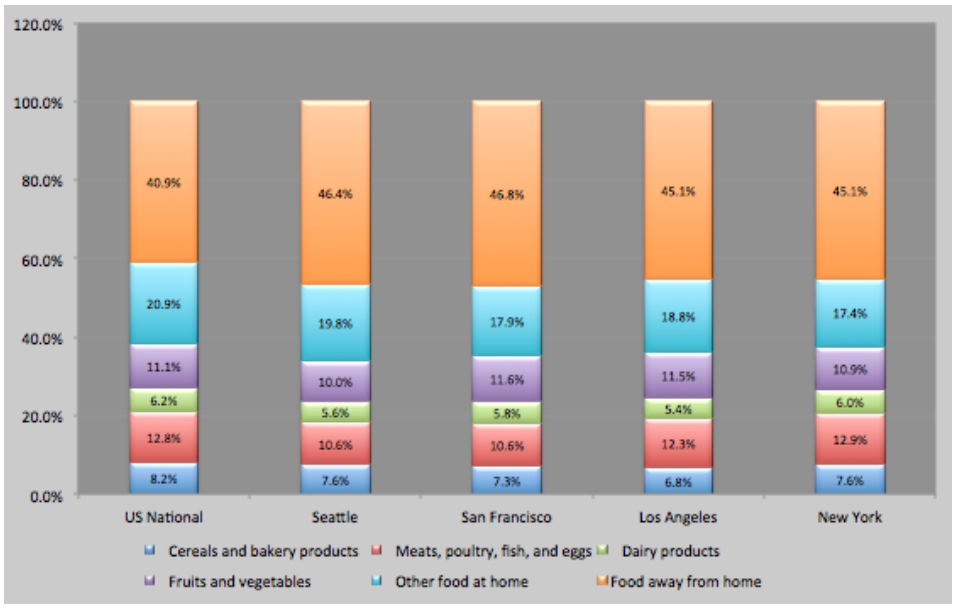
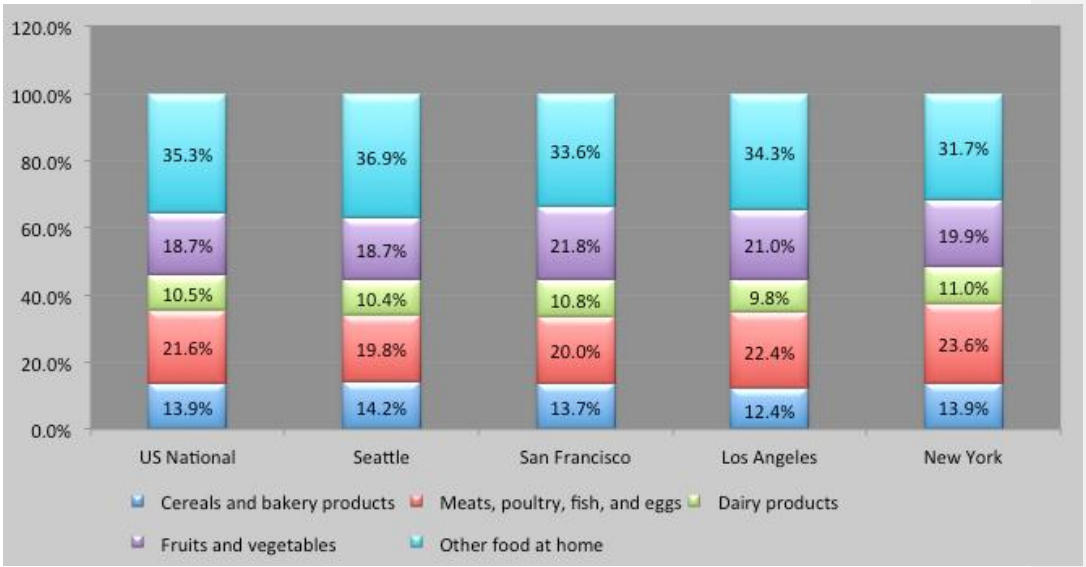


Image 5: Food Expenditures – Food At Home



HOW MUCH OF ALL FOOD CONSUMED IS SOURCED LOCALLY FROM WESTERN WASHINGTON PRODUCERS?

DEFINING LOCALLY SOURCED FOOD IN WESTERN WASHINGTON FOODSHED

Data measuring actual consumption of local foods is not currently available, however, the value of direct-to-consumer sales provides one approximation. The Census of Agriculture collects county-level data on the "value of agricultural products sold directly to individuals for human consumption," which includes farmers' sales through such venues as roadside stands, farmers' markets, pick-your-own operations, and CSAs.

Estimating Locally Sourced Food Consumption

In order to estimate local consumption as represented by direct-to-consumer sales, Census of Agriculture data was aggregated for the 19 counties comprising Western Washington. Because this data point excludes sales of non-edible crops, such as nursery stock, seeds, and cut flowers, the total value of agricultural crop sales was adjusted in order to allow for a direct comparison.

Findings

The 2007 Census of Agriculture data show that direct-to-consumer sales in Western Washington was approximately $350,268,442, representing roughly 5.77% of the total market value of edible crops sold. See Table 4.

Table 4: Total Market Value of Direct-to-Consumer Sales

Total Market Value of Direct-to-Consumer Sales (based on 2007 Census of Agriculture data)	
Total market value of edible agricultural crops	$350,268,442
Total market value of agricultural products sold directly to individuals for human consumption	$20,235,300
Direct-to-Consumer sales as a percent of total sales of edible agricultural crops	5.77%

The Census data provides only a narrow perspective on local consumption that substantially underestimates actual sales of local food. A recent USDA study analyzed the 2008 Agricultural Resource Management Survey (ARMS),[21] which was the first year where farmers were asked an extensive set of questions specifically about direct sales. The study found that most sales of local food occur through "intermediated marketing channels," such as regional distributors and grocery stores, restaurants, other local retailers. *Gross national sales of locally marketed food was $4.8 billion in 2008— four times greater than previous census and ARMS' estimates, with intermediated channels accounting for anywhere from 50 to 66% of the total value of local food sales.*

The raw ARMS data is not readily available and must be requested through the Economic Research Service. However, this data set presents a starting point for future supply chain analysis. Furthermore, several survey studies of regional grocery stores and farmers represent potential models for gathering a more comprehensive, on-the-ground vision of local consumption as approximated by local food sales.

HOW MUCH OF ALL FOOD CONSUMED IS CERTIFIED ORGANIC

DEFINING ORGANIC FOOD IN WESTERN WASHINGTON FOODSHED

The Washington State Department of Agriculture requires that all organic food products meet the standards outlined by, and be certified under the process of the National Organic Program (NOP) as regulated by the United States Department of Agriculture.[22] These standards provide regulations and guidance on certification, production, handling, and labeling of organic products for the purposes of fostering the cycling of resources, promoting ecological balance, and conserving biodiversity.[23]

Although an increasing portion of farms in Washington State have become certified organic (or are in transition to becoming certified organic) the question of organic food consumption in this study was not limited to organic foods produced only within the study boundary. The purpose was to determine the amount of organic food products consumed by residents of Western Washington regardless of the point of origin of the products.

Estimating Organic Food Consumption

A literature review was performed to determine the various methods for estimating organic food consumption. The San Francisco Foodshed Study was a main reference for this study; however their analysis of organic consumption references only national trends in organic sales and thus provides a percentage of total national retail food sales. Several published papers on foodshed analysis authored by Christian Peter et al., were also reviewed. While providing extensive documentation on calculating potential land production, consumption estimates were based on diet models and did not include reference to estimating organic consumption.

The United States Department of Agriculture has reported annual patterns in the U.S. organic foods market. Recent estimates report that organic sales constitute 3.7% of all food sales in the United States.[24] The report also states that 49% of all organic products were sold in conventional supermarkets, 48% were sold in natural and health product stores, and 3% through direct-to-consumer methods.[25]

The USDA Organic Foods Market report referenced several market surveys concerning consumer preferences and buying habits for organic foods. Several of these studies, conducted in 2001, report that between 57% - 66% of respondents (depending on the survey) have purchased organic foods. Of these respondents, roughly 3% reported being regular buyers of

organic products. This second pattern of consumption contrasts to a more recent (2006) market survey conducted by the Hartman Group. This study states that roughly three-quarters of respondents reported having purchased organic food, and out of these respondents, 23% were made regular (weekly) purchases.[26] It is not clear, however, what percentage of these purchases were produce, dairy, meat, or processed/ manufactured organic products. The USDA report cited another Hartman Group survey which lists the top 10 purchased organic products as: strawberries, lettuce, carrots, other fresh fruit, broccoli, apples, other fresh vegetables, grapes, bananas, and potatoes. These products as a percentage or weight of total purchases made by consumers was, unfortunately, not available in the USDA study.

A Washington State University survey, conducted in 2002, reported on food consumption attitudes and behaviors in King County.[27] This study reports that 26.5% of respondents reported buying organically grown products weekly. The study, however, does not report what quantity or percentage of food purchased was organic, or what kinds of organic products were purchased.[28] In addition, the study respondents were 79% white and thus do not necessarily constitute a representative demographic.

Upon completion of the literature review, it was apparent that qualitative data regarding organic food consumption was not available at the scale or in the form necessary to accurately determine consumption numbers for Western Washington. Therefore, representatives from three major food retailers were contacted in regards to organic sales: Charlie's Produce, Whole Foods Market®, and Safeway™. These three retailers were contacted in order to broaden the representative consumer base, and thus give a more accurate depiction of organic food purchase (and thus consumption) in Western Washington. These representatives were asked if information was publicly available regarding the amount of organic food products sold. If actual sales numbers could not be provided, representatives were asked to provide the amount of organic sales as a percentage of total sales.

The food retail sales numbers will be used as the primary source for estimating organic food consumption. Percentage of total sales numbers will be used to determine an estimate for the weight of organic food consumption in Western Washington. This will be calculated by multiplying these percentage values and total consumption numbers (derived in the sections above). Due to the time constraints of this study, individual farmers, farmers markets, and

CSAs were not approached for data. These sources, however, could provide valuable data and would be a starting point for future work.

Findings

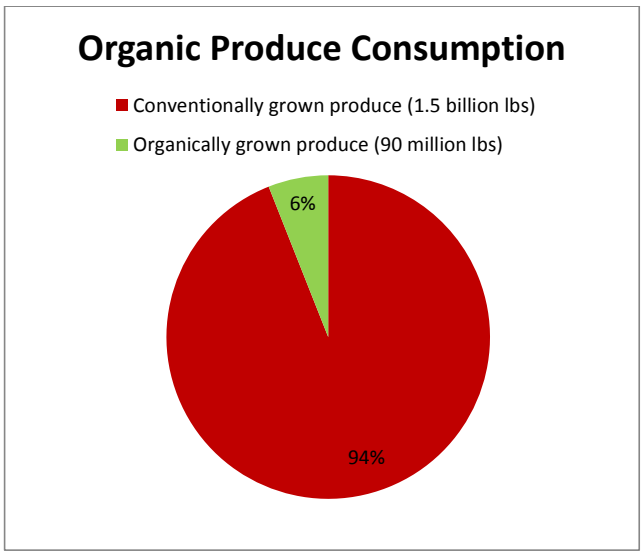
The representative for Safeway returned with a sales figure stating that organic sales constituted 6%-7% of all produce sales for Western Washington. It should be noted that this percentage was for produce only, and does not include other organic food items such as dairy, meat, or packaged foods.

As described earlier, Western Washington residents consume 1.5 billion pounds of produce annually (about 289 pounds per person). Assuming that 6% of all produce purchased in Western Washington is organic, then:

Total Produce Consumption x % Organic = Total Organic Consumption

1.5 billion pounds x 6% = 90 million pounds

It can therefore be estimated that Western Washington consumes 90 million pounds of organic produce per year, roughly equivalent to 17 pounds of organic produce per person.

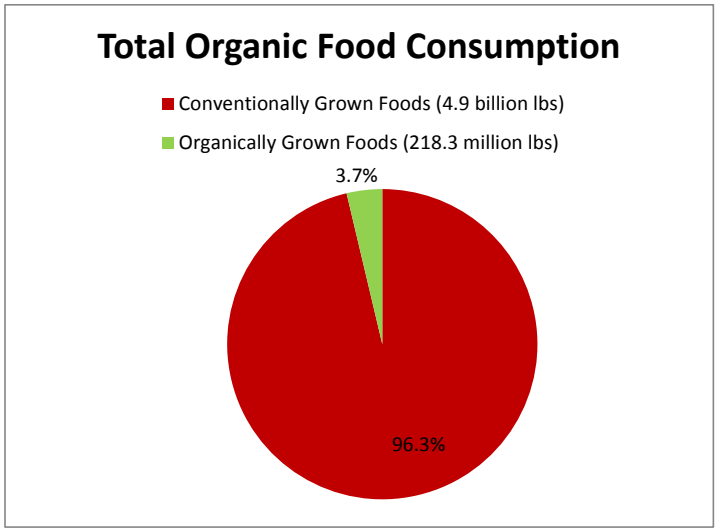


Since sales data were not obtained for all organic products, National organic sales values can be used to obtain a rough estimate for total organic consumption for all products (including produce, meat, dairy, and processed/packaged). It was reported in the above literature review that organic food sale constituted 3.7% of all food sales for 2010. This study calculated the total food consumption of Western Washington at 4.9 billion pounds per year (equivalent to 932 pounds per person). The amount of organic food consumed in Western Washington can be estimated as follows:

Total Food Consumption x % Organic = Total Organic Consumption

4.9 billion pounds x 3.7 % = 218.3 million pounds

It is thus estimated that Western Washington residents consume 218.3 million pounds of organic foods each year, roughly equivalent to 34.5 pounds of per person.



The representative for Charlie's Produce relayed that sales are tracked according to zip code. Organic sales numbers could be pulled from this data provided that all the zip codes in Western Washington were used to define the sales area. Unfortunately, due to the time constraints of this study, sales numbers were not obtained in time for inclusion in this report. Similarly, sales numbers from Whole Foods were not obtained in time for inclusion in this report.

COULD WESTERN WASHINGTON FARMS SUPPLY ENOUGH FOODS FOR RESIDENTS TO EAT ACCORDING TO THE DIETARY GUIDELINES FOR AMERICANS?

