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Conducting a Sustainability Assessment of UBC Food Services' Meat and Meat Alternative Food Products

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Scenario 2:

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By: Group 5

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Abstract

University of British Columbia Food Services (UBCFS) is one of the two main food providers serving over 45,000 students at the Vancouver Campus. UBCFS teamed up with the students of LFS 450 to conduct a life cycle assessment (LCA) on the four main meat proteins (pork, chicken, beef, and plant-based) served at the residence dining halls of Place Vanier and Totem Park. Our group specifically analyzed the sustainability of fresh pork products. The inputs and outputs at the four main stages of pork production (feed-crop agriculture, pig housing, slaughterhouse, and transportation) were examined. Inputs included land, energy, and water; whereas for outputs, the greenhouse gases (GHG) methane, nitrous oxide, and carbon dioxide were assessed. The functional unit used is 53kg of fresh pork and all the GHG emissions were converted into carbon dioxide equivalents to simplify the results.

A total of 101,255 kg of CO_2e is released from the production of fresh pork that UBCFS consumes annually. The slaughterhouse contributes the most to GHG emissions (~411 kg CO_2e/pig), while transportation is less of a concern since UBCFS mainly receives its pork sources from the British Columbia lower mainland. The prices of organic pork sources were found to be double the current prices UBCFS receives from their supplier, Centennial Food Service. Recommendations to UBCFS include incorporating animal welfare guidelines into their Request for Bid form, while a further investigation by future LFS 450 students is recommended prior to introducing organic pork into the menus at Vanier and Totem.

Introduction

The area of focus in this paper is on conducting a sustainability assessment of UBC Food Services' (UBCFS) meat and meat alternative food products. Our LFS 450 group, along with three other groups, collaborated with UBCFS and were assigned the task of recommending more

sustainable protein options to our community partners, Dorothy Yip and Andrew Parr. The protein choices under investigation were chicken, beef, pork and tofu. Our group focused specifically on fresh pork products offered at the Totem Park and Place Vanier student residence cafeterias. Currently, UBCFS is the primary food service provider at the University of British Columbia (UBC), and they are actively involved in the sustainability movement in the campus food system (Green Report, 2008). Although UBC Food Services has become involved in a number of sustainable initiatives and integrated many sustainable practices into their food outlets, the issue of meat selections that is offered in their outlets has not yet been addressed.

The purpose of this paper is to provide recommendations from our literature and group findings for more sustainable fresh pork products. We investigated carbon dioxide equivalent (CO_2e) emissions from pig production using a Life Cycle Assessment. We formulated a Life Cycle Assessment by collecting data and information from previous research reports and meetings with stakeholders (pork distributors and suppliers). As well, we considered questions such as: What ecological impacts do the protein option have? How sustainable are the protein options offered at UBCFS cafeterias? What are the indicators for their sustainability? Do other products exist that would help enable UBCFS to become a true model of a sustainable food service provider? In doing so, we were able to use the information to assist us in our findings and to provide recommendations for UBCFS. Specifically, this paper consists of an overview and objective, identifying the problem, central findings, discussion and recommendations.

Problem Definition

The consumption of animal products has increased dramatically as a result of the the world's growing population (Zhu & van Ierland, 2004). Presently, in the industrial world, the annual consumption of meat per person is approximately 80 kg (Halweil, 2008). The rise in the

production of animal protein foods has also caused significant negative impacts on environmental health (Zhu & van Ierland, 2004). In order to support the high demand for animal products, there is more reliance placed on industrial farming and the use of concentrated animal feeding operations (Halweil, 2008). The animals are raised in poor housing conditions (ie. crowded spaces) and have little exposure to sunlight or pasture (Salvi & Hatz, 2004). Furthermore, antibiotics are incorporated into animal feed to prevent the spread of diseases between animals (Salvi & Hatz, 2004); in the long term, resulting in an increase in antibiotic resistant bacteria worldwide (Salvi & Hatz, 2004). Other than animal health concerns, the manure generated from factory farms is polluting rivers and streams; thus, imposing significant damages to both environmental and human health (Salvi & Hatz, 2004).

Pork is consumed in the greatest quantity worldwide in comparison to other types of meat (Zhu & van Ierland, 2004). Factory farms depend on commercial breeding of pigs that gain weight quickly when fed a high protein diet (Halweil, 2008). China is currently the largest pig producer in the world but other countries in South America are also expanding their pork production industry (Halweil, 2008). At each stage of the pork production chain, harmful effects are being imposed on the environment, particularly by means of the greenhouse effect (Zhu & van Ierland, 2004). It has been stated that the high levels of greenhouse gas (GHG) emissions observed are mainly due to human activities (Lague, 2003). In Canada, closely following behind the transport sector and electricity sector, the agriculture sector is demonstrated to be the third major source of greenhouse gas emissions (Lague, 2003). 42% of the total agricultural GHG emissions in Canada originate from the livestock industry (Langue, 2003). This is approximately 0.13% of the global GHG emissions from human activities (Langue, 2003). Methane (CH_4), carbon dioxide (CO_2) and nitrous oxide (N_2O) are three major greenhouses gases in the

atmosphere (Sutton, 2010). These gases maintain the Earth's temperature and prevent the removal of energy from Earth into space (Sutton, 2010). However, the increase in these greenhouse gases have led to considerable changes in climate and warming of the Earth (Sutton, 2002). Some consequences of global warming that have been proposed include the rising of the sea levels, melting of glaciers, possible reduction in global food production, and higher flood risks due to extreme precipitation (LiveSmart BC, 2007a). In addition to the greenhouse effect, other pressures placed on the environment which are associated with the pork chain include acidification and eutrophication, fertilizer, pesticide, land and water usage (Zhu & van Ierland, 2004).

