An Analysis of the Private Costs and Benefits to Californians from Eating the USDA Recommendations for Fruits and Vegetables.

by

Karen M. Jetter
Post-Doctoral Research Fellow
Agricultural Issues Center, University of California

James A. Chalfant
Professor and Chair
Department of Agricultural and Resource Economics
University of California, Davis

Daniel A. Sumner
Frank H. Buck Chair, Department of Agricultural and Resource Economics
University of California, Davis and
Director, Agricultural Issues Center, University of California

Paper Presented at the

Society for Nutrition Education meetings

Oakland, California

July 2001

This research was funded by a grant from the Center for Advanced Studies in Nutrition and Social Marketing, University of California, Davis.

INTRODUCTION

This paper discusses the potential costs and benefits to producers and consumers in California, should Californians increase their intake of fruit and vegetables to meet recommendations for a cancer prevention diet. Eating the recommended levels would cause the demand for fruits and vegetables to rise significantly, shifting the use of agricultural resources (such as land, labor and other purchased inputs) and benefiting agricultural industries.

Increased consumption of fruits and vegetables has been linked to a decrease in the risk of cancer. In a review of 196 epidemiology studies, scientists determined that the link between fruit and vegetable consumption and a lower incidence of cancer was probable (WCRF and AIC 1997). In addition, convincing evidence exists linking the consumption of specific fruit and vegetable groups to a reduction in certain types of cancers. For example, eating dark vegetables has been associated with a lower incidence of lung and stomach cancers (WCRF and AIC 1997). Therefore, the cancer risk reduction diet provides recommendations for the composition of fruit and vegetable consumption, as well as the total level.

USDA recommendations for a 2,200 calorie diet are 3 fruit servings and 4 vegetable servings a day (McNamara et al 1999). The more specific recommendations for fruit are at least one serving from the citrus / berry / melon group and at least two additional servings of any fruit. Two programs were developed for vegetables. The first recommends at least one serving of dark colored vegetables, one serving of salad, one half serving of a starchy vegetable and one and a half servings of any other vegetable. The second program further disaggregates the vegetable recommendations. In addition to the recommendations for dark, salad, and starchy vegetables, at least one half serving of cruciferous vegetables, 0.3 servings of tomato, and 0.7 servings of any other vegetable is advised. A complete listing of the vegetables that are included in each sub-category is in Appendix 1.

Despite the known benefits, many people do not eat recommended levels of fruits and vegetables. In some cases the gap between average and recommended consumption is quite large. McNamara et al. (1999) estimate that consumption of dark vegetables would need to increase by over 300 percent in order to meet minimum recommendations.

The first part of this study provides background on the current level of fruit and vegetable consumption and on the agricultural sector in California. The following section will present a graphical description of the distribution of costs and benefits between consumers and producers. Finally, the change in consumption needed to meet recommendations, under three different assumptions on the nature of the consumption shift, will be calculated.

CONSUMPTION OF FRUITS AND VEGETABLES

Current consumption of fruits and vegetables is far below recommended levels. Based on the California Survey of Dietary Practices, average consumption of fruits is 1.85 servings a day and average consumption of vegetables is 1.89 servings (Table 1). Fruit consumption would need to increase by 62 percent and vegetable consumption by 113 percent to achieve the minimum recommendations.

When categories are broken down into subgroups, greater variation in meeting targeted levels is apparent. California consumers come closest to meeting the target level for tomatoes. A 15 percent increase in this vegetable is all that is needed to meet the minimum recommendations. At the other end of the spectrum, consumption of dark vegetables would need to increase by over 200 percent.

Table 1. Recommended and Self-Reported Consumption Levels

	Servings per Day		Percent Increase
	Recommended	Self -Reported	Needed
Fruit			
Citrus, Melon, Berry	1	0.76	31
All other fruit	2	1.09	83
Total Fruit	3	1.85	62
Vegetable 1			
Starchy	0.5	0.25	101
Salad	1	0.49	103
Garden	1.5	0.83	82
Dark	1	0.31	223
Total Vegetable		1.88	113
Vegetable 2			
Starchy	0.5	0.25	101
Dark*	1	0.31**	223
Cruciferous*	0.5	0.19**	160
Dark non cruciferous		0.21	
Dark cruciferous		0.10	
Garden cruciferous		0.09	
Tomato	0.3	0.26	15
Salad	1	0.49	103
Garden non cruciferous	0.7	0.48	47
Total Vegetable		1.88	113

*Dark = Dark non cruciferous + Dark cruciferous.

*Cruciferous = Garden cruciferous + Dark cruciferous.

**Not counted in total as the dark cruciferous category would be counted twice.

Source: California Department of Health Services Bi-annual Consumption Surveys 1993-99.

The consumption levels calculated from the California Survey on Dietary Practices are consistent with the results of estimates from national studies for most food categories (Table 2). National consumption of fruits and vegetables has been estimated from the Continuing Survey of Food Intakes by Individuals (McNamara et al 1999; Tippett and Cleveland 1999) and from food supply data (Kantor 1998).

The main difference between the California data and the US data is in the consumption of starchy vegetables such as potatoes and sweet corn. US consumption is more than one serving per day greater than California consumption. Part of the difference is attributable to the inclusion of potato chips and french fries in the US data, and their absence in the California estimates. US consumers are eating about 0.7 servings of these

potato products a day (Kantor 1998). When adjusted, US consumption of starchy vegetables is 0.58 to 0.7 servings a day. On average, Californians eat more fruit, but fewer vegetables, than US consumers, even when the US data are adjusted by removing potato chips and french fries from the vegetable estimates.

Table 2. Comparison of Results of Food Consumption Studies

	California	CSFII	Food Supply
Citrus, Melon, Berry	0.76	0.74	0.6
Other Fruit	1.09	0.76	0.7
Total Fruit	1.85	1.5	1.3
Dark Vegetable	0.31	0.32	0.3
Starchy Vegetable	0.25	1.28*	1.4*
Other Vegetable	1.32	1.53	1.9
Total Vegetable	1.88	3.13	3.6
Total	3.73	4.63	4.9

*Includes potato chips and french fries

Agricultural industries stand to benefit significantly should consumers achieve the recommended levels of consumption in fruits and vegetables. As the largest producer of fruits and vegetables in the country, California would especially benefit.