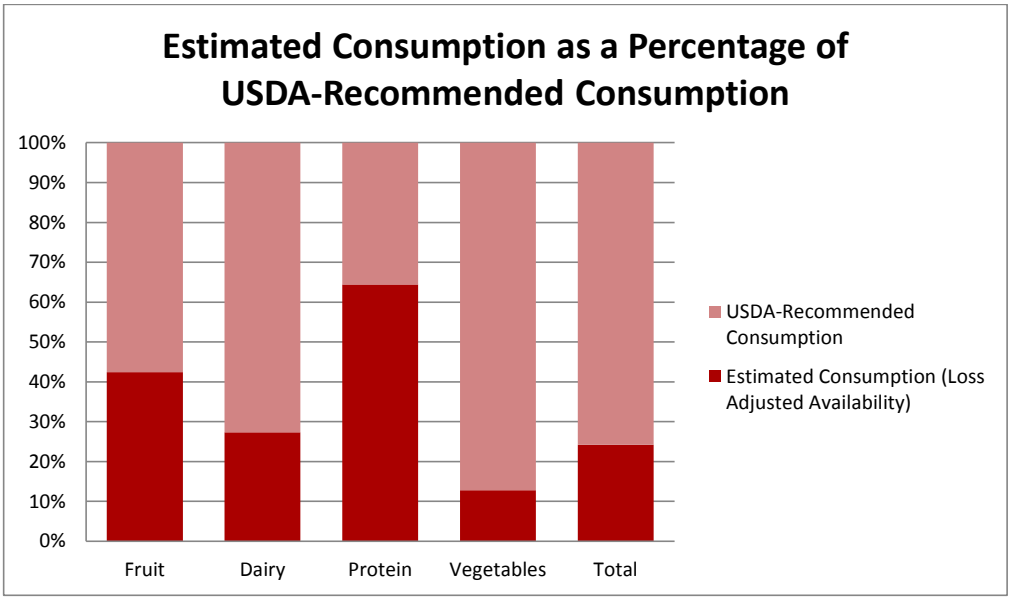
Beyond determining whether current production levels can meet Western Washington's consumption needs, this study also seeks to answer the question of whether the requirements of a healthy and balanced diet can be adequately met. A preliminary analysis estimates consumption levels according to the USDA's 2010 Dietary Guidelines for Americans and compares them with consumption estimates to determine whether the current diet fulfils the USDA's requirements.

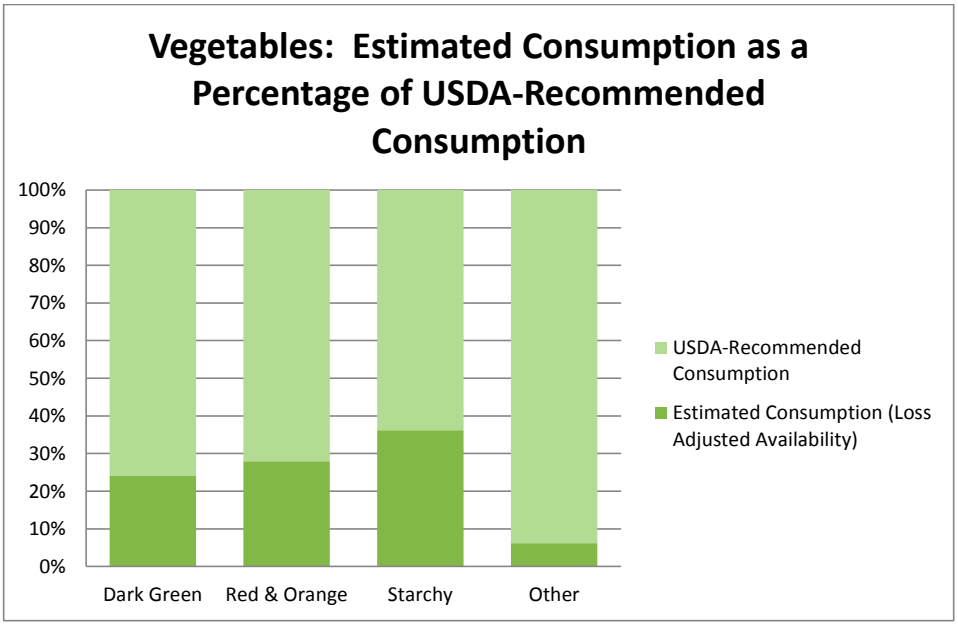
Estimating USDA-Recommended Consumption

The USDA's 2010 Dietary Guidelines for Americans[29] provides recommendations intended to help people achieve and sustain a healthy weight by maintaining a calorie balance over time and consuming nutrient-dense foods. Specific recommendations for each food group and specific types of foods vary according to levels of total daily caloric intake. The appropriate level of caloric intake is determined by an individual's age and gender. The amount of food, both in total and according to food group and type, can be determined based on Western Washington's demographic makeup. See Appendix for a more detailed description of the methodology used.

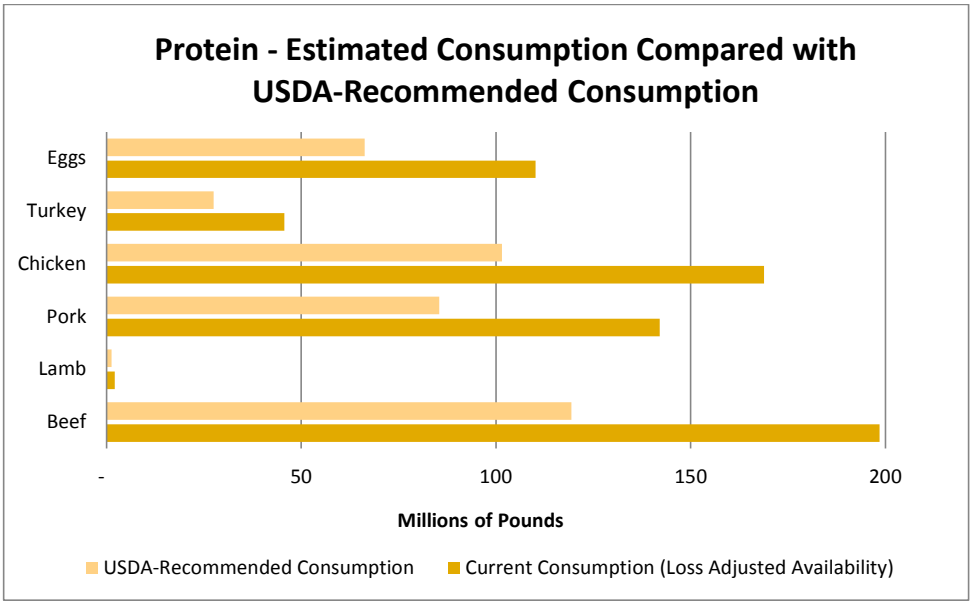
Results

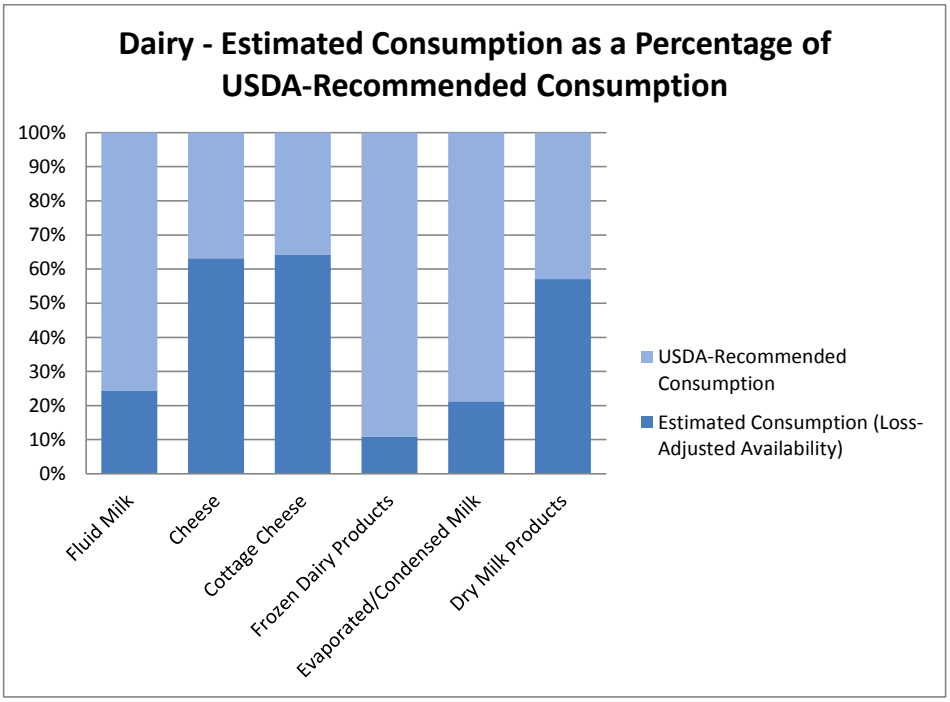
The total pounds of food necessary to meet the USDA dietary guidelines far exceed estimated total consumption. The bulk of the imbalance is accounted for by a dramatic discrepancy between estimated and recommended vegetable consumption—*Western Washington simply does not consume enough vegetables.* Estimated dairy consumption was also significantly lower than the USDA recommendations. Estimated fruit consumption only slightly exceeded recommended consumption, making it the food group closest in balance with the USDA guidelines. *Protein was the only food group where estimated consumption exceeded recommended levels.*

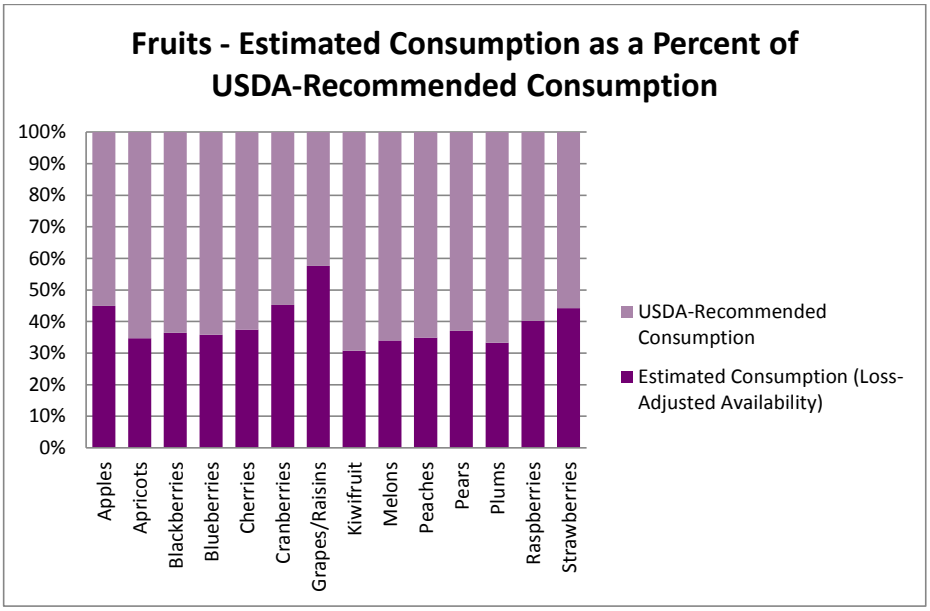




See the Appendix D for detailed vegetable consumption numbers.


Protein - Estimated Consumption Compared with USDA-Recommended Consumption
Eggs
Turkey
Chicken
Pork
Lamb
Beef
-
50
100
150
200
Millions of Pounds
USDA-Recommended Consumption
Current Consumption (Loss Adjusted Availability)


Dairy - Estimated Consumption as a Percentage of USDA-Recommended Consumption
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Fluid Milk
Cheese
Cottage Cheese
Frozen Dairy Products
Evaporated/Condensed Milk
Dry Milk Products
USDA-Recommended Consumption
Estimated Consumption (Loss-Adjusted Availability)



The stark disparity between estimated and recommended vegetable consumption may be due, in part, to the fact that the USDA adoption to MyPlate involved an increase in recommended vegetable consumption. MyPlate is a graphic designed to help eaters portion their meals in accordance with the USDA guidelines. MyPlate recommends that eaters make about half their plate fruits and vegetables.[30] Loss-adjusted availability data pre-dates the updated guidelines and the adoption of MyPlate. Despite this discrepancy, this comparison provides an instructive perspective on how dramatically consumption patterns need to change in order to meet the USDA requirements.

CONCLUSION

The substantial difference between estimated consumption and USDA-recommended consumption could provide a guide for ways in which the food system can be relocalized. This data suggests that in order to support a diet that is more healthful as well as more local, vegetable production and consumption will play a key role. With consumption levels already well beyond what is locally produced, this data demonstrates that shifts in production aimed at relocalizing the foodshed must be accompanied by modifications in diet and consumption preferences.

However, this is only a preliminary analysis. The data indicates how many pounds of food are needed to supply a healthy diet based on *existing* consumption preferences represented from consumption estimates themselves. The requirements of a healthy diet can serve as a guide for determine *how* to relocalize and, in turn, food system perform presents an opportunity to shift consumption practices toward healthier alternatives.

FUTURE WORK

While the general dietary trends of the region's residents are clear, the information challenges encountered over the course of this consumption study present opportunities for the next phase of this foodshed analysis:

- **Food loss:** Developing a deeper understanding of opportunities to reduce food loss between producer and consumer, thus making more food currently produced available for consumption.
- **Local food purchases:** Conduct a supply-chain analysis to determine how much locally produced food is consumed locally and identify opportunities to keep local food within the foodshed.
- **Organic food purchases:** Determine with greater accuracy the amount of organic food products consumed in Western Washington. Conduct a supply-chain analysis to determine how much Western Washington produced organic food is consumed by Western Washington residents.
- **Regional production to support healthier diets:** Determine which locally produced foods can be maximized to increase Western Washington's food security and bring consumption closer to USDA recommendations.

I. PRODUCTION

INTRODUCTION

The goal of the production component of this study is to determine the types and amount of agriculture occurring in Western Washington.

The study determines the following objectives regarding agricultural production in Western Washington:

1. Identify the number of farms and acres in farms in total and by county
2. Determine individual commodities produced by acreage and yields (by weight) by county
3. Determine yields by weight of each food group: fruits, vegetables, grains, dairy and protein.
4. Determine the number and acreage of organic farms in Western Washington.
5. Determine the yields (by weight) of the following organic commodities for each county: fruits, vegetables, grains, dairy and protein.
6. Quantify by county, and by the region as a whole, the total food being produced.
7. Compare the total food produced to the total food being consumed to determine the mass balance.

PRODUCTION METHODOLOGY

To determine the type and quantity of food being produced in Western Washington, a variety of methods were utilized. These methods followed the precedent set by several studies, including "The San Francisco Foodshed Assessment"[31] and "An optimization approach to assessing the self-sustainability potential of food demand in the Midwestern United States"[32].

Similar to the Midwestern study, the types and acreage of commodities produced were determined using the 2007 USDA Census of Agriculture (Ag. Census). When 2007 data was unavailable, the most recent data for each crop was used. The Ag. Census presented limited information on organic agriculture, only including acreage and total sales by county. The Washington State Department of Agriculture's list of Certified Crops and Producers provided detailed information on number and acres of farm by county, and a list of items produced.

Since most crops in the Ag. Census do not list a yield per acre, we followed the methodology in the San Francisco Foodshed Assessment and sought out local Washington reports. The 2009 Washington Annual Agriculture Bulletin (WAAB) was used to extrapolate statewide average yields to county acreages for individual commodities. The WAAB listed acreage and yields for individual items, and we used the average yield over a five-year period. Since certain crops are either not listed or aggregated in the WAAB (such as berries), local commodity commissions were contacted for those average yields.

It was desired to convert all yields into pounds for more understandable comparison, and to quantify in pounds the total amount of food being produced. Items that did not feature an average yield in weight, such as poultry and eggs, required more complex conversion equations. *See Appendix E for detailed conversions for each item*.

In compiling itemized lists of food produced, certain things such as poultry, melons, leafy greens, etc. were aggregated based on either the data available in the Ag. Census, or to better match data on food consumption. Food produced is also organized by food group, and includes: fruits, vegetables, grains, dairy, protein and other. Organizing by food group allows for easier comparison with consumption data, and the potential for further analysis in Phase II of this study.