Specifically, two of the main challenges UBCFS face in the purchase of meat products is quantity and cost. In terms of quantity, Place Vanier and Totem Park constantly require large amounts of meat products that many local, organic farms are unable to provide. In terms of price, a shift to grass-fed, organic, and locally grown pork can have a huge increase in price per kilogram. Since high volumes of meat products have to be purchased, a large increase in price makes many farms not an economically feasible option for UBCFS.

Vision Statement and Identification of Value Assumptions

1. Food is locally grown, produced and processed.
2. Waste must be recycled or composted locally
3. Food is ethnically diverse, affordable, safe and nutritious
4. Providers and educators promote awareness among consumers about cultivation, processing, ingredients and nutrition
5. Food brings people together and enhances community
6. Is produced by socially, ecologically conscious producers
7. Providers and growers pay and receive fair prices

Our group as a whole agrees with all seven principles that make up The Vision Statement for a Sustainable UBC Food System. Although our specific scenario touched on all seven values we feel that our project specifically relates to statements 1, 2, 6 and 7. Our community partners

asked us to find more sustainable choices of pork products which directly relates to principles 1, 2, and 6. We looked for local producers, slaughterhouses, and distributors, as well as organic farms, and ways to reduce packaging waste. Principle 7 relates directly to pricing which was a big part in our project. No option would be completely sustainable if economically it was unaffordable to UBCFS. Our group also came up with one principle that we felt should be added. In meat production it is important to have strong animal welfare standards throughout every stage of the animal's life (at the farm, slaughterhouse, and in transport). Adding in our value assumptions regarding animal welfare we believe that a statement stating, "Choose meat products from producers with humane animal practices" should also be included in the overall vision statement.

Methods

There were three main ways in which we collected data and information for this study. First, literature review searches were conducted to look for previous life cycle assessment studies that have been performed on pork products. In addition, online searches were conducted to find more sustainable, fresh pork options available locally (ie. preferably within BC) from organic pork producers and distributors. Information regarding UBCFS sustainability initiatives and procurement practices were also gathered from the UBCFS online publications. Second, we conducted interviews with several individuals and groups. A face-to-face interview was carried with Steve Golob, head chef at Place Vanier, to discuss the students' interests on the type of food products available and the types of pork products he prefers using as a chef. A phone interview was conducted with a sales representative from Centennial Food Service to gather information regarding their pork sources as well as the location of their facility and the slaughterhouse. We discussed with our community partners from UBCFS, Dorothy Yip and Andrew Parr, in terms of

what they would like us to focus on for this study (ie. fresh pork products). We paid a visit to the Place Vanier and Totem cafeterias and talked to some of the staff members there in regards to the staffs' waste disposal practices. Finally, the main methodology that was employed in this study was conducting a life cycle assessment on the fresh pork products purchased by UBCFS.

Life Cycle Assessment (LCA) is a method for analyzing the environmental impacts that occur throughout a life cycle of a process, product or service (Kim et al., 2008). In the food industry, the LCA method focuses on assessing a product from cradle-to-grave (ie. begins from the raw materials production, production of the final product, product usage, and disposal of the product) (Kim et al., 2008). It also gives an overall picture of the types of inputs and outputs along the whole process chain (Zhu & van Ierland, 2004). The impacts on the environment are quantified at each stage of the cycle and the results are highly useful for food producers and distributors to identify at which stage(s) of the cycle is/are the environmental impacts most severe (Kim et al, 2008). Moreover, the results from the LCA of different food products can be compared which enables consumers to select the food products that have smaller degrees of environmental impacts (Kim et al., 2008). In this study, the LCA method is employed to determine the carbon footprint of fresh pork products purchased by UBCFS. This is conducted by quantifying the greenhouse gases that are emitted from the processes involved in pork production (Zhu & van Ierland, 2004).

The Life Cycle Assessment method encompasses four stages (Kim et al., 2008). The stages include a) goal and scope definition, b) inventory analysis, c) impact assessment and d) interpretation (Zhu & van Ierland, 2004). Goal and scope definition refers to defining both the purpose, boundaries of the system and functional unit (Kim et al., 2008). The system boundary indicates the parts of the entire system that is included in the life cycle assessment (Kim et al.,

2008). In some cases, rather than assessing the complete system, specific segments (ie. cradle-to-gate, gate-to kitchen) of the cycle are analyzed (Kim et al., 2004). The functional unit describes the product from which the impact results will be based on (Kim et al., 2004). The inventory analysis stage calculates the resultant environmental impacts from inputs and outputs (Zhu & van Ierland, 2004). Impact assessment refers to the interpretation of the results obtained from the analysis (Kim et al., 2004). The impact results can be grouped into categories such as global warming, acidification and eutrophication (Kim et al., 2004). Greenhouse gases such as carbon dioxide, methane and nitrous oxide are expressed as carbon dioxide equivalents so as to yield one overall indicator of global warming potential (GWP) (Kim et al., 2004). The interpretation stage examines possible recommendations and improvements that can be made at the stage(s) in the life cycle (Kim et al., 2008).

