

How Does Meeting the 2015–2020 Dietary Guidelines for Americans Benefit U.S. Fruit and Vegetable Growers?

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This study estimates the economic impact on fruit and vegetable industries in the U.S. from an increase in consumption based on different scenarios, including a shift in demand that meets the recommendation in the 2015–2020 Dietary Guidelines for Americans. Our results show a substantial potential benefit to the fruit and vegetable industries in the range of \$24–\$38 billion.

Increased consumption of fruits and vegetables has been linked to a decrease in dietary-related chronic diseases such as obesity, heart disease, diabetes, and some types of cancer. As more people eat more fruit and vegetables, the producers of those commodities stand to benefit from the increase in demand. This study estimates the economic impact on fruit and vegetable industries in the U.S. from an increase in consumption to levels recommended in the 2015–2020 Dietary Guidelines for Americans (DGA).

Every five years, the dietary guidelines are updated based on current research. The 2015 DGA guidelines for fruit and vegetable consumption have almost doubled from the “5 A Day” (based on servings) recommendation in the 2005 DGA. Now the recommended amounts of fruits and vegetables range between 3.5 cup equivalents (7 servings) and 5 cup equivalents (10 servings) for most people depending on gender, age, and activity level (Figure 1). In addition to recommendations on the total amount

of consumption, the 2015 DGA also contains recommendations for the amount of starchy, deep red and dark orange, dark green, and other vegetables to consume.

Current average consumption by people who live in households above 130% of the poverty level exceeds the previous 5 A Day recommendations in the 2005 DGA. Current average consumption for people in these households is around 1.04 cup equivalents (2.08 servings) for fruits and 1.57 cup equivalents (3.14 servings) for vegetables. However, this falls short of the minimum recommendations in the current DGA (Figure 1).

People who live in households with an income at or below 130% of the poverty level consume lower amounts of fruits and vegetables, except for starches, than higher-income consumers. Current average consumption for these households is 0.96 (1.92 servings) cup equivalents for fruits and 1.26 (2.52 servings) cup equivalents for vegetables.

Fruit consumption would need to increase by 66% on average for people in households above 130% of the

poverty level, and 76% for people in households below 130% of the poverty level, to achieve the 2015 DGA recommendation at a sedentary activity level. Consumption within the individual vegetables subgroups would have to increase by 77% for people who live in households above the 130% poverty level for red and orange vegetables, 45% for dark green vegetables, and 71% for starchy vegetables (Figure 1).

As people in households at or below 130% of the poverty level eat less fruit and vegetables, the required shifts in demand are greater for them. In a study on the benefits to U.S. growers, if everyone in the U.S. met the 2005–2010 DGA 5 A Day recommendations, the net annual benefits to all growers in the U.S. were estimated to be \$460 million—about 69%, or \$316 million accrued to California. With the greater recommendations in the 2015–2020 DGA for fruit and vegetable consumption, these benefits may increase, even though people are consuming more now than when that study was completed.

As people who are more active are also able to consume more calories, the shifts needed to reach the

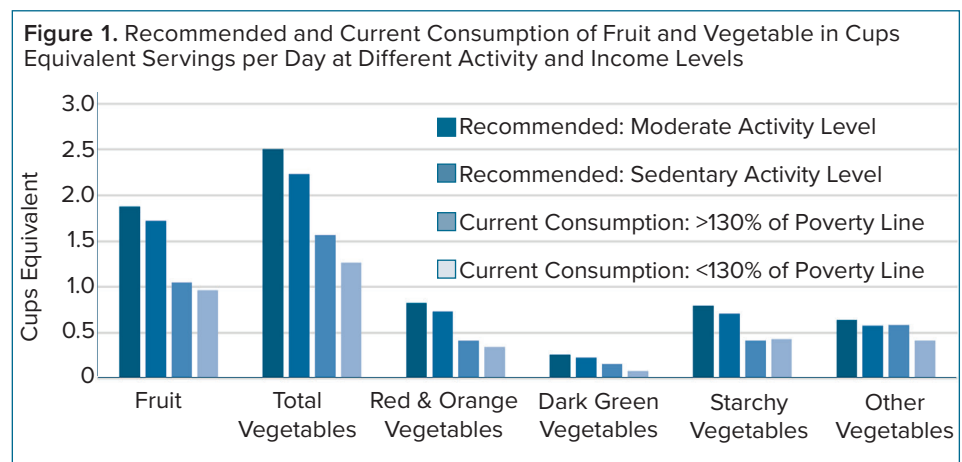
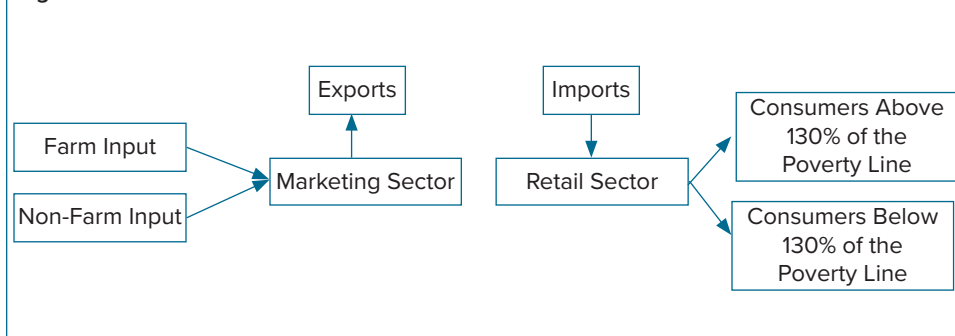