The annual value of California production of 25 principal vegetables and melons is $4.4 billion (USDA 1999b). This is 55 percent of the total value of US production of $8 billion. California's share of US fruit production is about the same. California annual fruit production value is $6 billion, just over 55 percent of the US value of $10.7 billion. Within California, 26 percent of farm receipts are from vegetable and melon production and 29 percent of farm receipts from fruit and nuts (Kuminoff et al., 2000).

California accounts for over 99 percent of national production of artichokes, Brussel sprouts, dates, figs, kiwi, clingstone peaches, persimmons, prunes, and raisins. It accounts for at least 50% of U.S. production of table grapes, wine grapes, lettuce (head, leaf and romaine), strawberries, broccoli, plums, celery, carrots, avocados, fresh market oranges, cauliflower, honeydew, cantaloupes, and processing tomatoes. While it produces less than 50 percent of US production of spinach and asparagus, California is still the largest producer of these items (USDA 1999b, 2000a, 2000b).

The shift in demand toward more fruits and vegetables would be met through increases in production within California, increases in imports from other regions, including the rest of the US, and a reduction in California exports to other markets. The ability of

California growers to increase production depends on the resources, such as land, labor and other purchased inputs, at their disposal. California has over 27.7 million acres devoted to agricultural production (USDA 1999a). Harvested cropland accounts for 8.5 million acres, with 3.5 million acres used for fruits and vegetables. Total farm expenses were $16.8 billion for all 27.7 acres in 1997 (USDA 1999a). Hired labor was the single largest category at $3.4 billion. In total, expenses for hired labor ($3.4 billion), contract labor ($1.4 billion) and other purchased inputs such as fertilizers ($746 million), petroleum ($488 million), and agricultural chemicals ($957 million) were about $7 billion, almost half of total farm expenses. Other significant farm outlays were for the purchase of livestock and poultry ($760 million), feed ($3 billion) and interest payments ($958 million).

Significant shifts in the production of other crops may occur in California as inputs are moved into producing fruits and vegetables. Moving inputs from one use to another is not cost free. For example, inputs may be diverted from the production of field crops, such as alfalfa or cotton. The production of field crops would decrease, potentially causing field crop prices to rise. Also, more labor is used to produce fruit and vegetable crops than field crops (Oliveira et al. 1993). If acreage is converted from field crops into fruit and vegetable production, the demand for farm labor will increase. In contrast, if acreage is converted from nursery crops to fruits and vegetables, then the demand for labor may remain unchanged or decrease (Oliveira et al. 1993). If net farm labor demand increases, wages may increase for all farm laborers, raising the production costs for field, nursery and nut crops. Because other crops are affected by the increase in fruit and vegetable production, commodities such as cotton, alfalfa, rice, nursery and nuts must also be included in the analysis.

The issue of resource availability was first discussed by O'Brien (1997). Given resource constraints, other researchers have discussed the potential for supply increases from trade, in addition to acreage adjustments, and other purchased inputs (Abbott 1999; Young and Kantor 1999). Even though resource availability issues have received attention, no estimates based on market analysis exist for the change in demand for agricultural inputs should fruit and vegetable consumption increase to meet recommended levels.

GRAPHICAL ANALYSIS

Private costs and benefits to consumers and producers of agricultural commodities can be estimated through changes in agricultural markets. Previous research has estimated the benefits of increased fruit and vegetable consumption through decreases in the cost of illness (Frazão 1999). That approach would be inappropriate here because we are interested in the market level effects between consumers and producers. Consequently, market based approaches are more appropriate.

Meeting the recommendations for a cancer prevention diet will shift demand toward more fruits and vegetables. The shift in demand is equal to the amount that will achieve the average minimum recommended level. The effect that this shift will have on final market prices and quantities can be shown in a demand / supply graph (Figure 1). This graph shows the relationship between demand and supply in commodity markets. The demand curve is labeled D and indicates the quantity consumers are willing to buy at each price level. It is downward sloping because as prices rise, consumers will buy less of the commodity. The supply curve is labeled S and indicates the quantity producers are willing to supply at each price level. It is upward sloping because as prices rise, producers will supply more of the commodity. Where the demand curve intersects the supply curve is the market equilibrium point. At this point total quantity demanded at price P' is equal to total quantity supplied Q'

From the supply and demand interactions, consumer and producer surplus may be estimated. Consumer surplus is the difference between the total value consumers receive from the consumption of a particular good and the total amount they pay for the good. It is the area under the demand curve D and above the market price (Nicholson 1989). It is the light shaded area. Producer surplus is the difference between the total value the producers receive and the total cost of producing a good. It is the area under the market price and above the supply curve S. It is the dark shaded area. Total economic surplus is equal to the sum of consumer and producer surplus.

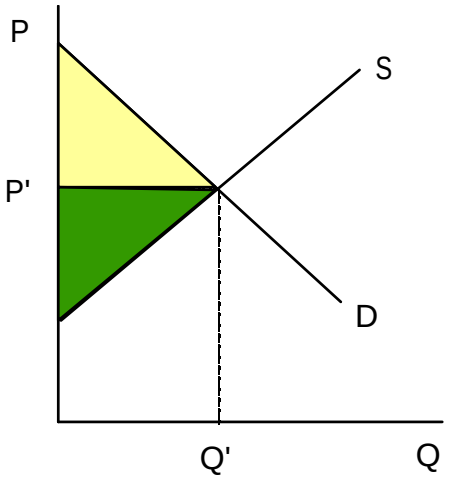

Figure 1: Supply and Demand

The increase in demand will (1) shift the demand curve to the right from D to D' by the amount k (Figure 2). Here, k is equal to the difference between current average

consumption and the recommended servings. Current servings are at Q' and the average recommended servings are equal to Q*.

Q* is not the final equilibrium point however. The increase in demand will (2) raise prices. Prices may increase as high as P*. The higher prices will (3) induce producers to grow more and importers to bring in more food. The increase in quantity supplied will cause prices to fall. In the long-run output will expand from Q' and prices will adjust until the new equilibrium point, b, is reached.

At point b the market equilibrium price is P" and the equilibrium quantity is Q". It is important to note that, at Q", quantity demanded is less than the recommended servings, Q*. The reason the new equilibrium is below the recommended consumption level is because the higher prices will reduce the quantity of fruits and vegetables demanded. Higher fruit and vegetable prices may also reduce income available for the purchase of other food items, housing or clothing (Kinsey and Bowland 1999). Low-income households with budgetary constraints would be especially affected.

