UBC Social Ecological Economic Development Studies (SEEDS) Student Report

Measuring Sustainability in Universities: Successes, Challenges, and Guidance in Conducting an Ecological Footprint Assessment of the UBC Campus

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Measuring Sustainability in Universities: Successes, Challenges, and Guidance in Conducting an Ecological Footprint Assessment of the UBC Campus

(Scenario 7: *Investigating the Overall Ecological Footprint of the University of British Columbia Point Grey Campus Food System*)

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ABSTRACT

The following report explores the rationale, methodologies and assumptions to conduct an Ecological Footprint Analysis (EFA) of the UBC Point Grey campus which will aid future Land, Food, and Community III (LFC III) colleagues to perform an actual EFA at UBC.

Our group explored the idea of performing an EFA of the UBC food system, but instead chose to focus on the entire UBC campus in the hopes that our work would help later groups identify and ameliorate the areas of largest contribution to UBC's ecological footprint (EF). We saw that across the world, the universities that chose to conduct EFAs also focused on the entire campus and that the food system was a relatively small contributor to a campus' EFA. We recommend that Rees and Wackernagel's Consumption Land Use Matrix methodology be used to perform the EFA using the data collected from a variety of sources across campus.

It is our belief that an EFA can become an important educational tool and a cornerstone of creating future sustainability programs and policies at UBC.

INTRODUCTION

UBC FOOD SYSTEM PROJECT (UBCFSP)

The UBC Food System Project (UBCFSP) is a collaborative research project as part of the Land, Food and Community (LFC) course series to evaluate the ecological, economic and social sustainability of the UBC Food System. This is the seventh year the project and it has been developing models and tools to evaluate the food system of UBC. Numerous projects have lead to the development of new research, policy formation, and sustainability education to improve the overall sustainability of the UBC Food System and thus the UBC campus as a whole.

2008 UBCFSP SCENARIO 7 PROJECT

The EFA of the campus' food services was one of the reoccurring recommendations proposed by previous LFC III groups (Bouris, 2003 AND Richer, 2004). It is suggested as a method to evaluate the ecological dimension, or weight, of the UBC Food System and as one of the possible indicators of evaluating the UBC Food System sustainability practices (Richer, 2004).

The objective of 2008 UBCFSP Scenario 7: *Investigating the Overall Ecological Footprint of the University of British Columbia Point Grey Campus Food System* is to explore, recommend, and develop a framework for future LFC III colleagues to conduct an ecological footprint analysis (EFA) of the UBC Point Grey campus food system. To broaden the scope of the project and create more opportunities for future improvements, our group has decided to expand on this concept and would prefer to assess the sustainability of the campus as a whole as our research later shows that more numerous sustainability initiatives have already been implemented at the UBC food system level rather than the campus level.

The results of an EFA can be used as a tool to evaluate the impact of the UBC community has on the environment, as an indicator of standing among and compared to other institutions and

communities, and as an instigator of suitable campus-based awareness and action policies that can ultimately lead to a more sustainable community. It is especially important for a post-secondary institution to lead the shift towards ecologically based living and operations by imposing long and short term changes around the campus. This is due to the ability of higher education to "influence future leaders through their students and current leaders through their alumni, [and have] the unique freedom to develop new ideas, comment on society, and engage in bold experimentation, as well as contributing to the creation of new knowledge" (Tufts University, 1995).

GROUP PARADIGM

A definition of our group's paradigm is important for completing any collaborative project in the Faculty of Land and Food Systems as it informs the reader of our values and possibly, of our biases. It also provides guidance to our group in analyzing research results and creating recommendations.

The decision to focus on conducting an EFA of the entire campus as opposed to just the food system is an integral part of our paradigm, as we believe that institution-wide change must be realized at UBC in order for true sustainability to be achieved. We believe that our LFC courses emphasize multi-disciplinary learning that is solutions-based, and wish to incorporate this into our project, as it could become a very real possibility for future groups to focus on the mechanics of the EFA instead of creating transformative changes across campus.

BACKGROUND

ECOLOGICAL FOOTPRINT

No matter how a society manages its natural capital, sustainable or unsustainable, it needs a system to accurately assess the various forms of resources and their use. As argued by Monfreda et al (2003), market prices or other monetary valuation methods are unreliable means for predicting the

long-term variability of ecosystems, making biophysical measures of our natural capital necessary. The ecological footprint, defined by Wackernagel & Rees, is "an accounting tool that enables us to estimate the resource consumption and waste assimilation requirements of a defined human population or economy in terms of a corresponding productive land area" (Wackernagel & Rees, 1995, p.9). The information found through an EFA can be used to stimulate wider public involvement, evaluate strategies, assist decision-making and monitor progress pertinent to sustainability.

Usefulness & Limitations

The EFA approach has its limitations. The model has been criticized for its over-simplifications, which can obstruct a truthful representation of our full demand on nature. Wackernagel and Rees (1995), however, argued that it would be impossible and impractical to have an ecological model that represents all potential interactions between the examined components. Even so, the estimates of the current land area necessary to provide the basic energy and material flows required by the economy show that people have overshot global carrying capacity (Wackernagel & Rees, 1995). Indeed, we should see the ecological footprint as an alarm that warns us about the extreme disparities between current demand and long-term resource availability, and the link between the global ecological challenge and personal decision-making responsibility; urging us to work promptly towards sustainable resource management (Wackernagel & Rees, 1995).

Consumption – Fair Earth Share

"The present Ecological Footprint of a typical North American (4-5 ha) represents three times his/her fair share of the Earth's bounty. Indeed, if everyone on Earth lived like the average Canadian or American, we would need at least three such planets to live sustainably."

