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Food Choices and the Environment:
A Food Miles Analysis of Local vs. Conventional Foods in Smithers, BC

1) Introduction

The choices Canadians make every day about to the food we place on our tables are having increasing impacts on our environment and, consequently, our food security. Particularly, the distance food travels from field to plate is becoming more of a concern as food in Canada now travels an average of 2,400 km before it reaches our kitchen tables (an increase of 22% in the last 20 years)[1]. These longer distances release increasing amounts of greenhouse gasses into the air, contributing to air pollution, health problems and global climate change. This has increasing implications for the agricultural sector which is particularly vulnerable to changes in the earth's climate. According to Agriculture Canada, the sudden changes associated with climate change "could have drastic results such as: changes in production patterns, increases in crop damage, water shortages, and new, unpredictable changes in the interactions among crops, weeds, insects, and disease"[2]. Unfortunately, in a time where the levels of greenhouse gasses in the atmosphere are of growing concern, our food supply chains continue to lengthen, increasing the negative impact that the food industry is having on global warming.[3]

2) Food Choices and Food Security

Food security is not only about having a reliable and accessible supply of nutritious food for all people, this food must also be produced and distributed in a way that ensures economic and environmental sustainability. Not only does the transportation of food products pollute the environment, so the practices used to prepare these foods to survive these trips[4]. As fruits and vegetables are prepared and/or processed to travel long distances, they are often treated with chemicals and packaged in containers, most of which are oil-based. Although Canadian data is sparse, in the UK, it has been estimated that the production, processing, packaging and distribution of food consumed by a family of four amounts to eight tonnes of CO2 emissions a year. Compare this with 4.4 tonnes of CO2 from their car and 4.2 tonnes

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[1] Mackinnon, J. & Allisa Smith (28 June 2005) The 100 Mile Diet. Vancouver: The Tyee. <http://thetyee.ca/Series/2005/06/28/100Mile/> (6 September 2006).
[2] Government of Canada (09 June 2003) Agriculture and the Environment – Air: Climate Change.. Ottawa: Government of Canada. <http://www.agr.gc.ca/policy/environment/air_03_e.phtml> (6 September 2006).
[3] Church, Norman (1 April 2005) Why Our Food is so Dependant on Oil. Energy Bulletin. <http://www.energybulletin.net/5045.html> (6 September 2006).
[4] Sierra Club of Canada, Food Miles. Ottawa: Sierra club of Canada. <http://www.sierraclub.ca/national/programs/health-environment/food-agriculture/campaign.shtml?x=840> (6 September 2006).

from their house for the same family[5]. Essentially, we can say that we live in a petroleum-based food economy. This is alarming as we are nearing the time of peak oil when we are consuming more than we're discovering in supply. From optimistic predictions of 2025 to those claiming we've already hit the peak, now is the time to be looking for alternatives. This decline in conventional oil is likely to be felt by increasing food prices which, when accompanied by the potential negative impacts on the agricultural sector, have strong implications for the future of our food security.

3) Local vs. Conventional Produce

The definition of local food is often flexible and prone to interpretation depending on whom you ask. Some people consider 'local' as referring to their city/town and immediate surroundings, others view it as the size of a specific 'ecoregion', while others go as far as to suggest 'local' being anywhere within their province's, or even country's, boarder. In northern towns such as Smithers, the idea of 'local' is often changing depending on the time of year. During the One Sky Food Security information booth at the Saturday Farmers' Market (August 12, 2006), I engaged in informal conversations with shoppers about the concept of local food in Smithers. Many people were of the opinion that while they could eat locally during two or three months of summer, it was not possible to eat locally during the remaining nine months of the year. As a result, many felt that the local zone of Smithers grew during the off-months to incorporate a larger, mostly undefined region. For some, this meant they had to consciously choose foods which were grown closest to home (no matter how far they travelled), while others conceded that while they try to eat locally when available, during the off-months, they did not take location into account. Others did not take location into account and shopped at the Farmers' Market as they saw it more of community meeting place or a nice way to spend a Saturday morning. Despite these views, people were aware that it was possible to eat locally in Smithers year round, however, this takes much effort. Preservation techniques such as canning, smoking fish, storing summer produce in root cellars, dehydrating meats and/or fruits and vegetables can all ensure that local food is available during the off season.