The system boundaries defined in this study initiates from the raw ingredients (soybean) production and ends at the consumer (UBC Food Services) gate. The components of the pork chain that this study will concentrate on are feed-crop agriculture (soybean meal) (stage 1), pig housing (stage 2), slaughterhouse (stage 3), transport of fresh pork to distributor (stage 4), and transport of fresh pork to consumer (UBC Food Services). The functional unit is defined as 53 kg fresh pork product which represents the amount of pork a pig at an average weight of 112.2 kg gives (Zhu & van Ierland, 2004). The sustainability assessment in this study focuses specifically on the impact of the pork chain on global warming. Hence, the analysis of the impact results will be concentrated on the amount of greenhouse gases (CO_2, CH_4 and N_2O) emitted at each stage of the system. Figure 1 below shows the inputs and outputs at each stage of the pork chain. Sustainability in the context of this study is defined as actions that will lower greenhouse gas emissions as well as promote animal welfare.

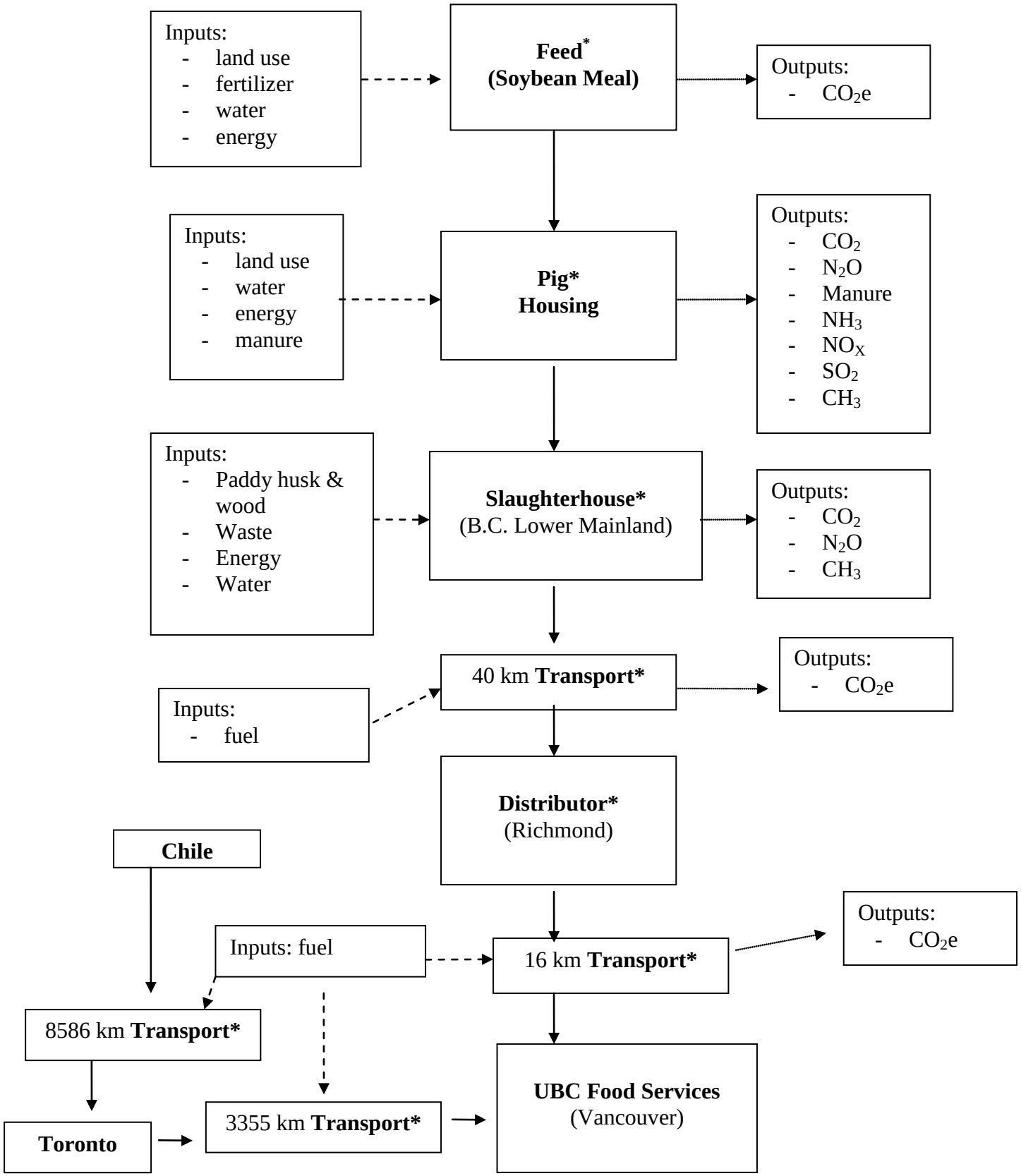

Figure 1: This shows the inputs and outputs at each stage of the pork chain.
* Indicates the stages where CO_2e emissions are estimated & included in fresh pork production LCA

Findings

i) Feed-crop Agriculture

A pig's diet is composed of a variety of ingredients such as rapeseeds, barley, sunflower meal, wheat, and soybean meal (Dalgaar, Halberg, & Hermansen, 2007). Soybeans are high protein sources for livestock and, therefore are the main components of a pig's diet. In the first stage of feed-crop agriculture, we focused on soybean meal due to the fact that soybeans are the main components of a pig's feed, thus contributing to most of the greenhouse gas emissions in comparison to rapeseeds, barley, and other grains (Garnett, 2009). With an increase in demand for meat products, production of soybeans and soybean meal accelerates in a rapid pace (Dalgaard, Schmidt, Halberg, Christensen, Thrane, & Pengue, 2008). This results in a loss in the biodiversity of crops as well as dramatic increases in greenhouse gas emissions from agricultural production (Dalgaard et al. 2008).