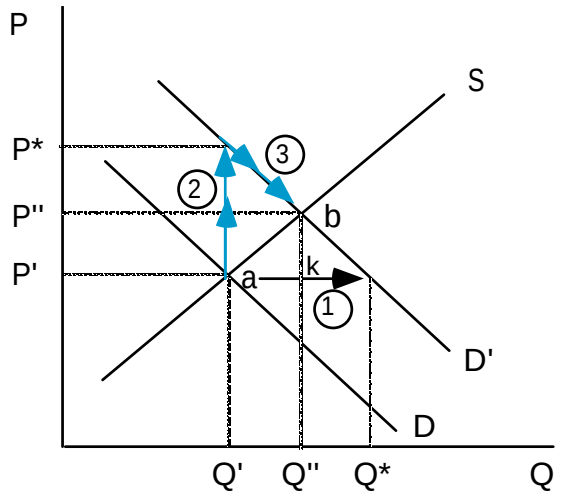

Figure 2: Market Adjustments Following An Increase in Consumption

From this shift in demand the benefits to consumers and producers may be calculated from the changes in total economic surplus. The benefits are equal to total consumer and producer surplus after the increase in fruit and vegetable consumption (the total shaded area in Figure 3) less consumer and producer surplus at the original consumption levels (non-striped shaded area). The change in benefits is equal to the striped shaded area in Figure 3.

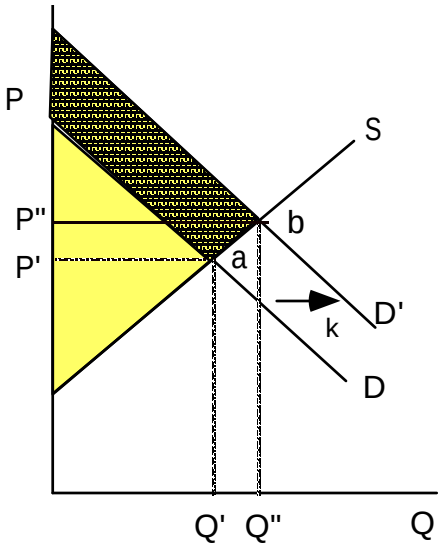

Figure 3: Consumer and producer surplus after adjustments.

Clearly, if the goal is to determine the benefits to the agricultural sector when the recommended levels of consumption are met, then the initial demand shift would need to be greater than k. The amount that is needed so that the recommended levels are reached after price adjustments cannot be determined a priori, and would need to be simulated over a range of values in order to determine it. An alternative approach is to model demand such that consumers are not responsive to price changes. When consumers are not responsive to price changes the demand curve is vertical (Figure 4). The shift in demand will then result in consumption at recommended levels.

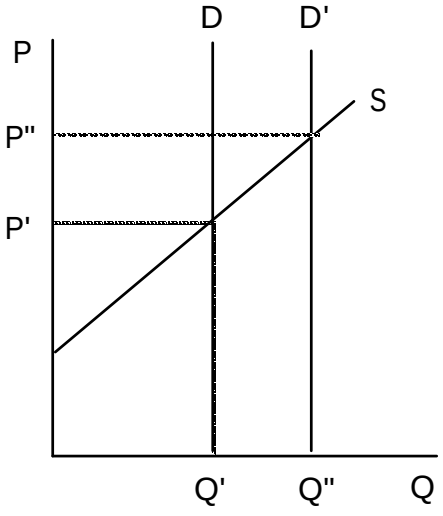

Figure 4. Demand shift with no price feedback effects.

Using a model where consumers are responsive to price changes is a more accurate depiction of commodity markets, but is more computationally difficult. Using a model where consumers are not responsive to price changes is more analytically tractable for estimation purposes, but is less realistic.

The above graphs depict the changes in consumer and producer surplus for fruits and vegetables. As agricultural inputs are drawn into fruit and vegetable production from other crops, the production of other crops will decline as the supply curve for other crops shifts left (Figure 5).

The market equilibrium moves from point a to point b. Quantity supplied decreases from Q' to Q" and prices rise from P' to P". The net losses to consumer and producer surplus are equal to total surplus before the supply shift (the entire shaded area) less total surplus after (the non-striped shaded area). Net losses are equal to the striped shaded area in Figure 5.

Because we assume that producers are rational and will pick the profit maximizing point, the gains from the shift into fruit and vegetable production will be greater than the losses from the shift out of production of other crops. Therefore, the net gains to consumers and producers are positive.

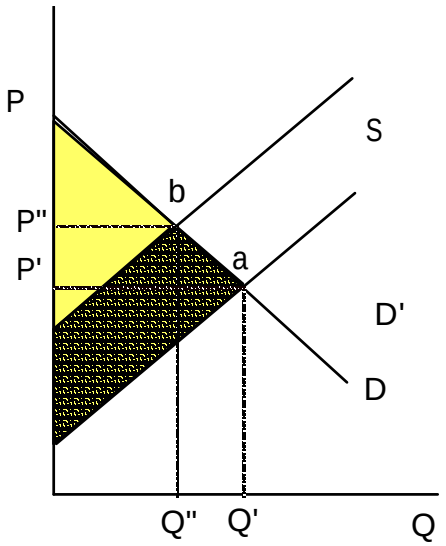

Figure 5. The market for other crops.

INCREASES IN THE DEMAND FOR SPECIFIC FRUITS AND VEGETABLES

A wide variety of fruits and vegetables will be included in our analysis (Table 3). These fruits and vegetables account for about 88 percent of total consumption (see Appendix I). Some items, such as mixed fruit salad, could not be allocated to any specific food items. Therefore, unspecified fruits and vegetables were excluded from the analysis. The remaining excluded commodities account for about five percent of total food consumption.

Bi-annual fruit and vegetable consumption data by Californians were provided by the California Department of Health Services for the years 1993 to 1999. The data were recorded according to how the food was prepared. Therefore, total consumption of a food item is equal to the sum of servings for the prepared item. For example, total consumption of cabbage is equal to consumption of cabbage plus sauerkraut plus coleslaw plus an allocation from the soup and mixed vegetable categories.

In some cases, more than one food was used to prepare the final product. When the prepared item contained two fruits or vegetables, 50 percent of the serving was allocated to each food item. When more than two are included, the allocation is slightly more complicated. Appendix II describes how each prepared item was converted into the individual food items.