- Our Ecological Footprint, 1995

Given that the amount of land available for the human race is finite, issues of resource equity cannot be simply dismissed. While twenty percent of the world's population is currently enjoying

unprecedented material well-being, another twenty percent remains in absolute poverty (Chambers et al, 2000). Regardless of the powerful argument that the amount of protected land should be increased to secure biodiversity, if nature's capital truly belongs to the global commons, then some level of redistribution is required. We should realize that the need to decrease our consumption is not a simple matter of personal lifestyle choice, but is an ethical and social responsibility to ensure that everyone has a fair share.

INDICATORS

Measurements of Sustainability

Gross Domestic Product (GDP) has been used as a measure for human development and well-being for many years due to society's implicit links between economic growth and elements of social security (Beyond GDP, 2007). However, GDP fails to account for many aspects of well-being such as environmental degradation, value of non-market goods and services, and does not distinguish between costs and benefits or constructive versus destructive activities. For example, "natural and 'man-made' disasters, crime, and accidents are seen as positive contributors to GDP since they generate production and income from the money spent to deal with these problems" (Maro, 2007, p.5). William Rees, a professor at UBC and creator of the ecological footprint concept, remarked during an LFS III class lecture, "how can we call ourselves an intelligent species when we measure progress and well-being with destruction and death?" (William Rees, personal communication, February 27th 2008).

It has been said that the "measurement of sustainable development (SD) is a prerequisite for a sustainable society…" (Mitchell, 1996, p.1), but as of yet there is no single index or measurement that has a consistent, widespread use (Mitchell, 1996). SD has been captured in the hearts and minds of numerous people and academics, who have created indicators for sustainability to replace,

supplement or adjust the GDP (Maro, 2007) These include the Genuine Progress Indicator (GPI), Human Development Index (HDI), Environmental Sustainability Index (ESI) and the Ecological Footprint. Until recently most of these indicators were used at regional and national levels and are not suitable for use at the institutional level. In 2007, the Association for the Advancement of Sustainability in Higher Education (AASHE) launched at new tracking system called Sustainability Tracking, Assessment and Rating System (STARS), which is a self-reporting framework for estimating the progress of universities toward sustainability (AASHE, 2007). Schools who register are required to share information with other universities; UBC has joined AASHE to compare achievements and share ideas and initiatives with other schools. It is meant to enable a collaborative approach to help institutions reach their goals in sustainability. This is a good initiative, in the sense that it involves hundreds of colleges and universities from all over the world, is a great resource on ways to increase sustainability on campuses and includes successful initiatives implemented by other institutions. However, it fails to provide an easily accessible and understandable rating system. In addition, the list of sustainable indicators is very long and specific, which may be hard for many institutions to find relevant data for these categories.

General Literature Review

An EFA is a tool to measure our impact on the environment and "an institutional EFA clearly demonstrates the extent of impacts and provides guidance on where effort to achieve sustainability is best focused" (Flint, 2001, p.60). Although UBC has yet to conduct an ecological footprint of the entire campus, two students, Jill Dalton and Maggie Baynham, completed one for the Pendulum restaurant in April 2005. Our group had the opportunity to interview Jill in February 2008; she spoke of many challenges in completing a footprint for a small business, mostly in the area of data collection. Examples include counting the number of times the dishwasher ran in an hour, the lack of specific energy data used by the restaurant, and the lack of tracking systems for the origins of food.

Dalton remarked that it is easier to perform an EFA on larger systems and should be used as an educational tool that is useful in providing direction for further research projects, and not as true marker for sustainability (Jill Dalton, personal communication, February 13, 2008).

Students at universities and colleges around the world have completed EFAs for their campus. Many of the students have found that, due to the nature of universities and institutions, carrying out an ecological footprint comes with many challenges. Environmental impacts are not well measured, evaluated or monitored (Flint, 2001). Gathering data for all consumption and land use categories is not always possible as university tracking systems are generally decentralized or not tracked at all. Some schools, like the University of Toronto, Mississauga (UTM), collected transportation and grocery data via surveys but because the response rate for transportation was low, they had to compare it to the number of parking permits and the Mississauga transit ridership survey (Conway et al, 2006). Other universities made assumptions for unfound data. For example, Colorado College, despite of not having any data on waste management, made the assumption that waste and pollution is a significant contributor to the EF and recommended methods for waste reduction (Wright, 2002).

Another challenge students face when collecting data is "the transience nature of university life, for the majority of the population, leaves the real impact of the tertiary institution unconsidered (Flint, 2001, p. 48)". This also makes calculations during summer all the more difficult. Several of the schools like UTM and the University of Newcastle only calculated the months that the school was at full capacity due to unavailable data (Conway et al, 2006).

One major impact category – energy - stands out for all of the universities and colleges that have calculated footprints. This is not surprising given we are a society that is completely dependent on fossil fuel. From both transportation and the operation of buildings, energy use at universities is upwards of 90% of the total footprint (Flint, 2001). Many proposed initiatives to reduce a campus

footprint are therefore focused on lowering energy use; these include alternate power sources, better transportation services and car-pooling to campus (Conway et al, 2006).

Students at UTM have created an ecological footprint calculator to measure progress of increasing sustainability at their campus, which is based on Rees and Wackernagel's consumption land use matrix. Since the summer of 2004, when the project first started, the calculator has been updated to reflect the organizational structure of the university, three progress reports and the footprints for 2005 and 2006 have been completed. A website, (http://eratos.erin.utoronto.ca/conway/ecofootprint/research.html) containing the calculator, progress reports, research and data collection, initiatives for reducing their footprint and links to information about the EFA, has been created which helps keep students of UTM and other universities informed of their progress. UTM has made a great tool that other universities can follow when considering to calculate an ecological footprint (EF).

