Carbon Footprint Analysis for Kaiser Permanente
Food Procurement Alternatives in Northern California

Prepared for the Community Alliance with Family Farmers

by

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1.0 Background

The Center for Sustainable Economy (CSE) provides analytical and legal support to non-profit organizations throughout the United States in the fields of environmental planning, environmental law, and natural resource economics. CSE's research team includes experts in ecological footprint analysis (EFA). In this report, we compare the carbon footprint associated with Kaiser Permanente's current procurement practices for whole fruit, whole vegetables, and processed fruits and vegetables in northern California with an alternative scenario that would procure a greater proportion these foods from local sources. The analysis is based on data provided by the Community Alliance with Family Farmers (CAFF) as well as constants and conversion factors from government and private sources.

2.0 What is the Carbon Footprint?

Ecological footprints provide a spatial measure of humanity's use of nature in terms of standardized hectares of average global productivity and with respect to four major biomes: crop land, pasture land, forest land, and marine and inland fisheries (Talberth et al., 2006). Ecological footprints also calculate the spatial demands of lands occupied by built space and the area needed to sequester our carbon emissions – or the carbon footprint. Carbon footprint analysis (CFA) is an adaptive tool that can be used to quantify the environmental impact of consumption at every level – global, national, state, city, business, and individual – in terms of carbon emissions and global hectares required to absorb those emissions. It can be calculated for all goods and services in aggregate or for individual items provided information on their production technologies and transport patterns are known. As such, carbon footprint analysis is a useful way to compare and contrast different food procurement systems.

For example, Pirog and Schuh (2002) analyzed three alternative systems for supplying fresh produce to consumers in Iowa. They found that the conventional system used four to 17 times more fuel and released five to 17 times more carbon dioxide than an Iowa based system that featured farmers who market directly to consumers through community supported agriculture enterprises and farmers markets and that relied on light trucks for transport.

3.0 Our Methodology

The carbon footprint methodology employed here involves seven distinct steps:

Step 1 – food profiles. In this step, ELI and CAFF developed two annual food profiles for delivery of whole fruits, whole vegetables, and processed fruits and vegetables to KP's 19 northern California hospitals: (a) a profile based on the current system, and (b) a profile based on a potential system that emphasizes a greater proportion of fruits and vegetables sourced from small to medium sized farmers in California. For each commodity, the profile identifies the source, transport mode(s), miles from that source to a South San Francisco processing facility managed by Fresh Point, Inc., and annual KP purchases in terms of weight (pounds). All of the figures in step one were provided by analysts at CAFF and submitted on Excel templates provided by ELI.

Step 2 – load equivalents. The second step requires the conversion of the raw profile data into equivalent ship, truck, and plane loads for each commodity. Shipments of food destined for KP hospitals are part of much larger shipments destined for multiple locations, so the proportion of those shipments attributable to KP were calculated by dividing the weight of each particular commodity by the average load. For trucks and ships, we compiled data on typical load configurations for various fruits and vegetables from the Port of Oakland, California and two private transport companies. For fruits, the average weight carried by a typical refrigerated truck or sea-bound container is 40,700 pounds. For vegetables, this figure is 34,667 pounds. Container ships transport an average of 4,000 containers. KP's pineapple shipments are the only commodity shipped by air, and according to Dole, Inc., those shipments are placed in the cargo holds of Boeing 747s. According to Boeing, Inc., the passenger and cargo payload of a 747 is 246,000 pounds.

Step 3 – food miles by mode. For each commodity, data on the country, state, and city of origin and route were compiled by CAFF. CAFF also estimated the mileage from these source areas to the South San Francisco processing facility. By multiplying this mileage by the equivalent load for each commodity we arrive at figures for food miles by transport mode.

Step 4 – fuel use. In step four, we divide food miles by fuel efficiency figures to arrive at fuel use, again by mode. For trucks, we take the Department of Energy's official fuel economy estimate of 7.3 miles per gallon of diesel. For ships, we rely on the Port of Oakland estimates for container vessels. According to Port officials, a typical container ship burns 1,876 gallons of bunker fuel per hour and averages 23 knots (26 miles) per hour so fuel efficiency is 70.86 gallons per mile. According to Boeing, the average fuel efficiency of 747s is 5 gallons per mile (or .20 miles per gallon).