PRODUCTION FINDINGS

The Western Washington region boasts a considerable amount of agriculture**.** *In total, the region produces 4,220,353,849 pounds of food.* There are 17,060 farms in the 19 county region, composed of 1,019,858 acres. Lewis County possesses the most amount of acreage in farms at 131,554 acres, followed by Grays Harbor County (119,267 acres) and Skagit County (108,541 acres). *For further details regarding farms and acreage by county, see Appendix F.*

There are 53 individual commodities produced in Western Washington, which include fruit, vegetables, grains, dairy, protein and other miscellaneous items such as honey and herbs. *Specific items and weights by county are provided in the mass balance spreadsheet attached as Appendix H.*

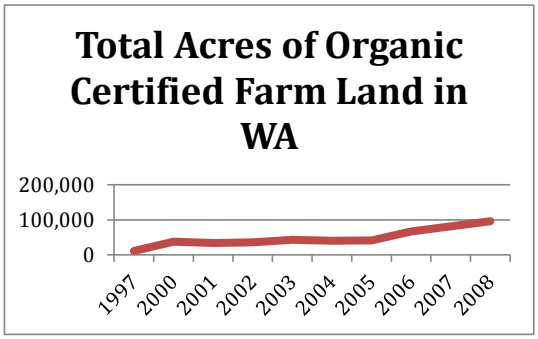
Food Group	Total Pounds Produced
Grains	137,113,024
Fruit	127,203,807
Vegetables	1,061,707,474
Dairy	2,703,514,215
Protein	190,174,271
Other	641,058
Total	**4,220,353,849**

Dairy is the item produced in the greatest quantity, and accounts for 64% of the pounds of food produced. Among the food groups, there are also several items that are produced in great quantities compared to others. These include: apples (21,794,880 lb), raspberries (57,346,764 lb), cucumbers (49,668,702 lb), green peas (55,108,620 lb), potatoes (763,902,000 lb), sweet corn (93,308,345 lb), chickens (97,184,064 lb), eggs (53,031,849 lb), and mollusks (31,875,000 lb).

The Western Washington region tends to have relatively mild winters, and results in certain crops having harvesting seasons that stretch into the winter months. It is interesting to note the correlation between length of harvest season and yields of certain crops. Fruits, berries, and nuts have the shortest growing season ranging from 1-4 months from April to December. Certain vegetables such as lettuce, spinach, potatoes, beets, carrots, and onions have growing seasons that stretch 8-10 months through January and February. Dairy products, greens, meat and poultry, shellfish, eggs, and honey are harvested the entire 12-month calendar year.[33] The long growing season for these items may account for the high production rates.

Compared to other states, Washington ranks high in the production of certain crops such as apples, potatoes, and rhubarb. Washington State is the nation's number one apple producer, producing over 50% of all apples. However, of the approximately 5.4 billion tons of apples produced by the state nationally[34], Western Washington produces less than 1% at only 10,897 tons. Washington State ranks second in the production of potatoes in the United States, and of the 140,000 acres of potatoes produced in the state[35], 10,353 acres were harvested in the Skagit Valley. Pierce County also leads the nation in rhubarb production, and the county single handedly produces 50% of the nation's supply on 232 acres.[36]

Organic Findings



Over the last two decades, organic farming has increased rapidly, both across the nation and in Washington State specifically. Since 1997, acres of organic farmland have increased over eightfold across the entire state of Washington. The number of farms has also increased from 512 in 2000 to 637 in 2008. Organic farming is flourishing in Western Washington, as well. Within the 19 counties of our study, there are 254 organic farms, totaling 25,422 acres. Counties leading the way in organic farm acreage are Skagit (5,358.48 acres), Thurston (4,149.75 acres) and Lewis (3,628.21) (*See Appendix G for detailed acreage by county*). Organic producers are growing a huge variety of crops; farmers report growing over 90 different types of crops and many different varieties. Dairy, fruits, grains, livestock and vegetables are all being produced organically. Further, organic farmers are growing timber, hay, animal feed, medicinal herbs and ornamental plants. Unfortunately, more detailed data on acreage by crop and organic crop yields is unavailable, so a more comprehensive exploration of organic production using our methodology is not possible but will be explored further in Part II of the study. Sales of organic crops in Western Washington totaled $4,157,938 in 2007 (excluding Wahkiakum County for which no data was available).

III. MASS BALANCE COMPARISON

INTRODUCTION

The mass balance is a comparison of the total food produced to the total food consumed in the region. Methods used in the San Francisco Foodshed Study were used to derive this comparison. The mass balance is significant because it represents a ratio of how much food is consumed for every pound produced. We derived this mass balance by dividing the amount of food consumed by the amount of food produced. In addition to the overall mass balance, we compared the pounds produced and the pounds consumed for individual items and food groups. Using these numbers, we can determine where the surpluses and deficits in Western Washington food production and consumption are found. In Part II of this study, recommendations will be made regarding how production of individual items can better match consumption levels, leading to a more efficient local food system.

MASS BALANCE COMPARISON METHODOLOGY

This "mass balance" is a way of comparing total production to total consumption *only for those items produced in the region.* This "mass balance" comparison does not compare total production with total consumption. As a result, it does not account for items such as bananas or oranges, which are heavily consumed but not possible to grow in this region.

The mass balance number for any given product is a ratio of pounds of food consumed by Western Washington residents to pounds of that same (or equivalent) food produced in Western Washington's 19 counties. The resulting number indicates how much more of that item we eat than what we produce. For example, the mass balance number for barley is 0.25. This number indicates that we consume only one-fourth of the amount produced regionally. On the other end of the spectrum, the mass balance number for cherries is 31.98. This number indicates that we eat nearly 32 times more cherries than are produced in Western Washington.

To begin to understand how food production and consumption amounts compare, the consumption data was categorized to match, as closely as possible, the categories used in the production data sets. Because there are 53 categories of food items produced in Western Washington, those same food items were copied from the consumption data set. Not all categories of food produced have a matching category in the consumption data, often because food items are grouped differently or because the data is not collected. Of the 53 food

categories produced, there were 40 items determined to have appropriate matches for food consumed.

For the most accurate comparison to the production yields, the consumption category of "primary weights," was used. These product weights are the consumption dataset's closest equivalent to farm, raw, or semi-processed weights.

Additionally, food items derived from the same source were grouped, even if items typically are considered as falling into different food groups. These groups include:

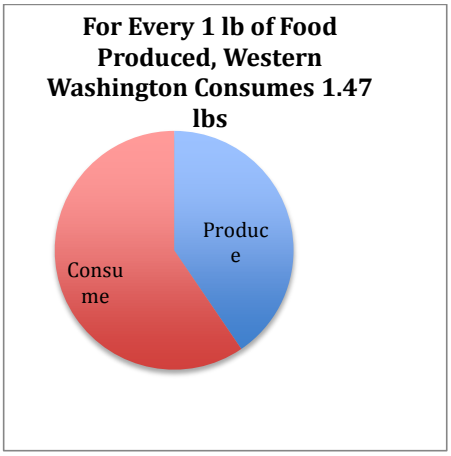
- Milk = all dairy products plus dairy fat
- Cattle and calves = all beef and veal plus edible beef tallow
- Eggs = eggs plus fat share of eggnog
- Pork = pork plus lard

It should also be noted that the consumption-side of weights for some items may only be recorded for one variety or treatment of that product. For example, the "raspberries" consumption category is only based on frozen raspberry weights, whereas the production weight for the same category is recorded pre-processing and therefore represents a number that is likely more representative of total raspberry availability. *The consumption categories combined for this mass balance are reported in Appendix H.*

It is also important to note that the mass balance was derived using the primary weight, before loss of waste and un-edible portions, which is closest to farm weight and therefore the best comparison. However, due to food loss and waste between farm and fork, the primary weight numbers are often far higher than the amount actually consumed. *See the Consumption chapter for more details on amounts consumed and loss calculations.*

Mass Balance Findings

The mass balance determines that we eat more than we produce in Western Washington. *It is determined that for every 1 pound of food produced in Western Washington, 1.47 pounds of the same food items are consumed*. A total of *4,173,553,227* pounds of food are produced in Western Washington, and a total of *6,142,173,777* pounds of the same food items are consumed. *For an item by item comparison of production and consumption, as well as comparison by food group see Appendix I.*



If the mass balance is adjusted to account for all food that is produced and consumed in the region, regardless of the food's origin, the mass balance shifts to 2.06.

It is interesting to note the large amount of dairy that is produced in Western Washington. Of the full total pounds of food produced, dairy accounts for 64%. If dairy is removed from the mass balance calculations, the mass balance shifts to 3.19 pounds of food consumed for every 1 pound of food produced.

Among the food groups, dairy is produced in sufficient quantity as to surpass the needs of regional residents by more than 50% and support exports. Vegetables, with a mass balance of 1.2, are almost produced in enough quantity to support local diets. This is mostly due to the high production volumes of green peas, pumpkins, and potatoes. Other food groups including grains, fruit, protein and other are not nearly produced in enough quantity to support local diets.

Food Group	Production	Consumption	Mass Balance= Consumption/Production
Grains	137,113,024	731,665,183	5.34
Fruit	127,203,807	1,105,013,701	8.69
Vegetables	1,048,658,792	1,259,294,380	1.2
Dairy	2,703,514,215	1,457,629,023	0.54
Protein	156,581,910	1,583,809,895	10.11
Other	481,479	4,761,596	9.89
Total	**4,173,553,227**	**6,142,173,777**	**1.47**

When examining individual commodities, there are certain items that are produced in amounts that exceed consumption. For example, the mass balance of potatoes, green peas, pumpkins, blackberries, raspberries, cranberries and other berries all demonstrate that Western Washington produces more than are consumed.

Other foods are produced locally, but not in sufficient quantities to meet the needs of the Western Washington population. Items that are consumed in much higher quantities than produced include pork (3,326), dry beans (6,307), watermelon (1,191), cantaloupe (1,107), and tomatoes (205). This means that Western Washington consumes, for example, 3,326 times more pork than is produced locally.

CONCLUSIONS

It is clear from the mass balance comparisons that Western Washington consumes more food than is produced. At best, about 67% of all food consumed by the 5,229,486 residents of Western Washington[37] might be produced within the region. The actual amount of food that is locally produced and consumed is most likely lower due to exports of locally produced food.

There are certain items, such as bananas and oranges, that are unsuited to the climate and will never be produced locally. However, certain items present an opportunity to increase production enough to meet local consumption needs. An example might be leafy greens, which are currently consumed 16 times more than is produced. It is possible to harvest certain greens 12 months a year in Western Washington, which presents an easy opportunity to increase production.

Other foods that are produced in sufficient quantities within the region, such as berries, may be unavailable at certain seasons. The mass balance approach used in this analysis disguises the seasonal nature of food production in Western Washington, particularly for the fruit and vegetable food groups.

Further analysis of the mass balance and land resources in the region is needed to evaluate additional potential to build supply levels of certain items. Part II of this study plans to delve into these concepts deeper, making recommendations to increase local food supply to better meet consumption needs.

IV. LAND RESOURCES

INTRODUCTION

Western Washington consumes far more food than it produces. To feed itself with locally grown food, Western Washington would have to target and reallocate resources to increase production. In other words, local farmland is critical to the goal of self-sufficiency. If we want to understand Western Washington's ability to feed itself, it is important to examine the existing agricultural land supply. Therefore, the question we are analyzing in this section of the report is:

"What is the agricultural potential (potential carrying capacity) of the Western Washington land base?"

The following analysis is broken into three sections. To stage this question we begin with a history of food production in Western Washington, and summarize the growing problem of farmland loss.

Second, to examine the potential agricultural carrying capacity of the region we describe four major land considerations.

1. Existing Agricultural Land
2. Agricultural Soils
3. Low Density Land Use
4. Urban Areas

Finally, several other factors play into identifying potential agricultural land. We detail other important qualities of land that should be considered for farmland conversion.

SECTION ONE: HISTORY OF FOOD PRODUCTION IN WESTERN WASHINGTON

Food production systems in Western Washington have morphed over time, as populations, technology, policy, and ideologies shifted. Particularly in the 20th Century, the amount of land dedicated to food produced in Western Washington shrunk, as food supplies became more influenced by global markets. In order to analyze our present-day land resources, we provide a history of Western Washington food production.

Native American Agriculture

The Native American tribes of Western Washington have a long history of food production. The Native American people are collectively are known as the Puget Salish and Southern Coast Salish, and consist of various individual tribes. Their food gathering territories often overlapped and covered much of Western Washington with greater density near the Sound.[38]

To cultivate and hunt a diverse set of food, Native Americans moved to different territories throughout the year. In the spring and summer, tribes hunted salmon (including Coho, Silver, Steelhead, and King salmon), salmon eggs, and herring. During the summer seasons, tribes hunted deer, elk, ducks, and dogs. From the plains and forests, they gathered camas, salmonberry sprouts and other greens, tiger lilies, wild carrots and berries.[39]

Ethnobotany accounts reveal that native inhabitants actively managed the landscape with activities like controlled burning of camas and huckleberry fields to reduce encroaching conifers and to increase available potassium and other nutrients from the ash.[40] Post-European settlement forced many native peoples into agricultural labor and, with irrigation and population increases, the food landscape began to change.

19th and early 20th Century

The first reports of commercial agriculture by Western settlers can be traced back to Fort Vancouver, which was established in 1824. The Fort remained self-sufficient by growing a variety of plants and raising livestock.[41]

In 1853, the Washington Territory separated from the Oregon Territory, and policies to drive settlement began by the federal government. In 1860 there were roughly 1,330 farms, most of which were in Western Washington.[42] This number would increase greatly over the next 30 years, mostly due to the Homestead Act of 1862. The main purpose of the policy was to encourage settlement and development of the land by allowing citizens, who were either the head of a family or over 21 years old, to apply for 160 acres. Recipients had to live on the land for five years and demonstrate the construction of living quarters and agricultural production.[43]

The construction of railroads and irrigation projects in the 1880s encouraged the expansion of agriculture far into Eastern Washington. By 1890, there were 18,056 farms in Washington State.[44] Already, there was a growing difference between what farms looked like in Western

compared to Eastern Washington. The farms that were located in Western Washington tended to be smaller (120-150 acres) and grew hops, potatoes, produce and milk. [45]

Expansive irrigation efforts created a shift in the agricultural landscape in the early 20th Century. As irrigated land was the most expensive farmland in the state, farmers converted land from low value to high value crops like apples in Eastern Washington. By 1930, wheat and apple production remained the predominant crops in the state.[46]

The Story of Farmland Loss

In the second half of the 20th Century, the loss of farmland became, and still remains, a national issue. According to American Farmland Trust, between 1982 and 2007, more than 23 million acres of America's agricultural land have been lost to development.[47] Most of this loss can be attributed to wasteful land management practices. While the US population grew 30 percent from 1982-2007, developed land increased 57 percent.[48] The USDA also highlights the problem, noting that a third of the value of U.S. agricultural output is produced on cropland that is subject to urban development pressure.[49]

From the 1950s to the present, Washington State lost several million acres of agricultural land. Washington reported 14.9 million acres of farms in 2007 compared to about 16.1 million acres in 1987 and 18.7 million acres in 1959 (see Table 5).[50]

Table 5: Farmland in Washington State from 1950 to 2007

	1959	1964	1974	1987	1997	2002	2007
Total farms (thousands)	52	46	29	34	40	36	39
Total farmland (millions of acres)	18.7	19.1	16.7	16.1	15.8	15.3	15.0
Percent of total land area	45%	45%	40%	38%	38%	36%	36%

*based on 42 million acres

For Western Washington, the statistics paint a grimmer picture. In 1950, Western Washington had roughly 2.3 million acres of farmland. In 2007, the reported acreage is roughly 1.02 million acres, resulting in a loss of 55 percent of our farmland over 57 years (see Table 6).[51]

Table 6: Farmland Loss in Western Washington

County	1950[52]	2007[53]	Percent Loss
Clallam	76,630	22,822	-70.2%
Clark	219,000[54]	78,359	-64.2%
Cowlitz	110,073	30,702	-72.1%
Grays Harbor	123,068	119,267	-3.1%
Island	51,455	17,699	-65.6%
Jefferson	45,581	12,717	-72.1%
King	153,301	49,285	-67.9%
Kitsap	46,031	15,249	-66.8%
Lewis	304,253	131,544	-56.8
Mason	56,130	25,185	-55.1%
Pacific	67,748	61,749	-8.9%
Pierce	165,932	47,677	-71.3%
San Juan	56,716	21,472	-62.1%
Skagit	161,163	108,541	-32.7%
Skamania	24,921	5,472	-78.0%
Snohomish	180,285	76,837	-57.4%
Thurston	170,640	80,617	-60.0%
Wahkiakum	32,809	12,025	-63.3%
Whatcom	209,947	102,584	-51.2%
Total	2,255,683	1,019,803	-54.8%

A major threat to cropland is development. A stark example comes from King County. Since the 1950s, much of King County's growth has occurred in suburban and rural areas. Housing developments, roads and shopping malls have replaced farms and berry fields.[55] By the late 1970s, 80 percent of the farms that existed in 1945 had disappeared. Despite policies like agricultural zoning and Purchase of Development Rights (PDR), King County had less than 18 thousand acres of cropland. Similar changes have occurred in other parts of urbanizing Western Washington.