Conventional produce, on the other hand, is usually grown on large farms and often involves the use of chemicals in its production. The fruits and vegetables are often shipped all over the world and can travel thousands of miles before being purchased. Between 1968 and 1998, world food trade increased by 184% while world food production increased by only 84%[6]. Alarmingly, much of this increased food trade is not in goods that countries cannot produce themselves (although this does account for some of the increase), as many countries import foods which can be and often are

[5] Building Research Establishment, Building a Sustainable Future. General Information Report 53, Energy Efficiency Best Practice Programme, Building Research Establishment, Glaston, UK.
[6] Sustain/EFRC (December 2001) Eating Oil – Food in a Changing Climate. London: Sustain:the alliance for food and farming. <http://www.sustainweb.org/pdf/eatoil_sumary.PDF> (6 September 2006).

grown locally. This can be seen when visiting local supermarkets in Smithers where garlic, which is grown by many local producers, is imported from China and the Philippines.

4) Benefits of Local Produce

There are definite advantages to choosing local produce over conventional produce. As noted above, local foods are less reliant on oil, for both transport and processing, meaning they have less of a negative impact on our environment. However, the advantages of selecting locally grown foods over conventional produce extend beyond a healthier environment. Often, locally produced food[7]:

- *Is more nutritious* – locally grown food is often consumed shortly after being harvested, meaning there is less nutrient loss and fewer preservatives than conventional foods.
- *Tastes better* – as mentioned above, conventional produce travels an average of 2,400 kms before reaching the table of the average Canadian. Travelling these long distances takes time, during which sugars in the food turn to starches and plant cells shrink, resulting in the foods losing much of their sweetness and taste.
- *Preserves genetic diversity* – in modern industrial agriculture, fruits and vegetables are chosen for their ability to travel long distances and store well on shelves rather than for taste or diversity. As only a small number of varieties meet these needs, farms producing conventional agriculture often grow one or two varieties of particular fruits and vegetables. Local farms, in contrast, often grow a large number of varieties, many of which are heirlooms passed down from generation to generation, preserving diversity.
- *Protects your families health* – locally grown foods typically undergo less processing and are usually grown and packaged without the use of growth hormones and chemicals induced on most conventional produce to extend its shelf life.
- *Helps to build community* – buying locally produced food puts the consumer in touch with the producer, establishing and strengthening urban-rural relationships and helps consumers better understand where their food comes from.
- *Promotes the local economy* – when you buy produce form local vendors, that money is recirculated in the community. Moreover, when you shop locally, you help to create and maintain local jobs.

5) Food Miles

[7] http://fogcity.blogs.com/jen/2005/08/10_reasons_to_e.htm

In Smithers, residents have access to a weekly farmers' market during the summer where local foods can be purchased. To see the impact of choosing to shop at the farmers' market rather than at local area supermarkets, we can apply the concept of food miles. Food miles are the distance food travels from field to plate; "the more food miles that attach to a given food, the less sustainable and the less environmentally desirable that food is"[8].

There are numerous equations for calculating food miles, however, the one used for this study is the most popular, and arguably comprehensive, of the available choices: Weighted Average Source Distance (WASD). This equation calculates a single distance figure that combines the distances from production to point of sale and the amount of food being consumed. WASD is a good measure of food miles as it "incorporates data on all possible sources from which a given agricultural commodity may be produced"[9]. The WASD equation is as follows:

$$WASD = \frac{\Sigma\,[m(k) \times d(k)]}{m(k)}$$

k = different location points of the production
m = weight (amount) from km each point of production
d = distance from each point of production to each point of sale (or use)

Once the WASD value is calculated, we are given a value in units of Tonnes-kilometre. Following this, we can use values determined in a UK study to calculate the energy used and emissions related from transporting food using various methods of travel.