The shift in demand for fruits and vegetables was determined for the fruit and vegetable groups, and for different sub-groups. The fruit sub-groups include the citrus / melon / berry group and all other fruit in another one. The vegetable 1 sub-groups include starchy, salad and dark, plus a garden category for all vegetables not included in the first three categories (see Appendix I). For the vegetable 2 sub-groups the garden category is further disaggregated into tomato and cruciferous sub-groups.

Table 3. Fruits and Vegetables that will be included in the analysis

Fruit		Vegetables	
Apple	Nectarines	Artichokes	Cucumbers
Apple Juice	Orange Juice	Asparagus	Eggplant
Apple Sauce	Oranges	Beans, Snap	Lettuce
Apricot	Peaches	Beets	Mushrooms
Avocado	Pears	Bell Peppers	Onions
Banana	Pineapple	Broccoli	Peas
Cantaloupe	Pineapple Juice	Brussel Sprouts	Potatoes
Grape Juice	Plums	Cabbage	Spinach
Grapefruit	Prunes	Carrots	Sweet Corn
Grapefruit Juice	Raisins	Cauliflower	Tomato, Fresh
Grapes	Strawberry	Celery	Tomato, Processing
Honeydew	Watermelon		
Mangos			

Three different scenarios were developed to determine the shift in demand for fruits and vegetables needed to reach the minimum recommended servings. The first scenario emphasis is on fruit and vegetable consumption in general. Consumption of all items increases by the same percentage.

The second scenario emphasizes meeting the targets for certain groups. Once those targets are met, achieving the recommended levels of fruit and vegetable consumption can be met through any food item. For fruit, the citrus / melon / berry sub-group target needed to be met. For vegetable group 1, the sub-groups of interest are starchy, salad, and dark. These sub-groups are also included in the vegetable group 2, plus the tomato and cruciferous targets are also met before increasing consumption of all vegetables by the same percentage.

The final scenario assumes that each category has a specific target, and those targets must be met. For fruit the two categories are citrus / melon / berry and other fruit. For vegetable group 1 the sub-groups are starchy, salad, dark and garden. The vegetable group 2 sub-groups are starchy, salad, dark, tomato, cruciferous and garden. Within each sub-group, each commodity increases by the same percentage. For example, consumption of oranges, grapefruit, strawberries and cantaloupe will each increase by 35 percent in order to reach the recommendation of at least one serving from the citrus / melon / berry group.

If consumption of all fruits increases by the same amount, then the minimum recommendation for the citrus / melon / berry group will be met (Table 4). Consumption of citrus / melon / berry increases the most when the targets for that group are met, then consumption is increased by the same amount for all fruits. However, consumption in the citrus / melon / berry category increases the least when the shift is by individual targets. The shift in this category ranges from a low of 35 percent to a high of 91 percent depending on the method used. The reverse happens for other fruits. Consumption increases the most when individual targets are used to determine the demand shift and least when specific sub-group targets are met before increasing consumption of all fruits. Again, a wide range in values is observed in the magnitude of the consumption shift, though not as large as in the citrus / melon / berry category.

Table 4. Consumption Shifts for Fruit Group

		Scenarios for Increases in Consumption					
		All by the same amount		Vitamin C group meets target, then all by same amount		Each group meets individual targets	
	Original Level	New Level	Increase	New Level	Increase	New Level	Increase
Citrus, Melon, Berry	0.763	1.175	61%	1.385	91%	1	35%
All other fruit	1.090	1.825	61%	1.615	41%	2	77%
Total	1.853	3		3		3	

Increasing all vegetable categories by the same amount will not result in achieving the minimum daily recommendation for the dark vegetable category (Table 5). As stated previously the gap between current and actual consumption of dark vegetables is greatest for this sub-group. All other categories reach the recommended levels when the increase is the same for all vegetables.

Table 5. Consumption Shifts for Vegetable Group 1

		Scenarios for Increases in Consumption					
		All by the same amount		Starchy, salad and dark targets met, then all by the same amount		Each group's individual targets met	
	Original Level	New Level	Increase	New Level	Increase	New Level	Increase
Starchy	0.249	0.580	133%	0.611	145%	0.500	101%
Salad	0.492	1.148	133%	1.222	148%	1.000	103%
Garden	0.826	1.595	133%	0.954	22%	1.500	117%
Dark	0.310	0.677	133%	1.214	328%	1.000	250%
Total	1.877	4		4		4	

As in the case of fruits, increasing specific vegetable sub-groups (starchy, salad and dark), and then increasing consumption of all vegetables to achieve the recommended four servings a day increases the percentage shift of the targeted sub-groups and lowers it for the garden vegetable category.

When the vegetable category is further disaggregated to include servings of tomatoes and cruciferous vegetables, calculating the increases in demand become more complicated since items such as broccoli are counted both as a serving of dark and as a serving of cruciferous (Table 6). Because of this a dark cruciferous category was added. The demand shift within each scenario was then estimated first by assuming that the dark vegetable category, including dark cruciferous, targets were met, then the cruciferous, including dark cruciferous, target met. The second method of calculating the demand shift was done by first looking at the cruciferous targets, and then the dark targets.

As was the case with fruit and vegetable group 1 a wide variation exists in the magnitude of the consumption shifts depending upon the method used to estimate the shift. Shifts in the consumption of garden vegetables ranges from 16 percent to 224 percent. Also, the same pattern in consumption shifts is apparent. When specific sub-group targets are met before increasing consumption of all vegetables, the shifts are greater than when each sub-group target is met, except for garden vegetables.

The extent to which consumers and producers are affected by increases in fruit and vegetable consumption depends on the magnitude of the shift, the share that the commodity has in production and consumption, and how responsive quantity demanded and supplied are to changes in prices. The larger the shift in consumption, the more producers and consumers are affected.

As the share a commodity has in total consumption increases the greater is the change in consumer surplus. The same applies to producer surplus. As the share a commodity has in total agricultural output increases, the greater is the change in producer surplus. For example, orange juice has a larger share of consumption than fresh oranges. Consumers drink 0.39 servings of orange juice a day on average, but only eat 0.07 servings of fresh oranges. However, California producers grow oranges mainly for the fresh market. In addition, the value of citrus production as a share of total crop production is large relative to other crops grown in California. Therefore, changes in fresh orange consumption would have a larger effect on California producers than changes in orange juice consumption. Finally, the more responsive producers and consumers are to price changes, the smaller are the effects to both groups. Estimation of the costs and benefits to consumers and producers is relegated to future work.