The universities and colleges that have calculated footprints range in size from just over 500 students, faculty and staff (Home Lacy College UK) to 20 000 (University of Newcastle). UBC however, has over 50 000 people coming to campus on a daily basis, 11 000 of those people live at UBC, some full time, others just for the school year (U-Town Library; FAQ, 2008). It also has a hospital, several elementary schools, a high school, a school of Theology and many other research centers and housing developments on campus, some of which are partially operated by UBC plant operations while others are separate. This creates many unique challenges, many of which have to do with lack of consistent tracking systems and decentralized building operations. It also makes drawing boundaries for the campus complicated and data collection extremely time consuming and increasingly difficult as the campus expands in housing and enrollment.

UBC INITIATIVES

According to William Rees, universities and institutions of higher education directly and indirectly impact the world's EF (Rees, 2003). Although there are only tools to measure direct impacts, it is the incalculable, indirect impacts, which need to be addressed in today's universities. The current curriculums established core values and beliefs, have lead our society into the "expansionist paradigm with its emphasis on maximizing growth through selfish individualism, competitive relationships, market mechanics, capitol accumulation, efficiency and globalization" (Rees, 2003, p. 96). Institutions must step up and become intellectual leaders and transform the current curriculum from the individual into the collective (Rees, 2003). At UBC, this is taking place at a campus wide level. It can be seen in courses like AGSC 450, sectors like the UBC Food Services and AMS food services, and with the creation of the Sustainability Office that has saved the administration millions of dollars through energy and material conservation associated with plant operations and thus significantly reduced the campuses' ecological footprint (Rees, 2003). Increasing sustainability through energy saving devices, is much easier than changing peoples core values and beliefs; these devices and schemes can only do so much, whereas nurturing a culture of sustainability by educating and involving people all throughout life, will eventually lead to a sustainable society.

UBC is often acclaimed to be one of the most sustainable post-secondary institutions in Canada. Recently, the Sustainability Office has commemorated a decade of sustainability initiatives and programs as ten years have passed since UBC first adopted a sustainable development policy (UBC Sustainability). During the last decade of action, a number of strategies, policies, and action plans have been implemented.

UBC uses the Brundtland Commission definition of sustainability, which is defined as "meeting the needs of the present without compromising the ability of future generations to meet their needs" (Our Common Future), which means that UBC, in order to be considered sustainable,

should be conducting all current operations without impairing the ability of future students to have the same access to resources and quality education that is enjoyed by current students.

UBC has signed a number of international documents and has partnered with other international organizations to meet these needs. The quest for sustainability began when UBC signed the Talloires Declaration, which provided the impetus needed for the eventual creation of the UBC Sustainability Office in 1998 (UBC Sustainability). The Sustainability Office itself is funded through cost savings made through the Ecotrek program's water and energy retrofits of UBC core campus buildings (UBC Ecotrek Project). UBC currently has a partnership with the Association of Advancement for Sustainability in Higher Education (AASHE), which has a number of resources available for its members. UBC has also created a number of on-campus connections such as UBC Trek, which works on creating sustainable transportation options, including the U-Pass, for those who are members of the UBC community (UBC Trek). In addition, there are links to University Town, Waste Management, Health, Safety, and Environment (UBC Sustainability). There is also an initiative called UBC Renew to tackle the problem of refitting older buildings to make them safe and accessible instead of having to completely rebuild (UBC Public Affairs).

UBC Alma Mater Society (AMS) has been another force in achieving campus sustainability. The AMS represents the student body of UBC and runs various student services, clubs, and businesses. The organization has been actively working toward integrating sustainability into their operations, beginning with policy adoption in January 2007 and continuing with the AMS Lighter Footprint Strategy which is a comprehensive plan covering all aspects of AMS operations and includes both internal and external strategies and targets (AMS).

A unique opportunity exists for UBC students wanting to be involved in sustainability projects across campus in a way that gives them practical experience and credits for experiential learning outside of class. The UBC Social, Ecologic, Economic Development Studies (SEEDS) program has already completed projects such as investigating the sustainability of seafood

purchasing practices at UBC or bio-diesel fuel testing (UBC SEEDS). Furthermore, opportunities exist for AGSC 450 students completing the UBC Food System Project to create meaningful change throughout this one-semester course, as in the case of creating a workable plan to use UBC Farm squash in the AMS-operated PieRSquared food service outlet.

PERSONAL INTERVIEWS

William Rees

William Rees is a professor and the originator of the EFA, and has written several books on EF calculations and methodology. He emphasized that the EF is an educational tool with the goal of instigating policies and actions towards ecological conservation. He also strongly recommended that the UBC Hospital should be omitted from the UBC EFA and evaluated as a separate entity due to complications in acquiring data from materials and products used in the hospital from medical corporations due to proprietary concerns (William Rees, personal communication, February 27, 2008).

Jill Dalton

Jill Dalton is one of the two undergraduate students who preformed an EF at UBC, measuring the consumption and emissions of Pendulum Restaurant in *Ecofootprinting the Pendulum Restaurant.* She shared some valuable insights on her preference of performing the EF at a whole system level rather than at the food system level.

Dalton expressed that EF calculations on a food system level would be grossly inaccurate due to the incorporation of assumptions from specific data sources. Dalton also suggested that first order impact would be sufficient enough for EFA because infrastructure, such as roads and dam construction, are shared by public and would be difficult to track and collect data (Jill Dalton, personal communication, February 13, 2008).