Table 5.1: Energy use and emissions for different modes of freight transport[10]

	Rail	Water	Road	Air
Primary Energy Consumption (KJ/Tonne-km)	677	423	2,890	15839

[8] Global Development Research Centre, What is Food Miles?. GDRC. <http://www.gdrc.org/uem/footprints/food-miles.html> (6 September 2006).
[9] Bentley, S & Ravina Barker (April 2005) Fighting Global Warming at the Farmer's Market. Toronto: FoodShare Toronto. <http://www.foodshare.net/resource/files/ACF230.pdf> (6 September 2006), p. 6.
[10] Pirog, R., T. Van Pelt, K. Enshayan & E. Cooke (June 2001) Food, Fuel, and Freeways: An Iowa perspective on how far food travels, fuel useage, and greenhouse gas emissions. Iowa: Leopold Center for Sustainable Agriculture. <http://www.leopold.iastate.edu/> (6 September 2006), p. 31.

Specific Total Emissions (g/Tonne-km)				
Carbon Dioxide	41.0	30.0	207	1,260
Hydrocarbons	0.06	0.04	0.3	2.0
Volatile Organic Compounds	0.08	0.1	1.1	3.0
Nitrogen Oxide	0.2	0.4	3.6	5.5
Carbon Monoxide	0.05	0.12	2.4	1.4

For this report, we are concerned only with carbon dioxide (CO2) emissions released from transportation; however, the values for other emissions have been calculated and are available in Appendix A and B.

It should be noted that the use of food miles is not an exact science nor does it provide the final word on the impacts our food choices have on our environment. As can be deferred from Sections A and B, the relationship between food transport and sustainability is not straightforward. Food supply chains are not homogeneous and, as a result, reducing the distance food travels will not be the end all in improving sustainability. There are four limitations of the WASD method we must take into account when interpreting Food Miles data[11]:

1) *Transport efficiency*: The WASD method of calculating food miles does not distinguish between the differences in efficiencies of different vehicles in the same method of transport. The equation takes all vehicles to be of uniform efficiency and does not take into account that farmers will use different makes and models of road transportation to transport their vehicles to market, not to mention the fact that conventional produce is often shipped over land using large transport trucks.
2) *Distances from Farm to Processing Plant*: The WASD method is prone to leaving out the distance conventional produce travels before reaching the processing plant where it is prepared for shipping. This is particularly true of meat products which can travel long distances to slaughterhouses, distances which are often unknown and therefore left out of the food miles data.
3) *Differences in food production systems*: The WASD method treats all food production as equal; however, "the impact of food transport can be offset to some extent if food imported to an area has been produced more sustainably than the food available locally"[12] The embodied energy of producing crops, that is the energy that goes into all stages of production, from preparing the field for

[11] Smith, A. et al, (2005) The Validity of Food Miles as an Indicitaor of Sustainable Development. London: DEFRA <http://statistics.defra.gov.uk/esg/reports/foodmiles/final.pdf#search=%22food%20miles%20advantage%20disadvantage%22> (6 September 2006), p. v.
[12] Ibid, p. v

planting to product delivery and sale, is not incorporated into the WASD equation. Clearly, conventional produce grown on larger farms will require more embodied energy than produce grown on small, local farms.

4) *Wider economic and social costs and benefits*: The "wider environmental, social and economic effects associated with different food supply chains are complex and very system specific"[13]. As the term food miles signifies more than just the direct impacts of the transport of food, economic and social issues are also part of the food miles debate. Issues such as subsidies and sanctions in international trade as well as the wider benefits of purchasing locally grown food are ignored by the WASD equation.

Keeping these constraints in mind will help us to better understand the implications and limitations the food miles data. Food miles should be used as an avenue for discussion and to provide insight into the impacts our food choices; however, it should not be taken as the definitive word in discussions regarding these impacts.

