

THE AGRICULTURAL  
CARRYING CAPACITY  
OF VANCOUVER ISLAND

Environmental Studies 402

James K. Rowe

University of Victoria

By Jared Smith

## INTRODUCTION

For the majority of homo-sapiens existence, the collection and preparation of a sufficient quantity of healthy food has been our most significant activity. Since our adoption of an agricultural food production system some 10,000-16,000 years ago, the amount of time consumed with this task has steadily declined. As yields increased due to specialization and technological innovations, there was a corresponding rise in society's level of complexity with food production surpluses allowing for time and effort to be dedicated to other interests. The pace of technological innovations and specialization in agriculture has expounded exponentially since that time. In developed areas of the world, Canada in particular, less than 2.5 per cent of the population is directly involved with agriculture<sup>1</sup>. This can be attributed largely to the increased mechanization of agricultural techniques and developments in food transportation systems that promote cultivation of a crop to be grown only in the most comparatively advantaged areas for that crop (regarding land, climate, and labour inputs).

Because so few people are directly involved in agriculture, there exists a significant disconnect with consumer knowledge and on the ground agricultural realities. Most people are surprised to find that much of our food has travelled significant distances<sup>2</sup>, been out of the ground or off the bush for weeks or months before consumption, and has required from one to twenty calories of fossil fuel energy for the production of one calorie of food<sup>3</sup>. As engaged citizens become more educated about a range of environmental issues, questions get raised as to

---

<sup>1</sup> Statistics Canada, 2010

<sup>2</sup> Kloppenburg et al. 1996

<sup>3</sup> Manning, 2004; Pimentel 1994. This number varies considerably among foods. For example, it is estimated that grass fed beef requires three calories fossil of fuel energy for every calorie produced while offshore fishing requires as much as 15-20 calories per calories produced.

the sustainability of our food production system, especially because of its heavy reliance on fossil fuels.

Vancouver Island is one such place where citizens are questioning the security of existing food supply systems. Although climate conditions and soil types allow for relatively productive agriculture, population increases and urban development are putting pressure on existing farm land. According to the Capital Region Food & Agricultural Initiatives Roundtable (CR-FAIR), Vancouver Island farmers produced as much as 85 per cent of the Island's food supply as recently as the 1950's, while current agricultural production is estimated to supply only 5-10 per cent of the Island's food supply as of 2004<sup>4</sup>. For residents, these figures are extremely worrying, especially given our relative geographic isolation from living on an island. In addition, most geoscientists agree that peak oil production has already occurred or will occur within the next decade<sup>5</sup>. With so much of our food supply reliant on fossil fuel dependant agricultural and transportation methods, a reduction in oil production has serious implications for food security. In fact, a Hazard Risk and Vulnerability Assessment conducted by the city of Victoria estimates that the food supply in supermarkets and warehouses on Vancouver Island have food for only three days worth of normal consumption<sup>6</sup>. A minor disruption in ferry transportation could result in food shortages for the Island. With a stated mandate to "foster a post-carbon way of life in the Victoria area by raising awareness and building connections, supporting positive vision and action to help create more resilient, joyful communities that no longer rely on fossil fuels as their primary energy sources,"<sup>7</sup> *Transition Victoria* is one local activist group concerned with food security issues on the Island. In response to growing concerns regarding the future of food security here on the Island, Transition

---

<sup>4</sup> MacNair, 2004

<sup>5</sup> Aleklett, et al 2008

<sup>6</sup> EmergeX Planning Inc. 2006 Individual emergency stocks would increase this number.

<sup>7</sup> Transitions Victoria: A Regional Initiative

Victoria questions the actual carrying capacity of current food production on the Island. This paper will focus on that question and seek to estimate a sustainable food production carrying capacity for the Island based on current consumption levels.

#### ASSUMPTIONS:

- This paper will focus primarily on the present production capabilities of the Island. There is no doubt that more land could be converted to agriculture; however, most land deemed worthy of horticulture (soil classes 1-3) and forage/pasture (soil classes 4-7) is already in the agricultural land reserve (ALR). This assumption is necessary within the scope of this paper. If necessity required, agriculture could be practiced in a variety of areas, both urban and rural, but this paper seeks to focus on present conditions and capabilities rather than extrapolations about future possibilities.
- This exercise also assumes that current agricultural production is sustainable. It assumes that the land will continue to produce at current output and will not suffer from environmental degradation or overuse. Although this is not the case, calculating topsoil loss, erosion, nutrient depletion, and yield decrease/increase due to a changing climate is beyond the papers scope and the author's abilities.
- This paper considers Vancouver Island's current population of 748,937<sup>8</sup>. In addition, estimates will not take into consideration further conversion of agricultural land to urban development.