Figure 2. Outline of the Sectors Included in the Market Model



recommendations if everyone engaged in moderate activity levels are higher than if everyone engaged in sedentary activity levels (Figure 1).

Fruit and vegetable industries stand to benefit significantly should consumers achieve the recommended levels of fruit and vegetable consumption. Greater fruit and vegetable consumption would be met with increases in production within the U.S., lower exports, and greater imports. California accounts for 38% of total acreage in fruit and vegetable production (NASS, 2012) and would, in particular, be affected. California also specializes in the higher-value fresh market sector for many crops, including fresh asparagus, snap beans, blueberries, carrots, cucumbers and grapefruit. It is the largest producer of fresh asparagus and oranges in the U.S., even though it is not the largest producer of these commodities.

While fruit and vegetable industries stand to benefit significantly if people eat the recommended amounts of fruits and vegetables, smaller shifts may also cause significant benefits. As a result, the following scenarios were analyzed:

- A 10% shift in demand for each commodity
- A 25% shift in demand for each commodity
- A shift in demand corresponding to a consumption level in the 2015 DGA corresponding to a sedentary activity level

- A shift in demand corresponding to a consumption level in the 2015 DGA corresponding to a moderate activity level

Methodology

Market model

The benefits to producers are calculated from estimated changes in prices and production due to a shift in demand for fruits and vegetables using a market model of the U.S. fruit and vegetable market. The market model specifies a system of demand and supply equations in log-linear form. It is used to measure how the increases in demand for fruit and vegetables affect retail prices, farm prices, final consumption, trade, and farm production (Figure 2).

In the market model, fruits and vegetables are produced in the farm sector. Due to California's large share of domestic production, separate equations are included for production from California and for production from the rest of the United States (RUS). The marketing sector takes the farm product and uses inputs to either pack it fresh, or process it to sell as juiced, canned, frozen, or dried products. Commodities are then sent to the retail market or exported. Additional supply to the retail market can be obtained from imports. U.S. market supply is then equal to domestic production in California and the RUS, plus imports, minus exports.

Commodities in the U.S. market are purchased by consumers. Because people who live in households above 130% of the poverty level currently consume more fruits and vegetables than people in households at or below 130% of the poverty, these two groups are specified separately. Finally, 41 individual commodities were included in the study to account for variation in the shifts of different vegetable subgroup recommendations. The fruits and vegetables included in the study, and the subcategories to which they belong are:

- **Fruit:** Apples, apricots, avocados, bananas, berries, blueberries, cantaloupes, cherries, dates, grapes, grapefruits, honeydew melons, lemons, kiwis, oranges, peaches and nectarines, pears, plums and prunes, strawberries, tangerines, watermelons.
- **Dark green vegetables:** Spinach, broccoli, lettuce (leaf and romaine).
- **Red and orange vegetables:** Carrots, sweet potatoes, tomatoes (fresh), tomatoes (processed).
- **Starchy vegetables:** Corn (fresh market sweet), peas, potatoes.
- **Other vegetables:** Lettuces (head, endive, etc.), artichokes, asparagus, beans (snap), celery, cucumbers, onions, bell peppers, cabbage, cauliflower.