The main inputs of processing soybean meal are land use, fertilizer, water, and energy (Dalgaard et al. 2008), while the greenhouse gas outputs are methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2). Growing soybeans require agricultural land, water, and energy. To produce 1.00 kg of soybean meal, an estimate of 1.21 kg of soybeans are required; thus, requiring 4.5 m^2 of agricultural land (Dalgaard et al. 2008). Transportation from soybean farm to soybean mill is not included due to lack of data provided; however, an approximate estimate of energy use for processing soybean meal is included.

A pig eats approximately 290 kg of soybean meal in its lifetime (Zhu & van Ierland, 2010). The lifetime of a pig is assumed to be approximately 5 months before it is sent to the slaughterhouse. In order to supply this amount of soybean meal, 1305 m^2 of land is needed to harvest 350.90 kg of soybeans (Dalgaard et al., 2008). Fertilizer use contributes the most to the

greenhouse gas emissions at this stage of the life cycle assessment. Phosphorus and potassium levels are assumed to be in their optimal level in the farm soil. Therefore, no N-fertilizer is needed while 5.97 kg of P-fertilizer and 8.77 kg of K-fertilizer are required to ensure that approximately 350.90 kg of soybeans are harvested for 1305 m^2 of land (The Pennsylvania State University, 2010). From the soybean farm, the soybeans are transported to soybean mills to be further processed. Processing requires the use of 4.14 kW of electricity to produce sufficient soybean meal (290 kg) for a pig to consume over its life time. (Dalgarrd et al., 2008).

Converting the amount of fertilizer use and electricity to carbon dioxide equivalents (CO_2e), the use of P-fertilizer on the soil emits approximately 5.90 kg of CO_2e while the use of K-fertilizer emits an estimate of 6.87 kg of CO_2e. The energy use from soybean mill for the processing of a pig's life time supply of soybean meal is approximately 2 kg of CO_2e. Summing up all the amount of CO_2e, the feed stage contributes to an estimate total of 14.77 kg of CO_2e/animal in the pork production chain. (Wood & Cowie, 2004)

ii) Pig Housing

The inputs associated with pig housing include energy, water and land use, and the outputs include manure, NH_3, CH_4, N_2O, CO_2, NO_x, SO_2 (Zhu & van Ierland, 2004). The majority of the carbon dioxide emission in swine production systems is derived from animal respiration (Lague, 2003). In addition, the aerobic and anaerobic decomposition of organic matter such as feed material and manure by microbes produces CO_2 (Lague, 2003). Methane (CH_4) is released as a result of the fermentation of feed materials in the pig's intestine as well as the manure management system in pig production (Lague, 2003). The nitrous oxide (N_2O) emission is also released from microbial decomposition of manure (Lague, 2003). Further N_2O is

produced when the manure is applied to the land for the purpose of crop production due to other biochemical processes such as nitrification and denitrification (Lague, 2003).

The amount of carbon emissions from swine production buildings in Saskatchewan and Quebec is studied by a group of researchers and this study is cited in Lague's (2003) review. In the study, the total greenhouse gas emissions from finisher pigs was detected in an 8-week period (Lague, 2003). It was found that each animal produces 22.50 g/kg living weight of CH_4 annually (Lague, 2001). The annual CO_2 emission was determined to be 405.2 g/kg living weight and the annual amount of N_2O emitted was 0.6779 g/kg living weight (Lague, 2001). By assuming that each pig is slaughtered at a life-time of 5 months and weighing approximately 112.2 kg (Zhu & van Ierland, 2004), a pig will emit 1.0 kg, 19.0 kg, and 0.03 kg of CH_4, CO_2 and N_2O respectively. The amount of carbon dioxide equivalent converted from 1.0 kg of CH_4 is 21.9 kg and 0.03 kg of N_2O constitutes 9.8 kg of carbon dioxide equivalent. The total carbon emission generated from a finisher pig at the swine production building is estimated to be 50.7 kg CO_2 equivalent per animal.