EFA: UBC FOOD SYSTEM VERSUS WHOLE OF UBC

Our assignment in completing the UBC Food System Project was to use the popular methodology of EFA to evaluate the UBC food system. Since the EFA is an indicator of sustainability and can be used year to year to benchmark achievements, it is the logical choice for this project. The intention of focusing on the UBC food system is to concentrate on one clearly defined area of the campus, an area that is within the scope and interest of the AGSC 450 curriculum. Initially our group focused on the UBC food system, but throughout our literature review, EFAs are mostly used to assess large, fluidly defined entities such as university campuses, cities, or even entire countries. So our group decided to take on a whole-campus approach instead of solely focusing on the food system.

The main reason for this decision was the fact that UBC is often acclaimed to be a leader in campus sustainability. A video introduction to sustainability on the web claims that UBC is "Canada's leader in campus sustainability" (UBC Sustainability Office). It is true that UBC has been a pioneer with a number of innovative initiatives for sustainability enhancement such as the U-Pass system to encourage commuting by public transit or the Ecotrek program of water and electricity retrofits for dramatic energy and water savings across campus, but there are no measurements or indicators used to prove UBC is a leader in sustainability.

Another reason UBC receives accolades for sustainability is that both major arms of food service on the campus, AMS Food and Beverage Services and UBC Food Services, are on board with leading sustainability strategies and have members acting as project partners for the UBC Food System Project. In January of 2007 the AMS adopted an Environmental Sustainability Strategy that builds upon other AMS initiatives such as serving organic, fair trade coffee and using biodegradable cups and offering discounts to those bringing their own dishes (Dorothy Yip, Personal Communication March 12, 2008). These initiatives have been a standard operating practice of AMS

Food and Beverage under the management of Nancy Toogood, who has taken a leadership role in integrating sustainable principles into business operations. UBC Food Services has recently decided to only serve fair trade, organic coffee as well (Vancouver Sun), which is an addition to using farm produce at Sage Bistro. The areas of food service on campus, which have not been adhering to stricter sustainability guidelines are the franchises under tenancy to UBC Food Services, and are not subject to regulations adopted by UBC Food Services (Dorothy Yip, Personal Communication March 12, 2008).

Another consideration is the differences in data collection and calculations that arise from these different approaches. The whole-campus approach has the benefit of using data from centralized sources, such as UBC Plant Operations, without having to break up or estimate pieces of data that pertain only to certain sectors such as food service. The main detractor is that there are many more sources of data and contributors to the footprint when considering the entire campus as opposed to one, neatly-defined sector. With a campus the size of UBC that caters to such a diverse array of studies and interests, there are many considerations and contributors to the ecological footprint.

We questioned the suitability of performing an EFA pertaining only to the food system at UBC. As mentioned above, the food system has been making important strides in increasing all aspects of sustainability, not just economic. Furthermore, a cursory literature review shows that the food system tends to be a very small part of the overall EF. For instance, the University of Newcastle found that food contributed 6% to the EF (Flint, 2001, pg. 57). The biggest contributors to a university's EF include categories such as energy, buildings, and transportation. In order to make changes to UBC's EF, it is more useful to focus on the larger areas rather than one that contributes such a small amount to the EF overall, particularly an area that is already taking great strides to decrease their impact on the environment.

It is hoped that UBC can use the results of a campus-wide EFA to back up claims of being one of the most sustainable university campuses—or least have the impetus to become one.

METHODOLOGY

HOW TO PERFORM AN ECOLOGICAL FOOTPRINT ANALYSIS

There are several methods in measuring and calculating an Ecological Footprint but the basic principles remain the same: The comparison of converting products and activities back into bio-productive land to the total available bio-productive land within an established geographical boundary (Nicols, 2003).

An EFA consists of two major components. First, it measures how much biological matter is being consumed and used to absorb waste by a population in terms of consumable land. This is compared to the fixed biological productivity on finite amounts of land within a given area, and the resulting figure is converted into global hectares (Chambers, Simmons, Wackernagel, et al 2000). If the consumption of the population exceeds the total biological productivity of the land within the population's boundaries, then carrying capacity has been overshot, and the populations land use practices are unsustainable (Baynham & Dalton, 2005).

Land use matrix

Under the ecological footprint, calculating the impact of human activities on the environment is measured through the Land-Use-Matrix, or the land in hectares used to produce and absorb the waste of goods and services (Chambers et al, 2000). Land used for human products and absorbing waste is deemed bio-productive land, while other land altered by human uses and is no longer biologically productive is deemed "Used" or "Built" land (Chambers et al, 2000, AND Baynham & Dalton, 2005).

The Land Use Matrix divides bio-productive land into five different land types with different bio-productivities under the standard global hectare: Arable Land, Pasture Land, Forest Land, Built Land, and Energy Land (Chambers et al, 2000, AND Baynham & Dalton, 2005). Arable land produces stable crops, Pasture land for grazing animals to produce commodities for humans, and forest land for paper and timber products (Chambers et al, 2000). Built land is land paved over for buildings and roads, and is no longer bio-productive (Chambers et al, 2000 AND Baynham & Dalton, 2005). Energy land is the amount of land needed to manage energy demands through sequestering CO2 emissions from energy consumption and/or embodied energies, or the total energy needed to create a product, and the direct energy spent locally (Chambers et al, 2000 AND Wackernagel, 1995). All human commodities and activities fit within these categories respectively.

There are also two other land types: Productive sea space, or the amount of bio-productivity given from the sea, and the biodiversity land, or the land that is conserved to preserve non-human species (Chambers et al, 2000). Neither of these land types are easily calculated, and are often often ignored in an EFA until better accounting methods can be found (Chambers et al, 2000).