A key parameter in the model is how consumers and growers will react to changes in prices. A change in the demand for fruits and vegetables will cause prices for these commodities to rise, causing consumers to buy less, growers to produce more, exports to decrease, and imports to increase. How consumers and growers will respond to the change in price is called an elasticity.

Consumers are assumed to be influenced by both the price of the good being analyzed and by changes in the price of goods that can be consumed in place of that good. For example, changes in quantity demanded for apples is influenced by changes in the price of apples, and also changes in the price of oranges, grapes, melons, etc.

Similarly, growers are influenced by the price of a commodity, and the prices of other commodities that can be grown in the same area during the same time period. For example, the choice to grow broccoli would be influenced by the price of broccoli, and the price of cauliflower, but not the price of cucumbers. This is because both broccoli and cauliflower are annual cool season crops and cucumbers are an annual warm season crop.

Data

Data needed to calibrate and parameterize the model are available from various sources for the years 2012–2014. U.S. and California production and farm value data are available from the USDA's *Fruit and Nut Yearbook and Outlook* reports, the *Vegetable and Melon Yearbook and Outlook* reports, and the National Agricultural Statistics Service (NASS). Trade data are available from the United States International Trade Commission's database. Retail prices are calculated from the National Household Acquisition and Purchase Survey (FoodAPS) for the year 2012. Consumption data for fruits and vegetables are obtained from the National Health and Nutrition Examination Study 2011–2012 surveys.

Own-price elasticities of demand and farm supply are obtained from the literature. Cross-price elasticities of demand and farm supply are calculated from the respective homogeneity conditions for linear demand and supply function.

Table 1. Total Change in Producer Benefit in the U.S. in Billions of Dollars

	Increase in Demand		Recommended Consumption Level	
	10%	25%	Sedentary Activity Level	Moderate Activity Level
Total Benefit to Producers	\$3.42	\$9.00	\$23.89	\$32.20
California	\$1.58	\$4.15	\$10.69	\$14.40
Rest of the U.S.	\$1.84	\$4.85	\$13.20	\$17.81

Table 2. Acres Adjustment in California and the U.S

	Increase in Demand		Recommended Consumption Level	
	10%	25%	Sedentary Activity Level	Moderate Activity Level
Total Change in Acres				
California	97,708	244,270	547,453	706,167
Rest of the U.S.	172,601	431,503	827,683	1,067,987
Percentage of Acres Used by Other Crops				
California	1.7%	4.3%	9.6%	12.4%
Rest of the U.S.	0.1%	0.1%	0.3%	0.4%

Armington elasticities are calculated for imports and exports. The elasticity for the marketing input is assumed to be perfectly elastic. The elasticity of substitution between the marketing input and the farm input is 0.05 for fresh commodities, and 0.1 for processed commodities because processed commodities typically use more inputs.

Results

As demand increases in each scenario, the benefits to fruit and vegetable industries increase (Table 1). Even for a small increase in demand of 10%, the net benefits for growers is \$3.42 billion. Benefits increase to \$9.00 billion for an increase in demand of 25%, \$23.89 billion if the recommended consumption level for a sedentary lifestyle is reached, and \$32.2 billion if the recommended level of consumption for a moderate lifestyle is reached. According to the 2012 Agricultural Census, the annual farm-gate value of U.S. production of fruit and vegetables was \$43 billion.