The method of pig manure storage also affects the amount of greenhouse gas emitted. As reviewed by Lague (2003), a group of researchers conducted a study on detecting the amount of methane, carbon dioxide and nitrous oxide emitted when a deep litter manure storage system is employed. The findings show that 191 g of CH_4, 7.37 kg of CO_2 and 58 g of N_2O are released per tonne of manure (Lague, 2003). By assuming that the average pig produces 2.7 kg of manure per day (Agriculture and Agri-Food Canada, 1998), the storage of manure produced from one pig will release 0.08 kg of CH_4, 3.1 kg of CO_2 and 0.02 g of N_2O. The amount of carbon dioxide equivalent converted from 0.08 kg of CH_4 is 1.6 kg and 0.02 kg of N_2O corresponds to 7.4 kg of carbon dioxide equivalent. The total carbon emissions from deep litter manure storage system of

a pig are estimated to be 12.1 kg CO_2 equivalent per animal. At the stage of pig housing, the estimated carbon emission based on the emissions from both swine production building and manure storage facility is approximately 62.8 kg CO_2 equivalent per animal.

iii) Slaughterhouse

18% of human induced greenhouse gas emissions are a result of the ranching and slaughtering of cows and other animals (Examiner National, 2009). Also the handling, storage, and utilization of slurry at the slaughterhouse all contribute to greenhouse gas emissions ("Danes reduce," 2009). Replacing artificial fertilizer with pig slurry can help to reduce the emissions ("Danes reduce," 2009). Improvements have been made in minimizing energy consumption in the meat industry by transforming slaughterhouse wastes into environmentally friendly biodiesel ("Danes reduce," 2009). The main inputs in a slaughterhouse are energy and water usage (Zhu & van Ierland, 2004). The main outputs are CO_2, NO_x, SO_2, CH_4, ferric chloride, and waste materials (Zhu & van Ierland, 2004). Slaughterhouse waste water is harmful to environment, causing deoxygenation of rivers and contamination of ground water (Masse & Masse, 2000). Furthermore, the blood from slaughtered pigs dissolves in water and has a chemical oxygen demand of 370 000 mg/L. As a result, 50% of the pollution in waste water contains insoluble and slowly biodegradable suspended solids (Masse & Masse, 2000).

In a 1995 study, 6 hog slaughterhouses were visited by researchers to examine the slaughterhouse waterway quality. The quality of the waterway depends on the blood capture of the waterways, the efficiency in blood retention during animal bleeding, and water usage within the slaughterhouse (Masse & Masse, 2000). The type of animal slaughtered plays an important role because the biological oxygen demand in the waste water is higher for cows than pigs (Masse & Masse, 2000). Slaughterhouses that are specific for animal slaughtering produce less

wastewater than slaughterhouses that also carry out meat processing activities (Masse & Masse, 2000). In an European pork study, it was found that at the stage of the slaughterhouse, the release of CH_4 and CO_2 is due to the enteric fermentation and respiration of feces and wastewater (Thanee et al., 2009). The findings of the study show that the production of CH_4 was 0.0071 kg /head/day which is equivalent to 22.5 kg of CO_2e of the entire life time of a pig. In addition, the release of CO_2 was 0.2536 kg /head/day which corresponds to 37.5 kg of CO_2e (Thanee et al., 2009). Greenhouse gases are also emitted from the use of electricity and transportation. Electricity emits 7.5 kg of CO_2e, transportation emits 1.50 kg of CO_2e, and wood and paddy husk emits 342 kg of CO2e (Thanee et al., 2009).

Currently, Canada only uses an aerobic digestion treatment for waste water (Masse & Masse, 2000). This means that microorganisms degrade organics in the presence of oxygen. This kind of system requires daily maintenance and daily drainage from the accumulation of sludge (Masse & Masse, 2000). A disadvantage of using an aerobic system is that it generates large quantities of biological sludge that must be treated again before disposal (Masse & Masse, 2000). The more wastewater is present, the more time and oxygen is required. Overall the estimated carbon emissions from this stage in the pork chain are approximately 411 kg CO_2 equivalents per pig.

iv) Transport

The combustion of fossil fuel created by transportation contributes to CO_2 emission greatly, accelerating the pace of global warming, air pollution, and climate change (Bentley & Barker, 2005). From the phone interview with Centennial Foodservice sales representative, all their fresh pork products come from pig farms that are located in the B.C. lower mainland. The slaughterhouse is located Langley and Centennial Foodservice (distributor) is located in

Richmond. (T. Lui, personal communication, April 9, 2010). However, unfortunately in the case of pork shortages, Centennial food service receives its pork products from Chile (T. Lui, personal communication, April 9, 2010).

The main inputs of transportation between slaughterhouse to distributor and distributor to UBC are energy and fuel while the outputs are the greenhouse gases, methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2). In this life cycle assessment, refrigeration trucks with an estimated mpg of 7 are assumed to be the main transportation of local fresh pork products, using diesel as its main fuel source. When pork products are in shortages, cargo planes become the main mode of transport for shipping pork products from Chile to Canada. Since there is no direct flight from Chile to Richmond (Centennial Foodservice), pork products need to first arrive at Toronto and then are transported to Richmond via refrigeration trucks.

To calculate the CO_2e emitted from fuel combustion, the approximate distances between the slaughterhouse and distributor (Centennial Foodservice) as well as distributor and UBC foodservices are estimated. Based on mpg (~7) of an average refrigeration truck, transporting one pig product from the slaughterhouse (Langley)to the distributor (Richmond) (40 km) uses an estimate of 16 L of diesel (National Energy Foundation, 2009); this releases an approximate amount of 42 kg of CO_2e. Furthermore, to deliver one pig from the distributor to UBC Food Services (~16km) requires an estimate of 6.4 L of diesel fuel, which releases an approximate value of 17 kg of CO_2e (National Energy Foundation, 2009). The total CO_2e emission from transporting one pig from the slaughter house to UBC Food Service via distributor is 59 kg of CO_2e/animal. However, when there is a shortage of local pork the total CO_2e emissions increase substantially. An estimate of GHG emissions from fuel combustion transporting fresh pork products from Chile to Toronto is 1547.18 kg of CO2e for flying a distance of 8586 km

