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Can Yamhill County Feed Itself?

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ENVS 485 - Environmental Problem Solving

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Introduction

Agriculture has been transformed, molded and engineered into the efficient powerhouse of production that it is today. Agriculture is inexplicably tied to chemical pools of fertilizers with engineers tampering in the genome to produce genetically modified organisms that are tolerant of disease as well as the very chemicals with which they are immersed (Feenstra, 2013). The farms of this generation are now buried in piles of paperwork and lawsuits against giant corporations such as the infamous Monsanto (Cummins, 2013). All in all, what was once a natural and holistic practice has been transformed into big business that is depleting nutrients in the soil. With the burgeoning human population causing an ever increasing need for agriculture, we are putting immense stress on the agricultural system (Biello, 2009). Although farms are now producing more than ever, there is a rising movement to eliminate unhealthy and non-environmentally friendly farming practices. An emphasis is being put on localizing the food system and creating communities around these systems. This was the focus of the study done this semester by the Linfield College ENVS 485 problem solving class.

We looked at if Yamhill County in Northwest Oregon were to become isolated, would the population be able to survive off the agriculture products grown within its boundaries? We looked at what the farms in Yamhill County grow and how large of a population they could support. Essentially, this looked at the feasibility of a purely local food system within the Yamhill County borders. We hypothesized that Yamhill County will not be able to feed itself without outsourcing. If this is correct, we will look at the maximum amount that can be produced locally and what would need to be imported to meet basic nutritional guidelines.

A study done in 2010 looked at the local food system of the Willamette Valley and compared the local agriculture with dietary needs for the population to determine if the valley could support itself. They determined that the Willamette Valley does not meet any of the nutrient needs for a healthy diet given by the USDA for any of the food groups (Giombolini et al, 2010). Due to the scope of their study and the methods, we decided to use this paper as a model for examining the local food system of Yamhill County.

Looking at the question of whether or not Yamhill County can feed itself with current production, we are essentially treating the county as a foodshed, a term defined by a 2008 study looking at local food in New York state as land areas that could theoretically feed urban centers. This study looked at New York State as a study area to see how feasible it would be to have New

York State feed itself. They determined that while most of the urban centers would be able to feed themselves on more locally sourced food, within 49km (about 30 miles), the largest urban center, New York City, would not be able to meet its food needs with local food (Peters et al, 2008). While we were looking at small towns and cities and not urban centers, the idea of localizing the food sources was similar.

The process of creating a more localized food system has many factors that need to be analyzed before we can determine if Yamhill County has the ability to go completely local. We need to determine what the term local means as well as the benefits and drawbacks, what can be grown in Yamhill County, and how healthy nutrition should be defined. We will also be studying what commodities need to be grown to satisfy the nutritional needs of everyone in the county, how the locally grown food can be stored in order to ensure year round sustenance, and how to keep the soil healthy enough to support Yamhill County far into the future. We will look at these various factors to see if Yamhill County can feed itself.

First, we need to look at local food and define it for this study. Local food and sourcing has a large variety of definitions for different groups. Eating local can be measured in food miles, which shows the amount of traveling the food underwent before it is consumed. For this paper, local is defined as food grown within the borders of Yamhill County. With local food, there are a host of benefits as well as drawbacks that need to be discussed. The benefits of eating local can be environmental, economic, social, and personal health related. Environmentally, one of the main benefits of eating local food is that it cuts down on the greenhouse gas emissions caused by transporting food (Edwards-Jones, 2010). Much of the food that Americans consume each day is transported hundreds, if not thousands of miles before winding up on the dining room tables in our homes. The typical meal of an American has journeyed a total of 1500 miles (CUESA, 2013). By reducing the distance our food travels, we can reduce automobile emissions and reduce the impact to global climate change in the process. Not only is buying local good for the environment, it is also beneficial for the local economy in that it supports those small local farmers who must make a living. Local food must go through fewer hands to arrive at the consumer and therefore the farmer gets a larger percentage of the money made. When the farmer spends that money within the community, it is reinvested into other local businesses. When purchases are made at the community level instead of in large chain supermarkets more than twice the amount of money stays in the community (Schwartz 2009).

Local food is beneficial for society as well in that it creates a connection between what we eat and the process in which the food is grown. Connecting to our food helps to show the importance of environmentally friendly practices and it bridges the gap that has been created from our modern food system (Svenfelt and Carlsson-Kanyama, 2010). When there is increased demand for local food sources, producers will often come together and create farmer's markets. These markets help promote community bonds by allowing social interactions to take place while promoting spending within the community, and simultaneously building up the economy as discussed earlier. Local eating is beneficial on a personal level as well as it tends to promote healthy diets that do not have heavily processed foods. Eating local also focuses on a simpler diet. When implemented on a large scale, this local diet can help prevent food inequalities among social castes and can lead to lower rates of obesity (Macias 2008). Overall, buying local is beneficial on the environmental, economic, social and individual level.