These land categories and their respective individual production rates are converted into global hectares, which are calculated using equivalence factors based on world averages for yields of each land type (Chambers et al, 2000 AND Nicols, 2003). This ensures local production will be converted into units (Global Hectares) that are easily translatable and universal (Baynham & Dalton, 2005). With these assumptions, EFAs are typically conducted in two "Process Analysis" methods: Compound Based Analysis and Component Based Analysis.

Compound Based Analysis

The Compound Based Analysis for the Ecological Footprint is suited towards nations with clearly established boundaries, as it deals with national trade flows and energy data (Chambers et al, 2000). The data is taken from statistical sources to find overall national consumption in terms of

imports minus exports (Nicols, 2003). These trade items are converted into bio-productive land consumed and waste generated to create them through the Land-Use-Matrix and measured against the nation's total bio-productive land giving the Ecological Footprint of the nation (Chambers et al, 2000 AND Nicols, 2003). However, this method is not appropriate for institutions that do not have readily available, cumulative data that can be tracked easily, or without clear and defined borders.

Component Based Analysis

The Component Based analysis is a "Bottom Up" based approach, where the ecological footprint is measured in terms of life cycles of a product or activity (Chambers et al, 2000). This measures the impacts of individual activities or products in their production, use, and end in their entirety. Then it translates each input or output into appropriate land categories within the land-use-matrix, sums them, and is compared to the bio-productivity of the land within defined boundaries (Chambers et al, 2000 AND Nicols, 2003). However, this method relies on embodied energies, which can be hard to find and makes numerous assumptions that may be unrealistic (Chambers et al, 2000).

At its most effective, this approach measures and instructs citizens and policy makers on the impacts of certain behaviours and activities (Chambers et al, 2000). It has also been found to be more suitable towards measuring the ecological footprint of institutions and cities, since it keeps track of inputs and effects at different production levels deeper than aggregate data (Nicols, 2003).

Input-Output Analysis

One alternative method is the Input-Output analysis, where the impacts of goods and services are mapped between all sectors within the economy rather than a few production layers, and utilizes the Land-Use-Matrix to generate global hectares in consumption versus local production (Nicols, 2003). This allows for the incorporation of indirect resource use through the analysis of upstream production layers not accounted for in Process Based Analysis and the differentiation of imported

and exported goods throughout the entire economic system through well kept government statistics (Nicols, 2003).

Land Disturbance Model

In comparison to the Land-Use-Matrix, the Land Disturbance model compares the rate of land degradation to the natural state of the land (Nicols, 2003). This accounts for differences in local land productivities and impacts, and differentiates between sustainable and unsustainable use (Nicols, 2003). Through the identification of indicator species within a natural habitat and measuring biodiversity, the land used by a population can be evaluated within several varying degrees of degradation of the local ecosystems. By using different disturbance categories and their weighing factors it is converted into global hectares to create an accurate EFA (Nicols, 2003).

UBC Campus

It is recommended that the UBC campus EFA be conducted under the Land-Use-Matrix with the Component Based, Process Analysis method. This is due to time constraints, lack of information on the inputs and outputs of the UBC campus, and for ease of comparison between different universities EFAs compared to other methods.

Input-output analysis cannot be conducted due to the fact that many materials cannot be tracked to their origin such as items that pass through Supply Management or UBC Logistics (Victoria Wakefield, Personal Communication, March 18th, 2008). Therefore, the EFA can only be calculated one or two production layers deep, relying on embodied energies supplied by the Wackernagel studies or other studies that cite similar production practices (Chambers et al, 2000 AND Flint, 2001).

Land Degradation is not a viable method for the UBC campus EFA because of the reliance on the “pristine” ecosystem as a barometer for land disturbance that uses an inventory of indicator

species and optimal biodiversity (Nicols, 2003). It is time consuming to conduct such an inventory, and does not distinguish between buildings prior to and after the implementation of Ecotrek green building program, or between long-term unsustainable practices vs. sustainable ones (Nicols, 2003).

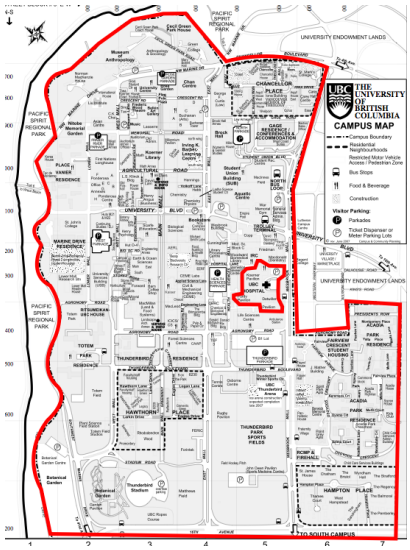
Although the Land-Use-Matrix, Component Based method is recommended, there are several problems. The decentralized accounting of materials and products for the UBC campus means that each department would have to be consulted to create an estimate on consumption data, and would have to rely on assumptions for products that aren't tracked (Victoria Wakefield, Personal Communication, March 18th, 2008). Due to the information available, this method relies on only a few production layers, which creates problems with origins of products, as they may be listed as wholesalers in specific warehousing units within the Vancouver region, while the actual products may be from greater distances (Dorothy Yip, personal communication March 12th, 2008). Students would have to track each product's origin with incredible scrutiny, and may even resort to using utilities such as Mapquest to estimate distances (Baynham & Dalton, 2005). Although an accurate EFA using the component based method would be distorted if students didn't go to such lengths, the time it would take to do this would not be worth the increased accuracy as the EFA is an estimate and will never be truly accurate.