6) Data Collection

For this study, I selected ten goods available at the Smithers Farmers' Market on August 5, 2006. The points of origin were obtained by asking the farmers who were selling their produce where their farms were located. As I wanted to make this study as comprehensive as possible, I have also included salmon and beef which are not available from the farmers' market but from other local sources. The local supplier for salmon comes from Morricetown, while the local supplier of beef is in Telkwa. These items were then compared with like products from the three local supermarkets, SuperValu, ExtraFoods and BV Wholesale, on August 7, 2006. The point of origin was obtained by looking at the label on the various items (either on the product packages or stickers). For weight, I used one pound of produce for each fruit and vegetable item (0.00045 tonnes), the weight of a dozen for eggs (0.00068 tonnes) and two pounds each for salmon and beef (0.0009 tonones). Once the point of origin was obtained, Google Maps (http://maps.google.com/) was used to obtain the distances food travelled in North America. For imports from overseas, calculations based on latitudinal and longitudinal coordinates gave distances 'as the crow flies' (data obtained from www.indo.com/distance/). Where only countries or states of origin were known, I used major port cities as points of reference (this is a common practice in the calculation of food miles). The goods shipped from overseas passed through Los Angeles, CA before being routed to BC. I tried to be as accurate as possible with the information received from the local supermarkets, however, when contacted, help was often less than adequate and answers were often extremely vague.

7) Observations

[13] Ibid, p. v

7.1) Distance Food Travels

Table 7.1: Smithers Farmers' Market and Local Producers, August 5, 2006

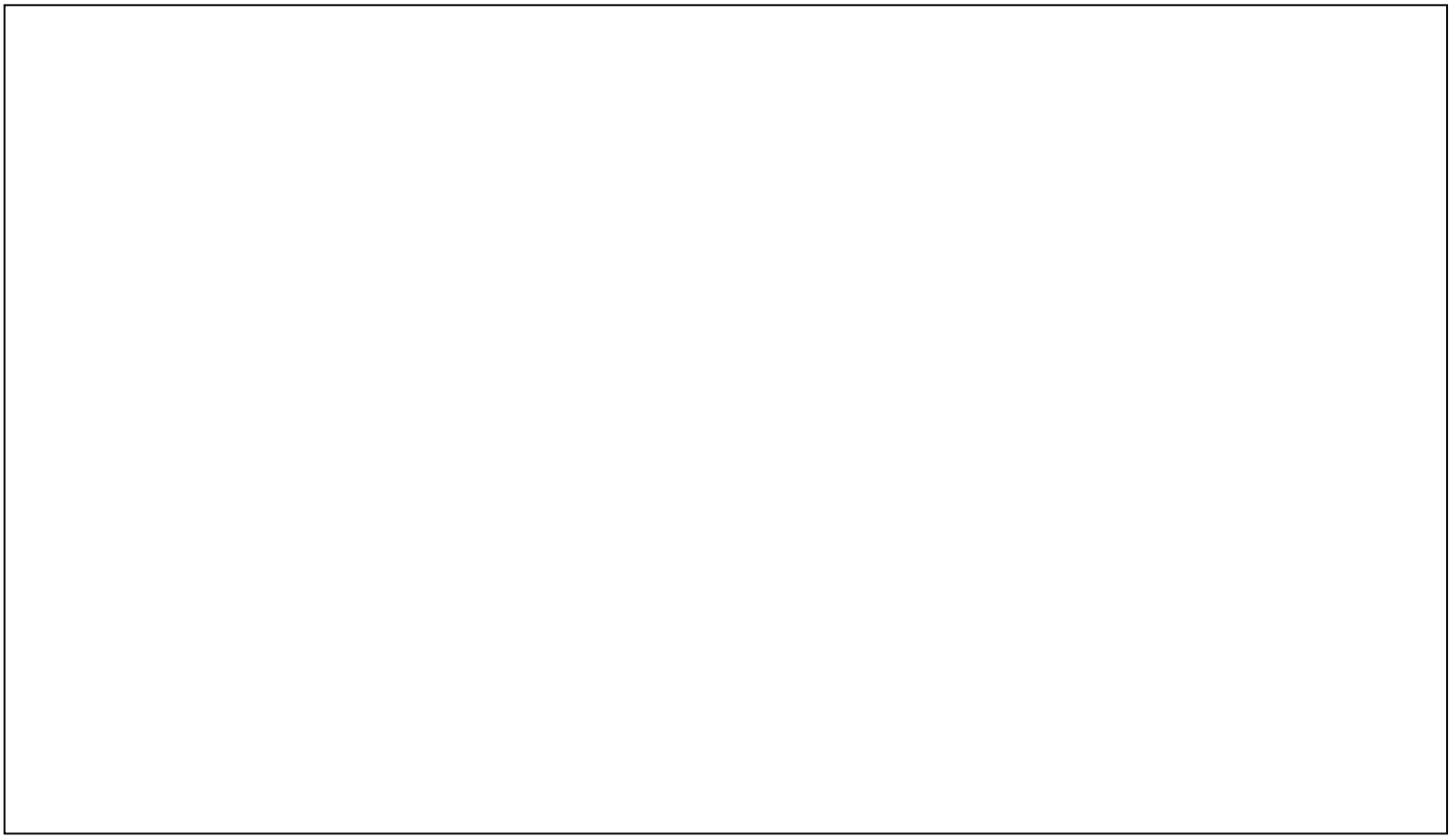
Item	**Origin**	**Average Distance Travelled (km)**	**Tonnes-km**
Eggs	Quick	30	0.0204
Lettuce	Quick; Telkwa	25	0.0113
Spinach	Quick	30	0.0136
Tomatoes	Smithers; Telkwa	12.5	0.0057
Carrots	Quick; Morricetown	27	0.0122
Cucumbers	Smithers	5	0.0023
Salad Mix	Morricetown	24	0.0109
Garlic	Morricetown; Telkwa	22	0.0998
Potatoes	Telkwa	20	0.0907
Radish	Telkwa	20	0.0907
Beef	Telkwa	20	0.0181
Wild salmon	Morricetown	24	0.0218
Average		**21.63**	**0.0331**