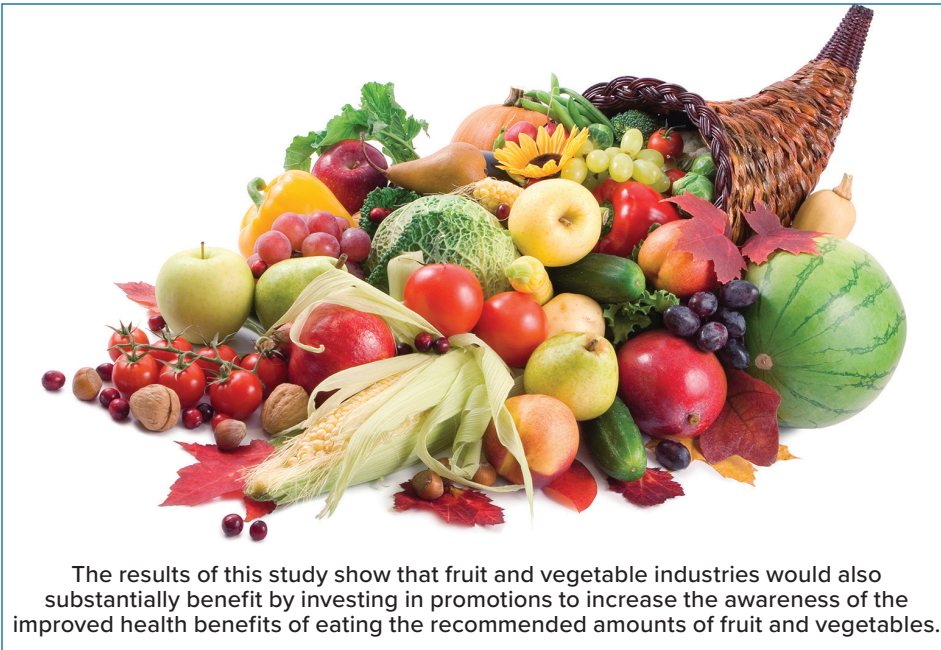
California accounts for around 45–47% of the change in benefits to producers in all the scenarios even though it has only 38% of the total fruit and vegetable acres. However, California

tends to specialize in production for the fresh market, and so it has a higher value of production than the rest of the U.S. in the subgroups fruit, dark vegetables, and red and orange vegetables. By value, California's share of production of the commodities included in the study is around 47%.

Long-Run Adjustment

Note that the model calculates the short-term benefits to the fruit and vegetable industries. As consumers demand more fruit and vegetables, more acreage would need to go into production for these commodities. This acreage would either come from less suitable land not currently used for agricultural production, or from other crops being displaced.

In the rest of the U.S., the number of acres planted for other crops not included in the study is 297.6 million average acres for the 2012–2014 period. Currently, these acres are used for cotton, hay, beans, various nuts, etc. We did not include pasture land in this calculation since pasture land is less suitable for fruit and vegetable production. Less than 0.5% of this acreage would need to be converted into fruits and vegetables



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for production from rest of the U.S. to reach the highest recommended levels for a moderate activity level (Table 2).

In the same period, 5.9 million acres were in production in crops other than fruits and vegetables in California. To increase the level of production needed for each scenario, California needs to convert 1.7% of the acres from other crops for the 10% scenario, 4.3% for the 25% scenario, 9.6% to reach the recommendation for a sedentary activity level, and 12.4% to reach the recommended level for a moderate activity level. Most likely the converted acreage would come from the least profitable crops first (Table 2).

This would cause prices for those crops to also rise, but the change in benefits to the non-fruit and vegetable industries would be a net decline in benefits due to a reduction in acreage. However, the net benefits to growers who shift production from a less profitable crop and into a more profitable crop would be positive. Also, if at the higher levels for the shifts in demand there is insufficient acreage to move to fruit and vegetable production in California, this means that growers in California are not as responsive to changes in prices than

growers in rest of the United States. This would put upward pressure on farm prices for growers. Growers in rest of the U.S. would then further expand production of fruits and vegetables.

Discussion

Most people are aware that leading a lifestyle that includes more exercise and greater consumption of fruits and vegetables will lead to a healthier life. How to increase fruit and vegetable consumption is the challenge. There is hope, however. After the 2005 DGA guidelines were published, average consumption of fruits and vegetables was far short of the recommended 5 A Day. Today, people in higher-income households consume just over 5 A Day on average, while people who live in lower-income households consume just under. The results of this study show that fruit and vegetable industries would also substantially benefit by investing in promotions to increase the awareness of the improved health benefits of eating the recommended amounts of fruit and vegetables. Even small changes of, say, 10%, result in large changes in benefits to fruit and vegetable industries.

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For additional information, the authors recommend:
 Jetter, Karen M., James A. Chalfant, and Daniel A. Sumner. "Does 5 A Day Pay? Potential Gains to Growers from Increasing Consumption of Fruits and Vegetables to Recommended Levels in a Cancer Prevention Diet." *Agricultural Issues Brief* No. 27, 2004. <http://aic.ucdavis.edu/pub/briefs/brief27.pdf>