---

<sup>8</sup> Statistics Canada 2009 population estimate

## METHODOLOGY

This paper will use two different approaches to determine the carrying capacity of Vancouver Island's agricultural production:

1. In 1996, Mathis Wackernagel and William Rees published *Our Ecological Footprint: Reducing Human Impact on the Earth*. Using a long established notion of carrying capacity (population size of the species that the environment can sustain indefinitely without impairing the natural environment upon which it relies), Wackernagel and Rees created a new term to apply to human activities. They coined it Ecological Footprint and defined it as the area of biologically productive land needed to provide a human's resources and absorb the waste he or she generates given a certain level of consumption. This paper will calculate the ecological footprint of Vancouver Island's population and determine whether our area of productive land base can support that population indefinitely.

2. The second method, being much simpler, will determine whether the amount of productive agricultural land on Vancouver Island is enough to satisfy current food consumption based on estimates of average crop yields and hectares of farmland/capita.

Method one focuses on a number of categories and is based on broad assumptions and generalized data. Method two focuses on current agricultural production and reliable estimates on the population that we can feed given existing circumstances.

## WHAT IS DOES OUR AGRICULTURAL LAND BASE CONSIST OF?

Vancouver Island's total area is about 32,134 square kilometres or 3,213,400 hectares. The mountainous nature of the Island, however, severely limits agricultural production. In addition, a majority of the soils are considered glacial till which is not conducive to productive agriculture<sup>9</sup>. According to the Canada Land Inventory (CLI), soil classes 1, 2, and 3 are considered suitable for sustained production of commonly cultivated crops while soil classes 4-7 have severe limitations but can sometimes be utilized for other agricultural uses such as grazing land<sup>10</sup>. Vancouver Island has 74,581 hectares of land with soil classes between one and three within the Agricultural Land Reserve (ALR)<sup>11</sup>. As of 2004, total area within the ALR is 103,319 hectares<sup>12</sup>. Figure from: Canada Land Inventory: <http://geogratis.cgdi.gc.ca/CLI/frames.html>