Table 7.2: Average of Three Local Super Markets

Item	**Origin**	**Average Distance Travelled (km)**	**Tonnes-km**
Eggs	Calgary, AV; Terrace, BC	838	0.5701
Lettuce	Salinas, CA; BC	1262.68	0.9898
Spinach	Burnaby, BC; Castroville, CA; San Juan Bautista, CA	2214.49	1.0045
Tomatoes	Okanogan, BC; Coquitlam, BC	1067.68	0.4843
Carrots	Delta, BC	1175	0.5330
Cucumbers	Coquitlam, BC	1143	0.5185
Salad Mix	Salinas, CA; San Juan Bautista, CA	2750.63	1.2477
Garlic	China; Philippines	14027.27	6.3626
Potatoes	Delta, BC; California; Yakima, WA	1632.47	0.7404
Radish	Redcliffe, AB; Michigan	2828.96	1.2832
Beef	Alberta	1100	0.9979
Salmon	Vancouver	1162	1.054
Average		**2600**	**1.3155**

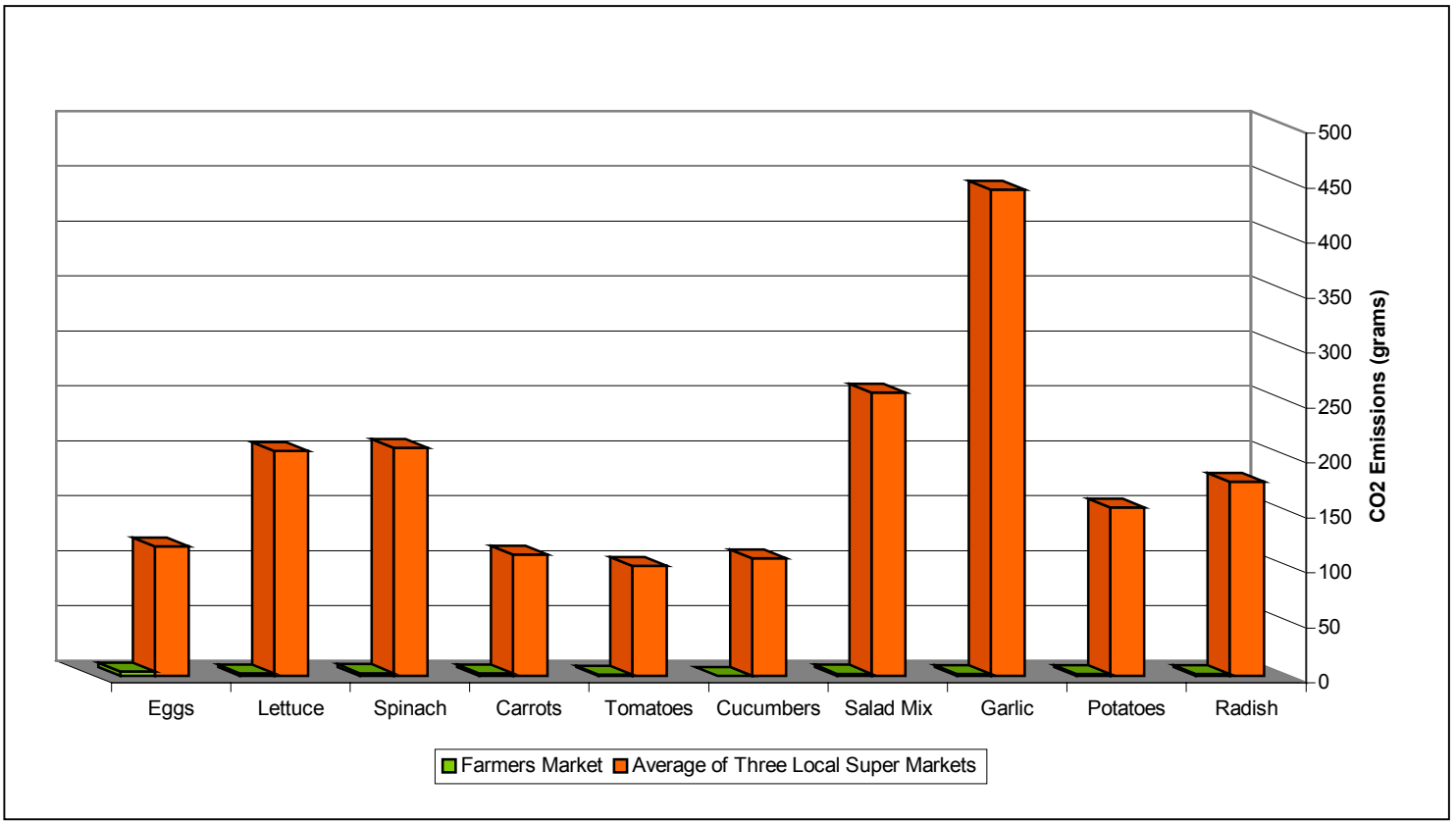
As expected, items purchased at the Smithers Farmers' Market travelled considerably less than those items purchased at area supermarkets – averaging 21.6 km compared to 2,600 km, respectively. From the data above, we see that food available at the local supermarkets in Smithers travels nearly 200 km further than the Canadian average. If an individual were to purchase these food baskets, the local produce will have travelled a total distance of 260 km while the conventional produce will have travelled over 31,200 km. This is the equivalent of traveling 2/3rds of the way from Smithers to Prince Rupert for local produce compared to making two trips from Smithers to St. John's, Newfoundland and back for conventional produce. It is safe to say that this distance is far greater if we're able to calculate the distance this food travels before reaching processing plants where it is prepared for travel. Garlic was the only item imported from overseas which came from China and the Philippines before arriving at the local supermarkets. Following this, garlic had the greatest discrepancy between the two sources as garlic that was available from local supermarkets travelled over 630 times further than garlic from the Smithers Farmers' Market. On average, goods available at the local supermarket travelled over 120 times further than goods available from the Smithers Farmers' Market.