(National Energy Foundation, 2009 & Travel Math, 2010). From Toronto, the fresh products are then transported to Richmond via cargo planes. Such transportation requires an estimate of 973 kg of CO2e from flying a distance of 3355 km (National Energy Foundation, 2009 & Travel Math, 2010). To sum up the amount of CO2e emission from receiving fresh pork products outside of Canada, the total estimate value is 2537.18 kg of CO2e/animal; making a significant difference than receiving fresh pork products from local pig farms.

v) Current Waste Disposal Procedures at UBC

In 2004, UBC Foodservices (UBCFS), UBC Waste Management and AGSC 450 students from Faculty of Land and Food Systems coordinated together to initiate composting practices by placing composting bins with posters identifying compostable material in all food outlets, kitchens, and offices (Richer, 2009). Ever since then, UBCFS has been a major participant in composting and recycling re-usable materials. In UBCFS' Request for Bid Form (RFB), it states "UBC Food Services appreciates the potential for environmentally sound products and reducing solid waste packaging".

Types of packaging for pork products from Centennial are plastics, wax paper, and cardboard boxes (S. Golob, personal communication, April 9, 2010). Pork products such as pork chops are individually quick frozen and layered between sheets of wax paper, then packaged in cardboard boxes (S. Golob, personal communication, April 9, 2010). Other pork strips or diced pork products that are used in stir-fry dishes are vacuumed packed in plastics then packaged in cardboard boxes (S. Golob, personal communication, April 9, 2010). Vanier cafeteria kitchen staff members' waste management is thorough and is ready to be picked by UBC Waste Management regularly. Cardboard boxes are compacted and composted while wax paper is washed and recycled. Unused pork ingredients are not wasted but are used in other forms of

cooking, such as stir-fry and stews (S. Golob, personal communication, April 9, 2010). The only packaging material that goes into the land fill is plastics (S. Golob, personal communication, April 9, 2010).

At the cafeteria, ceramic plates and metal forks, knives and spoons are provided for dining in. These cutleries are sanitized and reused. For take outs, the types of food product packaging are plastics for wraps and sandwiches, styrofoam soup bowls, plastic lids, Dixie reusable containers, paper plates, plastic cups, compostable paper bags, bio-degradable cutlery and bio-degradable containers. To reduce the amount of waste going into the garbage bins, all the take-out paper plates and boxes are charged with 10 cents green-tax while Dixie's reusable container can be bought for 50 cents each. Compost, recycle, and garbage bins are located in convenient spots with noticeable signs accompanied with decent explanation for compostable items. However, students appear to have poor disposal practices as food scraps, biodegradable cutlery and recyclable cans were observed to be thrown in the garbage bins instead of the appropriate bins. Overall, UBC Food Services' kitchen staff have extensive knowledge and practices for proper disposal procedures.

vi) Animal Welfare Standards

According to the British Columbia Farm Animal Care Council, in 1993, Agriculture Canada established a code of practice in the handling and care of pigs to ensure high standards of pig production and handling that will promote the well-being of the animal. In putting this code into practice, the pigs are able to maintain their normal way of life. Some of the basic factors of responsible animal care includes: comfort and shelter, opportunity to exercise, avoidance of unnecessary surgical alterations, opportunity for reasonable movement, access to fresh water and diet to maintain the health of the animal, prevention of disease, light of appropriate duration and

intensity (Agriculture Canada, 1993). These codes of practice are designed to avoid inhumane treatment of animals and promote responsible animal welfare standards and practices.

For example, a pig house must provide conditions suitable through all of the stages of a pig's life such as comfort, growth, good health and performance (Agriculture Canada, 1993). In addition there are proper ventilation and temperature requirements specific to a pig's size and age. Producers have a responsibility to ensure that the pigs are given the right amount of nutritious feed and that area of residence is clean with proper ventilation. The handling and transport of pigs is also an important factor to consider. Pigs often experience stress when being loaded or unloaded during transport from one place to another. If the handling is not done appropriately, then the trauma and stress can have negative effects on the pig (Agriculture Canada, 1993). Well-established handling facilities will reduce the stress and anxiety level of a pig to ensure easy and quick human sorting, treating and uploading of pigs (Agriculture Canada, 1993). The excitement and stress caused as a result of transport can have serious consequences and detrimental health effects for the animal such as heart failure or Porcine Stress Syndrome (Agriculture Canada, 1993). The provision and strict appropriate care is essential in order to achieve good productivity. That is why it is important for producers to follow the animal welfare standards and employ ethical human labor practices.

vii) Alternative Organic Pork Sources

Hills Food Ltd is a distributor of certified organic meats located in Coquitlam, BC (Hills Food Ltd). One of their farm suppliers of pork is from First Nature Farms. First Nature Farms is a 3300 acre farm located in Goodfare, Alberta (First Nature Farms, 2005). They pride themselves on raising organic, heritage breed pigs who have the freedom to move around and overall have a higher quality of life. This farm has organic and SPCA certification. The latter means that their

farm follows the SPCA's high farm animal welfare standards and allows annual, random inspections by professional third parties (BC SPCA).