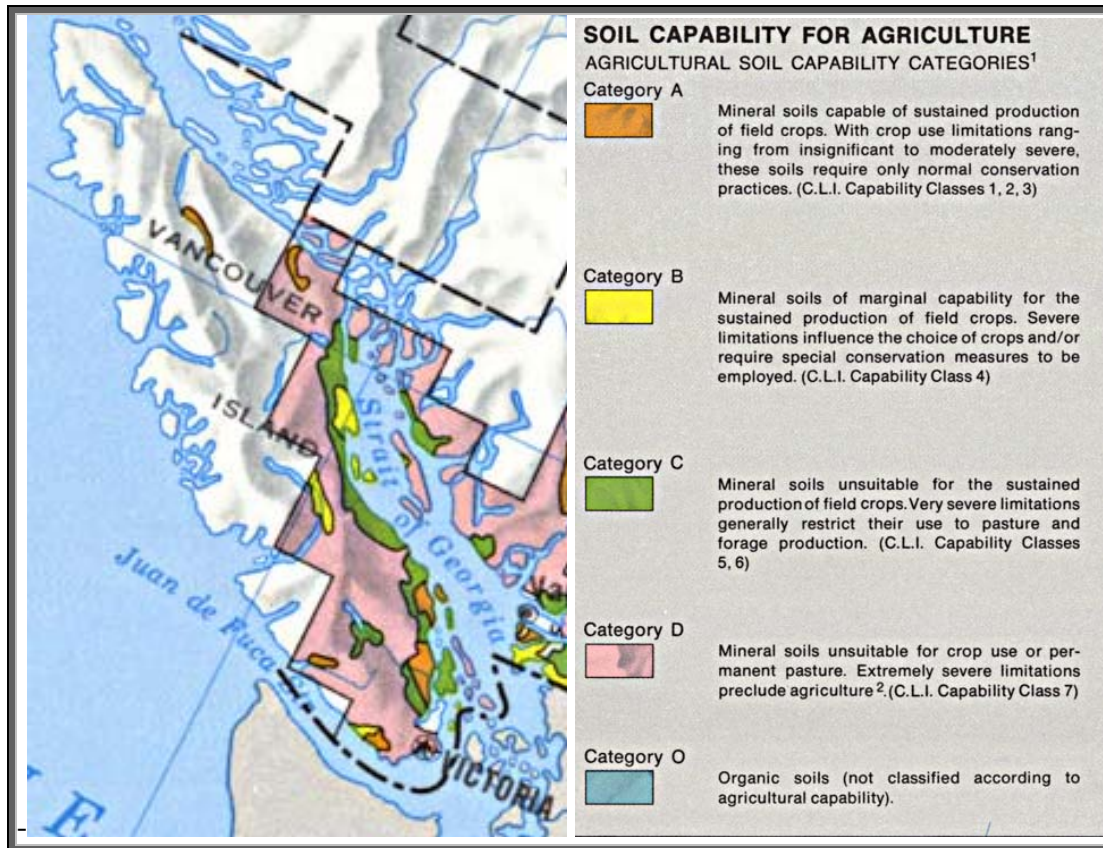
---

<sup>9</sup> Ministry of Agriculture 1978: *Agriculture on Vancouver Island and the Gulf Islands*

<sup>10</sup> Ministry of Agriculture and Food 1983: *Land Capability Classification for Agriculture in British Columbia*

<sup>11</sup> Ministry of Agriculture 1978

<sup>12</sup> MacNair, 2004



As noted in the above figure, productive agricultural land is limited to scattered pockets around the Saanich Peninsula and the Cowichan, Chemainus, Nanaimo, Comox, and Alberni valleys. The white section on the above figure represents land that has not been classified for agricultural purposes because of its general unsuitability. Climate conditions vary across the Island but are generally mild due to maritime influences. The lower altitudes, where most of the agricultural land exists, rarely freezes on the winter making much of this land suitable for winter vegetable production. Summer conditions, also due to the maritime influence, are significantly cooler than inland areas of the same latitude. The Island experiences long periods of stable high pressure systems in the summer and thus precipitation is limited with only 20 per cent of the

annual precipitation falling between April and September<sup>13</sup>. Because of this, irrigation is essential for most crops to achieve maximum production.

## METHOD 1: OUR ECOLOGICAL FOOTPRINT

According to the 2008 World Wildlife Fund (WWF) *Living Planet Report*, an average B.C resident requires 7.1 hectares of biologically productive land to satisfy consumption patterns and absorb wastes<sup>14</sup>. This is further separated into the following categories: 3.44 hectares for carbon, 1.83 hectares of cropland, .5 hectares grazing land, and 1 hectare of forest<sup>15</sup>. To determine if Vancouver Island's ecological footprint is larger than our productive land base, we'll address each category independently:

Carbon: this category defines how much biologically productive land is required to sequester the carbon dioxide (CO<sub>2</sub>) emitted from fossil fuel use and land disturbances and assumes that one hectare can absorb the CO<sub>2</sub> emission from burning 1450 litres of gasoline (global average). Vancouver Island's forests are able to sequester more CO<sub>2</sub> than the global average because of the high productivity of coastal forests, especially old growth. According to the Integrated Land Management Bureau, forests cover 91 per cent of the Island's total area. This provides 2,924,194 hectares of forest available to sequester carbon. Given a population of 748,937 and a carbon sequestration requirement of 3.44 hectares/capita, 2,576,343 hectares are needed to fulfill our carbon footprint. At our current population, Vancouver Island has enough forest cover to sequester the carbon dioxide emitted from fossil fuel use and land conversion. However, a population increase of only 101,000 people would bring us to capacity.

---

<sup>13</sup> Ministry of Agriculture 1978: *Agriculture on Vancouver Island and the Gulf Islands*

<sup>14</sup> World Wildlife Fund 2008

<sup>15</sup> Ibid.

Cropland: this category defines how much biologically productive land is required to cultivate the total food consumption of an individual. According to Living Planet Report, an average Canadian requires 1.83 hectares. Given Vancouver Island's current agricultural land base of 74, 581 hectares (soil classes 1-3 within the ALR), our current agricultural production is only sufficient to meet the needs of 40,754 residents. Upon closer inspection, however, cropland is further categorized into the following: energy for food production, garden area, cropland, pasture, and forest. Wackernagel and Rees in *Our Ecological Footprint* estimate that actual cropland and garden space required is closer to .62 hectares per person for food production<sup>16</sup>. Because the other categories can be satisfied with land of lesser productivity, we'll calculate requirements based on these two categories. With a population of 748,937 and a per capita land requirement of .62 hectares, our current population requires 464,340 hectares of productive agricultural land. On other words, current consumption requires an additional 383,759 hectares of agricultural land beyond existing ALR lands to satisfy our cropland requirements.

Grazing land: although accurate estimates of grazing land on Vancouver Island were unavailable, we'll assume all areas within the ALR with soil classes between 4-7 to be suitable for this purpose. This leaves us with an estimated 45,700 hectares of land within the ALR. Given our current population and a grazing land requirement of .5 per capita, we require an additional 328,768 hectares of land devoted to grazing to fulfill our current consumption level.