Figure 7.1 Number of Times Further Food Travels to Local Supermarkets than to the Smithers Farmers' Market



7.2) Emissions from Food Transport

Figure 7.2: Carbon Dioxide Emissions from Transporting 1lb of Produce to Smithers, BC*



* Data is calculated for one dozen eggs, not one pound of eggs.

The CO2 emissions from produce shipped to local supermarkets is much higher than the CO2 emissions from produce available at the Farmers' Market. In total, the ten items were responsible for a total of 29.9g of CO2 when purchased from the Farmers' Market compared to 2304.97g of CO2 when purchased at area supermarkets. This equates to nearly 77 times more CO2 emissions simply by purchasing produce at area supermarkets rather than at the Farmers' Market. The largest contributors to CO2 emissions were garlic and salad mix, both of which are readily available in Smithers during the summer months. These two items produces over 213 and 113 times the CO2 emissions respectively when purchased from area supermarkets rather than the farmers' market. When they did not come from local sources beef and salmon were also major contributors to CO2 emissions, each contributing over 200g of CO2, compared to approximately 4.25g when each are purchased locally. This amounts to over 50 times more CO2 emissions when purchasing these two meats at the supermarket rather than from local sources. Eggs, who had the smallest difference in CO2 emissions, still

emitted nearly 26 times the CO2 when purchased at local supermarkets rather than at the farmers' market.

8) Analysis and Recommendations

From the above observations we can see that choosing to eat locally will have an immediate reduction on the greenhouse gas emissions that result from food transportation. If we were to purchase our food basket every week during the operation of the Smithers Farmers' Market (approximately 13 weeks), we would save approximately 30kg CO2 from transportation alone during that time (this does not include the embodied energy required to produce these foods, nor does it include the emissions created from preparing these foods for travel).

Although the market is not operational year round, strides can be made during the 'off-season' to purchase foods grown as close to home as possible. Customers can request that area supermarkets carry more local produce and, in seasons when local produce is unavailable, purchase foods from as close to home as possible. Although, at the time of writing, the three area local supermarkets do not consider distance food travels when choosing which foods to stock, pressure by consumers can help to change this attitude. In addition, with more avenues to sell local produce, there will be more incentive to become a producer or see viability in setting up a market garden.

As eating locally year round can be challenging for many in northern environments, individual education and action can go a long ways in improving the local food stock. Initiatives such as community food kitchens, workshops on food preservation/storage, and extending the life of your greenhouse can all help to improve the prevalence of local foods year round.

Initiatives aimed at promoting the consumption of local foods can go a long way to helping people choose local over conventional produce. Currently there are many resources out there, such as the 100 Mile Diet (http://100milediet.org/), to provide support and educate people on how they can eat locally. Farmers markets and community supported agriculture programs, such as the good food box, are both opportunities to promote local foods. Such initiatives are intended to reverse the current trend and begin to shorten they supply chains in our current food system. In addition to promoting the consumption of local foods, these programs and other like them, such as gleaning, 'shared backyard' and community garden programs, also have wider social/community benefits.

At the government level, policy must be enacted to reduce the travel time of food and also avoid wasteful practices. Unfortunately the trend seems to be going in the opposite direction. Currently, in the beef industry where the government plans to ban the sale of beef from farm-gates next year, people in Smithers will no longer have the choice of purchasing beef locally. The beef will have to travel to government-approved plants to be slaughtered and then shipped back to Smithers. This will obviously increase the CO2 emissions from the increased travel distances. To their credit, the government has enacted measures to improve the efficiency of the freight

industry, aiming to cut GHG emissions in this industry by 2 megatonnes before 2001; however, policies should also be focused on strengthening local food systems.