Finally, the available figures and converters used for previous university and institutional studies for the Land-Use-Matrix are quite dated (Chambers et al, 2000). The global hectares consumed from certain land uses are based on calculations and figures that are over a decade old while recent figures are based on European and Australian studies with embodied energies and technologies that may not be applicable (Chambers et al, 2000, Barrett, Vallack, Jones, and Haq 2002, Flint, 2001).

Despite these flaws, the Component based Land-Use-Matrix has several advantages. First, it is the fastest way to make a reasonably accurate EFA since it is the most suitable and least time consuming in dealing with a decentralized system (Barrett et al, 2002 AND Chambers et al, 2000).

By assessing each component step by step, the EFA can address certain gaps in information that other analysis methods cannot. Second, it can easily be compared to other University EFAs since most universities use the same methods and typically the same embodied energies and land use conversion rates. Other methods, such as input-output analysis and land degradation, have not been used by the majority of University EFAs. Thirdly, there are already comprehensive resources available to conduct an EFA under the component based method, such as the U of T calculator, land conversion rates and embodied energies from the Wackernagel studies, and other useful information found from many similar EFAs. Despite being dated, the Land-Use-Matrix and Component Based method still behaves as a good indicator of environmental impacts by certain land use practices.

BOUNDARIES



The proposed boundaries of the UBC EFA are based on the physical boundaries of UBC Point Grey Campus while omitting the South Campus (UBC Farm, BC Research Center, TRIUMF buildings, etc) and the UBC Hospital. Explanation of the boundary selection will be explained in discussion.

Figure 1. Proposed boundary for UBC EFA

DATA GATHERED FROM COURSE OF STUDY

AMS and UBC Food Services

The AMS Food and Beverage Services and UBC Food Services provided transfer sheets of total number of products ordered per month in a year for each product (see Table 1 of Appendix). For

most food items, quantities were reported on a weight basis. To calculate the footprint, the yearly total mass (in kg) for each food product could be determined by summing up the twelve months' order. And then, using a series of specific "footprint multipliers" for each food category, the amount of each type of land (in m^2) can be determined for a particular mass of food in each category (see Table 1 of Appendix). With an overview of assumptions, these multipliers were obtained using data from 11.2 in Sharing Nature's Interest (2000). Baynham & Dalton's (2005) work on the ecological footprint of the Pendulum Restaurant provides detailed sample calculations of various food products. The waste and energy use of the food establishments would be accounted for in the data obtained from UBC Plant Operations.

Transportation

Each year, since 1997, UBC has collected data on the number of people travel to and from the Point Grey campus by single occupant vehicle, high occupant vehicle, public transit, bicycle, foot and sometimes motorcycle. This information is represented in person trips as aggregate numbers; refer to Table 2 of Appendix (UBC Trek, 2008). To examine the footprint of commuting, the distance traveled by the UBC population would also need to be determined. According to Hoffman and Chisholm (2001), the average commute distance to UBC is 17.3 km one way. There is no information that indicates a change in the average trip distance (Frantz, 2003). In a study done on UBC's greenhouse gas emission, Frantz (2003) defined distance traveled by UBC students, staff and residents as:

Kilometers Traveled = Commuting Population x Commuting Days x Trip Frequency x Mode Split x Trip Distance

After the kilometers traveled by the UBC population is calculated, the footprint can then be calculated by using the different conversation factors for different modes of transportation. For example, the footprint for bus is 0.03 hectare years per 1000 passenger Km (Chambers et al, 2000).

Due to the nature of the available data, the above calculation is only a rough estimation of the footprint; a constant framework should be developed to track the change in the average commute distance of the UBC population over time to ensure the quality of the footprint assessment (Frantz, 2003).

UBC Plant Operations

Data for a variety of sources is handled by UBC Plant Operations, which has control of a variety of campus operations such as electricity and waste management. We contacted the Director of Plant Operations, John Metras, who took the time to source out the data necessary for this project (John Metras, personal communication, March 6 2008).

UBC Bookstore

The UBC bookstore was interested in our project and eager to cooperate. We interviewed Debbie Harvy, the manager of the UBC bookstore, and found her to be willing to provide any information needed to conduct the EFA. She also informed us of some initiatives that the bookstore has taken to decrease its impact on the environment; including a compressor for recycling boxes more efficiently, buying fuel-efficient vehicles, and purchasing more online textbooks.

DISCUSSION

Performing an EFA is an important step in continuing down the road to sustainability at UBC, although it is not without its challenges. Our group believes that an EFA is plausible at UBC and can become an important education tool and way to measure progress in sustainability.

The most important consideration is to restrict the EFA to primary level and focus on the contributors that make an impact and that have data available (W. Rees, personal communication, March 5, 2008). Because the EFA operates using stated assumptions and standardized data, it is not necessary to focus on being accurate at the expense of completing a generally comprehensive EFA.

Completion of an EFA fits within UBC's culture of sustainability. With a dedicated Sustainability Office and a variety of initiatives across campus, the EFA can be used to reach the wider campus audience as an accessible indicator and way to track progression. Furthermore, the EFA can be used to highlight the biggest contributors and indicate where to focus on in future projects.

Our research has led us to acknowledge the limitations of performing an EFA, specifically at a university campus like UBC. We still believe it is a worthwhile exercise that can act as a gateway to further projects and help to move UBC forward in its pursuit of sustainability.

CHALLENGES AND LIMITATIONS

Physical Size of the UBC Point Grey Campus

With over 40,000 students and 10,000 faculty and staff (UBC Human Resources), UBC is the size of a small city. Conducting an EFA at UBC has presented a number of unique challenges and opportunities.