Table 6. Consumption Shifts for Vegetable Group 2

		Scenarios for Increases in Consumption									
		All by the same amount		All but garden targets met, then all by same amount- Dark First		All but garden targets met, then all by same amount- Cruciferous First		Each group's individual targets met- Dark First		Each group's individual targets met - Cruciferous First	
	Original Level	New Level	Percent Increase	New Level	Percent Increase	New Level	Percent Increase	New Level	Percent Increase	New Level	Percent Increase
Total Servings Tomato:	0.260	0.606	133%	0.356	37%	0.349	34%	0.300	15%	0.300	15%
Total Servings Salad	0.492	1.148	133%	1.185	141%	1.163	136%	1.000	103%	1.000	103%
Total Servings Cruciferous	0.192	0.406		0.587		0.576		0.500		0.500	
Total Servings Garden Cruciferous	0.091	0.170	133%	0.165	125%	0.232	239%	0.144	90%	0.204	191%
Total Servings Dark Cruciferous	0.102	0.237	133%	0.422	315%	0.344	239%	0.356	250%	0.296	191%
Total Servings Dark	0.310	0.000		1.179		1.157		1.000		1.000	
Total Servings Dark - non Cruciferous	0.209	0.440	133%	0.757	315%	0.813	348%	0.644	250%	0.704	285%
Total Servings Garden - other	0.475	0.820	133%	0.523	19%	0.517	16%	1.056	224%	0.996	201%
Total Servings Starchy	0.249	0.580	133%	0.593	138%	0.581	134%	0.500	101%	0.500	101%
Total	1.877	4.000		4.000		4.000		4.000		4.000	

References

Abbott, Philip. 1999. "Agricultural commodity production and trade: A trade economist's view on filling US food supply gaps". *Food Policy*. 24:181-196.

Frazão, Elizabeth. 1999. High Cost of Poor Eating Patterns in the United States. Chapter 1, *America's Eating Habits: Changes and Consequences*. Ed. Elizabeth Frazão. United States Department of Agriculture, Agriculture Information Bulletin Number 750.

Kantor, Linda Scott. 1998. *A Dietary Assessment of the U.S. Food Supply: Comparing Per Capita Food Consumption with Food Guide Pyramid Serving Recommendations.* Economic Research Service. United States Department of Agriculture, Agricultural Economic Report No. 772.

Kinsey, Jean and Bradley Bowland. 1999. "How can the US food system deliver food products consistent with the dietary guidelines?" *Food Policy.* 24:237-253.

Kuminoff, Nicolai V., Daniel A. Sumner and George Goldman. 2000. *The Measure of California Agriculture, 2000*. University of California Agricultural Issues Center.

McNamara, Paul E., Christine K. Ranney, Linda Scott Kantor and Susan M. Krebs-Smith. 1999. *The Gap Between food intakes and the Pyramid Recommendations: Measurement and Food System Ramifications.* Food Policy. 24:117-134.

O'Brien, Patrick. 1995. *Dietary Shifts and Implications for US Agriculture.* American Journal of Clinical Nutrition. 16(suppl):1390S-1396S.

Oliveira, Victor J., Anne B.W. Effland, Jack L. Runyan and Shannon Hamm. 1993. *Hired Farm Labor Use on Fruit, Vegetable and Horticultural Specialty Farms.* Economic Research Service, United States Department of Agriculture. Agricultural Economic Report Number 616. Washington D.C. 28 pgs.

Tippett, Katherine S. and Linda E. Cleveland. 1999. "How Current Diets Stack Up." Chapter 3 in America's Eating Habits: Changes and consequences. Elizabeth Frazao, ed. United States Department of Agriculture. Washington D.C.

United States Department of Agriculture. 1999a. *1997 Census of Agriculture. California State and County Data.* Volume 1, Geographic Area Series Part 5. National Agricultural Statistics Service. Wasington D.C.

United States Department of Agriculture. 1999b. *Vegetables Final Estimates 1992-97*. National Agricultural Statistics Service. Statistical Bulletin Number 964c. Wasington D.C.

United States Department of Agriculture. 2000a. *Agricultural Statistics 2000*. National Agricultural Statistics Service. http://www.usda.gov/nass/pubs/agr00/acro00.htm.

United States Department of Agriculture. 2000b. *Fruit and Nut Situation and Outlook Yearbook.* Market and Trade Economics Division, Economic Research Service. FTS-290.

World Cancer Research Fund and The American Institute for Cancer. *Food, Nutrition and the Prevention of Cancer: A Global Perspective.* Washington D.C. 1997.

Young, C. Edwin and Linda Scott Kantor. 1999. Moving Toward the Food Guide Pyramid: Implications for U.S. Agriculture. Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 779. Washington D.C. 26 pgs.

Appendix I: List of Commodities by Sub-Group

Category	Sub-category	ITEM	AVERAGE 93-99	Share in Sub-Category	Cumulative Shares by Sub-Category
Fruit	Citrus	ORANGE JUICE*	0.391	0.516	0.516
		CANTALOUPE, FRESH*	0.078	0.103	0.619
		ORANGES, FRESH*	0.065	0.086	0.705
		WATERMELON, FRESH*	0.057	0.075	0.781
		MELON, FRESH, OTHER	0.033	0.043	0.824
		STRAWBERRY, FRESH*	0.031	0.041	0.865
		CITRUS, FRESH, OTHER	0.024	0.032	0.897
		GRAPEFRUIT, FRESH*	0.019	0.025	0.922
		GRAPEFRUIT JUICE*	0.018	0.024	0.946
		HONEYDEW, FRESH*	0.009	0.012	0.958
		CITRUS JUICE, OTHER	0.007	0.009	0.967
		RASPBERRY, FRESH	0.006	0.008	0.975
		BLUEBERRY, FRESH	0.006	0.007	0.983
		CRANBERRY, FRESH	0.003	0.004	0.987
		TANGERINE, FRESH	0.003	0.004	0.991
		LEMON, FRESH	0.002	0.003	0.994
		MELON, JUICE, OTHER	0.001	0.002	0.995
		BERRY, JUICE, OTHER	0.001	0.002	0.997
		CRENSHAW MELON	0.001	0.001	0.998
		BLACKBERRY	0.001	0.001	1.000
		LIME, FRESH	0.000	0.000	1.000
		BERRY, FRESH, OTHER	0.000	0.000	1.000
		BOYSENBERRY, FRESH	0.000	0.000	1.000
		TANGERINE JUICE	0.000	0.000	1.000
		sub-total	0.758	1.000	
	Other Fruit	BANANA, FRESH*	0.280	0.240	0.240
		APPLE, FRESH*	0.237	0.204	0.444
		PEACHES, FRESH*	0.099	0.085	0.530
		GRAPES, FRESH*	0.094	0.080	0.610
		APPLE JUICE*	0.081	0.070	0.680
		PEARS, FRESH*	0.052	0.045	0.725
		FRUIT, OTHER, JUICE,	0.042	0.036	0.761
		PLUMS, FRESH*	0.036	0.031	0.792
		NECTARINES, FRESH*	0.035	0.030	0.823
		FRUIT, OTHER, FRESH	0.031	0.027	0.850
		GRAPE JUICE*	0.026	0.023	0.872
		RAISINS*	0.023	0.020	0.892
		PINEAPPLE, FRESH*	0.019	0.016	0.908
		AVOCADO, FRESH*	0.016	0.014	0.922
		PINEAPPLE JUICE*	0.013	0.011	0.934
		MANGOES, FRESH*	0.012	0.010	0.944
		PRUNES*	0.009	0.008	0.952
		APRICOT, FRESH*	0.008	0.007	0.959
		APPLE SAUCE*	0.008	0.007	0.966