While eating locally grown produce is beneficial, there are also some drawbacks for various groups. When looking at drawbacks for consumers of eating local, we looked at evidence from one woman, Carrie Sturrock, who participated in a 100 mile diet, eating only foods that were grown within 100 miles of her house. During this diet, she was able to regularly buy fruits and vegetables, but meats and carbohydrates were difficult for her to find (Sturrock, 2009). Her experiences suggest that eating local decreases the variety of available foods, especially in the winter when fewer crops are grown. While eating local can reduce greenhouse emissions due to limited need for transportation of food, Sturrock found that she was driving many miles in order to get variety in her diet, and thus was actually increasing her carbon footprint. Collecting all the food from many different sources increased the time needed to shop as well. The 100 mile diet study as examined by Sturrock highlights some of the problems involved in local food consumption for the consumer (Edward-Jones, 2010).

There are drawbacks of eating local to the consumer, but it must be noted that there are also some drawbacks for the farmers with an increased demand when individuals choose to eat local. A study was done by Nourish Yamhill Valley in the form of a survey which looked at the local food movement in the Yamhill Valley from a consumer and farmer perspective. The farmer survey looked at some of the drawbacks for the farmer and one of the biggest problems was marketing their food to the public and making connections that will allow them to make more sales. This is often very difficult and thus many times the farmers see no economic gain.

The survey also found a lack of acreage for many of the farmers where they were unable to expand their farms. Another issue for farmers was the lack of an adequate amount of storage and transportation as well as equipment. Some farms also had the issue of being unable to determine consumer demand to ensure the most profit and had difficulty finding enough help on the farm (Satterwhite, 2012). All of these issues for farmers are barriers to localizing the Yamhill County food system and need to be addressed.

When looking at the issues involved in whether or not Yamhill County can feed itself, we not only need to look at local food, but also at the characteristics of Yamhill County specifically and what can be grown in the area. Yamhill County is located in the heart of the Willamette Valley in northwestern Oregon. Yamhill County has an area of about 432,000 acres. Of that, about 83,600 acres or 19% is prime farming land (USDA, 2013b). This county, rich in agricultural land, is a prime location for growing crops and indeed has some of the most nutrient rich soil in the world. The soil is widely varied and is comprised of soil from dry sedimentary soils to the moist clay of volcanic soil. The two main soil types in the county are mollisols and utisols, which are the best soils for crop production (Bell and McDaniel, 2000; Giombolini, 2010). These high fertile soils allow for abundant production from a wide range of crops. Although Yamhill County has some of the most fertile soil in the nation, these lands are quickly being taken up by encroaching development and urban sprawl. This study aims to assess not only the amount of food produced in the valley, but also to determine the number of farms and the total area of cropland in the county (Cole, 2011). Although raising crops naturally depletes nutrients found in the soil, adding natural fertilizers such as compost and manure can help replenish these nutrients (Savage, 2013). Plants which add nutrients back into the soil can be planted to ensure nutrient rich foods, but often this introduces non-native plants to the area which can have negative consequences. For example, small scale farmers in tropical regions have introduced some legumes to re-fertilize and rehabilitate the soils, but these have spread so rapidly that they hurt more important crops (Kull et al. 2013). Due to the fertile soil in Yamhill County, a large quantity of nutrient rich crops could be produced in the area.

Not only is the soil in the Yamhill Valley optimal for crops, but the weather is temperate and moist for the majority of the year and has a longer than average growing season (Taylor, 2012). However, with this temperate weather, there is a substantial amount of variance throughout the year of the different seasons. This makes it difficult to get fresh foods year-round.

To compensate for this, a certain amount of storage is needed. When storing food for later consumption, the process used often extracts some of the valuable nutrients and minerals present in these foods (Edwards-Jones 2010).

The soils and the climate allow for a wide variety of crops to be grown, but as we will see, the potential of the area may not be taken advantage of by the farmers. In 2007, the top 5 agricultural commodities in Yamhill County were nursery crops, tall fescue, dairy products, wine grapes and perennial rye grass. In 2011, the top 5 crops shifted to nursery crops, wine grapes, dairy products, tall fescue, wheat grass, and legume seed taking up the most acreage of all the crops at 39,697. Hay and forage utilize the second largest amount of land at 19,450 acres and the third largest is grains, taking up a total of 16,817 acres (Oregon State University, 2011). It is interesting to note that of the top 5 crops in both years, only one or two of them are food crops that can go directly to human consumption. It is also interesting to note that while Yamhill County and the surrounding valley produce a large quantity of wine grapes, they are not very nutritious and cannot make up the bulk of one's diet. In 2007, it was estimated that 105,420 acres in the county were being used for crop production, taking up 23% of the total land area. Many of these crops are grown at the lowest elevations, which offer the warmest growing season temperatures. During the same year, 77,100 acres, or 17% or the total land, was being used for livestock grazing. It is unlikely that much more land will be converted to agricultural use due to the rising population in the area (Barney and Worth, 2009). While Yamhill County may have the potential characteristics for a high growing region, it does not appear to be making the most of this land and this will become a factor when looking at the feasibility of creating a more localized food system.