Step 5 – carbon emissions. Here, we rely on Department of Energy (DOE) figures for carbon dioxide emissions per gallon of fuel by fuel type. For diesel fuel burned by trucks, the DOE estimates carbon dioxide emissions to be 22.38 pounds per gallon. For bunker fuel burned by ships, the DOE puts that figure at 26.03 pounds. For jet fuel, the figure is 21.09. The molecular weight of carbon dioxide is 44 while that of carbon is 12, so we divide the weight of carbon dioxide emissions by 12/44 or .27 to arrive at the carbon emissions figures for each commodity.

Step 6 – carbon overshoot. Not all carbon emissions contribute to global warming. According to the Intergovernmental Panel on Climate Change, the Earth's terrestrial and aquatic ecosystems absorb roughly 3 gigatonnes (Gt) of carbon each year (IPCC, 2000). Thus, only the excess emissions over and above this amount are counted in footprint analysis. The latest global emissions figures put the amount of carbon overshoot to be 57% (Venetoulis and Talberth, 2006). Thus, we multiply the carbon emissions figures from Step 5 by .57.

Step 7 – carbon footprint. The final step in CFA is to divide the carbon overshoot figures from Step 6 (in tonnes) by the Earth's average global carbon sequestration rate (in tonnes per hectare). IPCC data used by Venetoulis and Talberth (2006) indicate an average carbon absorption rate of

.06 tonnes per hectare, so for every tonne of carbon emitted, 16.65 “average” hectares of the Earth’s surface are needed to absorb those emissions. An average hectare is a hectare with the same proportion of terrestrial and aquatic area as the Earth.

Step 8 – carbon footprint per pound. The carbon footprint can be divided by the total weight of each commodity then multiplied by 10,000, which is the number of square meters in a hectare to show the footprint per pound in square meters.

4.0 Results

In this section, we summarize the results of carbon footprint calculations under the baseline and local foods emphasis profiles for each commodity group: whole fruits, whole vegetables, and processed fruits and vegetables.

<u>Whole Fruits</u>

4.1 **Comparison of food profiles.** Appendices 1 and 2 provide the commodity by commodity carbon footprint calculations for each whole fruit profile. Information on commodities, origins, land, sea and air miles from the origin to South San Francisco, and weight for each profile was provided by CAFF. The baseline profile includes 67 types of apples, apricots, bananas, cherries, grapes, kiwis, lemons, melons, nectarines, peaches, pears, oranges, pineapples, plums, tangerines, tangelos, Clementines, blueberries, and strawberries weighing 334,925 pounds transported by trucks, ships, and jets from South and Central America and various U.S. states. The local food emphasis profile includes 63 commodities and partially substitutes California produce for a number of imported items such as red seedless grapes, cantaloupes, bananas, honeydew and watermelons. The amount of pineapple flown in from Hawaii is also reduced. The total weight of whole fruits under the local food emphasis profile is 341,343 pounds or 6,418 pounds more than the baseline.

4.2 **Comparison of the carbon footprint.** The table below compares the baseline with the local food emphasis profiles in terms of key metrics included in the carbon footprint calculations. Under the baseline profile, 7,318 truck miles, 1 ship mile, and 622 jet miles are needed to transport the 67 commodities. Truck fuel use is roughly 1,003 gallons, ship fuel use 71 gallons, and jet fuel use 3,111 gallons. Taken together, carbon emissions amount to 11.12 tonnes, of which 6.34 are considered excess. This translates into a carbon footprint of 105.54 hectares, or 3.15 square meters per pound of produce.

Under the local foods emphasis profile, 6,687 truck miles, .65 ship miles, and 498 jet miles are needed to transport the 63 commodities. Truck fuel use is roughly 916 gallons, ship fuel use 46 gallons, and jet fuel use 2,489 gallons. Taken together, carbon emissions amount to 9.18 tonnes, of which 5.23 are considered excess. This translates into a carbon footprint of 87.10 hectares, or 2.55 square meters per pound of produce.

Thus, we can say that by taking modest measures to substitute California produce for produce trucked, shipped, or flown in from afar, KP can reduce its overall carbon footprint with respect to whole fruit shipments by 17.47% and its carbon footprint per pound by 19.05%.