When performing an EFA at any university it is important to consider what size the footprint should be (Conway et al., 2008, p. 7). Since anything past the physical land and sea area of an entity is considered to be overshoot, virtually every university could be considered to be unsustainable unless they had large areas of resources such as forested lands to compensate. UBC is unique in that it currently has the UBC Farm, but this may change due to development pressures, and does not make up for overshoot from such a large university.

Data Collection and Calculation

One major limitation is the difficulty of collecting data. With a campus the size of UBC, unlike other post-secondary institutions that have performed EFAs, there are a variety of data collection sources. Food service outlets, for example, UBC has an entire list of restaurants whereas other

schools might have one cafeteria or a small store. For other factors such as supply procurement, there is no centralized system that tracks and collects data, meaning there are literally hundreds of points of contact to trace materials coming onto campus.

Other limitations with EFAs concern the calculation methods. There are significant problems when considering embodied energy and using conversion factors as the numbers that are readily available tend to be outdated, but still used because there simply are not updated numbers available.

Human Resources and Time Limitation

The execution of an EFA is constricted by several factors, and will continue to be problematic for future groups. One is skill level - university EFAs are often performed by students at the post-undergraduate level; independent consultants usually conduct city-level EFAs. When undergraduate students perform the analysis, close collaboration of a supervising faculty member is essential. The other restriction is time - for our group, simply collecting data and deciding the best methodology to be used, took the entire semester. Calculations are an enormous undertaking, as is conducting surveys or other methods to compensate for areas where data is not readily available.

Assumptions and Accuracy of EFA

The last limitation concerns the EFA itself. It is important to remember that the EFA is useful in certain contexts, such as being used as an educational tool or highlighting the biggest contributors to UBC's EF. It cannot be used as a quantitative tool or considered to be numerically accurate. However, performing an EFA can still contribute to UBC's vision for a sustainable future by acting as an easily understood indicator, which members of the UBC community can relate.

SOLUTIONS AND RECOMMENDATIONS

"Avoidance is sweet temptation, but denial today leads to greater pain tomorrow."
- Our Ecological Footprint, 1995

- Based on the results of the EFA, target the biggest contributors to the EF and create action-based groups that will conceive and facilitate solutions to the identified problem areas.

- Creation of a footprint action team: This will be a dedicated team, existing within the framework of the Sustainability Office, to perform an EFA yearly and handle the data compilation, media communication, and assisting with planning and executing sustainability related projects and studies that arise as a result of EFAs performed. There are funds available from the Student Environment Center (SEC), which can help initiate the formation of this team. The footprint action team should also create a website that everyone on campus and other universities can have access to and act as a hub for relationship building.

- Breaking up the EFA: To create a whole-campus EFA, it will be beneficial to split up the workload according to sources where data is available and sources where data needs to be compiled through surveys or other methods. This way, individual teams will be able to target each area and then compile together to create one comprehensive EFA for the campus.

- Creation of a UBC EF calculator: Although currently an ecological footprint calculator for the individual exists (http://www.sustain.ubc.ca/eco-survey/), it will greatly facilitate future calculations to create a campus-wide calculator, similar to the University of Toronto Mississauga. Yearly EFs can be performed easily and compared to track progress and effects of new programs and policies.

CONCLUSION

After a considerable amount of literature reviews, data collection, interviews and research, our group has decided that an EFA for the UBC campus is worthwhile and feasible. Although there are inherent difficulties in conducting a university EFA, we have seen the completed EFAs become part of several universities' sustainability culture. The UBC Point Grey campus can conduct an EFA based on the Land Use Matrix and Component Process based method, which has an abundance of resources available and is widely used in other universities.

Even though UBC has taken great strides to improve campus sustainability, it will be possible through an EFA to identify areas that have large ecological impacts, and can provide guidance for future initiatives and projects. It is our hope that sustainability initiatives go beyond the scope of the food system and that future projects will focus on creating changes through action to positively transform the UBC campus.

APPENDICES

TABLE 1: FOOTPRINT MULTIPLIER (M2 LAND USED PER KG OF FOOD) FOR EACH FOOD CATEGORY AND LAND TYPE[i]

Category	Fossil Energy (m^2)	Arable Land (m^2)	Pasture Land (m^2)	Sea (m^2)	Assumptions
Fruit, vegetables	0.50	0.56	-	-	-average global yields used -calculated for the whole group, not specific crops -transport, processing and agricultural energy included
Bread	2.00	2.36	-	-	-average global yields used -transport, processing and agricultural energy included
Rice, cereal, noodles	1.00	3.65	-	-	-same as above
Beans	1.00	11.73	-	-	-same as above
Milk, yogurt	1.00	-	19.92	-	-average global yields used -transport, processing and agricultural energy included -cattle raised on pasture land
Cheese, butter, cream	6.50	-	199.19	-	-same as above
Eggs (50 g each)	6.50	0.64	-	-	-average global yields used -transport, processing and agricultural energy included
Pork	8.00	21.83	-	-	-same as above
Poultry	8.00	12.75	-	-	-same as above
Beef	8.00	58.33	-	-	-average global yields used -transport, processing and agricultural energy included -cattle are grain fed
Fish	10.00	-	-	551.75	-average global yields used -transport, processing and agricultural energy included -pelagic (wild, not farmed) fish
Juice and wine	0.42	1.00	-	-	-average global yields used -transport, processing and agricultural energy included
Sugar	1.58	2.08	-	-	-same as above
Oil and fat - solid	3.92	5.42	-	-	-same as above
Oil and fat - liquid	3.08	4.33	-	-	-same as above
Tea and coffee	7.50	17.67	-	-	-same as above

[i] Chambers, Nicky, et al. Sharing Nature's Interest. London: Earthscan Publications, 2000; 169.