According to the United States Census Bureau, the estimated population size of Yamhill County in 2010 was 99,800 on 718 square miles (United States Census Bureau, 2013). Every year the population has been steadily climbing. Of that 99,800, 6.4% are under the age of five, 24.7% are under eighteen, and 13.8% are sixty-five or older. Women comprise 49.7% of the population (United States Census Bureau, 2013). Over half of Yamhill County's population lives in McMinnville and Newberg and about 18,000 people live in unincorporated areas (Population Research Center, 2012). The population is mostly of Caucasian heritage, with 78% of the population in 2011 being white. The Hispanic community is the second most populous at 15% in 2011. The median household income in the area is $53,819, while 12.8% of people still

live below the poverty line (United States Census Bureau, 2013). This population is rising and although the area experienced tremendous growth through the early nineteenth and twentieth centuries, the population growth has slowed down since this time period. This rising population must be supported by an increased infrastructure of available food (United States Census Bureau, 2013).

It is not enough to simply examine what foods are produced in the county but basic nutrition must be considered as well to see if a local and healthy diet for the residents of the county is plausible. There are many ways to measure nutrition and many avenues to determine what constitutes good nutrition. The big picture is that it's important to keep in mind the different macro and micro nutrients needed for basic human health and longevity. More importantly, it's necessary to know which kinds of foods contain these nutrients to ensure a healthy and balanced diet. Once this is known, a set diet needs to be decided upon (Wilson 2007; MyPlate 2013). The United States Department of Agriculture recommends a diet plan for healthy living and this is the standard that we will be going off of for our calculations of if the Yamhill County is able to feed its population (USDA, 2013a). The diet is based off the MyPlate food plan. This plan consists of five food groups: fruits, vegetables, grains, dairy, and proteins to make up a complete diet. Half of the plate should be fruits and vegetables, a quarter of the plate should be grains, and a quarter of the plate should be proteins. The dairy portion is separate from the plate but according to the USDA is still an important part of the diet. It is recommended that adults consume 2 to 3 cups of fruits, vegetables and dairy per day. It is also recommended that adults consume 6 to 8 ounces of grains and proteins per day (MyPlate, 2013). These are the guidelines as set by a national standard to have a well-rounded diet and the standards we will use to assess the local food system in Yamhill County.

The production, availability, and consumption of local food is essential for creating a self-sufficient and long lasting community and is a defining characteristic of a sustainable food system. As a class, we wanted to examine the feasibility of a solely local food system in Yamhill County based on current food productions. By examining and comparing the quantity and types of crops grown in the county, the demographics of the area, and national nutritional guidelines, we are able to see if Yamhill County can indeed feed itself and create a sustainable food system.

Methods

Population and Nutrition

Population numbers were gathered from the United States Census Bureau for the year 2010 (United States Census Bureau, 2013). Census data is categorized by sex and grouped into five year cohorts (e.g. 25-29 years). We used the nutritional recommendations suggested by MyPlate (MyPlate, 2013). These recommendations differ by sex and age, but they are broken into different age ranges than the census. Table 1 shows the breakdown of the nutritional recommendations by age and sex.

It was necessary to convert the census data into categories that matched the age groups of MyPlate. We had to make many assumptions about our data in the process. Because children under the age of five were in a single group in the census, we needed to determine the exact number of children of each age. The number of births in 2009 and 2010 were gathered for children under the age of two (Population Research Center, 2012). For ages two through four the 2009 and 2010 births were subtracted from the population of children under the age of five. We assumed each year in a census cohort had the same number of people (i.e. if there were 3998 males in a cohort, each age would have 1/5 the number of individuals). These assumptions allowed us to determine the number of people in Yamhill County that were in each MyPlate nutritional category. Children under the age of two were not included in the population for nutritional needs because they were not included on MyPlate and have different dietary requirements than the rest of the population. MyPlate also groups people above the age of fifty-five together which assumes that someone in their nineties is eating the same foods as a sixty-year-old. We assumed that the recommendations given by MyPlate are accurate and are in actuality what people would eat on a daily basis. We also assumed a moderate activity level for the entire population (MyPlate, 2013). We did not include dietary requirements for pregnant women even though we calculated and estimated the number of pregnant women in Yamhill for 2009 and 2010 by births in the county in each year. We also assumed there were no vegetarians, vegans, food allergies, or diabetics in the county.

After we determined the number of people in Yamhill County in each MyPlate age group, we could then determine the recommended daily nutritional needs of each food group (vegetables, fruits, grain, protein, and dairy) for each age group. The gender of individuals was

important in many of these age categories as nutritional needs differ between sexes. We then calculated the annual nutritional requirements by multiplying the daily nutritional needs by 365.

Table 1: Nutritional requirements by sex and age group (MyPlate 2013).