It is unlikely that pressures on farmland will decrease in the near future. To ensure that we have available land for local production in Western Washington, the first step is to identify where there are resources for future production.

SECTION TWO: POTENTIAL AGRICULTURAL LAND

As noted in previous sections, current food production in Washington is not sufficient to meet current consumption. A diverse set of potential approaches exists to enhance the ability of Western Washington to feed itself. This section focuses on the potential to bring new agricultural lands into production.

To thoroughly examine this possibility, we must first understand the extent of current food-producing lands. How much land in Western Washington is currently devoted to food production? Where are those lands? Can those lands be used to raise more food? We then consider what lands have the most potential to convert to agricultural production—an exercise in thoughtful scenario-building using a set of considerations including soils, land use, and parcel size.[56]

Please note that all numbers provided in this section are intended only to provide rough ideas, and not precise accounts, of the potential of expanding Western Washington's agricultural base. Similarly, maps show trends and possibilities at the large scale of Western Washington. They should not be interpreted to suggest site-specific findings. There are numerous challenges to this kind of process, both related to the data as well as the open-ended nature of the question. As best as possible, the primary challenges and limitations are mentioned in the text below.

For definitions of land use categories, a general description of the methodology in this section, and the methodology of the GIS mapping process, please see Appendices J, K, L, M and N.

Consideration #1: Existing Agricultural Lands and Fallow Lands

To increase food production in Western Washington, we must first consider land currently in agricultural production.

The 2007 US Census of Agriculture counts just over one million acres of farmland in Western Washington, or less than five percent of the total land area (see Table 7 below). Note that farmland consists primarily of agricultural land used for crops, pasture, or grazing, as defined by

the Census of Agriculture. It also includes woodland and wasteland not actually under cultivation or used for pasture or grazing, provided it was part of the farm operator's total operation.[57]

Table 7: Farmland in Western Washington, According to 2007 USDA Census of Agriculture

County	Land in Farms (Acres)	Total cropland (Acres)	Harvested cropland (acres)	Cropland only used for pasture or grazing (acres)	Other Cropland (includes idle, failed summer fallow) (Acres)	Pastureland, all type (acres)	Land Used for Vegetables (Acres)
Skamania	5,472	1,610	1,111	193	306	2,229	304
Wahkiakum	12,025	4,660	2,140	2,237	(D)	5,550	64
Jefferson	12,717	3,833	1,999	1,259	500	5,312	1,182
Kitsap	15,294	3,674	2,211	913	(D)	5,984	3,339
Island	17,699	8,557	7,019	741	208	5,801	141
San Juan	21,472	9,033	5,607	3,061	308	9,965	37
Clallam	22,822	8,750	6,995	1,205	391	(D)	938
Mason	25,185	6,075	3,374	1,640	810	7,515	101
Cowlitz	30,702	10,933	9,091	1,308	437	10,557	3,022
Pierce	47,677	17,319	12,100	3,918	1,045	23,003	83
King	49,285	17,963	9,459	5,699	1,980	28,207	(D)
Pacific	61,749	15,042	8,406	4,867	1,430	18,981	1,448
Snohomish	76,837	37,039	25,965	7,257	2,866	34,265	48
Clark	78,359	34,296	25,423	5,314	2,492	32,180	19,317
Thurston	80,617	26,283	18,066	6,081	1,860	35,147	N/A
Whatcom	102,584	73,705	64,336	5,965	3,014	19,739	4109
Skagit	108,541	69,810	58,163	8,246	2,665	26,073	372
Grays Harbor	119,267	24,070	17,391	4,594	1,668	19,351	4
Lewis	131,554	54,408	37,388	10,127	5,428	49,799	37272
Western Washington	1,019,858	427,060	316,244	64,498	21,980	289,859	2,763

Not all of the one million acres is currently being used for the production of food for direct human consumption, demonstrating potential for increased food production. About 427 thousand acres were planted cropland, with 316 thousand acres actually harvested. Over 20 thousand acres of cropland was considered idle, fallow, or failed. Close to 300 thousand acres were used for pasture.

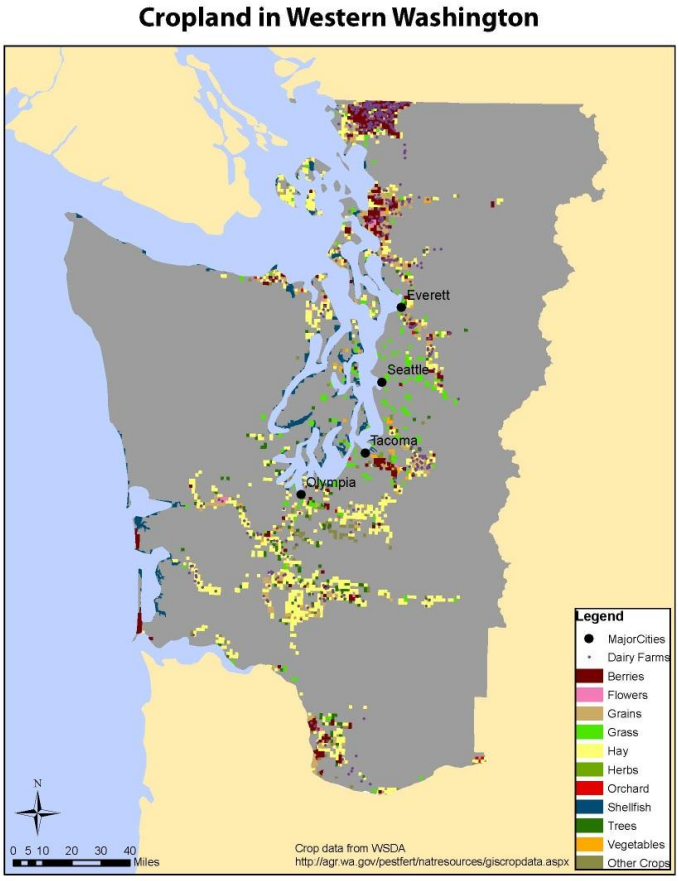
It is feasible that pasture lands could be used for more intensive food production or to produce food for (more) direct human consumption. Pierce, Skagit, King, Clark, Snohomish, Thurston and Lewis Counties each have more than 20 thousand acres of pasture land, indicating that

some counties may have great potential for increasing production on pasture lands. It is also feasible that other lands (such as idle and unharvested lands) could be used to grow more food than current production levels indicate.

As Image 6 confirms, much of Western Washington's farmlands are used to grow hay (which includes silage and lands that may be pastured), turf grass, and trees. One possibility for expanding food production in Western Washington includes converting land that currently grows hay, turf grass, trees and flowers to land that grows food for direct human consumption.

Image 6 also shows the geographic distribution of current crop production. In terms of food crops, berries are grown mainly in the north in Whatcom and Skagit Counties, along the coast in Pacific and Whakiakum Counties, and south in Cowlitz and Clark Counties, as well as in Pierce County southeast of Tacoma. Vegetable production occurs along the I-5 Corridor, near the larger cities, and in Skagit County.

Image 6: Cropland in Western Washington



Other than converting pastureland crops into land producing food for human consumption, fallow land can be put back into production. The Census of Agriculture, which relies on self-reporting and captures a point in time of production, reports roughly 1 million acres of farmland in Western Washington. The University of Washington Rural Technology Initiative (RTI), which classifies land based on aerial land cover photos, estimated 1.5 million acres of farmland in 2004.[58]

Table 8: Amount of Farm Land in Western Washington, According to Rural Technology Initiative Land Use Data

Type	Acres (in thousands)	Percentage of total land*
Land in intensive agriculture	522,726	2.5%
Mixed agriculture	676,972	3.3%
Other agriculture	339,352	1.7%
Total agriculture	1,539,051	*7.5%*

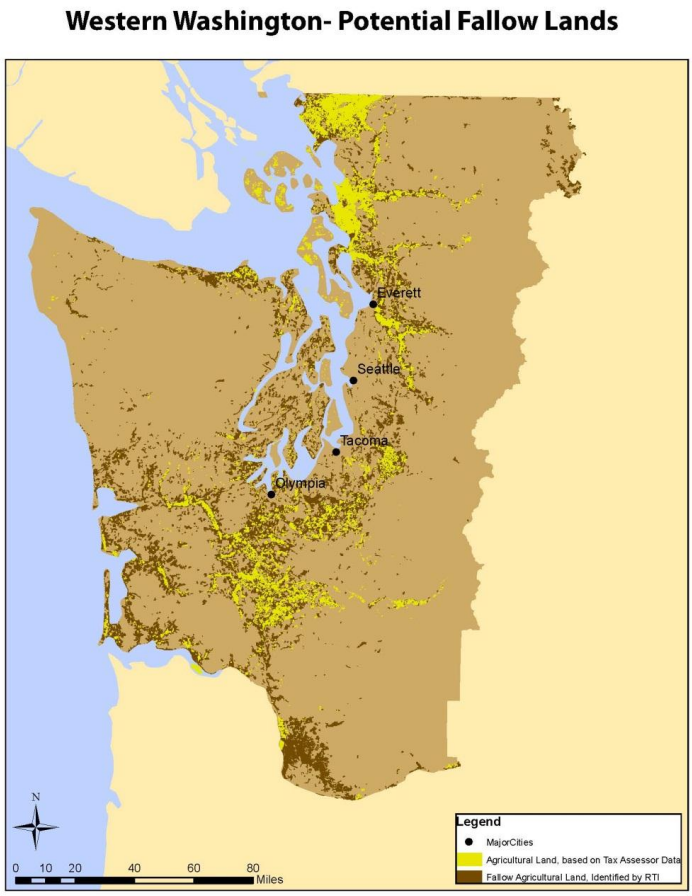
*This and all subsequent estimates are based on a total land area in Western Washington of about 20.5 million acres.

One potential reason that RTI estimates are higher than the Census of Agriculture is that classification from land cover imagery, as performed by RTI, includes three classifications: intensive, mixed, and other agriculture. Intensive is described as “agricultural and livestock lands dominated by irrigated crops or grassland, bare soil and dispersed farm buildings.” Mixed agriculture is described as “a mix of agricultural and livestock lands with some additional residences unrelated to agriculture and an occasional small development (which often includes non-irrigated and cleared lands and occasional industrial buildings).” Other agriculture is described as “agricultural and cleared lands that have a development density equated to 20 or 40 acre parcels that may be single-family residences, hobby farms or small agricultural operations.”

Thus, the RTI classifications likely include lands not in current agricultural production. These additional lands may provide a rough understanding of how much fallow, under-utilized and other potentially available agricultural land exists. Bringing this land into more intensive production would increase Western Washington’s producing lands.

The map below shows the 1.5 million acres of agricultural land as identified by RTI, in comparison to 2010 WSDA crop data (which is similar to the USDA Census of Agriculture data).

Image 7: Western Washington – Potential Fallow Lands



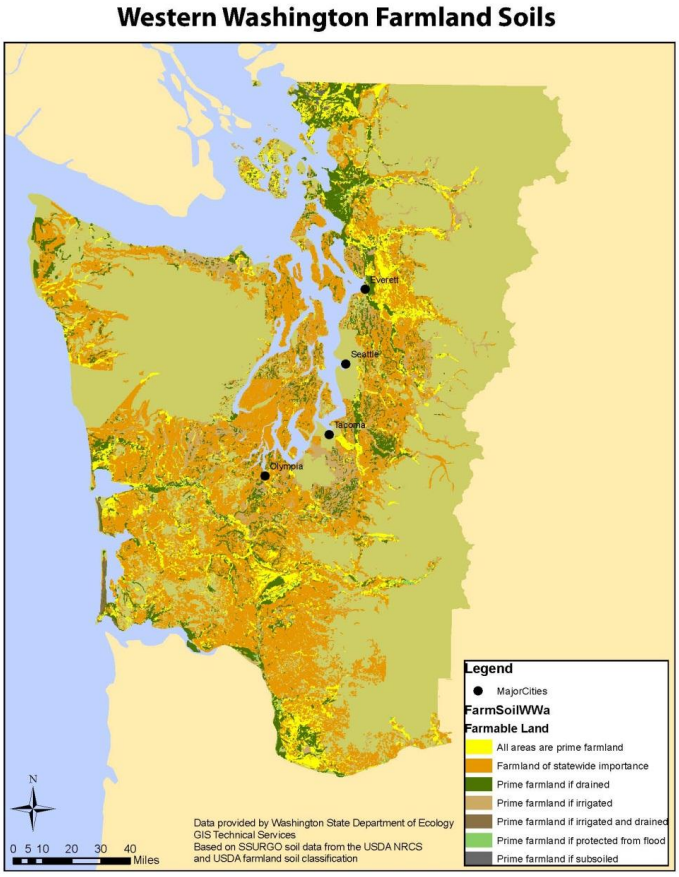
Consideration #2: Agricultural Soils

An important consideration for agricultural production is soil. Prime farmlands are lands that have the best combination of physical and chemical characteristics for producing feed, forage, fiber and oilseed crops. The soils which constitute prime farmlands are generally level, deep, well watered and have no serious limitations for use and management (as defined by the United Stated Department of Agriculture, National Resources Conservation Services).[59] Across Washington state, about 8 percent (or 2.2 million acres) of the non-Federal rural land base is classified as prime farmland.[60] This represents a 167 thousand acre loss since 1982, mostly to development for urban uses and transportation, farmsteads, and rural estates. Few and declining affordable sources of irrigation are also a factor in loss of prime farmlands.