Forest land: this category estimates the amount of forested land required to fulfill timber, paper, and fibre requirements of an individual. Assuming Vancouver Island residents have the same consumption level as other Canadians, we require 1 hectare per individual. Given our current population, we require 748,937 hectares of forest land to satisfy our requirements. This is

---

<sup>16</sup> Our Ecological Footprint 1996

well under our estimated 2,924,194 hectares of forest land available. This however, would be assuming that all of Vancouver Island's forest land is suitable and/or available for logging. While on 6 per cent of our forest land base is officially protected,<sup>17</sup> most residents would like to see this number increased substantially to protect for other values that our forests provide (i.e. carbon sequestration, water filtration, biodiversity, recreation, etc). Even with substantial increases in forest land protection, our forested land base is sufficient to meet current consumption.

Using Wackernagel and Rees's methodology and The World Wildlife Fund's footprint calculations, Vancouver Island has an ecological footprint deficit in terms of cropland and grazing land. To satisfy our current consumption level, Vancouver Island would need to bring 383,759 more hectares into sustained agricultural production (514 per cent increase) and expand grazing land by an additional 328,768 hectares (over 700 per cent increase). Our forested land base is sufficient to sequester carbon and provide timber, paper, and fibre needs of our current population.

## METHOD 2: AVERAGE CROP YIELDS AND CROPLAND PER CAPITA

According to a Ministry of Agriculture and Lands report titled: *BC's Food Self-Reliance: Can BC's Farmers Feed Our Growing Population?*, the average BC resident needs 524 hectares of productive land to satisfy their food requirements. This assumes land that is equal in productivity to BC's most productive land: that of the Okanagan and Lower Mainland valleys.

---

<sup>17</sup> Friends of Clayoquot Sound Website: <http://www.focs.ca/logging/factsheet.asp>

Table 5 Hectares Needed to Produce a Healthy Diet for One Person					
	Servings /day	Raw Weight/day	Raw Weight/Year	Yield/Ha/yr <sup>20</sup>	Hectares Needed (Irrigated)
Dairy	2.87	718 g	262 L	13,000 L	.020
				Grain	.048
Meat	2.5	188 g	68.6 kg		.394
				Range <sup>21</sup>	
Grains	8.5	140 g	51.1 kg	1,750 kg	.029
Vegetables	3.75	225 g	82.1 kg	6,600 kg	.0177
Fruit	3.75	319 g	116 kg	9,600 kg	.0152
<b>Total</b>					<b>.471</b>
					<b>.053</b>

From BC Ministry of Agriculture and Lands 2006.

As evident by the average crop yields per hectare, this estimate is dependent on intensive agricultural techniques with high levels of capital and technological inputs. Other studies, including one by R. Lal and D. Pimental estimate that .5 hectare/capita is the minimum to provide a diverse, healthy, and nutritious diet of plant and animal products similar to the one Vancouver Island residents enjoy currently<sup>18</sup>. Using the lower of the two estimates (.5 hectares) and our current population, we require 392,443 hectares of productive land to feed our population. In other words, an additional 317, 862 hectares of agricultural land would have to be brought into production to feed our current population at existing consumption levels. This is not far from the ecological footprint technique estimate of 383,759 hectares.

## CONCLUSION

Vancouver Island's food supply is heavily reliant on fossil fuel inputs for growing, harvesting, processing, and transporting our food. As fossil fuel supplies become limited, food supplies will be comparatively more expensive. In addition, the Island's geographic isolation

---

<sup>18</sup> Lal, R & Pimental, D. 1989

makes food security issues even more important. Because of this, questioning our current agricultural capabilities is essential. Knowing our ecological footprint and the Island's agricultural carrying capacity is the first step in addressing these issues. Using Agricultural surveys which identified suitable cropland and estimates of cropland/capita requirements, this paper found that Vancouver Island's agricultural production is inadequate to feed our current population. However, this does not mean that feeding our population without importing food is impossible. The above calculations were based solely on current agricultural production and soils that were already suitable. Significant amounts of land, albeit in smaller pockets, could be converted to agriculture. In addition, many soils initially deemed inadequate for sustained production can be remediated to become relatively productive. Furthermore, the above estimates (see above table) show that a large percentage of our land requirement, a full 84 per cent, is required to fulfill our meat consumption. Significantly less land is required to produce the same amount of protein in the form of legumes or other more efficient feed converting animals (i.e. pigs and chicken vs. cows). Although this paper has found that we cannot fulfill Vancouver Island's food requirements based on current consumption patterns, changes in diet, expansion of the agricultural land base, and remediation of less suitable soils have tremendous potential in allowing us to overcome these obstacles. Due to rapidly changing circumstances endangering our current food production system, these options should be considered carefully and implemented where possible to ensure food security into the future.