		Fruit	**Veg**	**Grain**	**Protein**	**Dairy**
Children	2-3 years old	1 cup	1 cup	3 ounce equivalents	2 ounce equivalents	2 cups
	4-8 years old	1 - 1 ½ cups	1½ cups	5 ounce equivalents	4 ounce equivalents	2 ½ cups
Girls	9-13 years old	1 ½ cups	2 cups	5 ounce equivalents	5 ounce equivalents	3 cups
	14-18 years old	1 ½ cups	2½ cups	6 ounce equivalents	5 ounce equivalents	3 cups
Boys	9-13 years old	1 ½ cups	2½ cups	6 ounce equivalents	5 ounce equivalents	3 cups
	14-18 years old	2 cups	3 cups	8 ounce equivalents	6 ½ ounce equivalents	3 cups
Women	19-30 years old	2 cups	2½ cups	6 ounce equivalents	5 ½ ounce equivalents	3 cups
	31-50 years old	1 ½ cups	2½ cups	6 ounce equivalents	5 ounce equivalents	3 cups
	51+ years old	1 ½ cups	2 cups	5 ounce equivalents	5 ounce equivalents	3 cups
Men	19-30 years old	2 cups	3 cups	8 ounce equivalents	6 ½ ounce equivalents	3 cups
	31-50 years old	2 cups	3 cups	7 ounce equivalents	6 ounce equivalents	3 cups
	51+ years old	2 cups	2½ cups	6 ounce equivalents	5 ½ ounce equivalents	3 cups

Food Production

Data on crop production for Yamhill County was obtained from an OSU crop data website (OAIN, 2013). We assumed that the information reported by the website was correct. For each crop the acres farmed and the amount produced were recorded in the published units (e.g., bushels, pounds, head counts, tons, boxes, or 1000 dozen). We recorded data for each crop

for five years, from 2007-2011, and then averaged those quantities to get an average yearly production. This was done in an attempt to account for differences in annual crop yields. Problems with using the Oregon Agricultural Information Network website included that it only reported the production yields of large farms, and if a supplier for a crop produced a large percentage of the crop it was not reported for privacy reasons. We were not able to accumulate data from small farms in Yamhill County (OAIN, 2013).

We calculated the total number of serving sizes per individual for each year. First we had to convert the agricultural data into MyPlate serving sizes. Because yields of different agricultural products are reported in a variety of measurements, we had to use many different conversion factors to do the calculations. We grouped each agricultural product into one of the five MyPlate food groups (vegetables, fruits, grains, protein and dairy) and determined the total amount of each nutritional group produced annually. We then calculated the difference between the total nutritional needs for the population of Yamhill County and the total agricultural output for each of the five MyPlate food groups. The conversions that were used in these calculations are listed in Table 2 (MyPlate, 2013).

Proteins were calculated using animal and nut sources (MyPlate, 2013). Animal sources included hogs and pigs, chickens, broilers, cows, and eggs. Nut sources included walnut and hazelnuts. Nuts were reported in tons, which were then converted to ounces by using the conversion of 32000 ounces per ton. For the meat sources we used the conversions in the Giombolini table to convert from the reported unit of per head into grams and then converted from grams to ounces (Giombolini, 2010). Eggs were reported per 1000 dozen and was assumed that each egg was 50 grams (Joy of Baking, 2013). Eggs were converted into grams and then into ounces.

Sources of grain included wheat, barley, and oats and production of each was gathered from OAIN (OAIN, 2013). Grains were converted from the agricultural unit of bushels to grams using a table in the Giombolini paper (Giombolini, 2010). The estimated grams per acre of grain harvested were 19,721 grams for wheat, 9,882 grams for barley, and 5,968 grams for oats. The grams were then converted to ounces by using the Metric Conversions website (Metric Conversions, 2012).

The fruit category was categorized by the county commodity report from OAIN (OAIN, 2013). The fruits included in the report were apples, sweet cherries, tart cherries, peaches, pears,

prunes/plums, wine grapes, strawberries, raspberries, Marion/blackberries, boysenberries and blueberries. Because the serving size of fruit is measured in cups, and the commodity report measurements are given in either boxes or pounds, and the servings produced annually was calculated by converting both to grams. The table in the Giombolini paper gives how many grams per yield for each type of fruit (Giombolini, 2010). In addition, the CalorieLab website gives information on how many grams of each fruit are in one cup, which is a single fruit serving (CalorieLab, 2013). For each type of fruit both values are multiplied together, and then multiplied by that fruits production per year to get the total servings per year. One thing that is important to note is that sometimes the CalorieLab website won't result in accurate numbers due to the fact that unless the grams per cup for the puree fruit are provided, there will be "holes" in the cup measurement, and none of the measurements were given as pureed fruit (CalorieLab, 2013).