Local food systems could be strengthened with policies aimed at supporting small, local farms over large-scale commercial farms. One step involves shifting government subsidies from these large-scale farms, which are mostly environmentally unsustainable, to smaller, environmentally sustainable farms. In addition to giving local farmers a fair price for their crops, measures ensuring that locally grown produce is less expensive than their imported counterparts will help promote the consumption of local foods. Government policy should also encourage local farmers to grow more crops for human consumption rather than animal consumption – a shift to grassfed livestock rearing. This will not only help increase the supply of locally grown food, but will also promote crop diversification (as noted above small scale farms tend to use more varieties of crops).

9) Conclusion

As this study has shown, eating locally, even in the short period of time during which the farmers' market operates in Smithers, can significantly reduce the environmental impact of our food choices; however, the benefits of eating locally can, and should, extend beyond the summer months. In a time where the majority of the challengers to global climate change have been silenced (there are still the remaining few who refuse to believe), the choices we make every day are becoming increasingly important to the future of our environment. By being conscious of the foods we place on our table, specifically where these foods come from, we can help to reduce the impact that our food supply system has on global warming. A combination of consumer action, community initiatives and (responsible) government policy can help to improve the prevalence of local foods in the Smithers' food system, ultimately reducing all of our food miles.

Appendix A: Energy Use and Emissions for Local Foods

	Carbon Dioxide (g/Tonne-km)	Hydrocarbons (g/Tonne-km)	Volatile Organic Compounds (g/Tonne-km)	Nitrogen Oxide (g/Tonne-km)	Carbon Monoxide (g/Tonne-km)
Eggs	4.225213	0.006123	0.022453	0.073482	0.048988
Lettuce	2.347341	0.003402	0.012474	0.040823	0.027216
Spinach	2.816809	0.004082	0.014969	0.048988	0.032659
Tomatoes	1.17367	0.001701	0.006237	0.020412	0.013608
Carrots	2.535128	0.003674	0.013472	0.044089	0.029393
Cucumbers	0.469468	0.00068	0.002495	0.008165	0.005443
Salad Mix	2.253447	0.003266	0.011975	0.03919	0.026127
Garlic	2.06566	0.002994	0.010977	0.035925	0.02395
Potatoes	1.877872	0.002722	0.009979	0.032659	0.021772
Radish	1.877872	0.002722	0.009979	0.032659	0.021772
Beef	3.755745	0.005443	0.019958	0.065317	0.043545
Salmon	4.506894	0.006532	0.02395	0.078381	0.052254

Appendix B: Average Energy Use and Emissions for Conventional Foods

	Carbon Dioxide (g/Tonne-km)	Hydrocarbons (g/Tonne-km)	Volatile Organic Compounds (g/Tonne-km)	Nitrogen Oxide (g/Tonne-km)	Carbon Monoxide (g/Tonne-km)
Eggs	118.0243	0.17105	0.627182	2.052596	1.368397
Lettuce	204.8889	0.29694	1.088782	3.563285	2.375523
Spinach	207.9266	0.301343	1.104924	3.616114	2.410743
Tomatoes	100.2471	0.145286	0.532714	1.743428	1.162285
Carrots	110.325	0.159891	0.586268	1.918696	1.27913
Cucumbers	107.3204	0.155537	0.570302	1.866442	1.244295
Salad Mix	258.2664	0.374299	1.37243	4.49159	2.994394
Garlic	442.8339	0.624609	2.059737	7.100169	4.009035
Potatoes	153.2786	0.222143	0.814524	2.665715	1.777143
Radish	177.0808	0.256639	0.941009	3.079666	2.053111
Beef	206.566	0.299371	1.097694	3.592452	2.394968
Salmon	218.2088	0.316245	1.159564	3.794935	2.529957