In Western Washington over 5 percent of land is considered prime farmland, and close to 15 percent is farmland of statewide importance. The majority of the prime farmland soils are forested. Lewis County contains approximately 20 percent of these forested prime farmland soils.[61] The likelihood of these timberlands being cleared for crop production is low. Barriers including equipment expenses, lack of local marketing opportunities, and rapidly changing land use patterns.

The map below shows all prime farmland, farmland of statewide importance, and other farmland of consideration in Washington.

Image 8: Western Washington Farmland Soils



We discuss Skagit and Pierce Counties to show various issues regarding soil in Western Washington.[62] In Skagit County, high quality farming soil tends to correlate with large floodplains and low elevation. The eastern part of the county has high variation in elevation, making land less suitable for farming, although there are stretches of prime farmland, farmland of statewide importance, and prime farmland if drained along the Skagit River. Much of the farming areas extending north-south along the I-5 corridor tend to be prime only if drained or protected from floods. Prime farmland in Skagit County totals roughly 90,000 acres, but urban development is an ongoing threat.

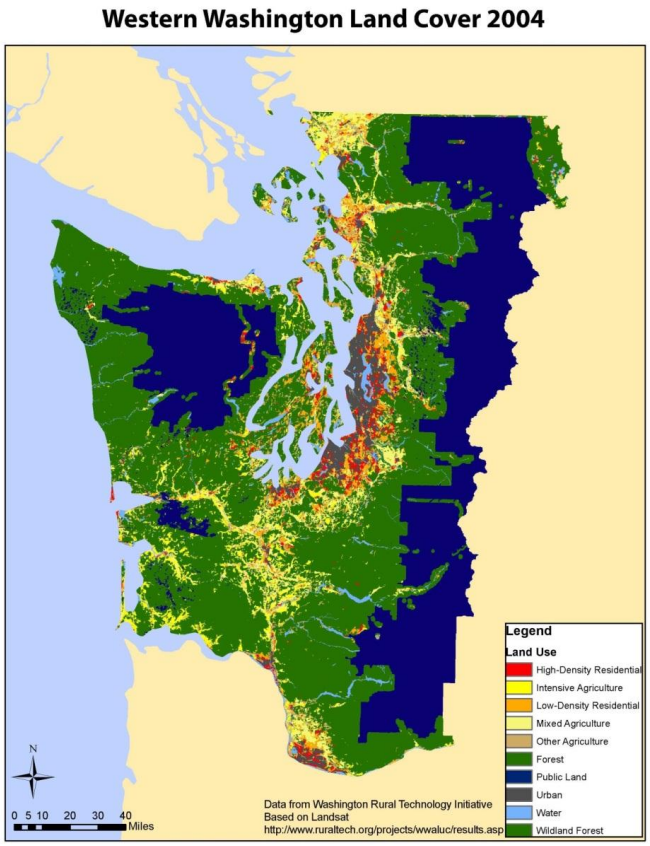
Meanwhile, in Pierce County, much of the farmland occurs in low-laying parts of the central and west portions. Almost half of the farmland is considered to be either prime or of statewide importance. The majority of the remaining farmland would be prime if irrigated. As is true for much of urbanizing Western Washington, development already has covered much of these soils or threatens to.

In general, prime farm soils may be best to convert to agricultural uses, since production is expected to be high. However, numerous challenges including urban development, competition from the timber industry, and the lack of monetary gain, suggests that this conversion is unlikely. Much of Western Washington's farmland is only considered prime if drained, irrigated, or protected from flooding.

Consideration #3: Low-Density Land Use

Lands with low-density land uses may also have potential for agricultural production. In Western Washington, these lands often occur on rural-zoned land. According to RTI, close to 500 thousand acres of Western Washington, or 2.4 percent of the land base, are characterized by low-density residential land use. RTI defines low density residential as land consisting of at least 40 contiguous class acres that are in a forest or agricultural land cover classification group and are between 20 and 50 percent developed. Image 9 shows Western Washington land use.

Image 9: Western Washington Land Cover



An important consideration for the agricultural potential of these low-density residential lands is soil quality. Table 9 breaks down low-density land use by soil type. About 16 percent of low-density residential land is prime farmland, while almost 28 percent is farmland of statewide importance. This suggests considerable potential for agricultural production.

Table 9: Low-Density Residential Land and Prime Farmland Soils

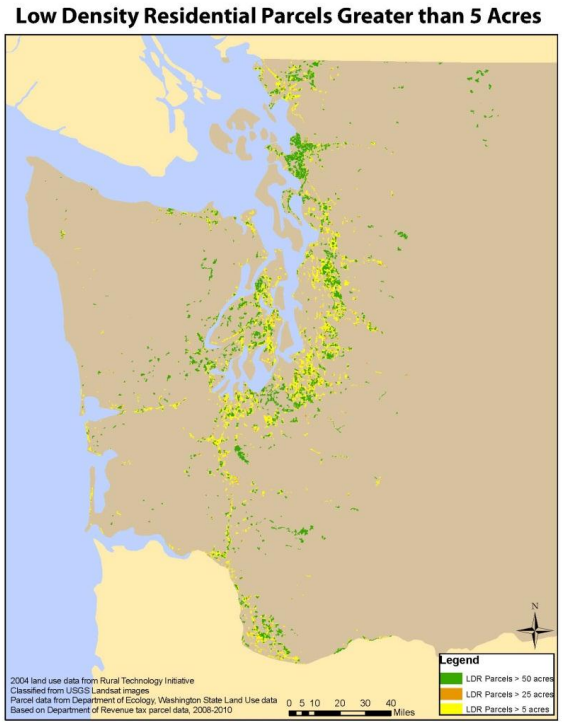
Soil Designation	Acres of Low-Density Residential Land Use (in thousands)	Percent of Total Low-Density Residential Land	Parcels
Prime farmland	77.5	15.71%	194
Farmland of statewide importance	137.6	27.90%	389
Prime farmland if drained	77.8	15.78%	257
Prime farmland if irrigated	102.2	20.72%	123
Prime farmland if protected from flood	7.8	1.59%	11
Prime farmland if subsoiled	1.2	0.24%	1
Prime farmland if drained and irrigated	1.1	0.22%	6
Total	405.2	82.18%	981

In addition to soil, the size of potential agricultural lots may be important to determine its feasibility for agricultural production. Larger lot sizes allow for scaled farm production. Table 10 shows the number of acres and parcels with low-density residential land use and parcel size over 5, 25 and 50 acres. Almost 80 percent of low-density residential land is on parcels greater than 5 acres. About 34 percent are greater than 5 acres in size and have prime farmland or farmland of statewide importance. Again, this suggests considerable potential for agricultural production.

Table 10: Low Density-residential Lands, by Parcel Size

	Acres (in thousands)	Percent of Total Low-Density Residential Land	Parcels
Low density residential parcels > 5 acres	393,813	79.8%	25,530
Low density residential parcels > 5 acres, with prime farmland or farmland of statewide importance	165,706	33.6%	
Low density residential parcels > 25 acres	196,539	39.8%	1,596
Low density residential parcels > 50 acres	183,913	37.3%	1,324

Image 10: Low Density Residential Parcels Greater than 5 Acres



Consideration #4: Urban Land

Urban land is another land category with potential for increased food production. Not only does the urban landscape provide another way to improve self-sufficiency, it has several indirect benefits on urban communities. With food production occurring within neighborhoods, community members can learn about and appreciate where their food comes from. In addition, urban agriculture epitomizes *local* food. There are little transportation costs, as food comes straight from the garden into the home. Overall, urban agriculture may have the largest potential to shift how our nation thinks about the current food system.

Compared to rural areas, urban lands are faced with different opportunities and constraints when it comes to food production, and thus warrant their own investigation of production potential and a different metric for assessing land potential. If we want to convert some of the denser urban areas within Western Washington into food production, which types of land would

we target to convert into productive land? While many of the criteria discussed previously may be applicable, there may be other, more relevant and pressing issues to converting urban land into food production.

In urban areas, plots sizes are smaller, many surfaces are impermeable or contain inadequate growing medium, and there are fewer acres that are free of use. Thus, different methods for identifying land and strategies of putting land back into production must be employed in denser, urban areas. Several studies in urban areas have embarked upon task of identifying land to put into production. This section outlines the approach of many studies focused on urban areas, to identify, inventory and categorize and rank urban land for food production.

Urban Agriculture – Successful Cities and their strategies

The term urban agriculture is used to describe a variety of food producing activities within an urban area, such as community gardens, commercial gardens, community supported agriculture, farmer's markets, personal gardens, and urban farms. In most cases, the purpose of urban agriculture is to feed local populations[63].

Many cities have taken a comprehensive and proactive approach to incorporating food production into the urban fabric through land use plans and zoning ordinances. Cities that have been successful often have a long history of production. For example, in Boston, urban agriculture has been an official priority since 1977, when a citizen advocacy group and land trust was established that permanently protects 44 community gardens[64]. Alternatively, cities like Detroit have made recent efforts to recognize and support urban food production. In its zoning codes, urban agriculture is not a permitted use anywhere within the city, and urban agriculture is described as "flying under the radar." While a provision of the current zoning code has been drafted to include urban agriculture, it has not been updated[65].

Regardless of the definition, most cities incorporate urban agriculture provisions into their zoning ordinances. Additionally, many do so by including provisions regarding community gardens, sales of produce, keeping animals, the length of time the property may be used as a garden, and many more[66]. Ultimately, there are many strategies that a city can employ to increase food production and specific strategies should be based upon an analysis and understanding of existing land use, and require creativity and support on all levels – federal, state, city, and local community.

Expanding Food Production in Urban Areas – Identifying Land

For urban areas that are looking to expand food producing lands, there are many variables that must be considered. The following studies in Seattle and Oakland offer potential methodologies for identifying agricultural land in urban areas. For the methodologies used in Detroit and Toronto studies, please see Appendix O.

Seattle, Washington

A study of potential urban agricultural land in Seattle, Washington looks at different categories of publically-owned land, including: vacant, excess and unused parcels, rights-of-way along multi-use paths, energy transmission lines and water pipes, and public school and public park properties[67].

GIS and aerial photo analysis was used to evaluate the potential for community gardening according to particular criteria, including size, slope, shade and building coverage, impervious surface, access, and local development plans. Other characteristics, such as proximity to an existing P-Patch or a public school and local population characteristics like population density, number of families, average median monthly income, percentage of rental housing, and percentage of minorities, were also identified to assist in future decision-making[68].

A total of 45 vacant and unused sites comprising over 12 acres of land are identified as being suitable for urban agriculture. In addition, 122 school properties and 139 public parks have under-used space that has the potential to be turned into community gardening space. Furthermore, the rights-of-way along four multi-use paths and one transmission line are shown to contain possibility of being converted into space for gardening[69].

While this study did not look at production potential of these lands, the climate of Western Washington is more temperate year-round than other cities and can likely produce more food on the off-peak seasons with properly conditioned soil.

Oakland, California

In Oakland, the amount of vacant public land was much more limited than in Detroit. The study chose to broaden the scope to include any public land that could potentially be used for agricultural production, such as lawns, fields, and other fallow open spaces. The land inventory began by identifying existing food production and categorizing into community garden, urban

agriculture organization garden, and school garden[70].

This study used GIS data, aerial photos and site visits to identify land. GIS data was used to identify publically-owned land and aerial photos were used to identify the parcels with open space that could potentially be used for food production. The study also classified each parcel by ground cover (soil/grass, hard surface, mixed surface, or dense vegetation); land with dense vegetation was considered for agroforestry potential but removed from the final inventory. The remaining parcels (soil/grass, hard surface, mixed surface) were combined. Once these sites were identified, further research looked at distance to slope, public transportation, distance to a school, and water access [within 10 feet of water meter][71].

In addition to the 1,200 acres found suitable for urban agriculture, the study identified 2,706 additional acres of publically owned land with potential for agro forestry development. Conditions suitable for agro forestry include forest, woods or other densely vegetated areas and can produce non-timber forest products such as fruit trees, mushrooms, honey and small livestock[72].

How much land is available?

It is not reasonable to assume that all vacant or otherwise potentially productive land should in fact be re-appropriated for food production. None of the studies outline above advocate for a full re-appropriation of unused land for food production. The Oakland study, for example, included all potentially productive land simply as a measure of the potential of Oakland to provide food for its residents[73]. Significant investments in the construction of hoop houses and larger quantities of land could supply even greater proportions[74]. Thus, these studies used the extreme scenario of calculating production on all potentially productive lands to serve as a basis of comparison.

None of these studies looked in great depth at the potential for residential lands to be cultivated for food production. While it is challenging to inventory residential lands suitable for food production on a macro-scale, there is a significant opportunity for individual households to become more self-sufficient in feeding themselves. In densely populated areas with little land vacancy and high land values, significantly increasing food production likely lies in converting land around homes and apartments to produce food.

Recommendations for Future Study

Each of the studies outlined above discussed recommendations for future exploration. These include: rank and classify potential sites for further assessment, which will include land-use history, site visits, soil sampling, and community feedback; create an online interactive land locator to assist the public in identifying and accessing available land; examine policy opportunities and constraints to urban agriculture.

SECTION THREE: OTHER CONSIDERATIONS

In identifying potential agricultural lands, there are many considerations. The previous section examined current agricultural production, fallow lands, agricultural soils, and current land use. We recognize that there are many other factors that must be considered when discussing the potential to expand agricultural production. These include land productivity, market demand for agricultural uses, land ownership, location (including proximity to other farmland, farm community infrastructure and markets), and transportation. Considerations for cropland productivity include soil type, slope, elevation/topography, water and irrigation, weather and climate (including climate change), and farm management practices. Some of these are discussed in greater detail below, while others are worthy of future examination. Meanwhile, it is also important to consider the environmental implications of expanding agricultural production as well as the development needs for a growing population.

Generally, increases in both agricultural land and production are likely to produce more food for local consumption while negatively impacting the environment and human health. Here are some additional considerations for evaluating potential lands for food production.

Soils

This discussion expands on the above, noting that soil is of prime importance in this discussion. The majority of agricultural soils in Western Washington are in the lowlands, below 1,200 feet elevation. These areas are subject to less severe slope and more moderate temperatures as compared to the rest of the region. Alluvial soils, formed from repeated flooding in the valleys, are best suited to agricultural production because of their water and nutrient holding capacity. Due to their flat nature and proximity to coastal population centers they are also targeted for sprawl. Most of the alluvial soils in King and Pierce counties have been lost to development. The vast majority of soils in northwestern Washington are glacial as well as some volcanic mudflow, both of which have lower drainage and are better suited for pastures. The glacier that

compacted the northwest 15,000 years ago did not reach south of Olympia. These southwestern soils are older with fewer course fragments and more clay, lending to less drainage. They have the potential for high row crop productivity if organic matter is maintained.[75] As is the case with all soils, management practices greatly determine long-term productivity for variable uses.

The variance in our soils allows for the possibility to select crops for specific microclimates, soil types and water availability. Further consideration can be given for crops with hardiness zones that are suited to climate change projections.