The OAIN reported that in 2008 there were 2,284 harvested acres of fresh market vegetables (OAIN, 2013). Vegetables were given as one commodity. We found there is an average of 10,642 pounds per acre (Gardens of Eden, 2013) and then found there is an average of 3 cups per pound of vegetables (Old Farmer's Almanac, 2013). This allowed us to calculate how many cups of vegetables were produced in 2008. There was only information available for 2008 and therefore this information was not averaged over five years like other commodities (OAIN, 2013).

Dairy production reported by the OAIN was measured in count weight, otherwise known as cwt (OAIN, 2013). According to the table in the Giombolini research paper, one count weight of dairy product is 45,359 grams (Giombolini, 2010). The CalorieLab website reports 244 grams in one cup of dairy product; therefore the number of grams per count weight is 186 (CalorieLab, 2013). Total servings per year are the total grams per unit times the total units produced, which is 1,150,000 count weight. This was calculated for each year and then this was averaged to get the average annual servings produced (OAIN, 2013).

Table 2: Servings produced in Yamhill County per year.

Food Type	Food item	Serving Unit	Commodity yield unit	Conversion factor of commodity units to serving units
Protein	Hogs and Pigs	Oz	per head	3172
	Chickens	Oz	per head	65
	Broilers	Oz	per head	65
	Eggs	Oz	per 1000 dozen	423
	Hazelnuts	Oz	Per ton	32000
	Walnuts	Oz	Per ton	32000
	Cows	Oz	per head	110400
Grains	Wheat	Oz	bushel	19721
	Barley	Oz	bushel	9882
	Oats	Oz	bushel	5968
Fruit	Apples	Cups	boxes	174
	Sweet Cherries	Cups	Tons	8808
	Tart Cherries	Cups	Tons	8808
	Peaches	Cups	boxes	141
	Bartlett Pears	Cups	Tons	5635
	Plums	Cups	Tons	5498
	Strawberries	Cups	per 1000 lbs	2984
	Raspberries	Cups	per 1000 lbs	3688
	B. Raspberries	Cups	per 1000 lbs	3688
	E. Blackberries	Cups	per 1000 lbs	3150
	Marionberries	Cups	per 1000 lbs	3150
	Boysenberries	Cups	per 1000 lbs	3436
	Blueberries	Cups	per 1000 lbs	3065
Veggies	Fresh Market Veggies	Cups	cups/acre	31,926
Dairy	Dairy Products	Cups	Count weight	1,150,000

Results

MyPlate gives the different nutritional needs for different age groups. We calculated the number of individuals in each age group in Yamhill Country. This information is displayed in Table 3 (MyPlate, 2010).

Table 3: Yamhill County's demographic data by MyPlate age category

	MyPlate Age Groups	**Demographics**
All Children	< 2	2379
	2 - 3	5092
	4 - 8	6803
Women	9 - 13	3477
	14 - 18	3784
	19 - 30	7602
	31 - 50	12547
	51+	16258
	Total Women	43668
Men	9 - 13	3603
	14 - 18	3923
	19 - 30	8085
	31 - 50	13419
	51+	14600
	Total Men	43629

Using the MyPlate recommendations for recommended daily intake of each of the five MyPlate food groups, we calculated the total annual food in each group that would be required by the population in Yamhill County. The daily and annual recommended fruit required by residents of Yamhill County is shown in Table 4. We found that the total amount of fruit needed per day was 167,678 cups and per year was 61,202,482.17 cups.

Table 4: Total daily and annual fruit requirements for Yamhill County residents.

Daily recommendation of fruits	Age (in years)	Amount Required (in cups)	Population size	Total daily cups needed	Total annual cups needed
Children	2-3	1	2,713	2,713	990,367
	4-8	1 - 1½	6,803	10,205	3,724,679.00
Girls	9-13	1½	3,477	5,216	1,903,876.50
	14-18	1½	3,784	5,677	2,071,959.00
Boys	9-13	1½	3,603	5,405	1,972,861.50
	14-18	2	3,923	7,846	2,863,790.00
Women	19-30	2	7,602	15,204	5,549,314
	31-50	1½	12,547	18,821	6,869,702
	51+	1½	16,258	24,386	8,901,036
Men	19-30	2	8,085	16,170	5,902,050
	31-50	2	13,418	26,836	9,795,140
	51+	2	14,600	29,199	10,657,708
			Total	**167,678**	**61,202,482.17**

We also calculated the daily and annual amount of vegetables required by residents of Yamhill County (Table 5). We found that the total amount of vegetables needed per day was 234,007 cups and the annual required vegetables were 85,412,713 cups.

Table 5: Total daily and annual vegetable requirements for Yamhill County residents.