Discussion:

i) From Our Life Cycle Assessment Analysis

UBC Food Services (UBCFS) purchases 10,026.41 kg of fresh pork products and spends approximately $70,000 on these purchases annually. Based on the LCA, the total annual carbon dioxide equivalent emission is estimated to be 101,255 kg carbon dioxide equivalent (CO_2e). This is approximately 0.00015 % of annual provincial CO_2e emission which is very minimal based on the 2007 total greenhouse gas emissions (67.3 million tonnes) in British Columbia (LiveSmart BC, 2007b). However, the values obtained in this study may also be overestimated or underestimated since many assumptions were made at each stage of the cycle. At the stage of feed crop agriculture, other components of pig's feed were not included in the contribution of CO_2e emission due to the fact that soybeans are high in protein and are main ingredients in pig feed (Dalgaar et al. 2007). With the assumption of optimal levels of phosphorus and potassium in soybean field, the use of fertilizers may be underestimated (The Pennsylvania State University, 2010). As well as not including transport between soybean farm and soybean mill in LCA due to time constraints, contribute to an underestimation of CO_2e emission at the feed crop agriculture stage. At the stage of the pig housing, the GHG emissions from energy usage were not accounted for since the majority of the gases come from the animals. Also, the GHG emission values for the manure storage facility were based on the use of a deep-litter manure storage system at the pig house. Depending on the type of manure storage facility employed, the GHG emitted will also vary (Lague, 2003).

The results from the life cycle assessment revealed that out of all the stages of the pork chain, the majority of the greenhouse gas emissions come from the slaughterhouse. Methane appears to contribute the most to greenhouse gas emissions at this stage and is mainly derived from enteric fermentation of the pigs. Both the carbon emissions from transport and electricity at the stage of the slaughterhouse are less significant as both of these factors only mildly contribute to the total carbon emissions. Since the slaughterhouse and distributor are located in the Lower Mainland (T. Lui, personal communication, April 9, 2010), both the transport from the slaughterhouse to the distributor as well as from the distributor to UBC generally contribute significantly lower CO_2e emissions relative to the emissions from the other stages. However, in the case of pork shortages, transport becomes a critical issue since Centennial Food Services relies on sources outside of Canada (ie. Chile). The carbon emissions derived from the use of cargo planes as the mode of transport are much larger (5x) than the emissions from the slaughterhouse.

Although the final value only makes up a small portion of the total annual carbon dioxide emissions in BC, it does not mean that improving the practices regarding pork at UBC is not an important issue. Finding a way to reduce emissions, (ie. by switching to organic pork or by removing plastic from the packaging materials) will play a role in both reducing the $C0_2$ emissions UBC creates over the years, and by setting an example to UBC students and other food providers. When looking at the data comparing the $C0_2$ emissions from local pork compared to the imported pork from Chile it is easy to see that locally produced food is much better for the environment. This result meant that our group only looked for local distributors and producers who could potentially supply pork to UBCFS.

ii) Food outlets with high level sustainability initiatives

An on-campus food outlet that is characterized by high level sustainability initiatives is Sprouts. Sprouts, located in the Student Union Building at UBC, is a food outlet that is 100% managed by student volunteers (Sprouts, 2009). At Sprouts, they strive for food products that are affordable, organic, local, fair-trade as well as products that have minimal packaging, and meet dietary needs (Sprouts, 2009). In addition, customers at Sprouts are encouraged to bring their own food containers and they do not provide take-out containers (Sprouts, 2009). UBC Food Services presently uses biodegradable materials for most of their take-out containers and cutleries at Place Vanier and Totem Park, except for the soup bowls and cold cups (UBC, 2010). Soup bowls are made of styrofoam and cups are made of plastic. Although it is impossible for UBC Food Services to completely eliminate take-out containers as Sprouts has, they may wish to further reduce their unsustainable food packaging materials to a minimal through introducing new types of soup bowls and cold cups that are recyclable or biodegradable. Also, one of Sprouts' initiatives is to support local producers that employ sustainable farming practices such as the UBC farm. Currently, UBC Food Services purchase green vegetables and herbs every summer from the UBC Farm which is approximately $3000 purchase value (UBC, 2010). UBC Food Services may wish to increase students' awareness of local and organic foods through featuring the ingredients that are from local sources on their menu items.

An off-campus food outlet that is characterized by high level sustainability initiatives is Raincity Grill. It is located on the west end of Vancouver, in close proximity to English Bay. The owner, Harry Kambolis, uses both local ingredients and produce that are available which helps to define the cusine of the Pacific Northwest (Raincity Grill, 2006). The owner is dedicated to provide menu items which are mostly comprised of local ingredients including seafood, poultry

and organic vegetables which originate from British Columbia, Alberta, Washington state and Oregon (Raincity Grill, 2006). Although UBC Food Services is presently taking part in the sustainable seafood program, which ensures that non-endangered seafood are captured in a sustainable method (ie. meet Ocean Wise standards) (UBC, 2010), they may wish to incorporate more local seafood products and feature them in menu items similar to Raincity Grill. In addition, the Raincity Grill homepage features a list and a description of the local and/or organic food suppliers from which the restaurant obtains their food ingredients. This helps to increase awareness and support to local farmers that are carrying out sustainable practices. UBC Food Services may also help to promote sustainability awareness and the importance of local and organic foods through featuring their local and/or organic suppliers on the UBC Food Services homepage.

iii) Challenges Encountered

One of the main challenges that we have faced while working on this project was the difficulty with contacting the community partners. Emails with our questions were not replied back until three weeks later. In addition, Centennial Food Service did not provide us with information regarding the location of their pork sources and as a result, a lot of assumptions had to be made in our life cycle assessment. Another challenge was in coming up with recommendations for UBC Food Services that do not require them to change their current pork supplier. UBC Food Services is currently under a contract for 2 years with Centennial Food Service and thus, a recommendation on switching suppliers is not plausible in the short run. Centennial also offers a rebate and loyalty program to UBC Food Services which means that UBC receives highly favorable prices from them. This means that any supplier our group was able to find had much higher prices for pork products. For example, you can see in Figure 2 that

when comparing the prices of the same pork products from Centennial to Hills Food Ltd the prices of the organic pork more than double the prices of the conventional pork.