Appendix I cont.

Category	Sub-category	ITEM	AVERAGE 93-99	Share in Sub-Category	Cumulative Shares by Sub-Category
		PAPAYA, FRESH	0.008	0.007	0.973
		KIWIS, FRESH	0.007	0.006	0.979
		FIGS	0.005	0.004	0.983
		PERSIMMONS, FRESH	0.004	0.003	0.987
		CHERRIES, SWEET, FRESH	0.003	0.002	0.989
		GUAVAS, FRESH	0.003	0.002	0.991
		DATES	0.003	0.002	0.993
		GUAVA JUICE	0.002	0.002	0.995
		PASSION FRUIT JUICE	0.002	0.002	0.997
		PRUNE JUICE	0.001	0.001	0.998
		POMEGRANATE,	0.001	0.001	0.999
		CHERRY JUICE	0.001	0.001	1.000
		PAPAYA JUICE	0.000	0.000	1.000
		CHERRIES, TART,	0.000	0.000	1.000
		CURRANTS	0.000	0.000	1.000
		PASSION FRUIT,	0.000	0.000	1.000
		RHUBARD	0.000	0.000	1.000
		sub-total	1.164	1.000	
		TOTAL FRUIT	1.922		
Vegetables	Starchy	POTATOES*	0.179	0.719	0.719
		SWEET CORN*	0.067	0.269	0.988
		PLAINTAINS	0.003	0.011	0.999
		YUCA	0.000	0.001	1.000
		YAMS	0.000	0.000	1.000
		sub-total	0.249	1.000	
	Dark	CARROTS*	0.138	0.659	0.659
		DARK, OTHER	0.035	0.168	0.827
		SPINACH*	0.027	0.132	0.959
		SWEET POTATOES	0.005	0.024	0.983
		WINTER SQUASH	0.003	0.014	0.997
		CHARD	0.001	0.003	1.000
		GREENS, OTHER	0.000	0.000	1.000
		BEET GREENS	0.000	0.000	1.000
		DANDELION GREENS	0.000	0.000	1.000
		sub-total	0.209		
	Dark Cruciferous	BROCCOLI*	0.092	0.908	0.908
		COLLARD GREENS	0.008	0.077	0.984
		MUSTARD GREENS	0.001	0.009	0.994
		TURNIP GREENS	0.001	0.006	1.000
		WATERCRESS	0.000	0.000	1.000
		KALE	0.000	0.000	1.000
		sub-total	0.102		

Appendix I cont.

Category	Sub-category	ITEM	AVERAGE 93-99	Share in Sub-Category	Cumulative Shares by Sub-Category
Vegetables	Garden Cruciferous	CABBAGE*	0.038	0.423	0.423
		CRUCIFEROUS, OTHER	0.032	0.348	0.771
		CAULIFLOWER*	0.015	0.166	0.937
		BRUSSEL SPROUTS*	0.003	0.030	0.967
		RADISHES	0.002	0.024	0.991
		RUTABAGAS	0.001	0.007	0.998
		TURNIPS	0.000	0.002	1.000
		PARSNIPS	0.000	0.000	1.000
		KOHLRABI	0.000	0.000	1.000
		sub-total	0.091		
	Salad	LETTUCE*	0.492	1.000	1.000
	Tomato	TOMATO, FRESH*	0.180	0.692	0.692
		TOMATO, PROCESSED*	0.080	0.308	1.000
		subtotal	0.260		
	Garden	GARDEN, OTHER	0.216	0.454	0.454
		BEANS, GREEN*	0.063	0.132	0.586
		SUMMER SQUASH	0.036	0.076	0.662
		ONIONS*	0.029	0.062	0.724
		PEAS, GREEN*	0.028	0.059	0.782
		BELL PEPPERS*	0.022	0.047	0.829
		CUCUMBERS*	0.020	0.042	0.872
		CELERY*	0.018	0.038	0.910
		MUSHROOMS*	0.012	0.026	0.936
		BEETS*	0.006	0.014	0.950
		EGGPLANT*	0.006	0.012	0.962
		ARTICHOKES*	0.004	0.008	0.970
		ASPARAGUS*	0.003	0.007	0.977
		BEAN, LIMA	0.003	0.007	0.984
		OKRA	0.002	0.003	0.988
		PRICKLY PEAR	0.001	0.003	0.991
		PEAS, SNOW	0.001	0.002	0.993
		ALFALFA SPROUTS	0.001	0.002	0.995
		BEAN SPROUTS	0.001	0.002	0.997
		SEAWEED	0.001	0.002	0.999
		BAMBOO SHOOTS	0.000	0.000	0.999
		JICAMA	0.000	0.000	0.999
		LEEKS	0.000	0.000	1.000
		WATERCHESTNUTS	0.000	0.000	1.000
		SUNCHOKES	0.000	0.000	1.000
		WINTERMELON	0.000	0.000	1.000
		sub-total	0.475	1.000	
		TOTAL VEGETABLE	1.787		