Daily recommendation of vegetables	Age (in years)	Amount required (in cups)	Population size	Total daily cups needed	Total annual cups needed
Children	2-3	1	2,713	2,713	990,367
	4-8	1½	6,803	10,205	3,724,679.00
Girls	9-13	2	3,477	6,955	2,538,502.00
	14-18	2½	3,784	9,461	3,453,265.00
Boys	9-13	2½	3,603	9,009	3,288,102.50
	14-18	3	3,923	11,769	4,295,685.00
Women	19-30	2½	7,602	19,005	6,936,642.50
	31-50	2½	12,547	31,369	11,449,502.50
	51+	2	16,258	32,515	11,868,048.00
Men	19-30	3	8,085	24,255	8,853,075.00
	31-50	3	13,418	40,254	14,692,710.00
	51+	2½	14,600	36,499	13,322,135.00
			Total	**234,007**	**85,412,713**

The daily and annual recommended amount of grains required by residents in Yamhill County is shown in Table 6. We found that the residents needed 583,640 ounces per day and 213,028,575.67 ounces per year.

Table 6: Total and daily grain requirements for Yamhill County residents.

Daily recommendation of grains	Age (in years)	Amount Required (in ounce equivalents)	Population size	Total daily ounces needed	Total annual ounces needed
Children	2-3	3	2,713	8,140	2,971,100
	4-8	5	6,803	34,015	12,415,597
Girls	9-13	5	3,477	17,387	6,346,255
	14-18	6	3,784	22,706	8,287,836
Boys	9-13	6	3,603	21,620	7,891,446
	14-18	8	3,923	31,384	11,455,160
Women	19-30	6	7,602	45,610.80	16,647,942
	31-50	6	12,547	75,284.40	27,478,806
	51+	5	16,258	81,288	29,670,120
Men	19-30	8	8,085	64,680	23,608,200
	31-50	7	13,418	93,926	34,282,990
	51+	6	14,600	87,597.60	31,973,124
			Total	**583,640**	**213,028,575.67**

The total daily and annual amount of protein required by residents of Yamhill County is shown in Table 7. The total amount of protein needed per day was 511,658 ounces, and the total protein needed per year was 186,755,036.17 ounces.

Table 7: Total and daily protein requirements required by Yamhill County residents

Daily recommendation of proteins	Age (in years)	Amount Required (in ounce equivalents)	Population size	Total Daily ounces needed	Total yearly ounces needed
Children	2-3	2	2,713	5,427	1,980,733
	4-8	4	6,803	27,212.27	9,932,477
Girls	9-13	5	3,477	17,387	6,346,255
	14-18	5	3,784	18,922	6,906,530
Boys	9-13	5	3,603	18,017	6,576,205
	14-18	6½	3,923	25,500	9,307,318
Women	19-30	5½	7,602	41,810	15,260,614
	31-50	5	12,547	62,737	22,899,005
	51+	5	16,258	81,288	29,670,120
Men	19-30	6½	8,085	52,553	19,181,663
	31-50	6	13,418	80,508	29,385,420
	51+	5½	14,600	80,298	29,308,697
			Total	**511,658**	**186,755,036.17**

The daily and annual dairy requirements for residents of Yamhill County are shown is Table 8. We found that the population required 284,327 cups per day and 103,779,403.67 cups per year.

Table 8: Total and annual dairy requirements of Yamhill County residents.

Daily recommendation of dairy	Age (in years)	Amount required (in cups)	Population size	Total Daily cups needed	Total yearly cups needed
Children	2-3	2	2,713	5,427	1,980,733
	4-8	2½	6,803	17,008	6,207,798.33
Girls	9-13	3	3,477	10,432.20	3,807,753.00
	14-18	3	3,784	11,353.20	4,143,918.00
Boys	9-13	3	3,603	10,810.20	3,945,723.00
	14-18	3	3,923	11,769.00	4,295,685.00
Women	19-30	3	7,602	22,805.40	8,323,971.00
	31-50	3	12,547	37,642.20	13,739,403.00
	51+	3	16,258	48,772.80	17,802,072.00
Men	19-30	3	8,085	24,255.00	8,853,075.00
	31-50	3	13,418	40,254.00	14,692,710.00
	51+	3	14,600	43,798.80	15,986,562.00
			Total	**284,327**	**103,779,403.67**

We calculated the difference between the amount of each food group that was produced in Yamhill County and the amount needed by residents of Yamhill County (Table 9). We found that the food groups that Yamhill County has a surplus of are grains, proteins and dairy whereas the county does not produce enough fruit or vegetables. Yamhill County would need to produce 38,882,463 more cups of fruit, and 75,434,613 more cups of vegetables.

Table 9: Total amount of each food group required by Yamhill County residents, produced in Yamhill County, and the difference between the two.

	Fruit (cups)	Vegetables (cups)	Grains (oz)	Protein (oz)	Dairy (cups)
Total annual amount needed	61,202,482	85,412,713	213,030,255	186,756,545	103,779,404
Total amount produced	22,320,000	9,978,100	26,004,704,069	974,199,254	106,284,818
Difference between amount produced and amount needed	-38,882,463	-75,434,613	25,791,673,814	787,442,709	2,505,414

Figure 1 shows the annual amount of all the food groups produced and what is required for dietary consumption. This chart was compiled using the data from Table 9.