Irrigation

Despite the lowered irrigation needs from Western Washington's wet climate, the dry summers necessitate supplemental water for many crops. In 2007 Kitsap County had 926 of 15,294 acres (6%) of farmland in irrigation.[76] A recent foodshed study from BC, Canada showed that the 4% of farmland in irrigation was responsible for 40% of farm gate sales.[77] An increase in irrigated farmland could result in higher fruit and vegetable production as well as an increase in some grains. This increased take of water is complicated by water rights that reserve water for other human uses as well as environmental systems.

Environmental Implications

Bringing more land into agricultural production would certainly have an impact on the environment, an important consideration in an era of declining land and water resources, topsoil loss, and climate change. Conventional industrialized agricultural production has a host of environmental impacts such as water contamination, greenhouse gas emissions and land development.[78] Different agricultural practices have differing kinds and levels of impact. It is important that the ongoing discussion of expanded agricultural production considers alternatives to conventional industrial agriculture. Priorities should include environmental stewardship and environmentally friendly farming practices including organic agriculture and permaculture.

Various lands produce ecosystem services that include cleaning water and air, sequestering carbon as well as benefits to food production including salmon habitat and erosion control. We identify that certain forested lands have potential for farmland conversion. As ecosystem services are better quantified, land use decisions can be informed to maximize benefits. Several agencies including the EPA (through the Urban Atlas program) are working to identify both potential agricultural lands and environmentally sensitive lands geographically, for cost benefit

analysis in planning and incentivizing development or conservation.

Currently, the use of agricultural land for environmental services is governed by federal, state and local agencies and jurisdictions. A major influence on shifting agricultural land to conservation is from USDA conservation easements in the form of direct payments to move production out of sensitive environmental areas. Additionally, some producers self regulate, deciding to protect areas of their farmland, often for economic benefits such as a reduction in bank erosion or the creation of a natural windbreak.

Agriculture, processing and transportation infrastructures

In addition to lot size, proximity of farmland to current farming communities and infrastructure can influence the scale of production. Our report looks at low-density residential and urban areas partially because of their proximity to population centers. Clustered agricultural uses increase resource sharing and reduce nuisance complaints.

DISCUSSION

In Western Washington, we are net importers of food. We have a large and growing population, but a dwindling number of acres devoted to farmland production. As the statistics demonstrate, this has been a long downward trend, not only for the nation, but within our communities. In this section, we have outlined several categories of land that could be potentially converted to agriculture.

The first category is areas of current agriculture. Out of 1 million acres of farmland identified by the 2007 Census of Agriculture about 316,000 acres were harvested cropland. A significant amount of farmland in production is devoted to the production of hay, turf grass, trees and flower. These lands may represent potential for producing more food for human consumption. Currently, the lack of farmland in production creates challenges to the potential for Western Washington to feed itself.

Within the region, there are food-rich and food-poor counties. Lewis, Gary Harbor, Skagit, and Whatcom Counties have over 100 thousand acres of farmland each, while Island, Kitsap, Jefferson, Whakiakum, and Skamania have less than 20 thousand acres each. A widespread and active distribution network is needed to address these disparities.

Another way to enhance the ability of Western Washington to feed itself is to expand the amount of land in agricultural production. When considering what lands may have the most potential to be brought into agricultural production, consideration was first given to fallow lands. Land use assessments using land cover imagery suggest that about 1.5 million acres of land in Western Washington is agricultural land. Compared to the 1 million acres identified by the USDA, this represents at least 0.5 million acres of potentially fallow lands that could be brought into more intensive food production.

Also considered were lands with prime farmland soils, low-density residential land use, and large parcel size. Over 165 thousand acres of land with prime farmland soils or soil of statewide significance, low density residential land use, and parcel size greater than 5 acres were identified. Altogether, *665 thousand acres* of fallow and low-density lands (generally in the non-urban areas) are identified as priorities to bring into more food production. The low number suggests that re-localizing Western Washington's food supply may require other complimentary actions.

Urban areas also provide another avenue to enhance our production in the region. While we do not identify urban lands in this study, other studies have provided a range of methodologies to build from. In the Seattle based study, the authors note there are 12 acres of vacant lots and over 200 schools and parks with under-utilized land. While these areas do not significantly contribute to Western Washington's total food production, new technologies have the potential to make urban agriculture more efficient. In addition, communities benefit from seeing food production in their neighborhoods, and reduced the distance food travels from the soil to the plate. Future studies may want to alter the methodologies used in the Seattle study to target a greater land base to convert to urban agriculture.

This study begins the discussion about expanding the production potential of Western Washington's land base. This is an important part of the conversation about enhancing the ability of the region to feed itself. However, considerations concerning feasibility, and the economic, social, and environmental implications of expanded agricultural production necessitate further dialogue and study.

CONCLUSION

In response to growing concern over the social and environmental sustainability of the current conventional food system, the concept of eating locally has also brought attention to, and raised the question of, whether communities can actually feed themselves from local food resources. In pursuit of an answer to this question, the above Western Washington Foodshed Study provided a preliminary analysis for determining the potential for Western Washington to feed itself locally (ie. from within the Western Washington study boundary). To this end, this study sought to identify the food that is being produced in the region, the food that is consumed in the region, and the potential of the region's land resources for production. All of the food that is produced and consumed in the region was then compared side-by-side in a Mass Balance to identify the surpluses and deficits of each item produced.

It was determined that for every 1 pound of food produced in Western Washington, 1.47 pounds of the same foods are consumed. If these numbers are adjusted to include *all* of the food items consumed in Western Washington (regardless of the food's origin) then the mass balance ratio shifts to 2.06 pounds consumed for every 1 pound produced. Finally, considering that dairy accounts for 64% of food produced, removing this from the mass balance shifts the ratio to 3.16 pounds of food consumed for every 1 pound of food produced.

This study clearly identified an overall deficit in Western Washington production capacity to meet consumption needs. Although some of the items consumed in large quantities (such as bananas and oranges) cannot be produced in Western Washington, many of the food items can be this end, this study also sought to identify available land resources and determine the potential for increased food production. It was determined that out of 1 million acres of farmland identified by the 2007 Census of Agriculture, about 316,000 acres were harvested cropland. A significant amount of land in use is for production of hay, turf grass, trees and flowers, and has the potential to produce more food for human consumption and use assessments using land cover imagery were used in to identify land for potential production. Consideration was given to lands with prime farmland soils, low-density residential land use, and large parcel size. Altogether, 665,000 acres of fallow and low-density lands (generally in non-urban areas) were identified as priorities to bring into food production.

This foodshed study also sought to address other consumption related questions such as the amount of locally produced foods consumed, the amount of organically produced foods consumed, and the amount of food necessary to meet USDA dietary guidelines. The analyses of how much locally and organically produced foods are consumed in the region proved to be inconclusive at the time of this report writing due to lack of regionally specific, qualitative data. It was determined, however, that the total pounds of food necessary to meet the USDA dietary guidelines far exceeded total estimated Western Washington consumption, especially in terms of vegetable and dairy consumption. Discrepancies could have arisen due to disparities between data sets and dietary guidelines; however these preliminary results provide an interesting perspective regarding the tendency of Western Washington residents to meet dietary needs.

The above Western Washington Foodshed Study represents Part I of an intensive study into the Western Washington Foodshed System. Many opportunities have been identified for future work opportunities, including a more detailed analysis of local and organic food consumption, as well as an investigation of the potential to reduce food loss and maximize local food production to increase Western Washington's ability to meet its food needs. Further analysis of the mass balance and land resources in the region is needed to evaluate additional potential for production and supply.

Part II of this analysis will build on these future work opportunities, will seek to further identify the pathways food travels (following individual items through the food supply chain), and will attempt to make recommendations regarding how to re-localize the food system.

APPENDIX A: DETAILED METHODOLOGY

ESTIMATING WEIGHT OF FOODS CONSUMED BY SPECIFIC FOODS AND OVERALL FOOD GROUPS

The Loss Adjusted data does not measure actual consumption, which is most commonly tabulated with large-sample studies involving self-reported consumption information and plate studies. Rather, these data represent the total amount of food produced within the country in a given year, plus the amount of food imported into the country, less the amount of food exported outside of the country. This amount is considered to be the amount of food available (per capita) to United States residents. This amount is then adjusted for food spoilage, waste, and other losses that occur along the food chain from production locations to retailers to consumers, as well as losses during the cooking process (including inedible portions like cores, stalks and bones; cooking loss; and food waste), in order to offer a more accurate approximation of the amount of food that residents actually consume at the end of the day. While the loss estimates are constantly being refined according to the most up-to-date methods, this data set is popularly considered a close proxy for the food consumption per capita.[79] Because the information is estimated per capita, however, it does not account for dietary differences between socio-economic, demographic, or geographic categories.[80] As noted in the documentation, this data set is "derived from data for raw and semi-processed agricultural commodities rather than for final food products," which means that the information can more easily be compared to farm-weight production data, as reported later in this study.[81]

The report contains a summary of the top five foods consumed within each food group category: fruit, vegetables, grains, dairy, meat and protein, fats, and added sugars. Both the primary weight (which equals or is closest to the farm or production weight) and the "per capita availability adjusted for loss" (which is the proxy for the amount of the food actually consumed annually by a person) are reported. In addition, the amount of food consumed is reported by the overall food group. While the Loss Adjusted dataset includes dried beans and lentils in the "vegetables" category, we have included this data alongside the "meat and protein" category, which is consistent with national dietary guidance and food categorization.

To obtain the food weights reported in this document, the 2009 values for each food category were used. Similar foods were grouped according to their original item. For example, fresh apples, frozen apples, dried apples, canned apples/applesauce, and apple juice were all

combined to create the total “apples” weights. Some foods were also re-categorized to more closely mirror the categories used in the Western Washington agricultural production data sources. For example, beef and veal were combined to most appropriately mirror the “cattle and calves” category.

It should be noted that in some cases, the dataset only includes certain treatments of food items. For example, it lists frozen raspberries but does not include data on fresh raspberries.

After the food items were re-categorized, these per capita amounts were multiplied by population amounts. First, they were multiplied by the population of the 19 Western Washington counties to estimate the total amount of food consumed in the region.[82]

Western Washington vs. National Consumption Differences

The San Francisco Foodshed study completed in 2008 by the American Farmland Trust attempts to address the potential discrepancy between national average consumption and regional preferences through comparing the Loss-Adjusted Food Availability data to data from the Food Commodity Intake Database. This second source is based on results from the Continuing Survey of Food Intake by Individuals and is broken out into different regions of the country. For the San Francisco study, the data recorded for urban residents within the Western United States was used as the comparison. When the consumption estimates of the two different sources were different, the higher of the two was used in the calculation of total food consumption to prevent the comparison with agricultural production data overestimating the ability of the region to meet the needs of the residents of the area.

The other main method used to evaluate the potential consumption of a population is determining the amount of food that would be required to meet dietary needs rather than measuring the actual food consumption within the region. This method was originally developed and used by Christian Peters in his analysis of the New York state foodshed[83]. Using this method, Peters developed 42 different diets containing the same amount of calories and servings from each food group, but varying in total fat consumption and meat servings. The agricultural requirements to provide these diets were then determined and compared against the agricultural capacity of the state of New York. Using this method, Peters eliminates the need for using national datasets to evaluate consumption of the residents of the area by relying on

potential diets of the population rather than attempting to evaluate the actual consumption of the residents.

This analysis for this study followed a similar approach as was taken in the San Francisco study. This approach was selected since the main goals for the study include a focus on identifying the actual consumption of the residents of Western Washington and determining if this consumption could be met with the production of the Western Washington land. It was thought that the actual consumption estimates would be more valuable than determining the amount of land it would require to feed residents should they eat based on certain dietary plans, as acting on the results of such an analysis would require efforts to change the way the population is currently eating. (However, this analysis is also being pursued as a secondary inclusion in the study.) Thus, a strategy more similar to that of the San Francisco study -- measuring consumption based on national data sets and attempting to adjust based on regional or local data as available – seemed the most appropriate approach to take. As shown in the evaluation of the amount of pounds consumed by the population previously, the Loss-Adjusted Food Availability national data was used to determine these numbers. However, obtaining accurate data to adjust these numbers given Western Washington preferences has been more difficult than anticipated. Similarly to San Francisco, the Food Commodity Intake Database was a desirable source by which to compare against the Loss-Adjusted Food Availability data. However, this data is no longer readily available as it hasn't been updated since originally collected by the USDA in 1994-1996, and 1998. Therefore, other sources were pursued, including grocery industry resources, Bureau of Labor Statistics Consumer Expenditure Data, and insights from the Western Washington Foodshed assessment Advisory

Estimating Weight of Foods Consumed by Specific Foods and Overall Food Groups According to USDA Dietary Guidelines

The USDA's Dietary Guidelines for Americans provides a standard diet generally defined in terms of recommended volumes of specific food categories and overall food groups. Total volumes per day are provided for food groups (i.e. vegetables or fruits), while specific food categories (i.e. dark green vegetables or meat) have recommended weekly recommended total volumes. All of these recommendations increase according total daily calories consumed, which ranges from 1,000 to 3,000 calories. An individual's calorie level is determined according to their age and gender.

Determining Calorie Levels for the Western Washington Population

In order to estimate the total weight of foods consumed you first need to know which calorie levels apply and to how many people. The U.S. Census provides county-level demographic data. The age breakdown for each gender across the counties of Western Washington were aggregated and then grouped according to the caloric intake levels recommended by the USDA. This indicates how many people in Western Washington fall into each caloric level, which can then be used to determine how many pounds of each food group and type are required to meet the needs of a particular diet. See Table XX below.

Table 11: Total People in Western Washington for Each USDA Calorie Level

Calorie Level	Men	Women	Total
1,400	169,758	162,109	331,867
1,600	165,875	158,773	324,648
1,800	0	886,760	886,760
2,000	0	1,252,683	1,252,683
2,200	438,938	167,653	606,591
2,400	897,542	0	897,542
2,600	559,486	0	559,486
2,800	356,137	0	356,137

Converting Volume Recommendations into Total Food Weights

The USDA's volumetric recommendations needed to converted into pounds to allow for comparison with consumption estimates. The following is a description of the conversion performed for every food item in the USDA recommendations analysis.

Table 12: Food Weight Conversion Table

Lbs. of food item/person Total lbs. of food group/person	X	weight (g) of food item cup of food item	X	cups week	X	52 weeks year	X	# of people in calorie level	X	pound 453.59237 g	=	Total lbs. of food item needed

The number of pounds per person divided by the total pounds of that food category (i.e. dark green vegetables or fruits), as reported in the Loss Adjusted Availability data, gives the ratio of that particular food item within its category or group. This ratio adjusted the total pounds of food to reflect preference for that food item as represented in the existing consumption estimates.

Thus, the recommended consumption data is intended to reflect current consumption preferences.

The ratio was then multiplied by the gram weight of one cup of the food item obtained from the USDA's National Nutrient Database for Standard Reference. For certain foods, one-cup equivalents determined by the USDA were used instead. This step converts the amount of food from volume to weight.

The amount is then multiplied by cups per week recommended by the USDA and by 52 to get the total amount of grams per year per person of the food item. This was then multiplied by the number of people in a calorie level and the conversion for each food item was performed for each calorie level and aggregated to get the total gram weight. The gram weight was then multiplied by the above conversion factor to get the total pounds need for the entire population of Western Washington.

This conversion was performed and aggregated across all of the calorie levels for each individual food item.