## REFERENCE LIST:

- Aleklett, Kjell, et al (2008). The peak of the Oil Age: Analyzing the World Oil Production reference scenario in World Energy Outlook 2008. *Energy Policy* 38:3 p. 1398-1414. Retrieved March 26, 2010 from: <http://www.tsl.uu.se/uhdsg/Publications/PeakOilAge.pdf>
- Miewald, Christiana (2007). *Community Food System Assessment Guide for British Columbia*. (2010). Centre for Sustainable Community Development. British Columbia. Simon Fraser University. Retrieved March 21, 2010: <http://www.sfu.ca/cscd/wp-content/uploads/2010/01/communityfoodassessmentguideforbc.pdf>
- BC Ministry of Agriculture and Lands (2006). *BC's Food Self-Reliance: Can BC's Farmers Feed Our Growing Population?* Province of B.C.
- Ministry of Agriculture (1978). *Agriculture on Vancouver Island and the Gulf Islands*. Province of B.C.
- CR-FAIR (Capitol Region-Food and Agriculture Initiatives Round Table). *The Real Cost of Food*. Community Social Planning Council of Greater Victoria. Retrieved March 21, 2010 from: [http://www.bitsandbytes.ca/resources/RealCost\\_of\\_Food\\_factsheet\\_CRFAIR.pdf](http://www.bitsandbytes.ca/resources/RealCost_of_Food_factsheet_CRFAIR.pdf)
- Edible Strategies Enterprises. (2007). *Islands Good Food Initiative "Contending with the Local Food Access Puzzle"*. Final Project Report to the BC Medical Services Foundation Retrieved March 21, 2010: [http://www.ediblestrategies.com/fsd/FinalReport\\_BCMSF.pdf](http://www.ediblestrategies.com/fsd/FinalReport_BCMSF.pdf)
- EmergeX Planning Inc. (2006). *Hazard Risk and Vulnerability Assessment: City of Victoria*.
- Food, Land, Population and the U.S. Economy, Executive Summary, Pimentel, David and Giampietro, Mario. *Carrying Capacity Network*, 11/21/1994.
- Friends of Clayoquot Sound Website (2010). *Forest and Logging Factsheet*. Retrieved April 17, 2010 from: <http://www.focs.ca/logging/factsheet.asp>
- Integrated Land Management Bureau (1996). *Vancouver Island Land Use Plan*. Retrieved April 9, 2010 from: [http://archive.ilmb.gov.bc.ca/slrp/lrmp/nanaimo/vancouver\\_island/plan/summary\\_lup/1.html](http://archive.ilmb.gov.bc.ca/slrp/lrmp/nanaimo/vancouver_island/plan/summary_lup/1.html)
- Kloppenburg, Jack; Hendrickson, John & Stevenson, G.W. (1996). *Coming into the Foodshed*. *Agriculture and Human Values* 13:3 p. 33-42.
- Lal, R. & Pimentel D. (Ed.), 1989. *Land degradation and its impact on food and other resources*. *Food and Natural Resources*, pp. 85-140. Academic Press, San Diego.

Macnair, Emily (2004). A baseline assessment of in British Columbia's Capital Region. Capital Region Food & Agricultural Initiatives Roundtable (CR-FAIR). Retrieved March 21, 2010: [http://www.communitycouncil.ca/pdf/CR-FAIR\\_FS\\_Assessment\\_2004.pdf](http://www.communitycouncil.ca/pdf/CR-FAIR_FS_Assessment_2004.pdf)

Manning, Richard (2004). *The Oil We Eat: Following the Food Chain back to Iraq*. Harper's Magazine. April 2004, pg. 4.

Wackernagel, Mathis & Rees, William (1996). *Our Ecological Footprint: Reducing Human impact on the Earth*. New Society Publishers, Gabriola Island, B.C.

Wittman, Hannah (2009). *Community Farms in BC: Building Local Food Systems for Sustainable Communities*. Burnaby: Simon Fraser University & The Land Conservancy. Retrieved March 21, 2010 from: [http://www.bitsandbytes.ca/resources/community\\_farms1.pdf](http://www.bitsandbytes.ca/resources/community_farms1.pdf)

Select Standing Committee on Agriculture (1978). *Land Productivity in British Columbia*. Province of B.C. Legislative Assembly.