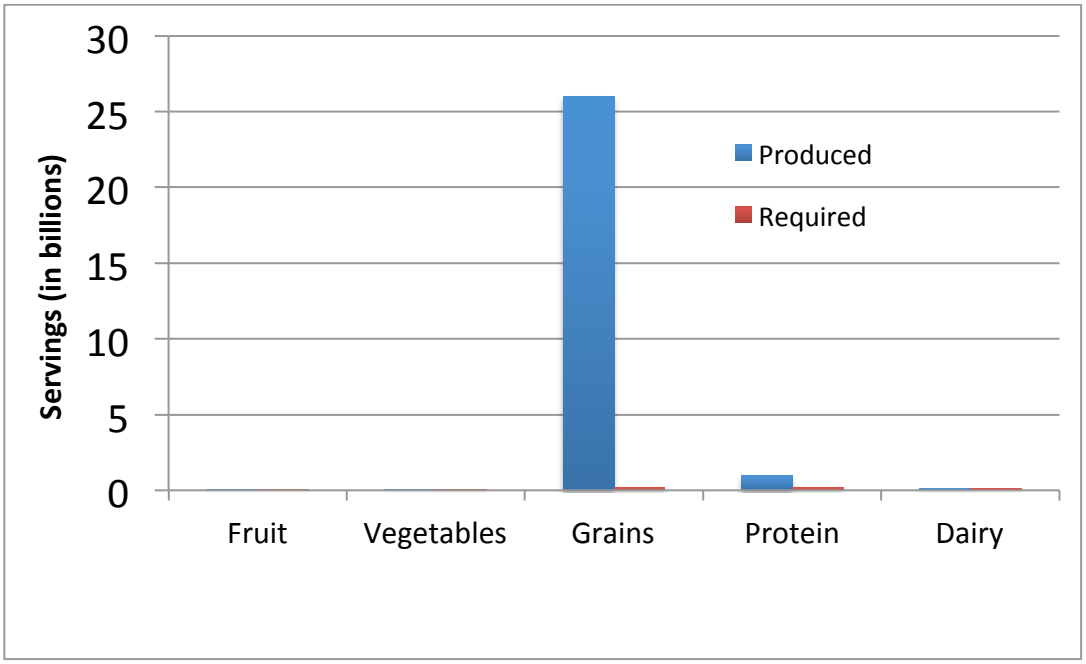

Figure 1: Annual agricultural output and required consumption for all food groups in Yamhill County.

It is difficult to see the values of all food groups other than grain in Figure 1 because the production is so high that it dwarfs all the other food groups. Figure 2 shows the same information as is shown in Figure 1, but grains are omitted.

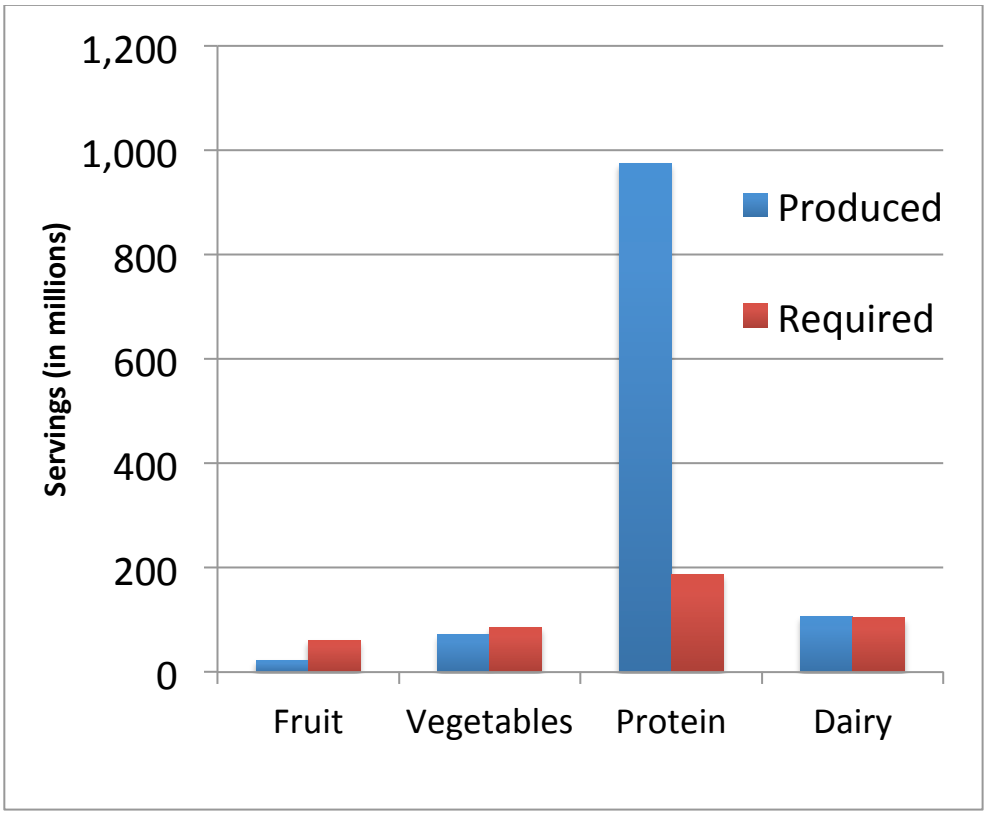

Figure 2: Annual agricultural output & required consumption in Yamhill County for all food groups other than grain.