*Starred items are included in the economic analysis

Appendix II: Food Categories

CONSUMPTION CATEGORY	FOOD CATEGORY
APPLE CIDER	APPLES, JUICE
APPLE JUICE	APPLES, JUICE
APPLE SAUCE	APPLES, PROCESSED
APPLES	APPLE, FRESH
APRICOT NECTAR	DROP
APRICOTS	APRICOT
AVOCADOS	AVOCADO
BANANAS	BANANA
BERRIES NS	OTHER BERRIES
BLACKBERRIES	BLACKBERRY
BLUEBERRIES	BLUEBERRY
BOYSENBERRIES	BOYSENBERRY
CANTALOUPE	CANTALOUPE
CANTALOUPE NECTAR	DROP
CHERRIES	CHERRY, SWEET
CHERRIES, sour or pie	CHERRY, TART
CONSUMPTION CATEGORY	FOOD CATEGORY
CRANBERRIES	CRANBERRY
CRANBERRY JUICE	DROP
CRENSHAW MELON	CRENSHAW MELON
CURRANTS RAW	CURRANTS
DATES	DATE
DRIED APRICOT	APRICOT
DRIED BLUEBERRIES	BLUEBERRY
DRIED CHERRIES	CHERRY, SWEET
DRIED CRANBERRIES	CRANBERRY
DRIED FRUIT	FRUIT, UNSPECIFIED
DRIED MANGO	MANGO
DRIED PEACH	PEACH
DRIED PEACHES	PEACH
ELDERBERRIES	OTHER BERRIES
FIGS	FIG
FRT JUICE-MELON	MELON, UNSPECIFIED, JUICE
FRT ON SNDWICH,PIZZA	FRUIT, UNSPECIFIED
FRUIT JUICE N-CITRUS	FRUIT, UNSPECIFIED, JUICE
GOOSEBERRIES	OTHER BERRIES
GRAPE JUICE	GRAPE, JUICE
GRAPEFRUIT	GRAPEFRUIT, FRESH
GRAPEFRUIT JUICE	GRAPEFRUIT, JUICE
GRAPEFRUIT ORANGE	50% GRAPEFRUIT,FRESH, 50% ORANGE, FRESH
GRAPEFRUIT-ORANGE JUICE	50% GRAPEFRUIT, JUICE, 50% ORANGE, JUICE
GRAPES	GRAPE, FRESH

Appendix II cont.

CONSUMPTION CATEGORY	FOOD CATEGORY
GUAVAS	GUAVA
HONEYDEW MELON	HONEYDEW MELON
JUICE-BERRY,CHERRY	25% BERRY JUICE, 25% CHERRY JUICE, 50% FRUIT UNSPECIFIED, JUICE
KIWIS	KIWI
KUMQUAT,QUINCE	DROP
LEMON	LEMON, FRESH
LEMONADE	DROP
LIME	LIME, FRESH
LIMEADE	DROP
LOGANBERRIES	BOYSENBERRY
MANGO NECTAR	DROP
MANGOS	MANGO
MELON NOT SPECIFIED	MELON, UNSPECIFIED
MIXED F-PAPAYA,GUAVA	50% PAPAYA, 50% GUAVA
MIXED FR.-BANANA	25% CITRUS, 25% FRUIT, UNSPECIFIED, 50% BANANA
MIXED FRT JUICE W C	50% FRUIT, UNSPECIFIED, JUICE, 50% CITRUS UNSPECIFIED, JUICE
MIXED FRT SAL	50% CITRUS, UNSPECIFED, FRESH, 50 FRUIT UNSPECIFIED
MIXED FRUIT	50% CITRUS, UNSPECIFED, FRESH, 50 FRUIT UNSPECIFIED
MIXED FRUIT W MELON	50% MELON UNSPECIFIED, 50% FRUIT, UNSPECIFIED
MULLBERRIES	OTHER BERRIES
MXD F JUICE W PAPAYA	50% FRUIT, UNSPECIFIED, JUICE, 50% PAPAYA, JUICE
NECTARINES	NECTARINE
ORANGE JUICE	ORANGE, JUICE
ORANGES	ORANGE, FRESH
Other fruit	FRUIT, UNSPECIED
PAPAYA JUICE	PAPAYA, JUICE
PAPAYA NECTAR	DROP
PAPAYAS	PAPAYA
PASSION FR.-GUAVA J.	50% GUAVA, JUICE, 50% PASSION FRUIT, JUICE
PASSION FRT JUICE	PASSION FRUIT, JUICE
PASSION FRUIT	PASSION FRUIT
PEACH NECTAR	DROP
PEACHES	PEACH
PEARS	PEAR
PERSIMMONS	PERSIMMONS
PINEAPPLE	PINEAPPLE
PINEAPPLE JUICE	PINEAPPLE, JUICE
PLUMS	PLUM
POMEGRANATE	POMEGRANATE
PRUNE JUICE	PRUNES, JUICE
PRUNES	PRUNES

Appendix II cont.

CONSUMPTION CATEGORY	FOOD CATEGORY
RAISINS	GRAPE , RAISIN
RASPBERRIES	RASPBERRY
RHUBARB	RHUBARB
STRAWBERRIES	STRAWBERRY
TANGERINE	TANGERINE
TANGERINE JUICE	TANGERINE, JUICE
WATERMELON	WATERMELON
ALFALFA SPROUTS	SPROUTS
ARTICHOKES	ARTICHOKES
ASPARAGUS or LIMA BEANS	50% ASPARAGUS, 50% LIMA BEANS
BAMBOO SHOOTS	BAMBOO SHOOTS
BEAN SPROUTS	SPROUTS, BEAN
BEET GREENS	GREENS, DARK
BEETS	BEETS
BELL PEPPER	PEPPERS, SWEET
BROCCOLI	BROCCOLI
BROCCOLI SALAD	BROCCOLI
BRUSSEL SPROUTS	BRUSSEL SPROUTS
CABBAGE	CABBAGE
CABBAGE,LET-SANDWICH	50% LETTUCE, 50% CABBAGE
CARROT JUICE	CARROT
CARROT,PEAS	50% CARROT, 50% PEAS
CARROTS	CARROT
CAULIFLOWER	CAULIFLOWER
CELERY	CELERY
CHARD	GREENS, DARK
CHINESE CABBAGE	CABBAGE
COLESLAW	CABBAGE
COLLARD GREENS	GREENS, CRUCIFEROUS
CONSUMPTION CATEGORY	FOOD CATEGORY
CONSUMPTION CATEGORY	FOOD CATEGORY
CONSUMPTION CATEGORY	FOOD CATEGORY
CORN	CORN
CRESS	GREENS, CRUCIFEROUS
CRUCIF SALAD	CRUCIFEROUS, UNSPECIFIED
CUCUMBERS	CUCUMBER
DANDELION GREENS	GREENS, DARK
EGGPLANT	EGGPLANT
FRIED POTATO	POTATO_F
G SALAD-BEAN,BEET...	50% LETTUCE, 50% GARDEN, UNSPECIFIED

Appendix II cont.