Carbon Footprint Comparison
Whole Fruits

Metric	Baseline	Local Foods	Difference	% Reduction
Truck miles	7318.00	6687.00	631.00	8.62%
Ship miles	1.00	0.65	0.35	35.00%
Jet miles	622.00	498.00	124.00	19.94%
Truck fuel used (gallons)	1003.00	916.00	87.00	8.67%
Ship fuel used (gallons)	71.00	46.00	25.00	35.21%
Jet fuel used (gallons)	3111.02	2488.81	622.21	20.00%
Carbon emissions (tonnes)	11.12	9.18	1.94	17.45%
Carbon overshoot (tonnes)	6.34	5.23	1.11	17.51%
Carbon footprint (hectares)	105.54	87.10	18.44	17.47%
Carbon footprint/ pound (m2)	3.1500	2.5500	0.6000	19.05%

Whole Vegetables

4.3 **Comparison of food profiles.** Appendices 3 and 4 provide the commodity by commodity carbon footprint calculations for each whole vegetable profile. As before, information on commodities, origins, land, sea and air miles from the origin to South San Francisco, and weight for each profile was provided by CAFF. The baseline profile includes 45 types of broccoli, cauliflower, tomatoes, cabbage, onions, parsley, potatoes, celery, lettuce, peppers, cucumbers, zucchini, squash, and peas weighing 53,469 pounds transported by trucks from various U.S. states and Mexico. The local food emphasis profile includes 40 commodities and partially substitutes California produce for a number of Mexican imports including tomatoes, cucumbers, zucchini, and bell peppers. The total weight of whole vegetables under the local food emphasis profile remains unchanged.

4.4 **Comparison of the carbon footprint.** The table below compares the baseline with the local food emphasis profiles in terms of key metrics included in the carbon footprint calculations. Under the baseline profile, 623 truck miles are needed to transport the 45 commodities. Truck fuel use is roughly 85 gallons. Carbon emissions amount to .24 tonnes, of which .13 are considered excess. This translates into a carbon footprint of 2.24 hectares, or .4198 square meters per pound of produce.

Under the local foods emphasis profile, 375 truck miles are needed to transport 40 commodities. Truck fuel use is roughly 51 gallons, while carbon emissions amount to .14 tonnes, of which .08 are considered excess. This translates into a carbon footprint of 1.35 hectares, or .2527 square meters per pound of produce.

Thus, we can say that by taking modest measures to substitute California produce for produce trucked in from Mexico, KP can reduce its overall carbon footprint as well as its carbon footprint per pound with respect to whole vegetable shipments by 39.81%.

Carbon Footprint Comparison
Whole Vegetables

Metric	Baseline	Local Foods	Difference	% Reduction
Truck miles	623.46	375.24	248.22	39.81%
Ship miles	0.00	0.00	0.00	0.00%
Jet miles	0.00	0.00	0.00	0.00%
Truck fuel used (gallons)	85.41	51.40	34.00	39.81%
Ship fuel used (gallons)	0.00	0.00	0.00	0.00%
Jet fuel used (gallons)	0.00	0.00	0.00	0.00%
Carbon emissions (tonnes)	0.24	0.14	0.09	39.81%
Carbon overshoot (tonnes)	0.13	0.08	0.05	39.81%
Carbon footprint (hectares)	2.24	1.35	0.89	39.81%
Carbon footprint/ pound (m2)	0.4198	0.2527	0.1671	39.81%

Processed Fruits and Vegetables

4.5 **Comparison of food profiles.** Appendices 5 and 6 provide the commodity by commodity carbon footprint calculations for each processed fruits and vegetables profile. Again, information on commodities, origins, land, sea and air miles from the origin to South San Francisco, and weight for each profile was provided by CAFF. The baseline profile includes 47 processed versions of fruits and vegetables generally included in Appendices 1-4 with a couple of notable additions such as garlic imported from China and sliced mushrooms weighing 108,442 pounds. All of these commodities are transported by trucks except for the garlic from China, which is transported by ship. The local food emphasis profile includes 46 commodities and partially substitutes California produce for a number of items imported from Mexico including diced tomatoes, zucchini crescents, and Jicama stick as well as potatoes from Florida. The total weight of processed fruits and vegetable shipments under the local food emphasis profile remains the same as the baseline.

4.6 **Comparison of the carbon footprint.** The table below compares the baseline with the local food emphasis profiles in terms of key metrics included in the carbon footprint calculations. Under the baseline profile 884 truck miles and a minute ship mile (.0023) are needed to transport the 47 commodities. Truck fuel use is roughly 121 gallons and ship fuel use is .16 gallons. Taken together, carbon emissions amount to .34 tonnes, of which .19 are considered excess. This translates into a carbon footprint of 3.18 hectares, or .2936 square meters per pound of produce.

Under the local foods emphasis profile 780 truck miles and the same number of ship miles are needed to transport the 46 commodities. Truck fuel use is roughly 107 gallons, ship fuel use is unchanged. Carbon emissions amount to .30 tonnes, of which .17 are considered excess. This translates into a carbon footprint of 2.81 hectares, or .2588 square meters per pound of produce.