	(Certified Organic) Hills Food ($/kg)	Centennial ($/kg)
Pork Chop	35.71	7.55
Pork – Loin	31.61	6.79
Pork – Butt	11.64	4.95

Figure 2: This shows the price points of pork products from Hills Food and Centennial (Hills Food Ltd) (S. Golob, personal communication, April 9, 2010).

Recommendations

i) To UBC Food Services

UBC Food Services (UBCFS) provides Request for Bid forms (RFB) to potential meat distributors and gives preferences to the distributor that best fits the requirements on the RFB form. Conditions such as reduced packaging material for meat products, and meat products that have less negative environmental impacts are required for food distributors to become a potential bidder (e.g. "UBC Food Services appreciates the potential for environmentally sound products" stated in the RFB for meat). However, no more specific information or guidelines are incorporated into RFB for potential competitors to abide by. Therefore we suggest that UBCFS updates their RFB forms by adding a section for animal welfare standards where UBCFS asks potential suppliers to follow the recommended Code of Practice for the Care and Handling of Farm Animals that was created by the British Columbia Farm Animal Care Council (Agriculture and Agri-Food Canada, 1993).

UBCFS currently purchases local pork products through the distributor Centennial except in the case of shortages (unfortunately Centennial was unable to say how often this occurred). It is therefore possible to recommend an organic pork source where pigs are pasture-raised and fed with hormone and anti-biotic free feeds. However, due to a 2-year contract with Centennial as well as the rebates and loyalty program they offer UBC, the price of pork products would increase substantially if UBC Food Services were to switch suppliers. Since there is an uncertainty to whether students are willing to pay for this price increase and due to past organic initiatives (Think Organic) being unsuccessful at Vanier and Totem, we suggest that UBC Food Services incorporates organic pork into their menu slowly. First we recommend future LFS students create a survey (see more in the next section), and then depending on the results we recommend UBC Food Services does a test run on incorporating organic pork into one item on the menu, therefore evaluating the students' true response to it.

ii) To Future LFS 450 Students

Future LFS students could conduct a life cycle assessment on organic certified pork from the local distributor, Hills Foods. This new data found could be compared to this project's findings and then used to help UBC Food Services decide whether or not to change distributors, and what affect Hills Food purchasing from Alberta farms has on greenhouse gas emissions. We also recommend that future students conduct a survey to the students at both Vanier and Totem cafeterias, using Hills Foods price list, to see if they would be willing to pay more for the organic pork. Included in this survey should not just be the price differences, but also information on the organic farms (ex: First, Nature Farms) and on the improved taste from eating organic so students understand why it is worth it to pay more for organic.

Presently, UBCFS recycles most of their packaging materials (ex: cardboard and wax paper), and composts or reuses most of their food waste. Unfortunately, the plastic wrap that comes around the fresh pork in delivery is thrown out. Our group recommends that future LFS students could research into a more sustainable packaging material, for example a biodegradable plastic, that could replace the plastic wrap in delivery, and is both suitable for fresh meat during distribution and affordable. Also during a visit to Vanier and Totem our group noticed weak composting efforts by the students at the cafeterias, although the composting bins were clearly marked. Next year a group of LFS students could brainstorm ways to improve the composting efforts by students. Creating posters with pictures and samples (not just words) of what can be composted next to the bins, and students visiting the dorms or first year classes giving a quick demonstration about composting were just a few ideas our group came up with.

Lastly, since four groups participated in this scenario and completed Life Cycle Assessments on pork, chicken, beef, and meat alternatives, we recommend that future students compare and contrast the results found in their group's LCA in order to determine the differences in sustainability. They could then take this information and work with the students and chefs at Vanier and Totem to find ways to increase the consumption and demand for the more sustainable protein sources. For example new recipes, posters and pamphlets explaining to students how by ordering this dish they are helping the environment.

Conclusion

In conclusion, the data retrieved from the life cycle assessment of fresh pork products used by UBCFS revealed that the slaughterhouse contributes the greatest amount of GHG emissions in comparison to the other stages in the pork chain. Transportation does not appear to be a significant issue unless there is a shortage of fresh pork which under such circumstance, the

supplier has to receive its pork products from Chile. As a result, the GHG emissions from transportation will increase significantly. This result demonstrates the importance of purchasing locally, and if UBCFS decides to purchase organic pork products in the future it is important for them to purchase from local organic pork producers. In addition, the high organic prices offered by Hills Food indicate that more studies needs to be carried out in order to determine if organic pork is an economically viable option for Place Vanier and Totem Park. Overall more research still needs to be conducted before UBCFS becomes a true model of a sustainable food service provider.

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