APPENDIX B: ALL CONSUMPTION ESTIMATES, BY FOOD GROUP

Table 13: Fruit consumption estimates

Fruit consumption estimates, in pounds per year (based on loss-adjusted availability)		
	Per person	Western Washington
Oranges	34	177,694,909
Apples	29	150,078,376
Bananas	10	52,362,251
Grapes and raisins	9	46,995,721
Pineapple	5	27,922,512
Peaches	5	25,890,964
Strawberries	5	24,687,111
Pears	4	19,923,659
Watermelon	4	19,196,239
Grapefruit	3	15,544,117
Cantaloupe and honeydew	3	13,596,664
Lemons	2	11,053,016
Blueberries	2	9,909,597
Avocado	2	9,886,378
Cranberries	2	9,686,583
Lime	2	8,989,999
Cherries	2	8,669,410
Tangerine	1	6,719,831
Other frozen fruit	1	5,827,481
Plums	1	4,992,807
Apricots	1	4,450,091
Mango	1	4,202,580
Olives	1	3,183,086
Raspberries	0.4	2,290,130
Kiwi fruit	0.3	1,379,398
Papaya	0.2	1,258,350
Dates	0.2	826,058
Blackberries	0.1	404,257
Figs	0.1	321,456
Other frozen berries	0.04	227,286
Total fruit	128	668,170,318

Table 14: Vegetable consumption estimates

Vegetable consumption estimates, in pounds per year (based on loss-adjusted availability)		
	Per person	Western Washington
Potatoes	44	228,994,200
Tomatoes	34	180,225,971
Lettuce	15	75,876,485
Onions	9	47,903,796
Bell and chile peppers	9	47,076,622
Corn	7	36,351,680
Carrots	6	30,408,443
Cucumbers	5	24,679,697
Snap beans	4	20,205,924
Cabbage and sauerkraut	4	19,967,738
Celery	4	19,269,341
Broccoli	4	18,363,677
Squash	2	11,454,832
Mushrooms	2	11,109,732
Green peas	2	9,893,615
Sweet potatoes	2	8,712,176
Pumpkins	2	8,535,039
Miscellaneous frozen vegetables	2	8,431,297
Other canned vegetables	2	7,884,605
Garlic	1	6,477,035
Spinach	1	5,684,402
Asparagus	0.5	2,541,782
Cauliflower	0.4	2,207,989
Eggplant	0.3	1,746,234
Radishes	0.3	1,400,627
Dark leafy greens	0.2	1,301,397
Artichokes	0.2	1,198,902
Okra	0.2	1,043,724
Fresh and frozen lima beans	0.2	858,866
Brussels sprouts	0.2	790,650
Escarole and endive	0.1	355,844
Total vegetables	161	840,952,320

Table 15: Grain consumption estimates

Grain consumption estimates, in pounds per year (based on loss-adjusted availability)		
	Per person	Western Washington
Wheat flour	95	495,337,955
Corn products (flour, meal, hominy, grits, starch)	23	121,319,435
Rice	15	77,972,956
Oat products	2	12,783,918
Barley products	0.4	1,881,443
Rye flour	0.3	1,762,313
Total grains	136	711,058,019

Table 16: Meat, beans, and nuts consumption estimates

Meat, beans, and nuts consumption estimates, in pounds per year (based on loss-adjusted availability)		
	Per person	Western Washington
Beef and veal	38	198,484,776
Chicken	32	168,864,291
Pork	27	142,045,876
Eggs	21	110,195,906
Legumes and dried beans	16	84,713,962
Turkey	9	45,689,815
Fish	7	35,894,885
Peanuts	6	29,148,667
Shellfish	4	19,382,957
Tree nuts	3	16,303,974
Dried peas and lentils	1	3,507,728
Coconut	0.5	2,614,329
Lamb	0.4	2,121,033
Hazelnut (filbert)	0.04	205,296
Total meat, beans and nuts	164	859,173,495

Table 17: Dairy consumption estimates

Dairy consumption estimates, in pounds per year (based on loss-adjusted availability)		
	Per person	Western Washington
Total fluid milk	134	699,694,768
Total cheese	25	129,701,712
Cottage cheese	17	89,889,635
Frozen dairy products	5	26,283,397
Evaporated and condensed milk	4	22,575,691
Dry milk products	2	8,738,471
Dairy portion of eggnog	0.1	502,031
Total dairy	187	977,385,704

Table 18: Fats and oils consumption estimates

Fats and oils consumption estimates, in pounds per year (based on loss-adjusted availability)		
	Per person	Western Washington
Salad and cooking oils	33	171,660,805
Dairy fats	14	74,320,934
Shortening	11	55,919,082
Margarine	3	15,109,783
Other edible fats and oils	2	8,355,920
Lard	1	3,807,418
Edible beef tallow	0.3	1,799,414
Fat portion of eggnog	0.2	1,030,680
Total fats and oils	63	332,004,035

Table 19: Added sugar consumption estimates

Added sugar consumption estimates, in pounds per year (based on loss-adjusted availability)		
	Per person	Western Washington
Corn sweeteners	47	244,769,182
Cane and beet sugar	45	236,596,709
Honey	1	3,390,256
Other edible syrups	0.3	1,568,846
Total added sugars	93	486,324,994

APPENDIX C: FOODSHED STUDIES – LITERATURE REVIEW

Geographic Area	Consumption Methodology	Consumption Data source
New York state	Rather than measuring actual consumption, 42 different diets were developed, each containing the same amount of calories and servings from each food group, but varying in total fat consumption and meat servings. Servings of food items produced in NY state were combined to make up the components of each diet.	Nutrient Database for Standard Reference, USDA Loss-Adjusted Food Availability, Food Commodity Intake Database
Midwest	Did we utilize this study for consumption methodology?	
San Francisco (100 mile region)	Reported consumption estimates derived from both the Loss-Adjusted Food Availability data and the Western U.S. data from the Food Commodity Intake Database, when there was a difference between the two sources the higher of the two was used for the purpose of the mass balance to reduce the probability of underestimating actual consumption.	USDA Loss-Adjusted Food Availability, Food Commodity Intake Database
Delaware Valley (100 mile region)	Generalized consumption trends using the USDA Loss-Adjusted Food Availability per-capita (2007) data and per-capita Beverage Availability (2007) data. This information was complimented by consumer expenditures in the Philadelphia area using Bureau of Labor Statistics Consumer Expenditure (2007) data. Also reported nutritional availability through the USDA "What We Eat In	USDA Loss-Adjusted Food Availability, USDA Beverage Availability, USDA "What We Eat In America". U.S. Bureau of Labor Statistics Consumer Expenditure data.

Comment [LR1]: If not – NA for these columns

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APPENDIX D: USDA-RECOMMENDED CONSUMPTION TABLES FOR VEGETABLE DATA

Table 20: Dark Green Vegetables – Total Estimated Consumption Compared to USDA-Recommended Consumption in Pounds

Vegetables	Estimated Consumption (Loss-Adjusted Availability)	USDA-Recommended Consumption	Ratio of Estimated to Recommended Consumption
Broccoli	18,363,677.07	51,158,470.29	0.36
Spinach	5,684,402.02	14,417,758.00	0.39
Dark Leafy Greens (kale, collards, turnip greens, mustard greens)	1,657,241.12	15,657,173.60	0.11

Table 21: Red & Orange Vegetables – Total Estimated Consumption Compared to USDA-Recommended Consumption in Pounds

Vegetables	Estimated Consumption (Loss-Adjusted Availability)	USDA-Recommended Consumption	Ratio of Estimated to Recommended Consumption
Tomatoes	180,225,970.77	481,367,818.16	0.37
Carrots	30,408,442.67	57,755,230.59	0.53
Sweet Potatoes	8,712,175.67	17,193,545.34	0.51
Pumpkins	8,535,039.00	31,028,356.14	0.28

Table 22: Starchy Vegetables – Total Estimated Consumption Compared to USDA-Recommended Consumption in Pounds

Vegetables	Estimated Consumption (Loss-Adjusted Availability)	USDA-Recommended Consumption	Ratio of Estimated to Recommended Consumption
Potatoes	228,994,199.84	407,786,001.66	0.56
Corn	36,351,679.93	61,713,062.02	0.59
Green Peas	9,893,614.73	15,738,972.08	0.63
Lima Beans	1,301,553.36	1,631,404.75	0.80

Table 23: Other Vegetables – Total Estimated Consumption Compared to USDA-Recommended Consumption in Pounds

Vegetables	Estimated Consumption (Loss-Adjusted Availability)	USDA-Recommended Consumption	Ratio of Estimated to Recommended Consumption
Artichokes	1,198,902.42	1,596,237.93	0.75
Asparagus	2,541,782.34	3,089,769.84	0.82
Brussel Sprouts	790,649.84	591,450.76	1.34
Cabbage	19,967,738.47	4,196,310,130.20	0.00
Cauliflower	2,207,988.84	2,008,317.56	1.10
Celery	19,269,341.43	16,543,979.35	1.16
Cucumbers	24,679,696.76	21,818,500.10	1.13
Eggplant	1,746,233.51	7,488,018.27	0.23
Garlic	6,477,035.15	7,488,018.27	0.86
Lettuce	75,876,484.78	36,764,934.09	2.06
Mushrooms	11,109,731.63	6,610,789.70	1.68
Okra	1,043,723.73	887,232.19	1.18
Onions	47,903,795.73	65,154,083.92	0.74
Bell Peppers	47,076,621.57	59,627,045.42	0.79
Radishes	1,400,626.88	1,381,122.44	1.01
Snap Beans	20,205,923.71	17,176,332.65	1.18
Squash	11,454,831.98	11,003,197.29	1.04

APPENDIX E: DETAILED PRODUCTION METHODOLOGY

Note: The primary source of information for determining county yields in Western Washington was the 2007 USDA Census of Agriculture (Ag. Census). Due to disclosure concerns, many county totals were not recorded in the Census. This occurred when three operations or fewer reported in the Census for a particular crop, or when a single operation dominated the county total such that the Census would effectively be disclosing an individual operation's production totals. For the purposes of this study, these unavailable production totals were treated as zeros. This would imply that Western Washington's actual food production is much higher than reported in this study.

Apples, Asparagus, Blueberries, Cranberries, Dry edible beans, Grapes, Green Peas, Hazelnuts, Mushrooms, Peaches, Plums and prunes, Raspberries, Strawberries: The number of acres harvested by county was taken from the Ag. Census, using the 2007 production data. This was multiplied by the Washington State average yield per acre for the past five years of available data, found in the 2009 Washington Annual Agriculture Bulletin.

Barley, Oats, Wheat: The number of bushels produced by county was taken from the Ag. Census, using the 2007 production data. This was multiplied by the weight per bushel, as listed in the "Weights and Measures" section of the USDA 2007 Agricultural Statistics Report.

Beets, Potatoes: The number of acres harvested by county was taken from the Ag. Census, using the 2007 production data. This was multiplied by 2007 Washington State yield per acre estimate, taken from the 2009 Washington Annual Agriculture Bulletin.

Blackberries and Other berries: The number of acres harvested of Blackberries – including dewberries, Boysenberries, Loganberries and Currants was taken by county from the Ag. Census, using the 2007 production data. The total number of acres harvested was multiplied by the Washington State "Other Berries" average yield per acre for the past five years of available data (found in the 2009 Washington Annual Agriculture Bulletin). The average yield per acre was determined by dividing the total pounds utilized by the number of harvested acres, then taking the average of these rates over the past five years of available data.

Canola, Garlic, Pumpkins, Squash, Tomatoes: The number of acres harvested by county was taken from the Ag. Census, using the 2007 production data. This was multiplied by the most recent (2006) national yield per acre estimate, taken from the USDA 2007 Agricultural Statistics Report.

Carrots (Fresh and Processing), Pears (Excluding Bartlett and Bartlett), Sweet Corn (Fresh and Processed): The number of acres harvested by county for the two types of crop (e.g. Pears, Excluding Bartlett and Pears, Bartlett) was taken from the Ag. Census, using the 2007 production data. In some cases this did not include acreage that was counted under the total number of acres harvested for the two types of crop *combined*. To determine how many of the undesignated acres should be counted as each type of crop, the total acres harvested were multiplied by the five-year average percentage of acres harvested for each type of crop (found

in the 2009 Washington Annual Agriculture Bulletin). The acres harvested for both types of crop and the *determined* acres harvested for both types of crop were then multiplied by the Washington State average yield per acre for the past five years of available data (also found in the 2009 Washington Annual Agriculture Bulletin).

Cattle: The number of "Cattle on Feed – Sales for Slaughter" in 2007 was taken from the Ag. Census. This was multiplied by the average weight of a head of cattle for the past five years of available data, found in the 2009 Washington Annual Agriculture Bulletin.

Cherries: The number of acres harvested by county for Sweet and Tart Cherries was taken from the Ag. Census, using the 2007 production data. The number of acres harvested for each type of cherry was multiplied by its own yield per acre (as found in the 2009 Washington Annual Agriculture Bulletin), averaged over the past five years of available data.

Chestnuts, Ducks, Goats, Squab, Turkeys, Walnuts – Not able to determine yield (no conversion factor available).

Cucumbers, Rhubarb, Snap Beans: The number of acres harvested by county was taken from the Ag. Census, using the 2007 production data. This was multiplied by the determined average yield per acre for "Other Fresh Vegetables", as found in the 2009 Washington Annual Agriculture Bulletin. The yield per acre was determined by dividing the total production by the acreage harvested.

Eggs: The number of chicken layers in county inventories in 2007 was taken from the Ag. Census. The average number of eggs laid per layer in Washington State was determined using the past five years of available data (found in the 2009 Washington Annual Agriculture Bulletin).

Herbs, Honey, Mollusks, Trout: 2007 production in pounds was taken from the Ag. Census.

Kiwifruit: The number of acres harvested by county was taken from the Ag. Census, using the 2007 production data. This was multiplied by the national average yield per acre for the past five years of available data, found in the USDA 2007 Agricultural Statistics Report.

Leafy greens: The number of acres harvested of Lettuce, Cabbage and Kale, Collard and Mustard Greens was taken by county from the Ag. Census, using the 2007 production data. The number of acres harvested of Lettuce was multiplied by the 1999 yield per acre estimate – the most recent and only figure available (found in the 2009 Washington Annual Agriculture Bulletin). The number of acres harvested of Cabbage and Kale, Collard and Mustard Greens were multiplied by the determined average yield per acre for "Other Fresh Vegetables" (see 'Cucumbers, Rhubarb, Snap Beans' above).

Melons: The number of acres harvested by county for Honeydew, Watermelon and Cantaloupe was taken from the Ag. Census, using the 2007 production data. The Watermelon and Cantaloupe numbers were multiplied by the most corresponding most recent (2006) yield per

acre estimate, taken from the USDA 2007 Agricultural Statistics Report. Though Honeydew is produced in Western Washington, the data was not available in the Ag. Census.

Milk: The 2007 sales of milk by county, measured in dollars, were taken from the Ag. Census. The pounds of milk per dollar sold conversion factor was found by dividing the 2009-2010 average total Washington State milk sales *measured in pounds* by the 2009-2010 average total Washington State milk sales *measured in dollars* (both taken from Survey data found through the USDA National Agricultural Statistics Service Quick Stats Database). The total production in pounds was converted to gallons using a factor of 8.6 gallons/pound, provided by the Washington State Dairy Commission.