Thus, we can say that by taking modest measures to substitute fruits and vegetables processed in California for those trucked in from afar, KP can reduce its overall carbon footprint as well as carbon footprint per pound with respect to processed fruits and vegetable shipments by 11.84%,

Carbon Footprint Comparison
Processed Fruits and Vegetables

Metric	Baseline	Local Foods	Difference	% Reduction
Truck miles	884.43	779.68	104.75	11.84%
Ship miles	0.0023	0.00	0.00	0.00%
Jet miles	0.00	0.00	0.00	0.00%
Truck fuel used (gallons)	121.15	106.81	14.35	11.84%
Ship fuel used (gallons)	0.16	0.16	0.00	0.00%
Jet fuel used (gallons)	0.00	0.00	0.00	0.00%
Carbon emissions (tonnes)	0.34	0.30	0.04	11.84%
Carbon overshoot (tonnes)	0.19	0.17	0.02	11.84%
Carbon footprint (hectares)	3.18	2.81	0.38	11.84%
Carbon footprint/ pound (m2)	0.2936	0.2588	0.0348	11.84%

<u>Overall Effects</u>

4.7 **Comparison of the carbon footprint.** The table below compiles information from the previous three tables into one to gauge the overall effects of a switch to the local foods emphasis profile. Under the combined baseline profile, 8,826 truck miles, slightly more than 1 ship mile, and 622 jet miles are needed to transport the foods now consumed in KP's network of hospitals. Truck fuel use is roughly 1,210 gallons, ship fuel use 71 gallons, and jet fuel use 3,111 gallons. Taken together, carbon emissions amount to 11.69 tonnes, of which 6.67 are considered excess. This translates into a carbon footprint of 110.97 hectares, or 3.8634 square meters per pound of produce.

Under the combined local foods emphasis profile, 7,842 truck miles, .65 ship miles, and 498 jet miles are needed. Truck fuel use is roughly 1,074 gallons, ship fuel use 46 gallons, and jet fuel use 2,489 gallons. Taken together, carbon emissions amount to 9.62 tonnes, of which 5.48 are considered excess. This translates into a carbon footprint of 91.26 hectares, or 3.0615 square meters per pound of produce.

Thus, we can say that by taking modest measures to substitute whole fruits, whole vegetables, and processed fruits and vegetables from California for food trucked, shipped, or flown in from afar, KP can reduce its overall carbon footprint by 17.76% and its carbon footprint per pound by 20.76%.

Carbon Footprint Comparison
Whole Fruits, Whole Vegetables, and Processed Fruits and Vegetables

Metric	Baseline	Local Foods	Difference	% Reduction
Truck miles	8825.89	7841.92	983.97	11.15%
Ship miles	1.0023	0.6523	0.3500	34.92%
Jet miles	622.00	498.00	124.00	19.94%
Truck fuel used (gallons)	1209.56	1074.21	135.35	11.19%
Ship fuel used (gallons)	71.16	46.16	25.00	35.13%
Jet fuel used (gallons)	3111.02	2488.81	622.21	20.00%
Carbon emissions (tonnes)	11.6920	9.6181	2.0739	17.74%
Carbon overshoot (tonnes)	6.67	5.48	1.19	17.80%
Carbon footprint (hectares)	110.97	91.26	19.71	17.76%
Carbon footprint/ pound (m2)	3.8634	3.0615	0.8019	20.76%

5.0 Conclusions and Future Refinements

This analysis has demonstrated at least some of the environmental benefits associated with local food sourcing. Using standard carbon footprint analysis methods as well as constants and conversion factors from published government and private sources, we showed how modest measures to substitute whole fruits, whole vegetables, and processed fruits and vegetables grown by California farmers for commodities imported from distant states in the U.S., Mexico, and South and Central America can reduce the footprint associated with foods procured for KP's northern California hospitals by roughly 20%.

Of course, additional carbon footprint savings can be achieved if local suppliers for a greater number of food items could be found. So one future refinement could be to quantify the effects of adding these items to the local food profiles shown in Appendices 2, 4, and 6. Another refinement could involve more precise constant and conversion figures, or better data about the actual transport modes associated with each of the food items (i.e. exact type of truck, ship, or plane used). A more substantial refinement would be to extend the analysis to address more than just the carbon footprint. In particular, it may be possible to modify the baseline and local foods profiles to incorporate information about different farming practices – i.e. large industrial farmers versus small scale organic farmers – and calculate the footprint based on assumptions or actual data regarding intensity of land use, application of pesticides and fertilizers, and farming practices of each group. In this way, the environmental benefits of adopting local food sourcing practices could be more comprehensively quantified.

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