Discussion

Yamhill County cannot feed itself according to our data and calculations. This is based on the fact that Yamhill County is not producing enough food in all five food groups to meet the servings necessary for the population demographics. Demographic and nutritional needs are shown in Tables 3, 4, 5, 6, 7, and 8. Yamhill County is able to produce enough servings per year to feed the county's population for grains, proteins, and diary. However, the county produces deficits of fruit and vegetable requirements. Crop production in Yamhill County is provided in Table 9. The top five agricultural commodities in Yamhill were nursery crops, tall fescue, dairy products, wine grapes, and perennial rye grass (Oregon State University, 2011). Most of the top five commodities aren't calculated within our data set as they aren't considered to be included in

the five food groups with the exception of dairy products. Our largest deficit is in the fruit food group, which would only feed about 30,000 people who eat 2 cups of fruit a day. Yamhill County's current population is about 100,000 people, therefore only about a third of the population could receive a full serving of fruits every day. Vegetables would need over 12 million servings a year to sustain the entire Yamhill County population. The current amount produced would feed about 80% of the population if everyone were allotted 2.5 cups of vegetables a day. These two categories are limiting factors in Yamhill County's ability to feed itself.

Grains produced in Yamhill County constitute over 1000% of what is required for nutritional needs within the county. However, an unknown amount of the grain that is produced is not used for human consumption, but rather goes to feed livestock as well as going to use for other agricultural needs. Therefore, this percentage of grains produced is a false representation of edible crops in Yamhill.

There was a large surplus of proteins produced within the county and a large portion of the food group comes from the hazelnut industry (AGMRC, 2013; OAIN, 2012). Yamhill County grows a large amount of protein sources besides those provided by animal sources. The county produces 2.5 million excess servings per year, which is equal to fewer than 7,000 extra servings per day. Yamhill County is able to produce a surplus in 3 out of the 5 food categories but often the nutrients and minerals that are needed for a healthy and well-rounded diet are found in the two categories of fruits and vegetables that have a deficit.

Implications

All of these calculations reveal the implications that if the population of Yamhill County were to survive locally by only consuming foods grown or produced within the county limits, then our calculations indicate that the county currently produces enough grain, protein, and dairy to be able to sustain itself. However, the county does not produce enough fruits or vegetables to be able to provide the daily fruit requirement to all Yamhill County citizens. Possible solutions to this problem include planting more orchards and other fruit crops. Apples thrive in this area as do blackberries. More of these crops should be produced in order for the county to be able to supply enough fruit for the entire Yamhill County population.

It may be advantageous to provide a legal framework or economic incentives to local farmers to encourage them to grow a range of crops so as to fulfill Yamhill County's nutritional requirements. This may be difficult to enact due to the large number of farmers producing wine grapes in the county. It may be difficult to convince farmers who grow wine grapes and receive large monetary sums in payment for this wine to convert their land to grow a lower income crop such as apples to better fulfill food group deficits within the county. Indeed, there were 5,800 acres of wine grapes harvested in 2012 (OAIN, 2013).

Limitations

Arguably the largest limitation is that the county does not house enough local infrastructure to be able to provide enough food to sustain all of its residents. Many of these products are shipped to other areas of the country for processing and do not arrive to the food stores in a raw state. For example, although a cow may be raised in Yamhill County, it may be shipped up to Washington or another state to be butchered, processed, and packaged for sale before being sent back to supermarkets in Yamhill County. Therefore, although we do produce enough food for many of our nutritional requirements, there is not enough agricultural processing infrastructure available within the county for Yamhill County to be able to feed all of the people that reside there. In order to better accommodate the Yamhill County residents based upon infrastructure needs, additional processing facilities should be implemented such as grain processing plants and slaughterhouses.

Conclusion

Each of the five nutritional requirements including fruits, vegetables, grains, protein, and dairy were analyzed specifically for the demographic population of Yamhill County in Oregon in order to determine if the county could support itself locally by only subsisting off products produced within in the county. After numerous calculations and research, it was found that the county produces enough of the three nutritional groups protein, grains, and dairy to support the Yamhill County population's nutritional requirements. However, the county does not produce enough vegetables or fruit to be able to cover all nutritional recommendations. In addition, a large limiting factor that restricts the county from providing enough food to feed its residents is that the county does not house enough infrastructure facilities to process the food grown within

the county borders. In future years, more fruit and vegetable crops should be planted and more agricultural infrastructure centers implemented in order for the county to be able to fully support itself locally.

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