Onions (Storage and non-Storage): The number of acres harvested by county was not differentiated for the two types of onion (storage and non- storage) in the Ag. Census. The yield per acre is substantially different for each however, warranting separate calculations. Using the 2007 production data, the total acres harvested were multiplied by the five-year average percentage of acres harvested for each type of onion (found in the 2009 Washington Annual Agriculture Bulletin). The determined acres harvested for each type of onion were then multiplied by the Washington State average yield per acre for the corresponding type of onion for the past five years of available data (also found in the 2009 Washington Annual Agriculture Bulletin).

Chicken: The number of "Broilers – Sales, Measured in Head" in 2007 was taken from the Ag. Census. This was multiplied by the average weight of a broiler sold for slaughter, determined by dividing the number of chickens sold for slaughter by the number of pounds sold for slaughter, averaged over the last five years of available data in Washington State (both figures found in the 2009 Washington Annual Agriculture Bulletin).

Pork, Sheep: The percentage of Washington State inventory slaughtered annually was determined by comparing the statewide inventory to the number slaughtered for the past five years of available data (both figures found in the 2009 Washington Annual Agriculture Bulletin). This percentage was multiplied by the number of head in 2007 Western Washington county inventories (taken from the Ag. Census) to determine the number slaughtered annually in each county. Dividing the total pounds produced in Washington State by the statewide inventory for the past five years of available data (found in the 2009 Washington Annual Agriculture Bulletin) determined the number of pounds produced by each head slaughtered.

Rye, Sugarbeets – No county information available (due to small number of farms)

APPENDIX F: NUMBER OF FARMS, LAND IN FARMS, AND AVERAGE SIZE OF FARMS IN WESTERN WASHINGTON

	Number of Farms	Land in Farms (acres)	Average Size of Farm (acres)
Clallam	512	22822	45
Clark	2101	78359	37
Cowlitz	481	30702	64
Grays Harbor	628	119267	190
Island	458	17699	39
Jefferson	211	12717	60
King	1790	49285	28
Kitsap	664	15294	23
Lewis	1717	131554	77
Mason	471	25185	53
Pacific	390	61749	158
Pierce	1448	47677	33
San Juan	291	21472	74
Skagit	1215	108541	89
Skamania	123	5472	44
Snohomish	1670	76837	46
Thurston	1288	80617	63
Wahkiakum	119	12025	101
Whatcom	1483	102584	69
TOTALS	**17060**	**1019858**	**68**

APPENDIX G: NUMBER OF ORGANIC FARMS AND TOTAL ACREAGE BY COUNTY IN WESTERN WASHINGTON

County	Number of Organic Farms	Total Acreage
Clallam	12	454.83
Clark	14	769.342
Cowlitz	2	20.074
Grays Harbor	7	1316.34
Island	11	293.59
Jefferson	13	811.24
King	21	2691.62
Kitsap	7	111
Lewis	21	3628.21
Mason	2	21.5
Pacific	1	10
Pierce	9	688.5
San Juan	10	373.5
Skagit	43	5358.48
Skamania	2	79.6
Snohomish	21	1001.83
Thurston	25	4149.75
Wahkiakum	2	871
Whatcom	31	2771.991
TOTAL	**254**	**25422.397**

APPENDIX H. WESTERN WASHINGTON FOODSHED STUDY MASS BALANCE

APPENDIX I. WESTERN WASHINGTON FOODSHED STUDY MASS BALANCE

APPENDIX J: DESCRIPTION AND DEFINITIONS OF RELEVANT LAND USE CATEGORIES, IN RURAL TECHNOLOGY INITIATIVE DATASET

For more information, visit http://www.ruraltech.org/projects/wwaluc/

Intensive Agriculture:

- Description: Agricultural and livestock lands dominated by irrigated crops or grassland, bare soil and dispersed farm buildings.
- Definition: At least 640 contiguous irrigated or soil acres and no more than 5 percent developed with a development density of 9 per square mile or less. Contiguous irrigated or soil class acres less than 640 and less than 1 percent developed or mixed ag/soil land cover classification and less than 1% developed.

Mixed Agriculture:

- Description: A mix of agricultural and livestock lands with some additional residences unrelated to agriculture and an occasional small development. Often includes non-irrigated and cleared lands and occasional industrial buildings.
- Definition: At least 640 contiguous class acres in an agricultural land cover group and no more than 20 percent developed with a development density of 12 per square mile or less.

Other Agriculture:

- Description: Agricultural and cleared lands that have a development density equated to 20 or 40 acre parcels that may be single-family residences, hobby farms or small agricultural operations.
- Definition: Any remaining land use polygons that are in an agriculture land cover classification group and not intensive agriculture or mixed agriculture.

Low-Density Residential:

- Description: Large areas of development in suburban and rural settings where parcel sizes are large and the landscape is dominated by roads, homes and commercial buildings.
- Definition: At least 40 contiguous class acres that are in a forest or agricultural land cover classification group and are between 20 percent and 50 percent developed.

APPENDIX K: GENERAL METHODOLOGY FOR RURAL POTENTIAL

Four similar foodshed analyses were reviewed to inform the methods used to identify Western Washington's agricultural land resources. The relevant characteristics of these four studies are in the table below.

The reviewed analyses informed our decisions about what lands to include, additional considerations, and data sources. Three of the appended analyses (New York, Midwest, and Delaware Valley) only identified existing agricultural lands. The San Francisco report was the only one to consider potential agricultural lands- and even then, only looked at remaining acres of high quality cropland. We began by considering all existing farmland. We then expanded the idea of potential lands and considered factors including low-density residential land use, classified agricultural soils, and urban land.

We were not, as in the New York or Midwest studies, trying to model how much of a population center's food supply could be 'local' based on where people live relative to where agriculture occurs. Instead, our approach was to examine the scope and characteristics of the existing and potential agricultural resource base, similar to the San Francisco and Delaware Valley approaches.

Geographic Area	Title of Report, Study or Article	Author	General Goal	General Approach	Identification of Productive Land	Data source
New York state	Mapping potential foodsheds in New York State: A spatial model for evaluating the capacity to localize food production (2008)	Christian Peters et al	To estimate the spatial distribution of food production capacity relative to the food needs of NYS population centers. To map potential local foodsheds and to evaluate the capacity for NYS population centers to supply their food needs within the state's boundaries.	GIS-based model, based on existing agricultural land. Optimizes distance between productive lands and urban areas.	Used GIS to spatially aggregate existing agricultural lands. Next, the land cover data were intersected with soils data to create spatial layers that showed the location of agricultural land cover along with expected crop yields and recommended rotations of the underlying soils.	1992 National Land Cover Dataset (NLCD), processed to reduce inherent error as recommended by USGS. Used the data at the most general level of land cover classification (agriculture, barren, forest, urban, water and wetland).
Midwest	An optimization approach to assessing the self sustainability potential of food demand in the Midwestern United States (2011)	Guiping Hu, Lizhi Wang, Susan Arendt, and Randy Boeckenstedt (all at Iowa State University)	To develop a method to assess the potential of regions to meet dietary requirements with more localized and diversified agricultural systems. Emphasis is on minimizing the distance between population centers and available cropland.	GIS-based model, based on existing agricultural land. Optimizes distance between productive lands and urban areas.	Used a linear programming model to optimize placement relative to each population center. This method applies county-level rates per square mile to the area covered by each county or population center.	2007 United States Census of Agriculture
San Francisco (100 mile region)	San Francisco Foodshed Report	American Farmland Trust	To examine the scope and characteristics of the agricultural resource base that is the foundation of the great	Descriptive. Mostly text with charts and maps.	Identified acres of high quality cropland remaining per acre of urban land. Include prime, unique, and farmland of state	State of California Farmland Mapping & Monitoring Program 2004 & 2006

			bounty produced by farmers and ranchers in the region.		importance.	
Delaware Valley (100 mile region)	Philadelphia Food System Study	Delaware Valley Regional Planning Commission	To look at the characteristics of the 100-Mile Foodshed's agriculture industry, which is the supply side of the regional food system.	Descriptive. Mostly text with charts and maps.	Presents total existing cropland and pastureland acres. Excludes "woodland not pastured" and "land in farmsteads, buildings, etc."	2007 United States Census of Agriculture

APPENDIX L: GIS EXPLANATION FOR RURAL MAPPING PROCESS

The following identifies the general steps taken. Also noted are the data sets used. Data sets considered and not used are identified later in the Appendix.

Step 1: Identify existing productive lands. Identify the kinds of agricultural products being produced on those lands.

- Crop data from Washington State Department of Agriculture, based on the 2007 Census of Agriculture, was used.

Step 2: Classify Western Washington land use. Identify lands being used for agricultural production. Three land use datasets were considered, and one was used.

- Western Washington 2004 Land Use, from the Rural Technology Initiative at the University of Washington. This dataset was created by RTI to assess changes in forest land use. Based on 2004 Landsat data. Includes two different land cover classifications: a general land cover classification (i.e. forest or irrigated lands) and a developed (i.e. concrete, rooftops) land cover classification. The dataset was processed to remove a buffer around federal lands and water and to remove lands outside of Western Washington.

Step 3: Identify fallow lands. The WSDA Crop data was layered over the RTI dataset. The RTI dataset likely classifies some allow land as agricultural land, so could be a reasonable estimate of fallow lands.

- WSDA Crop Data, compiled by WSDA crop mapping specialists. Also utilizes land use data, for example from the NASS Cropland Data Layer.

Step 4: Identify lands with prime agricultural soils.

- Prime Farmland dataset, provided by DOE.

Step 5: Identify additional lands with potential for agricultural use. Consideration was given to existing land use, soil type, and parcel size. Those lands that have low-density residential land use, prime farmland soils, and parcel sizes larger than 5 acres were identified.

- Land use data from RTI, mentioned in Step 2.
- Soil data from DOE, mentioned in Step 3.
- Parcel size information from Washington State Land Use, dataset from Washington State of Ecology. Based on 2009-2010 tax assessor data collected by the Department of Revenue. Includes parcel boundaries.

Notes: Datasets were clipped to western Washington boundaries when relevant.

Other datasets were used mainly for display purposes (including state and country boundaries, water, and major cities).

The area data for all lands was converted to acres to facilitate analysis.

Projected in North American 1983 UTM Zone 10N

APPENDIX M: MAIN GIS DATA SOURCES USED

Western Washington Land Use (1988, 1996, and 2004)

Abstract: Based on remotely sensed imagery from Landsat, classified by RTI. More detailed description of agricultural and low-density residential classifications in Appendix A.
Originator: Rural Technology Initiative
Link: http://www.ruraltech.org/projects/wwaluc/

WSDA Crop Data (2010)

Abstract: WSDA Crop Data, compiled by WSDA crop mapping specialists. Also utilizes land use data, for example from the NASS Cropland Data Layer. Data gathered using a GPS-equipped vehicle and a laptop computer, Classified by several categories: 1) general crop group (berry, cereal grain, orchard, vegetable, etc.); 2) crop types (blueberry, wheat, apple, potato, etc.), and 3) irrigation method (center pivot, drip, rill, none, etc.).
Originator: Washington State Department of Agriculture
Link: http://www.agr.wa.gov/PestFert/natresources/AgLandUse.aspx

Washington State Land Use (2010)

Abstract: The Washington State Land Use coverage was produced from digital county tax parcel layers using Department of Revenue (DOR) two digit land use codes.
Originator: Washington State Department of Ecology GIS Technical Services
Link: http://www.ecy.wa.gov/services/gis/data/data.htm#l
Note: This dataset was used primarily to conduct analysis regarding parcel size. The dataset identifies those agricultural lands classified under the current use law. Due to variability in county collection methods, this dataset was deemed to be less accurate. It also probably under-counts those agricultural lands not classified under current use taxation law. In total, DOE identifies about 550,000 acres of farmland. The table below shows the amount of agricultural land identified in this dataset, as well as open space, underdeveloped, and residential lands, since those lands may have some potential for expanding agricultural production as discussed in this report.

Table 24: Amount of Farm Land in Western Washington, According to Washington Department of Ecology Land Use Data

	Acres	Percent of total land
Agriculture classified under current use	473,212	2.3%
Agriculture not classified under current use	70,143	0.3%
Agriculture related activities	5,128	0.0%
Total agriculture land	548,483	2.7%
Open space classified under law	403,513	2.0%
Undeveloped land	797,170	3.9%
Other undeveloped land	4,938	0.0%
All residential (including single family, 2-4 units, and multi-unit household, condominiums, mobile home parks, vacation cabins, other)	1,508,049	7.3%
All forest	10,558,172	51.4%

APPENDIX N: GIS DATASETS CONSIDERED, BUT NOT USED

National Land Cover Database (2006)

Abstract: National Land Cover Dataset 2006 (NLCD2006) is a 16-class land cover classification scheme based primarily on the unsupervised classification of Landsat circa 2006 satellite data.

Originator: Multi-Resolution Land Characteristics Consortium.

Link: http://www.mrlc.gov/nlcd2006.php

Note: Not used because RTI data was considered more accurate.

APPENDIX O: ADDITIONAL URBAN AGRICULTURE STUDIES

Detroit, Michigan

A study of Detroit, Michigan looked at assessing land potential through a nutritional lens. This was done to assess the percentage of residents' diet that could be produced locally. This study compared the amount of vegetable and fruits required to feed Detroit's population with the amount of vacant and publically-owned land (parcels owned by the Department of recreation and parcels with abandoned buildings were excluded). The results show that food produced on vacant and publically-owned land (less than 300 acre) using high yield bio-intensive growing methods could equal 31 percent of seasonally available vegetables and 17 percent of seasonally available fruits of the diet of its 900,000 residents[84].

Secondary data was used to estimate fruit and vegetable consumption; seasonal availability by crop; quantity and acreage of Detroit's publicly owned vacant parcels, and acreage required to maximize local food supply based on fruit and vegetable yields. This methodology resulted in a range of acreages that could be cultivated to supply a given portion of the local diet[85].

Toronto, Ontario

The methodology of a study in Toronto is more complex than both Detroit and Oakland, as it examines more specific categories of land. In an initial approach similar to that taken in Detroit, this study, *Matching Consumption Requirements with Growing Spaces,* questions whether Toronto could produce 10 percent of its fresh vegetable requirements within its own boundaries. The investigation included several categories of land types, such as land still zoned for agricultural uses; lands zoned for other uses, such as parks and open space, that might be suitable for agriculture; existing census farms; institutional lands such as schools; potential roof top sites; and hydro corridors[86].

The analysis was conducted in two steps, the first using GIS data to identify land parcels, "both dispersed small plots that could be converted to small-scale but intensive production operations, and larger parcels that could be converted to more traditional forms of organic agriculture." Land where agriculture and recreation were at odds was excluded. The second step consisted of ground-truthing the sites identified in the first step in order to distinguish between different vegetation types and generally to discover more about site conditions[87].

This study found that 2,088 acres of land are available. Over half of these lands are currently

zoned for agricultural purposes, 25 percent is sited on lands currently zoned industrial, 10 percent is zoned parks and open space, 3 percent is zoned residential, and 1 percent is zoned institutional. The first part of this study that looked at consumption, found that 5,725 acres is required to meet the fresh vegetable needs of 10 percent of the population.

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