CONSUMPTION CATEGORY	FOOD CATEGORY
G SALAD-CABBAGE	50% LETTUCE, 50% CABBAGE
G SALAD-CARROT,CRUCF	50% LETTUCE, 25% CARROT, 25% CRUCIFEROUS, UNSPECIFIED
G SALAD-CRUCF,TOMATO	50% LETTUCE, 25% CRUCIFEROUS, UNSPECIFIED, 25% TOMATO, FRESH
GARLIC	DROP
GR. SALAD-CARROT	50% LETTUCE, 50% DARK_VEG
GR. SALAD-CRUCIF	50% LETTUCE, 50% CRUCIFEROUS UNSPECIFIED
GR. SALAD-SPINACH	50% LETTUCE, 50% SPINACH
GREEN BEANS	GREEN BEANS
GREEN PEAS	GREEN PEAS
GREEN SALAD	LETTUCE
GREEN SALAD	LETTUCE
GREENS COOKED	GREENS, CRUCIFEROUS
HOMINY	CORN, HOMINY
HOMINY-STEW	CORN, HOMINY
JALAPENO PEPPERS	PEPPERS, HOT
JERUSALEM ARTICHOKE	JERUSALEM ARTICHOKE
JICAMA	JICAMA
KALE	GREENS, CRUCIFEROUS
KOHLRABI	KOHLRABI
LEEKS	LEEKS
LETTUCE	LETTUCE
LETTUCE,CARROT-SANDW	50% LETTUCE, 50% DARK_VEG
LETTUCE,TOMATO	50% LETTUCE, 50% TOMATO, FRESH
LETTUCE,TOMATO ON...	50% LETTUCE, 50% TOMATO, FRESH
LIMA BEANS	LIMA BEANS
MEAT DISH WITH VEG.	GARDEN, UNSPECIFIED
MIXED VEG	GARDEN, UNSPECIFIED
MIXED VEG JUICE	TOMATO, PROCESSED
MIXED VEG SALAD	GARDEN, UNSPECIFIED
MIXED VEG W BROCCOLI	50% GARDEN, UNSPECIFIED, 50% BROCCOLI
MIXED VEG W POTATO	50% GARDEN, UNSPECIFIED, 50% POTATO
MIXED VEG W TOMATO	50% GARDEN, UNSPECIFIED, 50% TOMATO, PROCESSED
MIXED VEG. (CRU)	CRUCIFEROUS NON-SPECIFIED
MIXED VEG. (NON CRU)	GARDEN, UNSPECIFIED
MIXED VEG. (Y)	50% GARDEN, UNSPECIFIED, 50% DARK_VEG, UNSPECIFIED
MIXED VEG. (Y+CRU)	50% CRUCIFEROUS, UNSPECIFIED, 50% DARK_VEG
MIXED VEG.-STEW	GARDEN, UNSPECIFIED
MUSHROOMS	MUSHROOMS
MUSTARD GREENS	GREENS, CRUCIFEROUS
MV-COLLARED GREENS	GREENS, CRUCIFEROUS

Appendix II cont.

CONSUMPTION CATEGORY	FOOD CATEGORY
MXD VEG (CRU+TOMATO)	50% CRUCIFEROUS, UNSPECIFIED, 50% TOMATO, PROCESSED
OKRA	OKRA
OLIVES	DROP - OK
ONIONS	ONIONS
ORIENTAL MUSHROOMS	MUSHROOMS
OTHER VEG ON SNDWICH	GARDEN, UNSPECIFIED
PARSNIPS	PARSNIPS
PICANTE SAUCE,SALSA	50% TOMATO, FRESH, 50% TOMATO, PROCESSED
PICKLES	DROP - OK
PLANTAINS	PLANTAINS
POTATO SALAD	POTATO
POTATO SALAD	POTATO
POTATO SOUP	POTATO
POTATOES	POTATO
PRICKLEY PEAR,CACTI	CACTUS
RADISHES	RADISHES
RED CABBAGE	CABBAGE
RED PEPPER	PEPPERS, SWEET
ROMAINE,ENDIVE	LETTUCE
RUTABAGAS	RUTABAGAS
SAUERKRAUT	CABBAGE
SAUERKRAUT-SANDWICH	CABBAGE
SEAWEED	SEAWEED
SNDWCH W BROCOLI,MUSHRM	50% BROCCOLI, 50% MUSHROOM
SNDWCH W SPNACH,ZUCHINI	50% SQUASH, SUMMER, 50% SPINACH
SNDWICH W BELL PEPPR	PEPPER, SWEET
SNOW PEAS	SNOW PEAS
SPINACH	SPINACH
SPINACH SALAD	SPINACH
SUMMER SQUASH	SQUASH, SUMMER
SWEET POTATOES	SWEET POTATOES
TOMATO JUICE	TOMATO, PROCESSED
TOMATO SAUCE	TOMATO, PROCESSED
TOMATO SOUP	TOMATO, PROCESSED
TOMATOES	TOMATO, FRESH
TURNIP GREENS	GREENS, CRUCIFEROUS
TURNIPS	TURNIPS
VEG SALAD W Y VEG	DARK_VEG, UNSPECIFIED
VEG SOUP-BROCCOLI	BROCCOLI
VEG SOUP-CABBAGE	CABBAGE
VEG SOUP-CARROT	CARROT

Appendix II cont.

CONSUMPTION CATEGORY	FOOD CATEGORY
VEG SOUP-CRUCIF+Y	50% CRUCIFEROUS, UNSPECIFIED, 50% DARK_VEG, UNSPECIFIED
VEG SOUP-PEAS,BEAN..	GARDEN, UNSPECIFIED
VEG SOUP-SPINACH	SPINACH
VEG SOUP-TOMATO,CABG	50% TOMATO, PROCESSED, 50% CABBAGE
VEG.-STEW	GARDEN, UNSPECIFIED
VEGETABLE SOUP	GARDEN, UNSPECIFIED
WATERCHESTNUTS	WATERCHESTNUTS
WATERCRESS	GREENS, CRUCIFEROUS
WINTER SQUASH	SQUASH_W
WINTERMELON	WINTERMELON
YAMS	YAMS
YUCCA	YUCCA