TABLE 2: GATHERED DATA FOR UBC EFA

SOURCE	DATA	UNITS	BOUNDARIES	REPORTING
UBC Plant Ops – Utilities	Steam	lbs/hr and lbs	Core Institutional buildings, Ancillary buildings, Tenant buildings, some market housing buildings	Monthly
UBC Plant Ops – Utilities	Natural gas	GJs	Core Institutional buildings, Ancillary buildings, Tenant buildings, some market housing buildings	Monthly
UBC Plant Ops – Utilities	Electricity	kW	Core Institutional buildings, Ancillary buildings, Tenant buildings, some market housing buildings	Monthly
UBC Plant Ops – Utilities	Sanitary Sewer	Cubic feet	Core Institutional buildings, Ancillary buildings, Tenant buildings, some market housing buildings	Quarterly
UBC Waste Management	Garbage for landfill, recycled materials by category, compost	Tonnes by category, volume by building	Core Institutional buildings, Ancillary buildings, Tenant buildings, some market housing buildings	Monthly
UBC Bookstore	Books, computers	Units sold	Bookstores (Point Grey campus, Health Sciences (closing), Robson Square, UBC Okanagan	Annually
UBC Bookstore	Other supplies (ie. paper, notebooks, pens)	Per package	Bookstores (Point Grey campus, Health Sciences (closing), Robson Square, UBC Okanagan	Annually
AMS & FS				
UBC Food Services	Foods & beverages (i.e. bread, dairy products, spices, juices)	Varies, most on weight/ volume basis (i.e. lb, kg, ml) OR units sold (i.e. loaves, cases)	Saint John's College, Place Vanier, and Totem Park	Monthly
UBC Food Services	Cleaning supplies (i.e. soaps, bleaches)	Varies: L, kg, or units sold (i.e. packs)	Saint John's College, Place Vanier, and Totem Park	Year-to-date
UBC Food Services	Food paper (i.e. sampling cups, paper plates)	Units sold in cases/ rolls	Saint John's College, Place Vanier, and Totem Park	Year-to-date
AMS	Foods & beverages (i.e. baking supplies, breads, condiments, liquor)	Varies, most on weight/ volume basis (i.e. lb, kg, ml) OR units sold (i.e. loaves, cases)	Blue Chip Cookies, Bernoulli's Bagel, The Honour Roll, Gallery Lounge, The Moon, Pendulum, The Pit Pub, Pie R Squared	Weekly
AMS	Cleaning supplies (i.e. gloves, garbage bags)	Varies: L, kg, or units sold (i.e. cases)	Blue Chip Cookies, Bernoulli's Bagel, The Honour Roll, Gallery Lounge, The Moon, Pendulum, The Pit Pub, Pie R Squared	Weekly

AMS	Food paper (i.e. paper bags, toothpicks)	Units sold in cases, tubes or bundles	Blue Chip Cookies, Bernoulli's Bagel, The Honour Roll, Gallery Lounge, The Moon, Pendulum, The Pit Pub, Pie R Squared	Weekly
AMS	Operation supplies (i.e. cash register tapes, ink cassettes)	Units sold (i.e. rolls, cases)	Blue Chip Cookies, Bernoulli's Bagel, The Honour Roll, Gallery Lounge, The Moon, Pendulum, The Pit Pub, Pie R Squared	Weekly
Transportation				
www.trek.ubc.ca	Travel patterns to and from UBC	Person trips[a]	UBC campus	Annually
UBC Plant Operations	Fleet Vehicle Usage	Km and fuel usage	All Plant Operations Vehicles	Annually

[a]See Discussion on Data Collected for conversion (to distance) method.

FROM UBC Plant Ops:

1) Core Institutional - Includes all academic and administration buildings owned by the University. Waste Management and Utilities exclusively provide service to all these buildings.
2) Ancillary - Includes University-owned facilities for support operations such as Student Housing, Food Services, and Athletics. Waste Management and Utilities exclusively provide service to all these facilities on a fee-for-service basis.
3) Tenant - Includes facilities within the boundaries of the campus that are not owned by the University. Examples are Triumf, Forintek, Paprican and the Technology Enterprise Facilities (Gerald McGavin, Donald Rix, TEF III). Waste Management and Utilities provide service to almost all of these facilities on a fee-for-service basis.
4) Market Housing - Includes all residential and community buildings in neighbourhood housing developments such as Hampton Place, Hawthorne Lane, Chancellor, etc. Waste Management provides service to a very small number of these developments (they are mainly serviced by outside contractors). Utilities provide service to most, but not all, of these developments.

TABLE 3: UNTRACEABLE DATA: REASONS AND ASSUMPTIONS

UNTRACEABLE DATA	REASON	METHOD	ASSUMPTIONS
Waste from market housing	Contracted out independent of UBC waste services	Multiply Van estimate per number of residence	Per-capita waste similar to per-capita of Vancouver
Supplies not handled by UBC Supply Management (Canadian products)	Decentralized; literally thousands of points of contact	Separate project: Institute more efficient centralized tracking system that faculties are required to fill out	Important and should be undertaken as a separate project
No data on Franchises: Starbucks, Tim Hortons	No data available	Work with UBC food services to institute a relationship with franchises to establish a tracking system	It is a significant contributor cannot be accounted for until a relationship is established
Independent Colleges: Food and purchasing unattainable	Uncooperative	N/A	Not a significant contributor to the footprint
UBC Hospital not being included	Entity in itself, Presently it is hard to reduce a hospitals footprint; complexity of tracking and collecting relevant data; (Bill Rees)	N/A	Important contributor however it is beyond the scope of this project
UBC market housing: food and consumer goods	Info not available	Create random sampling surveys	Should be included as it is a growing contributor and could be significant to the footprint

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